

**EXPERT REPORT AND VEGETATION ROOT STUDY ON THE
JEANERETTE LUMBER AND SHINGLE COMPANY, L.L.C.
PROPERTY IN IBERIA PARISH, LOUISIANA**

IN THE MATTER:

JEANERETTE LUMBER AND SHINGLE COMPANY, L.L.C.

VERSUS

***CONOCOPHILLIPS COMPANY, ALTA MESA HOLDINGS, LP,
CHEVRON U.S.A., INC., APACHE CORPORATION, AND TEXAS
PETROLEUM INVESTMENT COMPANY***

**16th Judicial District Court, Div. "E", Docket No. 13407
Iberia Parish, Louisiana**

Prepared by:

Holloway Environmental Services, Inc.
9269 Hwy. 124
Harrisonburg, Louisiana 71340

Environmental Resources Management, Inc.
3838 North Causeway Boulevard, Suite 3000
Metairie, Louisiana 70002

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ERM Project 0519829

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List of Acronyms

| | |
|---------|---|
| AOI | Area of Investigation |
| dbh | diameter at breast height |
| EC | Electrical Conductivity |
| ESP | Exchangeable Sodium Percentage |
| E&P | Exploration and Production |
| ERM | Environmental Resources Management Southwest, LLC |
| ERZ | Effective Root Zone |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| JLS | Jeanerette Lumber and Shingle Co. |
| LDNR OC | Louisiana Department of Natural Resources, Office of Conservation |
| LIDAR | Light Detection and Ranging |
| msl | Mean Sea Level |
| NRCS | U.S. Department of Agriculture Natural Resources Conservation Service |
| RS | Root Study |
| SAR | Sodium Adsorption Ratio |
| USACE | U.S. Army Corps of Engineers |
| USDA | U.S. Department of Agriculture |
| USGS | U.S. Geological Survey |

1.0 INTRODUCTION, DESCRIPTION, AND LAND USE OF THE PROPERTY

1.1 INTRODUCTION

Jeanerette Lumber and Shingle Company, LLC et al. (Plaintiffs) filed a lawsuit against current and former oil and gas exploration and production (E&P) operators/lessees alleging soil, sediment, and groundwater contamination from historical E&P activities for properties within the Bayou Pigeon Oil and Gas Field. Holloway Environmental Services Inc. and Environmental Resources Management, Inc. (ERM) have been retained by oil company defendants to provide expert services in the case. Dr. Luther Holloway conducted a tour and review of the Site on October 26, 2020 and March 8, 2021. Mr. Patrick Ritchie (ERM) visited the Site on November 19, 2020 to conduct a review of vegetation types and condition factors on the property. Dr. Luther Holloway and Mr. Patrick Ritchie also visited the Site on December 9-11, 2020 for an evaluation of plant rooting habits and plant rooting depths.

The defendants in this case have been sued by the Plaintiffs' for various allegations of damages to their property including soil, sediment, and groundwater contamination. Consultants for the Plaintiffs' (Miller and Prejean, 2020) have proposed one option for "restoration of soil and sediment outside of the canals to a maximum depth of approximately 18-20 feet below ground surface to remove the contaminated peat layer" for the site designated as AOI-2. AOI-2 is located in the southern central portion of the property which includes canal areas associated with the Jeanerette #001 (SN70817), Jeanerette Lumber and Shingle Co. #001 (SN186695), and P RC SUA; JL&S #001 (SN187214) wells. The restoration option proposed by the Plaintiff's consultants includes clearing of the existing forested wetland habitat and stockpiling compliant soils onsite, while removing allegedly contaminated soils and sediments for offsite disposal and replacing with "clean" soils at a cost of \$100,309,467. The proposed restoration plan determined contaminated soils and sediment as those with an "electrical conductivity (EC) of 6.3 mmhos/cm for cypress tree growth, Statewide Order 29B Elevated Wetland standards for metals, and LDEQ RECAP standards for petroleum hydrocarbons".

Additionally, AOI-1, located in the northern central portion of the property, associated with Jeanerette L&S Co. C #008 (SN9100675), JL&S C #001 (SN98208), JL&S C #002 (SN100356), JL&S C#1 (SN219929), JL&S C#2 (SN219930), and Jeanerette L&S SWD #001 (SN972653) is considered in this report. The proposed restoration at AOI-1 involves the hydraulic dredging of subaqueous sediment in canals and excavation of soils outside of canals at an estimated cost of \$4,081,271.

This report describes the methodology and results of the effective root zone (ERZ) study that was conducted within Iberia Parish, Louisiana (Appendix A, Figure 1). This study included the determination of root depths and effective root zones (ERZs) of plants growing in and around areas of alleged oil and gas E&P impacts (Appendix A, Figures 2-5). Representative forested plant communities were investigated in order to evaluate the depth for root penetration and density of roots throughout the soil profile, thus determining the appropriate depth of any potential soil remediation on the tract. The evaluation and data presented in this report represent a site-specific study, which is limited in scope to the JLS Property.

1.2 REPORT FORMAT

This report consists of six report sections and four appendices that follow this introduction:

- Section 2 provides a general description of the Root Zone Study Area including a summary of existing and historical land uses, together with standard desktop

information for wetlands, waterbodies, and soils derived from governmental agency reports, studies and datasets.

- Section 3 describes the ERZ study survey methods.
- Section 4 describes the findings of the field investigation, including summaries of the vegetation communities, soils, and hydrology observed during the ERZ study.
- Section 5 presents the conclusions of the ERZ study.
- Section 6 lists the literature references utilized throughout this report.

Appendix A contains twelve figures (Figures 1 through 12) providing various maps, background/desktop information and Geographic Information System (GIS) data overlays for the JLS property and the Study Area. Representative site photographs of the sample plots are included in Appendix B. Appendix C contains the five Root Zone Study Forms that are referenced throughout the report.

1.3 QUALIFICATIONS, AREAS OF EXPERTISE AND COMPENSATION

The following sections present the qualifications, areas of expertise, and compensation of the report authors.

1.3.1 Luther F. Holloway Qualifications, Areas of Expertise and Compensation

Dr. Holloway has worked as an expert witness for the U.S. Army Corps of Engineers, U.S. Department of Justice, states of Louisiana and Florida, and numerous corporate and individual clients. He has testified in the areas of botany and plant ecology, agronomy, petroleum production impacts to agriculture and floral-fauna components, wetland soils and hydrology, pesticides, fisheries and wildlife ecology, environmental impacts and ordinary high water lines and wetlands. He has testified in numerous U.S. District Courts, U.S. Court of Claims and state district courts in Louisiana, Mississippi, Florida and Oklahoma. He has also testified in administrative hearings in Florida, Texas, Louisiana and Oklahoma. Dr. Holloway's professional profile is provided in Appendix D. Dr. Holloway's hourly rate is \$275.

1.3.2 Patrick M. Ritchie's Qualifications, Areas of Expertise and Compensation

Mr. Patrick Ritchie is a certified professional wetland scientist (PWS # 2780) working in the practice of site investigation and ecological assessment. He has a Bachelor of Science degree in Ecology and Evolutionary Biology from Tulane University and a Master of Science Degree in Soil and Water Science from the University of Florida. He has worked in support of site remediation, impact assessment and site planning, facility permitting and development and habitat restoration projects for more than 13 years. Through education and practice, he has gained competency in effective root zone analysis, wetland delineation, ecological inventories, wildlife habitat evaluations, wetland functional assessment and mitigation, protected species investigation, water quality assessment, and ecological risk assessment. Mr. Ritchie's professional profile is provided in Appendix D. ERM's hourly rate for Mr. Ritchie is \$186.

2.0 SITE DESCRIPTION AND EXISTING CONDITIONS

2.1 SITE LOCATION

The Jeanerette Lumber and Shingle Co. (JLS) property is located within the Bayou Pigeon Oil Field, approximately 18 miles southwest of the town of White Castle, Louisiana within the Atchafalaya Basin Swamp (Figure 1). The property described in the lawsuit is situated within multiple sections of Township 12 South, Range 10 East. Figure 2 and 4 presents the Site on the Morgan City 30 x 60 Minute Geologic Quadrangle map while Figure 3 and 5 are aerial photographs showing the vegetation and access canals on the property. The Root Zone Study Area assessed for the purpose of this report includes submerged forested wetland and freshwater canals and waterbodies.

2.2 PREVIOUS AND PRESENT LAND USE

The JLS property has historically been used for forestry and silviculture, oil field exploration and production activities (E&P), and commercial and recreational hunting, trapping and fishing. A single house boat located within the north-south canal, within AOI-2, approximately 300 feet south of the former SN 70817 well location was observed during the site investigation. The houseboat is visible on historical aerial imagery dating back to 2005 and appears to be used for recreation. A tank battery and associated production equipment is located within AOI-1 on a self-contained barge. The site is accessible only by boat. Present day use is for commercial and recreational hunting, trapping, fishing and E&P operations.

2.3 GEOLOGY

The underlying geology of the Study Area is mapped by the U.S. Geologic Survey as Holocene Backswamp (Hb) deposits of the Mississippi and Atchafalaya Rivers (Figure 6). They consist of fine-grained, usually clayey and often organically rich sediments that underlie flood basins between meander-belts. The deposits are typically gray to black clays with thin peat beds.

2.4 IBERIA PARISH SOIL SURVEY

The Web Soil Survey for Iberia Parish, published by the U.S. Department of Agriculture Natural Resources Conservation Service and the 1978 Soil Survey of Iberia Parish (Soil Survey Staff, 1978) as shown on Figure 7 and 8, illustrates the following soil mapping units within the Study Area: Fausse soils (FE), 0 to 1 percent slopes, frequently flooded.

The Fausse clay map unit are very poorly drained, very slowly permeable, occurring in floodplains which are frequently flooded and ponded with freshwater most of the year. Typically, the surface layer material is dark-gray clay about 20 inches thick with subsoil material are gray and dark-gray mottled with shades of brown. The acreage represented in the study area is wooded and part of the Atchafalaya Basin Floodway used for woodland, recreation, and wildlife habitat, including the main source of natural habitat for deep-water crawfish. Fausse soils are wet throughout the year with 2 to 8 feet of flooding from December through June receiving annual deposits of clayey sediment from the Atchafalaya River. Soils are not suited to cultivated crops or pasture plants unless protected from flooding, which occurs annually. The main limitations of this soil map unit include flooding, wetness, very high shrink-swell potential and low strength.

2.5 ELEVATION AND RELIEF

Light Detection and Ranging (LIDAR; LSU, 2009) data reviewed for this study provided high-resolution elevation data within the Study Area (Figure 9 and 10). Elevation within the Study Area ranges from approximately 0.76 to 8.80 feet above mean sea level (msl). Higher elevations occur along the swamp water interface where dredged materials were placed to create the oil and gas field access canals. The elevation remains fairly uniform across remaining portions of the Study Areas.

2.6 HYDROLOGY

Hydrology is contingent on numerous factors of an area (e.g., precipitation, soil stratigraphy, soil permeability, topography and plant cover type and abundance). The main factors affecting hydrology in the Study Area include surface water inputs from the Atchafalaya River and local precipitation. Figure 11 shows the U.S. Army Corps of Engineers (USACE) Water Management Units, USACE Levee System and USACE Structures for the Atchafalaya Basin. A detailed analysis of site hydrology and inundation frequency is provided by other experts.

2.6.1 Atchafalaya River

The Atchafalaya River is the largest tributary of the Mississippi River and was originally a tributary of the Red River. The Atchafalaya was formed when Turnbull's Bend, an enlarging loop of the Mississippi River, converged into the basin of the Red River between the Teche and Lafourche ridges. Inflows into the system include the Red/Black Rivers that enter from their northwest and north drainage basins. Completion of the Old River Control Structure in 1962 and the Auxiliary Control Structure in 1986 in south Concordia Parish by the U.S. Army Corps of Engineers allows controlled discharge of 30 percent of the flow of the Mississippi River into the Atchafalaya Basin (Basin). This discharge from the Mississippi River dwarfs other upstream river inflows and is the driving force of the system that significantly affects flow volumes, flood amplitudes and sediment deposition throughout the Basin. In 1963, the Atchafalaya Basin was leveed on both sides, reducing the area from 2.4 million acres to approximately 600,000 acres and resulting in increased water depth in the remaining forested wetlands inside the Basin (McPhee, 1989). Additionally, concrete floodwalls have been constructed atop the Basin levees promoting greater water and silt retention. The guide levees to the east and west prevent the lateral distribution of sediment and water. This has caused sedimentation in the central and the lower end of the Basin, above Morgan City, gradually forming a barrier to flow and creating deeper water levels within the Basin.

2.7 VEGETATION

Vegetation on the JLS property consists of two distinct community types. Areas on the constructed spoil banks along the oil and gas field access canals are the highest elevated areas and have plant communities that are reflective of the successional stages after dredge material disposal. Investigation of AOI-2 shows areas of higher elevation along the banks are comprised of woody and non-woody vegetation. Non-woody species include smooth beggartick (*Bidens laevis*), balloon vine (*Cardiospermum halicacabum*), Carolina coralbead (*Cocculus carolinus*), rosemallow (*Hibiscus*, spp.), loosestrife (*Lythrum* spp.), lanceleaf fogfruit (*Phyla lanceolata*), smartweeds (*Polygonum* spp) and roundleaf greenbrier (*Smilax rotundifolia*). Woody species include water locust (*Gleditsia aquatica*), black willow (*Salix nigra*), American sycamore (*Platanus occidentalis*) and juvenile baldcypress (*Taxodium distichum*) that are populating higher elevations on the spoil banks. The vegetative community type transitions to wooded swamp as elevation decreases away from the spoil banks and area maintained near the house boat. The wooded

swamp generally consists of shrub-type species including eastern swamp privet (*Forestiera acuminata*), buttonbush (*Cephalanthus occidentalis*) and reproduction of the overstory. Overstory vegetation in these areas is dominated by two species, baldcypress and water tupelo (*Nyssa aquatica*). Areas with heavy canopy are generally devoid of any substantial amount of understory or herbaceous species, however, some areas contain floating aquatic species such as common duckweed (*Lemna minor*), water pennywort (*Hydrocotyle umbellata*), water spangles (*Salvinia minima*), and common water hyacinth (*Eichhornia crassipes*). Wetter areas are vegetated with understory species such as lizard's tail (*Saururus cernuus*), Cuban bulrush (*Oxycaryum cubense*) and smartweed. Some areas with open canopy contain stands of invading Chinese tallow trees (*Triadica sebifera*) with the overstory including red maple (*Acer rubrum*) and water locust.

Selected areas for review are shown in Appendix A, Figure 12 for tree observations.

3.0 FIELD INVESTIGATION – APPROACH AND METHODOLOGY

3.1 GENERAL ROOT STUDY INVESTIGATION APPROACH

The approach for conducting an ERZ study has been developed with many years of field investigations to assess the effects of oil field E&P activities on plant roots, particularly in Louisiana. The approach and methodology follow the accepted methods (Schuurmann and Goedewaagen, 1971; U.S. EPA, 2015) such as those found in published documents and recognized by the Louisiana Department of Natural Resources – Office of Conservation (LDNR OC) for effective root zone investigation (Holloway, 2019). The authors of this report have substantial experience documenting root depth and distribution conditions in a wide variety of habitats and vegetative communities. The experience gained from the consistent approach to similar field investigations supports the understanding that root densities and penetrations vary based on vegetation type, soil types, disturbance factors, area hydrology. The results of such an investigation support development of remediation strategies when necessary. Although general root zone assumptions can be made, it is important to design an investigation that is specific to the plants and soils of the areas of alleged impact and comparable surrounding areas, in order to determine the particular depths at which plant roots grow. The results of the ERZ study should be considered when formulation of potential soil remediation measures may be required. The following sections describe the methods utilized during ERZ study of the Study Area.

