REVIEW OF PLANT CONDITIONS AND VEGETATION ROOT STUDY ON THE H.C. DREW MANUAL ESTATE "15" NO. 1. IN CALCASIEU PARISH, LOUISIANA

IN THE MATTER:

H.C. DREW MANUAL ESTATE

VERSUS

NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.

14th Judicial District Court
Parish of Calcasieu
State of Louisiana

PREPARED BY:

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1.0. Introduction, Location, Land Use, Investigation, Retention and Objective

1.1. Introduction

H.C. Drew Estate, represented by its trustees, Louie D. Barbe, III and C.W. Shaddock (Drew Manual Estate) filed a lawsuit against former oil and gas exploration and production (E&P) operators/lessees alleging soil and groundwater contamination from historical E&P activities for properties within the North Choupique oil and gas field. Neumin Production Company (Neumin) and Stokes and Spiehler, Inc. (Stokes and Spiehler) are the named defendants in the suit, alleged to have caused environmental damage to the property through the operation of the HC Drew Manual Estate "15" No. 1 Well (SN225207) and associated oil and gas production facility.

1.2. Location and Site Description of Property

The property subject of the lawsuit is approximately 175.55 acres located in Section 15, Township 10 South, Range 11 West of Calcasieu Parish in the North Choupique oil and gas field approximately six miles west of the town of Sulphur. The Petition for Damages and First Supplemental and Amended Petition identify the former H.C. Drew 15 No. 1 Well site as the operational area at issue. The former operational area consists of approximately one acre. The one-acre operational area, hereby referred to as the Site, includes the former well head site, a former tank battery and the former production area. The property surrounding the former operational area is used primarily for cattle grazing. Figure A-1 of Appendix A shows the general location of the property while Figure A-2 shows the site within the Public Land Survey Sections. Figure A-3 is a high resolution imagery basemap of the property.

1.3. Previous and Present Land Use

Review of historical topographic and aerial images indicate that the primary use of the property has historically been cattle grazing and oil and gas exploration and production activity. On August 23, 2000 Neumin entered into a lease agreement with the Drew Manual Estate to drill and produce hydrocarbons from the F RA SUA; HC Drew Manual Estate "15" No. 1 Well and a road servitude on December 1, 2000. Well SN225207 was initially completed as an oil well in February 2001 with several recompletions occurring in 2002, 2009 and 2011. During this time, several small berms were constructed along with a tank battery and production

equipment utilized in operation of the field. The well was plugged and abandoned on September 15, 2015 with the tank battery and appurtenant facilities being removed soon afterward. Upon investigation there appeared to be no dwellings located on the property and no other structures except for oil field structures used in oil production activities. The surrounding properties are currently used for cattle grazing as well.

1.4. Site Investigation by Others

Soil and groundwater investigations around the SN225207 operational area were conducted by Acadian Engineers and Environmental Consultants Inc., Southland Environmental, LLC and Environmental Resources Management. The authors of this report reviewed all available data collected by others in formulation of their opinions on the matter.

1.5. Retention of Holloway Environmental Services, Inc.

For the Limited Admission Plan being submitted to the Louisiana Department of Natural Resources (LDNR), Holloway Environmental Services, Inc. has been retained by Neumin to provide expert services in the case. Dr. Luther F. Holloway of Holloway Environmental and Patrick Ritchie of ERM visited the Site on September 8-9, 2021 to conduct a review of vegetation types and condition factors on the property and an evaluation of plant rooting habits and plant root depths.

1.6. Objective of this Report

This report considers the characteristics of pasture vegetative communities for root penetration in order to determine depths of particular plant populations growing at various areas on the H.C. Manual Estate tract. Also considered are characteristics of the vegetation communities for root penetration in order to determine depths of the effective root zones (ERZs) of tree species growing on the property. The consideration of vegetative ERZ is important in determining the true depth of remediation required for propagation of primarily herbaceous grass species or revegetation with woody tree species on the tract. These data represent a site specific study which relates directly to the property under investigation and at issue in this Limited Admission Plan.

2.0. Geology, Elevation, Soils, Vegetation

2.1. Geology and Physiography

The underlying geology of the Site is mapped by the U.S. Geologic Survey (USGS) as Beaumont Alloformation, comprising the highest of the Prairie terraces west of the Mississippi River alluvial valley (Figure A-4). It is composed of coastal plain deposits of the late to middle Pleistocene consisting of 30 to 60 m clay-rich sediments transected by dip-oriented fluvial sands, sandy fluvial and deltaic-distributary channels. These sediments accumulated as short depositional episodes during multiple high-frequency glacio-eustatic sea-level fluctuations (LGS, 2002).

