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Biological Assessment
The Dow Chemical Company
Light Hydrocarbon 9 (LHC-9) Unit Project
Freeport, Brazoria County, Texas

Prepared for:

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AND

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Executive Summary

The Dow Chemical Company (Dow) has owned and operated an integrated chemical manufacturing complex (Dow Freeport Site) in Freeport, Brazoria County, Texas since 1940. The site consists of four major areas: Oyster Creek, Plant A, Plant B, and Stratton Ridge.

Dow proposes to construct a new ethylene production unit (Light Hydrocarbon 9 (LHC-9)) within Oyster Creek. LHC-9 will use ethane and propane as feedstock. A new 78-mile 12-inch pipeline will be constructed between Mont Belvieu and Freeport, Texas to supply ethane to the proposed LHC-9 Unit. The primary products produced at the LHC-9 facility (ethylene and propylene) will be used as feedstock for other existing units at the Dow Freeport Site or transported via pipeline to existing underground storage caverns at Stratton Ridge.

Dow has determined that the proposed project will require a Prevention of Significant Deterioration (PSD) permit issued by the U.S. Environmental Protection Agency (USEPA) for Greenhouse Gas (GHG) emissions. Dow has retained the services of URS Corporation (URS) to prepare a Biological Assessment (BA) to evaluate the proposed project site for federally-protected threatened and endangered (T&E) species and/or their potential habitat and to provide an evaluation of the project's likelihood to jeopardize the continued existence of listed species.

Federally-protected species considered in this BA include: Texas prairie dawn, green sea turtle, Atlantic hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, blue whale, finback whale, humpback whale, sei whale, sperm whale, whooping crane, eskimo curlew, piping plover, Attwater's greater prairie chicken, West Indian Manatee, jaguarundi, ocelot, red wolf, Louisiana black bear, smalltooth sawfish, red-cockaded woodpecker, and Houston toad. This BA includes a pedestrian protected species habitat evaluation of the Dow Freeport Site and an evaluation of potential environmental impacts based on ground disturbing activities associated with the construction and operational phases of the project, air quality dispersion modeling results, and proposed changes in the complex's wastewater effluent discharge into the Brazos River Tidal.

URS completed detailed pollutant emission calculations for the project in accordance with the Air Permit Application requirements. URS performed dispersion modeling of air pollutants that will be emitted by the proposed project in accordance with the Prevention of Significant Deterioration (PSD) Permit requirements. Dispersion models indicate that when LHC-9 is operational, the majority of the concentrations of all regulated constituents will be below significant impact levels (SIL) outside the fence line of the Dow Freeport Site.

The Action Area of potential impact has been defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involve in the action" according to federal regulation (50 CFR 402.2). For the basis of this BA, the project's Action Area was defined by the following parameters: 1) areas where construction activities would occur; 2) areas where criteria air pollutants exceed SIL; and 3) new or changes to existing wastewater effluent dilution areas resulting from the proposed project. As such, the Action Area for the LHC-9 Project includes the following project areas (Figure 3):

1) Areas where construction activities would occur

a. **LHC-9 Unit Site –** The LHC-9 process unit will be constructed on an approximate 35-acre block within Oyster Creek. The project includes the installation of process piping to adjacent process units within Oyster Creek and a new 8 to 16-inch wastewater line connecting to existing twin 24-inch wastewater headers to direct LHC-9 process wastewater to the Plant B Wastewater Treatment Plant (WWTP).

b. **Associated Pipelines –** Multiple feedstock and product pipelines will be installed for LHC-9 operations will be located within the existing pipeline rights-of-way. A 78-mile 12-inch pipeline (SOW #1) will be constructed between Mont Belvieu, Texas and Freeport, Texas to supply ethane to the proposed LHC-9 Unit. The pipeline will include the construction of new metering skids at the existing the Dow Pipeline Cedar Bayou Metering Station. Three newly constructed ethane pipelines will extend from Winfree Pump Station to surrounding facilities (SOW #3).

   Multiple feedstock and product lines will be installed between LHC-9 and Stratton Ridge for processing and storage. There will be four pipelines for ethane/ethylene storage within Stratton Ridge (SOW #5, #9, #10, and #12). Multiple metering facilities and pump stations will be constructed within the Stratton Ridge plant boundary to support the safe and efficient transport of ethane and ethylene products to and from LHC-9 (SOW #4, #6, #7, #8, #13, #14, and #15). Two pipelines will transport ethane and ethylene to and from LHC-9 and Stratton Ridge (SOW #11 and #16).

c. **Construction Laydown Area –** Dow will utilize a temporary laydown area during construction of the proposed project. The approximate 39-acre site is currently being developed in association with other Dow Plant expansion projects that are currently underway, and will be subsequently used for LHC-9 construction. As this previously disturbed area will be utilized during the construction phase of the project, it will be included in the project's Action Area.

2) **Areas where criteria air pollutants exceed SIL**

URS performed dispersion modeling of the proposed emissions of air pollutants from the proposed project in accordance with the PSD Permit requirements. The proposed increase in emissions above the baseline conditions were modeled to determine whether the resulting both off-property and on-property concentrations of criteria pollutants are greater than the de minimis SILs. The highest modeled concentration values for 1-hour NO2, 1-hour SO2, and 24-hour PM2.5 exceeded the SIL in areas within the Dow Freeport Site property boundary, both within the process areas of Dow Oyster Creek and over the Dow Barge Canal.

3) **New or changes to existing wastewater effluent mixing areas resulting from the proposed project**

   a. According to the TPDES permit, treated wastewater within Dow Oyster Creek is discharged via Outfall #202 into the Outfall #002 Canal, which is later discharged from Outfall #002 into the Brazos River, Segment No. 1201 (Brazos River Tidal). Dilution models predict that wastewater constituents and parameters will reach background concentrations before reaching the Brazos River. Therefore, the Action Area includes the Outfall #002 Canal between Outfalls #202 and the floodgate near Outfall #002.

Cooling tower blowdown will be discharged via Outfall #901 into the Dow Wastewater Canal that discharges into the Brazos River Tidal via Outfall #202. Dilution models predict that wastewater constituents and parameters will reach background concentrations before reaching the Brazos River. Therefore, the Action Area includes the Dow Wastewater Canal between Outfall #901 and the floodgate Outfall #001.

Direct permanent effects to protected species from proposed project including the construction of LHC-9 and all associate structures and pipelines will not occur; there is no suitable habitat in the areas proposed for new construction of the project. Indirect effects to protected species resulting from the project's air emissions and proposed changes in the complex's wastewater effluent discharge into the Brazos River Tidal are negligible; potential adverse effects to protected species and their habitats are not likely to occur from the project.

Based on the information gathered for this BA, URS recommends the following determinations:

Protected Species	Classification- Reason for Evaluation	Determination of Effect
Federal List of T&E Species		
Texas Prairie Dawn[3]	Listed by U.S. Fish and Wildlife Service (USFWS) as Endangered.	No effect
Green Sea Turtle[1,2,4]	Listed by USFWS and National Marine Fisheries Service (NMFS) as Threatened.	No effect
Atlantic Hawksbill Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.	No effect
Kemp's Ridley Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.	No effect
Leatherback Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.	No effect
Loggerhead Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Threatened.	No effect
Whooping Crane[1]	Listed by USFWS as Endangered.	May affect, not likely to adversely affect
Attwater's Greater Prairie Chicken[2]	Listed by USFWS as Endangered.	No effect
Eskimo Curlew[1,2]	Listed by USFWS as Endangered.	No effect
Piping Plover[1,2,4]	Listed by USFWS as Threatened.	No effect
West Indian Manatee[1,2,3,4]	Listed by USFWS as Endangered.	No effect
NOAA List of T&E Species		
Blue Whale	Endangered	No effect
Finback Whale	Endangered	No effect
Humpback Whale	Endangered	No effect
Sei Whale	Endangered	No effect
Sperm Whale	Endangered	No effect
State-Recognized List of Federal T&E Species		
Jaguarundi[1]	Listed by the Texas Parks and Wildlife Department (TPWD) as Endangered.	No effect
Ocelot[1]	Listed by the TPWD as Endangered.	No effect
Red Wolf[1,2,3,4]	Listed by the TPWD as Endangered.	No effect
Louisiana Black Bear[1,2,3,4]	Listed by the TPWD as Threatened.	No effect
Smalltooth Sawfish[1,2,3,4]	Listed by the TPWD as Endangered.	No effect
Red-cockaded Woodpecker[3]	Listed by the TPWD as Endangered.	No effect
Houston Toad[3]	Listed by the TPWD as Endangered.	No effect

Note: 1. Brazoria County 2. Galveston County 3. Harris County 4. Chambers County

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1.0 Introduction

The Dow Chemical Company (Dow) has owned and operated an integrated chemical manufacturing complex (Dow Freeport Site) in Freeport, Brazoria County, Texas since 1940. The complex consists of four major areas: Oyster Creek (Oyster Creek), Plant A, Plant B, and Stratton Ridge (Dow 2013), as shown on Figure 1.

Dow proposes to construct a new ethylene production unit (Light Hydrocarbon 9 (LHC-9)) within Oyster Creek. LHC-9 will use ethane and propane as feedstock. A new 78-mile 12-inch pipeline will be constructed between Mont Belvieu and Freeport, Texas to supply ethane to the proposed LHC-9 Unit. The primary products produced at the LHC-9 facility (ethylene and propylene) will be used as feedstock for other existing units at the Dow Freeport Site or transported via pipeline to existing underground storage caverns at Stratton Ridge.

Dow has determined that the proposed project will require a Prevention of Significant Deterioration (PSD) permit issued by the U.S. Environmental Protection Agency (USEPA) for Greenhouse Gas (GHG) emissions. Dow has retained the services of URS Corporation (URS) to prepare a Biological Assessment (BA) to evaluate the proposed project site for federally-protected threatened and endangered (T&E) species and/or their potential habitat and to provide an evaluation of the project's likelihood to jeopardize the continued existence of listed species.

1.1 Project Location

The proposed LHC-9 Unit will be located entirely within the Oyster Creek plant of the Dow Freeport Site, approximately 0.3 miles northwest of State Highway 523 and 0.5 miles southwest of State Highway 332 (Figure 1). The site is located on the Freeport United States Geological Survey (USGS) Quad, at 28.9779° north latitude and -95.3495° west longitude. The LHC-9 Unit will be constructed within the OC-2 block of the plant. The OC-2 block is an approximately 35-acre site, located along the southern boundary of the Oyster Creek plant that formerly maintained Dow's Chlor-Alkali, Unit II which was decommissioned and demolished in 2012.

In addition to the LHC-9 Unit installation, multiple pipelines included in the scope of work (SOW) will be installed primarily within the Dow Freeport Site (Figure 2). A new 78-mile pipeline will connect the Dow Complexes in Mont Belvieu, Texas City, and Freeport in order to supply ethane to the proposed LHC-9 Unit. Feedstock and product storage will be located within Stratton Ridge. Two pipelines will transport ethane and ethylene to and from LHC-9 and Stratton Ridge. A new wastewater pipeline will connect LHC-9 to the wastewater treatment plant in Plant B. All of the proposed pipelines and associated facilities (e.g. metering stations, pumps, process valving, etc.) will be located within the existing plant boundaries and pipeline and utility rights-of-way.

1.2 Project Purpose

The purpose of the project is to increase ethylene production by constructing a new light hydrocarbon unit (LHC-9) with associated appurtenances. The project is part of Dow's comprehensive plan to further connect its U.S. operations with cost-advantaged feedstocks; increase ethylene supply and ethane cracking capabilities at existing U.S. Gulf Coast facilities; strengthen the competitiveness of Dow's Performance Plastics, Performance Products and Advanced Materials businesses; and enable profitable growth in the Americas.

1.3 LHC-9 Process and Operations

The LHC-9 Process is comprised of a new ethylene cracking/production unit and associated feedstock and product pipelines required for unit operation and storage. Descriptions of these components are provided below.

1.3.1 LHC- 9 Unit

The role of the cracking system is to convert saturated hydrocarbons into ethylene, propylene, butenes, and butadiene. The conversion takes place in the presence of dilution steam by rapidly raising the hydrocarbon/dilution steam temperature to cracking temperatures. The extreme temperature acts to destabilize the structure of the hydrocarbon molecule and initiate the rearrangement of the hydrocarbon molecular bonds. LHC-9 will include new steam cracking furnaces, recovery equipment, utilities, refrigeration, cooling tower, and treatment systems. The new process will include installation of the following equipment:

- Eight new ethylene cracking furnaces;
- One pressure-assisted flare;
- One low-pressure flare;
- One cooling tower;
- Two backup diesel generators;
- Several new storage tanks are included in the proposed plant. These tanks will store materials such as ammonia, quench water, compressor wash oil, caustic, spent caustic, sulfuric acid, and various water and process additives; and
- Additional maintenance, startup, and shutdown (MSS) emissions associated with the periodic clean-out of the new and modified process equipment.

1.3.2 Regulation of Air Quality

The Clean Air Act requires that air quality standards be maintained to protect public health and the environment. These standards are the National Ambient Air Quality Standards (NAAQS) and are regulated by the EPA. Ambient air is the air to which the general public has access, as opposed to air within the boundaries of an industrial facility. The NAAQS are concentration limits of pollutants in ambient air within specific averaging time. The averaging time is the time period over which the air pollutant concentrations must be met to comply with the standard. The NAAQS are classified into two categories: primary and secondary standards. Primary standards are set to protect public health, including "sensitive" populations. Secondary standards are set to protect public welfare, including the environment.

The EPA sets NAAQS for six principal air pollutants, also referred to as "criteria air pollutants." The six criteria air pollutants are nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), particulate matter (PM), carbon monoxide (CO), and lead (Pb). A geographic area whose ambient air concentration for a criteria pollutant is equal to or less than the primary standard is an "attainment area." A geographic area with an ambient air concentration greater than the primary standard is a "nonattainment area." A geographic area will have a separate designation for each criteria pollutant.

The Clean Air Act also requires the EPA to establish regulations to prevent significant deterioration of air quality in attainment areas. The EPA established PSD Increments to satisfy this requirement. A PSD Increment is a measure of the maximum allowable increase in ambient air concentrations of a criteria pollutant from a baseline concentration after a specified baseline date. A significant impact level (SIL) is a concentration that represents a *de minimis*, or insignificant, threshold applied to PSD permit applicants. The SIL is a measurable limit above which a source may cause or contribute to a violation of a PSD Increment for a criteria pollutant. Before a PSD permit can be issued, the applicant must demonstrate that the proposed emissions from a project will not cause or contribute to a violation of a NAAQS or to an increase above a PSD Increment for each pollutant emitted in significant amounts by the project.

1.3.3 Emission Controls

Per 30 TAC §116.111(a)(2)(c), new or modified facilities must utilize Best Available Control Technology (BACT), with consideration given to the technical practicability and economic reasonableness of reducing or eliminating the emissions from the facility. LHC-9 will include eight new steam cracking furnaces, recovery equipment, utilities, refrigeration, cooling tower, and treatment systems. New flare systems (pressure-assisted flare and a low pressure flare) will be constructed on the LHC-9 site (Figure 2). The Dow Freeport Site is in a nonattainment area for ozone and the installation project will not trigger Nonattainment New Source Review (NNSR) for nitrogen oxide (NO_x) and volatile organic compounds (VOC). In addition, the estimated CO, NO_2, PM less than 10 microns in diameter (PM_{10}), and PM less than 2.5 microns in diameter ($PM_{2.5}$) emission increases associated with the proposed installation will trigger PSD review. PSD will not be triggered for the remaining criteria pollutants SO_2 and Pb. There are no potential Pb emissions from the facility; therefore, Pb will not be addressed elsewhere in this document.

Dow will utilize BACT to control emissions from the project and thus minimize impacts to the surrounding environment to the maximum extent practicable. Dow has selected TCEQ BACT guidance for each of the criteria pollutants. Details of the selection can be found in the TCEQ and EPA permit applications for this project: TCEQ Permit #107153, Project #185971; EPA application submittal date November 29, 2012 for Dow Chemical Company, Light Hydrocarbon 9. The following control technologies were selected for the listed pollutants:

- **FURNACE EMISSIONS:**
  - NOx Selective catalytic reduction
  - NO2 Low-NOx burners
  - CO Good combustion practices
  - PM Good combustion practices
  - VOC Good combustion practices
- **COOLING TOWER EMISSIONS:**
  - PM Drift eliminators

A cooling tower (EPN: OC2CT936) will be constructed to provide process heat removal. This cooling tower will be a multi-cell, induced draft, counter-flow type cooling tower.

Wet cooling towers provide direct contact between the cooling water and air passing through the tower. As part of normal operation, a very small amount of the circulating water may be entrained in the air stream and be carried out of the tower as “drift” droplets. Because the drift droplets may contain the same salt impurities as the water circulating through the tower, the particulate matter constituent of the drift droplets is classified as an emission. Cooling water conductivity and total dissolved solids are parameters used to estimate particulate emissions from the unit.

VOC emissions from the cooling tower are generated by leakage of hydrocarbons from process heat exchangers into the cooling water system, and are released to atmosphere with the cooling tower fan discharge to atmosphere. The cooling water system will include totalizing flow measurement and on-line analysis to detect and speciate Highly Reactive Volatile Organic Compounds (HRVOC) hydrocarbons in the cooling water.

Several new storage tanks are included in the proposed plant. These tanks will store materials such as ammonia, quench water, compressor wash oil, caustic, spent caustic, sulfuric acid, and various water and process additives. Some tanks will be routed to control. No increase in GHG emissions are being represented from the proposed storage tanks with atmospheric vents.

A new flare system (EPNs: OC2F5961 and OC2F597) will be constructed to provide safe control of gases vented from the proposed plant. This system will consist of a pressure-assisted flare for managing the main portion of vented gases, and a low pressure flare for managing lower pressure vented gases including those from the plant's low pressure rated storage tanks. The flare system will be equipped with totalizing flow measurement and on-line analysis to speciate the hydrocarbons in the flared gases, including HRVOCs.

1.3.4 Water Use

The Dow Freeport Site receives its fresh water supply from the Brazos River utilizing intake pumps along the river and placing water into Dow reservoirs that provides water distribution to the entire Dow Freeport Site, including the LHC-9 ethylene manufacturing unit. Dow takes water from the Brazos River Tidal, Segment No. 1201. The Brazos River Tidal is not listed as an impaired water body on Section 303d list. Texas Parks and Wildlife Department (TPWD) has designated Segment 1201 as an ecologically significant stream under designation criteria 31 TAC 357.8 (TCEQ 2012) for its support of unique live oak-water oak-pecan bottomlands community and is a riparian conservation area. These bottomland communities are located upstream of the Dow facility and are not anticipated to be affected by the proposed project. Dow does not anticipate that an increase in fresh water intake will result from the operation of the LHC-9 Unit. The Dow water supply system consists of Dow owned water rights, reservoirs, and a river water canal system that is capable of supporting the proposed project without any increases in water rights.

Wastewater from LHC-9

Dow is authorized to treat and discharge wastes from the Dow Freeport Site under Texas Pollutant Discharge Elimination System (TPDES) Permit No. WQ0000007000. Process wastewater is collected in a tank and pumped to an on-site wastewater treatment facility in Plant B for treatment. According to the TPDES permit, treated water is discharged via Outfall #202 into the Outfall #002 Canal, which is later discharged from Outfall #002 into the Brazos River, Segment No. 1201 (Brazos River Tidal). Cooling tower blowdown will be via Outfall #901 into the Dow Wastewater Canal that discharges into the Brazos River Tidal via Outfall #202.

The Brazos River Tidal is not an impaired water body by Section 303(d), and is utilized by aquatic life and contact recreation. As mentioned above, Segment 1201 is designated by TPWD as an ecologically significant stream based on the designation criteria 31 TAC 357.8 for unique communities primarily found upstream of the Dow facility. The Dow Freeport Site is currently subject to effluent limitations, monitoring requirements, and other conditions described in the permit. The Dow Freeport Site's process wastewaters undergo primary and secondary treatment and disinfection prior to discharge from Outfall #202. The proposed LHC-9 Unit would discharge approximately 1,024 gallons per minute (gpm) of wastewater including spent caustic streams and dilution steam blowdown to an on-site wastewater treatment plant. Wastewater from the plant will be expelled out Outfall #202. Cooling tower blowdown and re-generation purging will discharge approximately 1,625 gpm into Outfall #901. Water quality at the outfalls is currently maintained within all permit limits. The proposed water discharge will be subject to the current permit limitations. No TPDES permit revisions will be required with the addition of LHC-9. The proposed LHC-9 plant will also include systems to collect rain water and process wastewater.

If ancillary areas are disturbed in support of the construction project, structural controls may be used to protect surrounding areas from impacted surface runoff. Runoff from within the site is directed through a series of onsite ditches and weirs before discharged through permitted outfalls. Additional erosion control measures (silt fence, sandbags) may be used if excess erosion and/or sedimentation are observed during the construction phases. Re-vegetation is not a concern since the site is a heavy industrial site consisting of gravel or concrete-paved surfaces.

Dow will develop Spill Prevention, Control, and Countermeasure (SPCC) Plans for the operation phases and Storm Water Pollution Prevention Plans (SWPPP) for the construction phases of the project. Dow will provide implementation training to plant and contractor employees. Best Management Practices will be utilized in accordance with Section 401 of the Clean Water Act, Chapter 279 of the Texas Water Code, and as prescribed in the Dow SWPPP.

1.3.5 Noise Levels

The new equipment should not alter the pre-existing noise exposure at all construction sites. Dow engineers estimate that the proposed project will not produce increased noise levels during construction compared to noise levels from maintenance activities that currently take place at the plant. Any equipment louder than 90 decibels will be evaluated on a case-by-case basis.

1.3.6 Associated Pipelines

Multiple feedstock and product pipelines will be installed for LHC-9 operations within the existing pipeline and utility rights-of-way (ROWs; Figure 2). A new 78-mile 12-inch pipeline (SOW #1) will be constructed between Mont Belvieu, Texas and Freeport, Texas to supply ethane to the proposed LHC-9 Unit. The pipeline will commence in Mont Belvieu, Texas and travel 42-miles, crossing into Harris County, the Houston Ship Channel, and then into Galveston County to Texas City. It then travels southwest for 36-miles into Brazoria County, terminating at Stratton Ridge. A new pump station (Winfree Pump Station) that will supply ethane to the system will be constructed in Mont Belvieu and connect to three (3) new 10-inch ethane pipelines extending to surrounding Mont Belvieu facilities (SOW #3). A new metering skid will be installed at Dow's Cedar Bayou Metering Station, approximately 4 miles south of the Winfree Pump Station.

Feedstock and product lines will be installed between LHC-9 and Stratton Ridge for processing and storage. There will be four pipelines for ethane/ethylene storage within Stratton Ridge (SOW #5, #9, #10, and #12). Multiple metering facilities and pump stations will be constructed within the Stratton Ridge Area boundary to support the safe and efficient transport of ethane and ethylene products to and from LHC-9 (SOW #4, #6, #7, #8, #13, #14, and #15). Two 5.2-mile, 12-inch pipelines will transport ethane and ethylene to and from LHC-9 and Stratton Ridge (SOW #11 and #16). A 50-foot operations ROW will be maintained along the pipeline route for pipeline access and maintenance.

1.4 LHC-9 Construction

The LHC-9 Unit will be constructed within the OC-2 Block of Oyster Creek, an approximately 35-acre site, located along the southern boundary of Oyster Creek that formerly maintained Dow's Chlor-Alkali, Unit II which was decommissioned and demolished in 2012 (Figure 2). Construction of the LHC-9 project is scheduled to start in January 2014. The LHC-9 Unit is expected to be in operation by January 2017.

1.4.1 LHC-9

LHC-9 construction will consist of site preparation and LHC-9 process unit installation. Because the OC-2 Block previously housed a process unit, the ground surface in the majority of the construction area is comprised of concrete, caliche, or previously disturbed soils. Site preparation will include excavation down to 6 feet for the removal of remaining concrete slabs from the former process. Existing pilings that were installed to depths of 35-40 feet will remain in place. Additional pilings will be installed to depths of 35-40 feet for the new process unit. Clean soil will be brought in from an approved borrow site to elevate the site approximately 4 feet above grade. Multiple utility and process pipelines will be installed within Oyster Creek for unit operations and will include aboveground lines (ranging from 3 to 76-inches) to be installed on existing and new pipe racks and underground lines (ranging from 8 to 96-inches) connecting to other process units. Underground pipelines will require trenching to depths of 3 to 15 feet below grade. The proposed towers, furnaces, flares, etc. are in-keeping with the current landscape and will have a maximum height that is less than existing surrounding structures, approximately 275 feet.

Construction of the LHC-9 process will also require the relocation of an existing plant road (OC-2), an associated levee, and a roadside drainage ditch that is part of Oyster Creek's storm water drainage infrastructure. Site preparation activities to relocate the existing roadway, levee, and roadside drainage ditch will include the demolition of the levee and roadway, and filling of the drainage channel. The new roadway will be constructed on top of the replacement levee and will require the placement of suitable levee (clay, etc.) and roadbed (asphalt, gravel, caliche, etc.) materials. Excavation will be required to construct a new roadside drainage ditch.

1.4.2 Construction Equipment

Equipment required to complete the proposed LHC-9 construction activities is roughly estimated to include the following for the listed time periods.

- 4 Piling Rigs - 16 weeks
- 4 Excavators - 52 Weeks
- 2 Compactors - 52 Weeks
- 6 Dump trucks - 40 Weeks
- 8 Concrete Trucks - 26 Weeks
- 2 Concrete Pump Trucks - 26 Weeks
- 3 Large Cranes (>200 tons, ≤300 feet) - 40 Weeks

- 1 350-foot Crane – 12 Weeks
- 8 Large Cranes (100-200 tons) - 52 Weeks
- 16 Small Cranes (<100 tons) - 78 Weeks
- 20 School busses - 100 Weeks
- 30 Pick-up Trucks - 100 Weeks
- 15 Flat-bed Trucks - 100 Weeks
- 20 Man Lifts - 78 Weeks
- 200 Welding Machines - 52 Weeks
- 10 Air Compressors - 52 Weeks
- 20 Light Towers - 32 Weeks
- 10 Gator Personnel Vehicles - 100 Weeks
- 2 Water Trucks - 100 Weeks

1.4.3 Construction Laydown Areas

During construction of the proposed project, Dow will utilize a temporary laydown area, located approximately 1-mile west of Oyster Creek on State Highway 332. The approximate 39-acre construction laydown area will be previously converted from pastureland to a graded area with an aggregate base that will be utilized as a laydown area for various projects within the Dow Freeport Site, to subsequently be used for the LHC-9 construction. As this disturbed area will be utilized during the construction phase of the project, it will be included in the project's Action Area.

1.4.4 Associated Pipelines

All of the proposed pipelines, and associated appurtenances (e.g. metering stations, pumps, process valving, etc.) will be located within either the existing plant boundaries or within existing pipeline ROWs (Figure 2). No additional easements will be acquired; no land disturbing activities will take place outside of the existing ROW for either pipeline construction or operations. The ethane and ethylene pipelines will be co-located with other underground pipelines in an existing previously cleared ROW that is maintained (mowed and kept clear of woody vegetation) for operations and maintenance. The pipeline will be installed, except as detailed below, utilizing standard open-cut (trenching) methods within a 100-foot-wide temporary construction corridor. Standard, open-cut pipeline construction procedures include staking of the right-of-way; clearing and grading; trenching; pipe stringing, bending, and welding; lowering the pipe into the trench; backfilling the trench; hydrostatic testing of the pipeline; and restoration of the right-of-way. All temporary workspace will be restored as close to its original state as possible and in accordance with applicable permits. Post-construction, a 50-foot-wide permanent easement will be maintained above the pipeline for maintenance.

In addition to standard techniques, the pipelines will be installed using horizontal directional drilling (HDD) at major water body crossings along the proposed corridor to minimize environmental impacts (Figure 2).

The following major water bodies will be crossed using HDD:

- Austin Bayou,
- Basford Bayou,
- Bastrop Bayou and tributary,
- Brazoria National Wildlife Refuge Canal,
- Big Slough,
- Cedar Bayou,
- Chocolate Bayou,
- Clear Lake,
- Dickinson Bayou,
- Galveston County Diversion Canal,
- San Jacinto River (Houston Ship Channel),
- Halls Bayou,
- Highland Bayou and tributary,
- Highland Bayou Diversion Canal,
- Moses Bayou,
- New Bayou and tributary,
- Oyster Creek (Corridor P and R),
- Persimmon Bayou,
- Pine Gully,
- Tabbs Bay,
- Taylor Bayou,
- Unnamed drainage channel adjacent to Moses Lake,
- An unnamed drainage channel adjacent to Trinity Bay, and
- Willow Bayou.

The HDD method involves drilling a pilot hole under the water body and banks, then enlarging the hole through successive ream borings with progressively larger bits until the hole is large enough to accommodate a pre-welded segment of pipe. Pipe sections long enough to span the entire crossing would be staged and welded along the construction work area on the opposite side of the water body and then pulled through the drilled hole.

The San Jacinto River/Houston Ship Channel HDD crossing will require routing the 12" ethane pipeline through Spilmans Island; a U.S. Army Corps of Engineers regulated dredge material placement area. The pipeline will be installed through Spilmans Island utilizing the open-cut method, described above. The pipeline would then be installed by HDD across Hog Island to an existing pipeline ROW located south of Baytown, Texas. The pipeline would be installed within existing pipeline and utility ROWs on Spilmans Island and Hog Island.

1.5 Purpose of the BA

The purpose of this BA is to evaluate and document the potential for the proposed project and its interdependent and interrelated actions to have a direct, indirect, or cumulative effect on any federally-protected species. Specifically, the BA considers potential temporary impacts from construction activities and permanent impacts from the additional emissions and water discharges that will result from the operation of the proposed project. An Action Area of potential impact has been defined and is shown in Figure 3. This BA includes a pedestrian protected species habitat evaluation of the proposed construction area and areas of potential habitat within the Dow Freeport Site property. This evaluation of potential environmental impacts is based on field surveys by Benchmark Engineering, Inc., total emissions and dispersion modeling data, discharge modeling, background review data collected, literature review, and research of potential effects of known pollutants on flora and fauna provided by URS.

The conclusion of this BA will include a recommended determination of effect on each listed federally-protected species and its habitat. Three possible determinations offered by the USFWS and National Oceanographic and Atmospheric Administration-National Marine Fisheries Service (NOAA-NMFS) for the purpose of Biological Assessments and Evaluations are described below.

1. No effect – A "no effect" determination means that there are absolutely no effects from the proposed action, positive or negative, to listed species. A "no effect" determination does not include effects that are insignificant (small in size), discountable (extremely unlikely to occur), or beneficial.
2. May affect, not likely to adversely affect – A "may affect, not likely to adversely affect" determination may be reached for a proposed action where all effects are beneficial, insignificant, or discountable. Beneficial effects have contemporaneous positive effects without any adverse effects to the species or habitat (i.e., there cannot be a "balancing,"

where the benefits of the proposed action would be expected to outweigh the adverse effects – see below). Insignificant effects relate to the size of the effects and should not reach the scale where take occurs. Discountable effects are those that are extremely unlikely to occur.

3. May affect, likely to adversely affect - A "may affect, likely to adversely affect" determination means that all adverse effects cannot be avoided. A combination of beneficial and adverse effects is still "likely to adversely affect" even if the net effect is neutral or positive.

1.6 Action Area

According to federal regulation (50 CFR 402.2), the Action Area of potential impact has been defined as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action". For the basis of this BA, the project's Action Area was defined by the following parameters: 1) areas where construction activities would occur; 2) areas where criteria air pollutants exceed SIL; and 3) new or changes to existing wastewater effluent mixing areas resulting from the proposed project. Based on these parameters, the Action Area for the LHC-9 Project includes the following project areas (Figure 3):

1) Areas where construction activities would occur

a. **LHC-9 Unit Site** – The LHC-9 process unit will be constructed on an approximate 35-acre block within Oyster Creek. The project includes the installation of process piping to adjacent process units within Oyster Creek and a new 8 to 16-inch wastewater line connecting to existing twin 24-inch wastewater headers to direct LHC-9 process wastewater to the Plant B Wastewater Treatment Plant (WWTP).

b. **Associated Pipelines** – Multiple feedstock and product pipelines will be installed for LHC-9 operations will be located within the existing pipeline rights-of-way. A 78-mile 12-inch pipeline (SOW #1) will be constructed between Mont Belvieu, Texas and Freeport, Texas to supply ethane to the proposed LHC-9 Unit. The pipeline will include the construction of new metering skids at the existing the Dow Pipeline Cedar Bayou Metering Station. Three newly constructed ethane pipelines will extend from Winfree Pump Station to surrounding facilities (SOW #3).

   Multiple feedstock and product lines will be installed between LHC-9 and Stratton Ridge for processing and storage. There will be four pipelines for ethane/ethylene storage within Stratton Ridge (SOW #5, #9, #10, and #12). Multiple metering facilities and pump stations will be constructed within the Stratton Ridge plant boundary to support the safe and efficient transport of ethane and ethylene products to and from LHC-9 (SOW #4, #6, #7, #8, #13, #14, and #15). Two pipelines will transport ethane and ethylene to and from LHC-9 and Stratton Ridge (SOW #11 and #16).

c. **Construction Laydown Area –** Dow will utilize a temporary laydown area during construction of the proposed project. The approximate 39-acre site is currently being developed in association with other Dow Plant expansion projects that are currently underway, and will be subsequently used for LHC-9 construction. As this previously disturbed area will be utilized during the construction phase of the project, it will be included in the project's Action Area.

2) Areas where criteria air pollutants exceed SIL

URS performed dispersion modeling of the proposed emissions of air pollutants from the proposed project in accordance with the PSD Permit requirements. The proposed increase in emissions above the baseline conditions were modeled to determine whether the resulting both off-property and on-property concentrations of criteria pollutants are greater than the de minimis SILs. The highest modeled concentration values for 1-hour NO2, 1-hour SO2, and 24-hour PM2.5 exceeded the SIL in areas within the Dow Freeport Site property boundary, both within the process areas of Dow Oyster Creek and over the Dow Barge Canal. Details are provided in Section 7.1.

3) New or changes to existing wastewater effluent mixing areas resulting from the proposed project

According to the TPDES permit, treated wastewater within Dow Oyster Creek is discharged via Outfall #202 into the Outfall #002 Canal, which is later discharged from Outfall #002 into the Brazos River, Segment No. 1201 (Brazos River Tidal). Dilution models predict that wastewater constituents and parameters will reach background concentrations before reaching the Brazos River. Therefore, the Action Area includes the Outfall #002 Canal between Outfalls #202 and the floodgate near Outfall #002. Details are provided in Section 7.2.

Cooling tower blowdown will be discharged via Outfall #901 into the Dow Wastewater Canal that discharges into the Brazos River Tidal via Outfall #202. Dilution models predict that wastewater constituents and parameters will reach background concentrations before reaching the Brazos River. Therefore, the Action Area includes the Dow Wastewater Canal between Outfall #901 and the floodgate Outfall #001. Details are provided in Section 7.2.

The analysis of protected species likely to be affected by the proposed project focused on impacts within the Action Area. The Action Area includes impacts by ground disturbance, changes in air quality, and changes in water quality resulting from the construction and operation of the LHC-9 process unit as well as the potential impacts from the proposed pipeline construction and associated appurtenances. The Action Area is approximately 1,901.8 acres. Land use and plant community types within the Action Area include process areas (fill or concrete), maintained grasses, mixed woodland, wetlands, riverine, and open water. A significant portion of these habitats have historically been constructed, manipulated, or otherwise previously impacted by industrial activities.

1.6.1 Potential Impacts from Construction

The following information was considered for this analysis regarding threatened and endangered species that may be affected by the proposed project: consultations with US Fish and Wildlife Service (USFWS), TPWD, National Oceanographic and Atmospheric Administration (NOAA), and NMFS-Galveston; review of Threatened and Endangered Species Reports and Wetland Delineation Reports provided by contracted consultants that surveyed along the proposed pipeline corridors; review of available lists and databases of protected species and habitats, including TPWD's Texas Natural Diversity Database (TXNDD); TPWD's Ecologically Significant Stream Segments; NatureServe Explorer Ecological System records; NOAA's Sea Turtle Stranding and Salvage Network (STSSN); and USACE's Sea Turtle Data Warehouse.

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The operation of LHC-9 has the potential to impact local air and water quality due to increased air emissions and water effluent discharges. The potential for these increases in emissions and discharges to impact listed species was assessed through the interpretation of SIL modeling under EPA standards and water modeling under EPA and Texas Commission on Environmental Quality (TCEQ) water quality standards coupled with species occurrence data and assessment of potential habitat for each species of concern. No additional ship traffic is anticipated to result from the proposed project.

Associated Pipelines

Potential impacts to listed species resulting from pipeline construction including habitat loss, degradation, and fragmentation were considered for the proposed associated pipelines.

2.0 Existing Conditions

2.1 General Environmental Information

This section provides applicable environmental characteristics for the general region in which the project is located.

2.1.1 General Region Information

The proposed project involves the new construction of LHC-9 and associated pipelines. LHC-9 and five accompanying pipelines (SOW #5, #9, #10, #12, and wastewater line) are located within Brazoria County and are confined to Major Land Resource Area (MLRA) 150B, Gulf Coast Saline Prairies ecoregion. The construction of SOW #1 pipeline will span across four counties (Brazoria, Galveston, Harris, and Chambers Counties) and two MLRAs: MLRA 150B and MLRA 150A, Gulf Coast Prairies ecoregion.

MLRA 150B

The portions of the Project's Action Area within Brazoria and Galveston Counties are located within MLRA 150B. According to the United States Department of Agriculture (USDA) nomenclature, MLRA 150B is in the Gulf Coastal Plain physiographic province of North America (USDA 2012). Because the majority of the river basins of Texas drain towards the Gulf of Mexico, there are multiple dynamic ecosystems within this MLRA including bays, estuaries, salt marshes, freshwater wetlands, tidal flats, marshes, and swamps. Hardwood bottomlands, prairies, and oak mottes are also common throughout this region. These ecosystems are home to an abundance and variety of wildlife including mammals, birds, reptiles, amphibians, fish, and invertebrates and are important breeding grounds and fish hatcheries.

MLRA 150A

Harris County and Chambers County are located within the Gulf Coast Prairies eco-region of Texas, which is in the West Gulf Coastal Plain Section of the Coastal Plain Province of the Atlantic Plain (USDA 2012). Natural grass prairies with hardwood trees originally dominated this MLRA with spots of vegetation such as little bluestem, Indiangrass, switchgrass, and big bluestem. This vegetative community supported local populations of white-tail deer, raccoons, opossums, rabbits, fox, coyotes, and other small mammals as well as migratory waterfowl. Now the area primarily is dominated by grassland vegetation. Some of the major wildlife species supported in the area include white-tailed deer, alligator, javelina, jackrabbit, cottontail, bobwhite quail, ducks, and geese.

2.1.2 Air Quality

Air quality is impacted by a high density of industrial facilities and the population density in an area. The proposed project, including LHC-9 and associated pipelines, will be located in nonattainment areas for ozone. Nonattainment areas are designated to locations where air pollution levels are persistently exceeding the NAAQS. The Dow Freeport Site is in a nonattainment area for ozone and the installation project will not trigger Nonattainment New Source Review (NNSR) for nitrogen oxide (NO_x) and volatile organic compounds (VOC). In addition, the estimated CO, NO_2, PM less than 10 microns in diameter (PM_{10}), and PM less than 2.5 microns in diameter ($PM_{2.5}$) emission increases associated with the proposed installation will trigger PSD review.

2.1.3 Land Use

Land uses within the Action Area include agricultural lands, forested areas, and industrial regions (Figure 4). Due to the abundant water resources and close proximity to the coast, much of the Action Area has been previously altered for ranching, urbanization, and recreational areas.

The proposed pipeline travels through and along a few designated resource protection areas. Brazoria National Wildlife Refuge (NWR) is located along Christmas Bay, West Bay, and Chocolate Bay southwest of Angleton, Texas. The USFWS has granted a ROW Permit (P-6) for the project within the Brazoria NWR, in effect October 1, 2013.

Nature Conservancy Texas City Prairie Preserve (Preserve) is located north of Moses Lake and east of SH 146 in Texas City, Texas. The proposed pipeline will not be constructed within the Preserve; actual construction will be separated from the Preserve by SH 146.

2.1.4 Climate

According to the World Media Group (2013) the mean annual precipitation in Brazoria County is approximately 50 inches. The city of Freeport, Texas averages 43 inches of rain annually (USACE 2012).The growing season averages 309 days a year. The annual average low temperature is 60°F; the annual average high temperature is 79°F. Annual average wind speed is approximately 16.15 miles per hour (mph). The annual average humidity is approximately 83 percent.

According to the World Media Group (2013), the mean annual precipitation in Galveston County is approximately 56 inches. The annual average low temperature is 42°F, and the annual average high temperature is 79°F. Annual average wind speed is approximately 12 miles per hour (mph). Annual average humidity is approximately 77 percent.

According to the World Media Group (2013), mean annual precipitation in Harris County is approximately 50 inches. The annual average low temperature is 42°F, and the annual average high temperature is 92°F. Prevailing winds are from the south with an average speed of 12 miles per hour. Average humidity is 74 percent.

According to the World Media Group (2013), the mean annual precipitation in Chambers County is approximately 56 inches. The annual average low temperature is 60°F, and the annual average high temperature is 79°F. Annual average wind speed is approximately 16 mph. Annual average humidity is approximately 78 percent.

2.1.5 Topography

The topography of the LHC-9 site is flat, but is located near the Brazos River Tidal which has a steep shoreline. The elevation of the project area is approximately 2 feet above mean sea level (Figure 5). Drainage is generally to the southeast into Brazos River Tidal via a system of onsite ditches.

The proposed SOW #1 pipeline will generally follow the coast line of the Gulf of Mexico and its bays. Maximum distance from the shoreline will be approximately 37,000 feet and the pipeline will intersect the shoreline where it extends under the San Jacinto River (Houston Ship Channel). The proposed project will be located on typical low, flat terrains that are intersected with numerous streams, creeks, and rivers flowing out to the Gulf of Mexico.

According to the Federal Emergency Management Agency (FEMA) flood insurance rate map (FIRM), the proposed LHC-9 construction site is located outside of the designated 100-year floodplain. Approximately 591.77 acres of the proposed pipeline routes are located in the FEMA 100-year floodplain (Figure 6). The Action Area is located across several FEMA FIRM Community Panel Numbers as shown in Table 1.

Table 1 - FEMA FIRM Community Map Panel Number

Community Map Panel Number	Effective Dates
4801190135B	6/15/1983
4801190145B	6/15/1983

Community Map Panel Number	Effective Dates
4801190285B	6/15/1983
4801190295B	6/15/1983
4801220005A	8/16/1982
48039C0320H	6/5/1989
48039C0340H	6/5/1989
48039C0470H	6/5/1989
48039C0480H	6/5/1989
48039C0485H	6/5/1989
48039C0490H	6/5/1989
48039C0630H	6/5/1989
48039C0635H	6/5/1989
48039C0640H	6/5/1989
48039C0760I	6/5/1989
48039C0780I	6/5/1989
48201C0760L	6/18/2007
48201C0770L	6/18/2007
48201C0935L	6/18/2007
48201C0945L	6/18/2007
48201C0955L	6/18/2007
48201C0955L	6/18/2007
48201C0960L	6/18/2007
48201C1085L	6/18/2007
48201C1095L	6/18/2007
48201C1125L	6/18/2007
4854700029C	5/2/1983
4854700035C	5/2/1983
4854700100C	5/2/1983
4854700205C	5/2/1983
4854700230C	5/2/1983
4854700235C	5/2/1983
4854700240C	5/2/1983
4854790010D	4/4/1983
4854790015D	4/4/1983
4854810001B	4/4/1983
4854810003B	4/4/1983
4854860010D	2/16/1983
4854860020D	2/16/1983
4855140009C	5/2/1983

Community Map Panel Number	Effective Dates
4855140010C	5/2/1983
4855140030C	5/2/1983
4855140045C	5/3/1983

2.1.6 Geology

The specific geologic formation found in the project site for LHC-9 and the wastewater pipeline is the Alluvium Formation, Qal, from the Holocene Era. All pipelines and related appurtenances within Stratton Ridge are located on the Beaumont formation, (Qb) as well as the SOW #1 pipeline with the exception of Hogg Island. Hogg Island is located on a Fill and Spoil formation, (FS).

The following is the description of the geologic units provided by the USGS (USGS 2012):

> The Alluvium Formation consists of alluvium and low terrace deposits along streams, sand, silt, clay, and gravel. Thickness is variable. These deposits of clay and silty, clayey fine to very fine quartz sand and shell sand accumulate on alternately dry and flooded barren flats 0.3 m below to 1 m above mean sea level. Mapped areas include active eolian sand dunes on the landward side of barrier islands.
>
> The underlying Beaumont Formation from the Pleistocene is dominated by clay and mud of low permeability. It consists of light to dark gray and bluish to greenish gray clay and silt, intermixed and interbedded. It also contains beds and lenses of fine sand, decayed organic matter, and many buried organic-rich with oxidized soil zones that contain calcareous and ferruginous nodules. The sediment is primarily cemented by calcium carbonate present in varied forms including veins, laminar zones, burrows, root casts, nodules. Locally, small gypsum crystals are present. Plastic, compressible clay, and mud deposited in flood basins, coastal lakes, and former stream channels on a deltaic plain would also be found in this formation.
>
> The Beaumont Formation, Qb, consists mostly of clay, silt, and sand and includes mainly stream channel, point-bar, natural levee, backswamp, and to a lesser extent coastal marsh and mud-flat deposits. Concretions of calcium carbonate, iron oxide, and iron manganese oxides can be found in the zone of weathers. The surface is almost featureless and is characterized by reliet river channels shown by meandering patterns and pimple mounds on meanderbelt ridges. These are typically separated by acres of low, relatively smooth, featureless backswamp deposits without pimple mounds with a thickness +/- 100 feet.

Fill and spoil, FS, is material dredged for raising land surface above alluvium and barrier-island deposits and for creating land. Spoil is dredged material along waterways.

2.1.7 Soils

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The USDA Natural Resources Conservation Service (USDA-NRCS) soil units mapped within and surrounding the proposed project areas are listed and described in the following tables.

Table 2 - USDA NRCS Soil Units for Brazoria County

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth * (in.)	Drainage	Permeability	
2	Asa silt loam	0-12 12-51 51-61 61-80	Well Drained	Moderately fast	Not Hydric
3	Asa silty clay loam	0-14 14-61 61-65 65-80	Well Drained	Moderately fast	Not Hydric
6	Bacliff clay (0-1% slopes)	0-28 28-80	Poorly Drained	Slow	Partially Hydric
7	Bernard clay loam	0-13 13-65 65-69	Somewhat Poorly Drained	Slow	Partially Hydric
8	Bernard-Edna Complex	0-12 12-60 60-64	Somewhat Poorly Drained	Slow	Partially Hydric
10	Brazoria clay (0-1% slopes)	0-20 20-70	Moderately Well Drained	Slow	Partially Hydric
13	Edna fine sandy loam (0-1%)	0-8 8-48 48-60	Somewhat Poorly Drained	Slow	Partially Hydric
14	Edna fine sandy loam (1-5%)	0-4 4-45 45-60	Somewhat Poorly Drained	Slow	Partially Hydric
15	Edna-Aris Complex	0-8 8-36 36-60	Somewhat Poorly Drained	Slow	Partially Hydric
16	Follet clay loam	0-4 4-62	Very Poorly Drained	Slow	Hydric

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth * (in.)	Drainage	Permeability	
17	Francitas clay	0-18 18-36 36-80	Somewhat Poorly Drained	Slow	Partially Hydric
19	Harris clay	0-16 16-60 60-64	Very Poorly Drained	Slow	Hydric
21	Ijam clay	0-9 9-60	Poorly Drained	Slow	Hydric
24	Lake Charles clay	0-13 13-40 40-64 64-80	Moderately Well Drained	Slow	Partially Hydric
27	Leton loam	0-23 23-62	Poorly Drained	Moderately Slow	Partially Hydric
28	Leton-Aris Complex	0-13 13-60	Poorly Drained	Moderately Slow	Partially Hydric
29	Morey silt loam	0-11 11-36 36-61	Somewhat Poorly Drained	Moderately Slow	Partially Hydric
32	Narta fine sandy loam	0-7 7-18 18-74	Somewhat Poorly Drained	Slow	Partially Hydric
36	Pledger clay	0-26 26-50 50-64 64-80	Moderately Well Drained	Slow	Partially Hydric
39	Surfside clay	0-14 14-72	Poorly Drained	Very Slow	Hydric
43	Veston silty clay loam	0-11 11-26 26-60 60-80	Poorly Drained	Moderately Slow	Hydric
W	Water	-	-	-	-

Table 3 - USDA NRCS Soil Units for Galveston County

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth* (in.)	Drainage	Permeability	
Ba	Bacliff clay	0-35 35-60	Poorly Drained	Slow	Partially Hydric
Be	Bernard clay loam	0-10 10-60 60-65	Somewhat Poorly Drained	Slow	Partially Hydric
Bn	Bernard-Edna Complex	0-10	Somewhat Poorly	Slow	Partially Hydric

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth* (in.)	Drainage	Permeability	
		10-60	Drained		
Ed	Edna fine sandy loam	0-8 8-45 45-60	Somewhat Poorly Drained	Slow	Partially Hydric
Fo	Follet loam	0-8 8-60	Very Poorly Drained	Slow	Partially Hydric
Fr	Francitas clay	0-13 13-73	Somewhat Poorly Drained	Slow	Partially Hydric
ImA	Ijam clay (0-2% slopes)	0-10 10-60	Poorly Drained	Slow	Partially Hydric
Iu	Francitas-Urban land complex	0-12 12-60	Somewhat Poorly Drained	Slow	Partially Hydric
KeA	Kemah silt loam (0-1% slopes)	0-15 15-38 38-60	Somewhat Poorly Drained	Slow	Partially Hydric
Ku	Kemah-Urban land complex	0-15 15-38 38-60	Somewhat Poorly Drained	Slow	Not Hydric
LaA	Lake Charles clay (0-1% slopes)	0-10 10-24 24-62 62-80	Moderately Well Drained	Slow	Not Hydric
Le	Leton loam	0-12 12-60	Poorly Drained	Moderately Slow	Partially Hydric
Ls	Leton-Aris Complex	0-21 21-60	Poorly Drained	Moderately Slow	Partially Hydric
Mb	Mocarey-Algoa Complex	0-11 11-60	Somewhat Poorly Drained	Moderately fast	Partially Hydric
Mc	Mocarey-Cieno Complex	0-12 12-16 16-60	Moderately Well Drained	Moderately fast	Partially Hydric
Md	Mocarey-Leton Complex	0-12 12-24 24-60	Poorly Drained	Moderately Fast	Partially Hydric
Me	Morey silt loam	0-11 11-60	Somewhat Poorly Drained	Moderately Slow	Partially Hydric
Mf	Morey-Leton complex	0-11 11-60	Somewhat Poorly Drained	Moderately Slow	Partially Hydric
Na	Narta fine sandy loam	0-9 9-60	Somewhat Poorly Drained	Slow	Partially Hydric
Tx	Tracosa mucky clay-clay, low complex	0-8 8-60	Very Poorly Drained	Slow	Partially Hydric
Ve	Verland silty clay loam	0-6 6-30 30-60	Somewhat Poorly Drained	Slow	Partially Hydric

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth* (in.)	Drainage	Permeability	
Vx	Veston loam, slightly saline-strongly saline complex	0-10 10-28 28-60 60-80	Poorly Drained	Moderately Slow	Partially Hydric
W	Water	-	-	-	-

Table 4 - USDA NRCS Soil Units for Harris County

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth *(in.)	Drainage	Permeability	
Am	Aldine very fine sandy loam	0-10 10-19 19-60	Somewhat Poorly Drained	Slow	Not Hydric
Ap	Aris fine sandy loam	0-21 21-28 28-60 60-78	Poorly Drained	Slow	Partially Hydric
AtB	Atasco fine sandy loam (1-4% slopes)	0-16 16-19 19-60	Moderately Well Drained	Slow	Not Hydric
Ba	Beaumont clay	0-9 9-21 21-59 59-73	Poorly Drained	Slow	Partially Hydric
Is	Ijam soils	0-8 8-60	Poorly Drained	Slow	Partially Hydric
LcA	Lake Charles clay (0-1% slopes)	0-10 10-22 22-74 74-80	Moderately Well Drained	Slow	Not Hydric
Md	Mocarey-Leton Complex	0-7 7-20 20-72	Somewhat Poorly Drained	Slow	Partially Hydric
Mu	Verland-Urban land complex	0-7 7-20 20-72	Somewhat Poorly Drained	Slow	Not Hydric
VaB	Vamont clay (1-4%slopes)	0-8 8-70 70-80	Somewhat Poorly Drained	Slow	Not Hydric
W	Water	-	-	-	Not Hydric

Table 5 - USDA NRCS Soil Units for Chambers County

NRCS Map Unit Symbol	NRCS Map Unit Name	USDA Classification			NRCS Hydric Soil
		Depth * (in.)	Drainage	Permeability	
An	Aldine-Urban land complex	0-18 18-28 28-62 62-74	Moderately Well Drained	Slow	Not Hydric
Be	Beaumont Clay	0-22 22-48 48-72 72-80	Poorly Drained	Slow	Partially Hydric
Fs	Leton-Morey complex, leveled	0-9 9-60	Poorly Drained	Moderately Slow	Partially Hydric
Ha	Harris clay	0-12 12-44 44-60	Very Poorly Drained	Slow	Partially Hydric
LaA	Lake Charles clay (0-1% slopes)	0-12 12-36 36-64 64-80	Moderately Well Drained	Slow	Partially Hydric
LaB	Lake Charles clay, 1 to 5 percent slopes	0-10 10-20 20-70 70-80	Moderately Well Drained	Slow	Not Hydric
Mo	Morey silt loam, leveled	0-12 12-42 42-64	Somewhat Poorly Drained	Moderately Slow	Partially Hydric
OW	Oil waste	-	-	-	Not Hydric
VaB	Vamont clay (1-4% slopes)	0-4 4-44 44-60	Somewhat Poorly Drained	Slow	Not Hydric
W	Water	-	-	-	Not Hydric

*=This column identifies the depth to the upper and lower boundaries of each layer within that soil type.

2.1.8 Water Resources

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Construction is proposed within the Dow Freeport Site, which is located within the Austin-Oyster Watershed (Hydrologic Unit Code 12040205), near its boundary with the Lower Brazos watershed and the West Galveston Bay Watershed (USEPA 2).

The nearest major river is the Brazos River, which originates in Stonewall County, Texas and flows approximately 900 miles to the Gulf of Mexico. The tidal portion of the Brazos River (Brazos River Tidal), which is immediately west of the project site, flows into the Gulf of Mexico approximately 9 river miles southwest of the project area. The Brazos River supports around 81km^2 of coastal wetlands (USEPA 1999). The coastal segment of the Brazos River flows through the low, wet, marshy coastal area surrounding Freeport, Texas.The National Wetlands Inventory (NWI) indicates the presence of estuarine and marine deep water features immediately outside of the Dow Freeport Site, forested freshwater emergent ponds to the south of the Oyster Creek Facility, as well as several man-made freshwater ponds within the property. Benchmark Ecological Services, Inc. (Benchmark) evaluated the protected species habitat along the pipeline corridors within the Action Area; they identified at least 35 types of wetlands (Benchmark 2012c) along the proposed pipeline corridor. Wetland types are described in Section 3.1 and shown in Figure 7.

The following are the water features within the Dow Freeport Site, their Cowardin classification as identified by the NWI Map, and a brief description of the feature:

- Dow wastewater treatment ponds are identified as freshwater ponds. Wastewater treatment ponds within the wastewater treatment unit have been in place since the Dow Freeport Site's first development. There are also treatment ponds within the Oyster Creek unit.
- Brazos River Tidal is described as a natural riverine feature. The Brazos River Tidal's flow terminates in the Gulf of Mexico.
- Flag Lake Drainage Canal is described as a riverine feature. This canal is a man-made leveed drainage feature maintained by the Velasco Drainage District.
- Wastewater Canal is described as a riverine feature. It is a man-made feature in place since the Dow Freeport Site's first development. This canal contains Outfall #901 and Outfall #001 and ultimately discharges into the Brazos River. A 20 foot tall floodgate separates waters within the Action Area from the Brazos River; the floodgate is located

approximately 650 feet from the mouth of the Brazos River. The floodgates are open except for emergency situations. A spillway (weir) allows discharged water to exit the Dow Freeport Site and separates the Wastewater Canal from the tidal conditions of the Brazos River. At incoming tides, debris and sediment collect at the downstream side of the floodgate. During outgoing tides, turbulent conditions are created as discharged water flows into the lower receiving water.

- Dow Barge Canal is described as an estuarine and marine deep water feature. The Dow Barge Canal is a man-made channel with barricades near the southern entrance to restrict boat access. This canal is not a traditionally navigable waterway and is not publicly accessible. The Dow Barge Canal was constructed during early development of the facility. It provides Dow barges access to the Gulf of Mexico via the Freeport Harbor Channel.
- The Outfall #002 Canal extends from Outfall #202 to the Brazos River; it is described as an estuarine and marine deep water feature. Outfall #202 contains a control structure and allows water from the wastewater treatment pond to the Outfall #202 Canal. Farther downstream, a floodgate separates waters within the Action Area from the Brazos River; the floodgate is located approximately 880 feet from the mouth of the Brazos River. Conditions at this floodgate are similar to those described for the Wastewater Canal.
- There are several other drainage features within the facility; some are described as lake features and some as freshwater ponds. There are also several small freshwater emergent wetlands.

The proposed installation will include a discharge to the Brazos River Tidal (Segment ID: 1201), which is not on the Section 303(d) state list of impaired streams. According to TPWD (2012), Segment 1201 is an ecologically significant stream under designation criteria 31 TAC 357.8 for its support of unique live oak-water oak-pecan bottomlands community upstream of the Dow facility. As mentioned in Section 1.3.4, this unique community is not anticipated to be affected by the proposed project.

Associated Pipelines

According to the EPA (2013), the associated pipelines are primarily located within Freeport, Texas (Austin-Oyster watershed) along with LHC-9 with the exception of SOW #1 and SOW #3. The proposed SOW #1 route will cross the Austin-Oyster watershed (HUC code: 12040205), West Galveston Bay watershed (HUC code: 12040204), and North Galveston Bay watershed (HUC code: 12040203). SOW #3 will be located within the North Galveston Bay watershed.

SOW #1 pipeline route will cross through three major deep water areas: Chocolate Bayou, Clear Lake, and the San Jacinto River. An HDD technique will be utilized in these areas to minimize environmental impacts.

Several NWI-mapped wetlands directly intersect the proposed pipeline routes. Benchmark Ecological Services, Inc. (2012a-c, 2013a-c) categorized 35 types of wetlands along the corridor. Primarily palustrine forested/scrub shrub wetlands and palustrine emergent wetlands were found within the corridor. One NWI-mapped marine wetland was identified near Dickinson, Texas.