Studies by the Plaintiffs' consultant and others have documented depths or depth intervals of soils samples for salt parameters such as electrical conductivity (EC), exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR). The authors of this report have found this to generally overestimate (at many times grossly so) these parameters. Root physiology has long been studied and it is understood that the effective root zone is where the majority of water and mineral ions are absorbed by the plant. Remediation for exceedances of such parameters at depths of 8 feet below ground surface (bgs) or more demonstrate a fundamental misunderstanding of plant systematics. Additionally, the soils samples extracted from 2 to 4 foot intervals, which are mixed for analysis, can show levels that are much higher and misrepresent the affected interval. To be accurate for salt parameters in root zones and to determine the need for remediation for the growth and propagation of trees, soil samples should reflect specific depths of the ERZs and/or root zones, not deeper depths where roots do not occur or occur in only negligible quantities.

3.2 METHODS

Effective root zone (ERZ), according to one popular definition, represents the depth of the roots that are necessary for the plants to grow and complete their life cycles. The effective root

zone does not represent the deepest roots but comprises the depth where the majority of the roots that sustain the plants through growth and reproductive phases reside. Another definition of effective root zone states that ERZ is the area where eighty percent of the roots reside beneath the plants and from where the plants receive their nutrients. The authors have researched soils in Louisiana, such as those present on the JLS property, and have found that this definition generally underestimates the depth of the ERZs. Therefore, the former definition was used for the JLS property study. This method includes a much higher percentage of roots and gives the landowner the benefit of greater ERZ depths.

To determine the root depths and distributions of the woody vegetation, five trees (T-01 to T-05) were selected for study on Site located outside of the remediation area proposed by Plaintiffs' consultants. The locations of these plants are shown in Figure 12 and are an appropriate representation of habitat occurring within the proposed remediation area. The general distribution of the typical plants that grow in the area were chosen for study and represent a general mix of the most abundant species that occur on the JLS property. Trees selected for the study were measured at diameter breast height (dbh). The dominant roots extending from the trees were measured for depth to top of root at various distances along their lengths. They were also measured from the bole (trunk) of the tree to the deepest depth of the deepest root, and in some cases, depth to the top of the root, depth to the bottom of the root and root diameter or circumference. These data were entered on a root form along with species name and coordinates showing the location of the plant. Extensive reviews were conducted of the dominant roots on the trees by probing with steel rods to determine the general depths of all of the major roots around the tree. After comparing those with the greater depths, a root was selected to follow by either probing all along the length of the root or removing the soil from the top of the root to observe the root as it extended away from the bole of the tree. Additionally, observation of feeder roots were made of the trees. Photographs of individual trees, root distributions and surrounding plant communities are shown in Appendix B, while root depths and other important information for the trees are shown on the tree root forms in Appendix C.

A review of the JLS Property showed that lower elevations consisted of forested swamp with areas of canal bank consisting of spoil material creating higher elevations. In fact, almost all of the areal extent of the potential remediation area is currently made up of baldcypress and tupelo gum, the species suggested by the Plaintiffs' consultants as the restoration goal habitat for the Site. Root study plants typical of the undisturbed lower elevations were observed for root profile depths and distribution in this root study.

3.3 RESULTS

A total of five observational areas were set up across the JLS property to determine the ERZ depth. The locations of these areas are shown in Figure 12. These included typical and healthy woody plants across the JLS property as described above. The majority of the property includes forested swamp dominated by baldcypress and tupelo gum. Appendix B shows the photographs of the plants as they were observed and conditions of the surrounding vegetative communities. The data for each of the root systems observed at each location shown in the root forms is located in Appendix C. Each observational area investigated is described in the following section.

3.3.1 Observation Tree T-01

Baldcypress (*Taxodium distichum*) DBH = 18.8"; ERZ = 12.0"

Observation area for T-01 is located southwest of the former Jeanerette #001 well location outside of the proposed remediation area delineated by the Plaintiffs' consultant. The area is

located within the natural stand of trees representative of native conditions and an appropriate representation of habitat occurring within the proposed remediation area. Vegetation in the surrounding area consists of a multilayer, multi-cohort structure with a mix of sizes present providing vertical and horizontal diversity. Distinct age classes and tree layers mark this area with a sparse distribution of fallen trees and decayed stumps from former harvesting. Vegetation in the surrounding area consists of a mixed stand of baldcypress and tupelo gum as the dominants. Woody shrub species present include young black willow, swamp privet and button bush. Ground cover at this site is not present due to the heavy overstory and wet conditions. Floating aquatic plants such as duckweed and water spangles were present indicating the area is inundated throughout the year.

This tree is in excellent condition with no evidence of stress, injury, or any other symptoms of disease or defect. Photo B-1 shows the canopy and bole of the tree. Photo B-3 shows the vegetation facing north at the site with baldcypress and tupelo gum stands. Extensive probing starting at the root collar of main roots vertically and horizontally around this tree showed most of the roots were located near the surface of the ground with most roots ranging from 5.0 to 8.75 inches in depth. Anchor root bottoms ranged from 9.5 to 17.0 inches below the surface. Photos B-4 and B-5 show the root distributions around the tree. Form C-1 includes a diagram drawn for the root distribution of major roots measured along with root depths, total root lengths and distances of measurements from the bole of the tree. All of these roots are very healthy showing no evidence of any sodicity factors or other impacts affecting the roots in any manner. All of these roots were in excellent condition and based on the results of the investigation, an ERZ of 12.0 inches would be appropriate for Tree T-01.

3.3.2 Observation Tree T-02

Tupelo Gum (*Nyssa aquatica*) DBH = 17.8"; ERZ = 24.0"

The co-dominant tree species in this area is tupelo gum. It tolerates poorly-drained soils, can grow in standing water, and is often distributed alongside baldcypress trees. Observation area T-02 was located several hundred yards south of Observation area for T-01 within the natural stand of trees representative of native conditions and the habitat within the proposed remediation area. Similarly to T-01, the vegetation in the surrounding area is dominated by a mixed stand of baldcypress and tupelo gum. Woody shrub species present include young black willow and button bush. Ground cover at this site is not present due to the heavy overstory and wet conditions. Minor amounts of surface water were present at the time of observation with floating aquatic plants such as water hyacinth, duckweed, and water spangles present indicating the area is inundated throughout the year. Due to the timing of the investigation, T-02 and surrounding deciduous species had already been through fall leaf abscission as seen in Photo B-6, depicting the crown of the tree. Photo B-7 shows the bole of the tree and surrounding habitat.

T-02 is in excellent condition with no evidence of stress, injury, irregular habit, or any other symptoms of disease or defect. The authors of this report conducted extensive probing of main roots vertically and horizontally around and under this tree. The roots were located near the surface of the ground with the deepest individuals observed approximately 27.75 inches below the surface. Some spoil appeared to have covered some of the areas where the roots resided at the site. This condition likely resulted in the measurement of deeper root depths. Photos B-8 and Photo B-9 show the root distribution around the tree while Photo B-10 is a view of the vegetation growing to the north of the tree. Form C-2 includes a diagram drawn for the root distribution of major roots measured and deepest depths encountered. All of these roots are very healthy showing distribution and depth common for this species with an appropriate ERZ of 24.0 inches for Tree T-02.

3.3.3 Observation Tree T-03

Tupelo Gum (*Nyssa aquatica*) DBH = 13.4"; ERZ = 14.0"

Observation area for T-03 is located on the right descending bank of the access canal, west/northwest of the Plaintiffs' consultant's proposed soil remediation area. The area is located within the natural stand of trees representative of native condition and the habitat within the proposed remediation area. The stand of trees in the surrounding area consists mainly of tupelo gum with a similar multilayer, multi-cohort structure as the other observational areas of the Site. Age class uniformity is present for the dominant species with reproduction of the overstory present in the shrub strata. Woody shrub species present include young black willow and button bush. Ground cover at this site is not present due to the heavy overstory and wet conditions. Floating aquatic plants such as water hyacinth and water spangles were present indicating the area is inundated throughout the year. A large decaying baldcypress stump is in the vicinity of T-03, likely harvested during former logging operations of the Site.

T-03 is in excellent condition with no evidence of stress, injury, or any other symptoms of disease or defect. Photo B-11 shows the tree crown while Photo B-12 shows the bole. Extensive probing starting at the root collar of main roots vertically and horizontally around this tree showed most of the roots were located near the surface of the ground and with the deepest individuals observed approximately 17.0 inches below the surface. Photo B-13 shows the distribution of the roots around Tree T-03 while Photo B-14 shows vegetative stands in the area. Form C-3 includes a diagram drawn for the root distribution of major roots measured and deepest depths encountered. All of these roots are very healthy showing no evidence of any sodicity factors or other impacts that were affecting the roots in any manner. These measurements represent similar depths as to other tupelo gums observed on site in the study. Based on these considerations, an ERZ for Tree T-03 would be 14.0 inches.

3.3.4 Observation Tree T-04

Baldcypress (*Taxodium Distichum*) DBH = 13"; ERZ =14.0"

A baldcypress was selected for Observation T-04 as a representative of the co-dominant tree species of the Site. The area is located within the natural stand of trees representative of native condition on the left descending bank of the bayou southwest of the Plaintiffs' consultant's proposed remediation area. Vegetation in the surrounding area consists of a multilayer, multi-cohort structure with a mix of sizes present providing vertical and horizontal diversity. Distinct age classes and tree layers mark this area with a sparse distribution of fallen trees and decayed stumps from former harvesting practices. Vegetation in the surrounding area consists of a mixed stand of baldcypress and tupelo gum as the dominants. Woody shrub species present include young black willow and button bush. Ground cover at this site is not present due to the heavy overstory and wet conditions. Floating aquatic plants such as duckweed and water spangles were present indicating the area is inundated throughout the year.

This tree is in excellent condition with no evidence of stress, injury, or any other symptoms of disease or defect. Extensive probing starting at the root collar of main roots vertically and horizontally around this tree showed most of the roots were located near the surface of the ground and extending no more than approximately 17.0 inches below the surface. Photos B-15 and B-16 show the crown and bole. The general root distribution around the tree is shown in Photo B-17. Form C-1 includes a diagram drawn for the root distribution of major roots measured and distances of measured depths from the bole of the tree. All of these roots are very healthy showing no evidence of any sodicity factors or other impacts that were affecting the roots in any

manner. All of these roots were in excellent condition and based on the results of the investigation, an ERZ of 14.0 inches would be appropriate for Tree T-04.

3.3.5 Observation Tree T-05

Tupelo Gum (*Nyssa aquatica*) DBH = 12.4”; ERZ =11.0”

Observation area for T-05 is located near T-04 in a multi-cohort stand with a mix of tree and shrub species present. T-05 is a healthy tupelo gum with a bifurcation in the trunk that does not affect the root system. Distinct age classes and tree layers mark this area with a sparse distribution of decayed stumps from former harvesting. Vegetation in the surrounding area consists of a mixed stand of baldcypress and tupelo gum as the dominants. Woody shrub species present include young black willow and button bush. Ground cover at this site is not present due to the heavy overstory and wet conditions. Floating aquatic plants such as duckweed and water spangles were present indicating the area is inundated throughout the year.

This tree is in excellent condition with no evidence of stress, injury, or any other symptoms of disease or defect. Extensive probing starting at the root collar of main roots vertically and horizontally around and under this tree showed most of the roots were located near the surface of the ground and extending no more than approximately 16.5 inches below the surface. Photos B-18 and B-19 show the crown and bole while Photos B-20 and B-21 show the general root distribution. Vegetation typical of the stand in the investigation area is shown in Photo B-22. Form C-5 includes a diagram drawn for the root distribution of major roots measured. All of these roots are very healthy showing no evidence of impacts from former E&P operations. All of these roots were in excellent condition and based on the results of the investigation, an ERZ of 11.0 inches would be appropriate for Tree T-05.

Table 3.1. Effective Root Zone (ERZ) of plant species

| Site ID | Common Name | Scientific Name | ERZ (in) |
|---------|-------------|---------------------------|----------|
| T-01 | Baldcypress | <i>Taxodium distichum</i> | 12.0 |
| T-02 | Tupelo Gum | <i>Nyssa aquatica</i> | 24.0 |
| T-03 | Tupelo Gum | <i>Nyssa aquatica</i> | 14.0 |
| T-04 | Baldcypress | <i>Taxodium distichum</i> | 14.0 |
| T-05 | Tupelo Gum | <i>Nyssa aquatica</i> | 11.0 |

4.0 GENERAL DISCUSSION

The effective root zone study conducted on the Jeanerette Lumber and Shingle property showed vegetative communities typical of those found in the Atchafalaya Basin. The study area consisted of the native cypress-tupelo gum swamp habitat. The vegetation consisted primarily of a wetland forest community dominated by a multi-cohort stand that showed no evidence of any kind of impacts from typical salt parameters associated with E&P activities. On the dredge spoil banks along the former oil and gas field canals and bayou, the plant communities were in various stages of succession providing evidence of a wet hydrologic condition. For example, healthy juvenile baldcypress have colonized higher elevations of the property and within areas the Plaintiffs’ consultant are proposing remediation for cypress tree growth. Photos B-23 and B-24 show young baldcypress trees populating elevated spoil piles west of the house boat located within the north-south canal approximately 300 feet south of the former SN 70817 well location.

This phenomenon is indicative of deeper and more prolonged flooding amplitudes in recent years. A detailed review of the site vegetation showed freshwater species prevalent within and outside of the Plaintiffs' consultant's proposed remediation area.

For the purpose of this root study, detailed reviews of the dominant woody species are shown in Figure 12. Throughout the investigation, none of the trees showed any impacts in either the below or above ground portions from either salt parameters or petroleum hydrocarbons associated with former E&P operations. The effective root zone study showed a very shallow distribution of healthy and non-impacted roots on all of the trees in the observational areas. Extensive probing and spot checks of the depths of the roots both under and emanating from the root collar showed generally very shallow root depths on all of the woody species. As shown in Table 3.1, baldcypress in the study exhibited effective root zones between 12.0 to 14.0 inches bgs. All of the roots were healthy with no signs of impacts and characteristic knees were present for each individual. The tupelo gum investigated typically occurred in deeper portions of the swamp and showed slightly deeper root penetrations. ERZs for tupelo gum observed ranged from 11.0 to 24.0 inches bgs. Based on the extensive reviews for typical trees growing on the JLS property, a remediation depth of 18.0 inches would be more than adequate for remediation of any sites that, if required, could be planted for cypress trees or tupelo gums for areas within AOI-1 and AOI-2. The depth of alleged impact constituents begins at depths of 6 and 8 feet bgs within AOI-2, significantly deeper than the ERZ depth of 14.0 inches for baldcypress and the maximum depth of 24.0 inches found for one of the tupelo gums. The other two tupelo gums had ERZs ranging from 11.0 to 14.0 inches indicating these areas currently support adequate depth for both baldcypress and tupelo gum survival, reproduction and propagation without requiring a considerable dig and haul program as proposed by the Plaintiffs' consultants. In fact, any remediation would require total destruction of healthy stands of 75 to 100+ year old cypress-tupelo gum trees that are thriving and producing timber. Also, after destruction of the stands and replanting for remediation (even if physically possible), an additional 75 to 100+ years would be required to produce cypress-tupelo gum communities like the healthy and unimpacted stands growing on sites in both areas AOI-1 and AOI-2 today.