2.2. Elevation and Relief

Light Detection and Ranging (LIDAR; LSU, 2009) data reviewed for this study provided high-resolution elevation data within Operational Area (Figure A-5). Elevation at the Site ranges from approximately 12.0 to 14.0 feet above mean sea level (msl). The topography of the Site is generally flat with approximately one to two feet of relief, typically in the form of man-made ditches and the natural rise and fall of the coastal prairie with 0-1% slope.

2.3. Soils

The US Department of Agriculture Soil Survey of Calcasieu Parish (USDA-NRCS Soil Survey Staff, 1988) defines three types of soil map units on the plaintiffs' property (Figure A-6). The following descriptions of the soil types are provided below (Soil Survey Staff, 1988 & 2019):

- Prairieland silt loam (Lt, 0 to 1% slopes) consists of poorly drained, slowly permeable soils comprising the former well site and the northwest portion of the Manual estate. This soil series is found on low, broad flats and along drainageways on the Gulf Coast Prairies. The listed use for this soil type is rice and soybean production, rotated with crawfish aquaculture or pasture. Native vegetation consists of tall grasses and sedges.
- Mowata-Vidrine complex (Mt, 0 to 1 percent slopes, rarely flooded) comprises areas to the north and east of the former well site. This series consists of poorly drained, very slowly permeable soils found on broad, slightly concave flats and along drainage ways on the Gulf Coast Prairies.
- Midland silty clay loam (Mn, 0 to 1 percent slopes, rarely flooded) makes up

the area to the southwest of the former well site, but no root sampling occurred in this area. This soil is level and poorly drained and found on low, broad, slightly concave areas on the Gulf Coast Prairies.

2.4. Vegetation

Vegetation on the Drew Manual Estate property consists of mixed herbaceous grassland species. There are a few isolated trees north of the well site occurring in small stands as well as shrub and trees lining the boundaries and waterbody banks. The unmanaged pastures on the Site are vegetated with a variety of grasses and weeds that consist of grass species such as Bermuda grass (*Cynodon dadctylon*), Vasey's grass (*Paspalum notatum*), dallis grass (*Paspalum dilatatum*) and hairy crabgrass (*Digitaria sanguinalis*). Weedy species consist of annual marsh-elder or sumpweed (*Iva annua*), woolly croton or goat weed (*Croton capitatus*), Brazilian vervain (*Verbena brasiliensis*) and dog fennel (*Eupatorium capillifolium*).

Slightly lower areas in the vicinity of the operational area are vegetated with wetland species including beaksedge (*Rhynchospora corniculata*) and other wet species such as spikerushes (*Eleocharis* spp.), flatsedges (*Cuperus* spp.), soft rush (*Juncus effusus*) and a few patches of smartweed (*Polygonum* sp.).

Tree species observed at the Site include live oak (*Quercus virginiana*), Chinese tallow (*Triadaca sebifera*), and sugarberry (*Celtis laevigata*). A small stand of Chinese tallow (*Triadaca sebifera*) was observed growing north of the operational area which appeared dead from herbicide application. During the field investigation, the authors of this report witnessed aerial application of herbicide occurring on adjacent property. A detailed review of the entire tract and surrounding areas showed all of the vegetation to be in excellent condition with no evidence of any kind impacts from oil field E&P operations.

3.0. Effective Root Zone Study – Approach and Methodology

3.1. General Aspects

The approach for conducting an Effective Root Zone (ERZ) study has been developed with over a decade of field investigations to assess the effect of oil field E&P activities on plant roots, particularly in Louisiana. The approach and methodology have been developed based upon accepted industry procedure and has become recognized by the Louisiana Department of Natural Resources –

Office of Conservation (LDNR-OC) for effective root zone investigation. The authors of this report have substantial experience documenting root depth and distribution condition. The experience gained from the consistent approach to similar field investigations support the understanding that root densities and penetrations vary based on vegetation type, soil types, disturbance factors and area hydrology. The data collected is used to support remediation strategies intended on supporting future uses of the property. 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 area of alleged impact and comparable surrounding areas in order to determine the particular depths at which plants roots grow. The results of the ERZ study should be considered when formulation of potential soil remediation measures may be required.