Water Body Crossings

Construction of the associated pipelines for the project will require crossing 97 water bodies, primarily along the SOW #1 pipeline that extends from Mont Belvieu to Freeport. A list of major water body crossings is provided in Section 1.4 and shown on Figure 8.

Five TPWD recognized Ecologically Significant Streams have been identified along the SOW #1 pipeline route (Figure 7). Stream names were obtained from a GIS shape file of designated Ecologically Significant Streams provided by TPWD and were matched with the listed streams on the Ecologically Significant Stream website (TPWD 2012e). Streams identified on the TPWD website conflicted with stream naming conventions from USGS websites. Ecologically Significant Streams are identified based on their biological function, hydrologic function, proximity to riparian conservation areas, high water quality, exceptional aquatic life, high aesthetic value, and support for threatened, endangered, and unique communities. As per 16.051 (f) of the Texas Water Code, this designation solely means that a state agency or political subdivision of the State may not finance the actual construction of a reservoir in a specific river or stream segment designated by the legislature under this subsection. The LHC-9 treated wastewater effluent will be discharged into the Brazos River Tidal Segment 1201. The SOW #1 will cross four Ecologically Significant Streams: Austin Bayou, Bastrop Bayou, Halls Bayou, and Armand Bayou (TPWD 2012e). These streams will be cross with an HDD technique to minimize environmental impacts.

The Brazos River extends from its confluence with the Gulf of Mexico upstream to FM 529 in Austin/Waller County and includes segments 1201 and 1202. The proposed LHC-9 installation project will discharge treated wastewater to Segment 1201. The Brazos River supports the unique live oak-water oak-pecan bottomlands community and small sand bars along its banks upstream of the proposed project (TPWD 2013a). The proposed project will not impact any sites upstream.

Austin Bayou extends the confluence with the Intracoastal Waterway in Brazoria County upstream to State Highway 288 in Brazoria County (TPWD 2013a). This coastal stream segment is surrounded by native prairie and woodlands that display significant overall habitat value and is a riparian conservation area for Brazoria NWR. Austin Bayou joins Bastrop Bayou before terminating in the Gulf of Mexico. Brazoria NWR, which is approximately 4 miles south of the SOW #1 pipeline, is designated as an internationally significant shorebird site by the Western Hemisphere Shorebird Reserve Network (USFWS 2014b). It supports wood stork, reddish egret, and white-faced ibis populations.

Bastrop Bayou extends from the confluence with the Gulf Intracoastal Waterway in Brazoria County to the FM 523 crossing in Brazoria County (Segment 1105). This stream segment exhibits significant overall habitat value and combines with Austin Bayou before draining into the Brazoria NWR, approximately 4 miles south of the SOW #1 pipeline. As mentioned above, the Brazoria National Wildlife Refuge is designated as an internationally significant shorebird site by the Western Hemisphere Shorebird Reserve Network (USFWS 2014b). It is a riparian conservation area for the Brazoria NWR located approximately 4 miles from the Dow Freeport Site and also supports wood stork, reddish egret, and white-faced ibis populations (TPWD 2013a).

Halls Bayou originates from Halls Lake in Brazoria County which is upstream to FM 2004. Halls Bayou is surrounded by extensive wetlands that exhibit significant overall estuarine habitat value and supports some of the last seagrasses downstream in the Galveston Bay (TPWD 2013a).

SOW #1 will intersect the downstream flow of Armand Bayou. Armand Bayou extends from the confluence with Mud Lake in Harris County (TPWD 2013a). It is upstream to Genoa-Red Bluff. It is a riparian zone that is associated with marshes that exhibit a significant overall habitat value and the Armand Bayou Coastal Preserve located approximately 3 miles upstream from the proposed SOW #1 pipeline. Armand Bayou functions in flood attenuation for the Pasadena and Clear Lake areas. TPWD has noted that this bayou is rated highly for its aesthetics in an urban setting. The proposed project will not impact any sites upstream.

2.2 Protected Species

2.2.1 Threatened or Endangered Species List

The USFWS and the National Oceanic and Atmospheric Administration - National Marine Fisheries Service (NMFS) regulate the Endangered Species Act (ESA) of 1973. "The purpose of the ESA is to protect and recover imperiled species and the ecosystems on which they depend." Imperiled species specifically includes those listed by the USFWS as threatened or endangered. Candidate species are those "the [US]FWS has enough information to warrant proposing them for listing but is precluded from doing so by higher listing priorities." Candidate species are not specifically protected by the ESA and will not be included for the purposes of this BA.

Section 9 of the ESA prohibits the "take" of threatened and endangered species. "Take" is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." "Harm" is defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering."

The USFWS lists ten threatened or endangered species within the affected counties: Brazoria, Galveston, Harris, and Chambers (USFWS 2014a). These species are Texas prairie dawn (*Hymenoxys texana*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), Atlantic hawksbill sea turtle (*Eretmochelys imbricata*), whooping crane (*Grus americana*), Attwater's greater prairie chicken (*Tympanuchus cupido attwateri*), eskimo curlew (*Numenius borealis*), piping plover (*Charadrius melodus*), and West Indian manatee (*Trichechus manatus*). NOAA lists an additional ten threatened or endangered species (NOAA 2014). These species are green sea turtle (*Chelonia mydas*), Atlantic hawksbill sea turtle (*Eretmochelys imbricate)*, Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*). TPWD lists an additional seven species with federal threatened or endangered species status within the affected counties (TPWD 2012a, b, & c, 2014), jaguarundi (*Herpailurus yaguarondi*), ocelot (*Leopardus pardalis*), red wolf (*Canis rufus*), Louisiana black bear (*Ursus americanus luteolus*), smalltooth sawfish (*Pristis pectinata*), red-cockaded woodpecker (*Picoides borealis*), and Houston toad (*Bufo houstonensis*).

2.2.2 Threatened or Endangered Species Descriptions

Texas Prairie Dawn (*Hymenoxys texana*)

The Texas prairie dawn is federally listed as an endangered species. It is a small, tap-rooted, annual plant with extant populations found in eastern Fort Bend County, west of the city of Houston, Texas (USFWS 1989, Poole et al. 2007). The Texas prairie dawn is found in small, sparsely vegetated areas, described as slick spots, on the lower sloping portion of pimple (mima) mounds or on the level land around the mound's base. The soils that comprise the pimple mounds are sandier than the soils of the surrounding flat areas and are sticky when wet, and powdery when dry. The Texas prairie dawn flowers from late February to early April, and may be the dominant plant in its microhabitat in late winter and early spring. Plants may be senescent during the summer. According to the USFWS recovery plan, the primary threat to the Texas prairie dawn is habitat destruction owing to housing development and roadway construction in western and northwestern Brazoria County. USFWS (2012d) has not identified critical habitat for this species.

Green Sea Turtle (*Chelonia mydas*)

The green sea turtle can grow to 4 feet in length and reported weights vary from 350-850 pounds. The carapace is smooth and keelless, and the color varies with shades of black, gray, green, brown, and yellow. Adults are herbivorous. Hatchlings are omnivorous.

Green sea turtles occupy three ecosystems according to life stage: terrestrial zone, neritic zone, and oceanic zone. The terrestrial zone is occupied briefly during nesting and hatching activities. Hatchlings move out to the oceanic zone until their carapace reaches approximately 20-25 centimeters in length. Juveniles and adults primarily occupy benthic feeding grounds in shallow, protected waters. Preferred feeding grounds include pastures of seagrasses and/or algae.

Green sea turtles have a worldwide distribution in tropical and subtropical waters. The nesting season in the southeastern US is June through September. Nesting is nocturnal and occurs in 2, 3, or 4-year intervals. Females nest an average of 5 times per season at 14 day intervals. Hatchlings typically emerge at night. Approximately 200 to 1,100 females are estimated to nest on US beaches. Nesting occurs on high energy oceanic beaches, primarily on islands with minimal disturbance. Green turtles return to the same nesting site and are known to travel long distances between foraging areas and nesting beaches.

Breeding populations of green sea turtles in Florida and on the Pacific coast of Mexico are federally listed as endangered; all other populations, including those on the Texas coast, are listed as threatened (NMFS-USFWS 1991). Green sea turtles have been observed within Galveston Bay, which is approximately 4 miles south of the proposed project area, as recent as 2012. These sea turtle species utilize the area for seasonal foraging (Galveston Bay Estuary Program [GBEP] 2004a). NOAA identified critical habitat to include coastal waters surrounding Culebra Island, Puerto Rico (NOAA 1998).

Hawksbill Sea Turtle (*Eretmochelys imbricata*)

The USFWS describes the hawksbill sea turtle as a small to medium-sized marine turtle with a reddish-brown carapace. The head is relatively small with a distinctive hawk-like beak. The adult hawksbill sea turtle is commonly 2.5 feet in length and weighs between 95 to 165 pounds.

Hawksbill hatchlings live in a pelagic environment, specifically in the weed lines that accumulate at convergence zones. Juveniles will return to a coastal environment when their carapace reaches approximately 20-25 centimeters in length. Juveniles and adults will spend most of their time in their primary foraging habitat, coral reefs. The hawksbill sea turtle feeds primarily on sponges.

Hawksbill sea turtle nesting occurs sometime between April and November. Nesting is nocturnal and occurs every 2 to 3 years, 4 to 5 times per season, approximately every 14 days. Preferred nesting habitat includes low and high energy beaches in tropical oceans. Nesting habitat is often shared with green sea turtles. Hawksbill sea turtles can traverse beaches limited to other species of sea turtles with their ability to traverse fringe reefs. Hawksbill sea turtles have a tolerance for a variety of nesting substrates and often build their nests under vegetation.

The hawksbill sea turtle is found in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Hawksbill sea turtles are typically associated with rocky areas and coral reefs in water less than 65 feet. Mexico is now considered the most important region for hawksbills in the Caribbean yielding 3,000 to 4,500 nests/year. The hawksbill sea turtle is an occasional visitor to the Texas coast (NMFS-USFWS 1993). Hawksbill sea turtles' favored habitat is coral reefs and they are not known to occur within Galveston Bay (BEP 2007). NOAA identified critical habitat to include coastal waters surrounding Mona and Monito Islands, Puerto Rico (NOAA 1998).

Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

The Kemp's ridley sea turtle is considered the smallest sea turtle with an olive-gray carapace and a triangular shaped head and a hooked beak. Adults can grow to about 2 feet in length and weigh up to 100 pounds. This turtle is a shallow water benthic feeder with a diet consisting primarily of shrimp, jellyfish, snails, sea stars, and swimming crabs.

Kemp's ridleys, similar to loggerhead sea turtles, occupy three ecosystems according to life stage: terrestrial zone, neritic zone, and oceanic zone. The terrestrial zone is occupied briefly during nesting and hatching activities. Hatchlings move out to the oceanic zone for an average of 2 years. Juveniles and adults primarily occupy the neritic zone (nearshore marine environment).

Most nesting occurs on the eastern coast of Mexico, however a small number consistently nest at Padre Island National Seashore in Texas and various other locations along the Gulf and lower Atlantic coasts. Nesting occurs from May to July during daylight hours. Large numbers of females emerge for a synchronized nesting event referred to as "arribada". Arribadas are thought to be caused by female pheromone release, offshore winds, and/or lunar cycles. Females nest up to 4 times per season at intervals of 10 to 28 days. The preferred nesting beaches are adjacent to extensive swamps or large bodies of open water.

The Kemp's ridley turtles range includes the Gulf coasts of Mexico and the US, and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland (NMFS 2011). Kemp's ridley sea turtles have been observed within Galveston Bay , which is approximately 4 miles south of the proposed project area, as recent as 2012; they are known to utilize the area for seasonal foraging (BEP 2007).

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is the largest sea turtle. The adult leatherback can get up to 8 feet in length and up to 2000 pounds. The turtle lacks a "normal" turtle shell and is covered by firm, rubbery skin that is approximately 4 inches thick. Coloration is predominantly black with varying degrees of pale spotting; including a notable pink spot on the dorsal surface of the head in adults. Their diet is primarily jellyfish and salp, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed.

Leatherbacks are highly migratory and the most pelagic of all sea turtles. Females prefer high energy, sandy beaches with vegetation immediately upslope and a beach sloped sufficiently so the crawl to dry sand is not too far. Preferred beaches have deep, unobstructed oceanic access on continental shorelines.

In the United States, nesting occurs from March to July. Females nest on average 6 times per season at 10 day intervals. Most leatherbacks return to their nesting beaches at 2 to 3- year intervals.

Distribution is worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. The leatherback is also found in small numbers as far north as British Columbia, Newfoundland, and the British Isles and as far south as Australia and Argentina. The leatherback has a small presence in the US with most nesting occurring on the Florida east coast, Sandy Point, US Virgin Islands, and Puerto Rico (NMFS 1992).

Leatherback sea turtles are most commonly found in deep water habitats and are not known to nest in Galveston Bay (USFWS 2012b). Leatherback sea turtles would not be expected to utilize habitat in the vicinity of the project.

Loggerhead Sea Turtle (*Caretta caretta*)

The loggerhead sea turtle is a reddish-brown marine turtle characterized by a large head with blunt jaws. Adults can be up to 500 pounds and 4 feet in length. Adult loggerheads feed on jellyfish, floating egg clusters, flying fish, mollusks, crustaceans, and other marine animals.

Loggerheads occupy three ecosystems according to life stage: terrestrial zone, neritic zone, and oceanic zone. The terrestrial zone is occupied briefly during nesting and hatching activities. Hatchlings move out to the oceanic zone until their carapace reaches approximately 40-60 centimeters in length. Juveniles and adults primarily occupy the neritic zone (nearshore marine environment).

The nesting season in the US is May through August. Nesting occurs every 2-3 years and is mostly nocturnal. Females can nest up to 5 times per season at intervals of approximately 14 days. Hatchling emergence is mostly nocturnal. Loggerheads nest on oceanic beaches between the high tide line and dune fronts and occasionally on estuarine shorelines with suitable sand. Females prefer narrow, steeply sloped, coarse-grained beaches.

Distribution of loggerhead sea turtles includes the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Although the majority (~80%) of the US nesting activity occurs in south Florida, loggerheads nest along the Gulf and Atlantic coastlines from Texas to Virginia. Loggerheads are considered an occasional visitor to Texas (NMFS 2008). Loggerhead sea turtles have been observed within Galveston Bay, which is approximately 4 miles south of the proposed project site, as recently as 2012. These sea turtles utilize the bay areas for seasonal foraging (BEP 2007).

Blue Whale (*Balaenoptera musculus*)

The blue whale is the largest species of baleen whale. Blue whales can weigh up to 330,000 pounds and reach approximately 108 feet in length. The body is typically mottled with a gray color pattern that appears light blue through the water. Blue whales become sexually mature between 5-15 years of age (NOAA 2013a). Foraging habits are seasonal, and the diet almost exclusively consists of krill. Blue whales forage during the summer to build up energy reserves before migrating to their breeding and birthing grounds in the winter.

This species is found worldwide. Blue whales typically migrate between summering and wintering areas; however they are generally distributed where krill can be found in large concentrations. The two subpopulations (eastern north Pacific and western north Pacific) are separated by the ocean basins in which they are found. The eastern North Pacific is believed to spend winters near Mexico and Central America.

Even though whale hunting was banned in 1966 by the International Whaling Commission, poachers continued depleting blue whale populations. The increase in ocean noise due to water vessels and sonar fishing has impacted communication among this highly social species. Climate change concerns based on the increase in freshwater flow into the oceans also pose a threat to blue whales. There are only two records of stranded blue whales in the Gulf of Mexico (Davis and Schmidly 1997). One was identified as stranded near Sabine Pass, Louisiana in 1924, and the other was identified as stranded on the Texas coast between Freeport and San Luis Pass in 1940. Though these records are questionable, neither location is within ~15 miles of the Action Area.

Fin Whale (*Balaenoptera physalus*)

The fin whale is the second largest species of baleen whale after the blue whale. Fin whales can weigh up to 160,000 pounds and reach approximately 85 feet in length (NOAA 2013a). The body is streamlined with a falcate dorsal fin and distinctive coloration patterns that are typically used by experts to identify individuals within a population. The dorsal and lateral sides of the body are black or dark brownish-gray with pale undersides. A V-shaped head distinguishes the fin wale from the blue whale (Davis and Schmidley 1997). Fin whales become sexually mature around 6-10 years of age. Foraging habits are seasonal and consist of krill, small schooling fish, and squid.

Fin whales are found in social groups of 2-7 whales. Typical habitat is in deep, offshore waters worldwide. This migratory species moves in and out of high-latitude foraging areas throughout the year.

As mentioned before, historical commercial whaling posed a major threat to whale populations. Current threats include vessel collisions, fishing gear entanglement, reduction in prey abundance, habitat degradation, underwater noise disturbance, and pathological conditions resulting from parasitic copepods, barnacles, and amphipods (NOAA 2013a). The only known Texas record involves an individual finback whale was found stranded on the beach at Gilchrist, Chambers County, Texas in 1951 (Davis and Schmidley 1997).

Humpback Whale (*Megaptera novaeangliae*)

Humpback whales are a species of baleen whale can weigh up to 80,000 pounds and reach approximately 60 feet in length (NOAA 2013a). The pectoral fins are a distinguishing feature that can extend approximately 15 feet. Humpback whales have stocky bodies with a hump and black dorsal coloration with varied patches of white on the pectoral fins and belly. Pattern variations on the tail fin, also known as a fluke, are sufficient indicators in identifying individuals. This species utilizes a variety of foraging techniques that enable them to capture and filter feed their seasonal diet of krill, plankton, and small fish.

Humpback whales migrate from summer feeding grounds near the poles to warmer winter breeding waters near the Equator. During migration, humpback whales can be found near the surface of the ocean. Feeding grounds are typically in cold, productive coastal waters. Calving grounds are near offshore reef systems, islands, or continental shores (NOAA 2013a).

Historical whaling, fishing gear entanglement, ship strikes, whale watch harassment, habitat impacts, and current harvest have all posed as threats to humpback whale populations. Within the Gulf of Mexico, this species is typically observed near the coasts of Florida, Alabama, and northern Cuba. The only known Texas record involves an individual humpback whale observed swimming along the inshore side of Bolivar Jetty near Galveston in 1992 (Davis and Schmidley 1997).

Sei Whale (*Balaenoptera borealis*)

Sei whales are the third largest species of baleen whale can weigh up to 100,000 pounds and reach approximately 60 feet in length (NOAA 2013a). The body is dark gray with variable white undersides, usually limited to the throat grooves. A typical erect falcate, dorsal fin extends about two-thirds down the whale's back. The seasonal diet consists primarily of copepods, krill, small schooling fish, and cephalopods. Unlike most baleen whales' foraging techniques, the sei whales typically skim feed and gulp-feed (DEC 2013).

Sei whales are usually found alone or in small groups of 2-5 individuals. This species prefers subtropical waters, and are found in the Atlantic, Indian and Pacific Ocean. Sei whales are typically observed in deeper waters far from the coastline.

The distribution of this species ranges from the North Atlantic Ocean to the Venezuelan coast and northwest to the Gulf of Mexico. Historical threats included commercial hunting and whaling. Current threats include ship strikes and fishing gear entanglement. Based on available data, there have been no known sei whale strandings or observations in Texas. Infrequent observations within the Gulf of Mexico have occurred in the past. The closest observations were of two documented strandings: one stranding occurred in Fort Bayou, Louisiana in 1956 and another in Gulfport, Mississippi in 1973 (Mead 1977).

Sperm Whale (*Physeter macrocephalus*)

Sperm whales are the largest toothed whales, also known as odontocetes. This species is considered the most sexually dimorphic Cetacean. The males can weigh up to 45 tons and reach approximately 52 feet in length while females can weigh up to 15 tons and reach approximately 36 feet in length. The sperm whale is distinguished by its large head, which makes up 25-35% of the total body length (NOAA 2013a). The body is mostly dark gray in coloration with varied white patches along the belly. The flippers are paddle-shaped, and the fluke is triangular. The seasonal diet consists of large squid, sharks, skates, and fishes. While this species pursues its prey, dives have been known to last over and hour and reach depths over 3,280 feet.

Sperm whales tend to reach sexual maturity around 9 years of age. Breeding grounds are located in tropical latitudes. This species is commonly found in areas with a water depth of approximately 1,968 feet and are uncommonly observed in shallow waters.

The distribution of this species is inclusive of all the oceans, and sperm whales are primarily found between 60oN and 60oS latitudes. Historical threats included commercial hunting and whaling. Current threats include ship strikes, fishing gear entanglement, underwater noise disturbance, and coastal pollution. Sperm whales are present in the Gulf of Mexico during all seasons (NOAA 2013a), and sightings near the Texas coast are regarded as common (Davis and Schmidley 1997).

Whooping Crane (*Grus americana*)

The whooping crane can approach 5 feet in height with a wingspan of 8 feet. Adults are snowy white with black primary feathers and a bare red face and crown. The bill is typically a dark olive-gray that becomes lighter during breeding season. Immature cranes have a reddish coloration that appears mottled by the growing white feather bases. Whooping cranes are insectivorous, carnivorous, and frugivorous.

Whooping cranes occupy saltmarshes during the winter and poorly drained wetlands in the summer. Whooping cranes migrate in September and reach wintering grounds in south Texas by October or November (USFWS 2014b).

Whooping cranes are monogamous and return to the same breeding territory. Adults reach sexual maturity at 4-5 years of age. Nests are constructed from sedges, bulrushes, and cattails. Females lay 1-3 eggs in April and May. Eggs incubate for 30 days. Typically, only one chick survives.

Whooping cranes are federally listed as endangered as a consequence of hunting, low genetic diversity, human disturbance and loss of critical wetland habitat. Colorado, Idaho, Kansas, Nebraska, New Mexico, Oklahoma, and Texas have been designated critical habitat. The historic range extended from the Arctic coast to south-central Mexico. Currently there are two distinct migratory populations (USFWS 2014b). One population winters along the southeastern United States and summers in central Wisconsin. The other group winters along the Gulf Coast of Texas at Aransas National Wildlife Refuge which is approximately 100 miles southwest of the Dow Freeport Site. They summer in northwestern Canada. Small, non-migratory populations are located in central Florida and coastal Louisiana. According to TXNDD, there are no recorded sightings within an approximate 15 mile radius from the proposed project site.

Attwater's Greater Prairie Chicken (*Tympanuchus cupido attwateri*)

Attwater's greater prairie chicken is approximately 17 inches in length, weighs around 2 pounds, and has a wingspan of 28 inches. It is typically striped-brown and white in uniform coloration. Males have extravagant orange air sacs lining the sides of the neck and vivid yellow eye-combs. These sacs are used during the mating season to produce a booming sound (TPWD 2014b). The diet consists of small seeds, leaves, buds, and insects.

Attwater's greater prairie chicken inhabits coastal prairie grasslands that are dominated by little bluestem, Indian grass, and switchgrass. The tall grass habitat provides cover, protection, and nesting material.

Breeding grounds are small bare patches amidst the tall grass. Males congregate in leks and perform dances, display raised feathers, and create unique sounds to attract a mate. Females can lay 8-12 eggs in ground nests during mid-April which will hatch in approximately 2 weeks (Audubon 2013).

This species is only found in the coastal prairies of Texas and has been declared endangered since 1967. Attwater's greater prairie chicken is at risk due to conversion of the prairies for farmland, ranchland, and urban development. According to TPWD (2012), only 42 individuals were surveyed from known conservation locations. USFWS (2012d) has not identified critical habitat for the Attwater's greater prairie chicken at this time.

Eskimo Curlew (*Numenius borealis*)

The Eskimo curlew is approximately 12 inches in length, weigh approximately 10-12 ounces, and have a wingspan of 27 inches. Feathers are typically brown with white speckles while the feet range in coloration from dark green to dark grey-blue. The curlew group is distinguished by an obvious decurved bill. The diet is believed to consist of insects during the spring and coastal berries mixed with varied local vegetation during fall.

Eskimo curlews are migratory and their round-trip route extends 20,000 miles (Audubon 2013). This species inhabits the arctic tundra for nesting and the southern, open grasslands for wintering grounds. Breeding season is from May to August in treeless tundra areas typically removed from human development. The return migration route from South America during spring includes the Gulf of Mexico and Texas Coast, which support prairie habitat.

Eskimo curlew populations declined dramatically due to unregulated market hunting in the 1800s and due to the conversion of native grasslands to croplands. This species has not been recorded with certainty since 1963 in Barbados and is thought to be extinct (Roberts et al. 2010). USFWS (2012d) has not identified critical habitat for the eskimo curlew at this time.

Piping Plover (*Charadrius melodus*)

Piping plovers are small shorebirds generally 7 inches in length, weighing around 2 ounces, with a wingspan of 15 inches. This species is distinguished by the tan coloration on the back, white underparts, and one black band on the chest. The legs are typically yellowish orange. The diet consists of invertebrates found along the waterline.

Piping plovers are migratory and range from the Great Lakes to the Gulf of Mexico. Suitable nesting habitat is generally near alkali wetlands, sandbars, dredge islands within major river systems, and sparsely vegetated beaches (Audubon 2013). Wintering habitat is found on coastal tidal flats and beaches.

During the mating season, the male’s bill is orange with a black tip and a black forehead bar. During the non-breeding seasons, the male’s bill is completely black. Mating pairs begin to build nests in late March. Females lay up to 4 eggs in a ground nest by late April. Eggs hatch within 27 days. Juveniles can breed within the first year.

Shoreline development, nest disturbance, and predation have led to the decline of the piping plover (DEP 2012). In the 1800s unregulated market hunting devastated the plover population along with several other bird species. Piping plovers have been classified as threatened and endangered since 1986. Only three breeding populations are believed to remain (USFWS

2014a). All three populations are known to winter in Texas from July to late February. Approximately 139,029 acres of critical habitat were revised in 2009. The revised critical habitat was located in Cameron, Willacy, Kennedy, Kleberg, Nueces, Aransas, Calhoun, Matagorda, and Brazoria Counties, Texas (USFWS 2009). Critical habitat in Texas is located along the coastal beaches and tidal flats. The closest designated critical habitat is located approximately 4.3 miles south of the Dow Freeport Site.

West Indian Manatee (*Trichechus manatus*)

West Indian manatees have a large fusiform body that is typically light to dark gray or brown in coloration. Calves are observed with darker coloration variation than adults. A distinguishing characteristic outside of the body shape and size is the lack of hind limbs/flippers. This herbivorous species has been known to reach 15 feet in length and weigh up to 3,570 pounds (Smithsonian Marine Station at Fort Pierce 2006). Diet consists of submerged vascular plants, algae, and seagrasses.

West Indian manatees inhabit shallow, slow-moving riverine, estuarine, bay, salt marshes, and coastal ecosystems. These habitats can support an abundance of seagrass beds. Manatees are typically found in water depths of approximately 12 feet. West Indian manatees can tolerate a wide range of salinities and regularly seek out fresh water sources (Haubold et al. 2006). During the summer months, manatees disperse to nearby states including Alabama, Mississippi, Louisiana, and Texas. This species has a high thermal conductance and is susceptible to cold-related illness. Herds cope by congregating in spring waters, canals, or turning basins that can maintain a constant temperature above 72^{o}F. Some manatees have been known to seek refuge near power plants and other industrial sites that release warm-water effluents (Smithsonian Marine Station at Fort Pierce 2006).

West Indian manatees become reproductively mature after 3 years of age. Females typically gestate for 11-14 months and produce one calf every 2-3 years. Mating occurs throughout the year with successive copulation.

The West Indian manatee U.S. population is concentrated in Florida. The decrease in population could be attributed to poaching and hunting, various human-related activities, habitat loss, and cold-related illness. West Indian manatees have been listed since 1967. A sighting of a West Indian manatee occurred in September 2012 in Corpus Christi Bay (ABC News 2012). Another sighting occurred in West Galveston Bay on October 2012(Houston Chronicle 2012). Both sightings were verified by the Texas Marine Mammal Stranding Network. Corpus Christi Bay is approximately 143 miles west of the proposed LHC-9 project site, and West Galveston Bay is approximately 3 miles south of the proposed SOW #1 pipeline. TXNDD identified one observation in 2011 of a West Indian manatee approximately 4 miles southeast of the Action Area in Brazoria County.

Jaguarundi (*Herpailurus yagouaroundi*)

The Jaguarundi are small, unspotted cats. Jaguarundi have three distinct color phases: black, reddish-brown, and brownish-gray. Their diet consists of birds, rabbits, reptiles, and small mammals. Mating season occurs between November and December. Females typically gestate for approximately 70 days with litters of 2-4 kittens.

Jaguarundi typically inhabit mixed, thorny shrublands dominated by desert yaupon, wolfberry, lotebush, white-brush, catclaw, lantana, elbowbush, or Texas persimmon. This species requires dense canopy cover and corridors that connect a variety of habitat tracts. The majority of the suitable brushland habitats have been converted to farmland for vegetables, citrus, sugarcane, cotton, and other marketable crops. USFWS (2012d) has not identified critical habitat at this time.

Jaguarundi have not been found within the Action Area counties in over 30 years; Contemporary sightings have been in Cameron County and Willacy County in South Texas (TPWD 2012f).

Ocelot (*Leopardus pardalis*)

Ocelots are small, nocturnal cats that have dark spots and stripes on the cheeks and body, with a dark-ringed tail. The head and limbs are marked with solid black spots and black lines above each eye. They can reach 4.5 feet in length and weigh up to 35 pounds. Their carnivorous diet consists of rodents, rabbits, young deer, birds, snakes, and fish (USFWS 2012c).

Ocelots mate once a year, typically during summer for Texas populations. Males reach sexual maturity around 2 years of age, and females reach sexual maturity around 1.5 years of age. Females gestate for approximately 70-80 days to produce a litter of 1-4 kittens. Three month old kittens will accompany the mother hunting.

Ocelots utilize a variety of habitats throughout its range. The populations within Texas prefer dense cover in brushy, thorny shrubs. Ocelots seek refuge in high tree limbs or in secluded, sheltered dens.

Ocelots are found worldwide. The local population's historical range formerly extended from Arkansas and Louisiana through Texas to Mexico. Currently, this species is only found in the southern tip of Texas and northeastern Mexico. Two isolated populations are known from southeast Texas. Individuals have been observed at the Lower Rio Grande Valley National Wildlife Refuge, Laguna Atascosa National Wildlife Refuge, and on a private ranch several miles away. The decline in population can be attributed to habitat conversion for agriculture, predator control, car collisions, fur-trade, and pet-trade (Defenders of Wildlife 2014; USFWS 2012c). Ocelots have been listed since 1972. USFWS (2013b) has not identified critical habitat at this time.

Red Wolf (*Canis rufus*)

The red wolf can reach 65 inches in length including the tail. Coloration is typically brown with some buff coloration. The tail is black-tipped. This species can weigh between 45-80 pounds and are primarily carnivorous.

The red wolf occupies wetlands, pine forests, upland shrublands, and crop lands. Wooded areas are required for denning and pup rearing. Hunting corridors extend along edge interface habitat. A pack consists of 7 animals with an alpha pair. A specific home range is actively defended.

The red wolf becomes sexually mature after 2 years. Breeding season occurs from January to March. An alpha female will normally produce a litter size of 5 pups once a year. First emergence from the den occurs when the pups are at least 4 weeks old and begin to hunt after 12 weeks. Hybridization has occurred with coyote (*Canis latrans*).

The red wolf is federally listed as endangered and has been extirpated from the historical range in the south central Texas area extending to Florida, and north to south central Maine. The current range extends from North Carolina to Tennessee and along the south eastern states. Predator control alongside fragmentation and loss of habitat has critically suppressed populations of red wolves. USFWS (2012d) has not identified critical habitat at this time.

Louisiana Black Bear (*Ursus americanus luteolus*)

The Louisiana black bear can reach 7 feet in height. Typically, males can weigh up to 400 pounds, and females weigh up to 200 pounds. They have long black hair and a short tail. Their muzzle is yellowish-brown with an occasional white patch on the lower throat and chest. They have a distinguishable long, narrow cranium and proportionally large molar teeth. Juveniles and adults are omnivorous.

Louisiana black bears occupy high-quality, productive bottomland forests. Important habitat characteristics include escape cover, travel corridors, den sites, and minimum human disturbance (USFWS 2014b). During the winter, hollow trees, brush piles, and ground nests are utilized as den sites.

Females reach sexual maturity around 3-5 years. Louisiana black bears give birth to 1-3 cubs in winter. Cubs have their first emergence from the den in spring, and they den with the mother through their first winter.

Louisiana black bears are federally listed as threatened and have been extirpated throughout much of their range (USFWS 2014b). Louisiana river basins are designated critical habitat, 74 FR 10350 10409. USFWS designated 1,195,821 acres of critical habitat in Avoyelles, East Carroll, Catahoula, Concordia, Franklin, Iberia, Iberville, Madison, Pointe Coupee, Richland, St. Martin, St. Mary, Tensas, West Carroll, and West Feliciana Parishes in Louisiana. Human encroachment, habitat fragmentation, and hunting have contributed to the population decline.

Smalltooth sawfish (*Pristis pectinata*)

The smalltooth sawfish can grow to 20 feet in length. The long, flat snout lined with pairs of teeth is a defining characteristic. Smalltooth sawfish feed primarily on fish and occasionally on crustaceans.

The smalltooth sawfish typically inhabit sheltered bays and shallow banks of estuaries (NOAA 2011). Lagoons, bays, mangroves, and shallow reefs are suitable habitat types. Habitat can include a wide range of salinity, temperature, and depth. The smalltooth sawfish reaches maturity after approximately 10 years. Females are ovoviviparous and produce litters of 17 pups.

The smalltooth sawfish is federally listed as endangered due to habitat conversion and bycatch. It is extirpated from large areas of its range. The historical distribution in the United States extended along the shores from Texas to New York (NOAA 2012). Charlotte Harbor Estuary Unit and the Ten Thousand Islands/ Everglades Unit are designated critical habitat, 74 FR 45353.

Red-cockaded Woodpecker (*Picoides borealis*)

Red-cockaded woodpeckers can grow to 7 inches in length with a wingspan of about 15 inches. Typical coloration consists of a distinguished black cap and nape with large white cheek patches. Black barring with white horizontal stripes can be readily identified on the back. They are primarily insectivorous with the occasional consumption of fruits.

Red-cockaded woodpeckers occupy mature, old-growth pine forests with preference for longleaf pines (*Pinus palustris*). It takes approximately 1–3 years to fully excavate a cavity. A typical group territory ranges from 125–200 acres, which is related to habitat suitability and population density.

Red-cockaded woodpeckers are territorial, cooperative breeders. Only one pair will breed each year from a group of 3–9 members. They nest from April through June. Females generally lay 3–4 eggs, which incubate for 10–12 days. Nestlings will remain in the cavity for approximately 26 days.

Red-cockaded woodpeckers are federally listed as endangered. There are approximately 6,000 groups left. They can be found in eleven states extending from Florida to Virginia and west to southeast Oklahoma and eastern Texas (USFWS 2014b). This is representative of approximately 1% of their historical range in the United States due to the replacement of old-growth forests and the suppression of periodic fires. USFWS (2012d) has not identified critical habitat at this time.

Houston Toad (*Bufo houstonensis*)

Houston toad adults can reach 3.5 inches in length. Their coloration can vary from light brown to gray and tend to show small dark spots on the ventral side. Males are identified by a darkened throat patch that can appear blue when inflated. Adults and juveniles are insectivorous.

Houston toad adults burrow in deep sandy soils that support loblolly pine (*Pinus taeda*), yaupon (*Ilex vomitoria*), post oak (*Quercus stellata*), blue jack or sandjack oak (*Quercus incana*), and little bluestem (*Schizachyrium scoparium*) during winter and summer seasons. Temporary pools of water must be available for breeding.

Houston toads breed from January to June. Males reach sexual maturity after 1 year, and females become sexually mature after 2 years. Females can lay several thousand eggs that are fertilized externally by males. Eggs hatch within 7 days. Toadlets are approximately 0.5 inch long and metamorphose within 15-100 days. Timing depends on the magnitude of predatory threat, water temperature and pond desiccation rates.

Houston toads are federally listed as endangered and have been extirpated across the Houston area (Brazoria, Fort Bend, and Liberty Counties) since the 1960s after undergoing severe drought and massive habitat loss/ conversion (USFWS 2014b). According to TXNDD, the last known sighting was in 1976 approximately 11 miles southwest from the proposed project site. Bastrop and Burleson Counties have been designated critical habitat, 42 FR 27009 27011, since 1978.

2.2.3 Other Protected Species and Habitat

Designated Critical Habitat

The nearest critical habitat designated by the USFWS is along the Gulf coast, approximately 5 miles south of the LHC9. This shoreline area is designated critical habitat for piping plovers (USFWS 2013b).

2.2.4 Texas Natural Diversity Database Results

A records review of the Texas Natural Diversity Database (TXNDD) was completed for the proposed project area and surrounding areas by the TPWD on November 19, 2012. The following topographic quadrats were included in the review: Oyster Creek, Lake Jackson, Jones Creek, Freeport, Christmas Point, Christmas Point OE, Cedar Lakes East, Cedar Lane NE, Brazoria, League City, Bacliff, La Porte, Morgan Point, Mont Belvieu, Highlands, Friendswood, Jacinto City, Pasadena, Danbury, Hoskins Mound, Mustang Bayou, Sea Isle, Hitchcock, Virginia Point, Texas City, Cove, and Dickinson. Element of occurrence (EO) data for jaguarundi in 1991 and Attwater's greater prairie chickens in 1985 were located along the proposed SOW #1 pipeline route within Brazoria County and Galveston County, respectively. In Harris County, Houston toads were sighted approximately 12 miles west of SOW #1 pipeline in 1976, and the Texas prairie dawn was sighted approximately 6 miles west of the SOW #1 in 2004. Based on the TXNDD, no additional federally-protected species are recorded within a radius of approximately 15 miles from the proposed project site (Figure 9).

2.2.5 Protected Species Evaluated

The protected species evaluated in this document include threatened and endangered species listed by the USFWS, species listed as federally threatened or endangered by TPWD, and marine mammals. Table 6 summarizes all the species considered in this BA.

Table 6 - Federally Protected Species Evaluated in the BA

Protected Species	Classification- Reason for Evaluation
Federal List of T&E Species (Brazoria County)	
Texas Prairie Dawn[3]	Listed by USFWS as Endangered.
Green Sea Turtle[1,2,4]	Listed by USFWS and National Marine Fisheries Service (NMFS).as Threatened.
Atlantic Hawksbill Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.
Kemp's Ridley Sea Turtle[1,2,4]	Listed by USFWS and as Endangered.

Protected Species	Classification- Reason for Evaluation
Leatherback Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.
Loggerhead Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Threatened.
Whooping Crane[1]	Listed by USFWS as Endangered.
Attwater's Greater Prairie Chicken[2]	Listed by USFWS as Endangered.
Eskimo Curlew[1,2]	Listed by USFWS as Endangered.
Piping Plover[1,2,4]	Listed by USFWS as Threatened.
West Indian Manatee[1,2,3,4]	Listed by USFWS as Endangered.
NOAA List of T&E Species	
Blue Whale	Listed by NOAA as Endangered
Finback Whale	Listed by NOAA as Endangered
Humpback Whale	Listed by NOAA as Endangered
Sei Whale	Listed by NOAA as Endangered
Sperm Whale	Listed by NOAA as Endangered
State-recognized List of Federal T&E Species (Brazoria County)	
Jaguarundi[1]	Listed by the TPWD as Endangered.
Ocelot[1]	Listed by the TPWD as Endangered.
Red Wolf[1,2,3,4]	Listed by the TPWD as Endangered.
Louisiana Black Bear[1,2,3,4]	Listed by the TPWD as Threatened.
Smalltooth Sawfish[1,2,3,4]	Listed by the TPWD as Endangered.
Red-cockaded Woodpecker[3]	Listed by the TPWD as Endangered.
Houston Toad[3]	Listed by the TPWD as Endangered.

Note: 1. Brazoria County 2. Galveston County 3. Harris County 4. Chambers County

3.0 Protected Species Habitat Evaluation and Analysis

URS completed a protected species habitat evaluation on February 22, 2013 to determine if habitat within the Dow Freeport Site was likely to support any of the federally protected species potentially occurring in Brazoria County. Benchmark evaluated the protected species habitat along the pipeline corridors within the Action Area. All habitats within the Dow Freeport Site are highly disturbed. Process areas and other filled portions of the facility would not provide habitat and were not included in the survey. The field evaluation included a pedestrian survey of the proposed Action Area within the Dow Freeport Site that could provide potential habitat. Data was collected to describe vegetation communities and assess the potential for occurrence of protected species. A photographic log of Oyster Creek is provided in Appendix A.

3.1 Habitats Observed

A significant portion of the habitats within the Action Area have historically been constructed, manipulated, or otherwise impacted by industrial activities. Construction is proposed in an industrial process area and within a 100-foot pipeline corridor. The project would also utilize an existing construction laydown area for a furnace contractor laydown and fabrication area and new equipment laydown. This previously converted laydown segment would be utilized during the construction phase of the project. The NatureServe database, URS' observations, and data from Benchmark indicate the following habitats within the proposed project area.

Construction Laydown

The construction laydown area will be previously converted from pastureland to a graded area with an aggregate base that will be utilized as a laydown area for various projects within the Dow Freeport Site. This disturbed area will not support vegetation. Therefore, this area will not provide suitable habitat for federally listed species.

LHC-9

LHC-9 will be constructed within the Oyster Creek facility on the Dow Freeport Site property. The area proposed for new construction of LHC-9 is an empty lot surrounded by industrial infrastructure and roadways. No vegetation currently exists in the proposed location for LHC-9 in Unit block 2. Habitat types within the Oyster Creek facility include industrial areas, maintained grasses, and open water. The Dow Barge Canal is located southwest of the proposed project site. The National Land Cover Database (NLCD) classifies the proposed project area as Developed High Intensity (Multi-Resolution Land Characteristics Consortium 2012). The existing process area does not possess habitat with the potential to support any federally-protected species and were not evaluated.

Maintained Grasses – Relatively small areas of maintained grasses were scattered throughout the property. Most of these areas appear to be mowed at least monthly or bi-weekly. This habitat type could not support any federally protected species.

Open water – The open water features are man-made detention ponds. Because the open water habitats have been man-made or altered, the observable quality of these open water habitats ranges from low to moderate.

Associated Pipelines

Land use and plant community types within the pipeline corridors include maintained grasses, mixed woodland, wetlands, riverine, and open water habitats. The majority of the habitats located within the corridor have been previously altered during the installation of various pipelines within the right-of-way. All associated pipelines will remain within existing, maintained corridors that are located in existing Dow rights-of-way. Benchmark (2012a-c, 2013a-c) provided wetland and threatened and endangered species reports that were utilized to prepare this BA.

Maintained Grasses – The pipeline corridor is consistently maintained in cleared and mowed condition by various pipeline companies. Maintained grasses dominate the pipeline corridor.

Mixed woodland – Mixed woodland areas in the pipeline corridor were identified by Benchmark (2012b).These forested areas are primarily located along the outer edges of the corridor. However, some of these forested areas will be crossed by SOW #1 pipeline. According to NatureServe (2012), this system includes sparse ground cover within oak-dominated forests woodlands, shrublands and savannas. The understory species include yaupon (*Ilex vomitoria*), saw greenbrier (*Smilax bona-nox*), mustang grape (*Vitis mustangensis*), and/or wax myrtle (*Morella cerifera*).

Riverine – Benchmark Ecological Services, Inc. (2012b) identified riverine habitats including several streams and rivers that will be crossed by SOW #1 pipeline. Based on NWI-mapped habitats, this pipeline will directly intersect eight riverine features.

Wetlands – Approximately 35 different types of wetlands were surveyed in the proposed project area. These are specifically identified and described in the Benchmark Ecological Services, Inc. (2012a, 2012b, 2012c, 2013a, 2013b, and 2013c) reports. Various types of estuarine, lacustrine, and palustrine wetlands were identified within the pipeline corridor including forested, scrub-shrub, emergent, and unconsolidated wetlands.

Open water- SOW #1 pipeline will intersect the Houston Ship Channel through Hogg Island, the connection between Clear Lake and Galveston Bay, and the northern section of Chocolate Bayou.

4.0 Assessment of Air Quality for LHC-9 Unit

The air quality analysis to demonstrate compliance with NAAQS PSD Increments is performed using computer models to simulate the dispersion of the emitted pollutants into the atmosphere and predict ground level concentrations at specified receptor locations in the area around the source of emissions. If the modeled concentration for a given pollutant and averaging period is less than the USEPA-specified SIL, the project is determined to have no significant impact on ambient air quality and no further analysis is required for that pollutant and averaging period. If the SIL is predicted by the model to be exceeded for a given pollutant, further modeling of the project emissions combined with existing emission sources in the area is required to estimate total ambient concentrations. The modeling must demonstrate that the total concentration, including an appropriate background, does not exceed the applicable primary and secondary NAAQS and PSD Increment.

4.1 Estimated Total Annual Emission Rate Overview

URS completed detailed pollutant emission calculations for the project in accordance with the Air Permit Application requirements. This BA does not include detailed estimated emission rates. Estimated emission rates and descriptions of emission calculation methods have been provided to the US EPA in both the GHG PSD permit application and the TCEQ NSR/PSD permit application.

A summary, provided by URS, of the total estimated annual emission for PSD pollutants that would be emitted by the proposed project is provided in Table 7.

Table 7 - Emission Point Summary

Emission Point Name	Air Pollutant Name	Air Pollutant Emission Rate (Tons per year)
OC2H121, OC2H122, OC2H123, OC2H124, OC2H125, OC2H126, OC2H127, and OC2H128 (Furnaces Source Group Cap)	NOX	194.29
	PM/PM10/PM2.5	81.20
	SO2	11.05
	CO	268.57
	VOC	24.17
OC2F5961 and OC2F597 (Flare Source Group Cap)	NOX	9.82
	SO2	0.03
	CO	52.56
	VOC	13.80
OC2CT936 (Cooling Tower CT-936)	PM/PM10/PM2.5	4.14/0.57/0.01
	CO	0.10
	VOC	11.45

Emission Point Name	Air Pollutant Name	Air Pollutant Emission Rate (Tons per year)
OC2FU2 (Process Area Fugitive)	CO	0.10
	VOC	10.05
OC2GE1 (Backup Diesel Generator No. 1)	NOX	0.03
	PM/PM10/PM2.5	0.000034
	SO2	0.01
	CO	0.11
	VOC	0.003
OC2GE2 (Backup Diesel Generator No. 2)	NOX	0.03
	PM/PM10/PM2.5	0.000034
	SO2	0.01
	CO	0.11
	VOC	0.003

Emissions resulting from gasoline and diesel-fueled vehicles and equipment during construction and maintenance are considered negligible. The project will not require a significant increase in vehicle and equipment use compared to current daily emissions for the ethylene manufacturing facility.

4.2 Area of Impact Dispersion Modeling

URS performed dispersion modeling of the proposed emissions of air pollutants from the proposed project in accordance with the PSD Permit requirements. According to the EPA, "dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source" (EPA 2007). This section provides the methods and results of the dispersion modeling. The dispersion modeling performed included areas on-site within Dow Oyster Creek property boundaries and outside of the property boundaries. The results of the modeling are provided as a summary of the maximum predicted concentrations. The project is subject to PSD review for CO.

4.2.1 Methods

This section discusses air quality modeling, monitoring, presentation of these data, and how background concentrations were obtained. If the SIL was exceeded for a pollutant, a NAAQS and/or PSD Increment analysis was performed. The appropriate background concentrations presented in this section were added to the modeling results to demonstrate compliance with the NAAQS primary and secondary standards and PSD Increments considering SIL concentrations as shown in Table 8. The modeling methods were provided by URS.

Table 8 - Standards for Comparison with Modeling for Criteria Pollutants

Pollutant	Regulation	Averaging Period	Modeling *De minimis* (µg/m^3)	Standard (µg/m^3)
SO_2	Chapter 112	30-min	20.4	1021
	NAAQS	1-hr	7.8	195
		3-hr	25	1300
		24-hr	5	365
		Annual	1	80
	PSD Increment	3-hr	25	512
		24-hr	5	91
		Annual	1	20
	PSD Monitoring	24-hr	13	NA
NO_2	NAAQS	1-hr	7.5	188.7
		Annual	1	100
	PSD Increment	Annual	1	25
	Monitoring	Annual	14	NA
CO	NAAQS	1-hr	2000	40,000
		8-hr	500	10,000
	PSD Monitoring	8-hr	575	NA
PM_{10}	NAAQS	24-hr	5	150
	PSD Increment	24-hr	5	30
		Annual	1	17
	PSD Monitoring	24-hr	10	NA
$PM_{2.5}$	NAAQS	24-hr	1.2 [1]	35
		Annual	0.3	15
	PSD Increment	24-hr	1.2 [1]	9
		Annual	0.3	4
	PSD Monitoring	24-hr	4	NA

Footnote: [1] EPA is currently reviewing the January 22, 2013, decision from the D.C. Circuit Court of Appeals that, on the EPA's request, vacated and remanded to the EPA for further consideration certain portions of two Prevention of Significant Deterioration (PSD) regulations (40 CFR 51.166 and 40 CFR52.21) that addresses Significant Impact levels (SILs) for PM2.5. Until EPA has their position, the analysis will use the current standard (SIL) for significance analysis since the proposed project is not PSD for PM2.5.

The model parameters specified for the modeled location, such as meteorological data, rural versus urban dispersion coefficients, and receptor grid are discussed below. Modeling was performed using the regulatory default options, which include stack heights adjusted for stack-tip downwash, buoyancy-induced dispersion, and final plume rise. As per U.S. EPA requirements, direction-specific building dimensions are used in the downwash algorithms.

AERMOD

Modeling was performed using the AMS/EPA Regulatory Model (AERMOD) (version number 12345). The AERMOD model was chosen because it is approved by the EPA as a Preferred/Recommended model and is approved by the TCEQ modeling staff.

AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD determines concentrations from multiple points, area, or volume sources based on an up-to-date characterization of the atmospheric boundary layer. The model employs hourly sequential preprocessed (AERMET) meteorological data to estimate concentrations. The AERMOD model is applicable to receptors on all types of terrain, including flat terrain, simple elevated terrain (below height of stack), intermediate terrain (between height of stack and plume height), and complex terrain (above plume height). In addition, AERMOD provides a smooth transition of algorithms across these different terrains. Therefore, AERMOD was selected as the most appropriate model for the air quality impact analysis for the proposed facility.

AERMAP

AERMOD uses advanced terrain characterization to account for the effects of terrain features on plume dispersion and travel. AERMOD's terrain pre-processor, AERMAP, imports digital terrain data and computes a height scale for each receptor from Digital Elevation Model (DEM) data files. A height scale is assigned to each individual receptor and is used by AERMOD to determine whether the plume will go over or around a hill.

Building Wake Effects

The emission sources are evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if stack discharges might become caught in the turbulent wakes of these structures. Wind blowing around a building creates zones of turbulence that are greater than if the building was absent.

Direction-specific building dimensions and the dominant downwash structure parameters used as inputs to the dispersion models was determined using the U.S. EPA Building Profile Input Program with PRIME enhancement (BPIP-PRIME), version 04274. BPIP-PRIME is designed to incorporate the concepts and procedures expressed in the GEP Technical Support document, the Building Downwash Guidance document, and other related documents.

The output from the BPIP-PRIME downwash analysis lists the names and dimensions of the structures, and the emission unit locations and heights. In addition, the output contains a summary of the dominant structure for each emission unit (considering all wind directions) and the actual building height and projected widths for all wind directions. This information is then incorporated into the data input files for the AERMOD air dispersion model.

Terrain

The Dow Oyster Creek property is located in Freeport, Texas in Brazoria County. The terrain surrounding the Dow Freeport Site varies in elevation from 0 feet (0 meters) to 26 feet (8 meters) above mean sea level within 10 km of the Complex.

The analysis used terrain heights obtained from United States Geological Survey (USGS) Digital Elevation Models (DEM). The data extracted was from a 7.5 minute topographic quadrat for the Freeport area. For the Dow Freeport Site, DEM files were obtained from Lakes Environmental Software (2008). AERMAP (AMS/EPA Regulatory Model Terrain Pre-processor) was used to process terrain data from the DEM files.

Receptor Grid

The analysis used a Cartesian receptor grid that extended 10-kilometers in all directions from the fence line. 'On-property' receptors were included for this biological assessment. The receptor spacing varied with distance from the facility as follows:

- Within the property-line (on-property), the analysis used 50-meter spacing;
- Along the property line and extending 100-meters beyond the property line, the analysis used 25-meter spacing;
- From 100 meters to 1,000 meters, the analysis used a 100 meter spacing;
- From 1,000 m to 5,000 m (5 km), the analysis used 500 meter spacing; and
- From 5,000 m to 10,000 m (10 km), the analysis used 1,000 meter spacing.

Meteorological Data

The Dow Freeport Site is located in Brazoria County; therefore based upon TCEQ guidance, representative National Weather Service (NWS) meteorological stations are as follows:

- Surface data – Angleton Brazoria Airport (NWS 12976);
  The Angleton Brazoria Airport (LBX) located approximately 9-miles (14.5-kilometers) north of Freeport facility.
  Mixing Height data – Lake Charles Regional Airport (NWS 03937).
  The Lake Charles airport located approximately 143-miles (230-kilometers) east of downtown Houston.

The analysis used five years (2006-2010) of processed meteorological data for PSD analysis (CO) and 24-hour averaging PM2.5 as the design value is based on 5 years of meteorological data. The analysis used one year (2008) of processed meteorological data for non-PSD pollutants (NO_2, SO_2, PM_{10}, and $PM_{2.5}$). TCEQ meteorological data downloaded from TCEQ (2012) website. The analysis did not modify meteorological data. The analysis used a profile base elevation for the Angleton Brazoria Airport of 8-meters (m) above sea level.

Several parameters are used to describe the character of the modeled domain, including surface roughness length, albedo and Bowen ratio. These parameters are incorporated into the surface meteorological data set used by AERMOD. TCEQ has developed three separate AERMOD-ready meteorological data sets for each county in the state. The different data sets correspond to three categories of surface roughness length:

- Category 1 – LOW: Appropriate for flat areas with surface roughness lengths of 0.001 m – 0.1 m.
- Category 2 – MEDIUM: Appropriate for rural/suburban areas with surface roughness lengths of 0.01 m – 1.0 m
- Category 3 – HIGH: Appropriate for urban/industrial areas with surface roughness lengths of 0.7 m – 1.5 m

AERSURFACE (version 13016) was run to estimate which land use category best describes the area around the Dow Oyster Creek property. Based upon a 1-kilometer radius, a surface roughness length of 0.347 was calculated; therefore, the meteorological data set that utilized the Category 2 (medium) surface roughness length values for Brazoria County was selected.

4.2.2 Results

The proposed increase in emissions above the baseline conditions were modeled to determine whether the resulting both off-property and on-property concentrations of criteria pollutants are greater than the *de minimis* SILs. As a new construction project, for all regardless of PSD-significant emissions (CO) or non-PSD-significant emissions (NO_2, SO_2, PM_{10} and $PM_{2.5}$), the proposed allowable emission rates were modeled for each source.

Since the secondary NAAQS are designed to protect public welfare, they along with the respective SILs, were utilized to define the Action Area. In addition, the primary NAAQS and respective SILs were also presented as additional information. The results of the Action Area modeling analysis as well as the associated SILs are summarized in Table 9 for off-property concentration (beyond the property and at the fence line) and Table 10 for on-property concentration (within the property). The reported CO concentration corresponds to the highest predicted concentration from any receptor over a 5-year period. The reported $PM_{2.5}$ concentration corresponds to the highest of the 5-year average concentration from any receptors. For all other criteria pollutants, the highest concentration using 1 year meteorological data was predicted.

The SIL is a level set by the EPA, below which, modeled source impacts would be considered insignificant. The highest modeled concentration value is the maximum ground level concentration as predicted by the model for each pollutant and averaging period resulting from this proposed project. The highest modeled concentration was calculated for both within and outside of the Dow Oyster Creek property boundary. If a highest modeled concentration value is less than the SIL, the modeled source impacts are considered insignificant and are not considered to cause or contribute to a violation of a NAAQS or PSD Increment for that pollutant and averaging period. If a highest modeled concentration is greater than the SIL, additional analysis is required to demonstrate that the project would not cause or contribute to a violation of the NAAQS or PSD Increment for that pollutant and averaging period.

Table 9 – Maximum Predicted Concentrations at Off-Property Receptors

Pollutant	Averaging Period	Highest Modeled Off-Property Concentration beyond Dow Oyster Creek (μg/m^3)	Modeling Significance Level (μg/m^3)	Significant?
CO	1-hour	78.56	2,000	NO
	8-hour	34.06	500	NO
NO_2	1-hour	7.498	7.5	NO
	Annual	0.63	1	NO
SO_2	1-hour	7.73	7.8	NO
	3-hour	6.77	25	NO
	24-hour	3.85	5	NO
	Annual	0.03	1	NO
PM_{10}	24-hour	1.92	5	NO
$PM_{2.5}$	24-hour	1.19	1.2	NO
	Annual	0.24	0.3	NO

Note: Pollutant and averaging periods associated with Secondary NAAQS were utilized to define Action Area, which are NO_2 (Annual), $PM_{2.5}$ (24-hour and Annual), PM_{10} (24-hour), SO_2 (3-hour). The pollutant and averaging periods associated with Primary NAAQS were presented as additional information.

Table 10 – Maximum Predicted Concentrations at On-Property Receptors

Pollutant	Averaging Period	Highest Modeled On-Property Concentration within Dow Oyster Creek ($\mu g/m^3$)	Modeling Significance Level ($\mu g/m^3$)	Significant?
CO	1-hour	202.34	2,000	No
	8-hour	153.15	500	No
NO_2	1-hour	8.42	7.5	Yes
	Annual	0.76	1	No
SO_2	1-hour	8.78	7.8	Yes
	3-hour	8.14	25	No
	24-hour	5.41	5	Yes
	Annual	0.05	1	No
PM_{10}	24-hour	2.70	5	No
$PM_{2.5}$	24-hour	1.44	1.2	Yes
	Annual	0.36	0.3	Yes

Note: Pollutant and averaging periods associated with Secondary NAAQS were utilized to define Action Area, which are NO_2 (Annual), $PM_{2.5}$ (24-hour and Annual), PM_{10} (24-hour), SO_2 (3-hour). The pollutant and averaging periods associated with Primary NAAQS were presented as additional information.

4.2.3 Conclusions

The highest modeled concentrations for 1- hour CO, 8-hour CO, Annual NO_2, 3-hour SO_2, 24-hour SO_2, Annual SO_2, and Annual $PM_{2.5}$ were less than the SIL for off-property areas outside of the Dow Oyster Creek property. The highest modeled concentration values for 1-hour NO_2, 1-hour SO_2, and 24-hour $PM_{2.5}$ exceeded the SIL for areas within the Dow Barge Canal, which is outside the Dow Oyster Creek property but within the overall Dow Freeport property boundary. Approximately 8.17 acres of the Dow Barge Canal are associated with SIL exceedances from the proposed LHC-9 Unit.