5.0 OPINIONS AND CONCLUSIONS

- a. The trees growing on the JLS property currently show very shallow root systems over all areas investigated. This is typical for soils, landscapes and hydrologic regimes occurring in this area and most of the southcentral part of Louisiana. Data from the root studies showed that all observed species growing on the property have shallow rooting depths.
- b. Effective rooting zones for all of the trees were very shallow with no baldcypress ERZs extending past 14.0 inches and most much shallower and very near the surface of the soil.
- c. No indicators of impacts from high salinity/sodicity factors were observed at the site such as leaf and branch dieback, epicormic branching, bark sloughing, stunted trees with small crowns, lack of cypress regeneration, low overall tree basal area or white crusts on soil surface when dry.
- d. Based on the data, if required, a remediation depth of 18.0 inches would be generous for the areas and trees around the Site. Even though this depth would be more than reasonable for the effective root zones of baldcypress remediation as proposed by the Plaintiffs' consultants, it is highly unlikely that any remediation could be conducted at this site since the areas are often deeply flooded much of the year and

have very fine clay soils with poor foundations. These characteristics would make remediation efforts very difficult or impossible to conduct without leveeing and extensive dewatering of the sites. Also, since cypress regeneration is presently moving upslope to higher elevations, any areas planted to cypress at lower elevations would very likely not survive.

- e. Other considerations for potential remediation would be the need to control sedimentation and erosion, prevent soil compaction from equipment trafficking, comply with the requirements of the Clean Water Act and prevent establishment of invasive and/or non-target species in order to maintain integrity of the site for these purposes.
- f. Observations made during the study indicate a healthy baldcypress-tupelo gum stand exists today within AOI-1 and AOI-2 and surrounding areas. This condition will very likely continue if no remediation is conducted at the site. The cost estimate derived by the Plaintiffs' consultants recognizes this by including \$54,624 for mitigation of 3.64 acres at AOI-1 and \$628,976 for mitigation of 41.93 acres at AOI-2 of cypress swamp habitat that would be destroyed due to the proposed remedy.
- g. Due to hydrologic modifications and increased flooding within the Atchafalaya Basin from inflows at the Old River and Auxiliary Control Structures that may cause reduced productivity and lack of natural regeneration in the natural cypress-tupelo gum stands, wildlife habitat and water quality protection may prove to provide greater value to the overall Atchafalaya Basin ecosystem than future timber production.

5.1 BASIS FOR OPINIONS AND CONCLUSIONS

The defendants in this case have been sued by the Plaintiffs for various allegations of damages to its property, including soil, sediment and groundwater contamination. This report considers the characteristics of the trees at the JLS property. A root study was conducted for root penetration in order to determine depths of the particular plant populations. This consideration is very important to determine the true depth of remediation, if required, for the propagation of the types of vegetation that grow in the area. These data represent a site specific study which relates directly to the JLS property that is under investigation. Consultants for the Plaintiffs have proposed expansive remediation depths significantly deeper than the observed Effective Root Zone depth for the natural vegetation occurring on the site. Additionally, healthy baldcypress-tupelo gum swamp habitat would be destroyed and unimpacted soils currently supporting the healthy vegetation would be excavated to remove soils unaffiliated with cypress tree health. Regulatory concerns for any proposed remediation activities, if any, will be addressed by other experts.

6.0 REFERENCES/LITERATURE REVIEWED

Holloway, Luther F. 2020. Expert Report and Vegetation Root Study Hero Lands Company, L.L.C. Property Plaquemines Parish, Louisiana. In the Matter: *Hero Lands Company, L.L.C. versus Chevron U.S.A. Inc. Et Al.* Docket No. 64-320, Div. "A", 25TH JDC for the Parish Plaquemines, State of Louisiana

Louisiana State University, Office of Research & Economic Development, Louisiana Geological Survey. 2013. Published geology maps.

<http://www.lgs.lsu.edu/deploy/content/PUBLI/contentpage17.php>

- McPhee, John. 1989. *The Control of Nature*. Farrar, Straus and Giroux. ISBN 0-374-12890-1 272 p.
- Miller, Gregory W. and W. Prejean. 2020. Expert Report and Restoration Plan for the Landowners; Jeanerette Lumber and Shingle, LLC v ConocoPhillips Company, et al; Docket 134307, Div "E"; 16th JDC; Lake Bayou Pigeon Oil Field, Iberia Parish, LA Prepared for Jones, Swanson, Huddell and Garrison, LLC, New Orleans, Louisiana (September 22, 2020).
- Schuurman, J.J. and M.A.J. Goedewaagen. 1971. *Methods for the Examination of Root Systems and Roots*. Centre for Agricultural Publishing Documentation, Wageningen, the Netherlands. 90 p.
- Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at <http://websoilsurvey.nrcs.usda.gov/>
- Soil Survey Staff. 1978. *Soil Survey of Iberia Parish, Louisiana*. USDA Soil Conservation Service. Washington, D.C. 67 p.
- U.S. EPA (U.S. Environmental Protection Agency). 2015. *Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments*. National Center for Environmental Assessment, Ecological Risk Assessment Support Center, Cincinnati, OH. EPA/600/R-15/176.

Holloway Environmental Services, Inc. and Environmental Resources Management, Inc. do hereby certify that the information reported in this document is, to the best of our knowledge, accurate and complete. We, Luther F. Holloway and Patrick M. Ritchie, reserve the right to supplement and/or amend this report should additional information become available.

Luther F. Holloway, Ph. D.

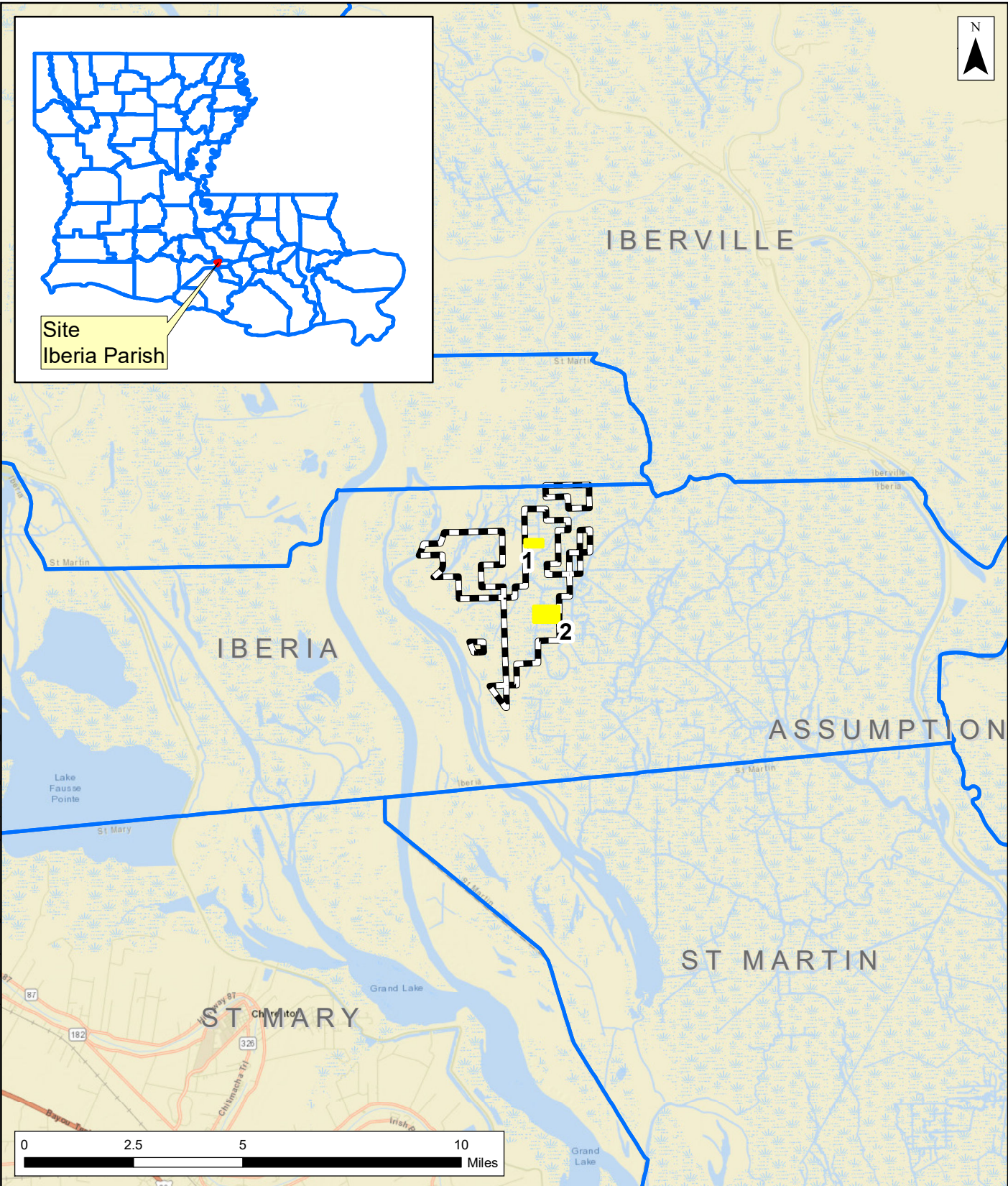
A handwritten signature in blue ink, appearing to read "Luther F. Holloway".

Patrick M. Ritchie, PWS

A handwritten signature in blue ink, appearing to read "Patrick M. Ritchie".

Appendix A Figures

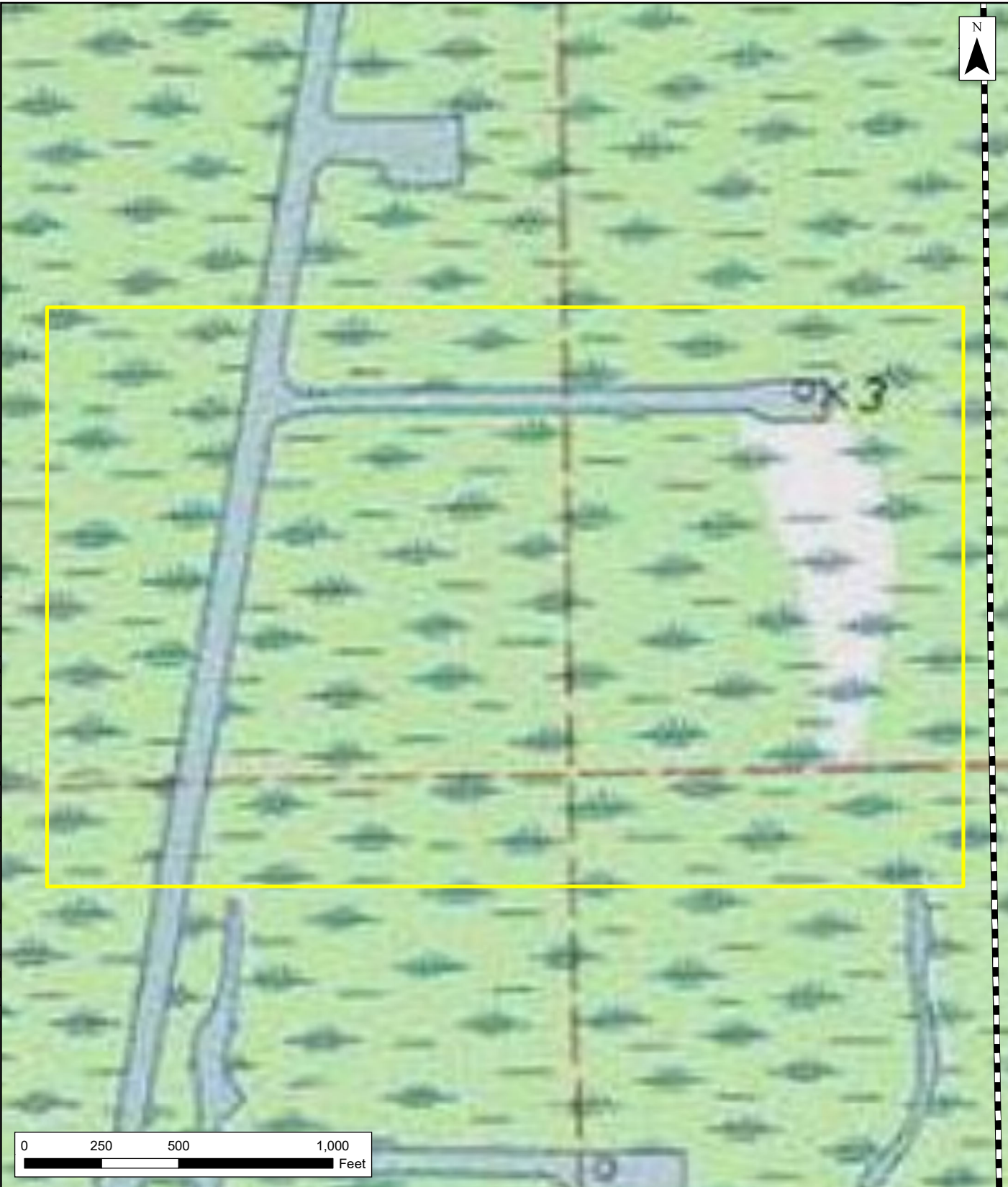
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- ICON AOIs
- Parish Boundary
- Property

Figure 1
Regional Location
 Jeanerette Lumber v. ConocoPhillips Company, et al.
 Bayou Pigeon Oil & Gas Field
 Iberia Parish, Louisiana

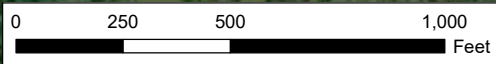
Notes:
 World Street Basemap via ArcGIS
 Online.



-  AOI 2
-  Property

Figure 2
AOI 2 - USGS Topographic Map & Public Land Survey Sections

Notes: Jeanerette Lumber v. ConocoPhillips Company, et al.
 USGS Topographic Map via Bayou Pigeon Oil & Gas Field
 ArcGIS Online. Iberia Parish, Louisiana



-  AOI 2
-  Property

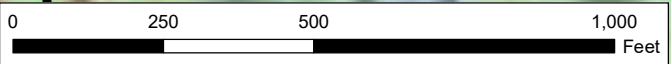
Figure 3

AOI 2 - Site Location

Jeanerette Lumber v. ConocoPhillips Company, et al.
Bayou Pigeon Oil & Gas Field
Iberia Parish, Louisiana

Notes:
World Imagery via ArcGIS Online.