Another important consideration that they have found in many studies is that depths or depth intervals of soil samples for salt parameters such as electrical conductivity (EC), exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR) generally overestimate (at many times grossly so) these parameters. For example, soil samples extracted from the 0 to 2 foot and 0 to 4 foot depths below ground surface, which is mixed for analysis, can show levels that are much higher than those within the ERZs that only extend to 6-12 inches in depth. To be accurate for salt parameters in root zones, 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. Methodology

The methodology used to determine the ERZ for plants has been developed through years of experience using a modified procedure as described in Methods for the Examination of Root System and Roots published in 1971 (Schuurman and Goedewaagen, 1971). Specifically, use of a modified/combined Excavation and Auger Method has been used for the investigation of this Site.

At each sample plot location, a general description of vegetative species observed, the soil profile, observed root system depth and density and photographs taken of surrounding plant communities were documented.

The ERZ represents the part of a plant's root system that can effectively extract water and nutrients for growth and necessary to complete the plants' life cycles. The ERZ does not include the entirety of the root system or deepest roots but comprises the depth where the majority of roots that sustain the plants growth and reproduction.

3.2.1. Tree Observation

Observation trees are selected to represent the typical growth pattern, root depth and density of woody species present at the Site. Trees are selected outside of any areas alleged to be impacted by oil and gas field E & P activities. Observation trees are selected based on their vigor, absent of visible stress or disease including, but not limited to stunted growth, small crown, low basal area or chlorotic foliage discoloration. Tree circumference is measured at breast height (DBH), which is defined as 4.5 feet above ground level, using a diameter tape that does not stretch. Major roots encircling the tree are probed, flagged (or spray-painted for better visual acuity), excavated and measured. Measurements recorded include the total length of the root from the bole of the tree and depth of the deepest observed roots. A root diagram is drawn on the field data form presenting a representation of the tree's rooting pattern as shown in Appendix C.

3.2.2. Herbaceous Observation

To evaluate root penetration and density of herbaceous species, a trench was hand-dug with shovels to a depth where roots were either no longer or minimally visible within the soil profile. For select observations, a hand auger was advanced an additional 14 to 26 inches below the bottom of the trench to confirm that the complete extent of the root system was adequately assessed. Root density or "prevalence" was recorded greatest to least occurrence within the soil profile: very abundant, abundant, common, sparse, very sparse and none. Root prevalence was recorded on Root Study Field Forms provided in Appendix C. Only live roots, attributed to the target species are included in this determination. To distinguish living and dead roots, the following features are observed to draw this distinction: the elasticity of the root, its color and the presence of cortex and lateral roots. If feasible, one observation is recorded for each distinct soil type present on Site.

3.3. Data Collection

To determine the root depths and distributions of the vegetative communities on the property, five herbaceous and two tree observation locations were selected for study. The locations of these observations are shown in Figure A-7. At each observation site, methodology described in Section 3.2 was performed including photographic documentation of the surrounding plant communities and the soil profile. Site photos are shown in Appendix B. Root prevalence for each observation was recorded and attached in Appendix C. Concurrent with root

observation, existing plant and habitat condition was assessed and any potential impacts form E&P operations such as leaf scorch, leaf burning and dieback were noted. Other identifiable salt or petroleum hydrocarbon impact in trees such as epicormic branching, witches' brooms and branch dieback were noted if present.

3.4. Results

The general distribution of plants growing on Site represent a typical plant community characteristic of historical habitat. Vegetation included grass, sedge, and rush species typical of unmanaged pasture with a dotted distribution of trees commonly found in Calcasieu Parish. Sample plots were designated by letter abbreviations (i.e., T – tree and H - herbaceous) and number identifier. The data recorded from the seven observation areas were used to determine the effective root zone depth and provide the practical remediation depth for the operational area if deemed necessary.

Table 3.4. Effective Root Zone (ERZ) of Plant Species on Site

Site ID	Common Name	*Scientific Name*	ERZ (in)
T-01	Live Oak	*Quercus virginiana*	10.0
T-02	Sugarberry	*Celtis laevigata*	10.0
H-01	Bermuda Grass	*Cynodon dactylon*	10.0
H-02	Shortbristle Horned Beaksedge	*Rhynchospora corniculata*	7.0
H-03	Annual Marsh-Elder	*Iva annua*	6.0
H-04	Crabgrass	*Digitaria sanguinalis*	6.0
H-05	Bermuda Grass	*Cynodon dactylon*	7.0

A general description, observations and the documented ERZ depth are described for each sample point location in the following sections.