Specific receptors occurring over the Dow Barge Canal were targeted to extract the modeled frequency of these SIL exceedances through the time frame of the meteorological data (as defined in the analysis in Section 4.2.1) over the canal. The applicable SIL concentration for 1-hour NO_2 is 9.38 $\mu g/m^3$. The modeled receptors for this pollutant indicated that the maximum predicted concentration over the canal is 9.82 $\mu g/m^3$ and was determined to exceed the SIL for 1-hour throughout one year of modeled meteorological data. The maximum SIL exceedance of 1-hour NO_2 concentrations over the Dow Barge Canal is only expected to last approximately 20 hours each year. The applicable SIL concentration for 1-hour SO_2 is 7.80 µg/m^3. The modeled receptors for this pollutant indicated that the maximum predicted concentration over the canal is 8.2 µg/m^3 and was determined to exceed the SIL for 1-hour throughout one year of modeled meteorological data. The maximum SIL exceedance of 1-hour SO_2 concentrations over the Dow Barge canal are only expected to last approximately 15 hours each year. The applicable SIL concentration for 24-hour $PM_{2.5}$ is 1.20 µg/m^3. The modeled receptors for this pollutant indicated that the maximum predicted concentration over the canal is 1.4 µg/m^3 and was determined to exceed the SIL for 2 hours throughout five years of modeled meteorological data. The maximum SIL exceedance of 24-hour $PM_{2.5}$ concentrations over the Dow Barge canal is expected to last approximately 73 hours over five years.

These SIL exceedances outside of the Dow Oyster Creek property over the Dow Barge Canal would occur at a low frequency over a relatively small area of open water. Therefore, the source impacts are considered insignificant based on stringent limits set to protect the most sensitive human populations. Due to this predicted lack of significant impact to sensitive human populations, the source impacts are not expected to significantly impact federally-protected species outside of the Dow Oyster Creek property. Therefore, only impacts to protected species within the Complex from potential changes to air quality are considered.

Modeling was conducted to determine if any criteria pollutant might exceed SILs within the boundaries of the Dow Oyster Creek property as shown in Table 10. The modeled concentrations that exceed SIL are predicted for 1-hour NO_2, 1-hour SO_2, 24-hour SO_2, 24-hour $PM_{2.5}$ and annual $PM_{2.5}$. The SIL exceedances identified in the Action Area in the vicinity of the Dow Oyster Creek property for NO_2, SO_2 and $PM_{2.5}$ are shown in Figure 10.

5.0 Assessment of Water Quality for LHC-9

The water quality analysis included discharge modeling to predict the distance at which the effluent concentration would be completely mixed within the ambient environment of the receiving water body (Brazos River) and a toxicity assessment of the chemical constituents discharged from Outfall #202 and Outfall #901.

5.1 Estimated Discharge Increase

Dow is not anticipating an increase in fresh water intake from the Brazos River for the proposed project. Total water discharges from LHC-9 will increase to 2,649 gpm. Approximately 1,024 gpm of the discharged wastewater will include spent caustic stream and dilution steam blowdown (Outfalls #202 and #002). Approximately 1,625 gpm will be discharged cooling tower blowdown and regeneration water (Outfalls #901 and #001).

5.2 Anticipated Discharge Concentrations

Concentrations of permitted chemicals in the discharge to the Brazos River are expected to remain unchanged. However, the proposed project will result in a larger total volume of discharge from Outfall #202 due to the new unit installation.

The concentrations of permitted chemical constituents in the treated wastewater effluent from Outfall #202 are below the authorized levels set forth by the TPDES permit. The current and anticipated concentrations are well below the permitted limits as shown in Table 11. Several processes currently in place will treat water discharges from the LHC-9 unit. The wastewater stream will undergo wet air oxidation before flowing into the wastewater treatment plant. The existing wastewater treatment facility is sufficient to treat the larger volumes of wastewater produced by the proposed project. In addition, chemical concentrations are anticipated to be diluted further between Outfall #202 and the discharge to the Brazos River.

Table 11 – Comparison of Permitted, Sampled (2012), & Anticipated Concentrations

Outfall #202 Flow: 65 MGD	Permitted Concentrations (Daily Max; ug/L)	Sampled Concentrations (Daily Max; ug/L)	Anticipated Concentrations (ug/L)
TSS	93,767.80	24,210.00	24,210.00
BOD	Report	5,240.00	5,240.00
TOC	Report	21,440.00	21,440.00
Ammonia	12,693.00	2,080.00	2,080.00
Chromium	37.61	0.00	0.00

Outfall #202 Flow: 65 MGD	Permitted Concentrations (Daily Max; ug/L)	Sampled Concentrations (Daily Max; ug/L)	Anticipated Concentrations (ug/L)
Zinc	283.91	20.00	20.00
Cyanide	79.27	18,430.00	18,430.00
Acenaphthene	39.64	<10.00	<10.00
Acenaphthylene	39.64	<10.00	<10.00
Acrylonitrile	163.89	<50.00	<50.00
Anthracene	39.64	<10.00	<10.00
Benzene	92.18	<10.00	<10.00
Benzo(a)anthracene	39.64	<10.00	<10.00
Benzo(a)pyrene	40.93	<10.00	<10.00
3,4 Benzofluoranthene	40.93	<10.00	<10.00
Benzo(k)fluoranthene	39.64	<10.00	<10.00
Bix(2-ethylhexyl) phthalate	188.60	<10.00	<10.00
Carbon tetrachloride	29.87	<10.00	<10.00
Chlorobenzene	22.68	<10.00	<10.00
Chlorethane	182.70	<50.00	<50.00
Chloroform	35.03	0.00*	0.00*
2 Chlorophenol	63.42	<10.00	<10.00
Chrysene	39.64	<10.00	<10.00
1,2 Dichlorobenzene	121.49	<10.00	<10.00
1,3 Dichlorobenzene	34.11	<10.00	<10.00
1,4 Dichlorobenzene	22.68	<10.00	<10.00
1,1 Dichloroethane	40.01	0.00*	0.00*
1,2 Dichloroethane	138.27	<10.00	<10.00
1,1 Dichloroethylene	18.18	<10.00	<10.00
1,2 trans-Dichloroethylene	37.06	<10.00	<10.00
2,4 Dichlorophenol	72.27	<10.00	<10.00
1,2 Dichloropropane	174.22	0.00*	0.00*
1,3 Dichloropropylene	37.24	<10.00	<10.00
Diethyl phthalate	134.77	<10.00	<10.00
2,4 Dimethylphenol	24.70	117.00	117.00
Dimethyl phthalate	31.89	<10.00	<10.00
Di-n-butyl phthalate	38.16	<10.00	<10.00
4,6 Dinitro-o-cresol	188.04	<50.00	<50.00
2,4 Dinitrophenol	120.20	<50.00	<50.00
2,4 Dinitrotoluene	184.17	<10.00	<10.00
2,6 Dinitrotoluene	414.80	<10.00	<10.00

Outfall #202 Flow: 65 MGD	Permitted Concentrations (Daily Max; ug/L)	Sampled Concentrations (Daily Max; ug/L)	Anticipated Concentrations (ug/L)
Ethylbenzene	79.46	<10.00	<10.00
Fluoranthene	45.72	<10.00	<10.00
Fluorene	39.64	<10.00	<10.00
Hexachlorobenzene	25.81	<10.00	<10.00
Hexachlorobutadiene	37.61	<10.00	<10.00
Hexachloroethane	44.25	<20.00	<20.00
Methylene Chloride	63.05	0.00*	0.00*
Methyl Chloride	132.37	<50.00	<50.00
Naphthalene	39.64	<10.00	<10.00
Nitrobenzene	97.34	<10.00	<10.00
2 Nitrophenol	50.70	<20.00	<20.00
4 Nitrophenol	92.18	<50.00	<50.00
Phenanthrene	39.64	<10.00	<10.00
Phenol	18.33	<10.00	<10.00
Pyrene	44.80	<10.00	<10.00
Tetrachloroethylene	40.93	<10.00	<10.00
Toluene	54.02	<10.00	<10.00
1,2,4 Trichlorobenzene	105.27	<10.00	<10.00
1,1,1 Trichloroethane	36.87	<10.00	<10.00
1,1,2 Trichloroethane	39.08	<10.00	<10.00
Trichloroethylene	37.06	<10.00	<10.00
Vinyl Chloride	178.83	<10.00	<10.00

*= These chemical constituents were found in trace amounts below the specified MAL (Minimum Analytical Level).

5.3 LHC-9 Process Streams

The wastewater stream from LHC-9 will be approximately 1.74 MGD and will include a spent caustic stream and a dilution steam blowdown (Table 12). The chemical concentrations from the LHC-9 Unit are anticipated to be significantly diluted during treatment before reaching the Brazos River Tidal. Outfall #202 discharges approximately 65 MGD of treated water from the wastewater treatment plant B-35 in Plant B. Discharged water from Outfall #202 flows via the Outfall #002 Canal before discharging into the Brazos River Tidal via Outfall #002 (322 MGD). Chemical concentrations sampled from Outfall #002 were not included in the analysis because its composition consists of discharge from Outfall #202, #102, and intermittent sheet flow rainwater from Plant B which are not directly connected to the process streams from LHC-9.

Dow engineers do not anticipate a required capacity increase for the condensate production to support LHC-9 because of condensate transference and recycling between LHC-9 and LHC-8. The cooling tower blowdown and regeneration water will flow through subsurface Outfall #901 into the Dow Wastewater Canal that will discharge through Outfall #001 into the Brazos River Tidal. The cooling tower blowdown (1.53 MGD) and regeneration water (0.81 MGD) from LHC-9 will be diluted before reaching the Brazos River Tidal. This assumption is based on the combination of the proposed discharge with storm water at Outfall #901, increased flow rate within Outfall #901 (4.2 MGD), and increased flow rate within Outfall #001 (322 MGD). The sampled concentrations from Outfall #001 were not included in the assessment due to the additional intake of discharge from various units within the Dow Freeport Site as well as a number of industrial neighbors' discharge into the Dow Wastewater Canal.

Table 12 – LHC-9 Wastewater Stream

FLOW= 1.48 MGD	Chemical Constituents	Wastewater (ug/L)	Outfall #202 Sampled Concentrations (ug/L)
Spent Caustic Stream (mg/L)	NaOH	699,561.15	-
	Na2CO3	3,785,016.95	-
	Na2S	532,591.21	-
	NaHS	0.00	-
	H2O	41,620,241.01	-
	Benzene	0.00048	<10
	Toluene*	0.00048	<10
	Xylene*	0.00048	NS
	Styrene*	0.00048	NS
	Ethyl Benzene*	0.00048	<10
	Phenols	0.00194	<10
Dilution Steam Blowdown (mg/L)	COD	952,702.70	NS
	BOD	476,351.35	5240
	TSS	47,635.14	24210
	TDS	9,527.03	NS
	p-xylene	75.26	NS
	Benzene	123.85	<10
	Toluene	123.85	<10
	Ethyl Benzene	66.69	<10

*=A total estimate was provided from Dow for these chemical constituents combined. The averaged values are shown above.
NS stands for not sampled.
Note: The approximation 1ppm=1mg/L was used because the density of the solution was approximately 1 g/mL.
Sodium hydroxide (NaOH), sodium carbonate (Na2CO3), sodium sulfide (Na2S), sodium hydrosulfide (NaHS), and water from the spent caustic stream are expected to be broken down in the wastewater treatment facility; therefore concentration levels are not typically tested for in Outfall #202.

5.4 Area of Impact Discharge Modeling

Modeling was conducted to demonstrate compliance with TCEQ and EPA standards for aquatic life. The analysis was used to estimate the mixing of discharge from Outfall #202 in the Outfall #002 Canal and from Outfall #901 in the Wastewater Canal respectively. The modeling was used to determine what portions of the aquatic environment to include within the Action Area. The Action Area includes the area in the canals that will be ultimately discharged from Outfalls #001 and #002, where the discharge is not completely mixed with the ambient water.

This approach was taken in two steps. The first step was to identify the current and anticipated distance until the discharge from Outfalls #202 and #901 were completely mixed without existing structures that including weirs, floodgates, etc. The second step identified all existing conditions within the Wastewater Canal and Outfall #002 Canal that would increase the rate of mixing.

5.4.1 Step 1- Estimation of Mixing Without Structures

Methods and Data

Calculations were conducted for two locations on the Dow Facility, Wastewater Canal and Outfall #002 Canal. The Wastewater Canal receives water from Outfall #901, and the Outfall #002 Canal receives water from Outfall #202. Both canals discharge directly into the Brazos River. Outfall #002 Canal discharges into the Brazos River about one-half mile upstream of the Wastewater Canal discharge.

A discharge into the side of a canal will mix vertically and horizontally across the canal eventually mixing to the bottom and across the canal. Though horizontal mixing is generally faster than vertical mixing, since canals (and rivers) are generally much wider than they are deep the time required for horizontal mixing controls the time required for complete mixing of a canal and vertical mixing can be ignored (Fisher et al. 1979).

The distance required for completed mixing, vertically and horizontally, of water discharged into a canal or river is shown in Equation 1 (Fisher et al. 1979). In Equation 1 complete mixing is defined as less than a 5% variation in concentration in the cross-section.

$$L = 0.4\ u\ W^2/e_t \qquad (1)$$

Where:

u = average velocity in the canal (ft/s)
W = width of the canal (ft)

e_t = transverse mixing coefficient (ft^2/s)

Equation 1 assumes that the discharge and ambient water have similar densities, and the discharge has minimal momentum. If the discharge has significant amount momentum (e.g., high velocity) the length required for complete mixing would be less. For example, if the velocity in the discharge was sufficient to propel the discharge to the center of the canal the length required for complete mixing would be ¼ the value predicted by Equation 1. Both the outfall discharge and the canal water are assumed to have the same density (i.e., similar temperature and salinity).

The transverse mixing coefficient can be estimated using Equation 2 (Fisher et al. 1979):

$$e_t = K*d*u^* \qquad (2)$$

Where:

K = 0.4 to 0.8 for natural streams and in the range 0.1 to 0.2 for straight uniform channels (Fisher et al, 1979). A value of 0.2 was used to represent the channels (Chau 2000).

d = depth of water in the channel (ft)
u^* = shear velocity (ft/s)

The shear velocity represent the generation of turbulence due to the bottom shear or friction. It is equal to (Chow 1959):

$$u^* = \sqrt{\frac{\tau_0}{\rho}} = \sqrt{gRS} \qquad (3)$$

Where:

T_o = bottom shear stress
ρ = density of water
g = gravitational constant (32.2 ft/s^2)
R = hydraulic radius (ft)
A/P
A = cross sectional area of the channel (ft^2)
P = wetted perimeter (ft) = 2 * d + W
S = slope (ft/ft)

The slope was estimated from Manning's equation:

$$u = 1.49/n\ R^{2/3}\ S^{1/2} \qquad (4)$$

Where n is the Manning's n value assumed to be 0.013, typical for troweled finished smooth concrete (Chow 1959). Rougher concrete will have a larger Manning's n value and results in complete mixing in a shorter distance due to the increased turbulence from a rougher bottom. For example, unfinished concrete has a Manning's n value of about 0.017. This would reduce the length required for complete mixing by over 20% due to the increased turbulence from the rougher bottom. Table 13 below shows the data used in the analysis.

Table 13 - Data used in the Mixing Calculations for Outfalls #901 and #202

Data	Canals	
	Wastewater Canal	**Outfall #002 Canal**
Flow Rate* (MGD) [Q]	284.000	425.000
Width (ft) [W]	80.000	30.000
Depth (ft) [d]	10.000	9.000
Length of Canal (ft) [l]	10700.000	1400.000
Mannings n (concrete) [n]	0.013	0.013
Discharge from #901 (MGD) [Q901]	4.200	NA
Discharge from #202 (MGD) [Q202]	NA	55.300
Additional Wastewater Stream (MGD) [q202]	NA	1.480
Additional Cooling Tower Blowdown (MGD) [q901]	2.340	NA

*Values for current flow rate (Q) were taken from 2012 sampling data provided by Dow Chemical Company.

Results

The results indicate that complete mixing of the water discharged from Outfalls #202 and #901 do not occur in the wastewater canals under pre- or post- project conditions (i.e., the variation in concentration across the section is greater than 5%). Fisher (1979) provides an equation to estimate the degree of mixing of a discharge into a canal at any distance downstream. The equation is shown below.

$$\frac{C}{Co} = \frac{1}{(4\pi x')^{1/2}} \sum_{n=-\infty}^{\infty} \left\{ \exp\left(\frac{-(y'-2n-y0')^2}{4x'}\right\} + \exp\left(\frac{-(y'-2n+y0')^2}{4x'}\right. \qquad (5)$$

Where C/Co = fraction of cross-sectional average concentration (e.g., if C/Co = 1 concentration equals average concentration).

X' = non-dimensional distance downstream = e_t/u/W

Y' = non-dimensional distance across the canal = y/W

X,y = distance downstream and across the canal (ft)

For a discharge into the side of a canal y0' = 0. The relative concentration opposite the side with the discharge is at y'=1. The results of the analysis are shown in Table 14 and Table 15. An example calculation is shown in Table 16 . Some of the values in Table 16 vary slightly from the values in Table 14 and Table 15 due to rounding of intermediate results.

Table 14 – Results of Mixing Calculations for Mixing in Wastewater Canal and Outfall #002 Wastewater Canal - Pre-Project

Data	Canals	
	Wastewater Canal	Outfall #002 Canal
Flow Rate in Canal (cfs)	439.000	658.000
Cross-section Area of Canal (ft^2) [A]	800.000	783.000
Average Velocity in Canal (ft/s) [u]	0.549	2.440
Hydraulic Radius (ft) [R]	8.000	5.600
Slope (ft/ft) [S]	1.436E-06	7.719E-05
Shear Velocity (ft/s) [u*]	0.020	0.150
Transverse Mixing Coefficient (ft^2/s) [e_t]	0.043	0.270
Length of Complete Mixing (ft) [L]	32,703.000	3,257.000

Table 15 – Results of Mixing Calculations for Mixing in Wastewater Canal and Outfall #002 Canal - Post-Project

Data	Canals	
	Wastewater Canal *	Outfall #002 Canal
Flow Rate in Canal (cfs)	443.000	660.000
Cross-section Area of Canal (ft^2) [A]	800.000	783.000
Average Velocity in Canal (ft/s) [u]	0.554	2.440
Hydraulic Radius (ft) [R]	8.000	5.600
Slope (ft/ft) [S]	1.459E-06	7.773E-05
Shear Velocity (ft/s) [u*]	0.022	0.150
Transverse Mixing Coefficient (ft^2/s) [e_t]	0.043	0.270
Length of Complete Mixing (ft) [L]	32,703.000	3,257.000

*Sample calculations for values in the Wastewater Canal column are shown in Table 16.

Table 16 - Example Calculation for Wastewater Canal

Parameter	Calculation	Result
Flow rate in Canal (Q)	284 MGD/day * 1.55 cfs/MGD	440 cfs
Cross-sectional area of canal (A)	W x d = 80 ft * 10 ft	800 ft^2
Average Velocity in Canal (u)	Q/A = 440 cfs/800 ft^2	0.55 ft/s
Hydraulic Radius (R)	A/P = A/(2*d+W) = 800 ft^2/(2*10+80)	8 ft
Slope (S)	$(u * n/1.49/ R^{2/3})^2$	1.44e-6 ft/ft
Shear Velocity (u*)	$\sqrt{g*R*S}$	0.019 ft/s
Transverse Mixing Coefficient (e_t)	0.2*d*u*	0.04 ft^2/s
Length for Complete Mixing (L)	$0.4\ u\ W^2/e_t$	35,000 ft

Conclusions

The concentration will be fully mixed vertically. This is the case for both the pre- and post-project conditions. That is, there is no significant change in the mixing conditions with and without the project and the impact area will be the same. For the end of the Wastewater Canal (at a distance of approximately 10,000 feet), the plume will not be fully mixed; however the concentration in the canal on the side opposite the discharge will be 50% of the average concentration in the canal. The concentration on the side with the discharge will be 1.5 times the canal average concentration. The Outfall #002 Canal is shorter so the mixing would be less complete at the end of the canal without an external source of mixing.

5.4.2 Step 2- Estimation of Mixing With Structures

The Wastewater Canal and Outfall #002 Canal are fairly straight and relatively smooth conveyance facilities. Under this condition, mixing is a slow process. The addition of structures into the flow can dramatically increase the rate of mixing at or near the structures as water is forced to mix (e.g. forcing all the water through a culvert) or turbulence is generated by flow through the structure (e.g. by an increase in velocity).

At the location of the Outfall #202 discharge, the wastewater treatment pond narrows from about 150 feet to 30 feet as it passes through a control structure into the Outfall #002 Canal. The treated wastewater discharged from Outfall #202 into the Outfall #002 Canal combines with this upstream flow which induces turbulence. This additional turbulence generated by the discharge and the flow through the upstream control structure creates turbulence that extends across the canal indicating water is mixed completely in the horizontal direction above Electric Road (170 feet downstream of the Outfall #202 control structure. Downstream from Electric Road, the canal should be fully mixed. Further, approximately 1,200 feet downstream of Outfall #202, water is channeled through a floodgate. At the location of the floodgate, the Outfall #202 Canal narrows from approximately 10 feet to 40 feet, through the control structure which contains a spillway and floodgates before discharging to the Brazos River an additional 650 feet downstream.

Outfall #901 is a discharge culvert to the Wastewater Canal. Over 2 miles downstream from Outfall #901, water is channeled through a floodgate. At the location of the floodgate, the Wastewater Canal narrows from approximately 170 feet to 175 feet, through the control structure which contains a spillway and floodgates before discharging to the Brazos River an additional 880 feet downstream. Downstream of the floodgate, the Wastewater Canal should be fully mixed.

Both the Wastewater Canal and the Outfall #002 Canal flow through similar floodgate structures before reaching the Brazos River. The upstream end of the structure is shown in the Appendix A. Downstream of the floodgate structure, the discharges from Outfalls #901 and #202 can be considered as fully mixed with the canal flow.

5.4.3 Conclusions of Impact Discharge Modeling

As determined in Step 1, the current and anticipated distance until the discharges from Outfalls #202 and #901 are completely mixed (less than a 5% variation in concentration in the cross-section) without existing structures was determined to be 3,257 feet for Outfall #002 Canal and 35,000 feet for the Wastewater Canal. Actual distances from the Outfalls to the Brazos River are approximately 2,050 feet and 12,396 feet, respectively.

The second step identified structures within the Wastewater Canal and Outfall #002 Canal that would increase the rate of mixing. The Outfall #002 Canal has a control structure at Outfall #202 and both canals have similar floodgates. Although the Wastewater Canal has only one turbulence producing structure, the canal itself is relatively long. As a result, the modeling predicts that the effluent discharge for the treated wastewater from Outfall #202 will be completely mixed at the floodgates in approximately 1,200 feet. The effluent discharge for the cooling tower blowdown and regeneration water from Outfall #901 will be completely mixed at the floodgate in approximately 2.21 miles. Complete mixing of the effluent discharge would serve to minimize any potential impact to water quality and habitat in Brazos River Tidal.

Therefore, the conservative Action Area involving discharges from both affected outfalls will extend from the discharge location to the floodgates within each respective wastewater canal (Figure 3).

5.5 Toxicity Assessment

Wastewater that is generated on site and discharged is subject to effluent limitations set in TPDES Permit No. WQ0000007000. Multiple outfalls are utilized by the Dow Freeport Site; however, the proposed project will primarily affect Outfall #202 and Outfall #901. Outfall #202is located in the southern section of Plant B B35. The wastewater stream will undergo wet air oxidation before flowing into the wastewater treatment plant. After treatment Outfall #202, a parshall flume, discharges into the Outfall #002 Canal and flows into Outfall #002 before draining into the Brazos River Segment 1201. Outfall #901 is approximately 0.23 miles southwest of State Highway 332. Outfall #901, which is located west of the proposed LHC-9 Unit, will discharge cooling tower blowdown and polisher-regeneration water. Outfall #901 is a subsurface pipe that discharges into the Wastewater Canal before exiting through Outfall #001 into the Brazos River. TCEQ associates the Brazos River Tidal with supporting high aquatic life. Segment No. 1201 is not listed on the State's inventory of impaired and threatened waters, Texas 2011 Clean Water Act Section 303 (d) list. The levels of permitted chemical concentrations discharged from the affected effluents into the Brazos River Tidal are not expected to change and will remain below the TPDES limitations. As a result, the proposed project is not anticipated to require an amendment to the existing TPDES Permit (Permit No. WQ0000007000).

The assessment of aquatic life impacts were based on a maximum permitted discharge of wastewater from Outfall #202 and Outfall #901. Outfall #202's effluent combines downstream with Outfall #002 in the Outfall #002 Canal before reaching the Brazos River Tidal. Outfall #901's effluent combines downstream in the Wastewater Canal and makes up a small portion of the effluent from Outfall #001 before discharging into the Brazos River. TCEQ calculated effluent discharge limitations to maintain the surface water quality standards based upon the most recent in stream criteria established in 30 Texas Administrative Code (TAC) 302.6 (c) and (d). Numerical water quality criteria were established by the TCEQ for specific contaminants where adequate toxicity information was available and have the potential to adversely impact the water in the state. Applicable criteria were developed in accordance with current USEPA guidelines for calculating site-specific water quality criteria. The current permitted water quality discharge limitations were created from the results of a series of effluent sampling as required for the most recent permit amendment. Mixing zone and toxicological assumptions are built into the model. Potential toxic effects on aquatic life, resulting from the wastewater discharge, were established by the TCEQ for specific toxic compounds where adequate toxicity information is available and that have the potential for exerting adverse impacts on water in the state. The appropriate criteria for aquatic life protection were derived in accordance with current USEPA guidelines for developing site-specific water quality criteria.

The federal guidelines 40 CFR part 414 will regulate the process wastewaters and discharge point sources that use end-of-pipe biological treatment. 40 CFR part 313 will regulate the discharge of domestic wastewater. Discharge limitations within the current TPDES permit will remain the same. The Dow Freeport Site has conducted whole effluent toxicity testing over the past 3 years. The TCEQ has defined unique dilution factors to assess the outfalls and the Brazos River Tidal based on applicable discharge volumes, critical low flow, and stream flows. The Aquatic Life Surface Water Risk-Based Exposure Limits (SWRBELs) and National Pollutant Criteria Database were used to compare maximum discharge limitations as criteria for aquatic life. Applicable criteria were developed in accordance with current EPA guidelines for calculating site-specific water quality criteria. The Aquatic Organism Bioaccumulation Criteria was used to compare discharge limitations as a criterion for human health consumption of marine fish tissue. The TCEQ used data from the original TPDES permit application to determine current discharge limitations. Effluent dilutions, aquatic organism bioaccumulation, dissolved oxygen, toxicity of aquatic life, toxicity of human health in consumption of marine organisms were modeled using TCEQ guidelines and procedures. TCEQ requires whole effluent toxicity tests (WET tests) biomonitoring and "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organism, Third Edition" (EPA-821-R-02-014) in order to assess or control potential toxicity. Studies have shown that alternative test organisms used in WET testing are dependable, biological indicators of potential toxic effects and represent listed vertebrate species toxicologically (Mayer et al. 2008; Dwyer et al. 2005; Sappington et al. 2001). Based on preliminary data for an amended TPDES permit, a chronic freshwater criterion is used for biomonitoring requirements at Outfall #002 and Outfall #001. Within the past 3 years, only one specimen lethality was recorded during WET testing in 2011. The Dow Freeport Site conducted two required re-tests and passed both. No further signs of toxicity have been indicated by the current chemical concentrations from the Outfall #002 and Outfall #001. The proposed LHC-9 installation is not anticipated to significantly increase chemical concentrations within effluents; the advanced capability of the wastewater treatment plant will maintain current concentrations. An increase in flow rate is anticipated as a result of the proposed project, which will in effect slightly increase the current dilution area. However, no increased toxicity is anticipated from the increase flow.

6.0 Assessment of Pipeline Construction

The alteration of habitats through vegetation disturbance, spread of non-native species, and interruption of waterways from the proposed pipeline construction were considered. All pipeline construction will occur within existing Dow pipeline ROWs; no additional easements will be acquired. A HDD technique will be used for larger water bodies to minimize the impact to aquatic habitats within the corridor. The remaining portions of the corridor were previously disturbed and are periodically maintained by various pipeline companies. The corridor is currently used for utility right-of-ways and will return to the same function at the completion of the proposed pipeline construction (Benchmark Ecological Services, Inc. 2012c). Temporary construction impacts will be within the 100-foot corridor (approximately 1,180 acres) which is included in the Action Area. Permanent pipeline impacts will be confined within the 50-foot corridor (approximately 590 acres) for maintenance and repair.

7.0 Potential Effects of the Proposed Action

This section presents the results of the analysis of potential impacts to federally protected species and state-recognized federal threatened and endangered species and/or their potential habitats with the defined Action Area (as defined in Section 1.6) for the proposed project. This analysis is based on the total emissions and dispersion modeling data provided by URS, dilution modeling, field survey and background review data collected by URS, correspondence with knowledgeable agencies (Appendix B), and literature review and research of potential effects of known pollutants on flora and fauna. The following impact sources are included in the analysis:

- Air Quality;
- Water Quality;
- Habitat/Vegetation Disturbance;
- Noise Pollution;
- Infrastructure-Related Disturbance;
- Human-Related Disturbance; and
- Federally-Protected Species and Habitat Effects.

7.1 Potential Air Quality Effects from LHC-9 Unit

7.1.1 General Emissions Effects

According to USEPA's "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals," the data presented in Tables 9 and 10 (Section 4.2.2) indicate the level, at or above which, airborne pollutant concentrations are known to cause significant impacts on flora and fauna (SILs). Concentrations at, or in excess of, any of the screening concentrations would indicate that the source emission may have adverse impacts on plants or animals. Pollutant concentrations predicted to be less than or equal to the SILs are expected to have no significant impact on flora and fauna. None of the modeled pollutant concentrations would exceed the SILs at receptors located outside of the Dow Freeport Site; therefore, no significant impacts are anticipated from air pollution offsite.

In general, it is commonly understood that air pollution has a greater impact on lower life forms than higher life forms. Lower life forms that would likely be the first to be impacted would include lichens, bryophytes, fungi, and soft-bodied aquatic invertebrates. Impacts to higher life forms are typically the result of indirect impacts to the food chain and reproduction, with the exception of extreme exposure. Potential indirect impacts include acidification, changes in food or nutrient supply, or changes to biodiversity and competition. Plant communities are less adaptable to changes in air pollution than animals. Animals typically have the ability to migrate away from unfavorable conditions.

7.1.2 Carbon Monoxide

Most of the literature on the effects of carbon monoxide is aimed at communicating the human health effects of overexposure to this chemical. Carbon monoxide preferentially binds to hemoglobin within the blood stream and prevents the transport of oxygen to essential organs within the body. Prolonged exposure at high concentrations can lead to death. This chemical is extremely dangerous to human health as it is colorless and odorless (U.S. EPA 2012a). Mammals and other living organisms that rely on oxygen transport via iron based carriers within the body will be susceptible to similar physiological ill effects if overexposure occurs. No significant impacts are anticipated from the proposed project.

7.1.3 Nitrogen

The Nature Conservancy and the Institute of Ecosystem Studies have published two documents that describe the known effects of airborne nitrogen and other airborne pollutants on various ecosystems in the eastern US. Airborne nitrogen dioxide is known to be converted into acid particles or acid precipitation. Both forms are deposited onto soils, vegetation, and surface waters.

The potential effects of airborne nitrogen dioxide on terrestrial ecosystems are generally long-term effects as opposed to short-term effects. Many soils are buffered against acid inputs; therefore, biodiversity losses are not immediately evident. The deposition of nitrogen can result in nitrate leaching, which can cause acidification of soils and surface waters as well as the release of aluminum, calcium, and magnesium. Arthropods with high-calcium needs are some of the animals inhabiting the soil that can be impacted by soil acidification. The release of aluminum into soil water from nitrate leaching can harm plant roots. The leaching of aluminum into surface waters can be toxic to aquatic plants, fish, and other aquatic organisms. The accumulation of nitrogen can impact plant species competition, thereby impacting community composition. Nitrogen accumulation can also lead to nitrogen saturation, which impacts microorganisms, plant production, and nitrogen cycling. Additional potential terrestrial ecosystem effects include reduced forest productivity and increased vulnerability to pests and pathogens.

The potential effects of airborne nitrogen dioxide on aquatic ecosystems include acidification and eutrophication. The effects of acidification on water quality, whether introduced by direct acid deposition or leaching from adjacent terrestrial ecosystems, include increased acidity, reduced acid neutralization capacity, hypoxia, and mobilization of aluminum. Stream and lake acidification can be chronic or episodic and both can be damaging. In general, larger aquatic ecosystems have a greater buffering capacity than smaller systems. Increased acidity can reduce dissolved organic carbon and increase light penetration and visibility through the water column. Increased light penetration can result in increased macrophyte and algal growth. Increased visibility can alter the predator-prey balance. Wetlands, estuaries, bays, and salt marshes are generally less impaired by acid deposition than other aquatic ecosystems. However, they are subject to eutrophication. Eutrophication is the over enrichment of nutrients into an aquatic system, which can result in excess algal growth. The decomposition of the excess algae can result in a decrease in dissolved oxygen, which can be harmful to fish and other aquatic organisms.

7.1.4 Sulfur Dioxide

Sulfur dioxide is highly soluble in water and forms sulfuric acid which can alter the pH balance of water bodies, both by reacting with surface water and with rain water, forming acid rain (Oklahoma Department on Environmental Protection 2011). Acidification of water bodies can result in increased acidity, reduced acid neutralization capacity, hypoxia, and mobilization of aluminum. Acidification can be chronic or episodic. Larger aquatic ecosystems are less subject to impacts as they have a greater ability to buffer the changes. Increased acidity can result in decreased dissolved organic carbon and increased light penetration and visibility through the water column. Increased light penetration can result in increased macrophyte and algal growth. Increased visibility can alter the predator-prey balance.

Sulfur dioxide may injure plant physiology when it is absorbed faster than it can be detoxified within an individual (Missouri Botanical Garden 2013). Once absorbed within a plant, SO2 is oxidized which interferes with photosynthesis and energy metabolism. Tolerance varies widely between species and is dependent on the species ability to detoxify and dispose of the pollutant.

7.1.5 Particulate Matter

PM is not a single pollutant, but a heterogeneous mixture of particles differing in size, origin, and chemical composition. Since vegetation and other ecosystem components are affected more by particulate chemistry than size fraction, exposure to a given mass concentration of airborne PM may lead to widely differing plant or ecosystem responses, depending on the particular mix of deposited particles. Though the chemical constitution of individual particles can be strongly correlated with size, the relationship between particle size and particle composition can also be quite complex in effect making it difficult in most cases to use particle size as a surrogate for chemistry. PM size classes do not necessarily have specific differential relevance for vegetation or ecosystem effects (Whitby 1978; USEPA 1996). Nitrates and sulfates are the PM constituents of greatest and most widespread environmental significance. Other components of PM, such as dust, trace metals, and organics can at high levels affect plants and other organisms. Particulate nitrates and sulfates, either individually, in combination, and/or as contributors to total reactive nitrogen deposition and total deposition of acidifying compounds, can affect sensitive ecosystem components and essential ecological attributes, which in turn, affect overall ecosystem structure and function (USEPA 2005).

PM levels in the U.S. "have the potential to alter ecosystem structure and function in ways that may reduce their ability to meet societal needs" (USEPA 2005). Currently, however, fundamental areas of uncertainty preclude establishing predictable relationships between ambient concentrations of PM and associated ecosystem effects. One source of uncertainty hampering the characterization of such relationships is the extreme complexity and variability that exist in estimating particle deposition rates. Since it is difficult to predict the rate of PM deposition, and thus, the PM contribution to total deposition at a given site, it is difficult to predict the ambient concentration of PM that would likely lead to the observed adverse effects within any particular ecosystem (USEPA 2005).

Chronic additions of reactive nitrogen are commonly a component of PM that tends to accumulate in ecosystems.

The USEPA Criteria Document provides a comprehensive review of PM toxicity (USEPA 2004). Potential direct air-to-leaf effects of PM on vegetation to some extent depend upon particle size and composition, although well-defined dose-response curves observed for gaseous phytotoxins (e.g., ozone and sulfur dioxide) have not generally been observed for PM. A notable exception has been adverse effects on foliation observed in the vicinity of cement production facilities, for which particulate emissions are highly caustic. For emissions from the proposed cracking furnaces, PM composition per se is not likely to harm plant species (with respect to direct foliar damage).

7.1.6 Fugitive Dust

Dust will be emitted during construction of the furnaces. This emission will be minimal and will last a few days. Dust emissions are expected to be negligible after initial land-disturbing activities are completed.

7.2 Potential Water Quality Effects from LHC-9 Unit

7.2.1 Atmospheric Deposition over Surface Waters and Watersheds

Atmospheric deposition of airborne constituents is expected to be negligible and have no effect on water quality or aquatic habitats in areas where ground-level SIL concentrations for regulated constituents are not exceeded. The surface waters that are contained within the area of SIL exceedance for SO_2, NO_2, and $PM_{2.5}$ are man-made detention ponds, which ultimately discharge to Outfall #901, and approximately 8.2 acres of the Dow Barge Canal. The terrestrial surface area that is contained within the area of SIL exceedance within the Dow Oyster Creek property boundary and is expected to drain to the same detention ponds. These SIL exceedances over the Dow Barge Canal will occur at a low frequency. Therefore, the source impacts are considered insignificant based on EPA's SIL limits.

Based on the background research described above in Section7.1.1, the potential effects on surface waters from NO_2 emissions include indirect, long-term effects, such as acidification or eutrophication. Potential impacts of SO_2 emissions on surface waters can be chronic or episodic and can involve acidification of water bodies, hypoxia, and mobilization of aluminum. Potential effects from PM emissions on surface waters involve changes in pH or eutrophication.

Due to the small areal extent of land and surface water that is contained within the SIL exceedance area, effects on water quality and aquatic habitats due to atmospheric deposition are expected to be negligible.

7.2.2 Wastewater Discharge

Dow estimates an increase of 1.48 MGD in wastewater to the wastewater treatment plant will be discharged from Outfall #202, and 2.34 MGD in cooling tower blowdown and regeneration water will be discharged from Outfall #901. The Action Area includes the area within the Wastewater Canal and the Outfall #002 Canal where the discharge is not completely mixed with the ambient water; effluent will ultimately discharge from Outfalls #001 and #002. Based on water discharge modeling, a conservative Action Area within these canals was determined to reach from both affected outfalls to their respective floodgates (Figure 3). Based on the mixing distance estimates, effects on water quality and aquatic habitats in the Brazos River due to the increase in wastewater discharge are expected to be negligible.

7.2.3 Mass Loading

The estimated increase in treated effluent discharge from Outfall #202 is not anticipated to result in increases in pollutant mass loading to the receiving water due to the capabilities of the current wastewater treatment plant. Therefore, no resulting additional elements are anticipated to be discharged into the surrounding environment. The relative toxicity is expected to be negligible, and the existing permit will not result in a deficiency of the Texas Surface Water Quality Standards.

7.2.4 Water Temperature

Temperature is independent of both concentration and mass loading parameters. The water temperature of Outfall #202 effluent is affected by raw water temperature, ambient air temperature, and physical limitations of the cooling tower. Due to its consistency with maintaining relatively close to ambient temperature (~74^{o}F), a temperature limit was not issued in the TPDES permit. Although the project will increase the treated effluent discharge volume from Outfall #202, there will be no significant change to effluent temperature as a result of the project. Effluent temperature will not violate Texas water quality standards.

7.2.5 Toxicity

All effluent data indicate that toxicity was within the discharge limitations based on the state criteria and EPA criteria for aquatic life and significant dilution of any toxic components within the effluent will occur before reaching suitable habitat for protected species. If permit levels are exceeded, there is a chance that wastewater effluent could be toxic to small aquatic life within the Brazos River Tidal. These animals serve as prey for larger species, which in turn may ingest toxins through small prey ingestion. This biomagnification of potentially harmful toxins is the process of accumulating higher chemical concentrations based on trophic levels through consumption of contaminated resources and has the potential to impair surrounding wildlife. This monitoring will allow the Dow Freeport Site to adjust processes and reduce downstream toxicity if effluents exceed permit limitations.

As described by the discharge modeling and toxicity assessment, the effluent discharge for the treated wastewater from Outfall #202 will be completely mixed at the floodgates in approximately 0.21 miles. The effluent discharge for the cooling tower blowdown and regeneration water from Outfall #901 will be completely mixed at the floodgate in approximately

2.21 miles. Complete mixing of the effluent discharge would serve to minimize any potential impact to water quality and habitat in Brazos River Tidal.

7.3 Habitat/Vegetation Disturbance

The LHC-9 construction will take place on previously disturbed areas. The open water features are man-made detention ponds. All grass areas are consistently maintained throughout the property. The wastewater line from the LHC-9 Unit will cross a small median within the Dow Barge Canal, which is outside of the Oyster Creek property boundary that was observed to be wetlands (Appendix A). An HDD or other alternative method will be used in this area to minimize environmental impact. Based on the above information, the LHC-9 construction will not likely impact the previously disturbed and altered landscape within the Dow Freeport Site.

Pipeline construction can inhibit the growth of native vegetation through the increased disturbance of soil. This type of soil disruption could potentially enable an invasive species to dominate these areas. All associated pipelines will be restricted to the existing, disturbed pipeline corridor, and will be coupled to an existing pipeline structure. The corridor will be returned to pre-existing conditions following construction. Based on the above information, the pipeline construction will not likely impact the surrounding plant communities through intense vegetation disturbance.

7.4 Noise Effects

Dow project engineers estimate that noise levels during construction should be comparable to noise levels from maintenance activities that currently take place at the plant. The new equipment should not produce noise levels greater than 90 decibels or alter the pre-existing noise exposure at the site. No noise effects to wildlife are expected as a result of the infrastructure construction or operations of the installation project. Although sharp noises can alter the behavior of protected species, the Dow Freeport Site facility creates a steady noise that is unlikely to greatly alter behavior patterns.

7.5 Infrastructure-Related Effects

Construction of the proposed installation project involves the addition of eight new ethylene cracking furnaces, two flares, one cooling tower, backup diesel generators, and various storage drums and tanks. The proposed furnace site is an existing cleared area from the previously demolished Chlor-Alkali Unit surrounded by industrial infrastructure and roadways. No vegetation or potential wildlife habitat will be directly impacted as a result of the infrastructure construction activities.

7.6 Human Activity Effects

Construction and operation of the proposed installation project will not require significant additional human activity compared to typical maintenance activities that occur at the plant on a regular basis. However, laydown, fabrication, and other temporary features associated with construction will occur in graded areas that will be lined with an aggregate base. The previously disturbed laydown areas will not be suitable habitat for federally listed species. No impacts to protected species are expected as a result of the increase in human activity associated with the proposed installation project.

7.7 Potential Impacts to Federally-Protected Species

The following provides an assessment of the project's potential to affect listed species.

7.7.1 Federally-Listed Species

Texas Prairie Dawn

Potential Occurrence

Populations of Texas prairie dawn are known to occur only in western Harris County and extreme eastern Fort Bend County in a specific habitat described as small, sparsely vegetated areas associated with pimple (mima) mounds. Of the four counties contained within the Action Area, the Texas prairie dawn is only listed in Harris County. Although the proposed project includes work in Harris County, no portion of the proposed project will be constructed in western Harris County. The SOW #1 78-mile pipeline will be constructed in extreme southeastern Harris County. The TXNDD does not include any observations of Texas prairie dawn within an approximate 11 mile radius of the proposed project site and no Texas prairie dawn habitat was observed within or near the proposed project site during the site surveys (Benchmark 2012a, 2012b, 2012c, 2013a, 2013b, and 2013c). Based on the soil analysis in **Section Error! Reference source not found.**, there are no suitable soils in the Action Area to support this species. No mima mounds or slick spots in nearly barren areas on slightly saline soils were observed within the Action Area during any of the surveys. Texas prairie dawn is highly unlikely to occur within or near the Action Area.

Potential LHC-9 Unit Impacts

LHC-9 will be constructed in eastern Brazoria County, distant from the Texas prairie dawn habitat in Harris and Fort Bend Counties. The construction laydown area is currently being developed in association with other Dow projects and is not suitable habitat for Texas prairie dawn. The Texas prairie dawn is not listed in, or known to occur in Brazoria County. Additionally, no potential habitat was observed during site reconnaissance. Because the Texas prairie dawn is not known to occur in Brazoria County and there is no potential habitat within the LHC-9 site or in the construction laydown area, the construction and operation of the proposed LHC-9 Unit would have **no effect** on the Texas prairie dawn.

Potential Pipeline Impacts

No pipelines will be constructed in western Harris County or eastern Fort Bend County where the Texas prairie dawn is known to occur. The SOW #1 78-mile pipeline will be constructed in extreme southeastern Harris County, distant from Texas prairie dawn habitat. Further, all pipelines will be constructed within existing, previously disturbed utility rights-of way. Because the Texas prairie dawn is not known to occur in the vicinity of the proposed project and no Texas prairie dawn habitat was observed during site reconnaissance, the proposed pipeline construction would have **no effect** on the Texas prairie dawn.

Sea Turtles

Potential Occurrence

Available sea turtle occurrence records databases were searched to identify any sightings in the vicinity of the Action Area. Some of these records do not indicate the sea turtle species. The TXNDD and USACE's Sea Turtle Warehouse (USACE 2013) had reports of sea turtle takes near Freeport Harbor and near the jetties which are located approximately 4 miles south of the Action Area. The Sea Turtle Stranding and Salvage Network (STSSN) indicates occurrences of sea turtles within all of the counties involved in the proposed project (STSSN 2011). The Brazos River Authority has reported isolated sightings of sea turtles within the Brazos River but the records do not include location or species information. Consultation with representatives of NOAA confirmed that sea turtles species have access to the San Jacinto River area and have the potential to occur in these areas incidentally. Dow has no reports of sea turtles or other large marine species within the canal system at the Dow Freeport Site.

When necessary, URS made contact with relevant agencies to confirm assumptions made to determine impacts to protected species; all personnel agency communications are contained in Appendix B. URS spoke with the Research Fishery Biologist at NOAA in Galveston (personal communication January 31, 2014) who stated that sea turtles can be found in brackish tidal rivers such as the Brazos River, and will even seek out freshwater for warmth or food sources such as shrimp, fish, crab, or seagrasses.

Because of similar behaviors and characteristics, many of the potential impacts would affect all sea turtles in similar ways. This section provides a general discussion of direct and indirect impacts to sea turtles from the project. Species specific impacts are discussed in later sections.

Direct Impacts

Direct impacts to sea turtles would only occur in their habitat, which is limited to aquatic areas and nesting areas. With respect to the project, aquatic areas within the Action Area are limited to the Wastewater Canal and Outfall #002 Canal. There is no suitable sandy dune habitat for turtle nesting within the Action Area at Dow Freeport.

All associated pipelines will be constructed within existing, disturbed pipeline corridors containing no appropriate sea turtle nesting habitat. Aquatic areas that contain potential sea turtle habitat will be avoided via HDD or similar trenchless methods to minimize environmental impact and disturbance. There is no suitable sandy dune habitat for turtle nesting within HDD workspaces.

The construction laydown area is currently being developed in association with other Dow projects and is not suitable habitat for sea turtles. BMPs will limit the amount of sediment leaving the construction site. Construction runoff from this area will drain into the Flag Lake Drainage Canal, which is a leveed man-made channel that is not suitable nesting or foraging habitat for sea turtles. The Flag Lake Drainage Canal discharges either to the Brazos River upstream of Dow Freeport or to Union Bayou.

The aquatic Action Area is limited to the Wastewater Canal and the Outfall #002 Canal and does not contain suitable sea turtle foraging or nesting habitat. These canals have steep banks and levees constructed of clay; it is unlikely that a sea turtle could climb them and nest construction would not be possible. Additionally, floodgates prohibit sea turtles from entering the Action Area from the Brazos River. These floodgates are typically open but are closed for storm surges or other potentially flooding events that could compromise the Dow Freeport Site. Sea turtles could not breach the floodgate unless an unusually high tide event and/or storm surge were to push them over the floodgate or if they were able to crawl up and around the steep bank. URS spoke with the Research Fishery Biologist at NOAA in Galveston (personal communication January 31, 2014) who stated that although there are many local accounts of sea turtles seeking out the warmth of wastewater canals, sea turtles are not going to climb banks, weirs, or gates to enter upstream waters, such as the Dow wastewater canals. They would only enter such canals if there was open passage through which the turtles could swim. Therefore sea turtles are extremely unlikely to occur within the Action Area and as such are unlikely to be directly impacted by the project.

There will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat.

Indirect impacts

Only indirect impacts to sea turtles are possible as a result of potential food sources within the Action Area being affected by discharge constituents or air emission deposition. Potential pollutants from deposition and effluent from the proposed project have not been found in levels great enough to impact downstream (Brazos River) water quality independently. Receiving water bodies are considered completely mixed (less than a 5% variation in concentration in the cross-section) before reaching the Brazos River, as described in Section 5. Similarly, although changes in water temperature can alter turtle behavior and the sex of offspring, there will be no change in temperature to effluent from the Dow Freeport Site as a result of the project.

Indirect impacts to turtles would potentially be from contamination of food sources from pollutants in the water. Herbivorous turtles could eat contaminated aquatic plants. Omnivorous turtles ingest higher trophic levels which may have bioaccumulated pollutants to potentially toxic levels. However, based on the 3 years of biomonitoring conducted by Dow and the negative results for toxic constituents, invertebrate prey species are not expected to be impacted by the proposed project. The results suggest that invertebrate species subjected to straight effluent are not toxic; therefore, it is safe to assume that plants at lower trophic levels, are also not toxic. As mentioned before, there is potential that the effluent stream could be cleaner than the receiving water body. Neither herbivorous nor omnivorous turtles will be indirectly impacted from project effluent’s negligible impact to food sources. Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality and therefore will not affect sea turtles indirectly.

Sea turtles with deep water food sources are even more unlikely to be impacted by the project activities at the Dow Freeport Site than those with potential food sources potentially near the Actions Area.

Green Sea Turtle

Green sea turtle critical habitat, as designated by NOAA in 1998, includes coastal waters surrounding Culebra Island, Puerto Rico (63 FR 46693 46701). The designated critical habitat is not located within or near the Action Area.

Potential Occurrence

The TXNDD does not identify any observations of green sea turtles within 13 miles of the proposed Action Area. USACE has identified 37 green sea turtle takes from dredging in the Galveston District from 1995 to 2013; specific locations are not recorded in the reports. The Sea Turtle Stranding and Salving Network (STSSN) recorded 13 green sea turtles in Brazoria County, 45 in Galveston County, 1 in Harris County, and 0 in Chambers County from 1998 to 2007. USACE Sea Turtle Data Warehouse (2012) and the STSSN does not identify specific locations of recorded turtles on the website. The Brazos River Tidal is adjacent to the Dow Freeport Site and drains into the Gulf of Mexico, which is potential habitat for green sea turtles. The San Jacinto River, which flows into Galveston Bay estuary, approximately 4 miles southeast of the SOW #1 pipeline section of the Action Area. Green sea turtles have been observed within Galveston Bay as recently as 2012. These sea turtle species utilize the area for seasonal foraging (Galveston Bay Estuary Program [GBEP] 2004a). Adults are herbivorous and utilize seagrasses and algae. Hatchlings occupy the oceanic zone which is not included in our Action Area. The Brazos River Tidal and San Jacinto River are not optimal areas for foraging due to the increased industrialization and lack of dietary resources for the green sea turtle. Green sea turtles are unlikely to occur in Brazos River Tidal or San Jacinto River with the exception of incidental or transient events and are anticipated to continue occurring in Galveston Bay and Gulf of Mexico downstream of the Action Area. Floodgates prohibit sea turtles from entering the Action Area at the Dow Freeport Site.

Potential Impacts

As already discussed, there will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat.

Eutrophication caused from the addition of nitrogen could affect potential food sources for the green sea turtle. Seagrass beds are known to decline under nutrient over-enrichment from light reduction caused from high-biomass algal overgrowth as in shallow coastal areas. No seagrass beds have been mapped within Brazos River Tidal (Pulich & White 1990, Pulich 1996). As already discussed, food sources are not expected to be impacted by the negligible concentration levels in effluent from the proposed project. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Because this species is not likely to occur within the Action Area at the Dow Freeport Site, there is no preferred habitat, food sources will not be significantly impacted, and discharges to suitable habitat will remain unchanged, the proposed project will have no effect on green sea turtles.

Hawksbill Sea Turtle

Hawksbill sea turtle critical habitat, as identified by NOAA in 1998, includes coastal waters surrounding Mona and Monito Islands, Puerto Rico (63 FR 46693 46701). The designated critical habitat is not located near the Action Area.

Potential Occurrence

No sources have been found to indicate that hawksbill sea turtles occur within the Galveston Bay estuary. The TXNDD does not identify any observations of hawksbill sea turtles in the vicinity (~13 miles) of the Action Area. USACE Sea Turtle Data Warehouse (2012) did not identify any hawksbill sea turtle takes from 1995 to 2013. STSSN recorded 4 hawksbill sea turtles in Brazoria County, 30 in Galveston County, and 0 in Harris County and Chambers County from 1998 to 2007. Hawksbill sea turtles' favored habitat is coral reefs, and they feed primarily on sponges. It would be highly unlikely for a hawksbill sea turtle to occur within the waters associated with the Action Area.

Potential Impacts

No coral reefs or sponges can be supported in the Brazos River Tidal, San Jacinto River, or in Galveston Bay therefore, hawksbill sea turtles are not known to occur within these areas (BEP 2007). As already discussed, there will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat. Indirect effects from food sources are also highly unlikely because of the diet of this turtle species.

Because this species does not occur within the Action Area at the Dow Freeport Site and dietary resources are not supported in the waters associated with the Action Area, the proposed project would have **no effect** on the hawksbill sea turtle.

Kemp's Ridley Sea Turtle

Kemp's ridley sea turtle critical habitat, as identified by NOAA in 1978, includes the Port Canaveral navigation channel in Cape Canaveral in Florida (43 FR 45905 45909). The designated critical habitat is not located near the Action Area.

Potential Occurrence

The Brazos River Tidal could be potential foraging habitat for the Kemp's ridley sea turtles. According to the TXNDD, a Kemp's ridley sea turtle was observed in 1994 approximately 4 miles south of the Action Area in Brazoria County at the termination of the Dow Barge Canal. USACE Sea Turtle Warehouse identified 17 Kemp's ridley sea turtle dredging/trawling takes from 1995 – 2013. STSSN recorded 55 Kemp's ridley sea turtles in Brazoria County, 542 in Galveston County, 7 in Harris County, and 17 in Chambers County from 1998 to 2007. The closest sighting of a stranded Kemp's ridley sea turtle was approximately 1,144 feet north of the northern alternative route across Hogg Island (STSSN 2012). These sea turtles have been intermittently observed within the Galveston Bay estuary, which is located approximately 4 miles from SOW #1 pipeline route, as recently as 2012. Kemp's ridley sea turtles have been observed within Galveston Bay , which is approximately 4 miles south the SOW #1 pipeline section of the Action Area, as recent as 2012. This species is a shallow water benthic feeder with a diet consisting primarily of shrimp, jellyfish, snails, sea stars, and swimming crabs.

Potential Impacts

As already discussed, there will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat.

Indirect effects from food sources are possible but highly unlikely. This turtle is a shallow water benthic feeder with a diet consisting primarily of shrimp, jellyfish, snails, sea stars, and swimming crabs. The populations of these aquatic organisms could be affected by cumulative toxicity, acidification, and eutrophication. Based on the biomonitoring results, food sources are not expected to be impacted by the negligible concentration levels in effluent from the proposed project. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Because this species is not likely to occur within the Action Area at the Dow Freeport Site, there is no preferred habitat, food sources will not be significantly impacted, discharges to suitable habitat will remain unchanged, the proposed project will have **no effect** on the Kemp's ridley sea turtle.

Leatherback Sea Turtle

Leatherback sea turtle critical habitat, as identified by NOAA in 1979, includes water adjacent to Sandy Point Beach, St. Croix, U.S. Virgin Islands (44 FR 17710 17712). The designated critical habitat is not located near the Action Area.

Potential Occurrence

Leatherback sea turtles are most commonly found in deep water habitats and are not known to nest on the shores of Galveston Bay (USFWS 2012b). Their diet is primarily jellyfish and salp, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. The portion of the Brazos River Tidal adjacent to the Action Area does not possess preferred leatherback sea turtle nesting or foraging habitat. The TXNDD does not identify any observations of leatherback sea turtles in the vicinity (~13 miles) of the Action Area. STSSN recorded 10 leatherback sea turtles in Brazoria County, 48 in Galveston County, 0 in Harris County, and 0 in Chambers County from 1998 to 2007. Because of the absence of foraging and nesting habitat, it is highly unlikely that leatherback sea turtles would occur in waters associated with the Action Area.

Potential Impacts

As already discussed, there will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat. Increases in effluent discharge or pollutant concentrations have the potential to affect leatherback foraging habitat due to cumulative toxicity, acidification, and eutrophication affecting the shrimp, jellyfish, snails, sea stars, and swimming crabs that the turtles feed upon. Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality independently. Based on the biomonitoring results, food sources are not expected to be impacted by the negligible concentration levels in effluent from the proposed project.

Because this species does not occur within or near waters associated with the Action Area at the Dow Freeport Site, food sources will not be significantly impacted, and discharges to suitable habitat will remain unchanged, the proposed project would have **no effect** on leatherback sea turtles.

Loggerhead Sea Turtle

No critical habitat has been identified for this species (USFWS 2014b).

Potential Occurrence

The TXNDD does not identify any observations of loggerhead sea turtles in the vicinity of the Action Area. STSSN recorded 99 loggerhead sea turtles in Brazoria County, 462 in Galveston County, 1 in Harris County, and 5 in Chambers County from 1998 to 2007. The portions of the Galveston Bay estuary that are not dredged are potential foraging habitat for the loggerhead. Loggerhead sea turtles have been observed within Galveston Bay, which is approximately 4 miles south of the SOW #1 pipeline, as recent as 2012. These sea turtles utilize the bay areas for seasonal foraging (BEP 2007). Adult loggerheads feed on jellyfish, floating egg clusters, flying fish, mollusks, crustaceans, and other marine animals. The closest sighting of a loggerhead sea turtle was approximately 1.5 miles east of SOW #1 pipeline route in La Porte (STSSN 2012). There is potential for incidental occurrence of loggerhead sea turtles in the vicinity of Action Area waters associated with the pipeline construction.