H:\0519829_Kean_Miller_LLP_(CVX)_Jeanerette_Lumber_v_COP_SIWGIS_Maps\07_Report_Figures\Root_study_Report_Figures\03_USGS_Topographic_Map_&_Public_Land_Survey_Sections.mxd...REVISED: 03/31/2021...SCALE: 1:3,827 when printed at 8.5...DRAWN BY: MMG



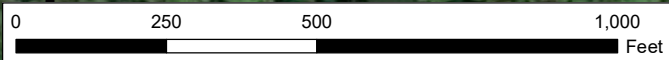
-  AOI 1
-  Property

Figure 4
AOI 1 - USGS Topographic Map & Public Land Survey Sections

Notes: Jeanerette Lumber v. ConocoPhillips Company, et al.
 USGS Topographic Map via Bayou Pigeon Oil & Gas Field
 ArcGIS Online. Iberia Parish, Louisiana

DRAWN BY: MMG

H:\0519829_Kean_Miller_LLP_(CVX)_Jeanerette_Lumber_v_COP_S\WG\SI\Maps\07_Report_Figures\Root_study_Report_Figures\01_Site_location_AOI_2_rev.mxd, REVISED: 03/31/2021, SCALE: 1:3,827 when printed at 8.5x11

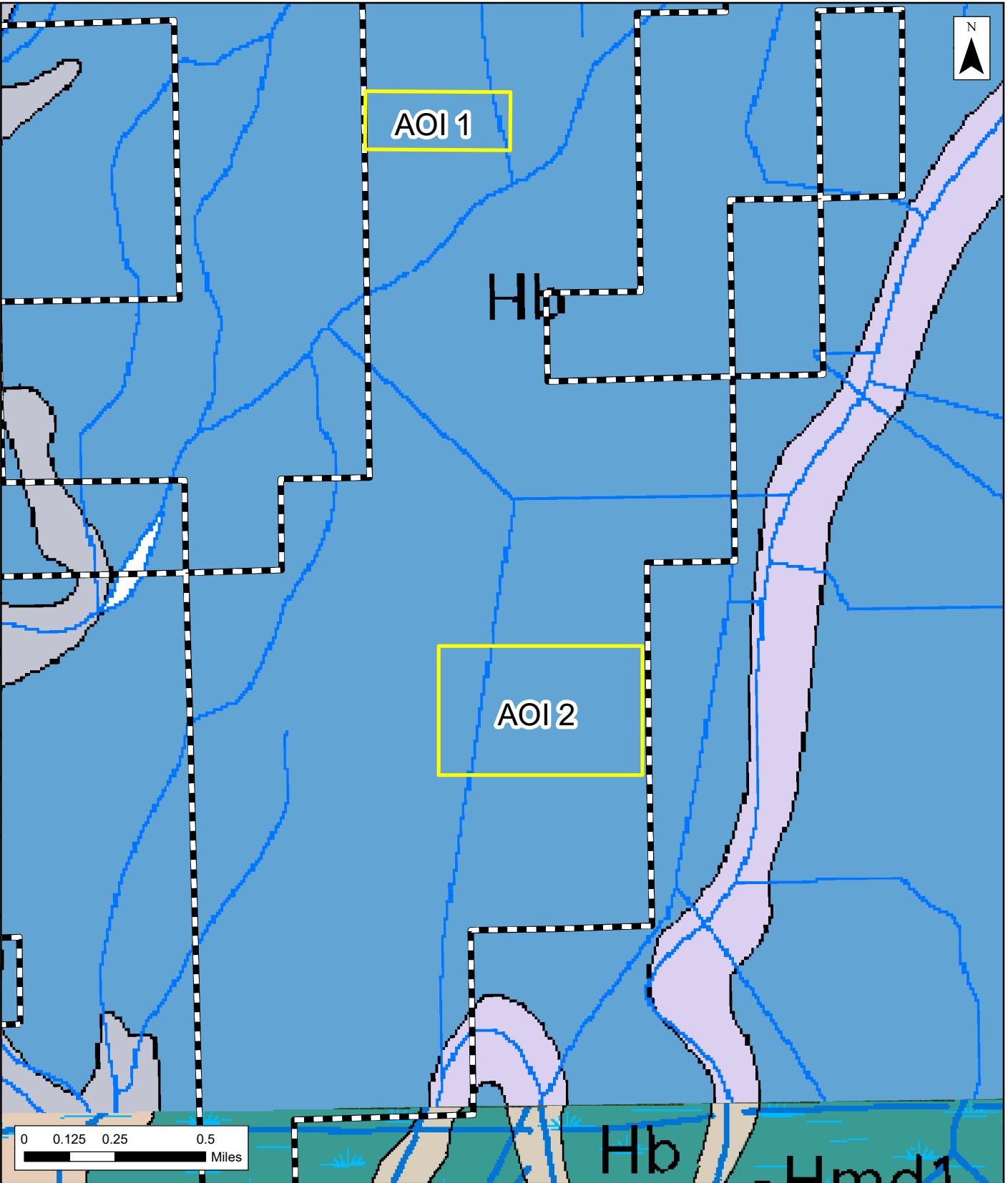


-  AOI 1
-  Property

Figure 5
AOI 1 - Site Location
 Jeanerette Lumber v. ConocoPhillips Company, et al.
 Bayou Pigeon Oil & Gas Field
 Iberia Parish, Louisiana

Notes:
 World Imagery via ArcGIS Online.

H:\0519829_Kean_Miller_LLP_CVX\Jeanerette Lumber v COP.SWIG(S)\Maps\07_Report\Figures\Root study report\Figures\24_Surface Geology.mxd REVISED: 03/31/2021 SCALE: 1:24,000 when printed at 8.5x11 DRAWN BY: MMG



 ICON AOIs

Hb - Backswamp deposits - Holocene deposits of the Mississippi and Atchafalaya Rivers.

They consist of fine-grained, usually clayey and often organically rich sediments that underlie flood basins between meander-belts.

Hmd1 - Distributary complex of Mississippi River meander-belt No. 1 - silty to clayey, natural levee deposits of distributaries originating from meander-belt No. 1

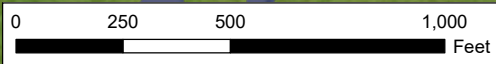
Jeanerette Lumber v. ConocoPhillips Company, et al.
Bayou Pigeon Oil & Gas Field
Iberia Parish, Louisiana

Notes:
Baton Rouge and
Morgan City 100k
Geology Maps.

Environmental Resources Management
www.erm.com



Figure 6
Surface Geology



-  Property
-  AOI 2
-  FE - Fausse soils, 0 to 1 percent slopes, frequently flooded
-  W - Water

Figure 7
AOI 2 - USDA Surface Soil Types

Jeanerette Lumber v. ConocoPhillips Company, et al.
Bayou Pigeon Oil & Gas Field
Iberia Parish, Louisiana

Notes:
Imagery Basemap
via ArcGIS
Online.

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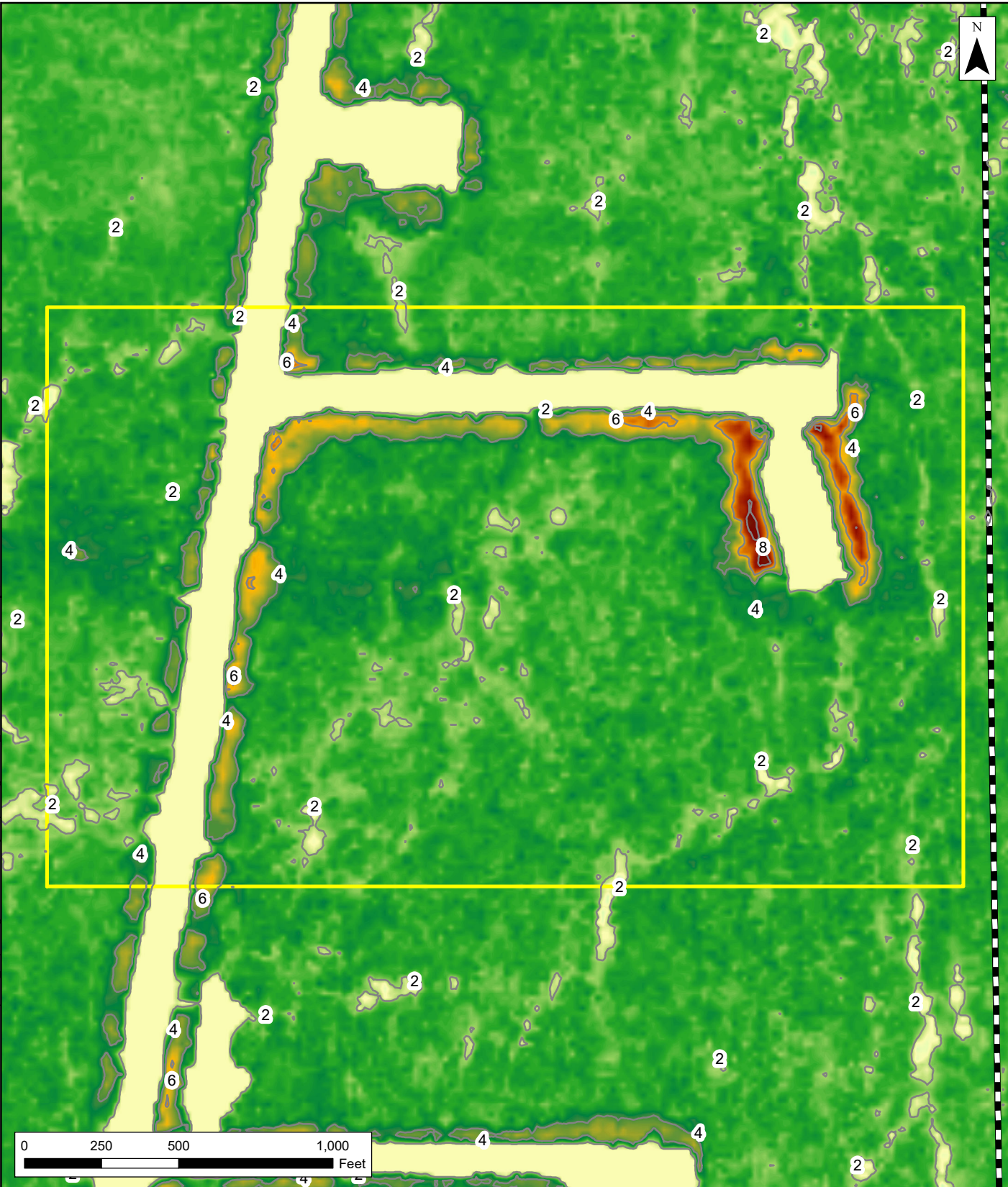
-  Property
-  AOI 1
-  FE - Fausse soils, 0 to 1 percent slopes, frequently flooded
-  W - Water

Figure 8
AOI 1 - USDA Surface Soil Types
 Jeanerette Lumber v. ConocoPhillips Company, et al.
 Bayou Pigeon Oil & Gas Field
 Iberia Parish, Louisiana

Notes:
 Imagery Basemap
 via ArcGIS
 Online.

H:\0519829\Kean.Miller.LLP.(CVX)\Jeanerette.Lumber.v.COP.SWGIS\Maps\07_Report_Figures\Root_study_Report_Figures\26_LiDAR Elevation Model.mxd... REVISED: 03/31/2021... SCALE: 1:5,368 when printed at 8.5x11



Property

AOI 2

2 ft LiDAR Elevation Contour

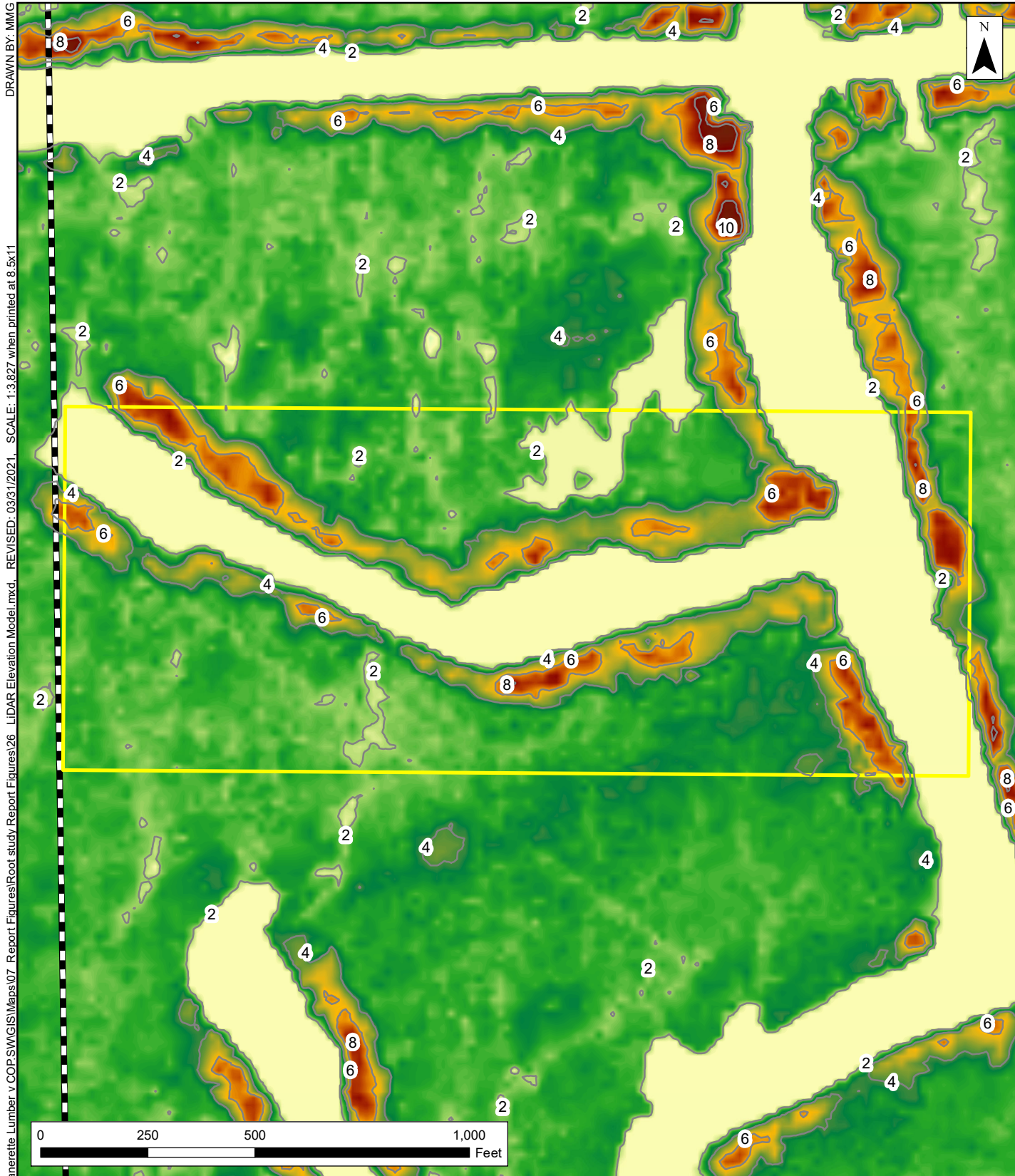
Lower Elevation Higher Elevation

0.76 ft 8.8 ft

Figure 9
AOI 2 - LiDAR Elevation Model

Notes: Jeanerette Lumber v. ConocoPhillips Company, et al.
 Elevation model based on LiDAR data from LSU Atlas. Bayou Pigeon Oil & Gas Field
 Iberia Parish, Louisiana