3.4.1. Observation T-01 – Live Oak (Quercus virginiana); DBH = 54.78"; ERZ = 10.0

This root observation area is located in the northern portion of the site in the Mowata-Vidrine soil series (Figure A-7). The observation is of a single large live oak growing on a slight topographic rise in the pasture. Photo B-1 shows the crown of this live oak tree. T-01 has a diameter at breast height (DBH) of 54.78 inches (Photo B-2). The area is built up from surrounding areas with a sugarberry tree (*Celtis laevigata*) in close proximity (Photo B-3). As shown in Photo B-4 and B-5, eight major roots branch from the bole of the tree. Root 1 and Root 5A were

measured to be 209.0 inches and 340.0 inches respectively. Depths of the top of these roots were measured as 10.0 inches (Root No. 1) and 5.0 inches (Root No. 5A) below ground surface (bgs). Many roots were at or above the ground surface. These roots are all healthy for this disturbed setting and showing no evidence of any kind of impacts. Based on the distribution of the roots at this site, an ERZ of 10.0 inches would be generous for this tree.

3.4.2. Observation T-02 – Sugarberry (Celtis laevigata); DBH = 23.40"; ERZ = 10"

Observation T-02 is a sugarberry tree growing in close proximity to T-01 (Figure A-7). T-02 is a multi-trunk tree with the primary bole having a DBH of 23.40 inches. Although the growth form of the tree is not ideal (i.e., multi-trunk) for an ERZ observation, this tree was located within the Mowata-Vidrine soil complex and within the same managed land parcel as the operational area. The crown and multiple trunks of the tree are shown in Photo B-6. This tree is also located on the slight topographic rise in the pasture, Photo B-7 and B-8 provides a good visual representation of the observation area. Many of the roots of this tree are at or near the ground surface, Photo B-9 and B-10 shows the eight main roots extending from the bole of the tree. The sugarberry tree roots are all healthy for this atypical and disturbed setting. Based on the distribution of the roots at this site, it has been determined that the ERZ of this tree is 10.0 inches.

3.4.3. Observation H-01 – Bermuda Grass (Cynodon dadctylon); ERZ = 10.0"

Observation H-01 includes an area of herbaceous vegetation dominated by Bermuda grass. Bermuda grass is an ideal species for cattle grazing and there were several cows feeding on a similar complex in the adjacent field during the observation. H-01 is located south of the operational area in the Mowata-Vidrine soil series. Photo B-11 shows the vegetation facing to the north with observation vegetation displayed in Photo B-12. This site consists of unmanaged pasture dominated by Bermuda grass typical of this area. The observations at H-01 show the area supports a lush stand of grasses and forbs with no evidence of any kind of impacts from E&P activities. There is no evidence of indicia such as leaf burning or dieback that may be indicative of sodic or saline properties in the soil. The observation was made along the profile wall which was carefully scraped with a knife to reveal the root system. The top of the profile is shown in Photo B-13 where the root identity is abundant in the 0.0 to 1.0-inch depth, common to sparse in the 1.0 to 10.0-inch depth and sparse to very sparse in the 10.0 to 15.0-inch

depth. The roots are healthy in this area again showing no evidence of any kind of impacts. Photo B-14 shows the root profile in the 15.0 to 26.0-inch depth with a very sparse to none distribution of roots while depths of 26.0 to 50.0 inches show no roots occurring at this depth (Photo B-15 and B-16). Again, these roots are all healthy and are indicative of herbaceous species for soils of this type. Based on these considerations, an ERZ for this area would be 10.0 inches due to the paucity of any roots below this depth.