Potential Impacts

As already discussed, there will be no direct impacts to sea turtles as a result of the project; there would be no construction within suitable turtle habitat.

Increases in effluent discharge or pollutant concentrations have the potential to affect loggerhead foraging habitat due to cumulative toxicity, acidification, and eutrophication affecting the jellyfish, floating egg clusters, flying fish, mollusks, crustaceans, and other marine animals that the turtles feed upon. Based on the biomonitoring results, food sources are not expected to be impacted by the negligible concentration levels in effluent from the proposed project.

Because this species does not occur within or near waters associated with the Action Area in the Dow Freeport Site, food sources will not be significantly impacted, and discharges to suitable habitat will remain unchanged, the proposed project would have **no effect** on loggerhead sea turtles.

Blue Whale

Potential Occurrence

There is only one documented Texas record of a stranded blue whale near Freeport in 1940. Deep water aquatic areas are required for this marine mammal, which are not located in the Action Area. Therefore, there is no potential for blue whales to occur within the Action Area.

Potential Impacts

Because this species has never been seen in the vicinity (~15 miles) of the project site, there are no aquatic resources within the Action Area, the SIL exceedances will not impact water quality or aquatic habitats and there will be no changes to the wastewater discharge, the proposed project would have **no effect** on the blue whales and this species was not evaluated further.

Fin Whale

Potential Occurrence

The only known Texas record involves a stranded finback whale on the beach at Gilchrist, Chambers County, Texas in 1951 (Davis and Schmidley 1997). Aquatic areas are required for this marine mammal, which are not located in the Action Area. Therefore, there is no potential for fin whales to occur within the Action Area.

Potential Impacts

Because this species has never been seen in the vicinity (~15 miles) of the project site, there are no aquatic resources within the Action Area, the SIL exceedances will not impact water quality or aquatic habitats and there will be no changes to the wastewater discharge, the proposed project would have **no effect** on the fin whales and this species was not evaluated further.

Humpback Whale

Potential Occurrence

The only known Texas record involves a humpback whale observed swimming at the inshore side of Bolivar Jetty near Galveston in 1992 (Davis and Schmidley 1997). Deep water aquatic areas are required for this marine mammal, which are not located in the Action Area. Therefore, there it is highly unlikely for humpback whales to occur within the Action Area.

Potential Impacts

Because this species has never been seen in the vicinity of the project site (~15 miles), there are no aquatic resources within the Action Area, the SIL exceedances will not impact water quality or aquatic habitats and there will be no changes to the wastewater discharge, the proposed project would have **no effect** on the humpback whales and this species was not evaluated further.

Sei Whale

Potential Occurrence

Based on available data, there are no known sei whale observations in Texas (Davis and Schmidley 1997). Aquatic areas are required for this marine mammal, which are not located in the Action Area. Therefore, there is no potential for sei whales to occur within the Action Area.

Potential Impacts

Because this species has never been recorded in the vicinity (~15 miles) of the project site, there are no aquatic resources within the Action Area, the SIL exceedances will not impact water quality or aquatic habitats and there will be no changes to the wastewater discharge, the proposed project would have **no effect** on the sei whales and this species was not evaluated further.

Sperm Whale

Potential Occurrence

Sperm whales are present in the Gulf of Mexico during all seasons (NOAA 2013a), and sightings near the Texas coast are regarded as common (Davis and Schmidley 1997). This species requires deep water and is highly uncommon in shallow water areas. Aquatic areas are required for this marine mammal, which are not located in the Action Area. Therefore, there is no potential for sperm whales to occur within the Action Area.

Potential Impacts

Because this species has never been seen in the vicinity (~15 miles) of the project site, there are no aquatic resources within the Action Area, the SIL exceedances will not impact water quality or aquatic habitats and there will be no changes to the wastewater discharge, the proposed project would have **no effect** on the sperm whales and this species was not evaluated further.

Whooping Crane

Colorado, Idaho, Kansas, Nebraska, New Mexico, Oklahoma, and Texas each contain USFWS-designated critical habitat for the whooping crane (43 FR 20938 20942). The designated critical habitat for whooping cranes in Texas is the Aransas NWR, which is located approximately 100 miles from the Action Area. No designated critical habitat is located within or near the Action Area; however, the Action Area is located between the Brazoria and Aransas NWR.

Potential Occurrence

Preferred over-wintering habitat for both adults and juveniles includes estuaries marshes, bays, and tidal flats. The Dow Freeport Site is located at the far eastern edge of the Aransas-Wood Buffalo breeding, migrating, and wintering area (Cornell Lab of Ornithology 2013). According to personal communication with the USFWS (January 31, 2014), the Freeport area would not likely experience migrating Whooping cranes; however, it may receive cranes already migrated to Texas for the winter. Benchmark surveys indicated that potential habitat near the Action Area were of low quality. Benchmark identified several rookeries within a 2.5 mile radius of the SOW #1 pipeline. All potential impacts to the proposed pipeline construction areas were considered as negligible in the Benchmark (2013b) report because the pipeline corridor will be returned to the pre-existing conditions post-construction.

The TXNDD identified the occurrence of whooping cranes within 3 miles of the Action Area in 1986. According to the Aransas NWR Whooping crane update for December, 5 2013, a single subadult whooping crane, marked in Canada as a chick the summer of 2012, was spotted with a group of sandhill cranes on and around Brazoria NWR in mid-November and then moved on to Matagorda County (USFWS 2013a).

Based on the disturbed nature of the poor quality habitats in the Action Area at the Dow Freeport Site and the rarity of sightings near the Dow Freeport Site, it is highly unlikely for whooping cranes to nest or forage within the Action Area at the Dow Freeport Site. However, they may be flying overhead in their travels along the coast. It is possible for whooping cranes to occur in Brazoria NWR near the proposed pipeline.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for whooping cranes.

Increases in effluent discharge or pollutant concentrations have the potential to affect whooping crane foraging habitat due to cumulative toxicity, acidification, and eutrophication affecting the fish and other marine animals that the cranes feed upon. Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality independently. Based on biomonitoring conducted by Dow and the non-toxic results, food sources near the facility are not expected to be impacted by the negligible concentration levels from the proposed project.

All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Oyster Creek is highly industrialized and does not have potential habitat for whooping cranes.

According to the Aransas NWR website and based on data collected in 2013, whooping cranes begin arriving at the Texas coast in mid-October and have migrated to the north by mid-April (USFWS 2013a). Construction will occur within the whooping crane wintering season. Tall structures (>200 feet) and their support wires can create a potentially significant impact on migratory birds. The project will involve the use of several tall cranes for construction and a permanent cooling tower proposed to be approximately 275 feet tall. The USFWS recommends using the USFWS Memorandum Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers for guidance regarding flagging or other marking of permanent structures for increased visibility (Appendix C). USFWS does not have mitigation or protective measures for temporary structures, such as construction cranes. Dow has considered these guidelines in their project design and for construction cranes. The proposed tower will be at or below the height of existing towers at the Dow Freeport Site and will not require any support wires. Red strobe lights, rather than white, will be used to mark taller cranes if permitted by the FAA. And security lighting will be restricted to the boundaries of the site and pointed down.

Although there is only low-quality potential habitat near the Action Area, food sources will not be significantly impacted, anticipated SIL exceedances will be insignificant, and the potential occurrence of whooping cranes within the vicinity is extremely rare, the proposed project **may affect, but is not likely to adversely affect** whooping cranes because construction will be occurring within their migrating and roosting season.

Potential Pipeline Impacts

All associated pipelines will be constructed within existing, disturbed pipeline corridors. The corridors will be returned to pre-existing conditions following construction; therefore, there would be no permanent impacts to whooping cranes. Although the proposed pipeline route is located near the whooping crane migration route, the habitats identified within the corridor do not have the potential to support whooping crane populations. As already mentioned, a rare siting of a whooping crane was spotted on and around the Brazoria NWR in mid-November 2013. Before that, the closest individual identified near the site was found wintering near Jones Creek around 20 years ago (Brent Ortego – TPWD, personal communication, January 18, 2013). Jones Creek is located approximately 4.5 miles west of Oyster Creek. Construction would occur partially within existing ROW in the Brazoria NWR during the migration or roosting season.

Benchmark (2013b) noted the potential for forested rookery habitat outside of the Action Area. TXNDD identified nearby rookeries outside of the Action Area that would enable incidental whooping cranes to find a suitable alternative location during construction. The proposed project **may affect, but is not likely to adversely affect** whooping cranes because construction will be occurring within their migrating and roosting season..

Attwater's Greater Prairie Chicken

USFWS (2012d) has not identified critical habitat for the Attwater's greater prairie chicken.

Potential Occurrence

Attwater's greater prairie chicken is only found in the coastal prairies of Texas and has been listed endangered by USFWS since 1967. Benchmark (2013a) identified TXNDD observations adjacent to the proposed pipeline corridor from their data request along the pipeline route near

Texas City in the Nature Conservancy Texas City Prairie Preserve (Preserve), just north of Moses Lake and east of SH 146. USFWS verified that a few individual Attwater's greater prairie chickens were found in the Preserve during the 2012 bird surveys. The 2013 bird survey did not find anything that would be impacted by a construction project occurring on the west side of SH 146. Construction is proposed in an existing pipeline ROW and is separated from the Preserve by a major highway. It would be highly unlikely for Attwater's greater prairie chicken to occur within the maintained pipeline corridor which does not support required tall grass habitat for this species to survive.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for Attwater's greater prairie chickens.

The Attwater's greater prairie chickens do not occur near the LHC-9 Action Area in Oyster Creek. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Oyster Creek is highly industrialized and does not have potential habitat for this species. Because there is no tall grass prairie habitat within or near the LHC-9 portion of the Action Area, no known occurrences within or near the Action Area, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on Attwater's greater prairie chickens.

Potential Pipeline Impacts

All associated pipelines will be constructed within existing, disturbed pipeline corridors. The corridors will be returned to pre-existing conditions following construction. The habitats recognized within the corridor would not support tall grass habitat required by Attwater's greater prairie chickens nor were any current sightings recorded within the proposed pipeline route. Potential booming (mating ritual), foraging, nesting, or roosting habitat is unlikely to be within the Action Area. According to Terry Rossingnol from USFWS in Aransas NWR (personal communication February 14, 2013), a small group of Attwater's greater prairie chickens were identified by near Moses Lake, which is adjacent to the existing pipeline corridor, during 2012 bird surveys. According to personal communication with the USFWS in Clear Lake (January 31, 2014), as long as the pipeline is located on the west side of SH 146, construction of the project would not disturb species within the Preserve. Permanent features will be below ground and also separated from Attwater's greater prairie chicken habitat by a major highway. Based on the above information, conducted surveys, and lack of preferred habitat within the pipeline corridor, the proposed project will have **no effect** to the Attwater's greater prairie chickens.

Eskimo Curlew

USFWS (2012d) has not designated any critical habitat for the eskimo curlew.

Potential Occurrence

The return migration route from South America during spring includes the Gulf of Mexico and Texas Coast, which support prairie habitat. Eskimo curlews are primarily insectivorous. The Action Area is located within a maintained pipeline corridor and within an industrial site in Oyster Creek. Preferred prairie habitat is not located within the Action Area. This species has not been recorded with certainty since 1963 and is thought to be extinct (Roberts et al. 2010). There is no potential for eskimo curlews to occur within the Action Area.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for eskimo curlews.

Oyster Creek is highly industrialized and does not have potential habitat for eskimo curlews. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Because there is no potential habitat within or near the Action Area, no recent occurrences within or near the Action Area, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on eskimo curlews.

Potential Pipeline Impacts

All associated pipelines will be constructed within existing, disturbed pipeline corridors. The corridors will be returned to pre-existing conditions following construction. No suitable habitat was identified in the pipeline corridor nor have there been any current curlew sightings recorded within or near the proposed Action Area. Based on the above information, conducted surveys, and lack of preferred habitat within the pipeline corridor, the proposed pipeline construction will have **no effect** on eskimo curlews.

Piping Plover

USFWS designated critical habitat for the piping plover is located in Cameron, Willacy, Kenedy, Kleberg, Nueces, Aransas, Calhoun, Matagorda, and Brazoria Counties, Texas (74 FR 23476

23600 [USFWS 2009]). Critical habitat in Texas is located along coastal beaches and tidal flats. The closest designated critical habitat is located approximately 4.3 miles south of the Dow Freeport Site. Although there is potential for piping plovers to occur in the vicinity of the Action Area, piping plovers are not likely to occur within the Action Area.

Potential Occurrence

TXNDD identified observations in 2008 and 2009 of piping plovers approximately 4 miles south of the Action Area (Figure 9). Due to the proximity of the designated critical habitat and observations, there is potential for piping plovers to occur in the vicinity of the Action Area, but they are not likely to occur within the Action Area due to the absence of habitat.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. Construction runoff from this area will drain into the Flag Lake Drainage Canal, which is a man-made channel. The construction laydown area and the Dow Barge Canal do not possess suitable sandbars or tidal flats for piping plovers.

Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality and therefore will not affect the prey species on which the piping plover feeds.

Piping plover habitat is located approximately 4 miles south of the LHC-9 Action Area in Oyster Creek and continues to follow the coast. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. The Action Area was not identified as a functional route for the migratory pathway of piping plovers. Oyster Creek is highly industrialized and does not have potential habitat for this species. Because there is no potential habitat within or near the LHC-9 portion of the Action Area, no known occurrences within the Action Area, effluent concentrations will be negligible, and anticipated SIL exceedances will be insignificant, the proposed action would have **no effect** on piping plovers.

Potential Pipeline Impacts

All associated pipelines will be constructed within existing, disturbed pipeline corridors. The corridors will be returned to pre-existing conditions following construction. There is no habitat within the corridor for piping plovers nor have there been any current sightings recorded within or near the proposed Action Area. Based on the above information, conducted surveys, and the absence of habitat within the pipeline corridor, the proposed pipeline construction will have **no effect** on piping plovers.

West Indian Manatee

Critical habitat was been designated for the West Indian manatee in 1976 that includes multiple waterways in Florida, including some waters near the Georgia-Florida border (41 FR 41914). There is no designated critical habitat near the Action Area.

Potential Occurrence

Two manatee sightings were verified by the Texas Marine Mammal Stranding Network in 2012. One of the sightings occurred in Corpus Christi Bay in September 2012 approximately 143 miles west of the Action Area. The other sighting occurred in West Galveston Bay in October 2012, approximately 3 miles south of the Action Area (Houston Chronicle 2012). TXNDD identified one observation in 2011 of a West Indian manatee approximately 4 miles southeast of the Action Area in Brazoria County (Figure 9). Some manatees have been known to seek refuge near power plants and other industrial sites that release warm-water effluents (Smithsonian Marine Station at Fort Pierce 2006). Floodgates exclude manatees from the Action Area; however, West Indian manatees may incidentally occur in the vicinity of the project.

Potential LHC-9 Unit Impacts

Similar to the discussion for sea turtles, there would be no direct impacts to manatees as a result of the project; there would be no construction within suitable aquatic manatee habitat.

The construction laydown area is currently being developed in association with other Dow projects. Construction runoff from this area will drain into the Flag Lake Drainage Canal, which is a man-made channel. The construction laydown area does not possess suitable habitat for West Indian Manatees.

Based on the biomonitoring results, food sources are not expected to be impacted by the negligible concentration levels in effluent from the proposed project. Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality and therefore will not affect the manatee. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant.

Because this species is unlikely to occur within the Action Area, food sources will not be significantly impacted, discharges to suitable habitat will remain unchanged, and anticipated SIL exceedances will be insignificant, the proposed action will have **no effect** on West Indian manatees.

Potential Pipeline Impacts

All associated pipelines will be constructed within existing, disturbed pipeline corridors. The corridors will be returned to pre-existing conditions following construction. HDD or other trenchless methods will be used to install pipelines across all major water body crossings to minimize environmental impact and disturbance. There are no water body crossings along the proposed pipeline corridor that are known to support manatee populations. Because manatees are unlikely to occur within the Action Area, and because impacts to major water bodies will be avoided through the use of HDD or other trenchless construction methods, the proposed pipeline construction will have **no effect** on West Indian manatees.

Jaguarundi

USFWS (2012d) has not identified critical habitat for the jaguarundi.

Potential Occurrence

The TXNDD report identified two occurrences of jaguarundi near the proposed SOW #1 pipeline route. The occurrences in 1991 were located in Brazoria County near Christmas Bay. The buffer zone around these sightings encompasses approximately 7.3 miles of the proposed SOW #1 pipeline corridor. Jaguarundis have not been found within the proposed pipeline corridors in over 20 years. They have only been found in Cameron County and Willacy County in South Texas (TPWD 2012f).

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for jaguarundi.

The jaguarundi is unlikely to utilize the LHC-9 Action Area in Oyster Creek given the lack of suitable ground cover and habitat in the industrial setting. All SIL exceedances will be primarily located within the Dow Freeport Site and are expected to be insignificant. Resulting air quality impacts are not anticipated to impact individuals utilizing the surrounding areas. Given the lack of habitat within the LHC-9 portion of the Action Area, the lack of recent sightings within or near the Action Area, and anticipated SIL exceedances will be insignificant; the proposed LHC-9 installation would have **no effect** on jaguarundi.

Potential Pipeline Impacts

The incidental occurrence identified by the TXNDD was rare. According to Ernesto Reyes from USFWS (personal communication February 13, 2013), there have been no confirmed sightings of jaguarundi in Brazoria, Galveston, Harris, or Chambers Counties. The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. Due to this consistent disturbance, it is unlikely that a jaguarundi would utilize the pipeline easement rather than the surrounding cover outside of the corridor. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Due to the lack of occurrence, lack of preferred habitat, and unlikelihood of utilization, the proposed pipeline construction would have **no effect** on jaguarundi.

Ocelot

USFWS (2012d) has not identified critical habitat for the ocelot.

Potential Occurrence

Two isolated populations are known from extreme southeast Texas, south of the Action Area. TXNDD did not identify ocelots in the vicinity of the Action Area (~13 miles). Ernesto Reyes from USFWS (personal communication February 13, 2013) concurs that ocelots are not likely to occur in Brazoria, Galveston, Harris, and Chambers Counties.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area does not possess suitable habitat for ocelots.

The LHC-9 Unit will be located in the Oyster Creek area, which is highly industrialized and contains no potential ocelot habitat. There is no potential habitat within or near the Action Area. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Based on the above information, lack of occurrence, lack of habitat, unlikelihood of utilization, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on ocelots.

Potential Pipeline Impacts

The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. Due to this consistent disturbance, it is unlikely that ocelots would utilize the pipeline easement rather than the surrounding cover outside of the corridor. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Due to the lack of occurrence, lack of preferred habitat, and unlikelihood of utilization, the proposed pipeline construction would have **no effect** on ocelots.

Red Wolf

USFWS (2012d) has not identified critical habitat for the red wolf.

Potential Occurrence

The red wolf is federally listed as endangered and has been extirpated from the historical range in the south central Texas area extending to Florida, and north to south central Maine. Red wolves are not likely to be found within the Action Area due to their extirpation. The TXNDD does not identify any observations of red wolves in the vicinity (~13 miles) of the Action Area. The Action Area and surrounding areas have been developed and disturbed; rendering the Dow Freeport Site and the existing pipeline corridor undesirable habitat for this species.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for red wolves.

The LHC-9 Unit will be located in the Oyster Creek area, which is highly industrialized. There is no potential red wolf habitat within or near the Action Area. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Based on the above information, lack of occurrence, lack of habitat, unlikelihood of utilization, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on red wolves.

Potential Pipeline Impacts

The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. Due to this consistent disturbance, it is unlikely that red wolves would utilize the pipeline easement rather than the surrounding cover outside of the corridor. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Because this species has been extirpated, there is lack of preferred habitat, and significant unlikelihood of utilization, the proposed pipeline construction would have **no effect** on red wolves.

Louisiana Black Bear

USFWS has designated 1,195,821 acres of Louisiana black bear critical habitat in Avoyelles, East Carroll, Catahoula, Concordia, Franklin, Iberia, Iberville, Madison, Pointe Coupee, Richland, St. Martin, St. Mary, Tensas, West Carroll, and West Feliciana Parishes, Louisiana (74 FR 10350 10409). There is no designated critical habitat located near the Action Area.

Potential Occurrence

The Action Area is located in highly industrialized areas that would not support habitat for the Louisiana black bear. The TXNDD does not identify any observations of Louisiana black bears in the vicinity (~13 miles) of the Action Area and there have been no recent sightings within the counties involved with the proposed project. TPWD (2012d) has identified one established breeding population in the Big Bend area approximately 500 miles from the Action Area. The proposed project area is not on or near suitable habitat for this species. It would be highly unlikely for Louisiana black bears to occur within or near the Action Area.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for Louisiana black bears.

Louisiana Black Bear populations in Texas are not located within or near the Action Area. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. LHC-9 will be located within a highly industrialized area with small pockets of maintained grass. There is no preferred habitat located within the Action Area or within a reasonable close distance. Because this species has been extirpated from the area, there is no potential habitat in the Action Area, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on Louisiana black bears.

Potential Pipeline Impacts

The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. Due to this consistent disturbance, it is unlikely that Louisiana black bears would utilize the pipeline easement rather than the surrounding cover outside of the corridor. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Because this species has been extirpated from the area, there is no preferred habitat in the Action Area, and the pipeline corridors will be returned to existing conditions, the proposed pipeline construction would have **no effect** on Louisiana black bears.

Smalltooth Sawfish

Smalltooth sawfish critical habitat has been designated in the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/ Everglades Unit in Florida (74 FR 45353). There is no critical habitat located near the Action Area.

Potential Occurrence

The smalltooth sawfish has been extirpated from large areas of its range. The TXNDD does not identify any observations of smalltooth sawfish in the vicinity (~13 miles) of the Action Area. Smalltooth sawfish inhabit lagoons, bays, mangroves, and shallow reefs; The Action Area does support these preferred habitat types. It would be highly unlikely for smalltooth sawfish populations to occur within or near the Action Area.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. Construction runoff from this area will drain into the Flag Lake Drainage Canal, which is a man-made channel. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for smalltooth sawfish.

Potential pollutants from atmospheric deposition and wastewater effluent from the operations of the LHC-9 Unit will not be at concentrations high enough to impact downstream water quality and therefore will not affect the smalltooth sawfish.

The smalltooth sawfish is extirpated from a large portion of its natural habitat. The LHC-9 Action Area does not encompass critical habitat or possible breeding grounds for the species to utilize. Based on available information, it is highly unlikely that the species utilizes the LHC-9 Action Area All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Based on the lack of occurrence within or near the Action Area, lack of preferred habitat, negligible effluent concentrations, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on smalltooth sawfish populations.

Potential Pipeline Impacts

The smalltooth sawfish is unlikely to occur within the Action Area because no nurseries have been identified within the Action Area vicinity. Individuals utilizing these rookeries may be subject to impacts during pipeline construction due to sediment disruption. HDD or other similar techniques will be utilized to minimize these impacts and disturbed areas will be returned to pre-existing conditions for pipeline operations. Construction and operation of the proposed pipeline will have **no effect** on the smalltooth sawfish.

Red-cockaded Woodpecker

USFWS (2012d) has not identified critical habitat for the red-cockaded woodpecker.

Potential Occurrence

There are approximately 6,000 groups of red-cockaded woodpecker remaining in the wild. They can be found in eleven states extending from Florida to Virginia and west to southeast Oklahoma and eastern Texas (USFWS 2014b). According to TXNDD, no sightings have occurred within an approximate 11 mile radius of the Action Area. Red-cockaded woodpeckers prefer open, mature, old-growth pine forests which occur in East Texas. The Action Area and vicinity has been developed; no old-growth forests are located within the area. The Action Area and surrounding areas are not suitable habitat for the red-cockaded woodpecker.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for red-cockaded woodpeckers.

The LHC-9 Unit will be located in the Oyster Creek property, which is highly industrialized. There is no potential habitat within or near the Action Area. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Based on the above information, lack of occurrence, lack of habitat, unlikelihood of utilization, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on red-cockaded woodpeckers.

Pipeline Impacts

The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. No old-growth forests are present within or adjacent to the intended right-of-way for the pipeline construction. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Because of the lack of preferred habitat, and significant unlikelihood of utilization, the proposed pipeline construction would have **no effect** on red-cockaded woodpecker.

Houston Toad

Houston toads have been extirpated from majority of their historical range since the 1960s and are only known to exist within their critical habitat. Portions of Bastrop and Burleson Counties, Texas were designated as critical habitat for the Houston toad in 1978 (42 FR 27009 27011). There is no designated critical habitat is located within or near the Action Area.

Potential Occurrence

There have been no reported observations of Houston toads in the vicinity of the Action Area since 1976. The 1976 observation was approximately 11 miles southwest of the proposed pipeline corridor. Houston toads prefer sandy forests of blackjack oak, yaupon, and little bluestem with temporary pools required for breeding, which are not found within the Action Area. Houston toads are not likely to occur within or near the Action Area.

Potential LHC-9 Unit Impacts

The construction laydown area is currently being developed in association with other Dow projects. The construction laydown area and the Dow Barge Canal do not possess suitable habitat for Houston toads.

The LHC-9 Unit will be located in the Oyster Creek property, which is highly industrialized. There is no potential habitat within or near the Action Area. Houston toads are sensitive to air emissions because they respire through their skin. All SIL exceedances associated with the construction and operation of LHC-9 will be primarily located within the Dow Freeport Site and are expected to be insignificant. Based on the above information, lack of occurrence, lack of habitat within or near the Action Area, and anticipated SIL exceedances will be insignificant, the proposed LHC-9 installation would have **no effect** on Houston toads.

Potential Pipeline Impacts

The pipeline corridor is primarily maintained grasslands that are periodically bush hogged by various pipeline companies. The pipeline construction will be temporary. The easement will be restored to pre-existing contours and will continue to be maintained. Due to the lack of habitat within or near the Action Area, history of extirpation, and continued maintenance of the pipeline corridor, the proposed pipeline construction would have **no effect** on the Houston toad.

8.0 Conclusions

This section is a summary of URS' recommended determination of effect for all federally-protected species, a description of any interdependent and interrelated actions, and a description of any anticipated cumulative effects resulting from the proposed project.

Direct permanent impacts to protected species from construction will not occur; there is no suitable habitat in the area proposed for new construction of the ethylene cracking furnace. Indirect effects resulting from air and water emissions are possible but unlikely to occur; protected species and their habitats will not likely be significantly impacted.

8.1 Determination of Effect

The recommended determinations of effect for all federally-protected species with the potential to occur within habitat located within the Action Area are summarized in Table 17 below.

Table 17 – Determination of Effect Summary

Protected Species	Classification- Reason for Evaluation	Determination of Effect
USFWS/NOAA List of T&E Species		
Texas Prairie Dawn[3]	Listed by USFWS as Endangered.	No effect
Green Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Threatened.	No effect
Atlantic Hawksbill Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.	No effect
Kemp's Ridley Sea Turtle[1,2,4]	Listed by USFWS and NMFS as Endangered.	No effect
Leatherback Sea Turtle[1,2,4]	Listed by USFWS and NMFs as Endangered.	No effect
Loggerhead Sea Turtle[1,2,4]	Listed by USFWS and NMFs as Threatened.	No effect
Blue Whale	Listed by NOAA as Endangered	No effect
Finback Whale	Listed by NOAA as Endangered	No effect
Humpback Whale	Listed by NOAA as Endangered	No effect
Sei Whale	Listed by NOAA as Endangered	No effect
Sperm Whale	Listed by NOAA as Endangered	No effect
Whooping Crane[1]	Listed by USFWS as Endangered.	May affect, but not likely to adversely affect
Attwater's Greater Prairie Chicken[2]	Listed by USFWS as Endangered.	No effect
Eskimo Curlew[1,2]	Listed by USFWS as Endangered.	No effect
Piping Plover[1,2,4]	Listed by USFWS as Threatened.	No effect

Protected Species	Classification- Reason for Evaluation	Determination of Effect
West Indian Manatee[1,2,3,4]	Listed by USFWS as Endangered.	No effect
State-recognized List of Federal T&E Species		
Jaguarundi[1]	Listed by the TPWD as Endangered.	No effect
Ocelot[1]	Listed by the TPWD as Endangered.	No effect
Red Wolf[1,2,3,4]	Listed by the TPWD as Endangered.	No effect
Louisiana Black Bear[1,2,3,4]	Listed by the TPWD as Threatened.	No effect
Smalltooth Sawfish[1,2,3,4]	Listed by the TPWD as Endangered.	No effect
Red-cockaded Woodpecker[3]	Listed by the TPWD as Endangered.	No effect
Houston Toad[3]	Listed by the TPWD as Endangered.	No effect

Note: 1. Brazoria County 2. Galveston County 3. Harris County 4. Chambers County

8.2 Interdependent and Interrelated Actions

The proposed project is limited to the construction and operation activities of the construction of the LHC-9 as outlined in Section 1.1. No additional interdependent or interrelated actions are proposed at this time.

8.3 Cumulative Effects

The proposed LHC-9 site is located within an industrial area and proposed pipeline locations will be restricted to the existing right-of-way. Multiple industrial facilities have historically been and continue to be operational within Freeport and Brazoria County, Texas. The area is likely to experience additional industrial development over time. Potential pollutants from deposition and discharge effluent from the proposed project have not been found at levels great enough to impact downstream water quality independently. As such, the project will contribute to cumulative impacts from industrial use in the area.

As with the proposed installation project, any new proposed developments may have the potential to impact federally-protected species. However, URS is not aware of any specific projects planned for this area at this time. No additional actions with the potential to impact federally-protected species are planned for the ethylene manufacturing facility installation at this time.

8.4 Conservation Measures

The construction of the proposed installation project will likely have no direct or indirect impact on federally-protected species habitat.

Dow plans to utilize the BACT to control emissions and thus minimize impacts to the surrounding environment to the maximum extent practicable. The proposed emissions of each pollutant subject to PSD review are consistent with both the TCEQ BACT guidance and the most stringent limit in the RBLC; and, are considered to be the top level of control available for the new and modified facilities.

Wastewater discharges will be subject to TPDES permit limitations, which have been designed to be protective of aquatic and marine species.

The project has been designed and would be constructed according to the USFWS Memorandum Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers. The proposed tower will be at or below the height of existing towers at the Dow Freeport Site and will not require any support wires. Red strobe lights will be used to mark taller cranes if permitted by the FAA. And security lighting will be restricted to the boundaries of the site and pointed down.

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10.0 References

ABC News 13. 2012. Rare manatee spotted near Corpus Christi. http://abclocal.go.com/ktrk/story?section=news/state&id=8819046

Audubon. 2013. Bird Profiles. http://birds.audubon.org/species

Benchmark Ecological Services, Inc. (Benchmark). 2012a. Winfree Pump Station Threatened and Endangered Species Evaluation: Chambers County, Texas. August 1, 2012.

Benchmark. 2012b. Gulfstream MSP Pipeline Project: Threatened and Endangered Species Evaluation for Brazoria and Galveston Counties, Texas. September 5, 2012.

Benchmark. 2012c.Gulfstream MSP Project Wetland Determination Report: Brazoria County and Galveston County, Texas. September 17, 2012.

Benchmark. 2013a. LHC-9 #1 12’’ Ethane Pipeline Project Threatened and Endangered Species Evaluation: Galveston, Harris and Chambers Counties, Texas. January 15, 2013.

Benchmark. 2013b. LHC-9 Project Freeport Area Facilities Threatened and Endangered Species Evaluation: Brazoria County, Texas. January 15, 2013.

Benchmark. 2013c. LHC-9 #19 Project Cedar Bayou Pump Station Threatened and Endangered Species Evaluation: Chambers County, Texas. February 11, 2013.

Chau, K.W., 2000. Transverse Mixing Coefficient Measurements in an Open Rectangular Channel. Advances in Environmental Research 4 (4). Elsevier Science.

*Chow, V. T., PhD. 1959. Open Channel Hydraulics. McGraw-Hill Company. New York. (interactive website; results not available)

Cornell Lab of Ornithology. 2013. Whooping Cranes: Current Range of the Whooping Crane. http://www.birds.cornell.edu/AllAboutBirds/conservation/success/whooping_crane/document_view

Davis, W.B. and D.J. Schmidly. 1997. The Mammals of Texas - Online Edition. http://www.nsrl.ttu.edu/tmot1/Default.htm. Accessed February 26, 2014.

Defenders of Wildlife. 2014. Basic Facts about Ocelots. http://www.defenders.org/ocelot/basic-facts. Accessed February 27, 2014.

Department of Energy and Environmental Protection (DEEP). 2012. Piping Plover: Charadrius melodus. http://www.ct.gov/dep/cwp/view.asp?A=2723&Q=326062

Dow Chemical Company, L.P. 2013. History of Texas Ops. http://www.dow.com/texas/freeport/about/history.htm

Dwyer, F.J., Hardesty, D.K., Henke, C.E., Ingersoll, C.G., Whites, D.W., Augspurger, T., Canfield, T.J., Mount, D.R. and Mayer, F.L. 2004. Assessing contaminant sensitivity of endangered and threatened aquatic species. Part III. Effluent toxicity tests. Archives of Environmental Contamination and Toxicology, 48(2):174-183.

Federal Emergency Management Agency. 2012. Map Service Center – Flood Insurance Rate Maps.

http://msc.fema.gov/webapp/wcs/stores/servlet/FemaWelcomeView?storeId=10001&catalogId=10001&langId=-1

*Fisher, H.B., E.J. List, R.C.Y. Koh, J. Imberger, N.H. Brooks. 1979. Mixing in Inland and Coastal Waters. Academic Press, New York. (hardcopy book; not available electronically)

Fry, J., Xian, G., Jin, S., Dewitz, J., Homer, C., Yang, L., Barnes, C., Herold, N., and Wickham, J., 2011. Completion of the 2006 National Land Cover Database for the Conterminous United States, PE&RS, Vol. 77(9):858-864.

Galveston Bay Estuary Program. 2007. Reptiles. http://www.gbep.state.tx.us/about-galveston-bay/reptiles.asp

Haubold, E.M., C. Deutsch, and C. Fonnesbeck. 2006. Final Biological Status Review of the Florida Manatee (Trichechus manatus latirostris). Status Assessment by the 2005-2006 Florida Manatee Biological Review Panel. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, FL. 133 pp.

Houston Chronicle. 2012. Rare manatee sighting in Galveston. http://www.chron.com/news/houston-texas/article/Rare-manatee-sighting-in-Galveston-3924028.php. October 15, 2012.

*Lakes Environmental Software. 2008. ISC-AEROMOD View: Texas-TX. http://www.webgis.com/terr_pages/terr_dem75_tx.html. (interactive website; results not available)

Mayer, F.L., Buckler, D.R., Dwyer, F.J., Ellersieck, M.R., Sappington, L.C., Besser, J.M., and Bridges, C.M. 2008. Endangered aquatic vertebrates: Comparative and probabilistic-based toxicology. EPA Document No. 600R08045. (hardcopy book; not available electronically)

Missouri Botanical Garden. 2013. Sulfur Dioxide Damage to Plants. http://www.missouribotanicalgarden.org/gardens-gardening/your-garden/help-for-the-home-gardener/advice-tips-resources/pests-and-problems/environmental/sulfur-dioxide.aspx

*Multi-Resolution Land Characteristics Consortium. 2013. National Land Cover Database. http://www.mrlc.gov/ (interactive website; results not available)

National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS). 1991. Recovery Plan for U.S. Population of Atlantic Green Turtle. Washington, D.C.: National Marine Fisheries Service.

NMFS and USFWS. 1992. Recovery Plan for Leatherback Turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. Washington, D.C.: National Marine Fisheries Service.

NMFS and USFWS. 1993. Recovery Plan for Hawksbill Turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico. St. Petersburg, Florida: National Marine Fisheries Service.

NMFS and USFWS. 2008. Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (Caretta caretta), Second Revision. Silver Spring, Maryland: National Marine Fisheries Service.

NMFS and USFWS, and SEMARNAT. 2011. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (Lepidochelys kempii), Second Revision. Silver Spring, Maryland: National Marine Fisheries Service. Approved September 22, 2011

National Oceanic and Atmospheric Administration Fisheries (NOAA). 1998. Designated Critical Habitat for Green and Hawksbill Sea Turtles. Federal Register. Volume 63: Docket No. 971124276. Identification No. 110797B. September 2, 1998. http://ecos.fws.gov/docs/federal_register/fr3295.pdf

NOAA. 2013a. Southeast Fisheries Science Center. Sea Turtle Stranding and Salvage Network Reports. http://www.sefsc.noaa.gov/species/turtles/strandings.htm. Results for June 13, 2013.

NOAA. 2013b. Southeast Region. Endangered and Threatened Species and Critical Habitats under the Jurisdiction of the NOAA Fisheries Service – Texas. http://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/Documents/texas.pdf

NOAA. 2014. Cetaceans: Whales, Dolphins, and Porpoises. http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/

NOAA – Office of Protected Resources. 2013. Smalltooth Sawfish (Pristis pectinata). http://www.nmfs.noaa.gov/pr/species/fish/smalltoothsawfish.htm.

Oklahoma Department of Environmental Protection. 2011. AIR: Sulfur Dioxide. November 2011. https://www.deq.state.ok.us/factsheets/air/so2.pdf

*Poole, J. M., Carr, W. R., Price, D. M., & Singhurst, J. R. 2007. Rare Plants of Texas. College Station, Texas: Texas A&M University Press. (hardcopy book; not available electronically)

Pulich, W. M. and W. A. White. 1990. Decline of submerged vegetation in the Galveston Bay system: chronology and relationship to physical processes. Journal of Coastal Research 7: 1125-1138.

Pulich, W. M., Jr. 1996. Map of Galveston Bay submerged aquatic vegetation. Compilation of a digital data layer composed of wetland habitats and coastal land cover data: final report to Natural Resources Inventory Program. Austin, Texas, Texas Parks and Wildlife Department.

*Roberts, D. L., Elphick, C. S., Reed, J. M. 2010. Identifying anomalous reports of putatively extinct species and why it matters. Conservation Biology 24(1): 189-196. (hardcopy journal; abstract only available electronically)

Sappington L.C., Mayer F.L., Dwyer F.J., Buckler D.R., Jones J.R., Ellersieck M.R. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environmental Toxicology and Chemistry. 20:2869-76.

Smithsonian Marine Station at Fort Pierce. 2006. Indian River Lagoon Species Inventory-Species Profile: Florida manatee. http://www.sms.si.edu/irlspec/. Updated June 12, 2006.

Texas Commission on Environmental Quality (TCEQ). 2012. 2012 Texas Integrated Report - Texas 303(d) List (Category 5). http://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/12twqi/2012_303d.pdf

TPWD. 2012a. Annotated County Lists of Rare Species – Chambers County. Last Revision: 6/1/2012 3:34:00 PM

TPWD. 2012b. Annotated County Lists of Rare Species – Galveston. Last Revision: 8/7/2012 4:08:00 PM

TPWD. 2012c. Annotated County Lists of Rare Species – Harris County. Last Revision: 8/7/2012 4:09:00 PM

TPWD. 2012d. Black bear activity on the upswing in the Hill Country and South Texas. http://www.tpwd.state.tx.us/newsmedia/releases/?req=20121127c. Released November 27, 2012.

TPWD. 2012e. Ecologically Significant Stream Segments. http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/

TPWD. 2012f. Jaguarundi. http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_bk_w7000_0013_jaguarundi.pdf. Accessed November 20, 2012.

TPWD. 2013a. Water Planning Data for Region H. http://www.tpwd.state.tx.us/landwater/water/environconcerns/water_quality/sigsegs/regionh.phtml. Accessed August 22, 2013.

TPWD. 2014. Annotated County Lists of Rare Species – Brazoria County. Last Revision: 1/22/2014 9:38:00 AM

United States Army Corps of Engineers (USACE). 2012. Final Freeport Harbor, Texas Channel Improvement Project Feasibility Report. Volume 1. http://www.swg.usace.army.mil/Portals/26/docs/Planning/FHCIP%20Final%20Feasibility%20Report%20Vol%20I%20August%202012.pdf

USACE. 2013. Sea Turtle Data Warehouse. http://el.erdc.usace.army.mil/seaturtles/. Updated February 20, 2013.

United States Department of Agriculture – Natural Resources Conservations Service (USDA-NRCS). 2004. Web Soil Survey. Spatial Data Version 1, Oct 20, 2004; Tabular Data Version 8, Sept 20, 2012. http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

United States Department of Agriculture (USDA). 2006. Major Land Resource Areas. http://soils.usda.gov/survey/geography/mlra/

United States Department of Agriculture (USDA) Soil Conservation Service (SCS), Brazoria County Commissioners Court, and Texas Agricultural Experiment Station. 1981. Soil Survey of Brazoria County, Texas. Issued June 1981

United States Department of Agriculture (USDA) Soil Conservation Service (SCS) and Texas Agricultural Experiment Station. 1976. Soil Survey of Chambers County, Texas. Issued May 1976.

United States Department of Agriculture (USDA) Soil Conservation Service (SCS), Texas Agricultural Experiment Station, and Harris County Flood Control District. 1976. Soil Survey of Harris County, Texas. Issued August 1976.

United States Department of Agriculture (USDA) Soil Conservation Service (SCS), Texas Agricultural Experiment Station, and Texas State Soil and Water Conservation Board. 1988. Soil Survey of Galveston County, Texas. Issued February 1988.

United States Environmental Protection Agency (U.S. EPA). 1996. Air quality criteria for particulate matter. Research Triangle Park, NC: National Center for Environmental Assessment-RTP Office; report nos. EPA/600/P-95/001aF-cF. 3v.

U.S. EPA. 1999. Ecological condition of estuaries in the Gulf of Mexico. EPA 620-R-98-004. U.S. Environmental Protection Agency, Office of Research and Development, National Health and Environmental Effects Research Laboratory, Gulf Ecology Division, Gulf Breeze, Florida. 80 pp.

U.S. EPA. 2004. Air Quality Criteria for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA 600/P-99/002aF-bF.

U.S. EPA. 2005. Review of the National Ambient Air Quality Standards for Particulate Matter, Policy Assessment of Scientific and Technical Information, OAQPS Staff paper. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards. EPA-452/R-05-005. http://www.epa.gov/ttn/naaqs/standards/pm/data/pmstaffpaper_20050630.pdf

U.S. EPA. 2007. Fact Sheet – Prevention of Significant Deterioration for Fine Particle Pollution – Increments, Significant Impact Levels, and Significant Monitoring Concentration. http://www.epa.gov/NSR/fs20070912.html

U.S. EPA. 2012a. Hydrologic Unit Codes. http://yosemite.epa.gov/water/adopt.nsf/by+state?SearchView&Query=FIELD+state+contains+Texas

U.S. EPA. 2012b. Carbon Monoxide. http://www.epa.gov/airquality/carbonmonoxide/

U.S. EPA. 2013. Surf Your Watershed. http://cfpub.epa.gov/surf/locate/index.cfm

United States Fish and Wildlife Service (USFWS). 1989. Hymenoxys texana Recovery Plan. Albuquerque, New Mexico: U.S. Fish and Wildlife Service.

USFWS. 2008. Bears Den in Wetland Reserve Program Lands. http://www.fws.gov/southeast/es/BearsDenWetlandReserveProgramLands.html

USFWS. 2009. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Wintering Population of Piping Plover (Charadrius melodus) in Texas. http://www.gpo.gov/fdsys/pkg/FR-2009-05-19/pdf/E9-11245.pdf#page=1

USFWS. 2012a. National Wetlands Inventory. http://www.fws.gov/wetlands/Data/mapper.html

USFWS. 2012b. Leatherback Sea Turtle (Dermochelys coriacea). http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/leatherback-sea-turtle.htm

USFWS. 2012f. All about Piping Plovers. http://www.fws.gov/plover/facts.html

USFWS. 2012g. Ocelot (Leopardus pardalis). http://www.fws.gov/southwest/es/arizona/Documents/Redbook/Ocelot%20RB.pdf

USFWS. 2012h. Western Hemisphere Shorebird Reserves. http://www.fws.gov/refuges/whm/WHSRnetwork.html

USFWS. 2013a. Aransas National Wildlife Refuge Whooping Crane Updates. http://www.fws.gov/nwrs/threecolumnPB.aspx?pageid=2147501472.

USFWS. 2013b. Critical Habitat Portal. http://criticalhabitat.fws.gov/crithab/

USFWS. 2014a. List of Species by County for Texas – Brazoria, Chambers, Galveston, and Harris Counties. http://www.fws.gov/southwest/es/ES_ListSpecies.cfm

USFWS. 2014b. Species-profiles – whooping crane, Louisiana black bear, Houston toad, red-cockaded woodpecker, loggerhead sea turtle. http://www.fws.gov/species/. Accessed February 27, 2014.

*United States Geological Survey (USGS). 2012. Mineral Resources On-Line Spatial Data. http://mrdata.usgs.gov/geology/state/state.php?state=TX. (interactive website; results not available)

Weather Channel. 2014. Averages and Records for Brazoria, TX, 77422. http://www.weather.com/weather/wxclimatology/daily/77422

*Whitey, K.T. 1978. The physical characteristics of sulfur aerosols. Atmospheric Environment. 12: 135-159 (hardcopy journal; abstract only available electronically)

World Media Group, LLC. 2013. Harris County Weather. Electronic document. http://www.usa.com/harris-county-tx-weather.htmABC News 13. 2012. Rare manatee spotted near Corpus Christi. http://abclocal.go.com/ktrk/story?section=news/state&id=8819046

URS

Figures

URS

Legend

Proposed Project Area

Dow Freeport Site

N

0 100 200 Miles

Vicinity Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
AM	3/20/2013	41569339	1 of 10

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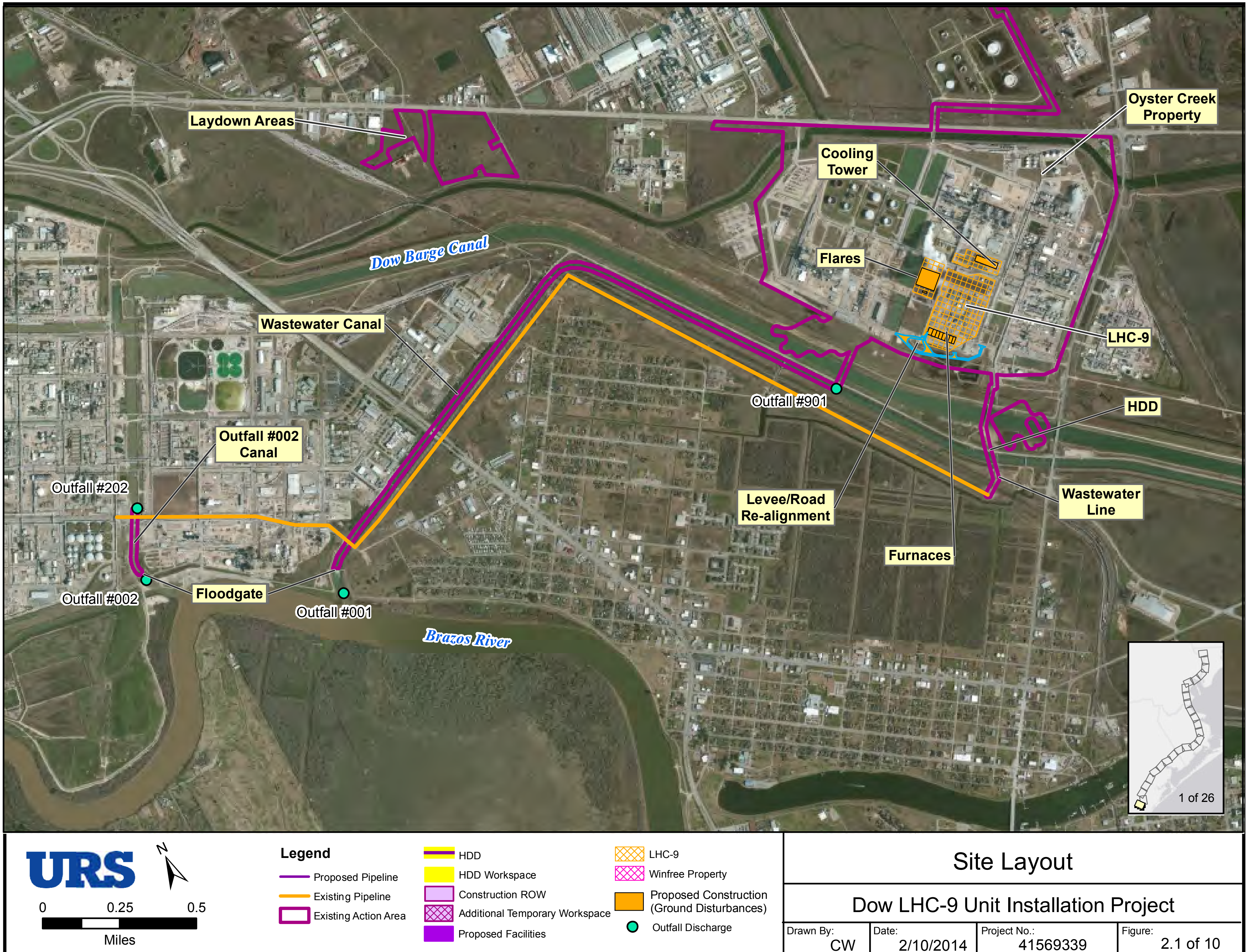

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.1 of 10

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.2 of 10

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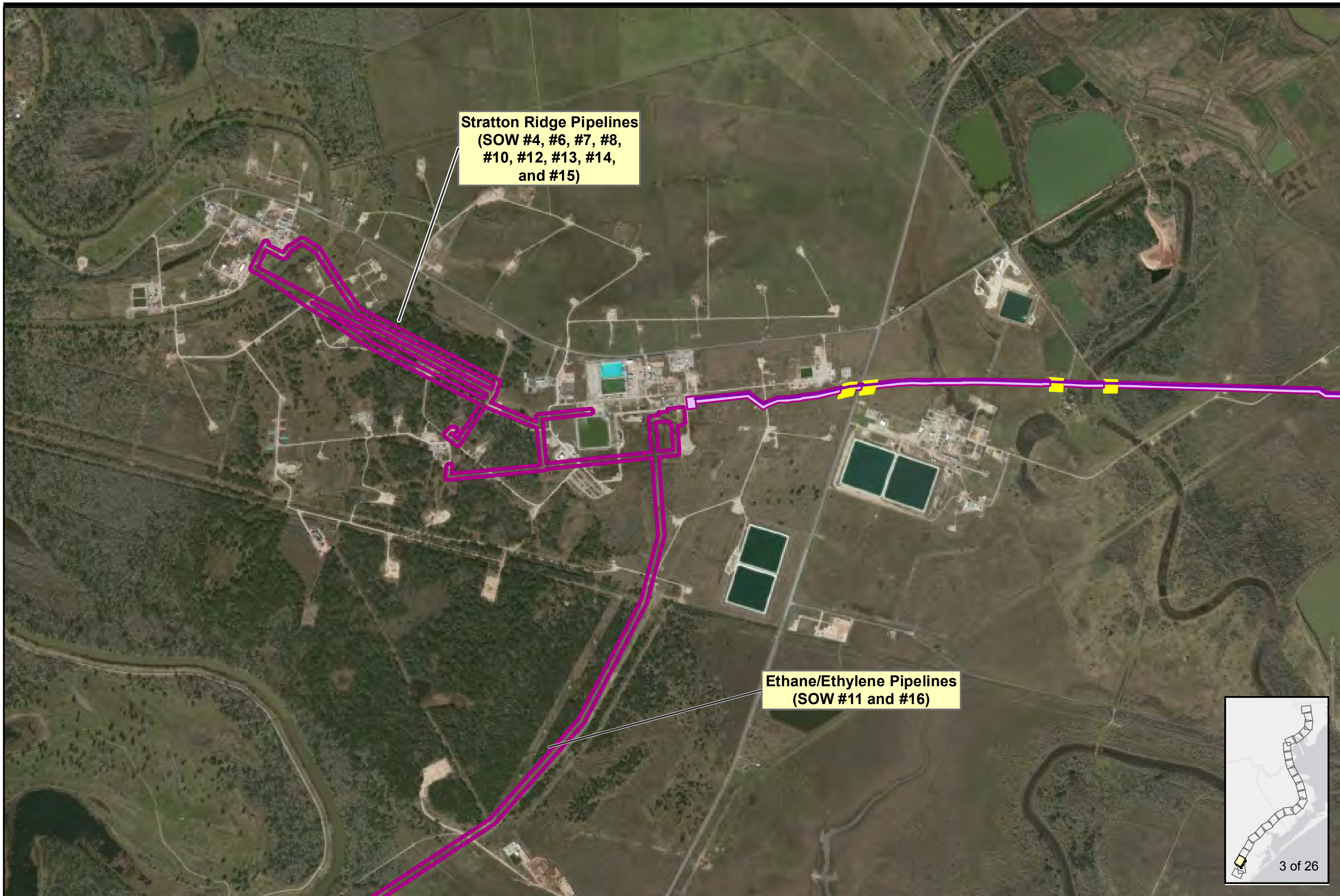

URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.3 of 10

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.4 of 10

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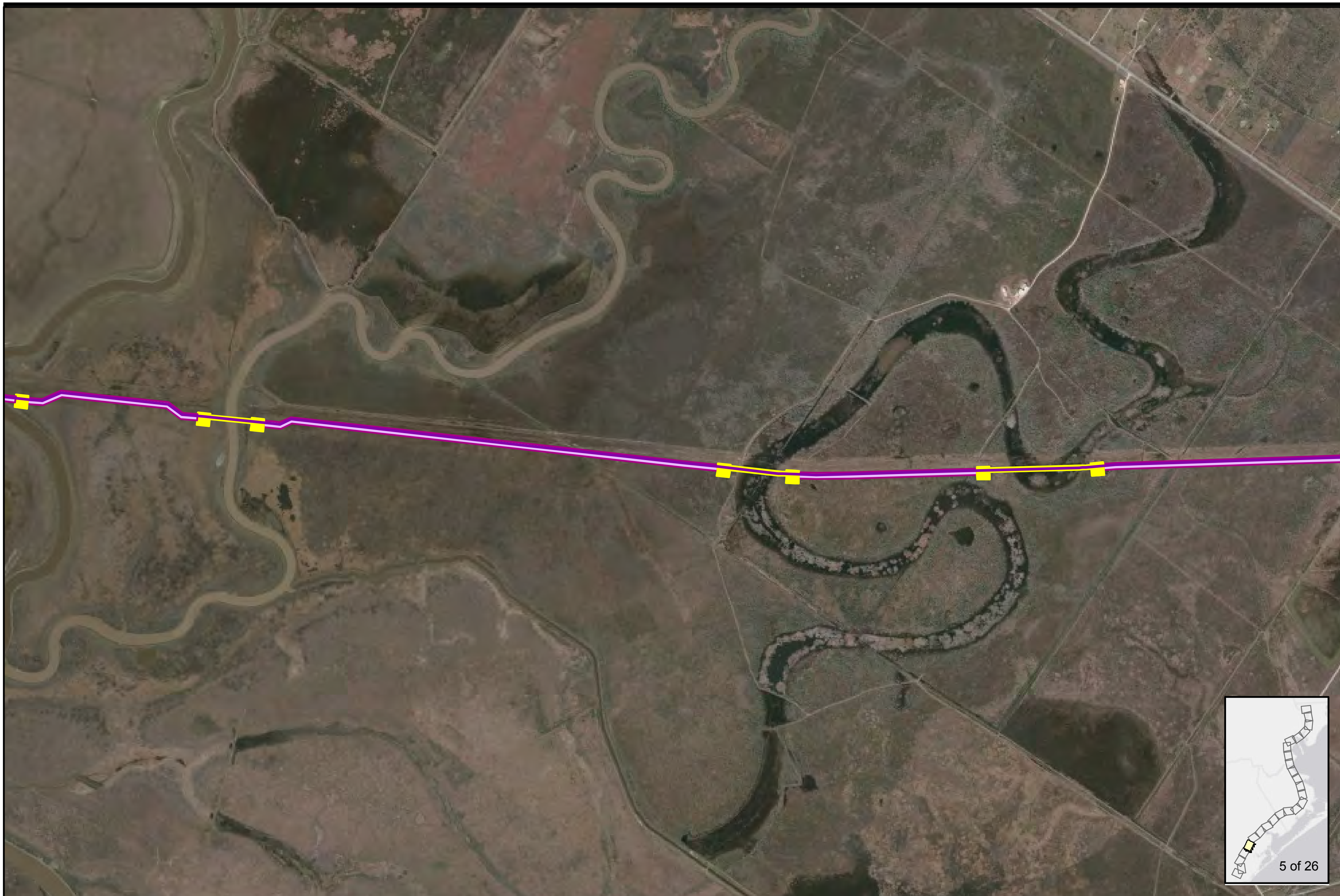

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.5 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.6 of 10

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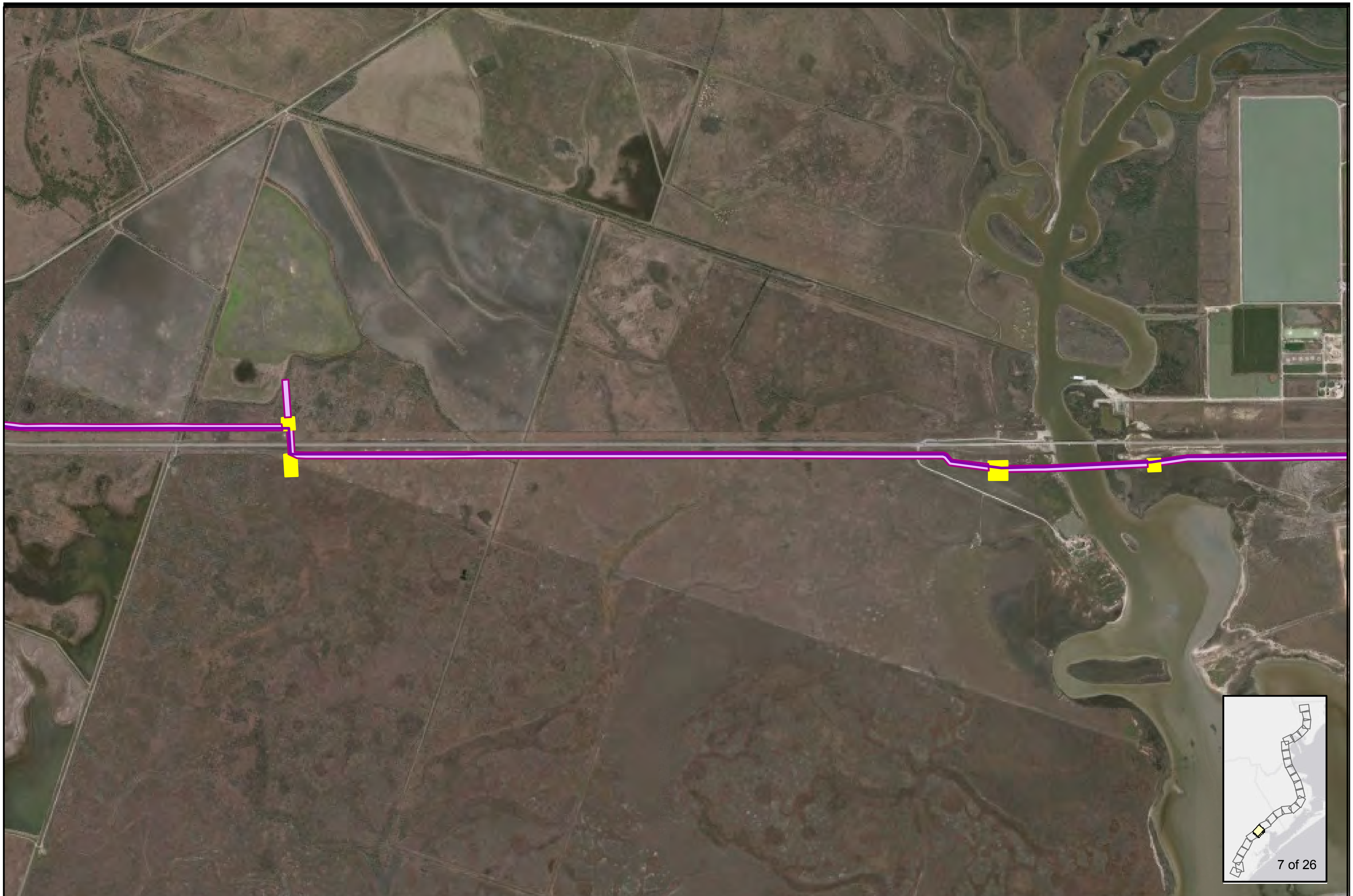