Source: Esri - ArcGIS Online; NAD 1983 UTM Zone 15N



DRAWN BY: MMG
 H:\0519829\Kean.Miller.LLP.(CVX)\Jeanerette Lumber v COP.SWGIS\Maps\07_Report\Figures\Root study Report\Figures\26_LiDAR Elevation Model.mxd_REVISED: 03/31/2021_SCALE: 1:3,827 when printed at 8.5x11

Property

AOI 1

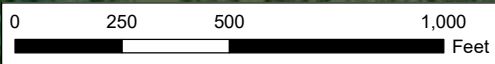
2 ft LiDAR Elevation Contour

Lower Elevation Higher Elevation

1.3 ft 8.2 ft

Figure 10
AOI 1 - LiDAR Elevation Model

Notes: Jeanerette Lumber v. ConocoPhillips Company, et al.
 Elevation model based on LiDAR Bayou Pigeon Oil & Gas Field
 data from LSU Atlas. Iberia Parish, Louisiana






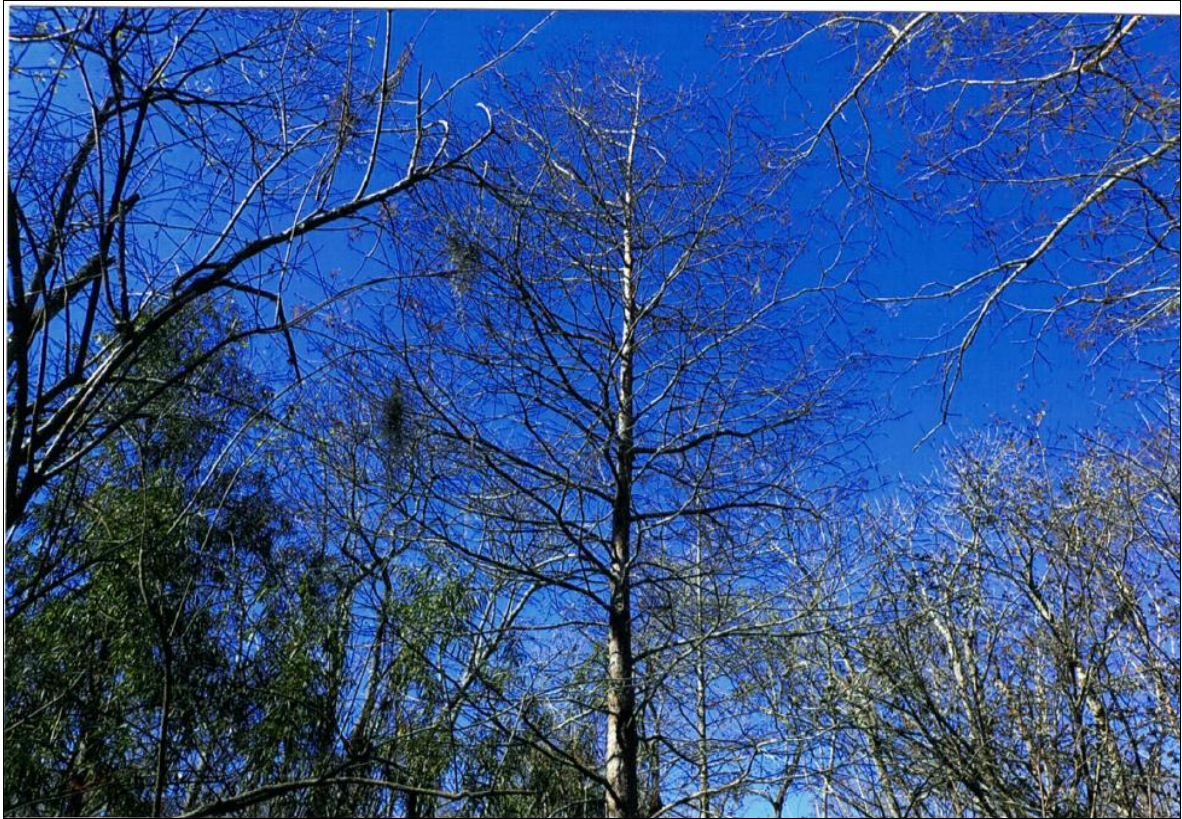
-  Property
-  AOI 2
-  Tree Root Study Locations

Figure 12
AOI 2 - Tree Root Study Locations
Jeanerette Lumber v. ConocoPhillips Company, et al.
Bayou Pigeon Oil & Gas Field
Iberia Parish, Louisiana

Notes:
Imagery basemap via ArcGIS Online



Appendix B Ground Level Photographs



| | |
|---------------------------|---------------------------------|
| Photograph: B-1 | Crown of Tree T-01, Baldcypress |
|---------------------------|---------------------------------|



| | |
|---------------------------|-------------------|
| Photograph: B-2 | Bole of Tree T-01 |
|---------------------------|-------------------|



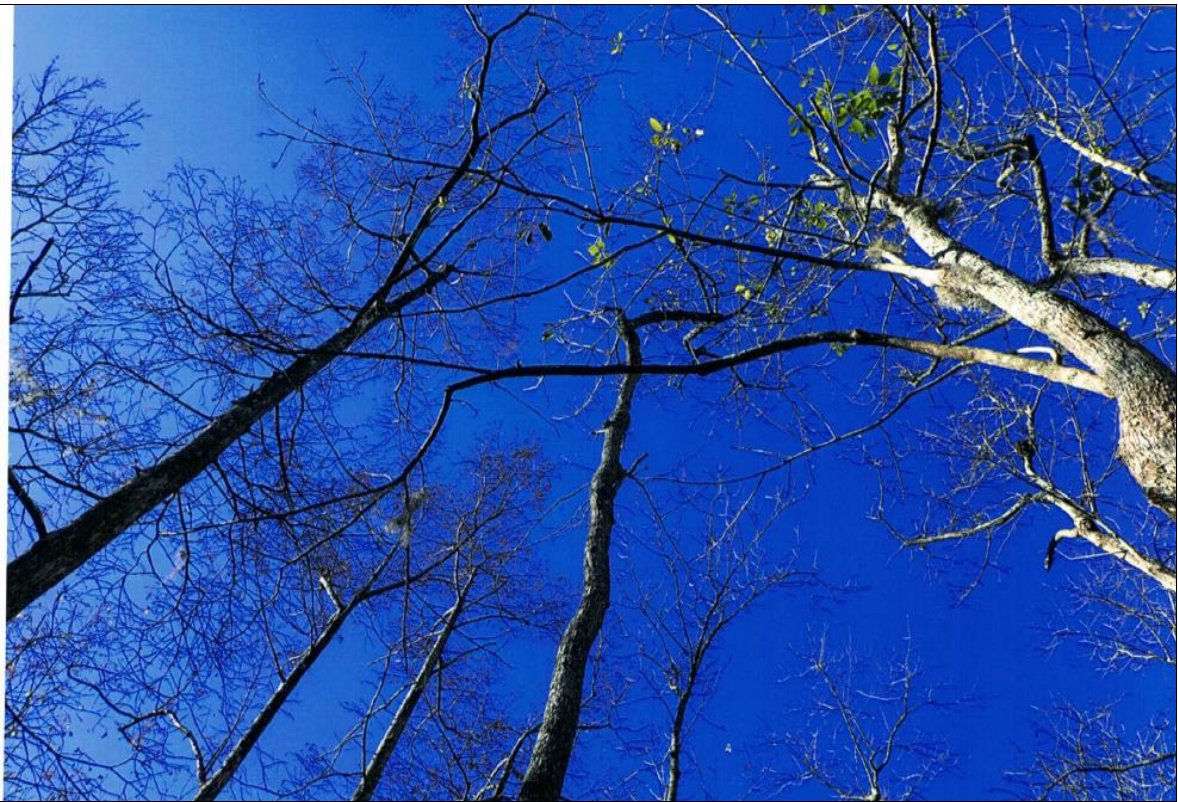
| | |
|---------------------------|---------------------------------|
| Photograph: B-3 | Vegetation facing North at T-01 |
|---------------------------|---------------------------------|



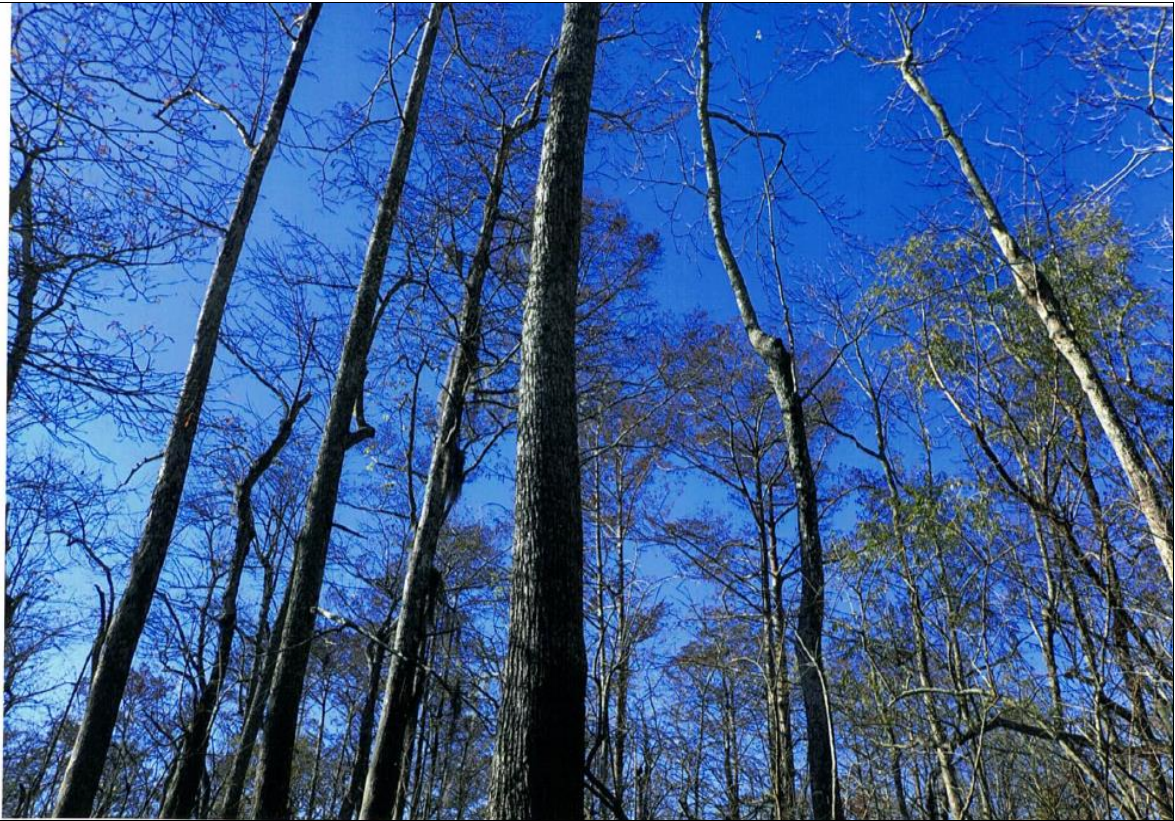
| | |
|---------------------------|---------------------------|
| Photograph: B-4 | Root Distribution at T-01 |
|---------------------------|---------------------------|



| | |
|---------------------------|--|
| Photograph: B-5 | Another view of root distribution at Tree T-01 |
|---------------------------|--|



| | |
|---------------------------|---------------------------|
| Photograph: B-6 | Crown of T-02, Tupelo Gum |
|---------------------------|---------------------------|



Photograph:
B-7

Bole of Tree T-02



Photograph:
B-8

Base of Tree T-02 showing root distribution facing North





Photograph:
B-9

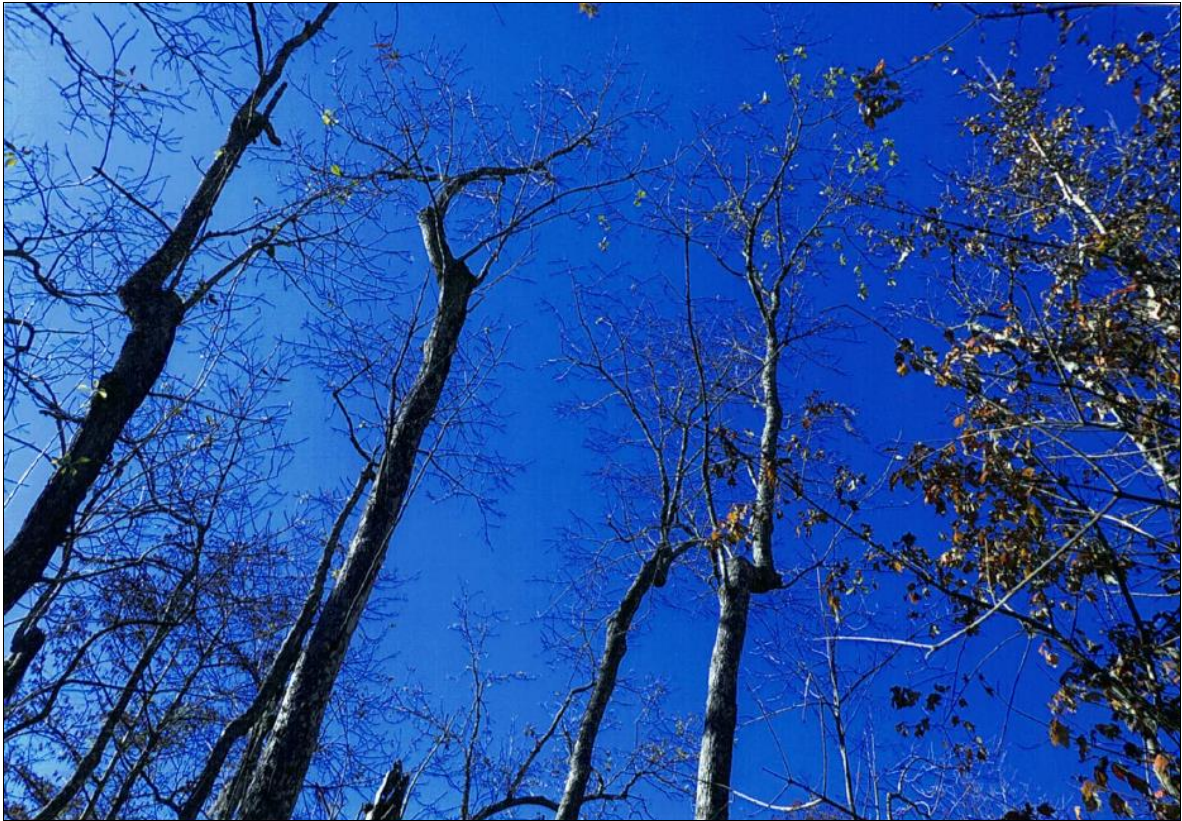
View of root distribution on South and West side of Tree T-02