3.4.4. Observation H-02 – Shortbristle Horned Beaksedge (Rhynchospora corniculata); ERZ = 7.0”

The pasture has a diverse collection of sedge species present, specifically the shortbristle horned beaksedge. A small stand dominated by this species is located slightly north of the operational area in the Leton soil series. H-02 was slightly lower topography than the surrounding pasture and had approximately one inch of surface water present. Photo B-17 at this area shows a healthy stand dominated by various wetland species. The vegetation at this site is healthy and showing no indications of any kind of impacts or indicia of soil sodic properties (Photo B-18). The observation was made along the profile wall which was carefully scraped with a pocket knife to reveal the root system. The root profile for this area as shown in Photo B-19 shows an abundant distribution of roots at the 0.0 to 4.0-inch level and an abundant to common distribution at 4.0 to 7.0 inches. All of the roots are healthy showing no impacts. Photo B-20 shows a root profile in the 7.0 to 10.0-inch depth and is sparse to very sparsely distributed across the profile while plant root distributions become dotted to none at 10 inches through the end of the excavation to 24.0 inches (Photo B-21 and B-22). The ERZ for the shortbristle horned beaksedge at this location is 7.0 inches.

3.4.5. Observation H-03 – Annual Marsh-Elder (Iva annua); ERZ = 6.0”

The annual marsh-elder formed a robust stand around T-01 and T-02 location, north of the operational area within the Mowata-Vidrine soil series (Figure A-7). Photo B-23 shows the plant community at this site. Annual marsh-elder is unpalatable to livestock and is a weedy pest of low-vigor pastures (USGS, 2021). H-03 is comprised of a healthy stand of annual marsh-elder with a spotted distribution of Vasey’s grass and several plants from the genus *Cyperus*. An observation pit was dug creating a profile wall which was then carefully scraped with a knife to reveal the root system. Viewing the profile wall, it appears the subsurface in the area has been disturbed (Photo B-24). The observation in Photo

B-25, shows the root distribution in the first 2.5 inches is abundant decreasing in distribution between 2.5 to 6.0 inches from common to sparse. From 6.0 to 10.0 inches (Photo B-26) the root distribution is sparse to very sparse in nature with no observed living roots between 10.0 to 16.0 inches (Photo B-25). All of these roots are healthy and are growing in a typical fibrous fashion for annual marsh-elder in this soil type (Photo B-28). The ERZ for annual marsh-elder at this Site is 6.0 inches.

3.4.6. Observation H-04 – Crabgrass (Digitaria sanguinalis); ERZ = 6.0”

Observation H-04 is located north of the operational area and situated between observations H-02 and H-03 (Figure A-7). Vegetation at this observation point consists of a healthy, unmanaged pasture grasses and herbaceous species (Photo B-29). An area dominated by smooth crabgrass was selected for this observation (Photo B-30). The plants in this area show no evidence of any kind of sodic factors. An observation pit was dug creating a profile wall which was then carefully scraped with a pocket knife to reveal the root system (Photo B-31). Photo B-32 shows the profile for the site with 0.0 to 2.0 inches containing an abundant root distribution with the ERZ continuing down through the 3.0 to 5.0 inch common to sparse prevalence. Past the ERZ of 6.0 inches, the root prevalence from 6.0 to 9.0 inches is very sparse to none. The bottom of the observation pit from 10.0 to 24.0 inches had no observed live roots (Photo B-33). The roots are all in good condition and are typical for a root profile of crabgrass. Based on the review of the site, a 6.0 inch ERZ would be appropriate for this location.

3.4.7. Observation H-05 – Bermuda Grass (Cynodon dactylon); ERZ = 7.0”

An area dominated by Bermuda grass was selected for Observation H-05. This site is located in the northeast corner of the Drew Manual Estate within the Mowata-Vidrine soil series. Photo B-34 and B-35 show the surrounding pasture and the site with robust vegetation growing in the unmanaged pasture. Similar to previous observation points, there is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties affecting the vegetation at this site. An observation pit was dug creating a profile wall perpendicular to the target species which was carefully scraped with a pocket knife to reveal the root system. Photo B-36 shows the area of the profile wall from the ground surface, 0.0 to 2.0 inches with an abundant root prevalence decreasing in density to common in the 2.0 to 7.0-inch zone. The root profile becomes spares in the 7.0 to 14.0-inch range (Photo 37) and very few to none in the 14.0 to 26.0-inch range (Photo B-38). A push tube

was advanced from 26.0 to 38.0 inches and examination of the soil core showed no roots present (Photo B-39 and B-40). The ERZ for Bermuda grass at this location is 7.0 inches.