URS

0 0.25 0.5
Miles

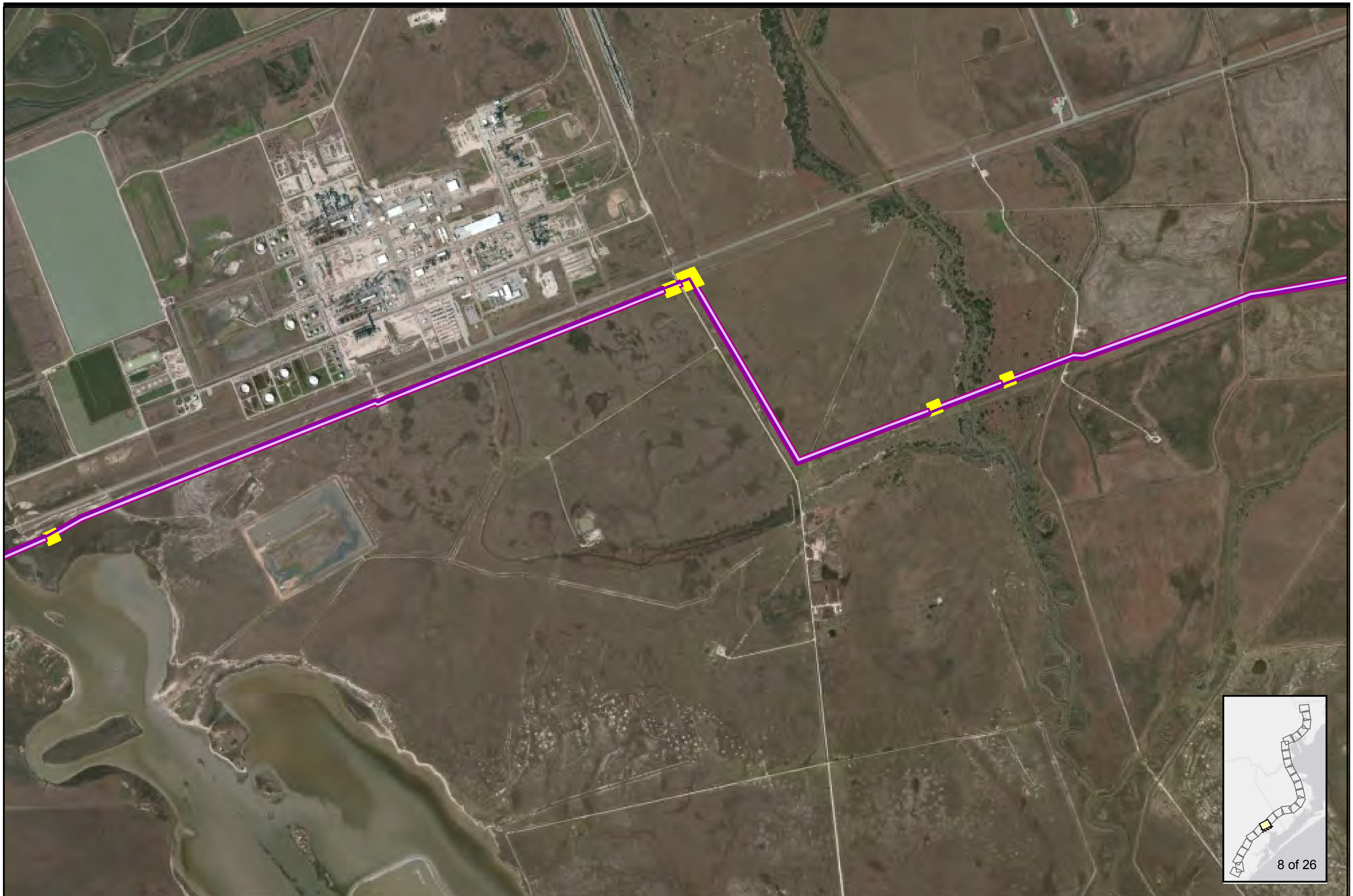
Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.7 of 10



URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.8 of 10

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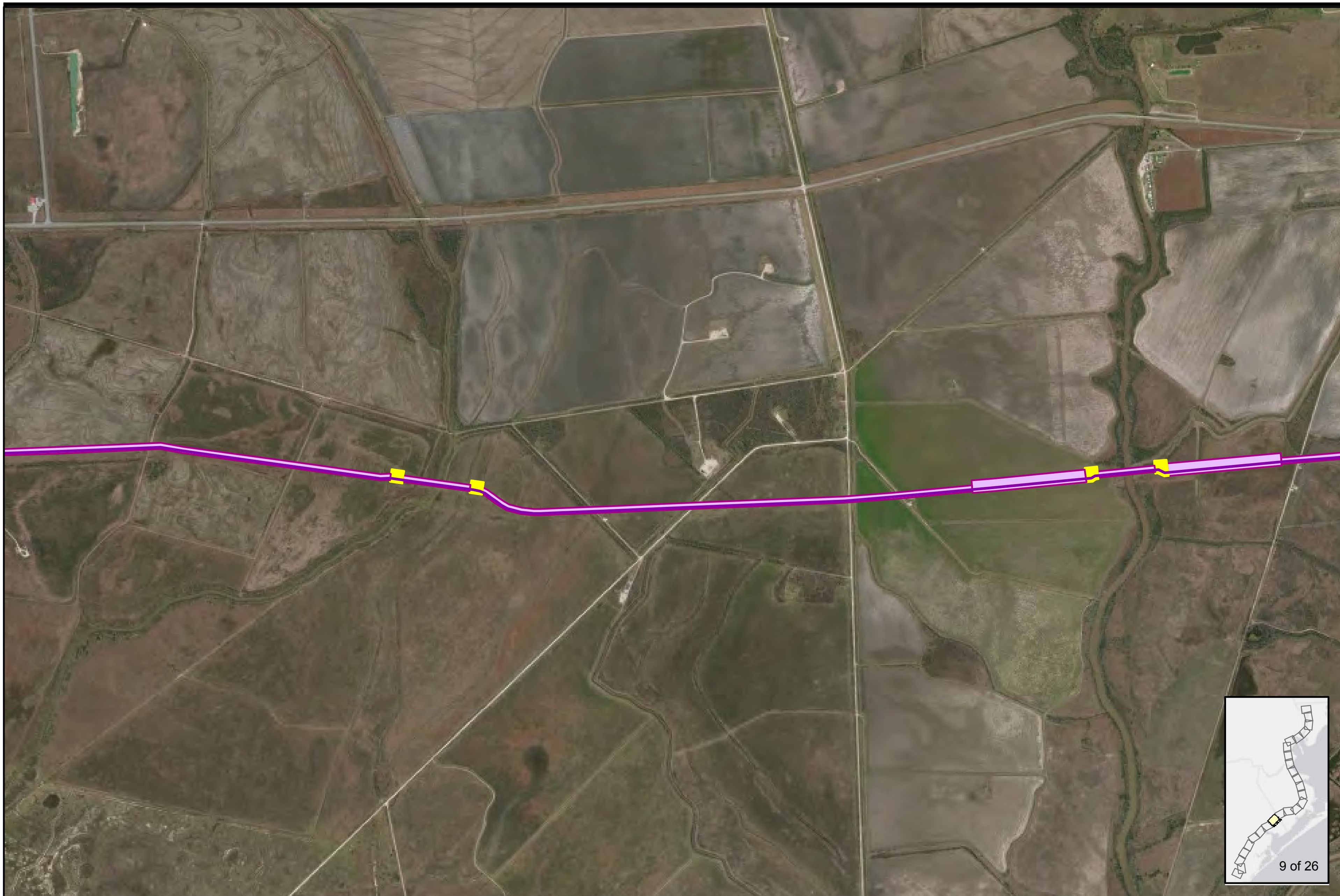


URS

0 0.25 0.5
Miles

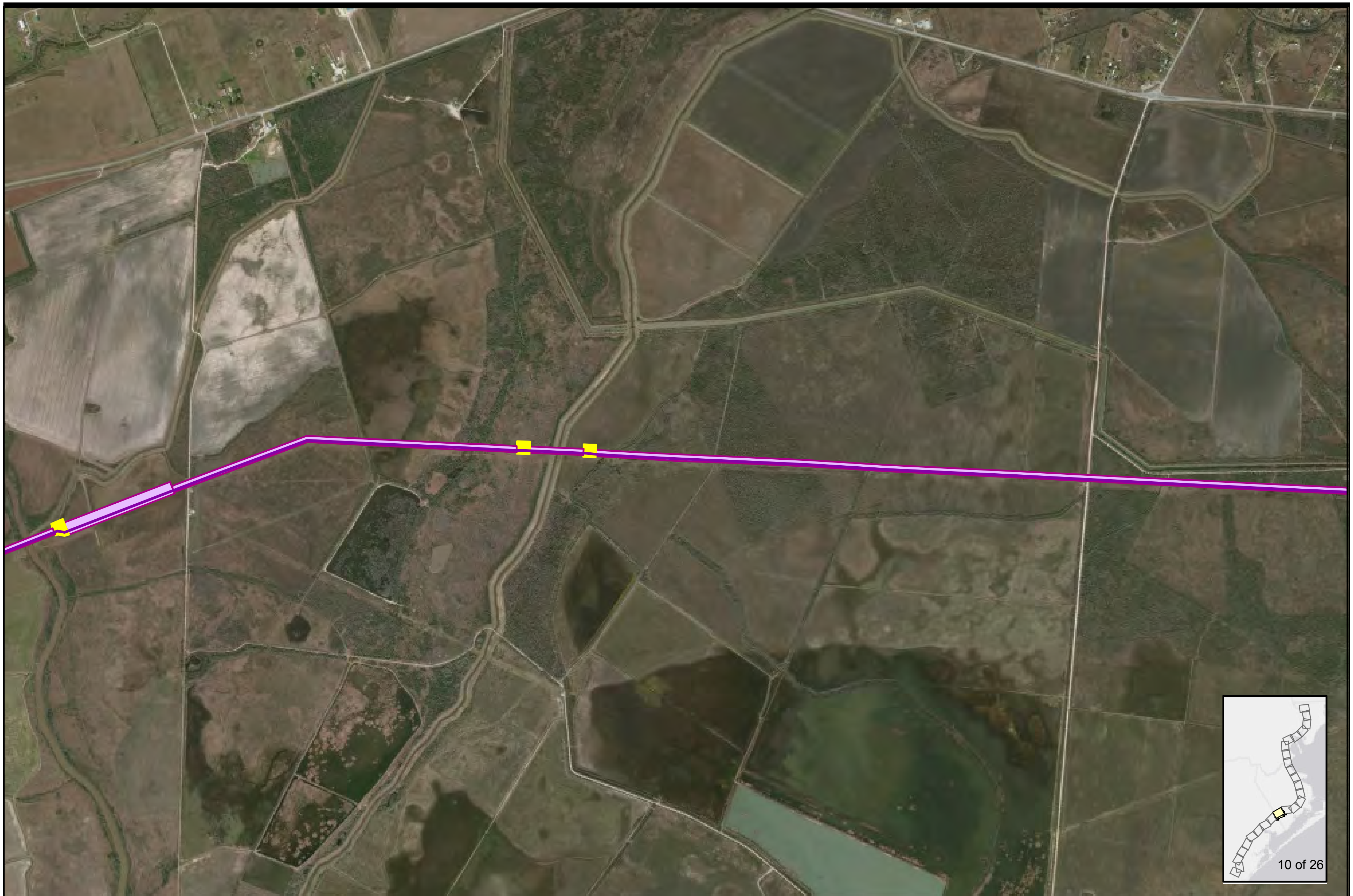
Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.9 of 10



URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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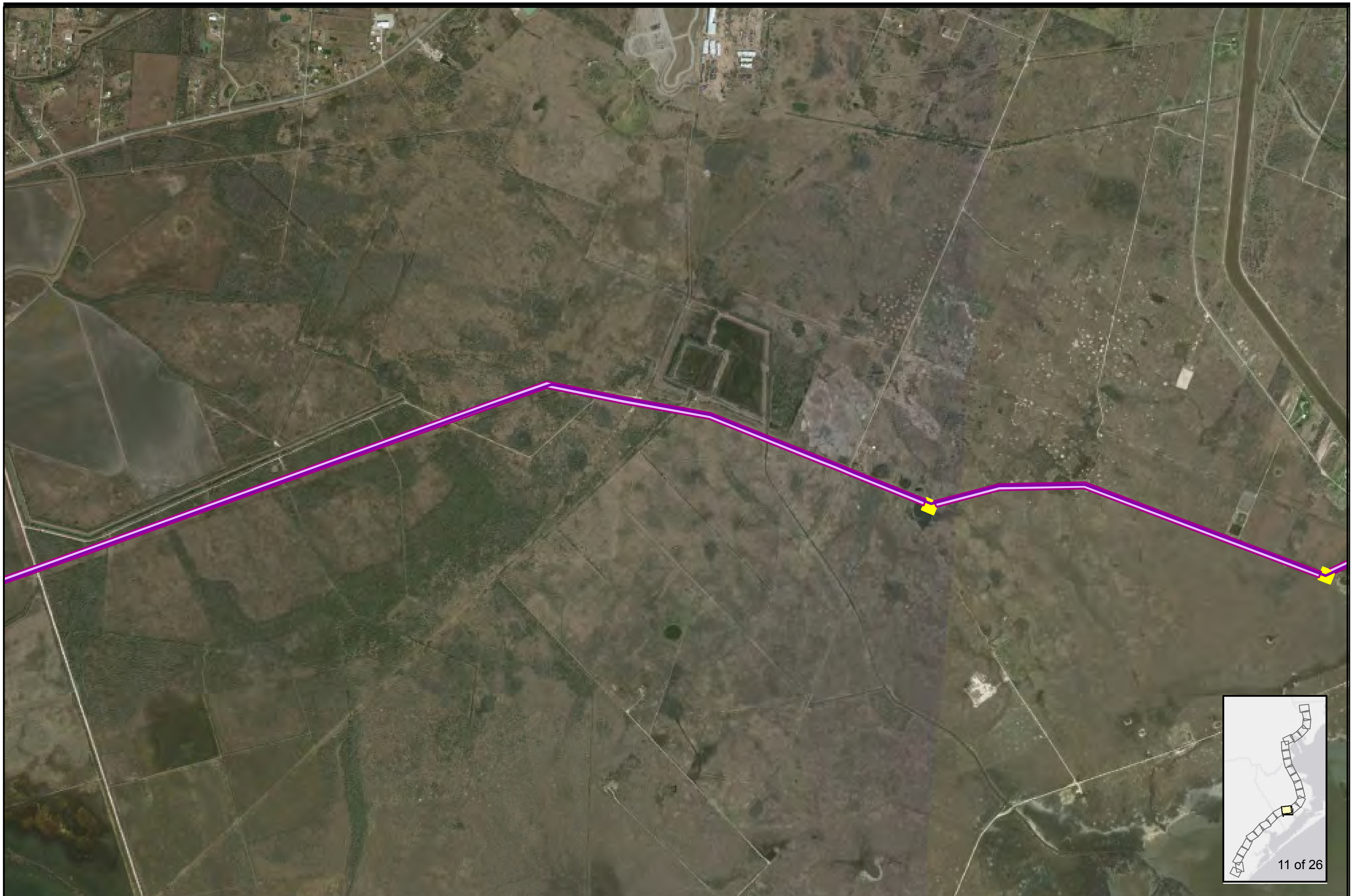

URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.11 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.12 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.13 of 10

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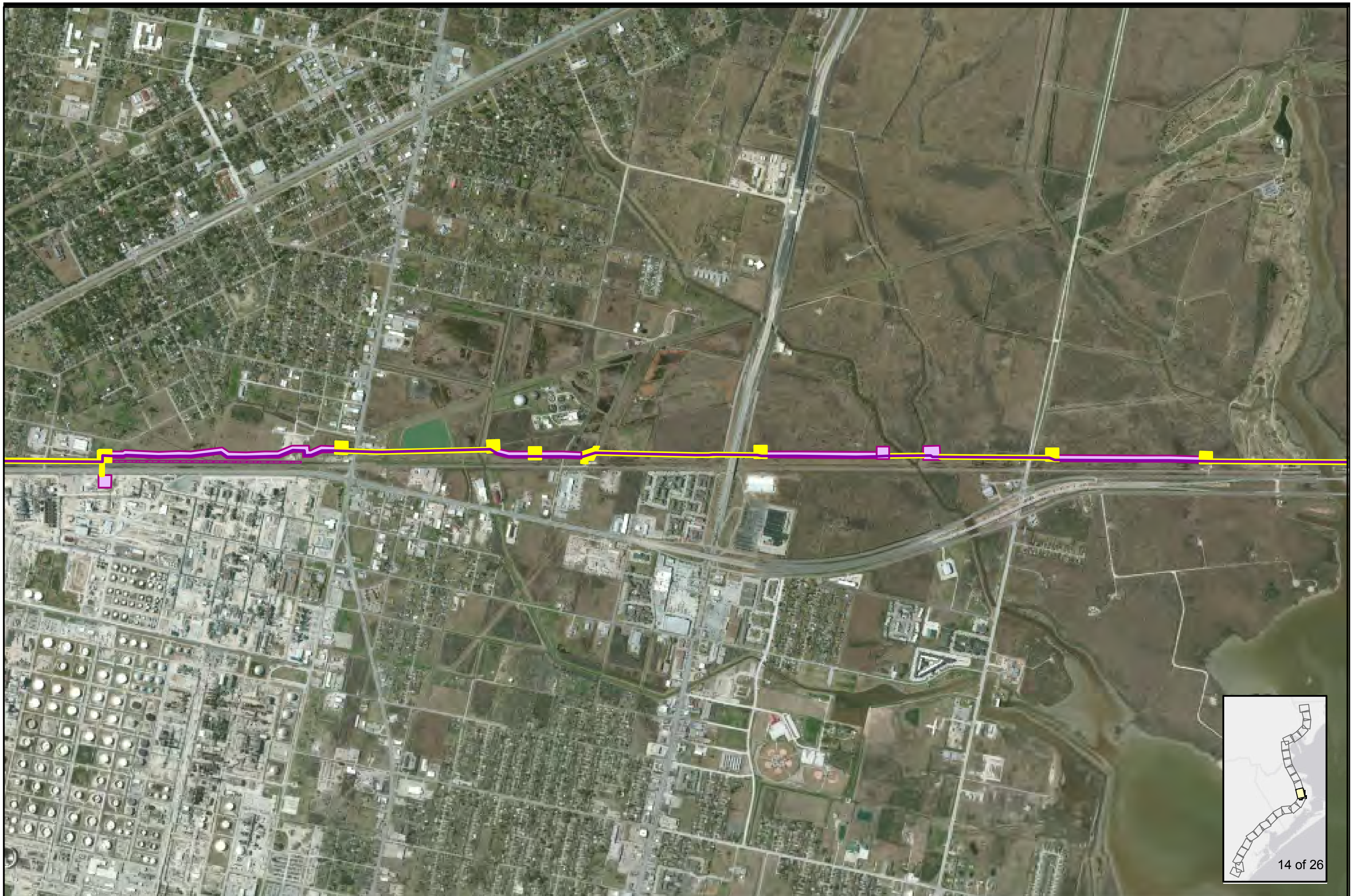

URS

0 0.25 0.5
Miles

N

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.14 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.15 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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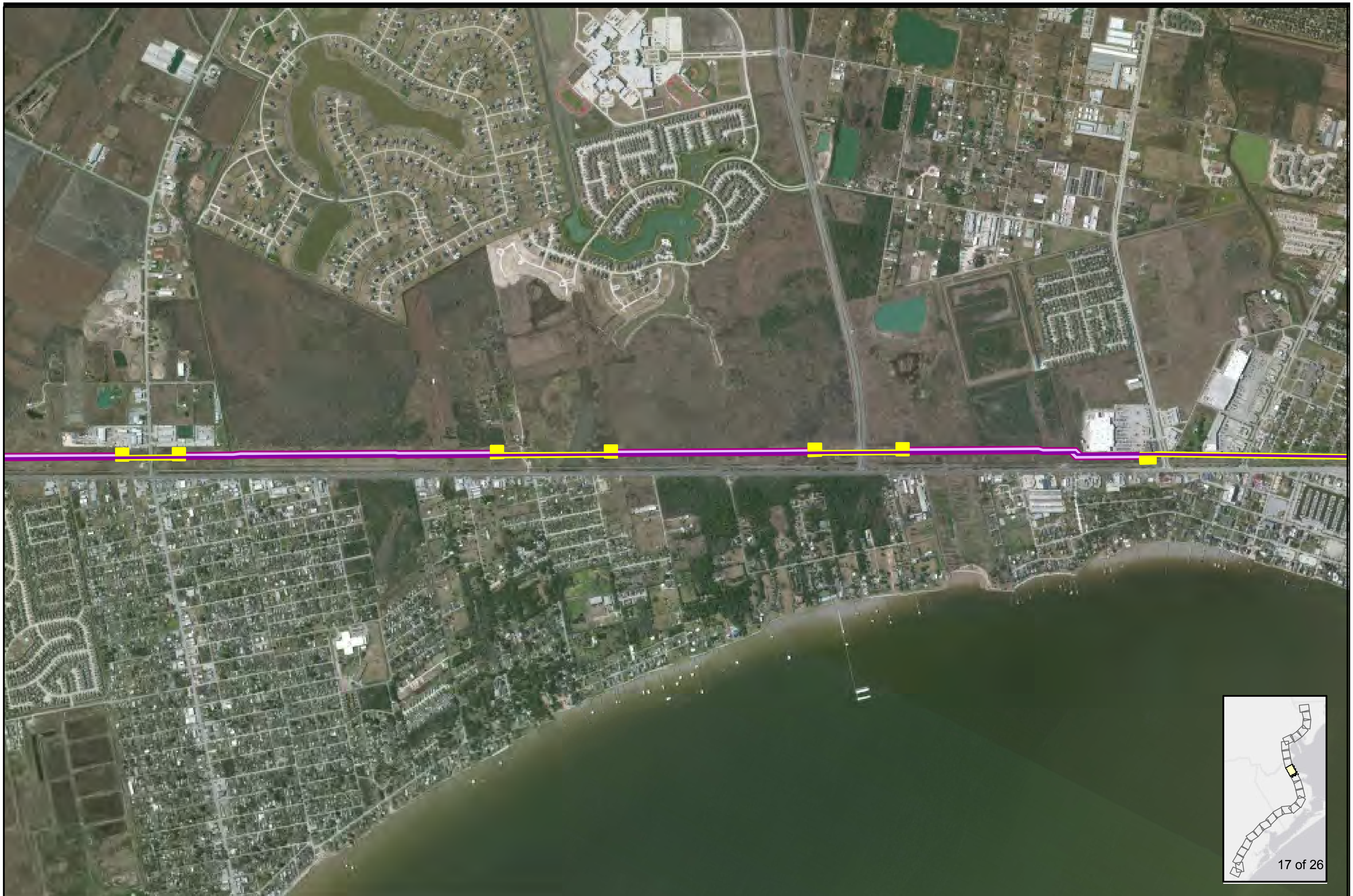

URS

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.17 of 10

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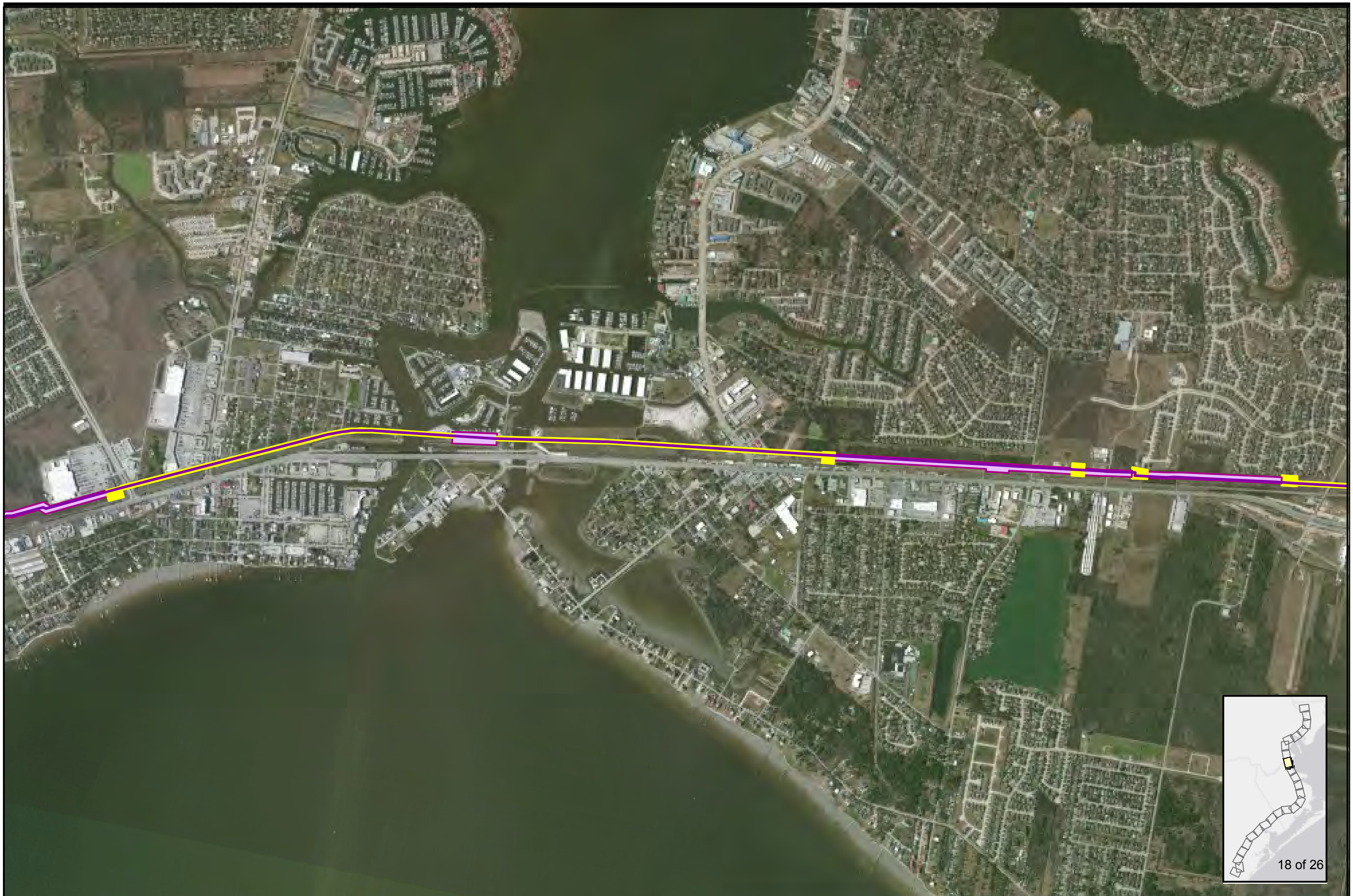

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.18 of 10

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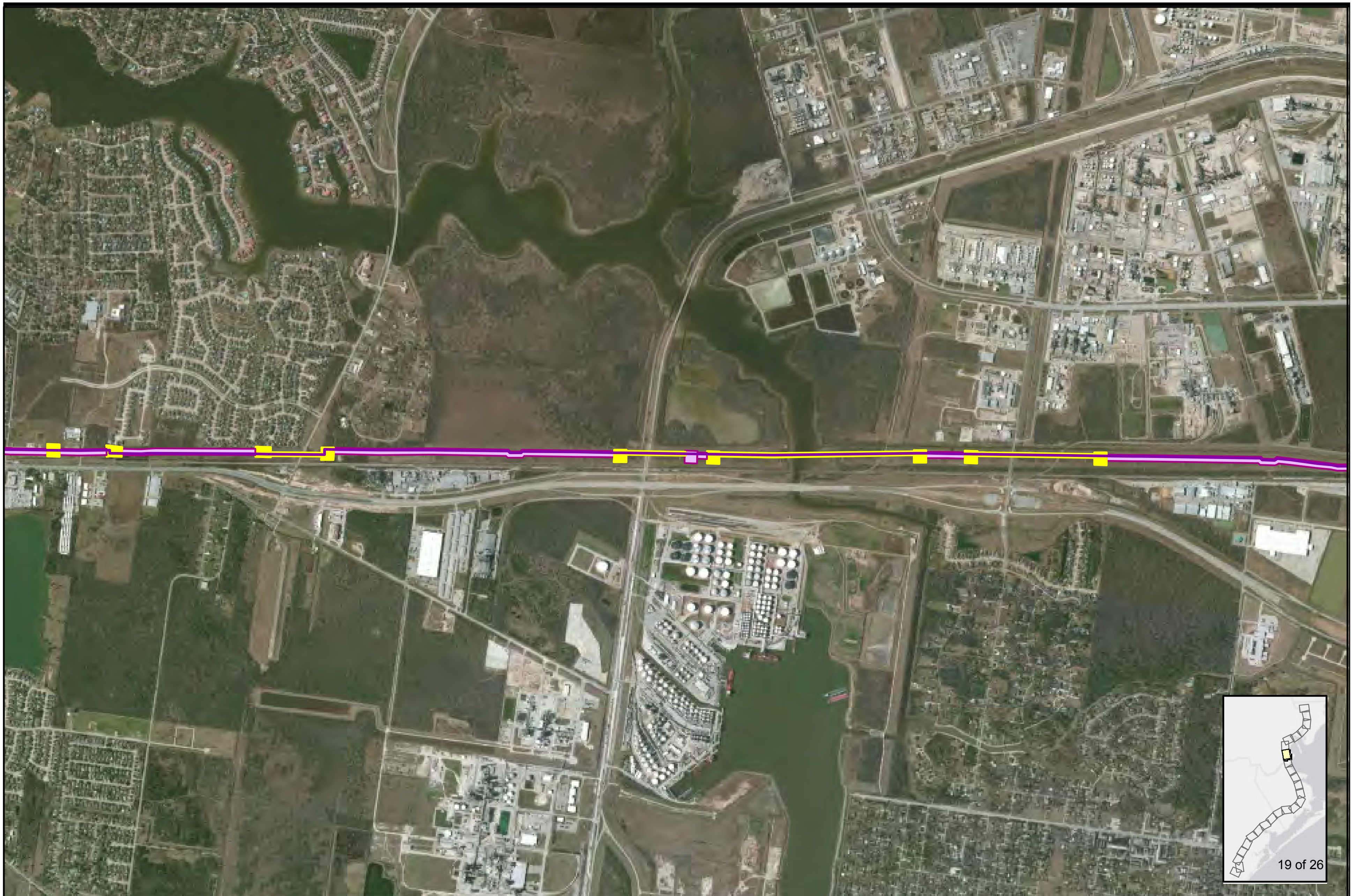

URS

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.19 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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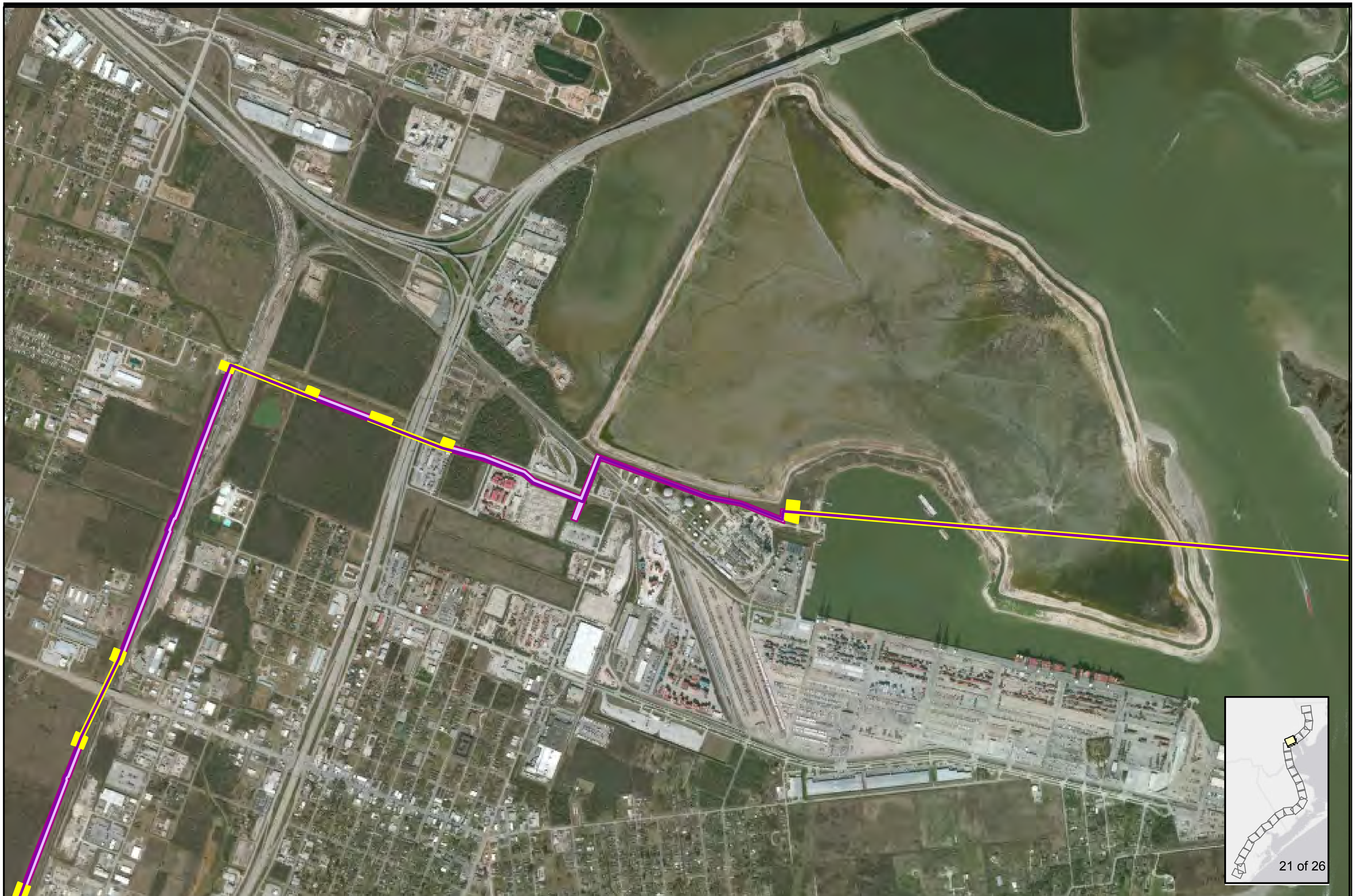

URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.21 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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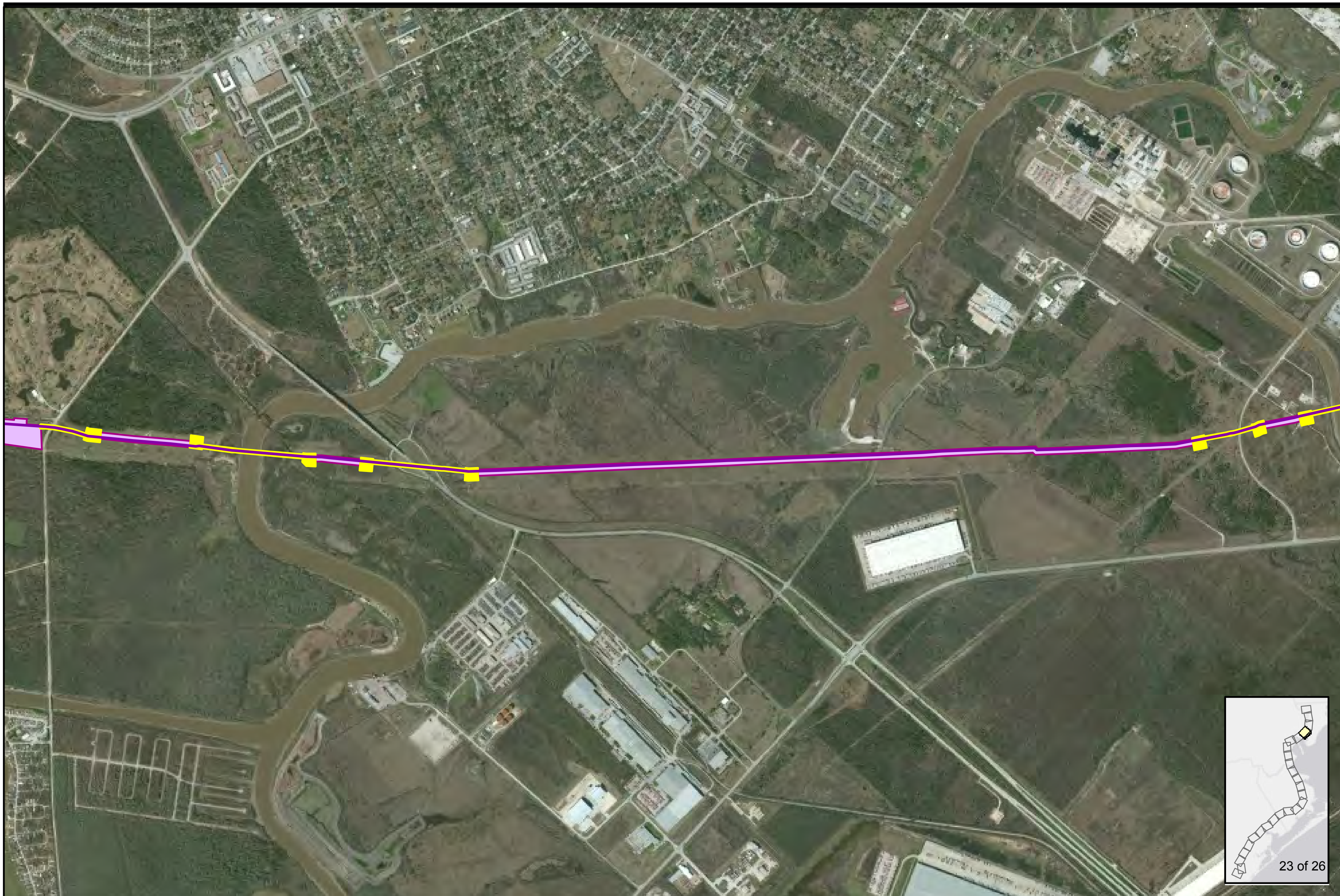

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.23 of 10

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URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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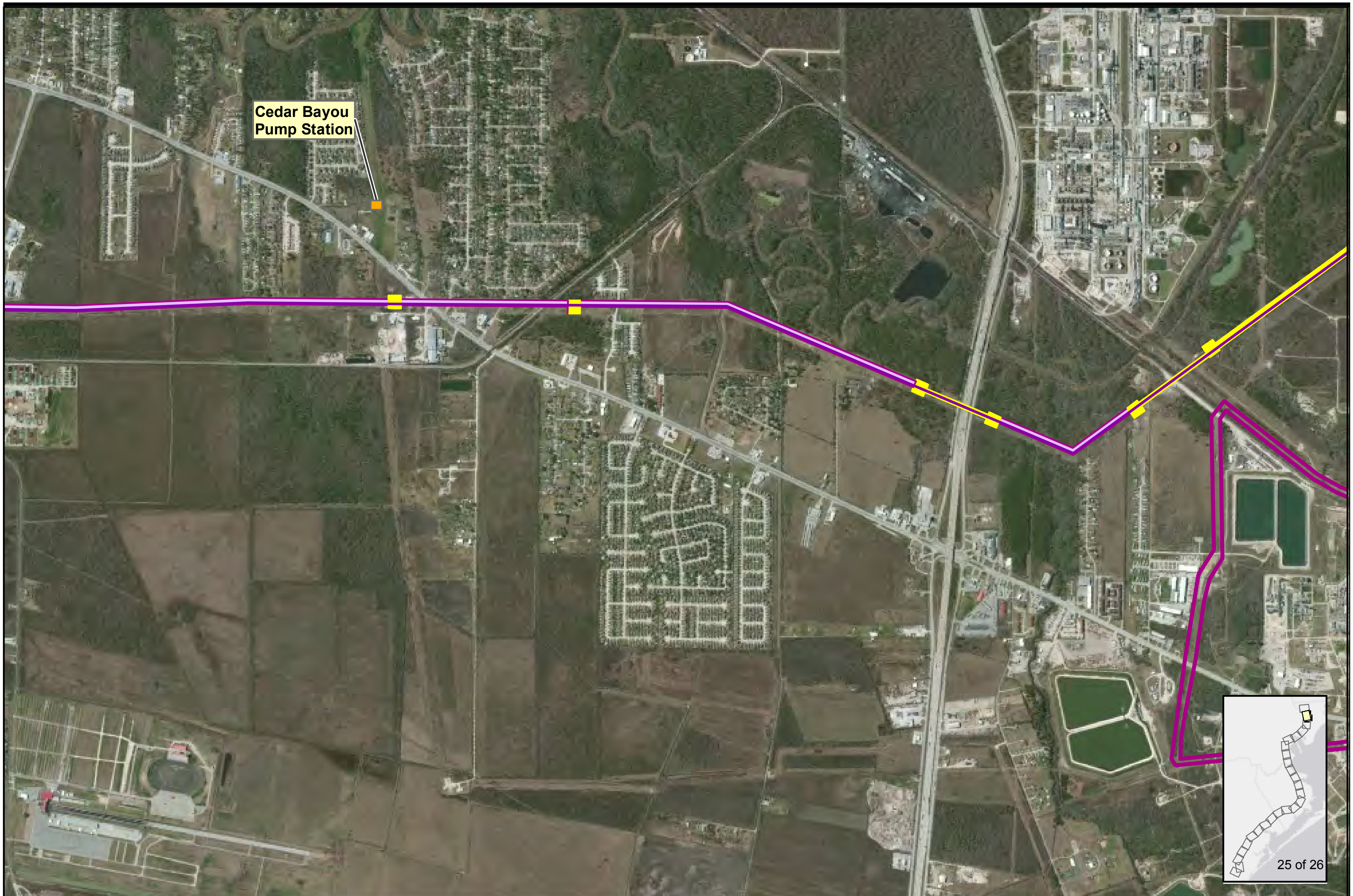

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URS

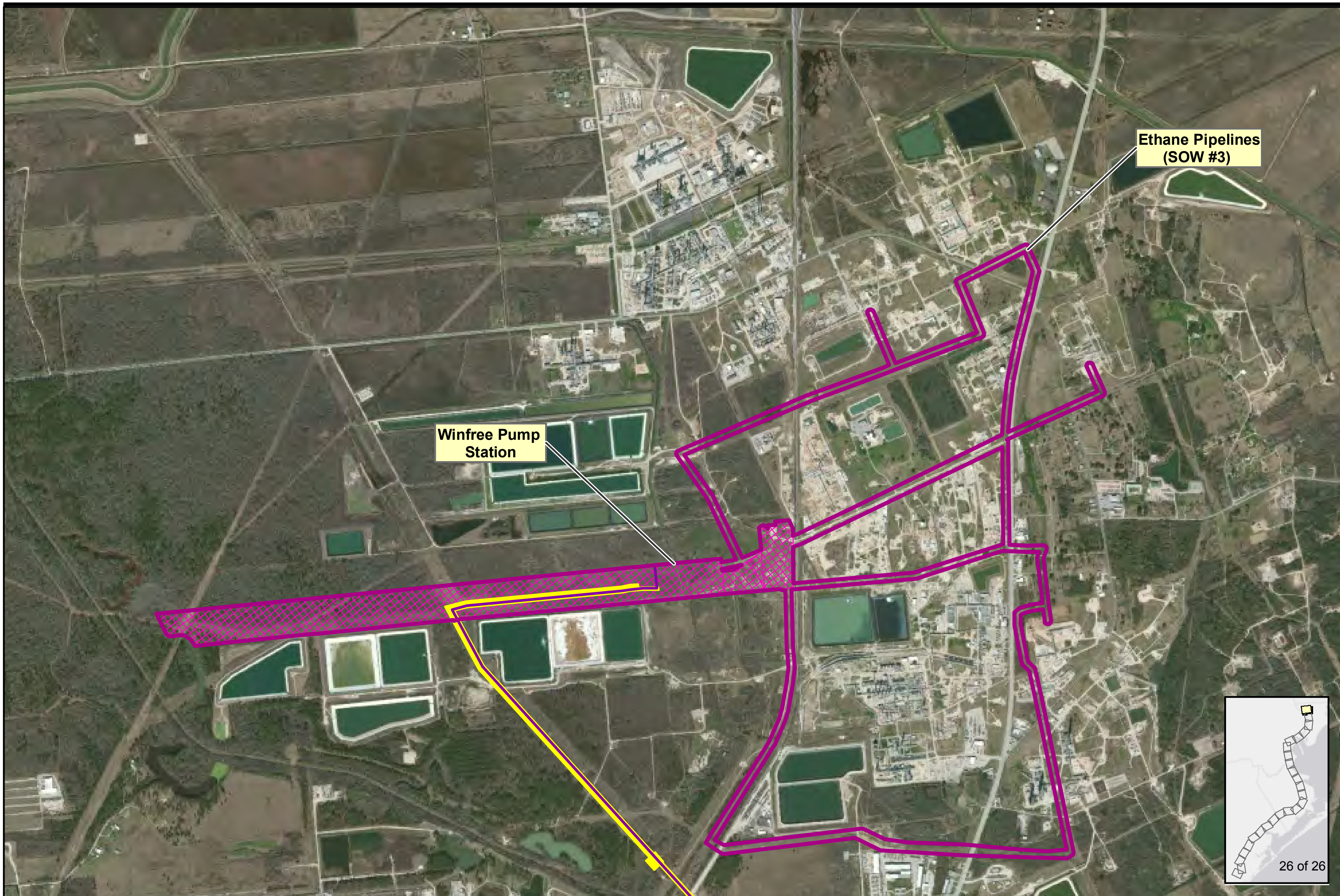
0 0.25 0.5
Miles

Legend
- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	2.25 of 10



URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Proposed Construction (Ground Disturbances)
- Outfall Discharge

Site Layout

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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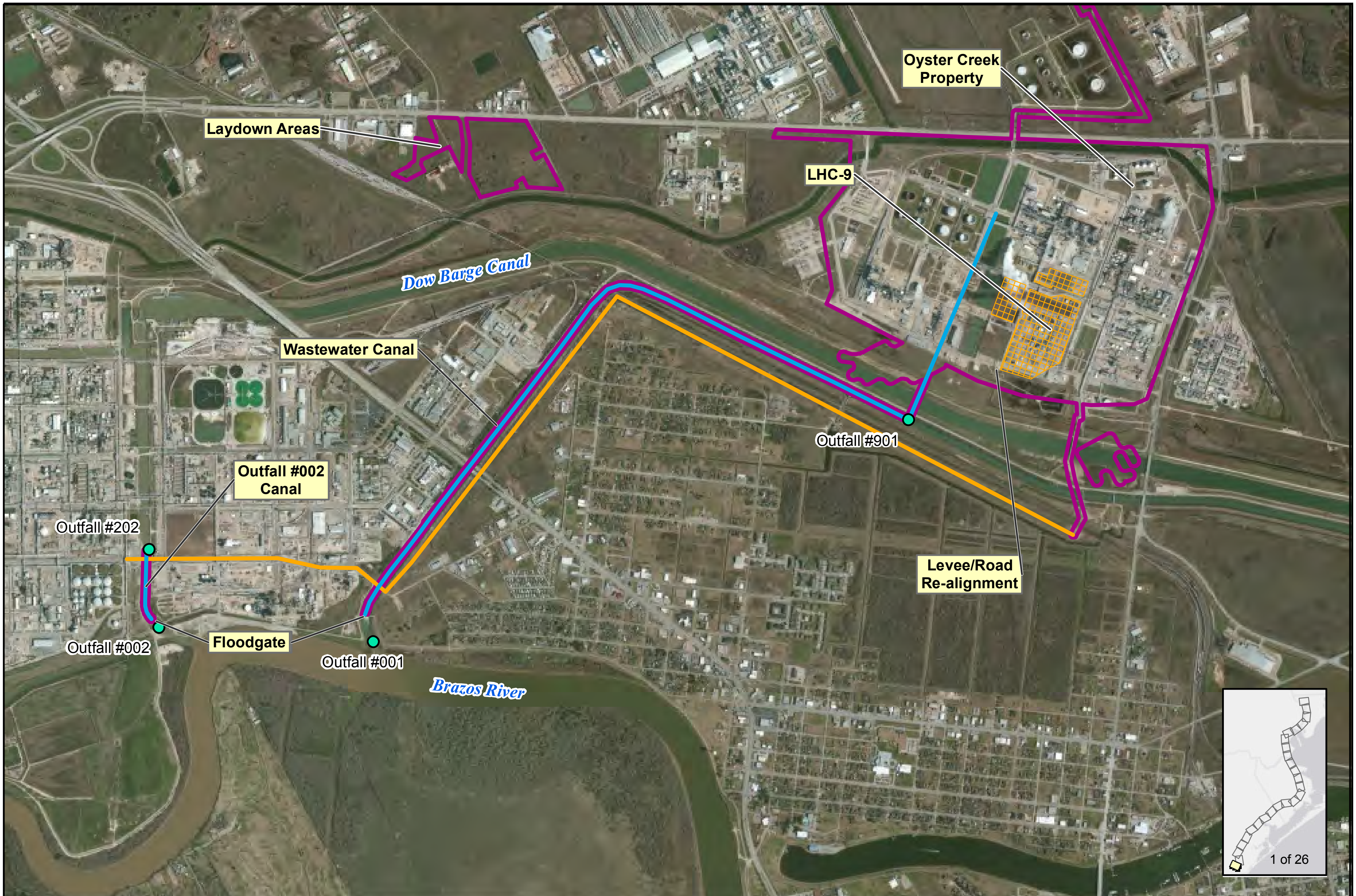

URS

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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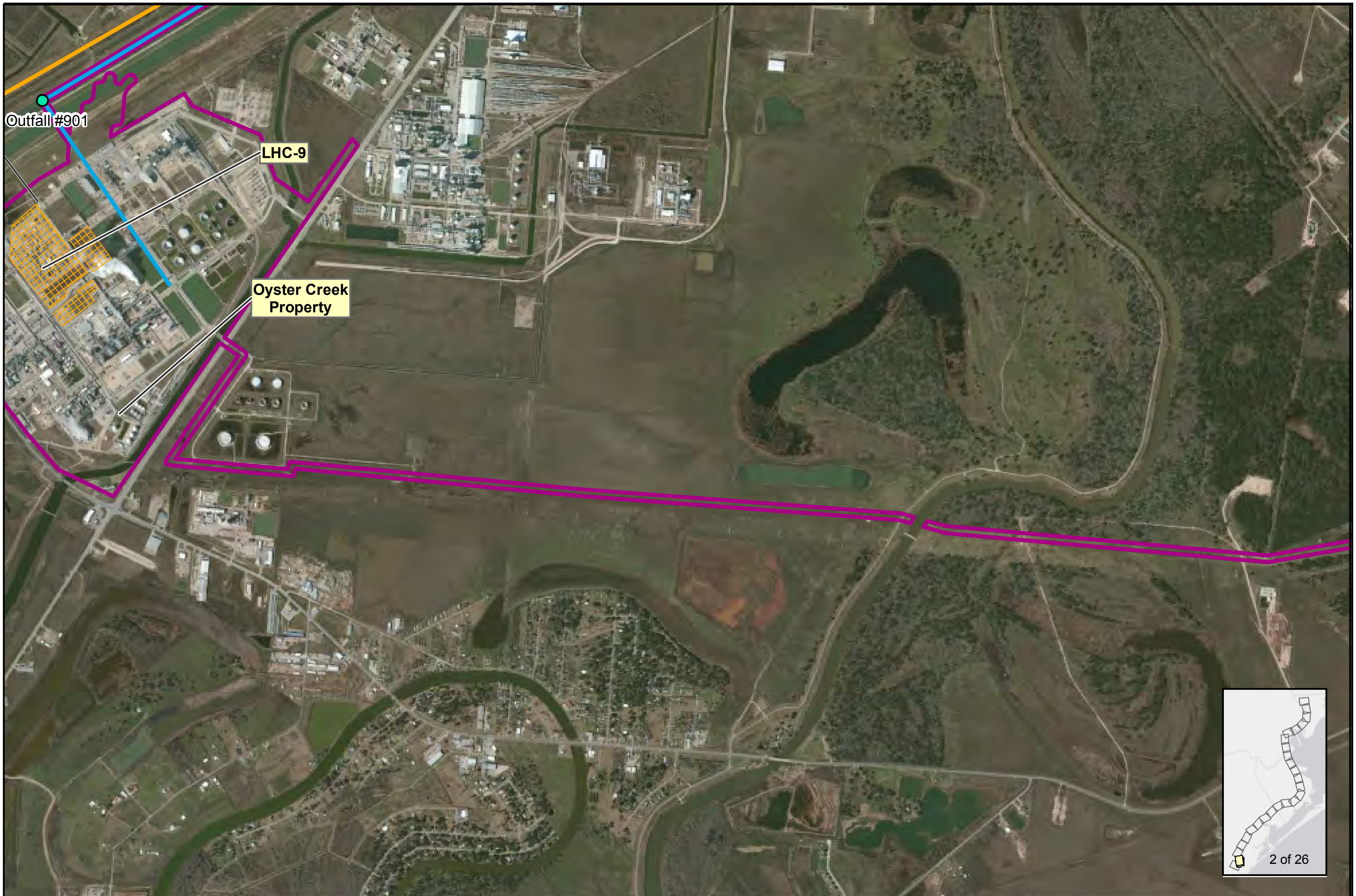

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.2 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.3 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.4 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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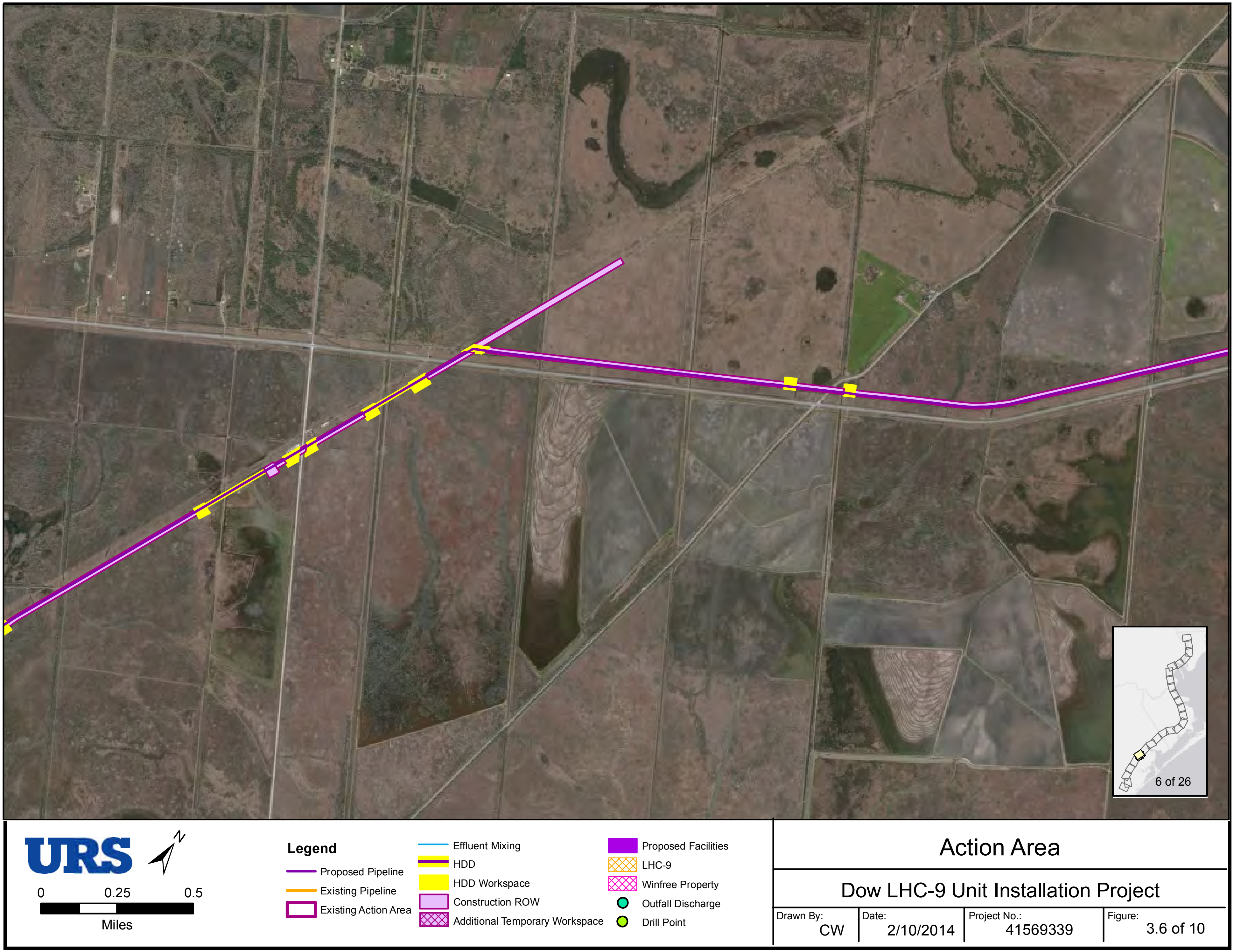