Photograph:
B-10

Vegetation near Tree T-02





Photograph:
B-11

Crown of Tree T-03, Tupelo Gum



Photograph:
B-12

Bole of Tree T-03





Photograph:
B-13

Root distribution at Tree T-03



Photograph:
B-14

Vegetation in area of Tree T-03

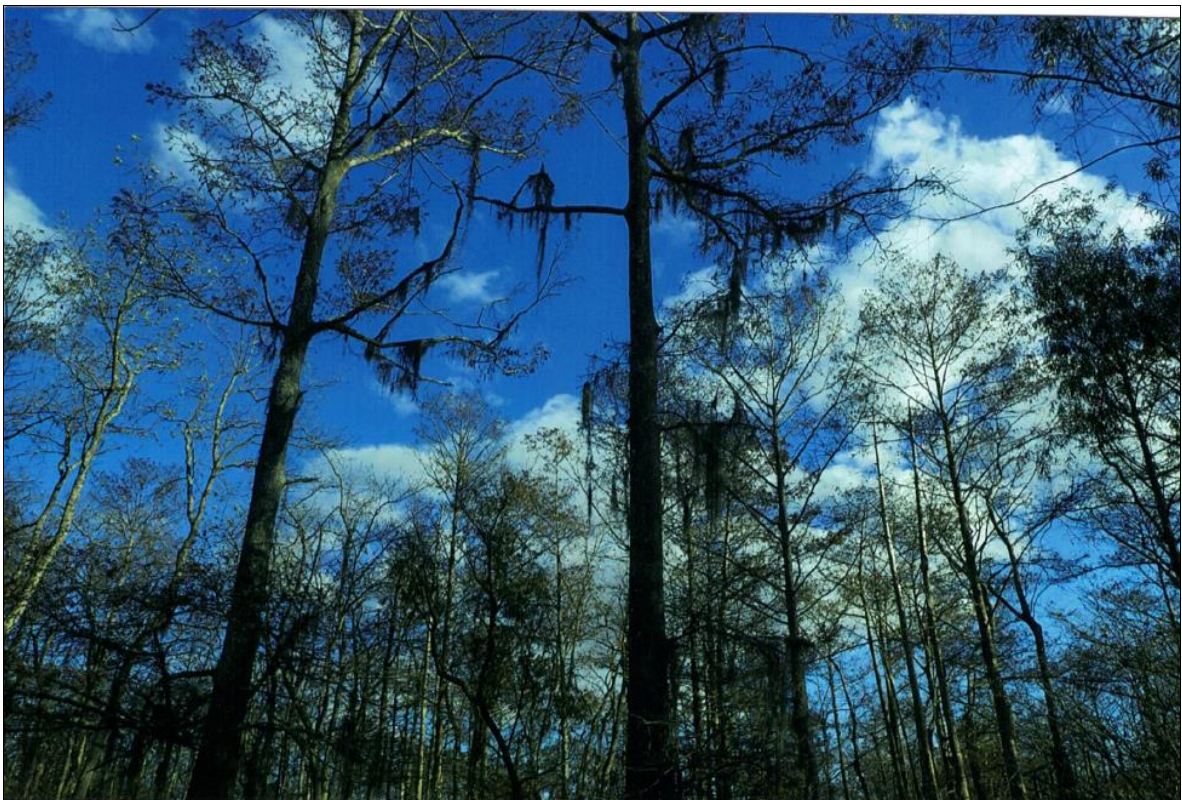


Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021



| | |
|----------------------------|---------------------------------|
| Photograph: B-15 | Crown of Tree T-04, Baldcypress |
|----------------------------|---------------------------------|



| | |
|----------------------------|-------------------|
| Photograph: B-16 | Bole of Tree T-04 |
|----------------------------|-------------------|

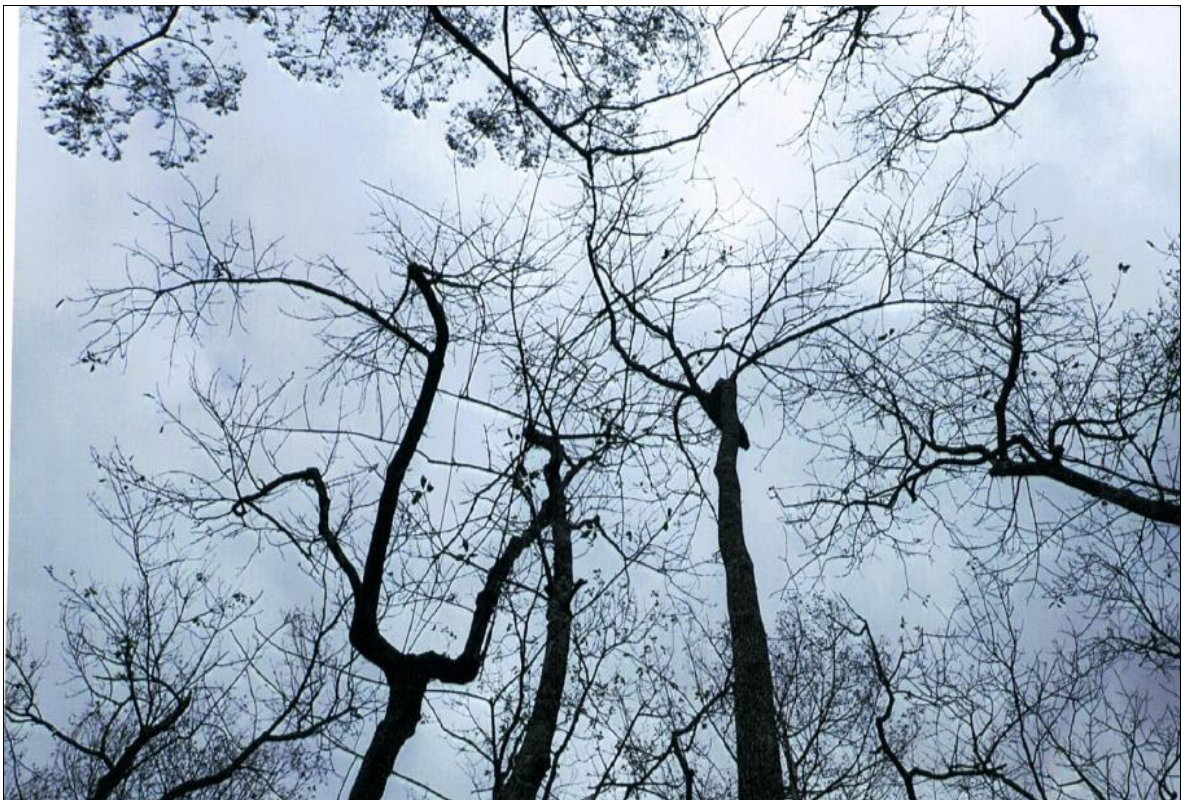


Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021



| | |
|----------------------------|--|
| Photograph: B-17 | Root distribution around Tree T-04 with typical vegetation in background |
|----------------------------|--|



| | |
|----------------------------|--------------------------------|
| Photograph: B-18 | Crown of Tree T-05, Tupelo Gum |
|----------------------------|--------------------------------|



Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021



| | |
|----------------------------|-------------------|
| Photograph: B-19 | Bole of Tree T-05 |
|----------------------------|-------------------|



| | |
|----------------------------|------------------------------------|
| Photograph: B-20 | Root distribution around Tree T-05 |
|----------------------------|------------------------------------|



Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021



| | |
|----------------------------|--|
| Photograph: B-21 | Another view of root distribution at Tree T-05 |
|----------------------------|--|



| | |
|----------------------------|--|
| Photograph: B-22 | Tree T-05 with typical stand of vegetation in background |
|----------------------------|--|



| | |
|----------------------------|---|
| Photograph: B-23 | Canopies of young baldcypress invading elevated areas |
|----------------------------|---|



| | |
|----------------------------|---|
| Photograph: B-24 | Basal areas and boles of young baldcypress invading areas |
|----------------------------|---|



Photograph:
P3080002

View of canal and vegetation facing east from facility and SWD #001. No evidence of any impacts to cypress or any other species.



Photograph:
P3080005

View of canal and vegetation in AOI-1 facing west At SWD #001 (SN972653). Cypress trees and other vegetation in excellent condition showing no impacts from salting or other E&P activities.



Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021



Photograph:
P3080008

View of cypress trees in AOI-1 with pennywort floating in water. Cypress trees of different age classes are healthy with no evidence of impacts.



Photograph:
P3080011

View of well SN219930 in AOI-1 with healthy stand of cypress and other species in the background.



Jeanerette Lumber v COP
Pigeon Bayou, LA
ERM Project Number 0519829

Date: 8 April 2021

Appendix C Root Study Field Forms

Date: 12/09/2020

By: L.F. Holloway & P. Ritchie

Observation ID: T-01

Property/Project: Jeanerette Lumber v COP

Geographic Coordinates: N 30° 01' 00.9" W 91° 24' 26.4"

Other Information: Anchor Bottoms

Root 3 (17" deep @ 17" from bole)

Root 5 (9.5" deep @ 19" from bole)

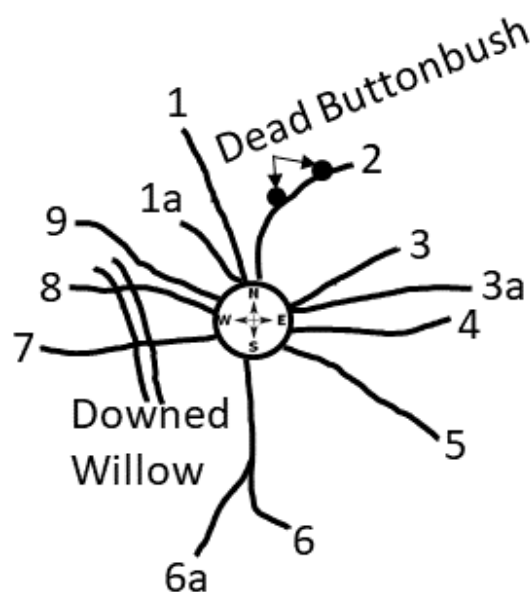
Root 7 (16.5" deep @ 18" from bole)

Root 7 (14.5" deep @ 27" from bole)

Species: **Baldcypress**

DBH= 18.8" @ 60.0"

| Root No. | Length | Depth to Top | Distance on Root | Root No. | Length | Depth to Top | Distance on Root |
|----------|--------|--------------|------------------|----------|--------|--------------|------------------|
| 1 | 54" | 5.0" | 36" | 7 | 85" | 5.0" | 85" |
| 1a | 30" | 8.75" | 18" | 8 | 67" | 8.0" | 42" |
| 2 | 84" | 7.5" | 51" | 9 | 72" | 8.0" | 40" |
| 3 | 74" | 6.25" | 52" | | | | |
| 3a | 124" | 8.5" | 72" | | | | |
| 4 | 99" | 7.0" | 60" | | | | |
| 5 | 102" | 7.25" | 72" | | | | |
| 6 | 76" | 13.5" | 76" | | | | |
| 6a | 62" | 6.0" | 62" | | | | |



*Not to scale

Date: 12/9/2020

By: L.F. Holloway & P. Ritchie

Observation ID: **T-02**

Property/Project: Jeanerette Lumber v COP

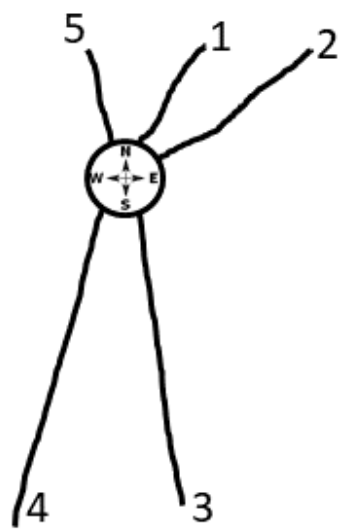
Geographic Coordinates: N 30° 01' 00.4" W 91° 24' 26.2"

Other Information:

Species: **Tupelo Gum**

DBH= 17.8" @ 83"

| Root No. | Length | Depth to Top | Distance on Root | Root No. | Length | Depth to Top | Distance on Root |
|----------|--------|--------------|------------------|----------|--------|--------------|------------------|
| 1 | 81" | 27.25" | 60" | | | | |
| 2 | 81" | 20.5" | 47.5" | | | | |
| 3 | 69" | 23.0" | 69" | | | | |
| 4 | 109" | 27.75" | 83" | | | | |
| 5 | 57" | 13.0" | 57" | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



*Not to scale

Date: 12/10/2020

By: L.F. Holloway & P. Ritchie

Observation ID: **T-03**

Property/Project: Jeanerette Lumber v COP

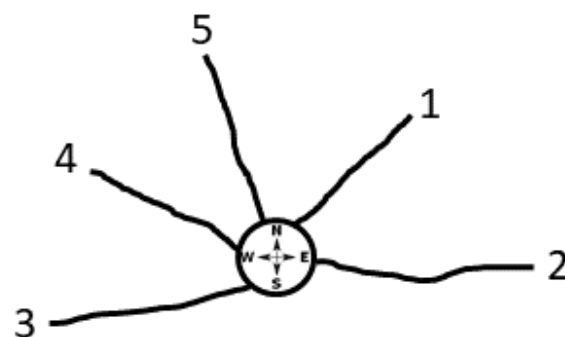
Geographic Coordinates: N 30° 01' 00.1" W 91° 24' 45.4"

Other Information:

Species: **Tupelo Gum**

DBH= 13.4" @ 75"

| Root No. | Length | Depth to Top | Distance on Root | Root No. | Length | Depth to Top | Distance on Root |
|----------|--------|--------------|------------------|----------|--------|--------------|------------------|
| 1 | 51" | 14" | 44" | | | | |
| 2 | 88" | 12" | 42" | | | | |
| 3 | 60" | 16" | 60" | | | | |
| 4 | 62" | 9.0" | 53" | | | | |
| 5 | 68" | 17" | 37" | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



*Not to scale

Date: 12/10/2020

By: L.F. Holloway & P. Ritchie

Observation ID: **T-04**

Property/Project: Jeanerette Lumber v COP

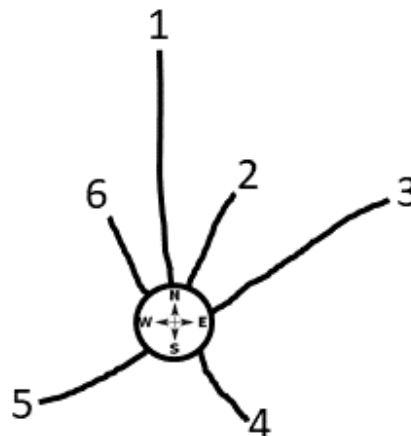
Geographic Coordinates: N 30° 00' 48.0" W 91° 24' 44.7"

Other Information: Spoil bed slope

Species: **Bald Cypress**

DBH= 13" @ 10'

| Root No. | Length | Depth to Top | Distance on Root | Root No. | Length | Depth to Top | Distance on Root |
|----------|--------|--------------|------------------|----------|--------|--------------|------------------|
| 1 | 172" | 16.5" | 172" | | | | |
| 2 | 57.0" | 13.0" | 57.0" | | | | |
| 3 | 107" | 12.0" | 107" | | | | |
| 4 | 22.0" | 11.0" | 31.0" | | | | |
| 5 | 53.0" | 11.0" | 53.0" | | | | |
| 6 | 43.0" | 21.0" | 43.0" | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |



*Not to scale

Date: 12/11/2020

By: L.F. Holloway & M. Greene

Observation ID: **T-05**

Property/Project: Jeanerette Lumber v COP

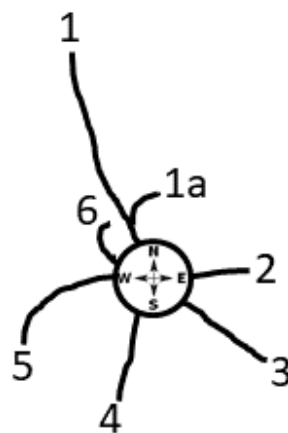
Geographic Coordinates: N 30° 00' 50.3" W 91° 24' 43.7"

Other Information:

Species: **Tupelo Gum**

DBH= 12.4" @ 75"

| Root No. | Length | Depth to Top | Distance on Root | Root No. | Length | Depth to Top | Distance on Root |
|----------|--------|--------------|------------------|----------|--------|--------------|------------------|
| 1 | 83" | 16.5" | 45" | | | | |
| 1a | 13" | 3.00" | 13" | | | | |
| 2 | 33" | 14.5" | 33" | | | | |
| 3 | 62" | 11.0" | 44" | | | | |
| 4 | 50" | 9.00" | 50" | | | | |
| 5 | 70" | 10.5" | 40" | | | | |
| 6 | 27" | 8.00" | 27" | | | | |
| | | | | | | | |
| | | | | | | | |



*Not to scale

Appendix D Resumes and Testimony

PERSONAL RESUME OF LUTHER F. HOLLOWAY

Address: 9269 Hwy. 124

Harrisonburg, Louisiana 71340

Telephone 318.744.5638

EDUCATION

Ph.D. in Plant Pathology, Louisiana State University, Baton Rouge, Louisiana, 1971.