3.5. Vegetative Summary

Site inspection and effective root zone observations on the Drew Manual Estate during the month of September 2021 showed that virtually all of the vegetation in the pasture of the property were healthy and growing well. The only areas showing signs of vegetative stress were small stands of young woody species that appear to have been sprayed with an herbicide application. Detailed observations of the plants showed no signs of leaf burn, leaf margin browning, plant dieback, chlorosis or any other symptoms that are typical of salt parameter impacts from E&P activities on the property. Also, no symptoms of plant burning and dieback that are symptomatic of petroleum hydrocarbon impacts were noted for any area on the entire property. The vegetation growing was typical of a coastal plain pasture and was similar in structure and composition to vegetation outside the perimeter of the property.

The ERZ observations documented a shallow root distribution at all seven locations. Similar to the above-ground plant structures assessed, below ground root structures showed no evidence of impacts from oil field E&P activities. The results of this study determined the ERZ of trees at two sample plots was 10.0 inches. The ERZ for the herbaceous vegetation at the five sample plots was 6.0 to 10.0 inches with a total root depth for all vegetation ranging between 12.0 to 24.0 inches below ground surface. The profile and ERZ depths are typical and similar to locations that have been investigated by the authors for the same species throughout southern Louisiana.

4.0. General Discussion

The review the herbaceous and woody vegetation at the Site indicate that all of the vegetation is healthy and in very good condition and is typical of plant communities growing in this area of south Louisiana where no oil field E&P activities have occurred. Based on these considerations, no impacts are occurring to the pasture vegetation and trees growing on the tract.

The root study that we conducted herein showed the deepest ERZs for the area of study to be no greater than 10.0 inches with very few roots below this level and actually no sign of roots past approximately 24.0 inches in all of the areas

that were investigated. Based on a generous ERZ of 10.0 inches, a depth of no greater than 12.0 inches would be sufficient to remediate any area on the Drew Manual Estate property. Based on the 10.0-inch depth of the ERZs for the site, if any remediation of the soil were to occur on the property at any of the locations deemed by the plaintiffs' consultants to be impacted, a remediation depth of 12.0 inches would be sufficient to allow typical species growing in and around the pasture area to thrive and produce a viable and productive plant community.

During the course of investigations for the tract only one soil sample located in the former tank battery area within the ERZ slightly exceeded 29-B salt parameters, B-19 S-1. The only exceedance detected within the ERZ was collected from the 0.0 to 2.5-foot depth below ground surface. This interval was then mixed for analysis. Mixing samples at this depth can show levels that are much higher than those within the actual ERZs that only extend to 6.0 to 10.0 inches in depth on the property. To be accurate for salt parameters in root zones, soil samples for the Site 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. Due to the fact that the pasture areas on the tract have few limitations for equipment operation during remediation activities conducted during dry periods, a 12-inch remediation depth would be appropriate for all sites observed on the property except for non-impacted areas containing hauled-in gravel, concrete or other materials. These sites may require removal to slightly deeper depths than 12.0 inches.

5.0. Opinions and Conclusions

a. The herbaceous pasture grasses and trees on the Drew Manual Estate all show good healthy stands that are experiencing no observed impacts from E&P activities on the property.

b. All of the areas selected and observed for the plant growth study indicate that these plant communities are thriving and the vegetation is showing no indication of stress or adverse impacts from oil field E&P activities either above or below ground level. If required, remediation of these plant communities would provide no significant benefit because the vegetation is healthy and exhibiting excellent growth. Data from the seven root studies that were performed throughout the property show that a broad range of vegetation have shallow rooting depths.

c. The effective root zones for the plants that were studied were very shallow with no effective root zone extending past 10.0 inches and many were much more shallow and very near the surface of the soil. Any remediation for any depths past the proposed remediation depths addressed herein would be ill advised and essentially worthless for growing vegetation on the Drew Manual Estate property.

d. Replacing the indigenous soils that have been in place for thousands of years with hauled-in dirt of unknown origin would result in an amorphous and non-homogenous soil medium that would bear little resemblance to the soil indigenous to the Drew Manual Estate property. Based on the site specific study prepared in this report, root zones of all of the vegetation that was studied support very shallow root zones. If required, remediation to a level of 12.0 inches would be adequate to suffice for remediation of the Drew Manual Estate property except small areas containing gravel road material or pads for E&P structures may have to be removed at slightly greater depths.

6.0. Basis for Opinions and Conclusions

This report considers the characteristics of herbaceous vegetation and trees at the Manual property. A root study was conducted for root penetration in order to determine depths of the particular plant populations growing at each area. This consideration is very important to determine the true depth of remediation, if required, for the propagation of pasturage and woody species that grow in the area. These data represent a site specific study which relates directly to the Manual property that is under investigation. Regulatory concerns, if any, will be addressed by other experts.