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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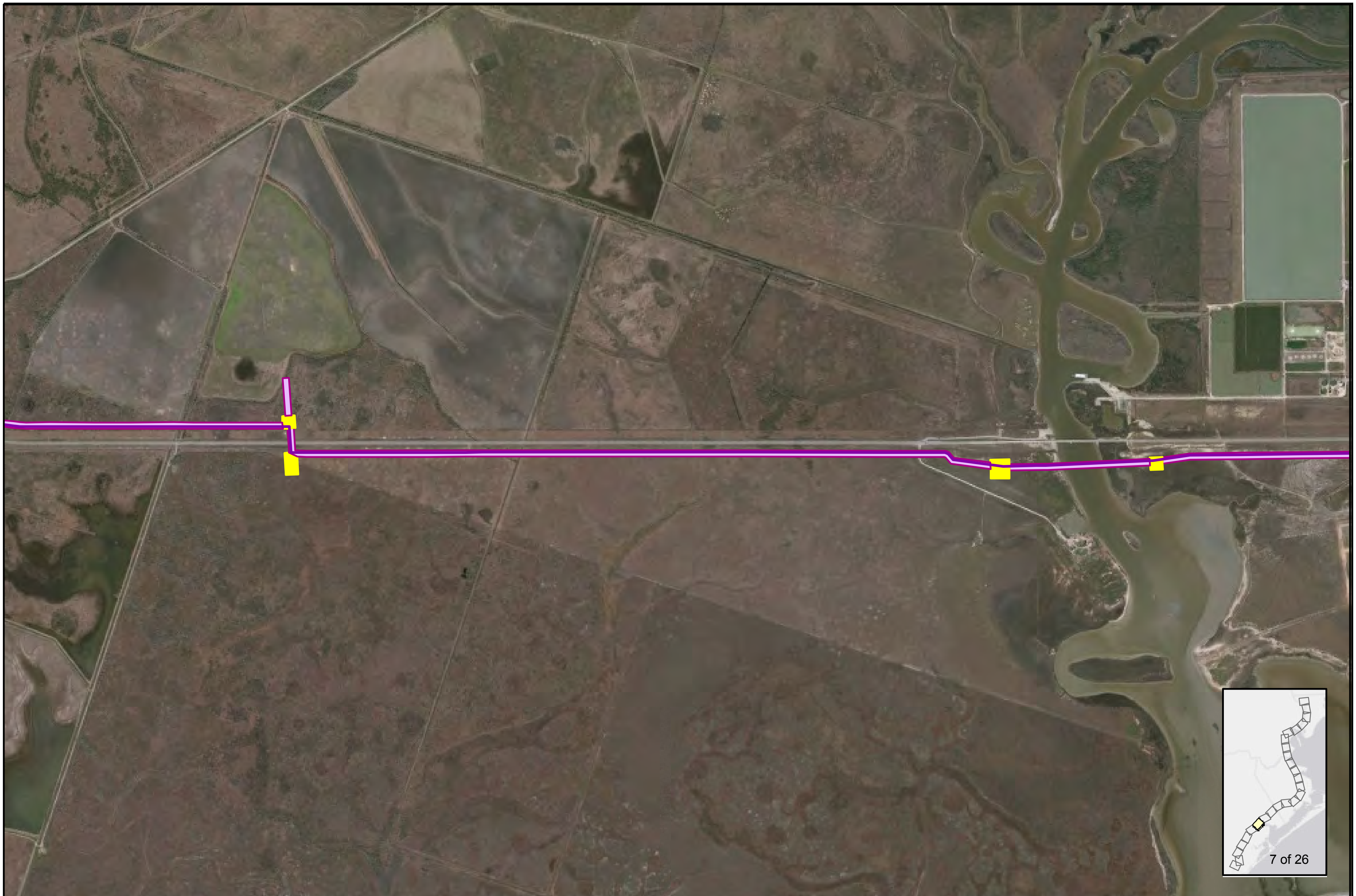

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.7 of 10

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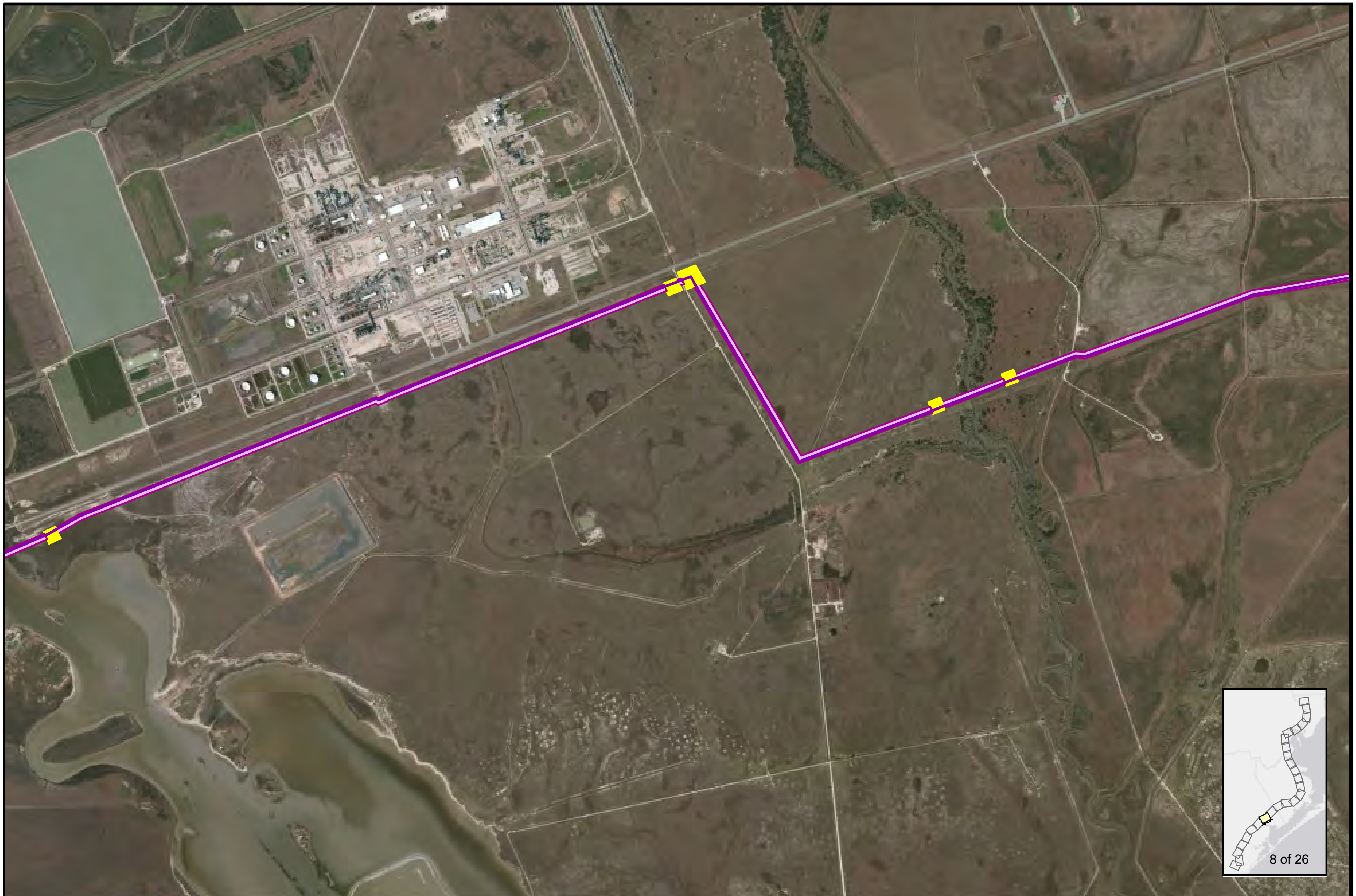

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.8 of 10

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URS

0 0.25 0.5
Miles

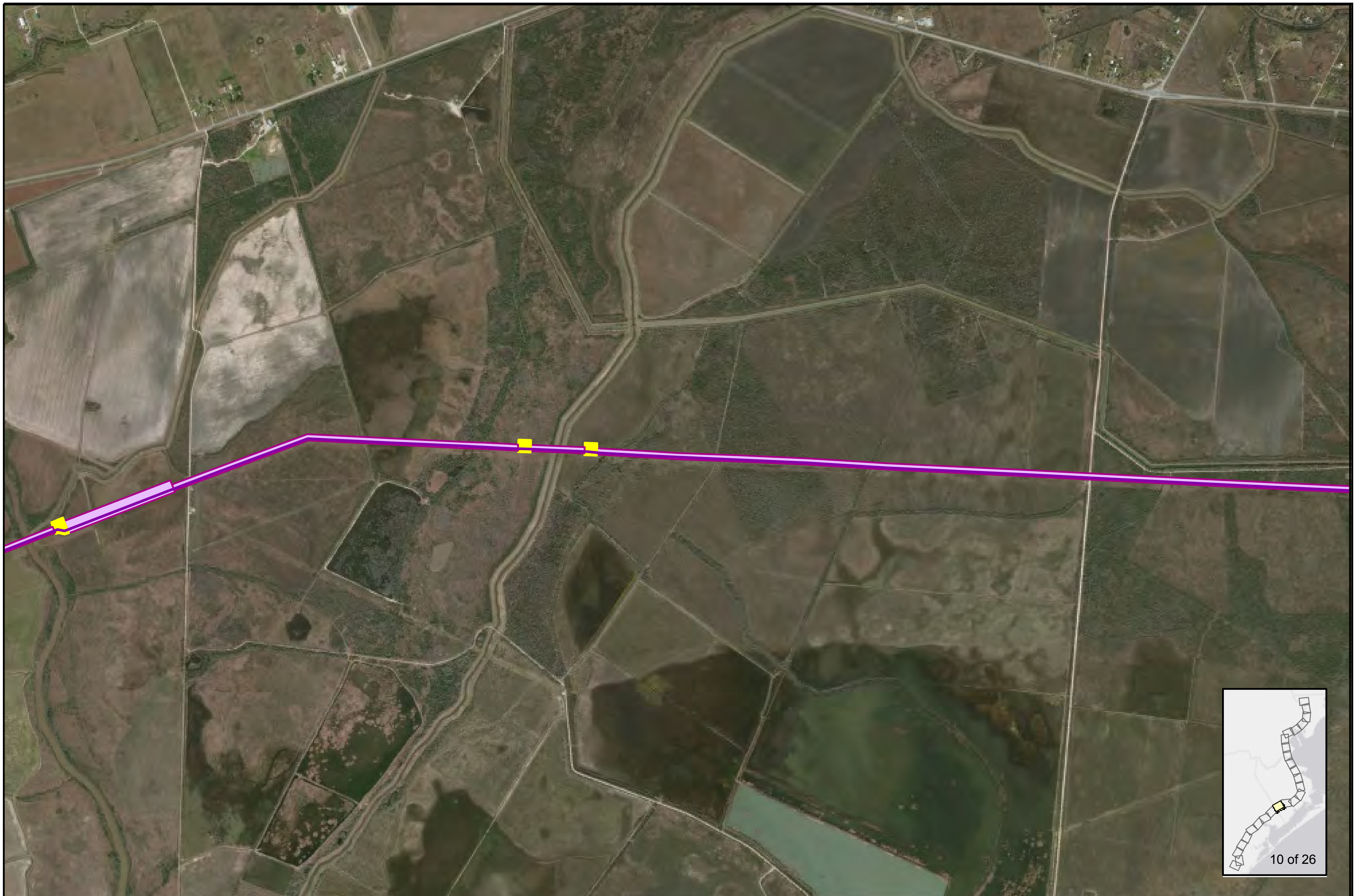
Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.9 of 10



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URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.10 of 10

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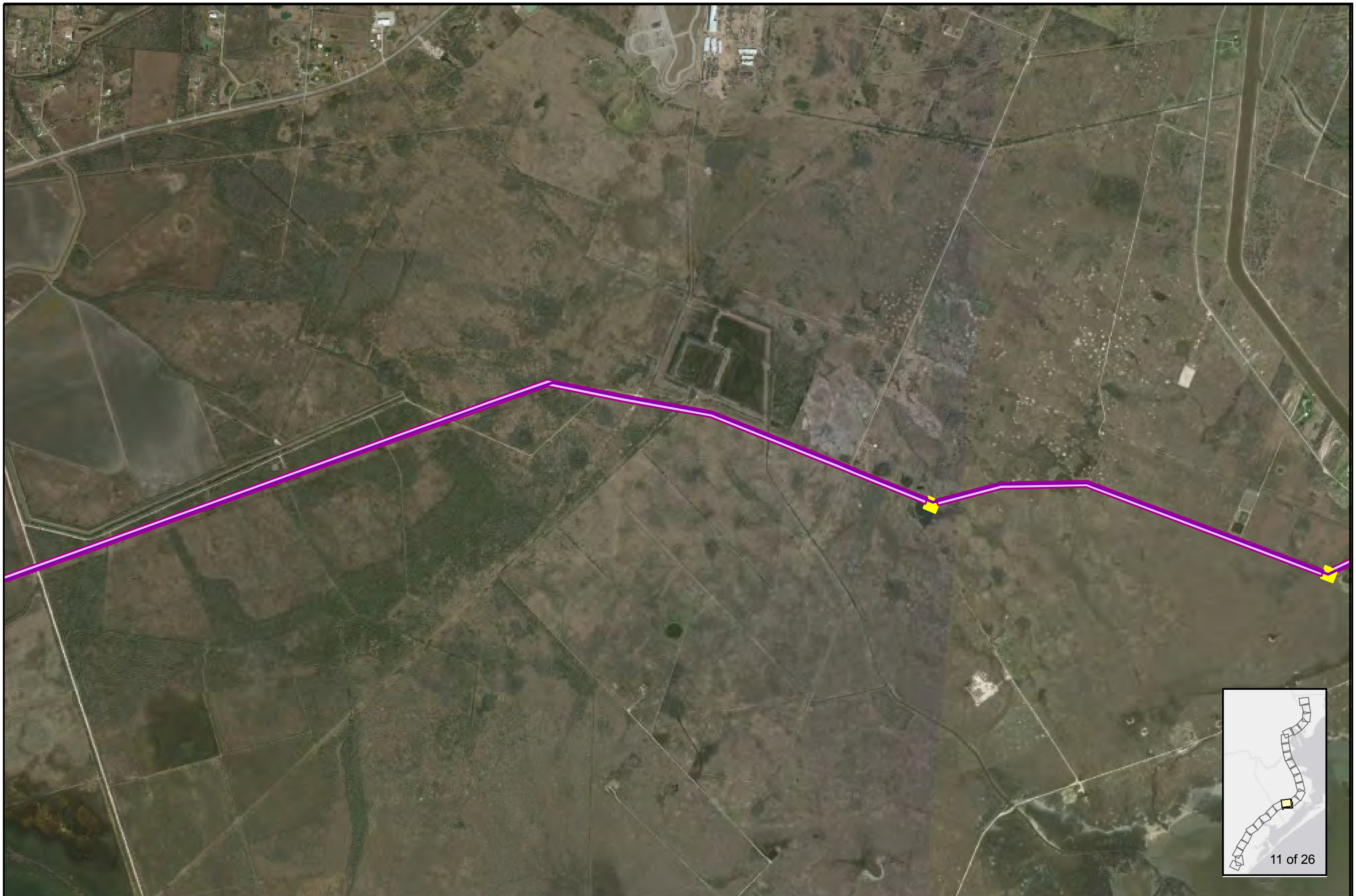

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.11 of 10

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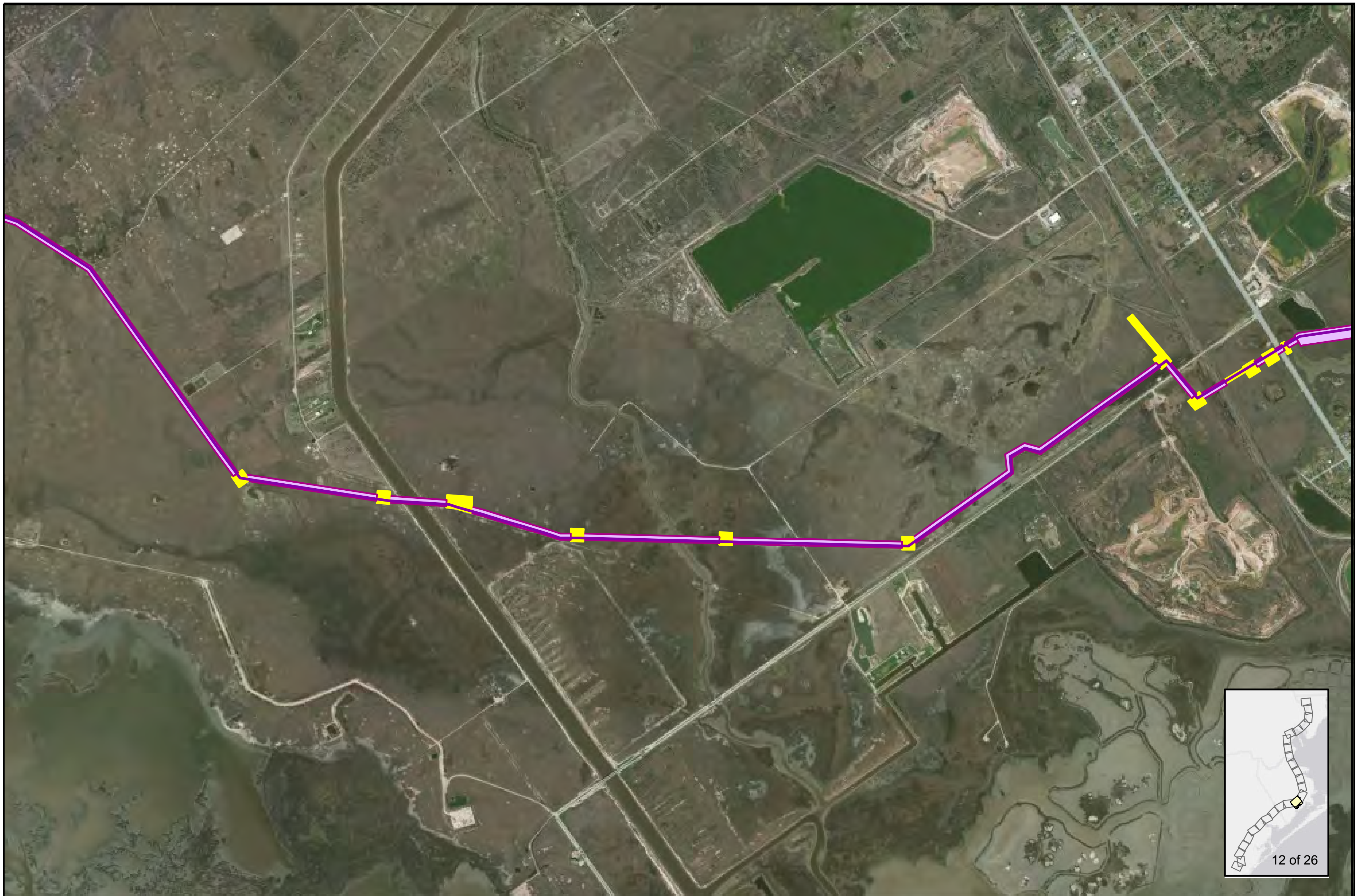

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.12 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.13 of 10

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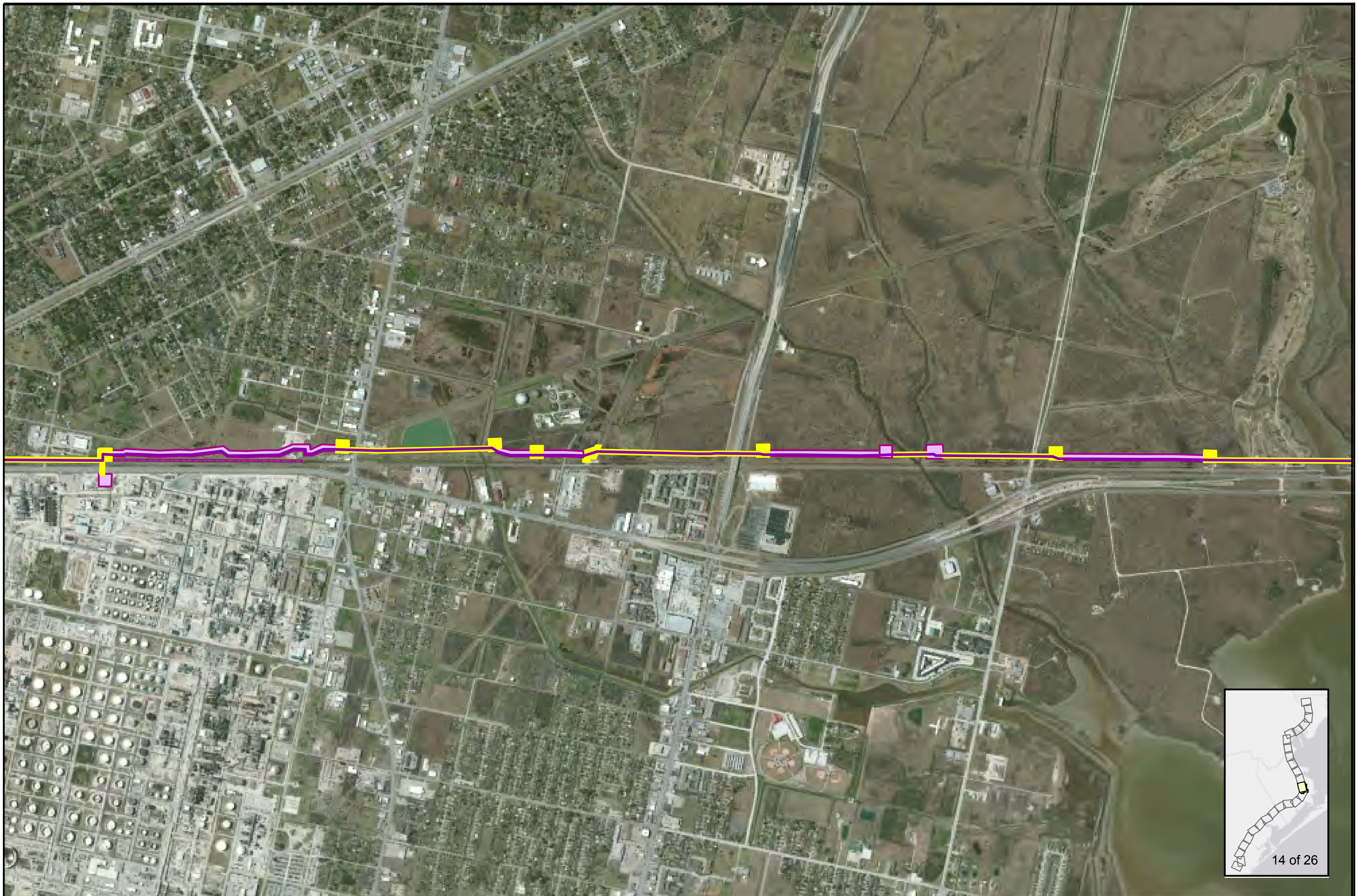

URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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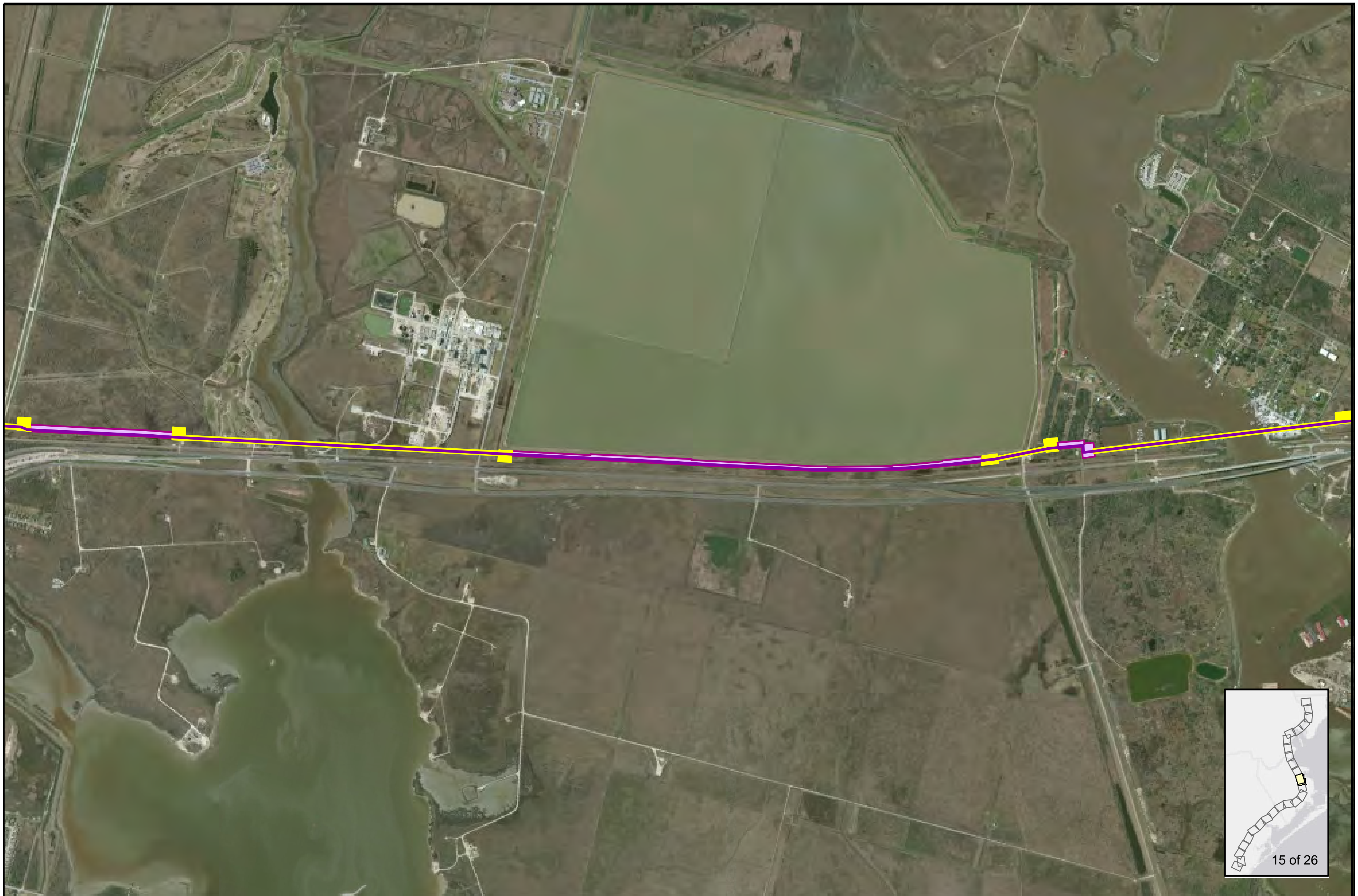

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.15 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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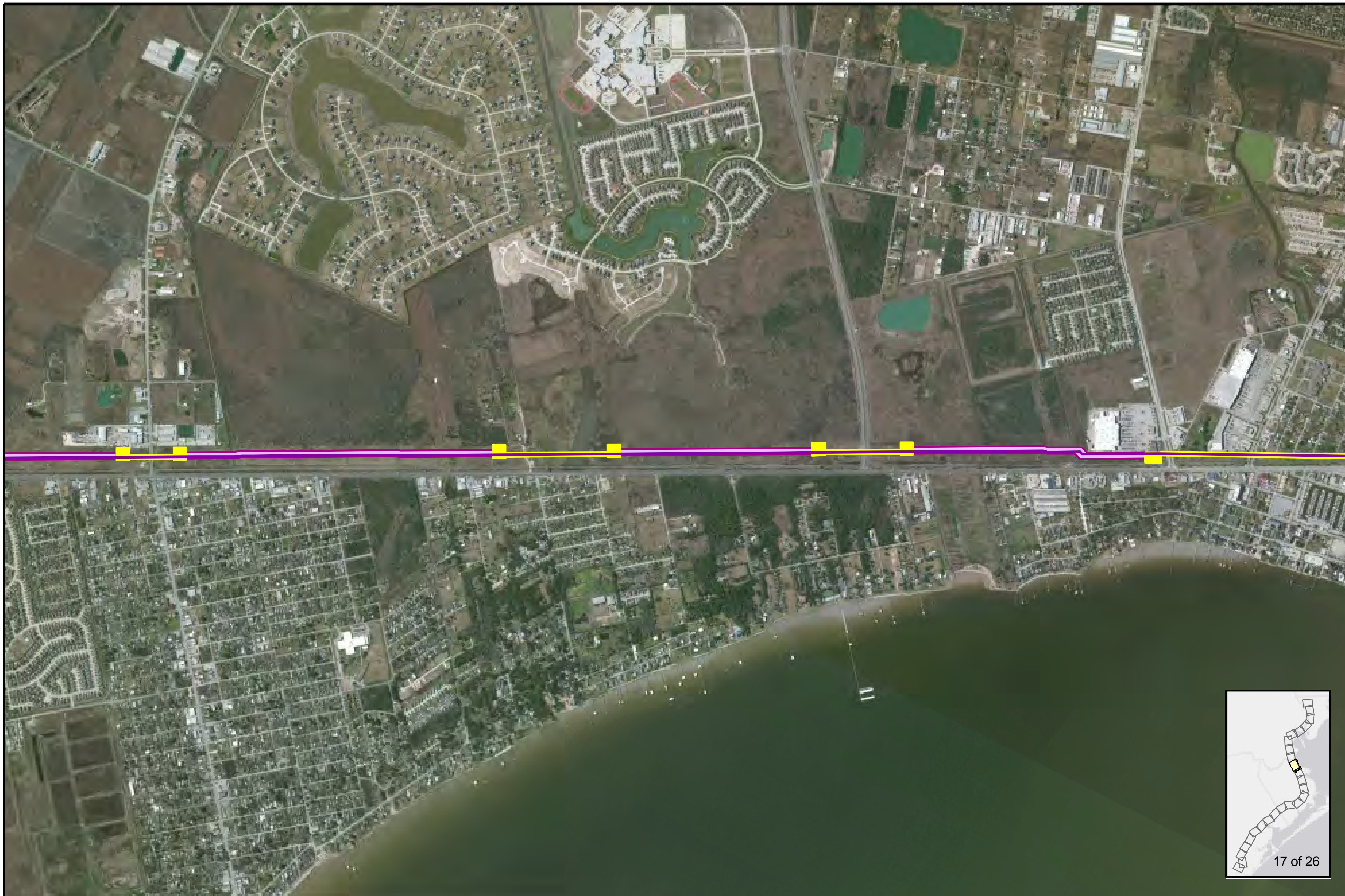

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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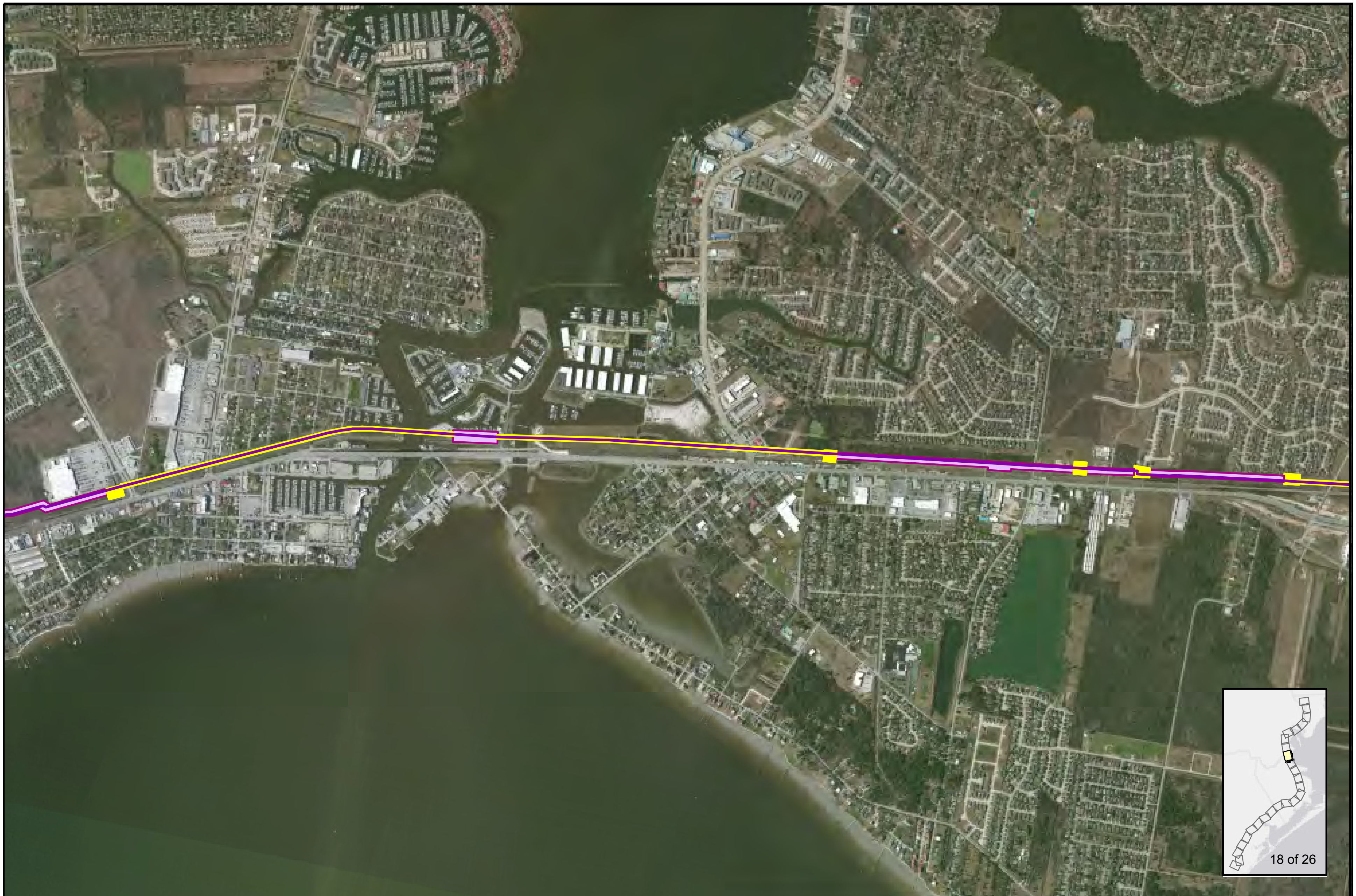

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.18 of 10

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.19 of 10

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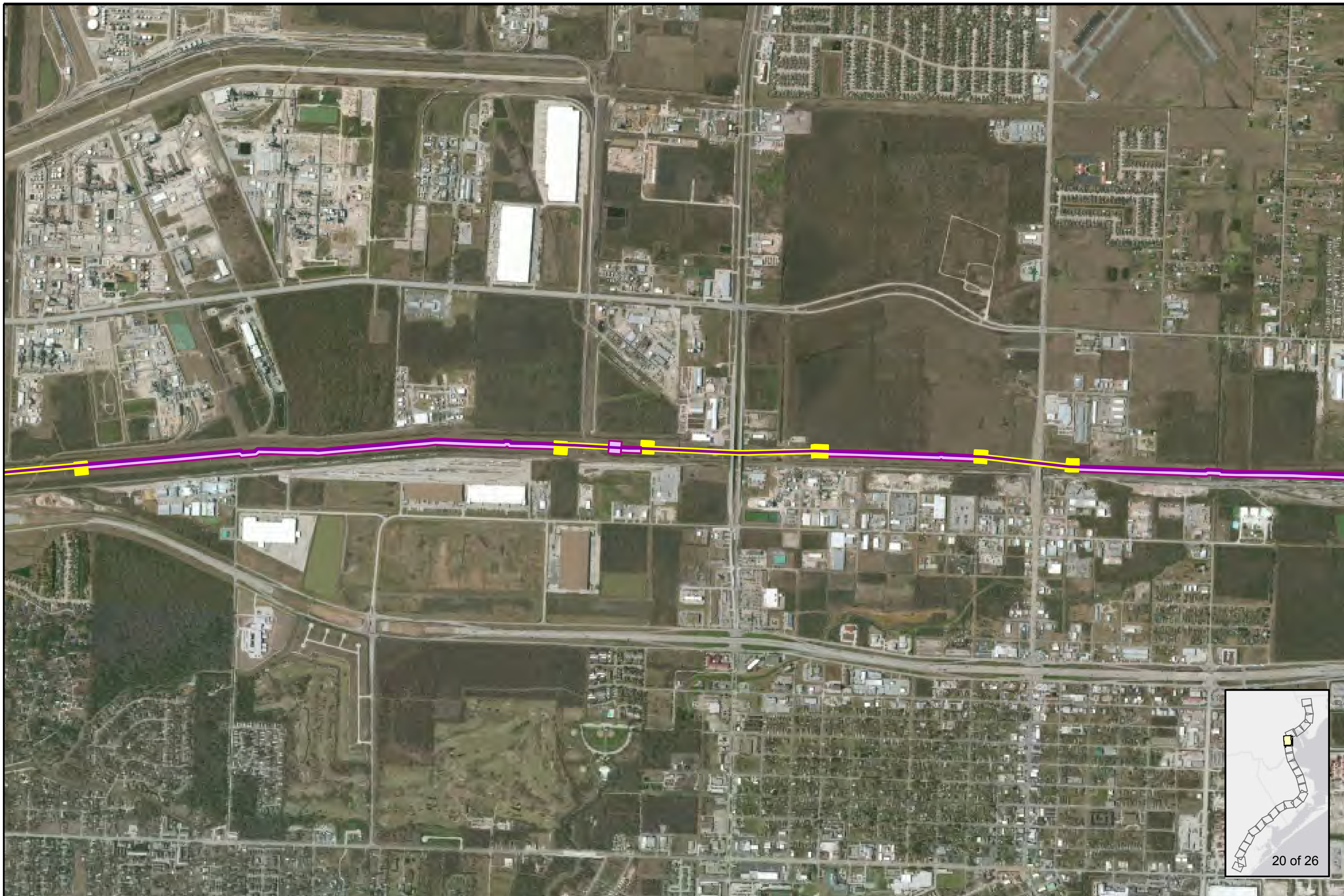

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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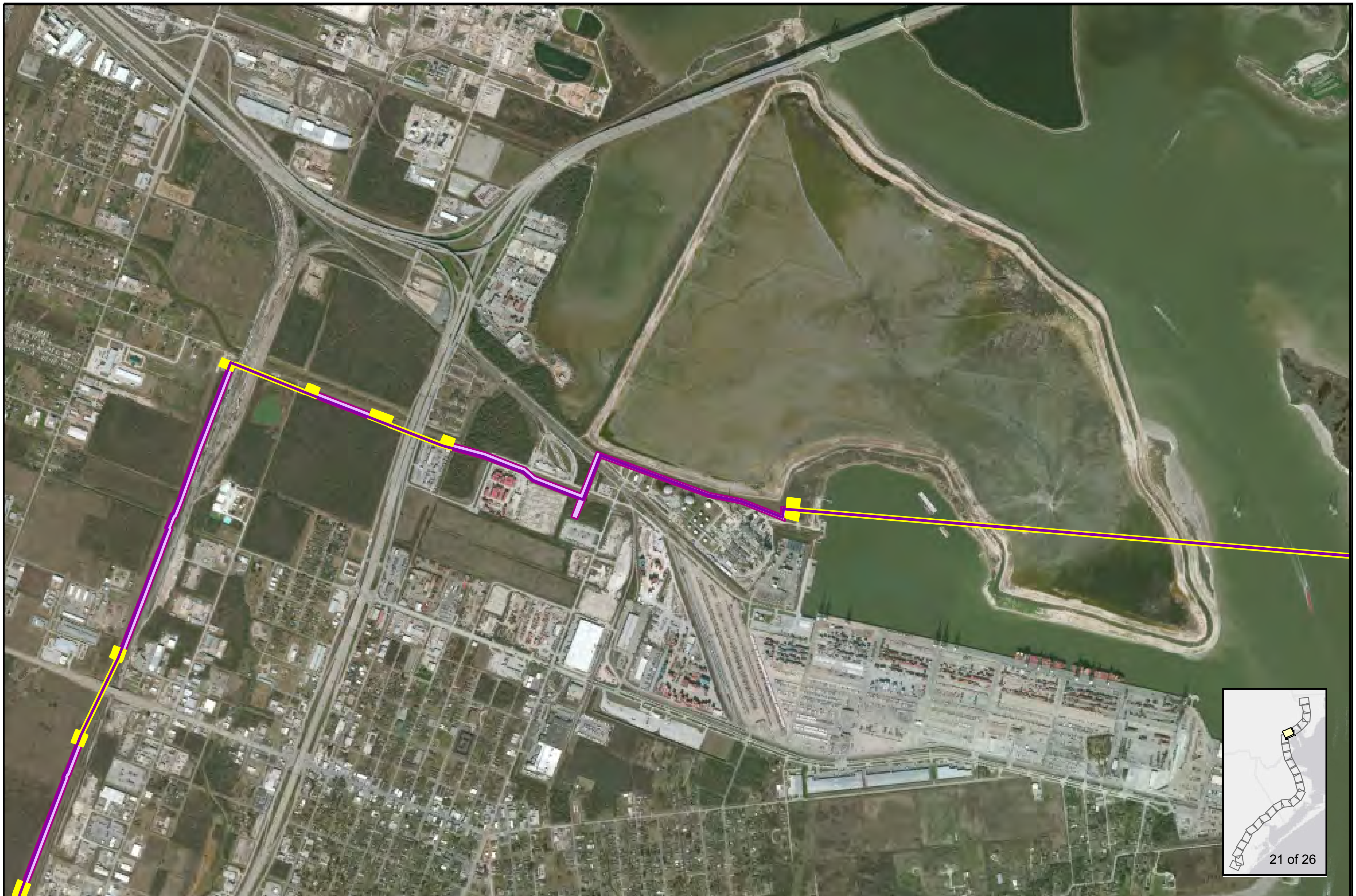

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.21 of 10

URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
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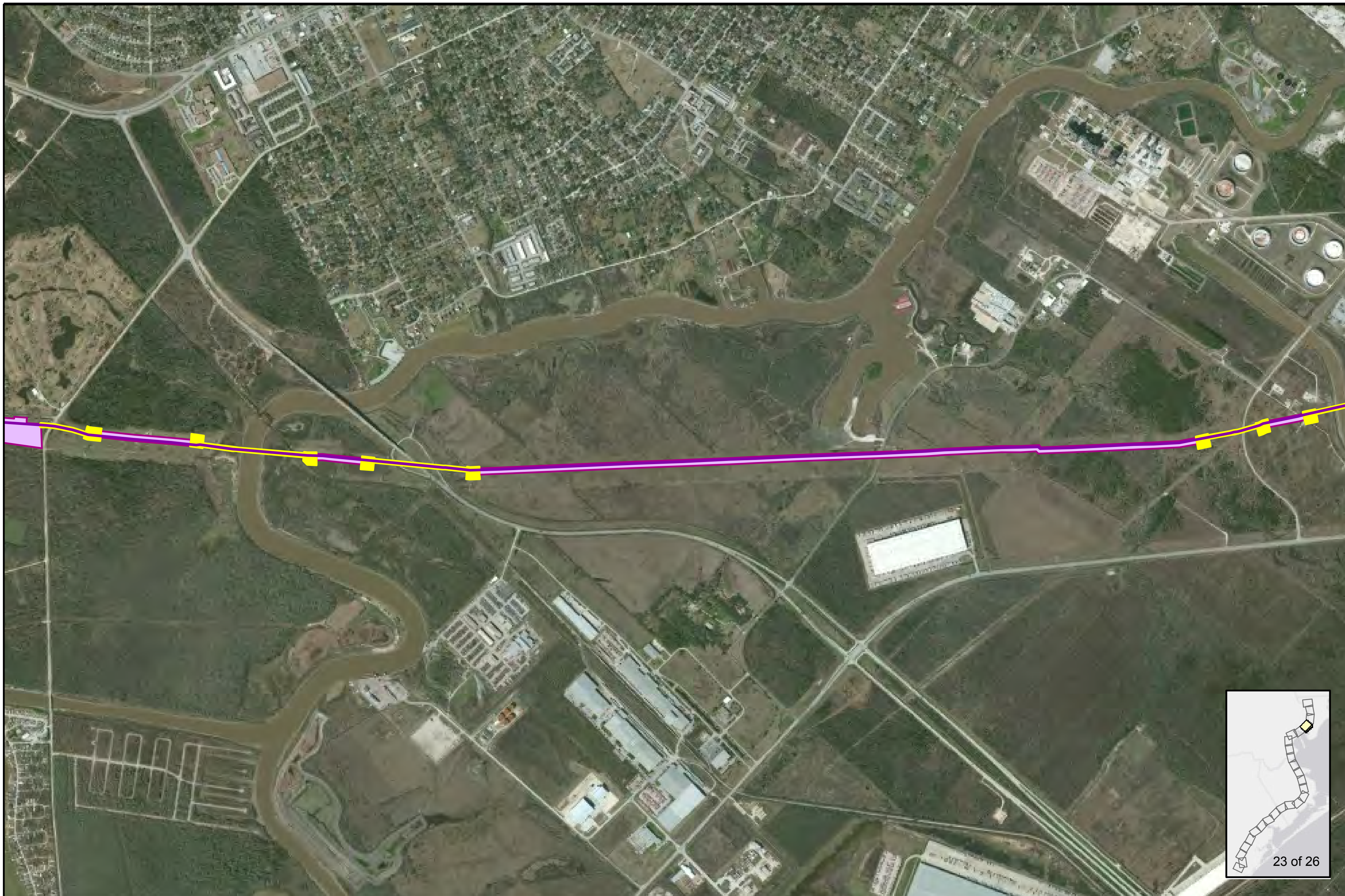

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URS

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.23 of 10

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.24 of 10

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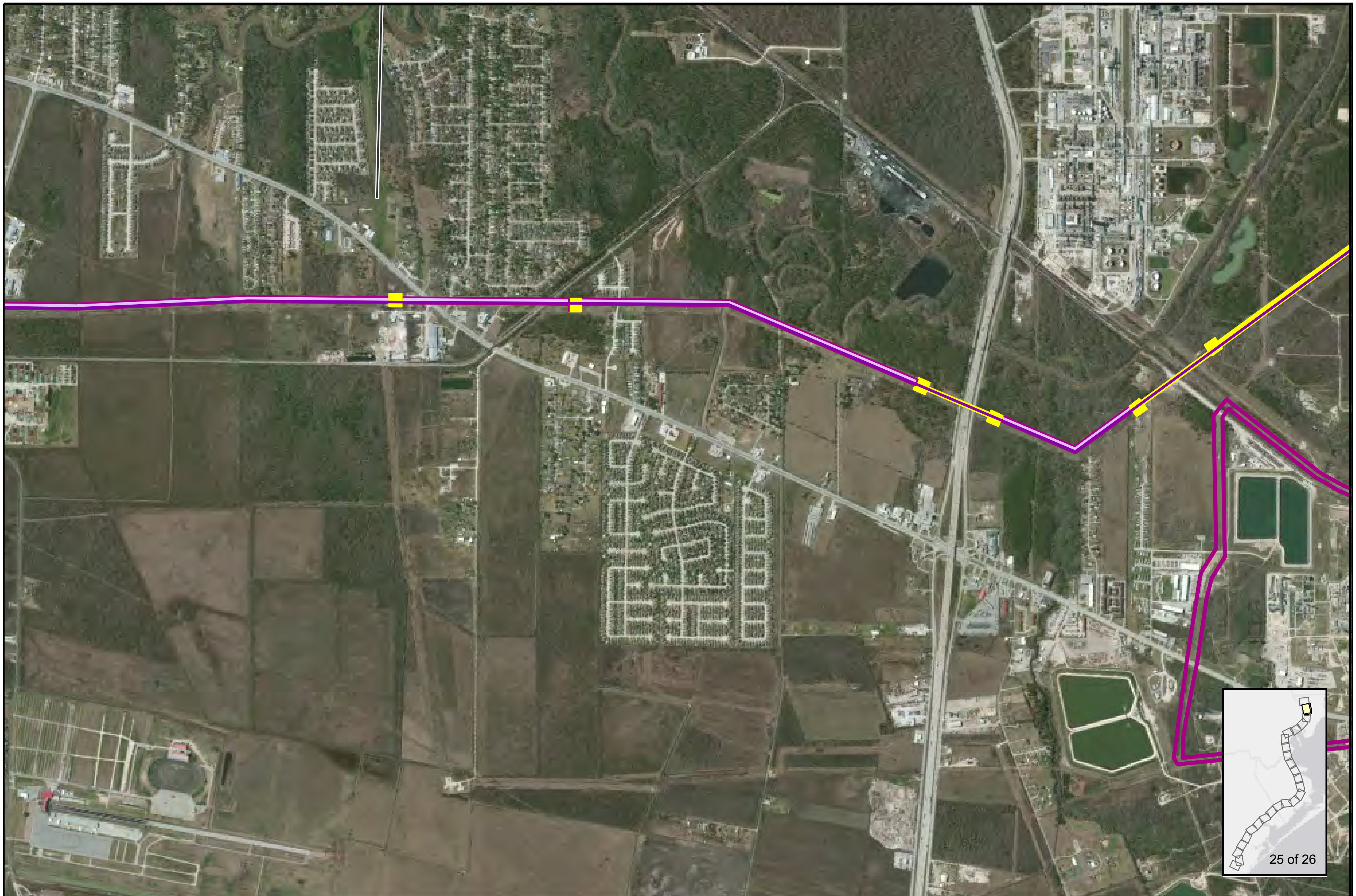

URS

N

0 0.25 0.5

Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.25 of 10

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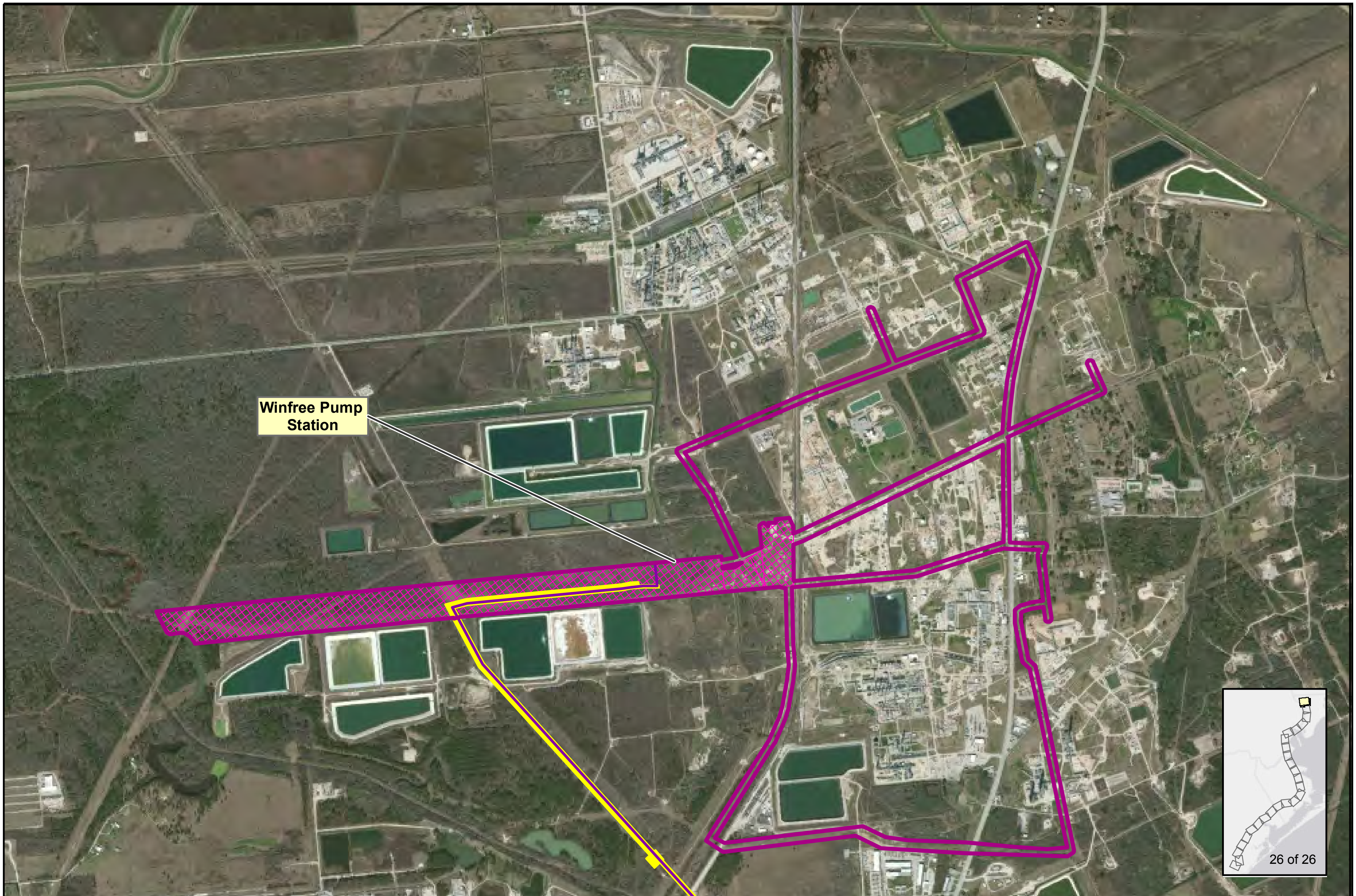

URS

N

0 0.25 0.5
Miles

Legend

- Proposed Pipeline
- Existing Pipeline
- Existing Action Area
- Effluent Mixing
- HDD
- HDD Workspace
- Construction ROW
- Additional Temporary Workspace
- Proposed Facilities
- LHC-9
- Winfree Property
- Outfall Discharge
- Drill Point

Action Area

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	3.26 of 10

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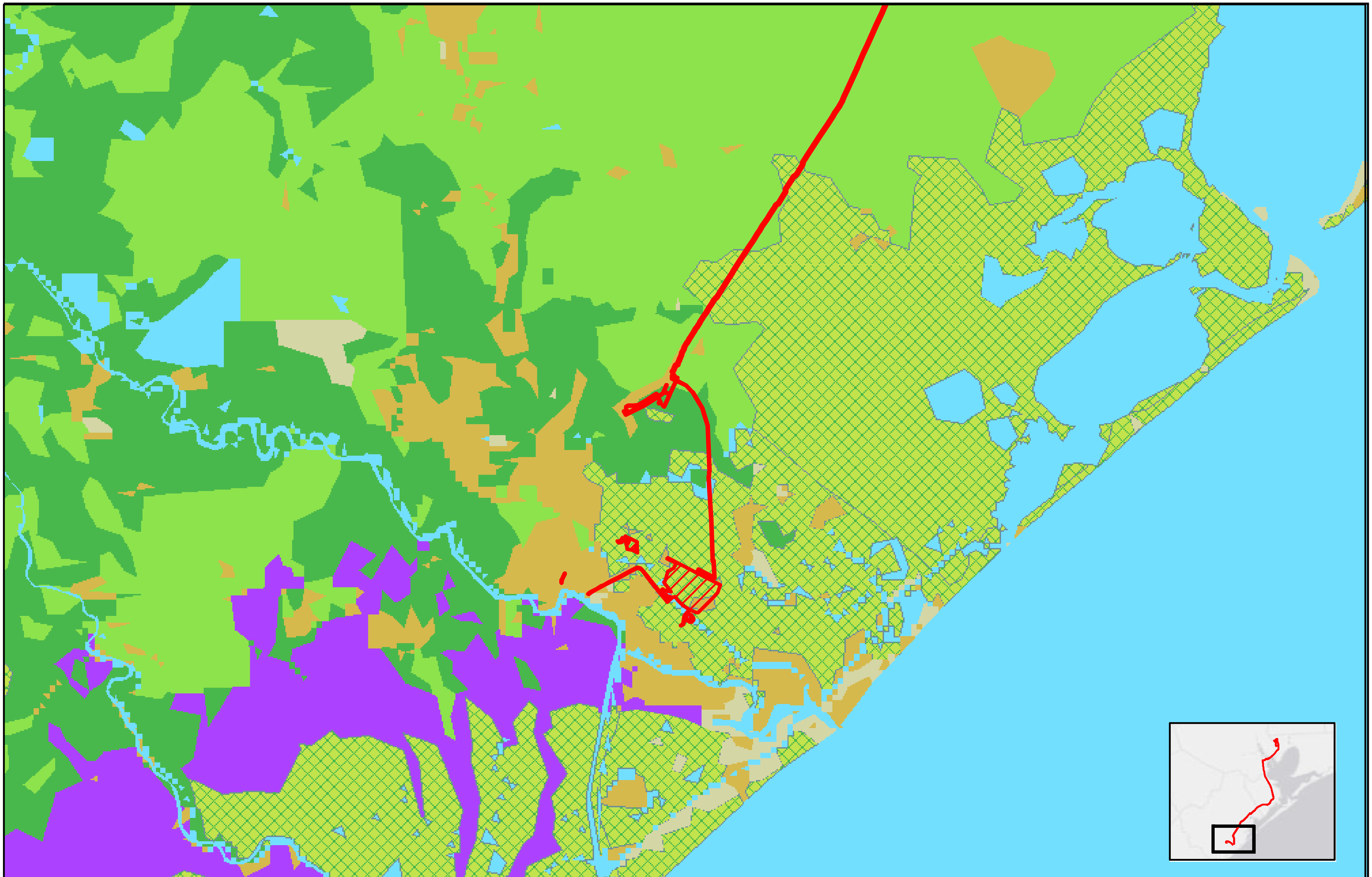

URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland

N

0 1.25 2.5 Miles

Note: Landuse data provided by NOAA C-CAP

Land Use Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	4.1 of 10

O:\Projects\ENV30\41569339\GIS\MXD\BA\2014Update\Fig_4_LandUse_Map.mxd

URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland

N

0 1.25 2.5 Miles

Note: Landuse data provided by NOAA C-CAP

Land Use Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	4.2 of 10

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland

N

0 1.25 2.5 Miles

Note: Landuse data provided by NOAA C-CAP

URS

Land Use Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	4.3 of 10

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URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland

N

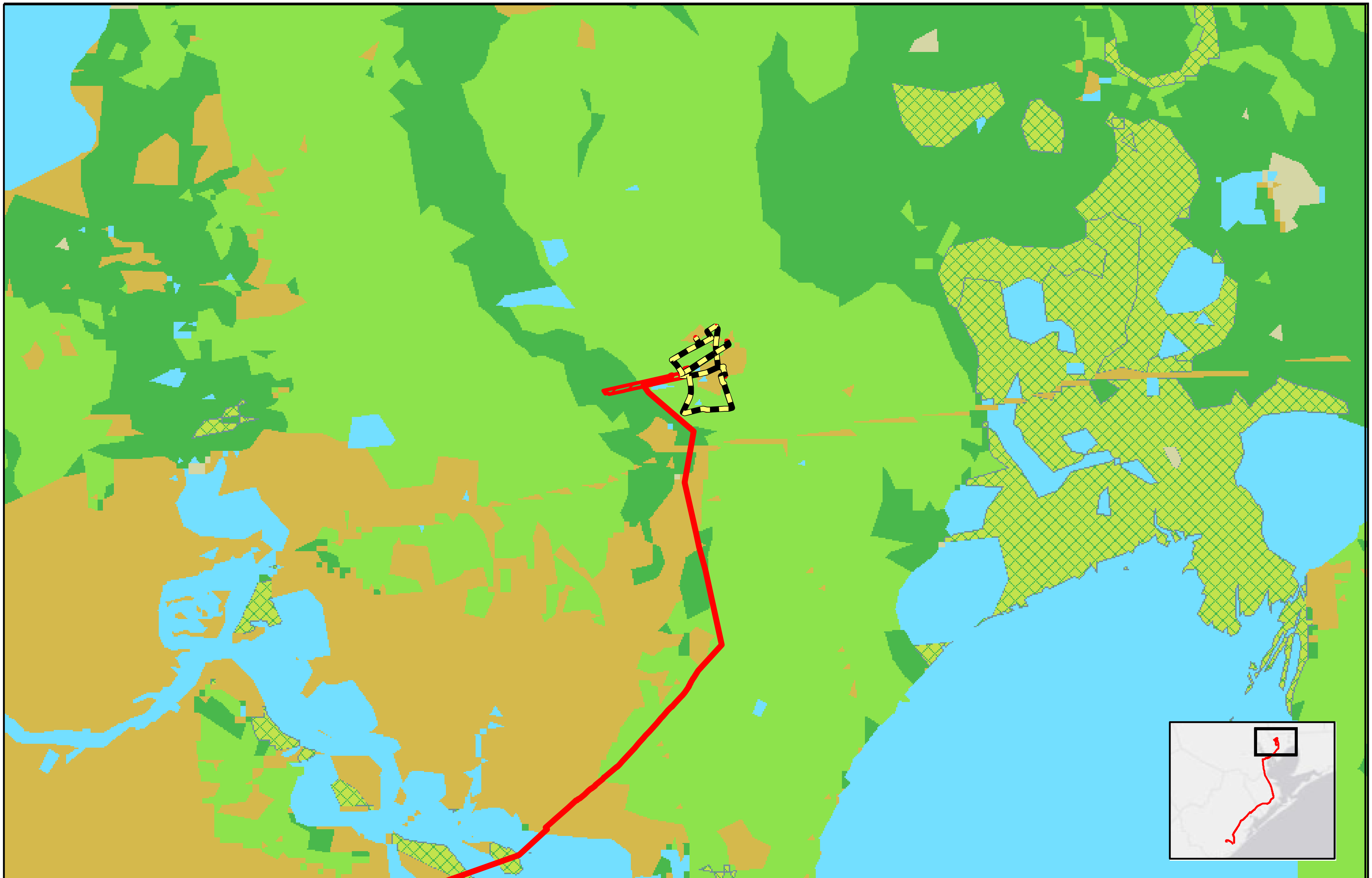
0 1.25 2.5 Miles

Note: Landuse data provided by NOAA C-CAP

Land Use Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	4.4 of 10



Legend

- Ethane Collection Lines
- Proposed Pipeline
- Agricultural Land
- Barren Land
- Forest Land
- Rangeland
- Urban or Built-up Land
- Water
- Wetland

URS

Note: Landuse data provided by NOAA C-CAP

Land Use Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	4.5 of 10

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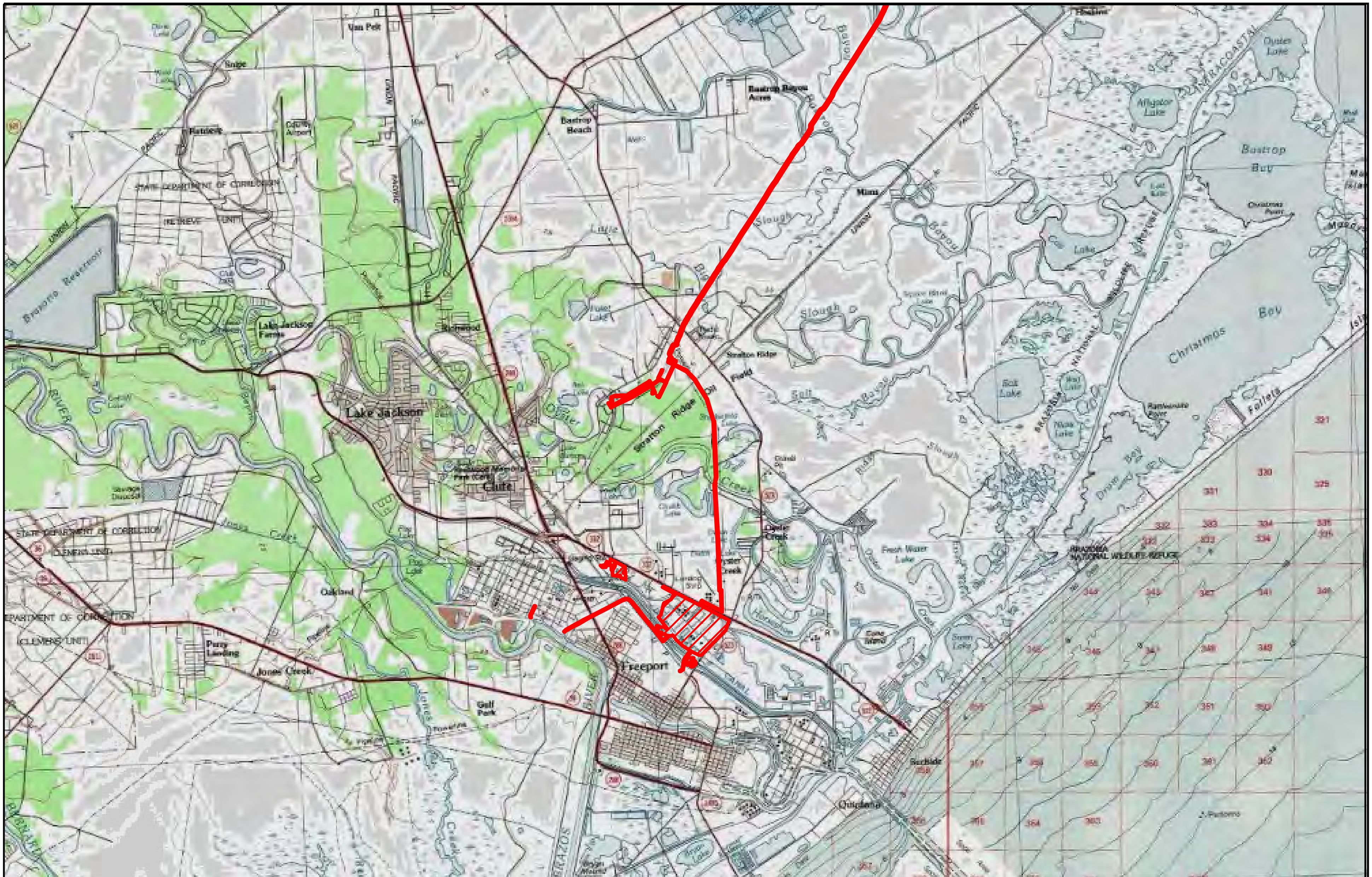

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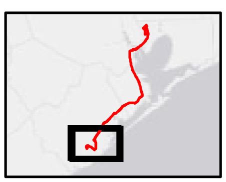

Legend

Proposed Pipeline

N

0 1.25 2.5 Miles

Topographic Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/7/2014	41569339	5.1 of 10

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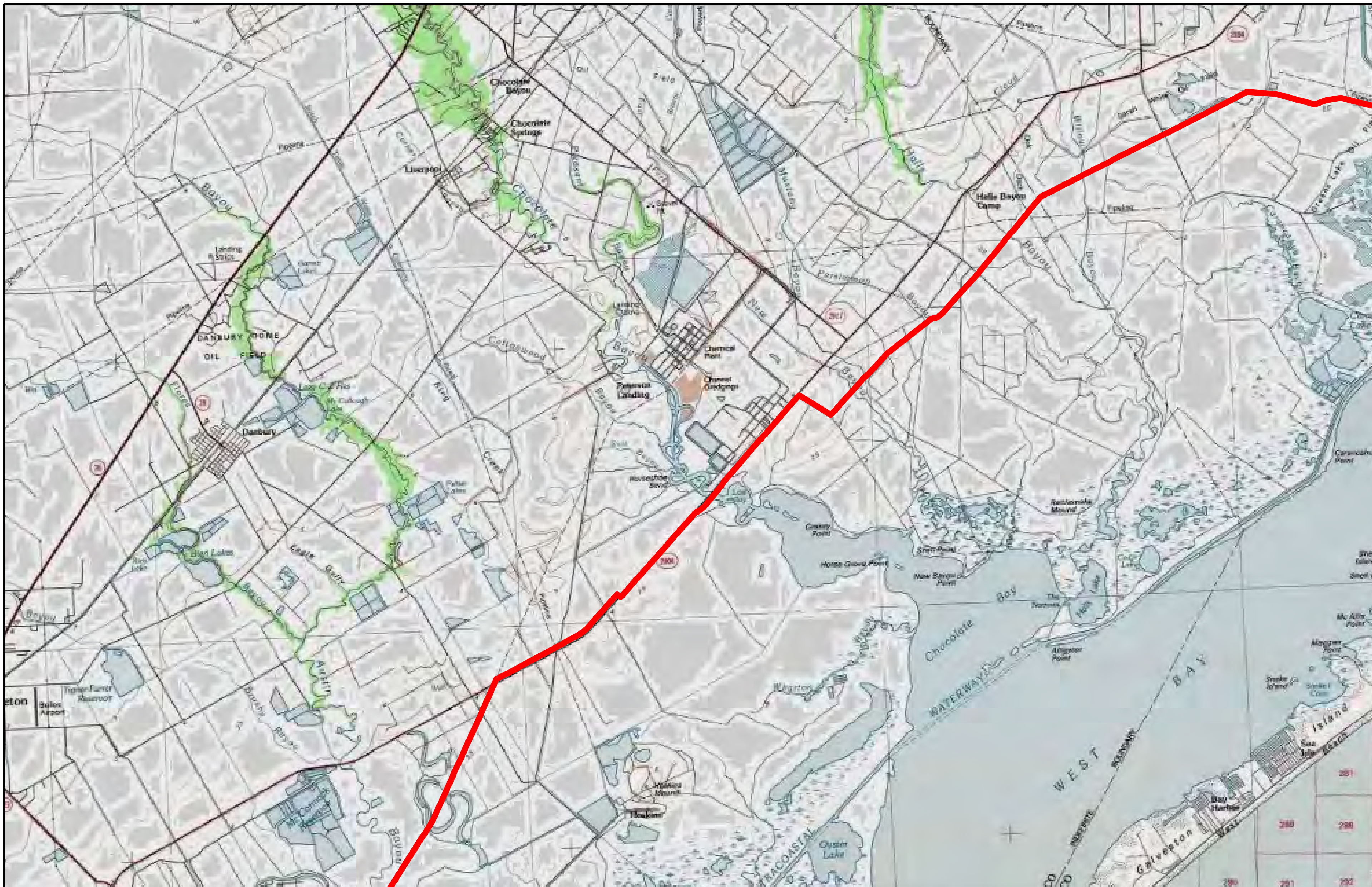

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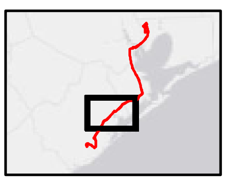


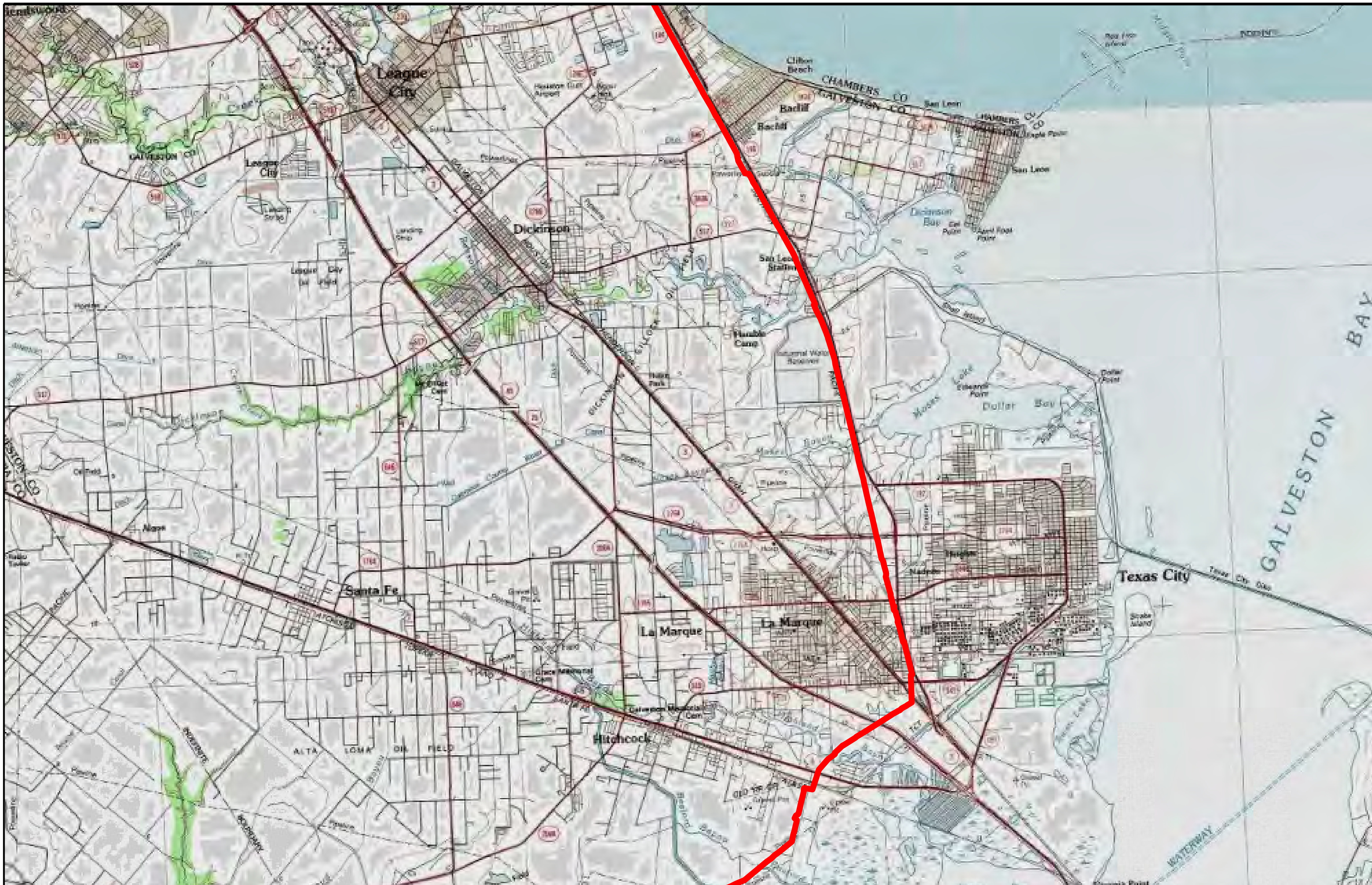
Legend

Proposed Pipeline

N

0 1.25 2.5 Miles

Topographic Map			
Dow LHC-9 Unit Installation Project			
Drawn By: CW	Date: 2/7/2014	Project No.: 41569339	Figure: 5.2 of 10



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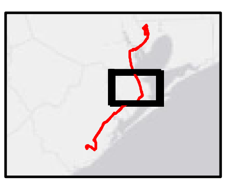

Legend

Proposed Pipeline

N

0 1.25 2.5 Miles

Topographic Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/7/2014	41569339	5.3 of 10

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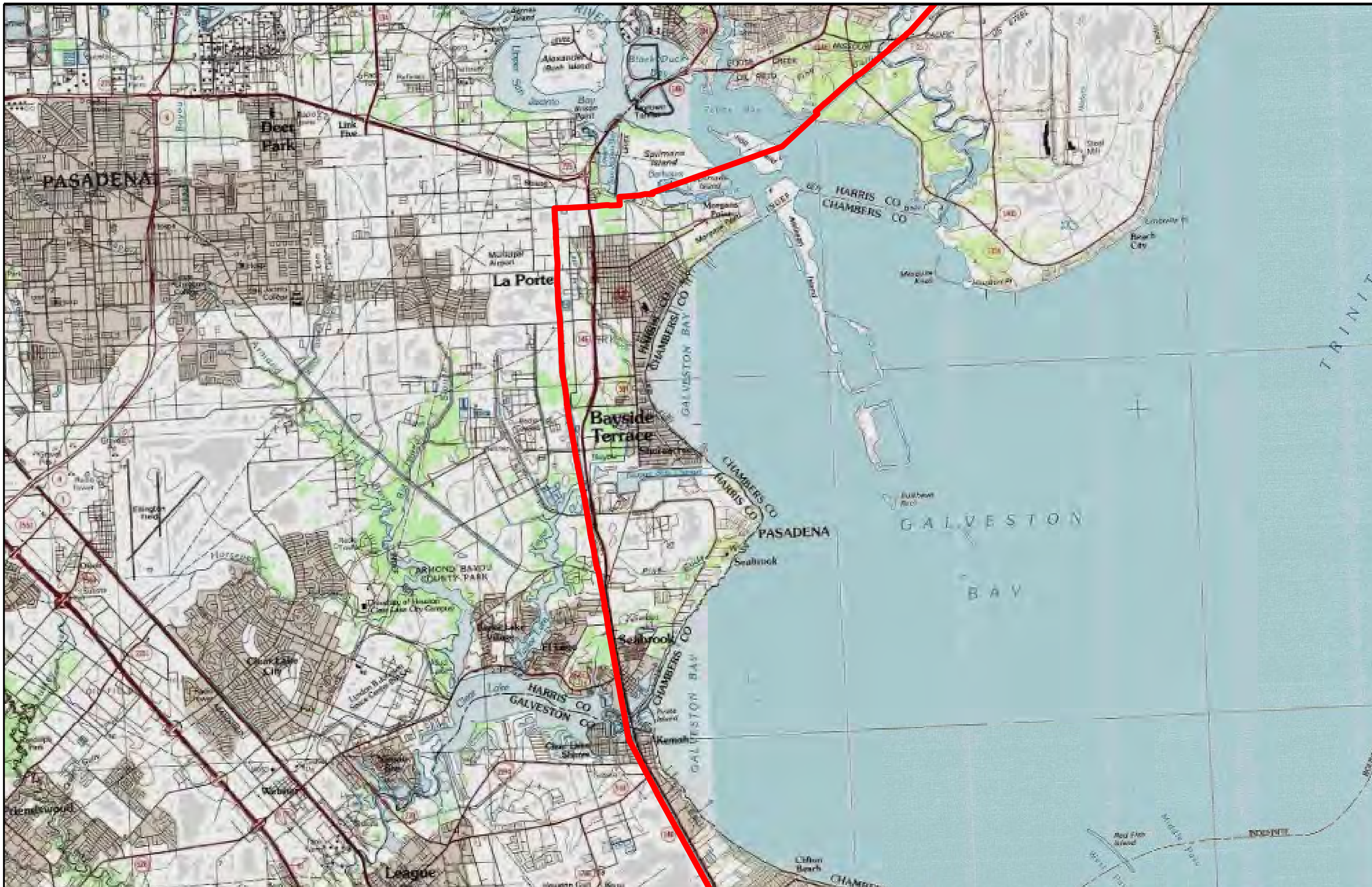

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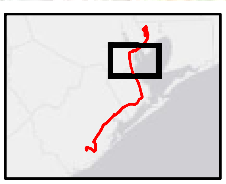


Legend

Proposed Pipeline

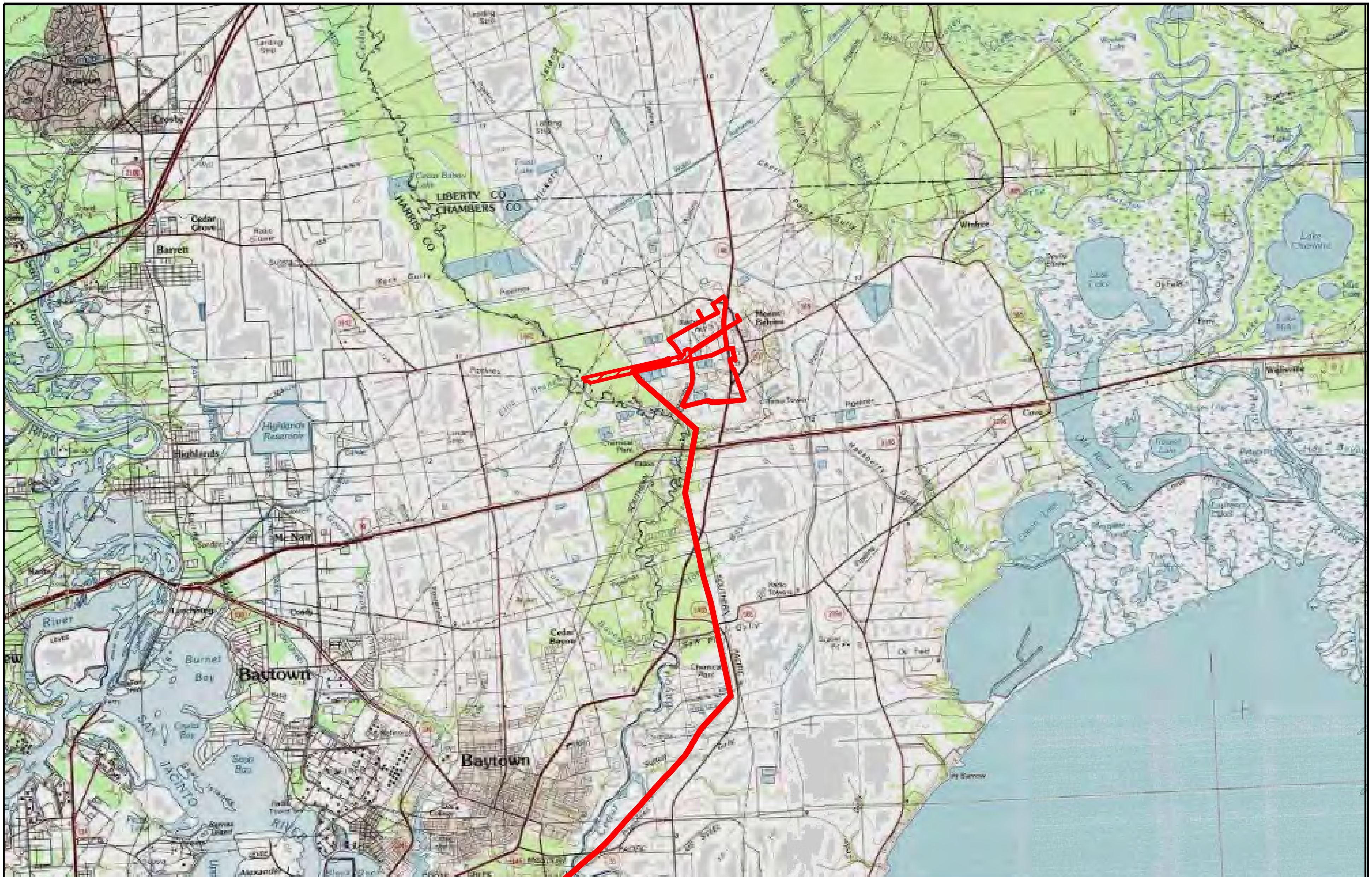
N

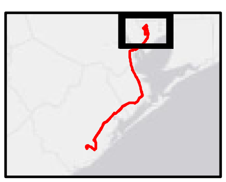
0 1.25 2.5 Miles

Topographic Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/7/2014	41569339	5.4 of 10





Legend

Proposed Pipeline

N

0 1.25 2.5 Miles

URS

Topographic Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/7/2014	41569339	5.5 of 10

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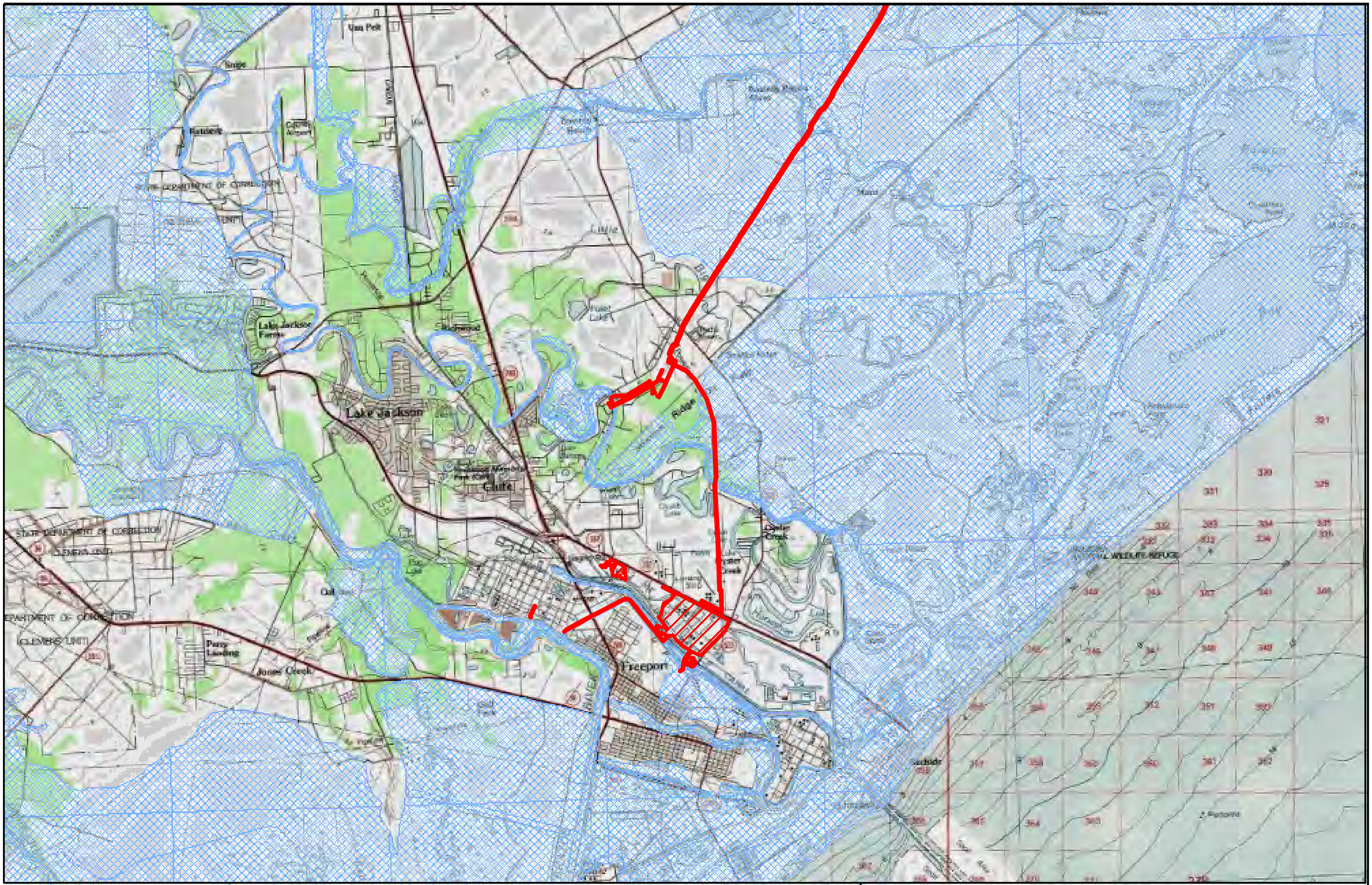

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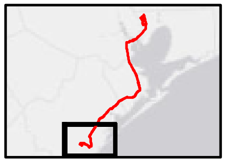


Legend

- Proposed Pipeline
- Ethane Collection Lines
- 100 Year Floodplain

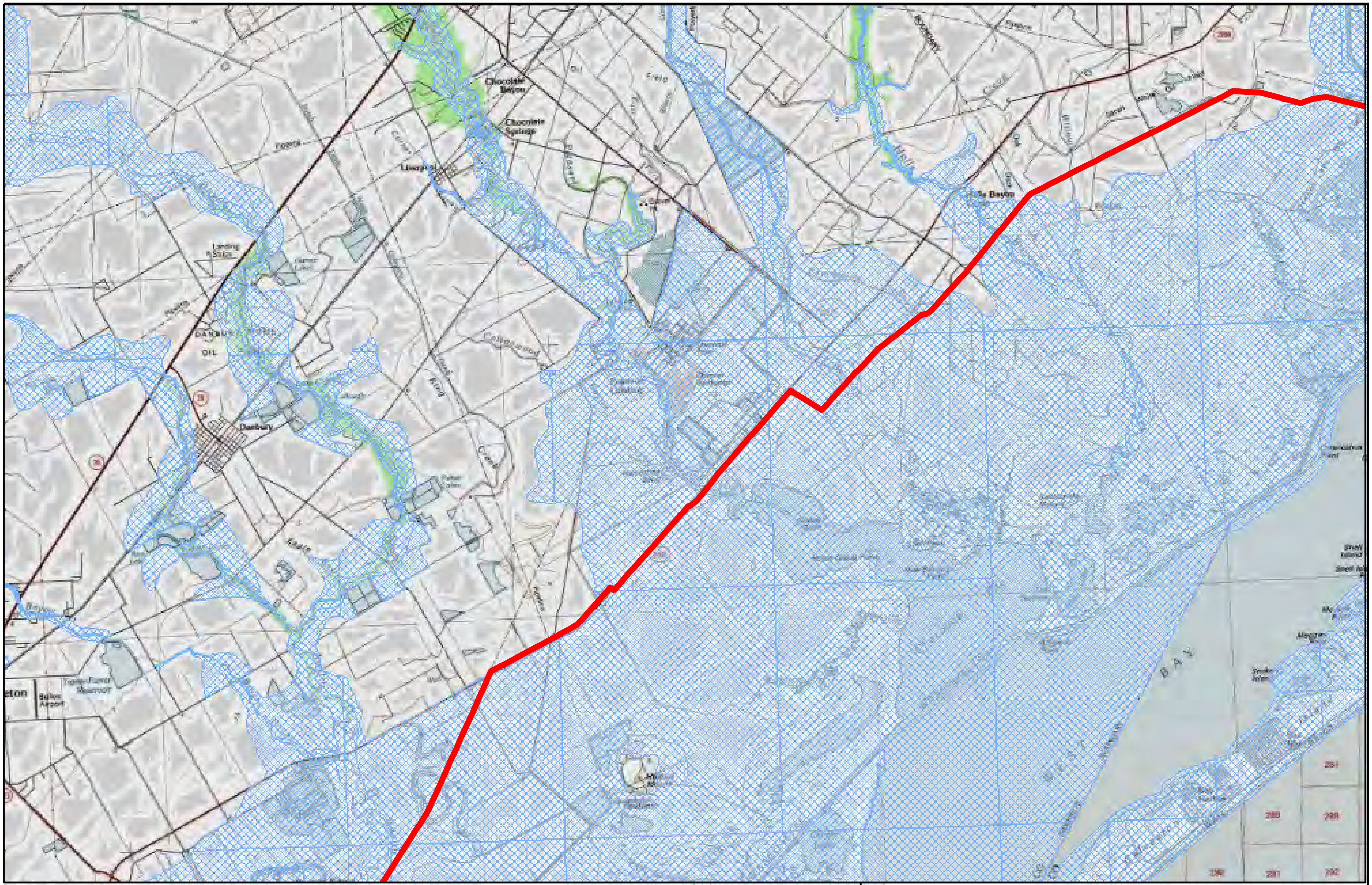
N

Miles: 0 | 1.25 | 2.5

FEMA 100-Year Floodplain Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	6.1 of 10



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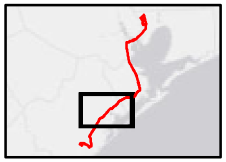

Legend

- Proposed Pipeline
- Ethane Collection Lines
- 100 Year Floodplain

N

0 1.25 2.5 Miles

FEMA 100-Year Floodplain Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	6.2 of 10

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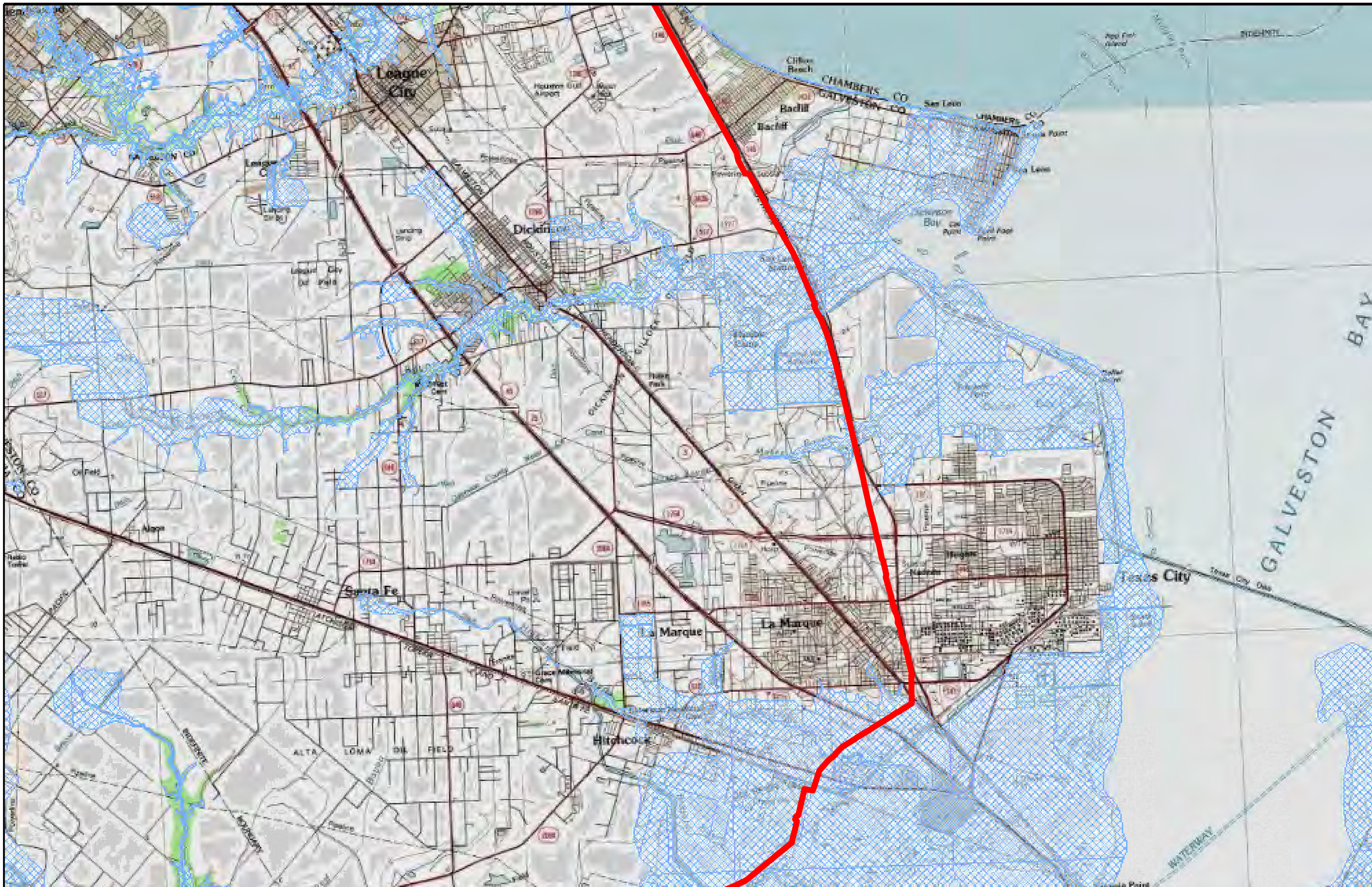

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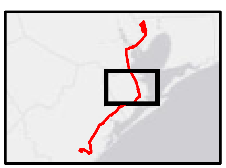

Legend

- Proposed Pipeline
- Ethane Collection Lines
- 100 Year Floodplain

N

0 1.25 2.5 Miles

FEMA 100-Year Floodplain Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	6.3 of 10

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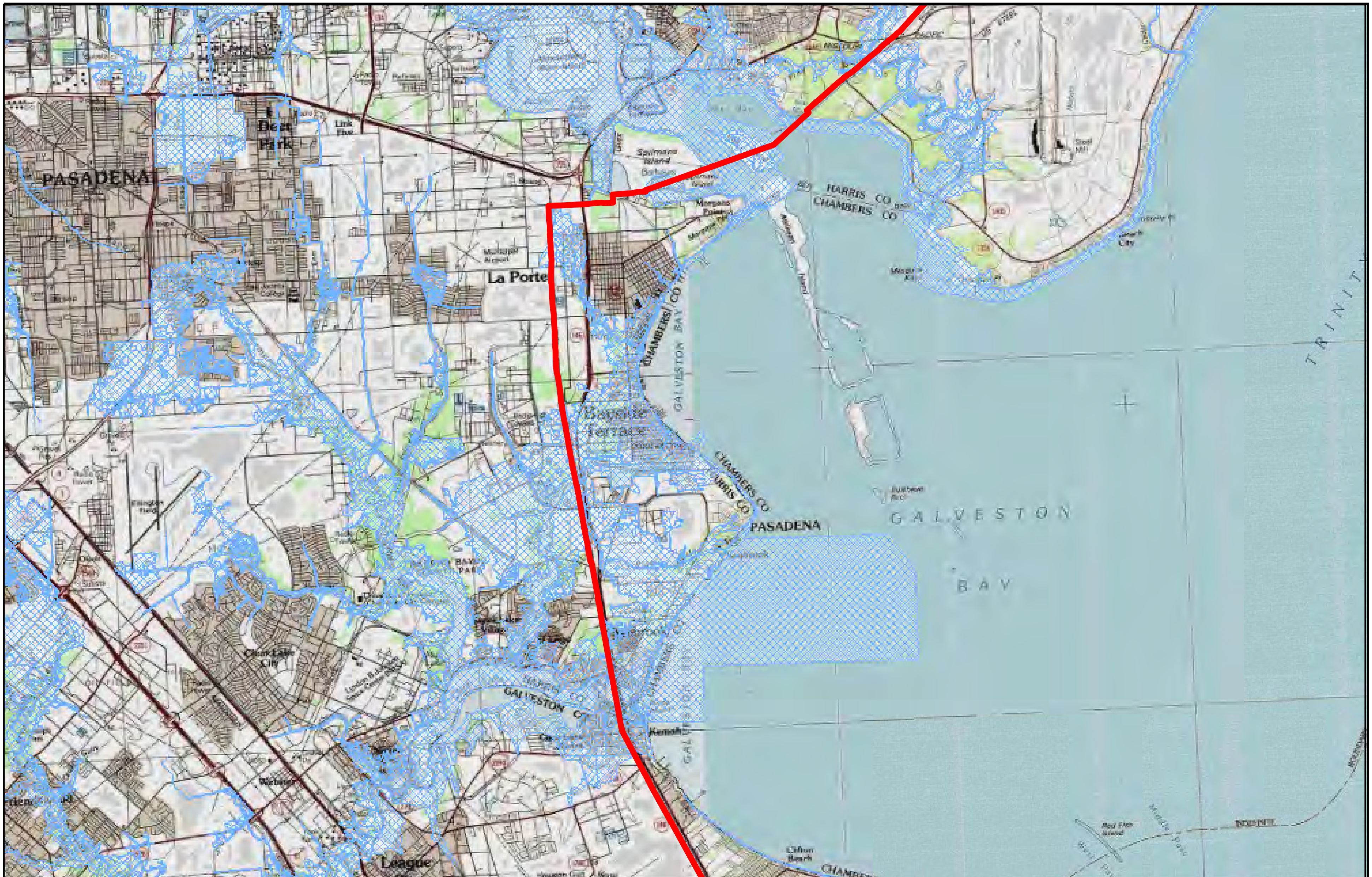

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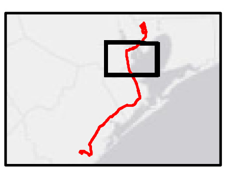

Legend

- Proposed Pipeline
- Ethane Collection Lines
- 100 Year Floodplain

N

0 1.25 2.5 Miles

FEMA 100-Year Floodplain Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	6.4 of 10

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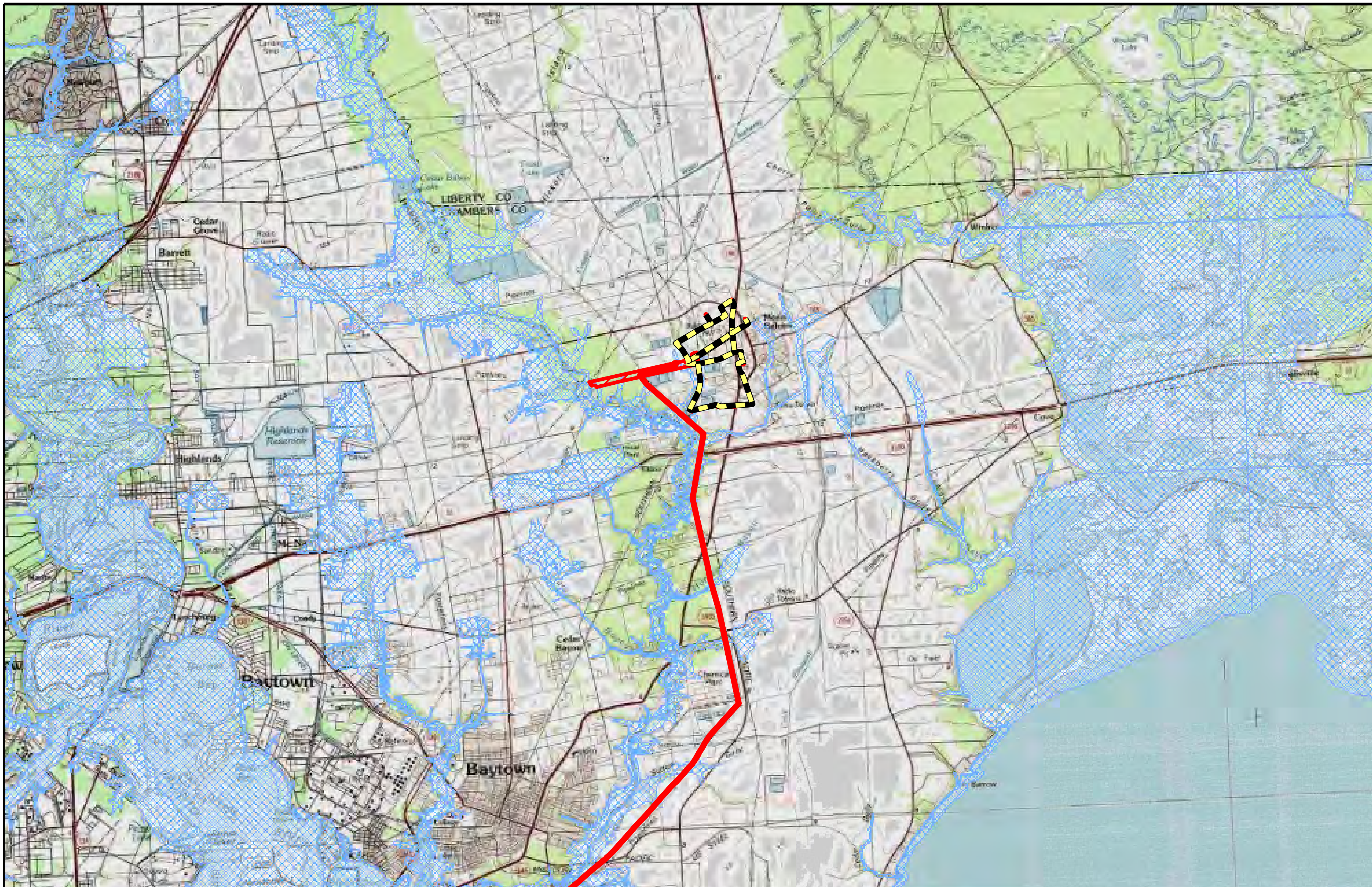
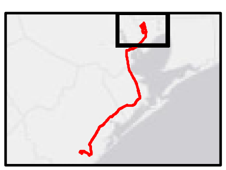


URS



Legend

- Proposed Pipeline
- Ethane Collection Lines
- 100 Year Floodplain

N

0 1.25 2.5 Miles

FEMA 100-Year Floodplain Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	6.5 of 10

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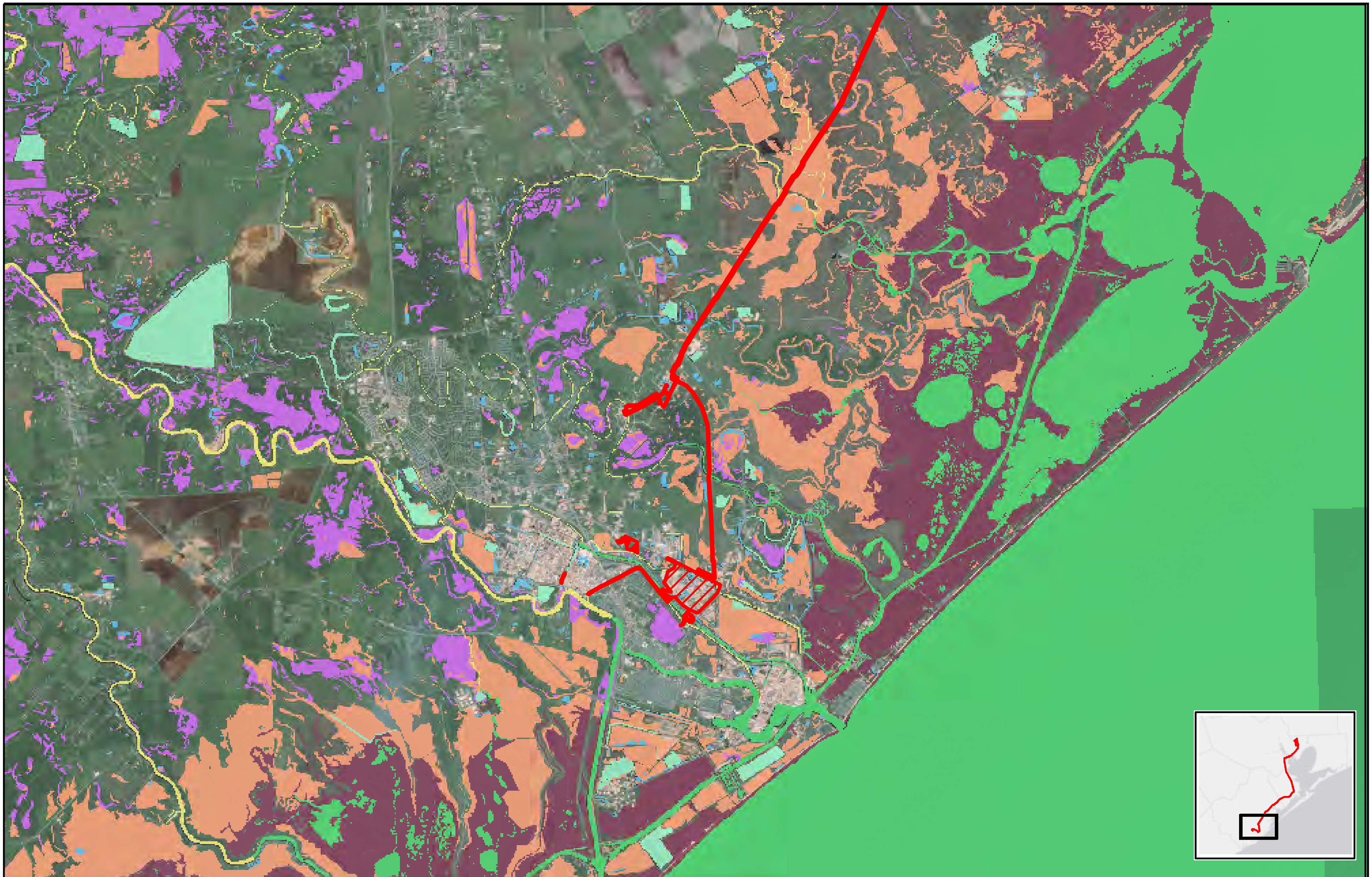


URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

N

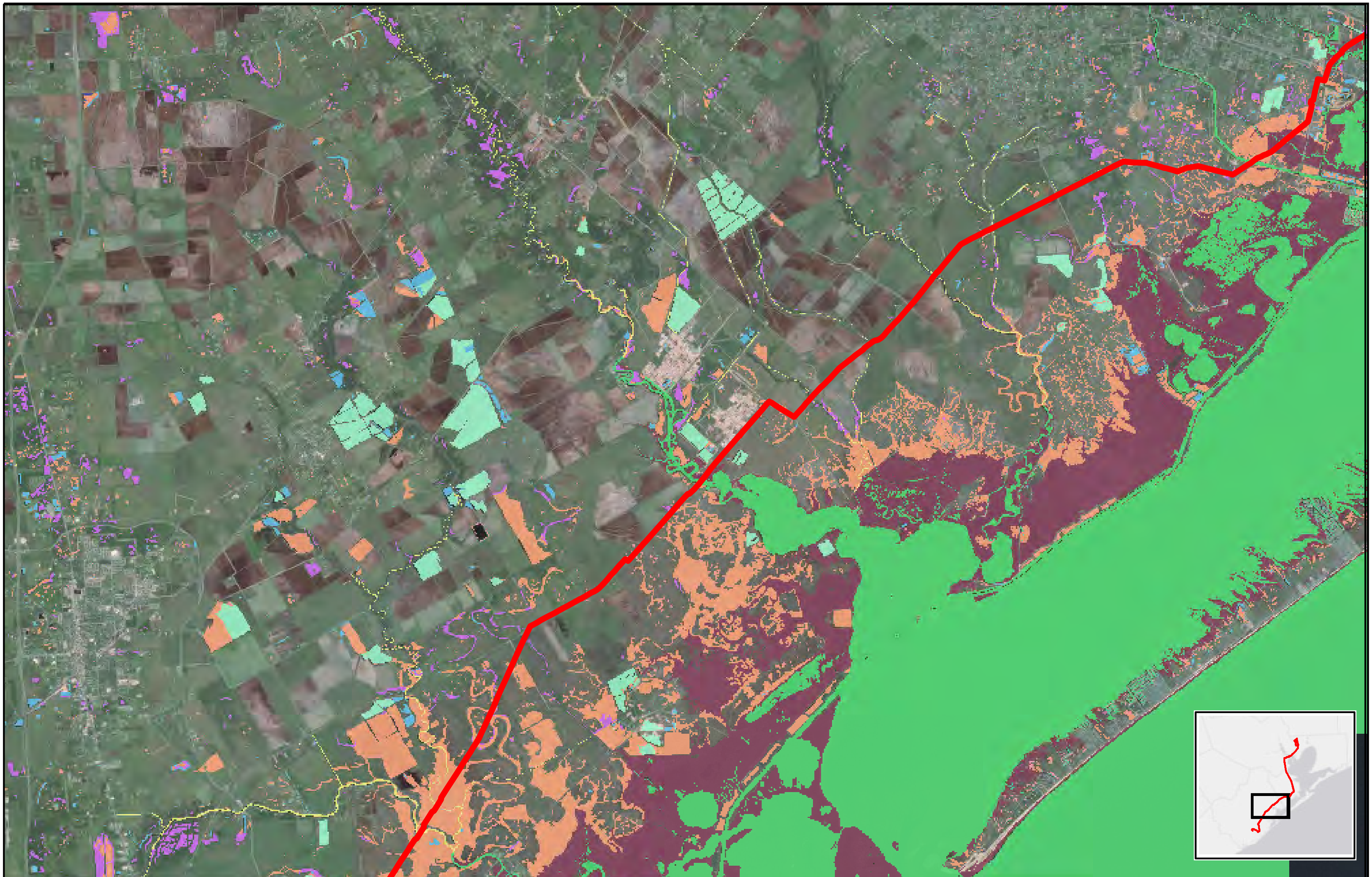
0 1.25 2.5 Miles

National Wetlands Inventory Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	7.1 of 10

O:\Projects\ENV30\41569339\GIS\MXD\BA\2014Update\Fig_7_NWI_Map.mxd



URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

N

0 1.25 2.5 Miles

National Wetlands Inventory Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	7.2 of 10

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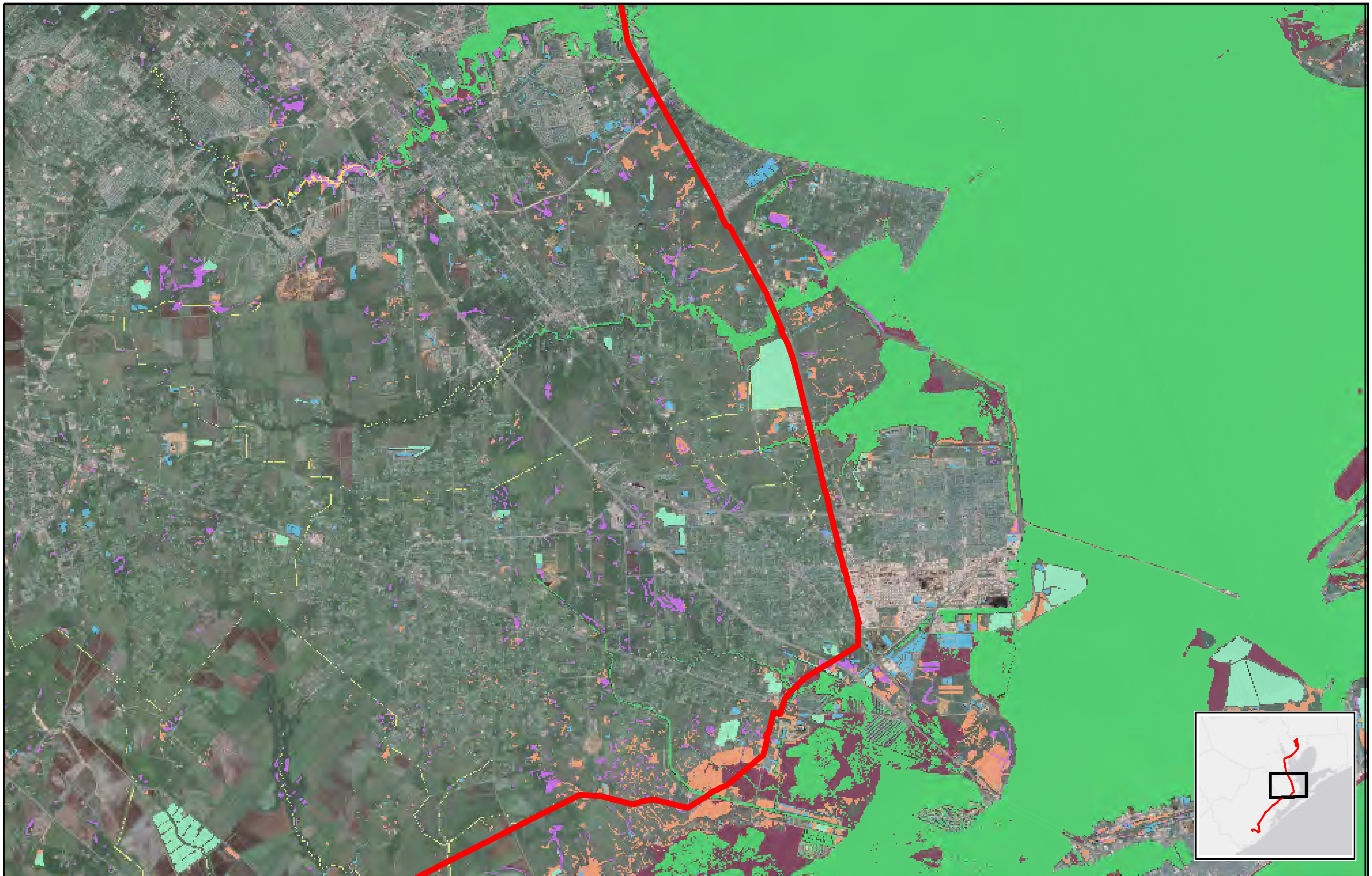


URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

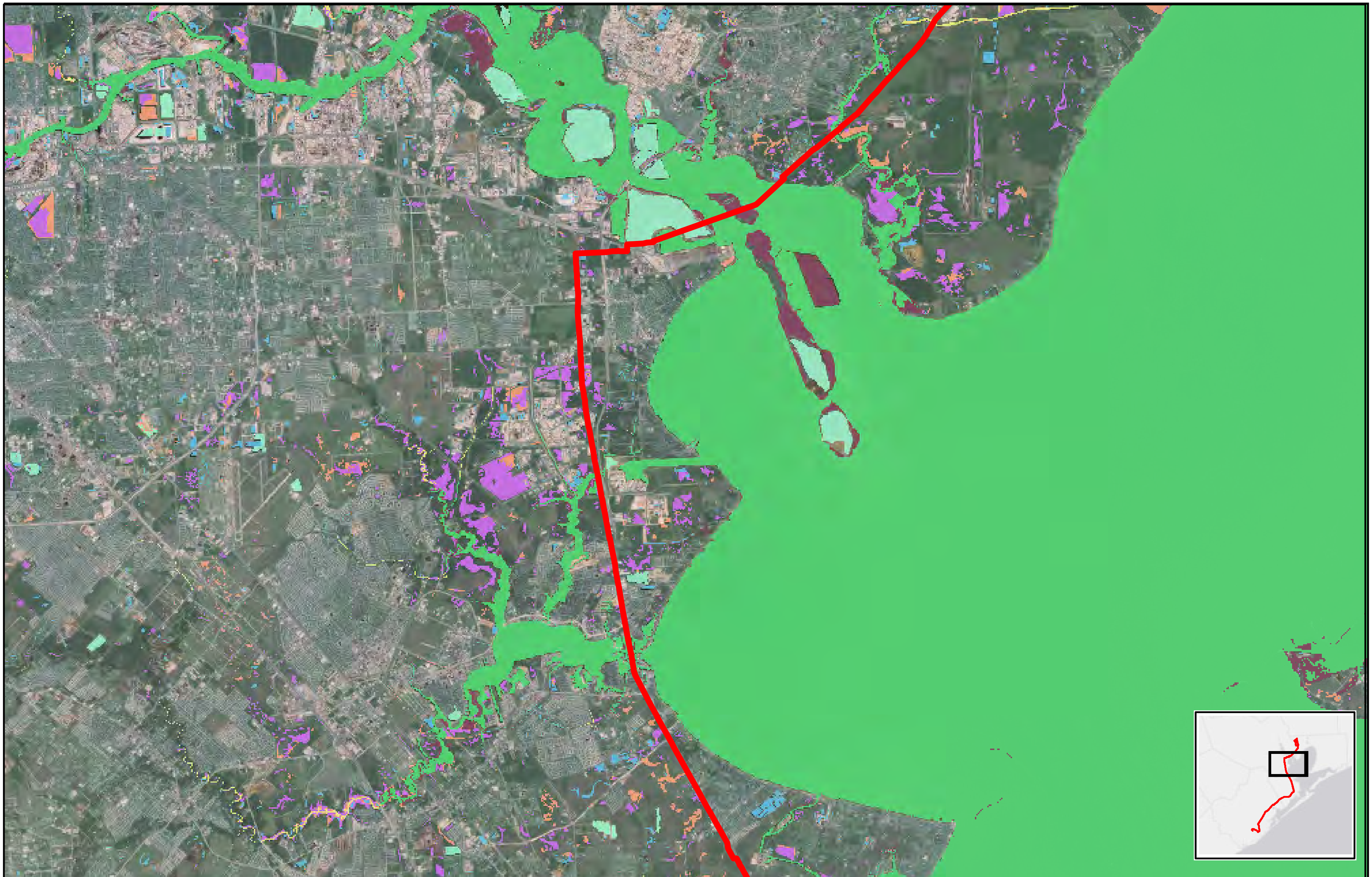
N

0 1.25 2.5 Miles

National Wetlands Inventory Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	7.3 of 10



URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

N

0 1.25 2.5 Miles

National Wetlands Inventory Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	7.4 of 10

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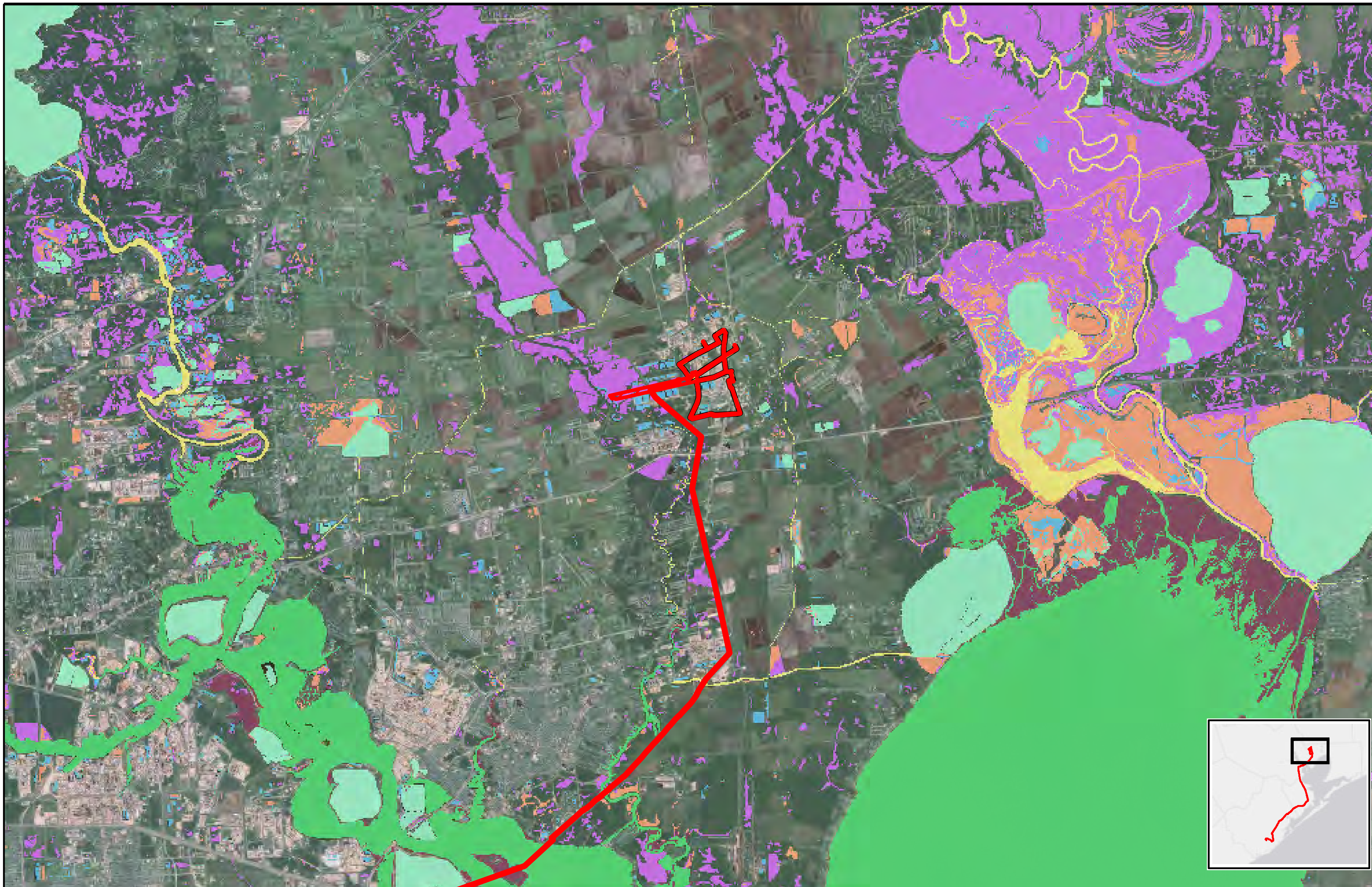

URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

N

0 1.25 2.5 Miles

National Wetlands Inventory Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	7.5 of 10

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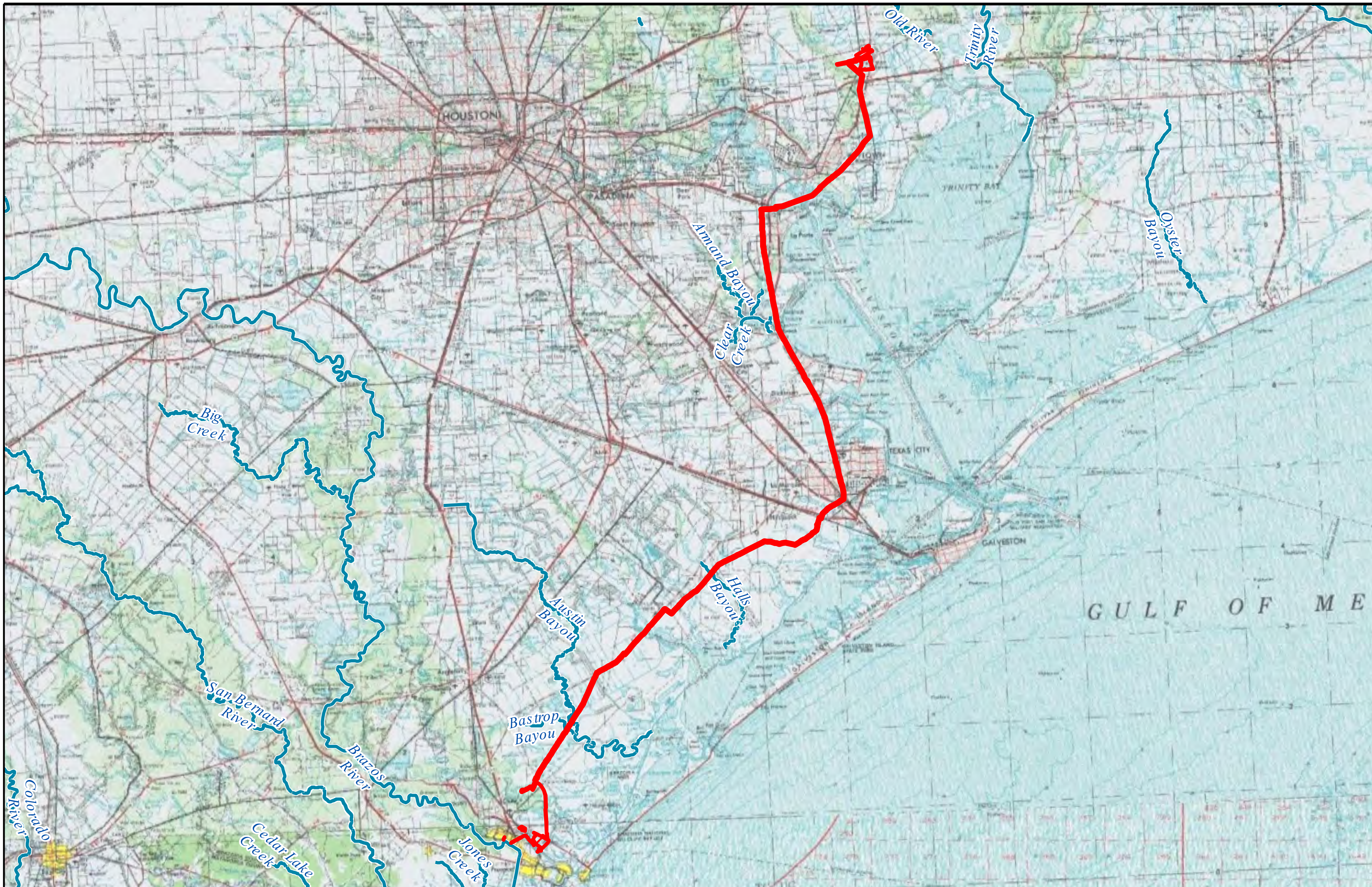

URS

Legend

- Proposed Pipeline
- Ethane Collection Lines
- Significant Streams in Texas

N

0 5 10 Miles

Significant Stream Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
AM	2/7/2014	41569339	8 of 10

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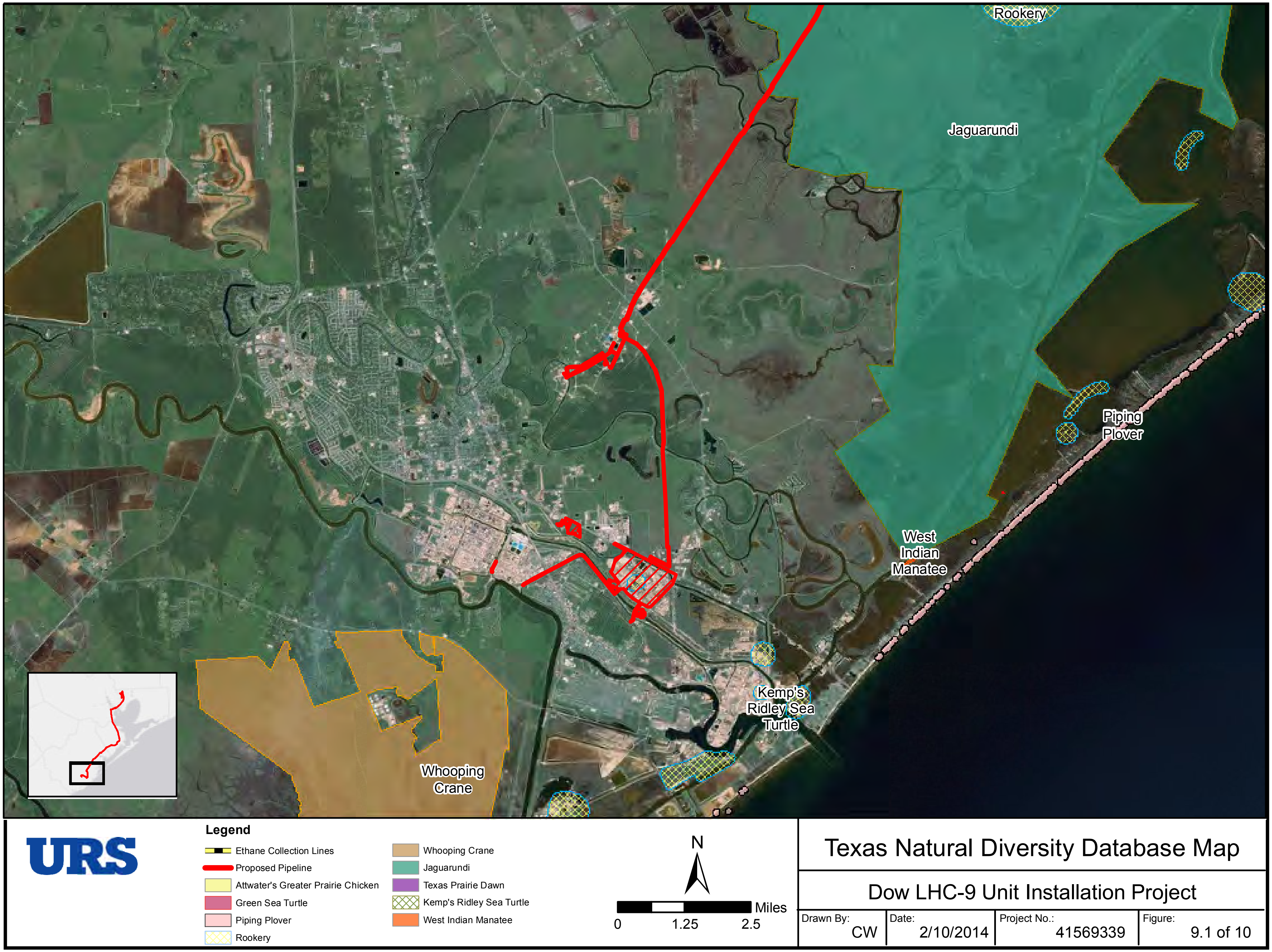

URS

Texas Natural Diversity Database Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	9.1 of 10

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URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Attwater's Greater Prairie Chicken
- Green Sea Turtle
- Piping Plover
- Rookery
- Whooping Crane
- Jaguarundi
- Texas Prairie Dawn
- Kemp's Ridley Sea Turtle
- West Indian Manatee

N

0 1.25 2.5 Miles

Texas Natural Diversity Database Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	9.2 of 10

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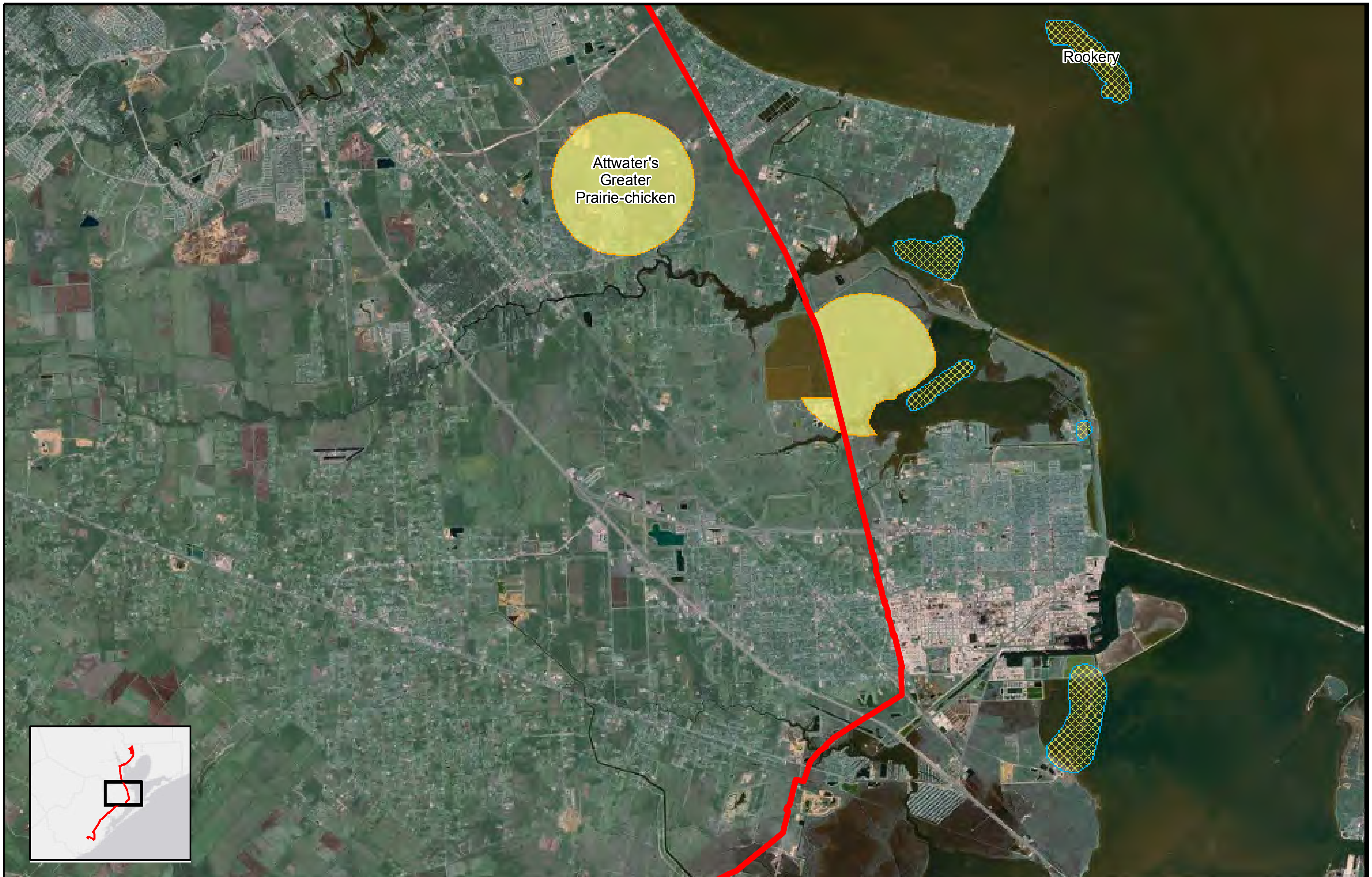

URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Attwater's Greater Prairie Chicken
- Green Sea Turtle
- Piping Plover
- Rookery
- Whooping Crane
- Jaguarundi
- Texas Prairie Dawn
- Kemp's Ridley Sea Turtle
- West Indian Manatee

N

0 1.25 2.5 Miles

Texas Natural Diversity Database Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	9.3 of 10

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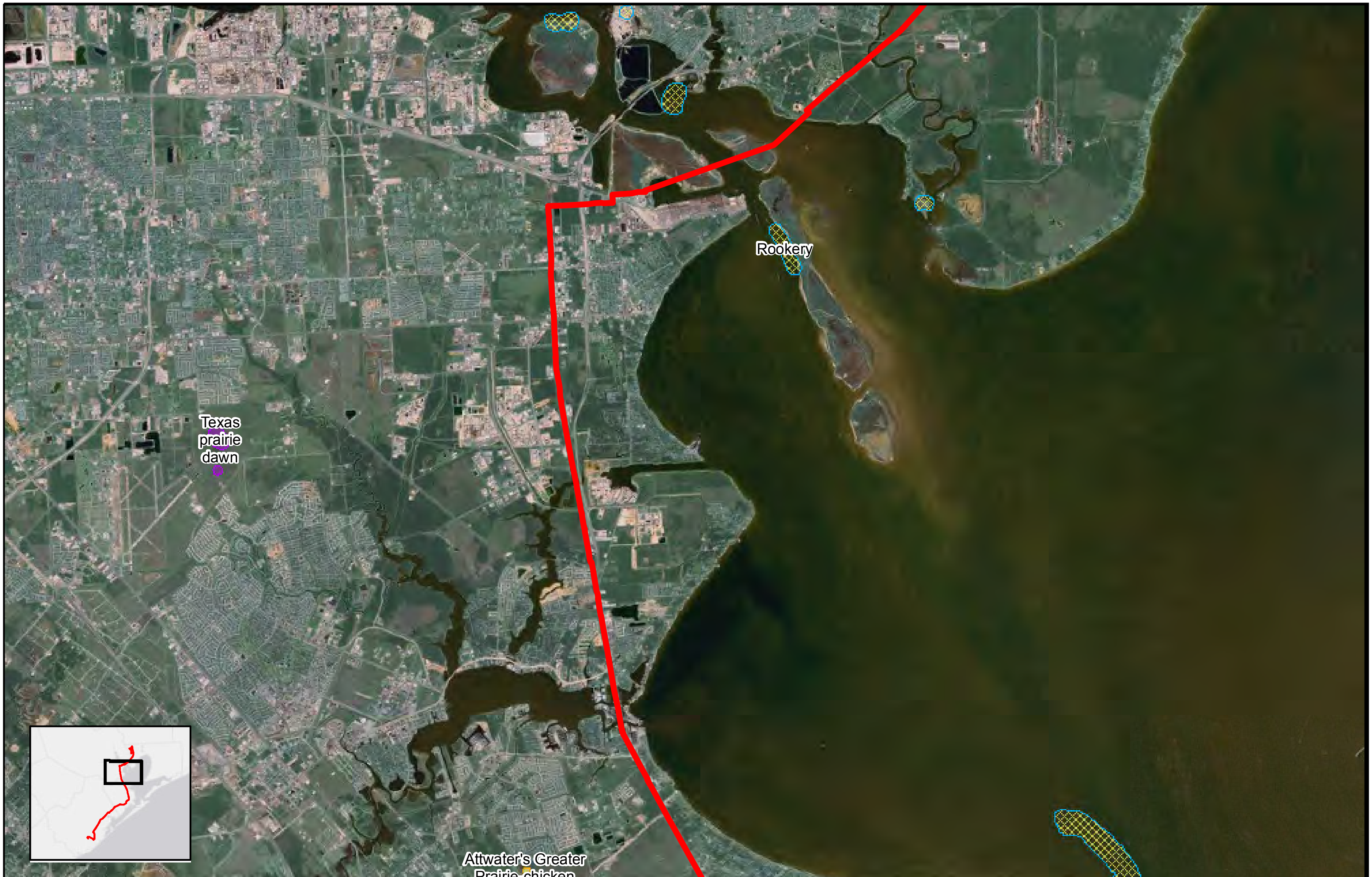

URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Attwater's Greater Prairie Chicken
- Green Sea Turtle
- Piping Plover
- Rookery
- Whooping Crane
- Jaguarundi
- Texas Prairie Dawn
- Kemp's Ridley Sea Turtle
- West Indian Manatee

N

0 1.25 2.5 Miles

Texas Natural Diversity Database Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	9.4 of 10

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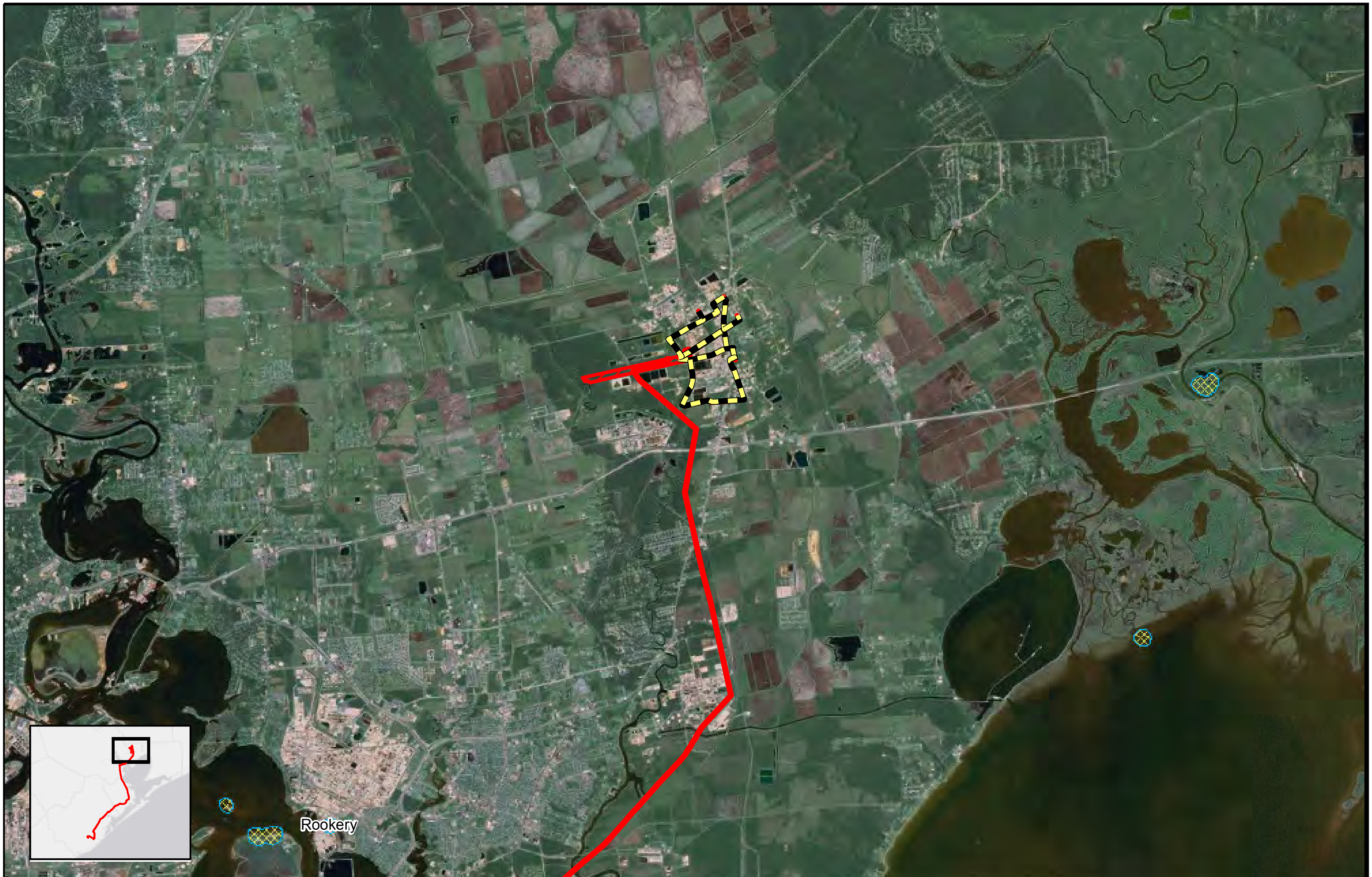

URS

Legend

- Ethane Collection Lines
- Proposed Pipeline
- Attwater's Greater Prairie Chicken
- Green Sea Turtle
- Piping Plover
- Rookery
- Whooping Crane
- Jaguarundi
- Texas Prairie Dawn
- Kemp's Ridley Sea Turtle
- West Indian Manatee

N

0 1.25 2.5 Miles

Texas Natural Diversity Database Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
CW	2/10/2014	41569339	9.5 of 10

URS

Oyster Creek Facility
NO2- 1 Hour
PM2.5- Annual
PM2.5- 24 Hour
SO2- 24 Hour
SO2- 1 Hour

N

0 750 1,500 Feet

Significant Impact Level Exceedance Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
AM	3/20/2013	41569339	10 of 10

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URS

Appendix A

Photographic Log

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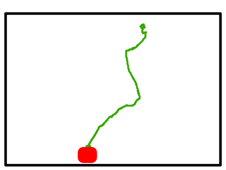
URS



Oyster Creek Facility

N

0 1,000 2,000 Feet

Photo Location Map

Dow LHC-9 Unit Installation Project

Drawn By:	Date:	Project No.:	Figure:
AM	3/20/2013	41569339	

URS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	1

Direction Photo Taken:

NE

Description:

LHC-9 Project Site

Date	Photo No.
2/22/2013	2

Direction Photo Taken:

NE

Description:

Southern boundary of LHC-9 site looking Northeast toward adjacent LHC-8 unit.

URS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	3

Direction Photo Taken:

N

Description:

Southern boundary of LHC-9 site looking North toward adjacent flare system.

Date	Photo No.
2/22/2013	4

Direction Photo Taken:

E

Description:

Southern boundary of LHC-9 site looking East toward adjacent process units.

URS

PHOTOGRAPHIC LOG

Client Name:	**Site Location:**	**Project No.**
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	**Photo No.**
2/22/2013	5

Direction Photo Taken:

SE

Description:

Southern boundary of LHC-9 site looking East along access road and levee. Access Road (OC 1) and Levee will be relocated south for citing of the LHC-9 Furnaces.

Date	**Photo No.**
2/22/2013	6

Direction Photo Taken:

SW

Description:

Southern boundary of LHC-9 site looking South at adjacent pipeline ROW and Dow Barge Canal levee.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	7

Direction Photo Taken:

W

Description:

Southern boundary of LHC-9 site looking West along access road (OC 1) and levee.

Date	Photo No.
2/22/2013	8

Direction Photo Taken:

NE

Description:

View of the LHC-9 Site. The site previously maintained the Chlor-Alkali, Unit II which was decommissioned and demolished. The site maintains some of the former pilings and concrete slabs from the former process unit.

URS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	9

Direction Photo Taken:

SW

Description:

LHC-9 Multi-Point Ground Flare Site.

Date	Photo No.
2/22/2013	10

Direction Photo Taken:

NE

Description:

LHC-9 Cooling Tower Site.

URS

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	11

Direction Photo Taken:

NE

Description:

LHC-9 Wastewater line will be routed over the Dow Barge Canal utilizing an existing pipe rack (left), then directionally drilled under Canal Road and Wastewater Canal terminating at an existing pipeline ROW.

Directional drill site.

Date	Photo No.
2/22/2013	12

Direction Photo Taken:

S

Description:

View of pipeline interconnects and ROW south of the Wastewater Canal.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	13

Direction Photo Taken:

N

Description:

Outfall 202. Effluent discharge from LHC-9 will be piped to the Plant B WWTP then discharged from Outfall 202 to the Brazos River via Outfall 002.

Date	Photo No.
2/22/2013	14

Direction Photo Taken:

N

Description:

Outfall 002.

A floodgate is located just north of this pipe rack structure. An identical floodgate is located near Outfall 001.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	15

Direction Photo Taken:

SE

Description:

Outfall 002 at the Brazos River south of the floodgate.

Date	Photo No.
2/22/2013	16

Direction Photo Taken:

NW

Description:

Wastewater Canal at Outfall 901. Cooling tower blow down and Regeneration water will be discharged to the Wastewater Canal via Outfall 901. The Wastewater Canal flows southwest to the Brazos River via Outfall 001.

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	17

Direction Photo Taken:

NE

Description:

Wastewater Canal at Outfall 001.

Date	Photo No.
2/22/2013	18

Direction Photo Taken:

SE

Description:

Floodgate northeast of Outfall 001 in the wastewater canal. An identical floodgate is present near Outfall 002.

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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	19

Direction Photo Taken:

S

Description:

Outfall 001 at the Brazos River.The floodgate is north of this discharge point.

Date	Photo No.
2/22/2013	20

Direction Photo Taken:

SE

Description:

Proposed construction laydown area located west of Dow Oyster Creek on State Highway 332.

Site is currently being developed in association with other Dow projects that are currently underway, and will be subsequently used for LHC-9 construction.

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
The Dow Chemical Company	LHC-9 Unit Installation	41569339

Date	Photo No.
2/22/2013	21

Direction Photo Taken:

S

Description:

View of construction laydown area. Site observations indicate that the site was previously used as pastureland.

Date	Photo No.
2/22/2013	22

Direction Photo Taken:

SW

Description:

View of adjacent property to construction laydown area. Site observations indicate that the site was previously used as pastureland.

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Appendix B

Agency Correspondence

Records of Communication: **Amy Vargas, Senior Environmental Scientist**

February 5, 2014 Wade Harrell USFWS Aransas National Wildlife Refuge

Whooping cranes winter in Texas from October 15th through April 15th¸ based on averages. Whooping cranes in Freeport would be a rarity. Whooping crane populations are growing and as they do so they will continue to expand their reach up the coast. Temporary impacts from construction cranes would not be an issue at this time as long as there is a biological monitor approved to do whooping cranes available during construction. Regarding the need to do a formal consultation, he would defer to Edith Erfling of the Clear Lake Field Office.

January 31, 2014 Ben Higgins NOAA Galveston

I called with regard to a Dow Freeport Site expansion and the potential impacts to sea turtles. The project will discharge to the Brazos River Tidal, which is brackish; however, impacts to water quality will be negligible and will only occur within man-made wastewater canals upstream of floodgates >600 feet from the Brazos River. Mr. Higgens stated that sea turtles can be found in brackish tidal rivers, and will even seek out freshwater for warmth or food sources such as shrimp, fish, crab, or seagrasses. There are many local accounts of sea turtles seeking out the warmth of wastewater canals. However, sea turtles are not going to climb banks, weirs, or gates to enter upstream waters, such as the Dow wastewater canals. They would only enter such canals if there was open passage through which the turtles could swim. I explained that I was attempting to support a determination of "no effect" based on the argument that there will be no changes to discharge effluent outside the Action Area, and that it is highly unlikely sea turtles that would be able to pass a floodgate with a weir. Mr. Higgins agreed that it was a logical argument to make for such a determination.

February 3, 2014 Edith Erfling USFWS Field Office

I called with regard to a proposed Dow Freeport Site expansion and the potential impacts to Whooping cranes and the Attwater's prairie chicken. The expansion at the Dow Freeport Site will include the use of tall cranes (>300 ft) for construction and the permanent installation of a cooling tower (<275 ft), which could potentially interfere with Whooping crane migration. The pipeline will pass along Highway 146 near Moses Lake and the Nature Conservancy Texas City Prairie Preserve, which is Attwater's prairie chicken habitat.

Regarding the Whooping crane, Ms. Erfling stated that it would not be unlikely for the cranes to fly within the Freeport area. The Freeport area would not likely experience migrating Whooping cranes; rather, once the cranes have arrived in Texas for the winter they tend to travel up and down the coast. There have been recent sitings in the Brazoria National Wildlife Refuge. Ms. Erfling suggested that we get the dates of crane migration from the Aransas National Wildlife Refuge. For guidance regarding flagging or other marking permanent structures for increased visibility, please refer to the USFWS guidance for cell towers and migratory birds (USFWS Memorandum Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers). Guy lines or support wires can also impact Whooping cranes. The schedule of the construction will also be important. Whooping crane migration occurs primarily in winter and summer construction would not affect Whooping cranes. Ms. Erfling knows of no mitigation or protective measures for temporary structures, such as construction cranes.

Regarding the Attwater's prairie chicken, Ms. Erfling stated that as long as the pipeline is on the west side of Highway 146, the project would not disturb the Preserve. If construction were to be on the east side of the highway, the project may disturb prairie chickens and also introduce invasives to the Preserve. In particular, the Preserve is concerned with the deeproot sedge.

In addition, Ms. Erfling also recommended that our document discuss if the project will remove any habitat, discuss the closest suitable habitats, and compare the heights of existing structures to those proposed.

February 3, 2014 Terry Rossignol USFWS Attwater Prairie Chicken Wildlife Refuge

I called Mr. Rossignol to determine if the 2013 APC count returned any birds in the Moses Lake area. He stated that nothing found in the 2013 bird count would be impacted by the project. He also agreed that disturbance to birds from construction on the west side of Highway 146 was unlikely.

Vargas, Amy

From: Ben Higgins - NOAA Federal <ben.higgins@noaa.gov>
Sent: Friday, January 31, 2014 3:42 PM
To: Vargas, Amy
Subject: Re: Dow Freeport Site BA- Potential Impacts to Sea Turtles

Amy,

I believe the summary below is an accurate summary of our discussion.

Good luck.

Regards, Ben.

On 1/31/2014 2:33 PM, Vargas, Amy wrote:

> Ben-
> Thank you for taking my call today (3pm EST). I called with regard to a Dow Freeport Site expansion and the potential impacts to sea turtles. The project will discharge to the Brazos River Tidal, which is brackish; however, impacts to water quality will be negligible and will only occur within man-made wastewater canals upstream of floodgates >600 feet from the Brazos River. You stated that sea turtles can be found in brackish tidal rivers, and will even seek out freshwater for warmth or food sources such as shrimp, fish, crab, or seagrasses. There are many local accounts of sea turtles seeking out the warmth of wastewater canals. However, sea turtles are not going to climb banks, weirs, or gates to enter upstream waters, such as the Dow wastewater canals. They would only enter such canals if there was open passage through which the turtles could swim. I explained that I was attempting to support a determination of "no effect" based on the argument that there will be no changes to discharge effluent outside the Action Area, and that it is highly unlikely sea turtles that would be able to pass a floodgate with a weir. You agreed that it was a logical argument to make for such a determination.
> Please respond to this email and confirm if you agree with my account of our conversation.
> Thanks again for taking the time to discuss this project with me-
> Amy
>
> **~***~ please note that my phone number and mailing address have changed ~***~**
>
> Amy Kunza Vargas
> Environmental Scientist - URS
> 4016 Salt Pointe Pkwy
> North Charleston, SC 29405
> Office 843-767-4602 ext. 132
> Mobile 281-755-5345
> amy.vargas@urs.com
>
>

--

Ben Higgins
Sea Turtle Program Manager
NOAA/NMFS
4700 Ave U
Galveston, Texas 77551
tel. office. 409-766-3671
tel. cell. 409-771-2893
fax. 409-766-3778

Vargas, Amy

From: Shaver, Donna <donna_shaver@nps.gov>
Sent: Thursday, January 30, 2014 12:45 PM
To: Vargas, Amy
Subject: Re: Biological Assessment for Dow Freeport Site- Record of Communication

Amy:

This sounds like my recollection.

Donna

On Thu, Jan 30, 2014 at 11:34 AM, Vargas, Amy <amy.vargas@urs.com> wrote:

Donna-

Thank you for taking my call this morning (10:40am EST). I called with regard to a Dow Freeport Site expansion and the potential impacts to sea turtles. The project will discharge to the Brazos River Tidal, which is brackish; however, impacts to water quality will be negligible and will only occur within man-made wastewater canals upstream of floodgates >600 feet from the Brazos River. You stated that sea turtles can be found in brackish tidal rivers, but clarified that you are not familiar enough with the Brazos River and the Freeport area to provide an opinion regarding the likelihood of sea turtle species in the Brazos River or its tributaries. As such, you would defer to the opinions of NOAA or other wildlife agencies in the Galveston Bay area.

Please respond to this email and confirm if you agree with my account of our conversation.

Thanks again for taking the time to discuss this project with me-

Amy

~*~ please note that my phone number and mailing address have changed ~***~**

Amy Kunza Vargas

Environmental Scientist - URS

4016 Salt Pointe Pkwy

North Charleston, SC 29405

Office 843-767-4602 ext. 132

Mobile 281-755-5345

amy.vargas@urs.com

--

Donna J. Shaver, Ph.D.
Chief, Division of Sea Turtle Science and Recovery, National Park Service, Padre Island National Seashore
Texas Coordinator, Sea Turtle Stranding and Salvage Network
Telephone (361)949-8173, ext. 226; fax: (361)949-9134; pager (361)851-4255
E-mail: donna_shaver@nps.gov
http://www.nps.gov/pais/
Facebook: Padre Island NS Division of Sea Turtle Science and Recovery

Address for mail:
Padre Island National Seashore
P.O. Box 181300
Corpus Christi, TX 78480-1300

Address for express mail services:
Padre Island National Seashore
20301 Park Road 22
Corpus Christi, TX 78418

Vargas, Amy

From: Vargas, Amy
Sent: Monday, February 03, 2014 10:53 AM
To: Edith Erfling (edith_erfling@fws.gov)
Cc: Mehok, Brian; Williams, Linda Me
Subject: Dow Freeport Site and Pipeline BA- Potential Impacts to Whooping Cranes and Attwater's Prairie Chicken

Edith-
Thank you for taking my call Friday (Jan. 31st, 3pm EST). I called with regard to a proposed Dow Freeport Site expansion and the potential impacts to Whooping cranes and the Attwater's prairie chicken. The expansion at the Dow Freeport Site will include the use of tall cranes (>300 ft) for construction and the permanent installation of a cooling tower (<275 ft), which could potentially interfere with Whooping crane migration. The pipeline will pass along Highway 146 near Moses Lake and the Nature Conservancy Texas City Prairie Preserve, which is Attwater's prairie chicken habitat.

Regarding the Whooping crane, you stated that it would not be unlikely for the cranes to fly within the Freeport area. The Freeport area would not likely experience migrating Whooping cranes; rather, once the cranes have arrived in Texas for the winter they tend to travel up and down the coast. There have been recent sitings in the Brazoria National Wildlife Refuge. You suggested that we get the dates of crane migration from the Aransas National Wildlife Refuge. For guidance regarding flagging or other marking permanent structures for increased visibility, please refer to the USFWS guidance for cell towers and migratory birds (USFWS Memorandum Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers). Guy lines or support wires can also impact Whooping cranes. The schedule of the construction will also be important. Whooping crane migration occurs primarily in winter and summer construction would not affect Whooping cranes. You know of no mitigation or protective measures for temporary structures, such as construction cranes.

Regarding the Attwater's prairie chicken, you stated that as long as the pipeline is on the west side of Highway 146, the project would not disturb the Preserve. If construction were to be on the east side of the highway, the project may disturb prairie chickens and also introduce invasives to the Preserve. In particular, the Preserve is concerned with the deeproot sedge.

In addition, you also recommended that our document discuss if the project will remove any habitat, discuss the closest suitable habitats, and compare the heights of existing structures to those proposed.

Please respond to this email and confirm if you agree with my account of our conversation.
Thanks again for taking the time to discuss this project with me-
Amy

~**~ please note that my phone number and mailing address have changed ~****~**

Amy Kunza Vargas
Environmental Scientist - URS
4016 Salt Pointe Pkwy
North Charleston, SC 29405
Office 843-767-4602 ext. 132
Mobile 281-755-5345
amy.vargas@urs.com

Pina, Vanessa

From: Terry_Rossignol@fws.gov on behalf of FW2_RW_AttwaterPrairieChicken@fws.gov
Sent: Thursday, February 14, 2013 10:03 AM
To: Pina, Vanessa
Subject: Re: Website Inquiry

Dear Ms. Pina,

Attwater's prairie chickens (APC) have not utilized the area around Dickinson for several years. Last spring's annual count near the Mose's Lake area did find a very small number of birds utilizing this area. Results from this year's count will not be complete until mid-April. If you have a project or activity that you believe may affect the APC or its habitat, please contact the Clear Lake Ecological Services Field Office at 281/286-8282. Their mailing address is 17629 El Camino Real, Suite 211, Houston, Tx 77058-3051.

"Pina, Vanessa" <vanessa.pina@urs.com>

02/11/2013 03:24 PM

To "FW2_RW_AttwaterPrairieChicken@fws.gov" <FW2_RW_AttwaterPrairieChicken@fws.gov>
cc
Subject Website Inquiry

Hello there.

I was wondering if Attwater's Greater Prairie Chickens still utilize areas near Dickinson and near Moses Lake? Thank you. Have a nice day.

Vanessa Pina, M.S. Wildlife Ecology

Wetland Biologist
URS Corporation
10550 Richmond Avenue, Suite 155
Houston, TX 77042
(713) 914-6344

Pina, Vanessa

From: Brent Ortego <Brent.Ortego@tpwd.state.tx.us>
Sent: Friday, January 18, 2013 5:12 PM
To: Pina, Vanessa
Subject: RE: whooping crane and bald eagle update

There used to be bald eagles nesting northeast of town near Oyster Creek. I don't know if it is still there. The last time we flew it was 2005. I have not heard of any birders finding any other nests in the area. There has not been any recent sightings of Whoopers near Freeport. There was 1 bird which wintered near Jones Creek about 20 years ago.

Brent

____

From: Pina, Vanessa [mailto:vanessa.pina@urs.com]
Sent: Fri 1/18/2013 2:46 PM
To: Brent Ortego
Subject: RE: whooping crane and bald eagle update

Brent,

The TXNDD database is a little dated. EPA has requested current data as to any known occurrences within Freeport, Texas for whooping cranes and bald eagles. I was wondering if you had aTny current data as to known locations within Freeport for nesting or current sightings.

Vanessa Pina, M.S. Wildlife Ecology

Wetland Biologist

URS Corporation

10550 Richmond Avenue, Suite 155

Houston, TX 77042

(713) 914-6344

From: Brent Ortego [mailto:Brent.Ortego@tpwd.state.tx.us]
Sent: Friday, January 18, 2013 1:56 PM
To: Pina, Vanessa
Subject: RE: whooping crane and bald eagle update

What do you need?

Brent Ortego, Ph. D.

Wildlife Diversity Biologist

Texas Parks and Wildlife Department

2805 N. Navarro, Suite 600B

Victoria, TX 77901

361-576-0022 office

361-648-9773 cell

361-578-4155 fax

From: Pina, Vanessa [mailto:vanessa.pina@urs.com]
Sent: Friday, January 18, 2013 1:50 PM
To: Brent Ortego
Subject: whooping crane and bald eagle update

Brent,

Hello. A TXNDD data request has identified known occurrences of bald eagle and whooping cranes within a project review area in Stratton Ridge over a Dow-Freeport facility. We have been informed by WoodGroup Mustang, Inc. that bald eagles are known to nest within expected foraging range of the study area. However, no suitable structures for nesting were identified in the study area. Bob Gottfried, TXNDD Administrator, has suggested that since one or more records of bald eagles or colonial waterbirds were identified in our project area, we should contact you for more up-to-date information on these birds of concern in Freeport, Texas.

Vanessa Pina

URS Corporation

10550 Richmond Avenue, Suite 155

Houston, TX 77042

(713) 914-6344

Pina, Vanessa

From: Reyes, Ernesto <ernesto_reyes@fws.gov>
Sent: Wednesday, February 13, 2013 11:10 AM
To: Pina, Vanessa; Dawn Whitehead; Mary Orms; Mitch Sternberg; Edith Erfling
Subject: Re: Current Occurrence Data

Vanessa,

Historical records indicate that the ocelot once occurred in South Texas the Southern Edwards Plateau, and along the Coastal Region. Ocelot populations declined due to habitat loss and predator control activities. Today, only South Texas has several small populations left in Texas with occasional sightings not in South Texas, but the sightings are not confirmed sightings like a road kill or a picture taken. Jaguarundis are also known to be in South Texas.

The ocelot and jaguarundi are not listed in Brazoria or Galveston County, so it is not likely that the ocelot and jaguarundi would be found up in those Counties. You can check with the Clear Lake Ecological Service Field Office, since they cover those counties, and contact the Field Supervisor (Edith Erfling) at at (281) 286-8282 to see if they have other listed species in those counties that need to be taken into consideration for your biological assessment. You can also check with the Texas Parks and Wildlife Department at (512) 912-7011 and check their data base for those counties for any endangered species occurrences.

Ernesto

On Tue, Feb 12, 2013 at 3:52 PM, Pina, Vanessa <vanessa.pina@urs.com> wrote:

Mr. Reyes,

I have been trying to identify USFWS personnel that could help me with identifying potential occurrence of jaguarundi and ocelots along an existing pipeline corridor. Mr. Sternberg gave me your contact information. I hope you don't mind. Please let me know if you can help me or if I need to contact someone else. I sent Mr. Sternberg the following e-mail:

I was hoping that you could help me in identifying occurrences of ocelots and jaguarundi along the coast near an existing pipeline corridor that extends from Freeport (Brazoria County) to Texas City (Galveston County) then onto Mont Belvieu (Chambers County). I want to accurately assess potential occurrence along the coast in order to analyze possible impacts from a pipeline project. The project will occur within an existing corridor restricted to the right-of-way. Please help me provide accurate data to better assist my evaluation of potential impacts for this biological assessment.

Please feel free to contact me by phone or e-mail. Have a nice day.

Vanessa Pina, M.S. Wildlife Ecology

Wetland Biologist

URS Corporation

10550 Richmond Avenue, Suite 155

Houston, TX 77042

Office: (713) 914-6344

Cell: (713) 732-8333

From: Sternberg, Mitch [mailto:mitch_sternberg@fws.gov]
Sent: Tuesday, February 12, 2013 1:09 PM
To: Pina, Vanessa
Cc: jonathan_moczygemba; Ernesto Reyes
Subject: Re: Current Occurrence Data

Vanessa:

The branch of FWS that deals with such requests is Ecological Services. Mr Reyes can respond to let you know who you will need to contact in that part of Texas.

Sorry about the delay.

On Tue, Feb 12, 2013 at 9:06 AM, Pina, Vanessa <vanessa.pina@urs.com> wrote:

I was hoping that you could help me in identifying occurrences of ocelots and jaguarundi along the coast near an existing pipeline corridor that extends from Freeport (Brazoria County) to Texas City (Galveston County) then onto Mont Belvieu (Chambers County). I want to accurately assess potential occurrence along the coast in order to analyze possible impacts from a pipeline project. The project will occur within an existing corridor restricted to the right-of-way. Please help me provide accurate data to better assist my evaluation of potential impacts for this biological assessment. Please feel free to contact me by phone or e-mail. Have a nice day.

Vanessa Pina, M.S. Wildlife Ecology

Graduate Biologist

URS Corporation

10550 Richmond Avenue, Suite 155

Houston, TX 77042

Office: (713) 914-6344

Cell: (713) 732-8333

From: Mason, Marion [mailto:marion_mason@fws.gov]
Sent: Saturday, January 19, 2013 12:32 PM
To: Pina, Vanessa
Cc: jonathan_moczygemba; Mitch Sternberg
Subject: Re: Current Occurrence Data

I am forwarding your request to our biologists who work with those species. They are cc'd here.

On Fri, Jan 18, 2013 at 3:39 PM, Pina, Vanessa <vanessa.pina@urs.com> wrote:

Marion,

Hello. I am currently working on a biological assessment for an industrial unit construction within an existing facility and the addition of a pipeline extending near the coast from Freeport, Texas to Texas City, then up to Chambers County. I realize that the TXNDD database is not up-to-date with occurrence data for threatened and endangered species. EPA has requested the utilization of current sightings near Freeport, Texas for the potential occurrence of species in and near the project areas. I was wondering if you could help provide me with current data on jaguarundi and ocelots in Freeport, Texas and along the coast.

If further clarification of my request is needed, please contact me.

Vanessa Pina, M.S. Wildlife Ecology

Graduate Biologist

URS Corporation

10550 Richmond Avenue, Suite 155

Houston, TX 77042

(713) 914-6344

--
Marion Mason, Ranger

Laguna Atascosa National Wildlife Refuge

22817 Ocelot Rd

Los Fresnos, TX 78566

956-748-3607x119

--
Mitch Sternberg

Zone Biologist - South Texas Gulf Coast

c/o South Texas Refuge Complex

3325 Green Jay Road

Alamo, Texas, 78516

Telephone: 956-784-7592

--
Ernesto Reyes
U.S. Fish and Wildlife Service
Texas DOI State Border Coordinator
Alamo Ecological Service Sub-Office
3325 Green Jay Rd
Alamo, Texas 78516
Tel:956-784-7560
Fax:956-787-8338

URS

Appendix C

USFWS Memorandum Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
*FWSIFHC/DHCIBF*A

Memorandum

To: Regional Directors, Regions 1-7

From: Director **/s/ Jamie Rappaport Clark** SEP 14

Subject: Service Guidance on the Siting, Construction, Operation and Decommissioning of Communications Towers

Construction of communications towers (including radio, television, cellular, and microwave) in the United States has been growing at an exponential rate, increasing at an estimated 6 percent to 8 percent annually. According to the Federal Communication Commission's *2000 Antenna Structure Registry,* the number oflighted towers greater than 199'feet above ground level currently number over 45,000 and the total number of towers over 74,000. By 2003, all television stations must be digital, adding potentially 1,000 new towers exceeding 1,000 feet AGL.

The construction of new towers creates a potentially significant impact on migratory birds, especially some 350 species of night-migrating birds. Communications towers are estimated to kill 4-5 million birds per year, which violates the spirit and the intent of the Migratory Bird Treaty Act and the Code of Federal Regulations at Part 50 designed to implement the MBTA. Some of the species affected are also protected under the Endangered Species Act and Bald and Golden Eagle Act.

Service personnel may become involved in the review of proposed tower sitings and/or in the evaluation of tower impacts on migratory birds through National Environmental Policy Act review; specifically, sections 1501.6, opportunity to be a cooperating agency, and 1503.4, duty to comment on federally-licensed activities for agencies with jurisdiction by law, in this case the MBTA, or because of special expertise. Also, the National Wildlife Refuge System Improvement Act requires that any activity on Refuge lands be determined as compatible with the Refuge system mission and the Refuge purpose(s). In addition, the Service is required by the ESA to assist other Federal agencies in ensuring that any action they authorize, implement, or fund will not jeopardize the continued existence of any federally endangered or threatened species.

A Communication Tower Working Group composed of government agencies, industry, academic researchers and NGO's has been formed to develop and implement a research protocol to determine the best ways to construct and operate towers to prevent bird strikes. Until the research study is completed, or until research efforts uncover significant new mitigation measures, all Service personnel involved in the review of proposed tower sitings and/or the evaluation of the impacts of towers on migratory birds should use the attached interim guidelines when making recommendations to all companies, license applicants, or licensees proposing new tower sitings. These guidelines were developed by Service personnel from research conducted in several eastern, midwestern, and southern States, and have been refined through Regional review. They are based on the best information available at this time, and are the most prudent and effective measures for avoiding bird strikes at towers. We believe that they will provide significant protection for migratory birds pending completion of the Working Group's recommendations. As new information becomes available, the guidelines will be updated accordingly.

Implementation of these guidelines by the communications industry is voluntary, and our recommendations must be balanced with Federal Aviation Administration requirements and local community concerns where necessary. Field offices have discretion in the use of these guidelines on a case by case basis, and may also have additional recommendations to add which are specific to their geographic area.

Also attached is a Tower Site Evaluation Form which may prove useful in evaluating proposed towers and in streamlining the evaluation process. Copies may be provided to consultants or tower companies who regularly submit requests for consultation, as well as to those who submit individual requests that do not contain sufficient information to allow adequate evaluation. This form is for discretionary use, and may be modified as necessary.

The Migratory Bird Treaty Act (16 U.S.C. 703-712) prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the Act has no provision for allowing an unauthorized take, it must be recognized that some birds may be killed at structures such as communications towers even if all reasonable measures to avoid it are implemented. The Service's Division of Law Enforcement carries out its mission to protect migratory birds not only through investigations and enforcement, but also through fostering relationships with individuals and industries that proactively seek to eliminate their impacts on migratory birds. While it is not possible under the Act to absolve individuals or companies from liability if they follow these recommended guidelines, the Division of Law Enforcement and Department of Justice have used enforcement and prosecutorial discretion in the past regarding individuals or companies who have made good faith efforts to avoid the take of migratory birds.

Please ensure that all field personnel involved in review of FCC licensed communications tower proposals receive copies of this memorandum. Questions regarding this issue should be directed to Dr. Benjamin N. Tuggle, Chief, Division of Habitat Conservation, at (703)358-2161, or

Jon Andrew, Chief, Division of Migratory Bird Management, at (703)358-1714. These guidelines will be incorporated in a Director's Order and placed in the Fish and Wildlife Service Manual at a future date.

Attachment

cc: 3012-MIB-FWS/Directorate Reading File
3012-MIB-FWS/CCU Files
3245-MIB-FWS/AFHC Reading Files
840-ARLSQ-FWS/AF Files
400-ARLSQ-FWS/DHC Files
400-ARLSQ-FWS/DHC/BFA Files
400-ARLSQ-FWS/DHC/BFA Staff
520-ARLSQ-FWS/LE Files
634-ARLSQ-FWS/MBMO Files (Jon Andrew)

FWS/DHCIBFAJRWillis:bg:08/09/00:(703)358-2183
S:\DHC\BFA\WILLIS\COMTOW-2.POL

Attachment

Service Interim Guidelines For Recommendations On Communications Tower Siting, Construction, Operation, and Decommissioning

1. Any company/applicant/licensee proposing to construct a new communications tower should be strongly encouraged to collocate the communications equipment on an existing communication tower or other structure (e.g., billboard, water tower, or building mount). Depending on tower load factors, from 6 to 10 providers may collocate on an existing tower.

2. If collocation is not feasible and a new tower or towers are to be constructed, communications service providers should be strongly encouraged to construct towers no more than 199 feet above ground level, using construction techniques which do not require guy wires (e.g., use a lattice structure, monopole, etc.). Such towers should be unlighted if Federal Aviation Administration regulations permit.

3. If constructing multiple towers, providers should consider the cumulative impacts of all of those towers to migratory birds and threatened and endangered species as well as the impacts of each individual tower.

4. If at all possible, new towers should be sited within existing "antenna farms" (clusters of towers). Towers should not be sited in or near wetlands, other known bird concentration areas (e.g., State or Federal refuges, staging areas, rookeries), in known migratory or daily movement flyways, or in habitat of threatened or endangered species. Towers should not be sited in areas with a high incidence of fog, mist, and low ceilings.

5. If taller (>199 feet AGL) towers requiring lights for aviation safety must be constructed, the minimum amount of pilot warning and obstruction avoidance lighting required by the FAA should be used. Unless otherwise required by the FAA, only white (preferable) or red strobe lights should be used at night, and these should be the minimum number, minimum intensity, and minimum number of flashes per minute (longest duration between flashes) allowable by the FAA. The use of solid red or pulsating red warning lights at night should be avoided. Current research indicates that solid or pulsating (beacon) red lights attract night-migrating birds at a much higher rate than white strobe lights. Red strobe lights have not yet been studied.

6. Tower designs using guy wires for support which are proposed to be located in known raptor or waterbird concentration areas or daily movement routes, or in major diurnal migratory bird movement routes or stopover sites, should have daytime visual markers on the wires to prevent collisions by these diurnally moving species. (For guidance on markers, see *Avian Power Line Interaction Committee (APLIC).* 1994. *Mitigating Bird Collisions with Power Lines: The State ofthe Art in* 1994. *Edison Electric Institute, Washington, D.c.,* 78 *pp,* and *Avian Power Line Interaction Committee (APLIC).* 1996. *Suggested Practices/or Raptor Protection on Power Lines. Edison Electric InstituteiRaptor Research Foundation, Washington, D. C;* 128 *pp.* Copies can be obtained via the Internet at http://www.eei.org/resources/pubcat/enviro/. or by calling 1-800/334-5453).

7. Towers and appendant facilities should be sited, designed and constructed so as to avoid or minimize habitat loss within and adjacent to the tower "footprint." However, a larger tower footprint is preferable to the use of guy wires in construction. Road access and fencing should be minimized to reduce or prevent habitat fragmentation and disturbance, and to reduce above ground obstacles to birds in flight.

8. If significant numbers of breeding, feeding, or roosting birds are known to habitually use the proposed tower construction area, relocation to an alternate site should be recommended. If this is not an option, seasonal restrictions on construction may be advisable in order to avoid disturbance during periods of high bird activity.

9. In order to reduce the number of towers needed in the future, providers should be encouraged to design new towers structurally and electrically to accommodate the applicant/licensee's antennas and comparable antennas for at least two additional users (minimum of three users for each tower structure), unless this design would require the addition of lights or guy wires to an otherwise unlighted and/or unguyed tower.

10. Security lighting for on-ground facilities and equipment should be down-shielded to keep light within the boundaries of the site.

11. If a tower is constructed or proposed for construction, Service personnel or researchers from the Communication Tower Working Group should be allowed access to the site to evaluate bird use, conduct dead-bird searches, to place net catchments below the towers but above the ground, and to place radar, Global Positioning System, infrared, thermal imagery, and acoustical monitoring equipment as necessary to assess and verify bird movements and to gain information on the impacts of various tower sizes, configurations, and lighting systems.

12. Towers no longer in use or determined to be obsolete should be removed within 12 months of cessation of use.

In order to obtain information on the extent to which these guidelines are being implemented, and to identify any recurring problems with their implementation which may necessitate modifications, letters provided in response to requests for evaluation of proposed towers should contain the following request:

> "In order to obtain information on the usefulness of these guidelines in preventing bird strikes, and to identify any recurring problems with their implementation which may necessitate modifications, please advise us of the final location and specifications of the proposed tower, and which of the measures recommended for the protection of migratory birds were implemented. If any of the recommended measures can not be implemented, please explain why they were not feasible."