Master of Science in Fisheries Biology (Emphasis in Estuarine Ecology), Louisiana State University, Baton Rouge, Louisiana, 1969.

Attended Oklahoma State University, Stillwater, Oklahoma, 1966-1967. Major: Zoology.

Bachelor of Science in Wildlife Management, Louisiana Tech University, Ruston, Louisiana, 1966. Major Courses: Botany, Zoology and Microbiology.

EXPERIENCE

1974-Present: President, Holloway Environmental Services, Inc., Harrisonburg, LA and Vicksburg, MS; Owner, Luther Holloway Farms (1989-Present).

1973-1977: Research Botanist, Environmental Laboratory, U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

1972-1973: Environmental Resources Specialist, U. S. Army Engineer District, New Orleans, LA.

1972-1972: Research Associate, Department of Entomology, LSU, Baton Rouge, LA.

1968-1971: Athletic Tutor, Athletics Department, LSU, Baton Rouge, LA. Courses: Biology, Agronomy & Statistics

1969-1971: Research Assistant, Department of Botany - Plant Pathology, LSU Baton Rouge, LA.

1967-1969: Graduate Research Assistant, Departments of Zoology and Forestry, LSU, Baton Rouge, LA.

1966- 1967: Graduate Research Assistant, Department of Zoology, Oklahoma State University, Stillwater, Oklahoma.

1965-1966: Undergraduate Laboratory Instructor, Department of Botany and Bacteriology, Louisiana Tech University, Ruston, LA.

PARTIAL WORK EXPERIENCE

2000-Present:

1. Dr. Holloway conducted investigations of the impacts of petroleum production and spills on agricultural and timbered areas in oil fields in Louisiana in areas ranging from near the Arkansas line to coastal wetland areas. He reviewed the impacts on soils, crops and natural vegetation on farms, wooded sites and marshes and assisted in site remediation measures along with pesticide uses and their effects.
2. Dr. Holloway assessed the impacts from a gasoline leak from a pipeline in Red River Parish. He assessed soil samples for petroleum hydrocarbons and pesticides in cropland soils and reviewed growth of crops in areas around the leak site. He also reviewed pesticide application procedures and potential impacts from adjuvants and defoliation agents.
3. He conducted a review of the plant communities and fish populations in and around the Bayou Corne sinkhole in Assumption Parish, Louisiana.
4. He prepared plans and oversaw remediation measures for limiting soil erosion on remediated disposal pits in an old oil field in Louisiana.
5. Dr. Holloway conducted numerous reviews of plant root zone distribution, depths and effective root zone depths in croplands, wetlands, pastures and forests in Louisiana and prepared remediation plans for salt impacted sites.
6. Dr. Holloway conducted investigations of the impacts of petroleum pipelines in marshes of Louisiana and the Atchafalaya Basin. He also reviewed the impacts of navigation in and around pipelines in marshes in Terrebonne, Plaquemines, St. Bernard and Jefferson Parishes in Louisiana. He studied changes in marsh ecosystems over time for vegetative communities, soil disturbance, soil erosion and water regimes. He also studied the impacts of animal herbivory on marshes along pipelines and studied wave surges from boat and barge traffic to pipeline canals along the Gulf Intracoastal Waterway (GIWW).
7. He conducted a review of impacts of oil production and production facility remediation measures for sites in Louisiana. He conducted investigations on soils, vegetation and potential remediation measures in marshes and chenieres at Johnson's Bayou in Cameron Parish.
8. Dr. Holloway conducted assessments of impacts to vegetation along a brine pipeline in St. James Parish. He evaluated conditions of herbaceous vegetation and timber at leak sites and unimpacted areas. Part of the work involved blow down of trees along the pipeline corridor and adjacent areas. He observed root zones and depths of the roots of trees that had been affected by wind damage.

1990-2000

1. Dr. Holloway conducted investigations on the impacts of oil spills in streams at

several locations in Oklahoma, Texas and Kansas. He studied spill impacts on fishes and macro-microinvertebrate populations of the streams and impacts on stream beds and growth of riparian vegetation. He assessed residual quantities of oil in stream beds and banks and associated marshes and recommended cleanup and remediation measures. He evaluated plant stands for damages along pipeline corridors and impacts of oil on plants and plant growth.

2. He investigated the impacts of salinity and increased flooding regimes on trees and herbaceous vegetation downstream of oil production sites at numerous locations in Oklahoma.
3. He studied the growth of hardwood trees downstream of a water flood unit and viewed root zones and depths of pecan trees in an unmanaged grove. He assessed the conditions of trees impacted by increased soil salinity/saturation of several creeks in southern Oklahoma. He also conducted investigations of faunal populations of ponds and streams located in oil production areas and in areas surrounding oil leaks and spills.
4. He conducted studies of impacts of oil production and distribution facilities on vegetative communities and compared tree growth in petroleum production areas to non-production sites in Mississippi. He compared soils in control versus impacted sites for tree growth and evaluated forage production on impacted sites. He also investigated impacts of naturally occurring radioactive materials (NORM) on vegetation in oil fields.
5. Dr. Holloway studied the impacts of spills from drilling mud pits on fauna and flora of adjacent lands and streams in Oklahoma and worked on wetlands permitting for construction of two solid waste landfills in Texas. He also conducted a review of wetland status and vegetative and faunal impacts (aquatic and terrestrial) of a proposed hurricane protection levee for Louisiana Offshore Oil Ports, Inc. (LOOP), in southern Louisiana.
6. Dr. Holloway conducted a study of stream meander processes on three locations on the Canadian River in Oklahoma and on the Sabine River in Louisiana. He also investigated the impacts of alleged flooding regimes on timber and farmlands adjacent to a highway in Oklahoma. He studied beaver herbivory and dam construction on the stream crossing the highway.
7. As owner of several farms in Louisiana, Dr. Holloway is intimately involved with the maintenance and upkeep of the farms. He conducts routine maintenance of roads, ditches and fields and conducts all surveys related to drainage, leveling and road construction on his properties. He reviews soil conditions, fertility needs and liming requirements on his farms. He also farmed 150 acres of crawfish for several years on one of his farms.

1987-1990

1. Dr. Holloway served as project director for the Attorney General of the State of Florida to determine sovereign lands along streams of the Central Florida Phosphate District. As part of a long-term study, he served as director of an interdisciplinary team of hydrologists, soil scientists, photogrammetrists, geologists and botanists to study ordinary high water lines (OHWLs) and impacts of phosphate mining on stream riparian areas.
2. He served as a consultant to the Corps of Engineers in the evaluation of aquatic faunal and plant community impacts of dredging and maintenance activities on the Yalobusha River in Mississippi. He also prepared mitigation plans for replacement of wetlands damaged by construction activities in private developments.
3. He conducted investigations of stream plant populations and aged trees for determining successional patterns in association with stream meander processes in Oklahoma. Some of the work involved stream movements that affected the ownership of lands related to oil royalties on accretion/reliction properties contiguous to rivers.

1984-86

1. Dr. Holloway served as a consultant to several landowners in Texas, Louisiana, Arkansas, Mississippi and Florida for determination of environmental impacts of construction and development activities for solid waste plants, housing developments and agricultural operations. Much of the work involved determination of wetland status of the properties and coordination of mitigation plans with local, state and federal agencies.
2. He conducted a review of the 1985 Food Security Act to determine the impacts of wetland provisions to farmers in Louisiana and Arkansas. He coordinated the work with the U. S. Soil Conservation Service to determine wetland status of farmlands and impacts of farming activities on wetlands. He participated in a study of timber management practices on wildlife for a large landowner in Louisiana and Mississippi.
3. Dr. Holloway served as a consultant to Monroe County, Florida, for development of a land use/land management plan for future development activities on the Florida Keys. He was a member of a team that considered the environmental impacts related to construction activities and all other perturbations associated with past and future development on the Keys with particular emphasis on wetlands and wetland quality.
4. He acted as a consultant to Boise-Cascade in evaluating their timber land management programs in Louisiana and conducted an OHWL investigation on the Yazoo River in Mississippi.
5. Dr. Holloway served as a consultant to several large landholders in Louisiana,

Mississippi, Arkansas and Florida for determination of wetland status on their property under Section 404 of the Clean Water Act. As part of these studies he considered the plant community types, soil conditions, discharges and flooding durations to the properties for contiguous/adjacent streams.

6. He served as a contractor and project manager for three extensive studies involving OHWL determinations, riparian soil types, and plant community types along the Yazoo, Ouachita and Black Rivers. The work was conducted for the Vicksburg District of the U. S. Army Corps of Engineers and involved approximately 500 river miles of these streams.

1981-84

1. During 1974-1984 Dr. Holloway owned a spray and consulting service that involved pest control and applications of fungicides, insecticides, herbicides and fertilizers on ornamental, turf and fruit trees. He routinely diagnosed plant diseases, insect damage and herbicide/air pollution damage on ornamentals and shade trees and evaluated trees and shrubs for casualty losses. He also evaluated soil/nutrient requirements for ornamental and fruit trees. He also taught pesticide use/safety to Department of Defense personnel. He has held numerous licenses in pesticide/herbicide application in Mississippi, Louisiana and Texas.
2. Dr. Holloway conducted an investigation of the effects of surficial aquifer contamination of irrigation waters from saltwater disposal wells for Gulf Oil Company in Wichita, Kansas. The work emphasized the impacts of salinity contaminated irrigation water on orchards and considered pesticide uses and generalized orchard practices on irrigated lands.
3. He served as a consultant to large landholders in Louisiana and Mississippi for conversion of woodlands to agriculture.
4. Dr. Holloway conducted an investigation of the alternatives for dredged material disposal in Mobile Bay for maintenance of Mobile Harbor. The study involved the sizing of disposal sites, productive uses of the materials and alternative means for transportation of dredged material and movement of materials out of the Mobile Bay area. Dr. Holloway also addressed the impacts of the disposal operations on plant and aquatic faunal communities.
5. During 1981-82, Dr. Holloway conducted an ecological assessment of the impacts of increased flooding regimes on vegetation due to construction of a new federal highway crossing on the Tombigbee River near Fulton, Mississippi. The study was conducted in a bottomland hardwood area and emphasized durations of flooding on trees and associated wetland systems upstream of a highway corridor.

1978-80

1. Dr. Holloway served as a project director for a multidisciplinary team for conducting OHWL investigations on the Peace River in the Central Florida Phosphate Region. As project director, he was responsible for integrating botanical, geologic, soils, photogrammetric and hydrologic studies for sovereignty boundaries for the State of Florida and for consideration of the impacts of mining and disposal activities on the aquatic resources in the area.
2. Dr. Holloway participated in a multidisciplinary study assessing the impacts of construction of the Tennessee-Tombigbee Waterway . The work involved the assessment of the change in the hydrologic regime and increased siltation from construction of the canal section of the waterway on adjacent lands with emphasis on bottomland forests and buildup of soil/silt over tree trunks and roots.
3. He completed a study of the impacts associated with construction of a hazardous waste facility in Macon County, Missouri. The work involved habitat delineations and wildlife populations in a two-mile perimeter around the proposed facility. Specific impacts associated with hazardous waste transfer and storage were addressed in the study along with determination of general construction impacts.
4. He conducted numerous studies on the OHWL of river systems in Florida, Mississippi, Arkansas, Louisiana and Ohio. He also conducted several detailed investigations concerning wetland delineations. Much of this work was conducted for federal agencies to assist them in the location and evaluation of wetland systems and the determination of OHWL for navigation servitude and sovereignty boundaries.
5. Dr. Holloway conducted a Section 404(b) assessment of the impacts of maintenance, dredging and disposal on the Black Warrior and Tombigbee Rivers in Alabama. The work for the Mobile District of the Army Corps of Engineers involved assessment of disposal sites, sizing of the disposal sites and the impacts on water quality from effluent from the disposal operations. He also conducted an OHWL study of the Ouachita River in the Columbia Pool in Louisiana.

1973-77

1. As a research botanist for the Waterways Experiment Station of the Army Corps of Engineers in Vicksburg, Mississippi, Dr. Holloway had the primary technical responsibility for botanical studies in a \$30+ million dollar research study of dredged material disposal operations of the Army Corps of Engineers. As a member of the habitat development project, he conducted investigations on the reclamation of dredged material through revegetation with marsh and upland vegetation. He devised marsh restoration/mitigation schemes for tidal wetlands in Florida, Texas, California, Georgia, Virginia and Alabama. He also investigated the

- potential for establishment of agronomic crops for dredge disposal sites.
2. Dr. Holloway monitored research projects in heavy metal uptake of plants from dredged material in both laboratory and field studies. He assisted in writing the Section 404 regulations of the Clean Water Act in 1975 for the Chief of Engineers. He also provided the sole technical expertise for presentation of the regulations by a special Corps/EPA task force at numerous public hearings across the United States.
 3. He assisted in the design and participated in the monitoring of a program to determine the uptake of nutrient and toxic materials from effluents of a dredge disposal site at Savannah Harbor, Georgia. In this study he assisted in making plant selections, sizing of runways and volumes of material for the study.

1972-1973

1. As an environmental resources specialist with the New Orleans District of the Army Corps of Engineers, Dr. Holloway provided input for development of environmental impact studies for various civil works projects in Louisiana, Arkansas and Texas. The work involved the assessment of impacts on flora and fauna, esthetic qualities, sociological factors and safety requirements for proposed and ongoing civil works projects.
2. He also served as a member of a special team to the Lower Mississippi Valley Division of the Corps of Engineers for preparing a report on the development of Gulf Coast Deep Water Port Facilities for oil import by supertankers. He prepared the environmental assessment for the Central Gulf Region (southern Louisiana) and participated in preparation of the environmental impact assessment for locating and operating a deep offshore oil terminal at areas ranging from western Florida to southern Texas. The study addressed the environmental impacts on aquatic and coastal plant and animal communities from oil importation and handling activities and associated pipeline distribution systems. He also provided technical input for biological/ecological impacts for the Water for Texas Plan routings from the Mississippi River.