Holloway Environmental Services, Inc. and Environmental Resources Management 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.

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The H.C. Drew Manual Estate "15" No. 1. in the
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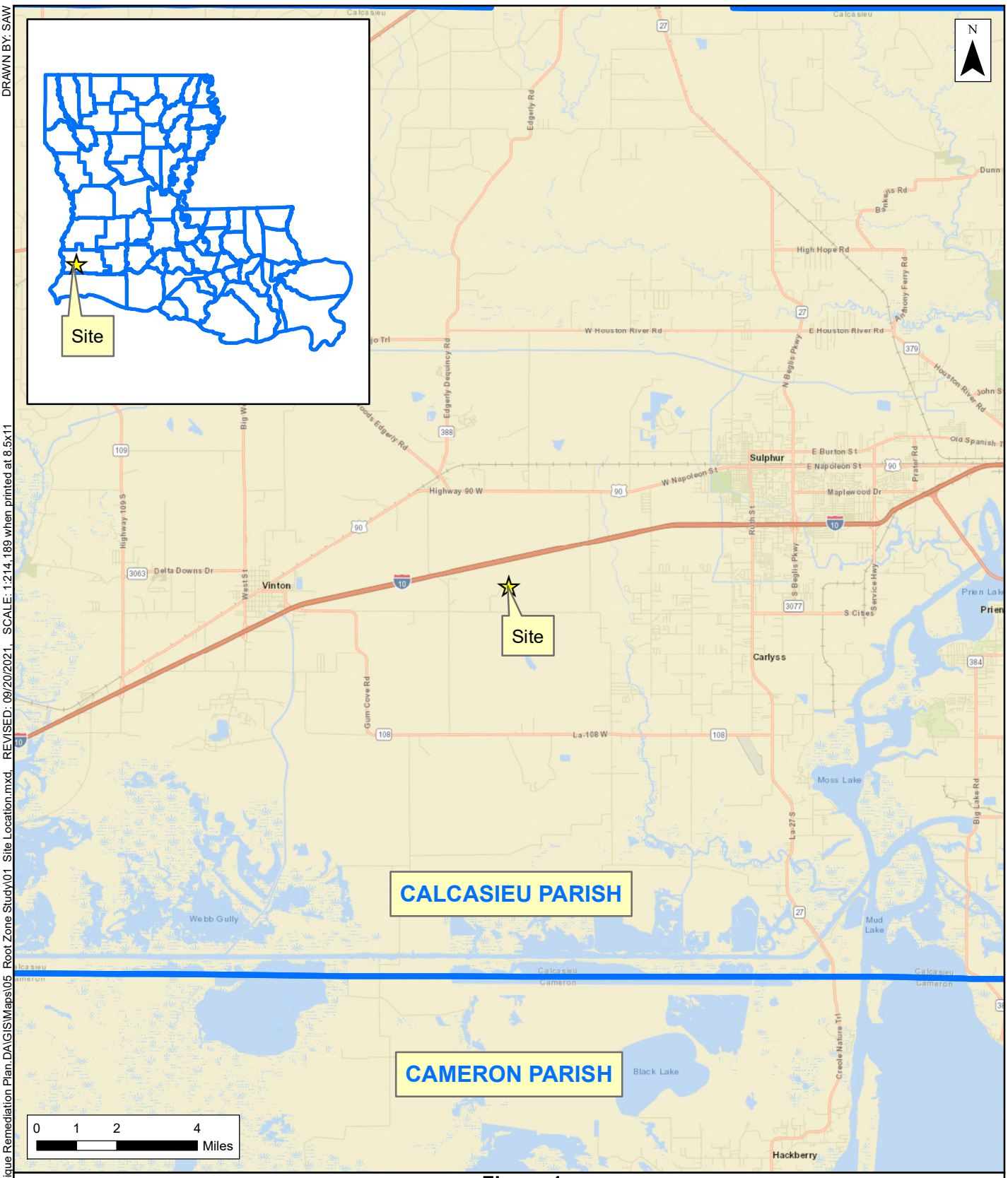
Appendix A
Figures

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana



Site Location

Parish Boundary

Figure 1

Site Location

HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

Notes:
World Street Basemap via ArcGIS Online.