EXPERT WITNESS ACTIVITIES

Dr. Holloway has worked as an expert witness for the U. S. Army Corps of Engineers, U. S. Department of Justice, states of Louisiana and Florida, and numerous corporate and individual clients. He has testified in the areas of botany and plant ecology, agronomy, petroleum production impacts to agriculture and floral-fauna components, wetland soils and hydrology, pesticides, fisheries and wildlife ecology, environmental impacts and ordinary

high water lines and wetlands. He has testified in numerous U. S. District Courts, U. S. Court of Claims and state district courts in Louisiana, Mississippi, Florida and Oklahoma. He has also testified in administrative hearings in Florida, Texas, Louisiana and Oklahoma.

**HOLLOWAY ENVIRONMENTAL SERVICES, INC.
COMPENSATION SCHEDULE**

JANUARY 1, 2021

I. Personnel

Luther F. Holloway, Ph.D.

Cost of services is computed at \$275.00/hour for field work with a four (4) hour minimum per day, including travel time. Work and travel times exceeding eight (8) hours per day will be charged at \$275.00/hour. Non-field work including testimony is \$275.00/hour.

Associates and Field/Laboratory Assistants as needed per project.

II. Travel and Subsistence

Lodging expenses at cost; meals flat rate of \$55.00/day.

Mileage costs are computed at a rate of eighty (\$0.80) cents per mile for company/personal vehicles (w/ trailer \$1.00 per mile). Rental vehicles charged at cost.

III. Purchased Services

Purchased services are charged at cost and include, but are not limited to, such items/activities as shipping/ mailing, map production and drafting, computer and word processing, subcontracted services and expendable supplies.

IV. Equipment

Rental or leased equipment charged at cost.

All terrain ATVs charged at \$125.00/day.

Heavy duty 4x4 RTVs charged at \$200/day.

Company-owned backhoes, dozers, tractors and boats/motors quoted per job.

V. Terms

Invoices are normally submitted monthly within ten days after the end of the month and are payable within thirty (30) days of the date of the invoice.

Late payments will incur interest rates as listed below, based on the number of days past the 30 day due date of the invoice:

01-30 days late One & one-half percent (1.5%);

31-60 days late Two & one-half percent (2.5%);

≥ 61 days late Five percent (5.0%) compounded monthly until paid & Cease All Operations.

Prompt paymentOne percent (1.0%) 21 days or less from date of bill.

VI. Revision of Compensation Schedule

Rates of items in the Compensation Schedule above are good for a period of one (1.0) year per individual project. Projects extending one year past the date of notice to proceed will be charged at revised rates based on the discretion of the management of Holloway Environmental Services, Inc.

TESTIMONY IN LAST FOUR+ YEARS

1. Depositions

Carolyn R. Bunch et al. v. Brighton Energy Co. et al. Docket No. C-43-11. 31ST Judicial District Court, Parish of Jefferson Davis, State of Louisiana

Sterling Sugars, Inc. v. BP America Production Company et al. Docket No. 113095. 16TH Judicial District Court, Div. "E", Parish of St Mary, State of Louisiana

Clyde Tucker et al. v. Shell Oil Company et al. Docket No. 42934, Div. "B". 3RD Judicial District Court, Parish of Union, State of Louisiana

David B. Currie et al. v. BP Production Co., et al. Docket No. 10-18837; 38TH Judicial District Court, Parish of Cameron, State of Louisiana

Joseph Dupont et al. v. Mobil E & P Southeast, Inc. et al. Docket No. 52,090. 18TH Judicial District Court, Parish of Iberville, State of Louisiana

Martha Zoe Moore et al. v. Denbury Onshore, LLC. Docket No. 43526 Div "B". 5TH Judicial District Court, Parish of Richland, State of Louisiana

Frank B. Allain et al. v. Exxon Mobil Corporation et al. Docket No. 62,430 Div. "Ad Hoc". 18TH Judicial District Court, Parish of Iberville, State of Louisiana

State of Louisiana and the Iberville Parish School Board v. BP America Production Company et al. Case No. 72,605 Div. "A", 18TH Judicial District Court, Parish of Iberville, State of Louisiana

Ritchie Grocer Co. v. 2H Inc., Civil No. 14-CV-2868, United States District Court, Western District of Louisiana, Alexandria Division

New 90, LLC, et al. v. Grigsby Petroleum, Inc., et al. Docket No. 130528 Div. "E", 16TH Judicial District Court, Parish of St. Mary, State of Louisiana

Jack Anthony Devillier et al. v. Chevron U.S.A. Inc. et al. Docket No. 12-C-5530, Div. "C". 27TH JDC, Parish of St. Landry, State of Louisiana

Hero Lands Company, L.L.C. v Chevron U.S.A., Inc. et al. Docket N. 64-320, Div."A", 25TH Judicial District Court, Plaquemines Parish, State of Louisiana

Louisiana Wetlands, LLC and New 90, LLC v. Energen Resources Corporation, et al. Docket No. 130527, Div. "B" 16TH Judicial District Court, Parish of St. Mary, State of Louisiana

James J. Martin Family, LLC and Robert Patricia Fleming, LLC v. BP America Production Co. et al. Docket Nos. 87428 & 87912, Div. "C", 16TH JDC, St. Martin Parish, State of Louisiana

2. Administrative Hearings

State of Louisiana Department of Natural Resources, Office of Conservation. In Re: Docket No. Env-L-2015-01. *Martha Zoe Moore, Et Al. v. Denbury Onshore, L.L.C.* U.S.D.C.-Western District, Monroe Division. Civil Action No. 3:14-CV-913

State of Louisiana Department of Natural Resources, Office of Conservation. In Re: Docket No. 2020-9442-DNR-OOC. *Hero Lands Co. LLC v. Chevron U.S.A. Inc.* Agency No. ENV-2020-L01

State of Louisiana Department of Natural Resources, Office of Conservation. In Re: Docket No. 2021-293-DNR-OOC. *Louisiana Wetlands LLC et al. v. Energen Resources Corp., et al.*

Patrick M. Ritchie, PWS

Senior Scientist

Mr. Patrick Ritchie has 13 years of environmental consulting and project management experience and two years high school teaching experience. He has served in various consulting positions including project manager, wetland ecologist, project scientist, scientific and technical writer, compliance manager, and geographic information systems analyst.

Experience encompasses a variety of regulatory programs under the LDEQ, LDNR, USACE, U.S. EPA, FERC and includes work in a variety of sectors including oil and gas exploration / production and refining, manufacturing, and chemical production in the Gulf Coast.



Experience: Over 10 years' experience in oil & gas, chemical and manufacturing sectors

Email: patrick.ritchie@erm.com

LinkedIn: <https://www.linkedin.com/in/patrick-ritchie-pws-rso-401a8442/>

Education

- M.S. Soil and Water Science, University of Florida (2015)
- B.S. Ecology and Evolutionary Biology, Tulane University (2005)
- A.S. Business Administration and Accounting, Colby Community College (2000)

Professional Affiliations and Registrations

- Registered Professional Wetland Scientist - #2780
- Wetland and Water Resource Management
- NORM Radiation Safety Officer
- NORM Surveying and Control
- Society of Wetland Scientists
- Ecological Society of America
- National Ground Water Association

Languages

- English, native speaker

Fields of Competence

- Wetland Assessments
- Environmental/Biological Surveys and Assessments
- Regulatory Compliance
- Ecological Risk Assessment
- Project Management
- Environmental Sampling Protocols, Procedures, and Instrumentation
- Naturally Occurring Radioactive Material Survey and Compliance
- Geographic Information Systems
- Water Based Operations and Safety

Key Industry Sectors

- Oil & gas
- Chemical
- Manufacturing

Key Projects

Ecological Assessment of Wetlands and Waterways Near Hydrocarbons and Brine Release

Coordinated, successfully executed, and authored a report for an Ecological Assessment of wetlands and waterways located near an industrial release of hydrocarbons and brine. The ecological assessment evaluated fish and vegetative communities as indicators of impact and biological response and recovery. Multiple fishing methods were utilized to assess the biodiversity and abundance of fish in natural and artificial waterbodies. Vegetative communities were assessed using visual observation and measurements.

Authored a Wetlands Functions, Value, and Services Report

Authored a report in support of litigation for an oil and gas client in coastal Louisiana. Report included an evaluation of wetland functions, value, and ecological services provided.

Wetlands Rapid Assessment, Cypress-Tupelo Swamp

Conducted a Wetlands Rapid Assessment of a cypress-tupelo swamp using the Louisiana Wetland Rapid Assessment Method (LRAM) as a framework for identifying functional value and habitat condition based on vegetative ecological metrics. LRAM was developed by the USACE as a rapid and repeatable assessment method for the purpose of providing compensatory mitigation for impacts to wetlands.

Ecological Risk Assessment, Heavy Metals and Hydrocarbons

Collected fish and blue crab (*Callinectes sapidus*) specimens for an ecological risk assessment of heavy metals and hydrocarbons. Collaborated with a team of environmental professionals and toxicologists to test the concentration of metals and hydrocarbons in the soft tissue, hepatopancreous, and/or exoskeleton of the crabs and forage fish. The

investigation area included natural bayous, lake, and manmade oilfield canals in Vermilion Parish, Louisiana. Deposited as a fact witness for this case.

Authored Technical Paper: Blue Crab Population Dynamics

Authored a Technical Paper as partial fulfillment of the requirements for the degree of Master of Science on blue crab population dynamics from waterbodies or southwest Louisiana compared to market samples from across the Gulf Coast. The technical paper includes an evaluation of arsenic and barium toxicity in crabs collected in waterbodies of an oil and gas field.

Co-Authored Report: Rapid Bioassessment of Four Waterways located in Hattiesburg, MS

Researched, planned, successfully executed, and co-authored a report for a Rapid Bioassessment of four waterways located in Hattiesburg, Mississippi. A Rapid Bioassessment is an evaluation of the condition of a waterbody using visual observations of habitat and physical characteristics, biological surveys and other direct measurements of the resident biota in surface waters. Field efforts included a physical characterization of streams, field water quality measurements, habitat assessment, and periphyton, benthic macroinvertebrate and fish sampling and collection.

Field Studies in Wetland Environments

Collected and compiled data for field studies in fresh, intermediate, brackish, and saline wetland environments as part of the Coastwide Reference Monitoring System – Wetlands Project (CRMS). Field studies included the positive identification of wetland plants to the species level, collection and measurement of porewater water quality parameters, collection of soil samples, wetland elevation and accretion measurements, surface water depth and water quality parameters, tree identification, measurements and canopy cover determination. Responsible for data collection, management and quality assurance/quality control.

Environmental Assessment, Brine Mining Facility

Performed field sampling, reporting, and assessment activities associated with an environmental issue at a brine mining facility, including: shallow and deep groundwater sampling, groundwater well installation and plugging and abandonment, industrial water well sampling, surface and deep water (200) sampling, brine sampling, deep groundwater microbial community sampling, shallow and deep well pressure monitoring and gas composition, H₂S testing of well fluids, fluid hydrocarbon sampling, gas bubbling release characterization and sampling, air and gas sampling, industrial outfall sampling, and seismic data monitoring. Tracked compliance with regulatory requirements via management and/or liaison with numerous contractors and expert consultants. Conducted an ecological assessment consisting of collecting, counting, and identifying fish; positive identification of wetland plants to the species level; and evaluated water quality using multiple analytical parameters. Data was recorded, tabulated, evaluated, and distributed to clients and associated state regulatory agencies. Project site included bayous, cypress-tupelo swamp, and industrial, commercial, and residential areas.

Root Study, Bottomland Hardwood Swamp

Conducted a Root Study in a bottomland hardwood swamp in order to ascertain the root system depth, critical root zone area, and effective root zone depth of trees located in a former oil and gas field with alleged soil contamination. Site-specific root zone depth is used in formulation of soil remediation strategies. Constituents of concern included parameters typical of oil and gas exploration and production activities.

Executed LDNR Declaration of Emergency Requirement for Natural Gas Bubbling Release Characterization Monitoring Program

Researched, created, planned, and successfully executed a LDNR declaration of emergency requirement for a natural gas bubbling release characterization monitoring program. Ensured

compliance with LDNR requirements for this complex monitoring program. Over 100 sites were located and monitored from seeps occurring throughout inundated wetlands and bayous using the SOP I developed. Trained personnel to conduct the monitoring program.

Site Closure, Oil Transport Pipeline Release Site

Evaluated multiple lines of evidence including Mann Kendall statistical analysis to prove monitored natural attenuation (MNA) of benzene in groundwater to attain site closure of an oil transport pipeline release site. As part of the Site Quarterly Report, completed a LDEQ RECAP evaluation for submittal to the LDEQ.

Environmental Assessments, Former and Active Oil & Gas Fields

Managed multiple crews conducting environmental assessment activities located in former and active oil and gas fields throughout Louisiana. Ensured the completion of multiple tasks and adherence to commonly accepted industry protocol sampling methodology of soil, groundwater, NORM, and wetland delineation. Conducted daily safety meetings and communicated hazards specific for each task to all employees and sub-contractors. Compiled all data, field notes, photographic documentation and associated project specific information for development of an expert report. Participated in the evaluation of data and development of remediation activities to meet site specific goals.

Site Setting Evaluation, Former Oil & Gas Production Site

Managed and performed the site assessment activities associated with a former oil and gas production site in south Louisiana. The assessment included evaluation of site setting (location, current and future land use, topography, regional geology, habitat) review of historical operations on the property including former oil and gas exploration and production activities, soil assessment, soil stratigraphy and lithology, groundwater assessment,

groundwater flow, and aquifer testing and classification. The site assessment report was provided to the LDNR Office of Conservation in response to a Compliance Order issued to the successor of former oil and gas operator regarding alleged contamination of the property. As part of the Site Assessment Report, completed a LDEQ RECAP evaluation to address constituents of concern (arsenic, barium, chlorides) in groundwater. The conclusion of the RECAP evaluation was that the COC will not endanger the USDW or the nearest down gradient surface water body. The LDNR Office of Conservation reviewed the Site Assessment Report, concurred with the conclusions of the report and determined that no further action (NFA) is deemed necessary at the site.

Liquefied Natural Gas Terminal and Pipeline Project in Coastal Louisiana

Regulatory compliance responsibilities include assisting clients with USACE permitting, FERC, EPA, USFWS, NOAA, NMFS, LDNR, LDEQ, LDWF correspondence, submissions, and compliance. Assisted in pipeline routing based on regulatory compliance and permitting strategies to maintain project schedule and budget.

NORM Survey and Sampling, Industrial Shipyard and Fabrication Facility

Performed NORM survey and sampling for an industrial shipyard and fabrication facility in south Louisiana. Assisted client and subcontractors with remedial options and goals according to USEPA guidelines for site closure and release for unrestricted use.

Listing of Cases in Which
Patrick M. Ritchie, PWS Has Testified

| Case | Year | Description | Area of Testimony |
|---------------------------------|-------------|---|--------------------------|
| VPSB v Louisiana Land, et al. | 2010 | Soil and Groundwater Investigation and Groundwater Remediation ^a | Site investigation |
| Tucker, et al. v. Shell, et al. | 2014 | Soil & Groundwater Investigation & Remediation ^a | Site investigation |

Notes:

(a) Deposition only.