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

DRAWN BY: SAW

REVISED: 09/20/2021, SCALE: 1:214,189 when printed at 8.5x11

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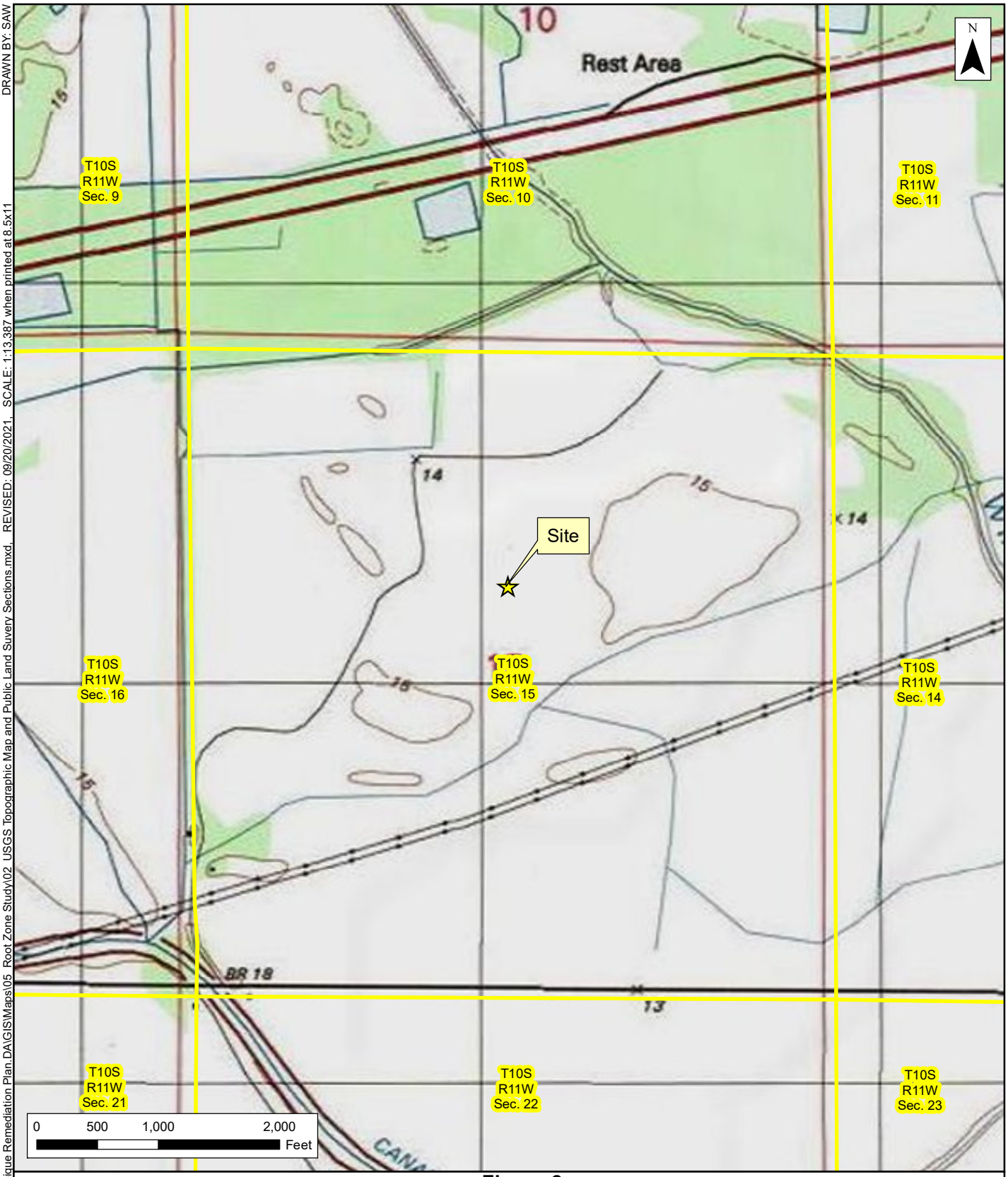

Site Location

Public Land Survey Sections

Figure 2

USGS Topographic Map and Public Land Suvery Sections

HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

Notes:
USGS Topographic Map via ArcGIS Online.

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

DRAWN BY: SAW

SCALE: 1:13,387 when printed at 8.5x11, REVISED: 09/20/2021,

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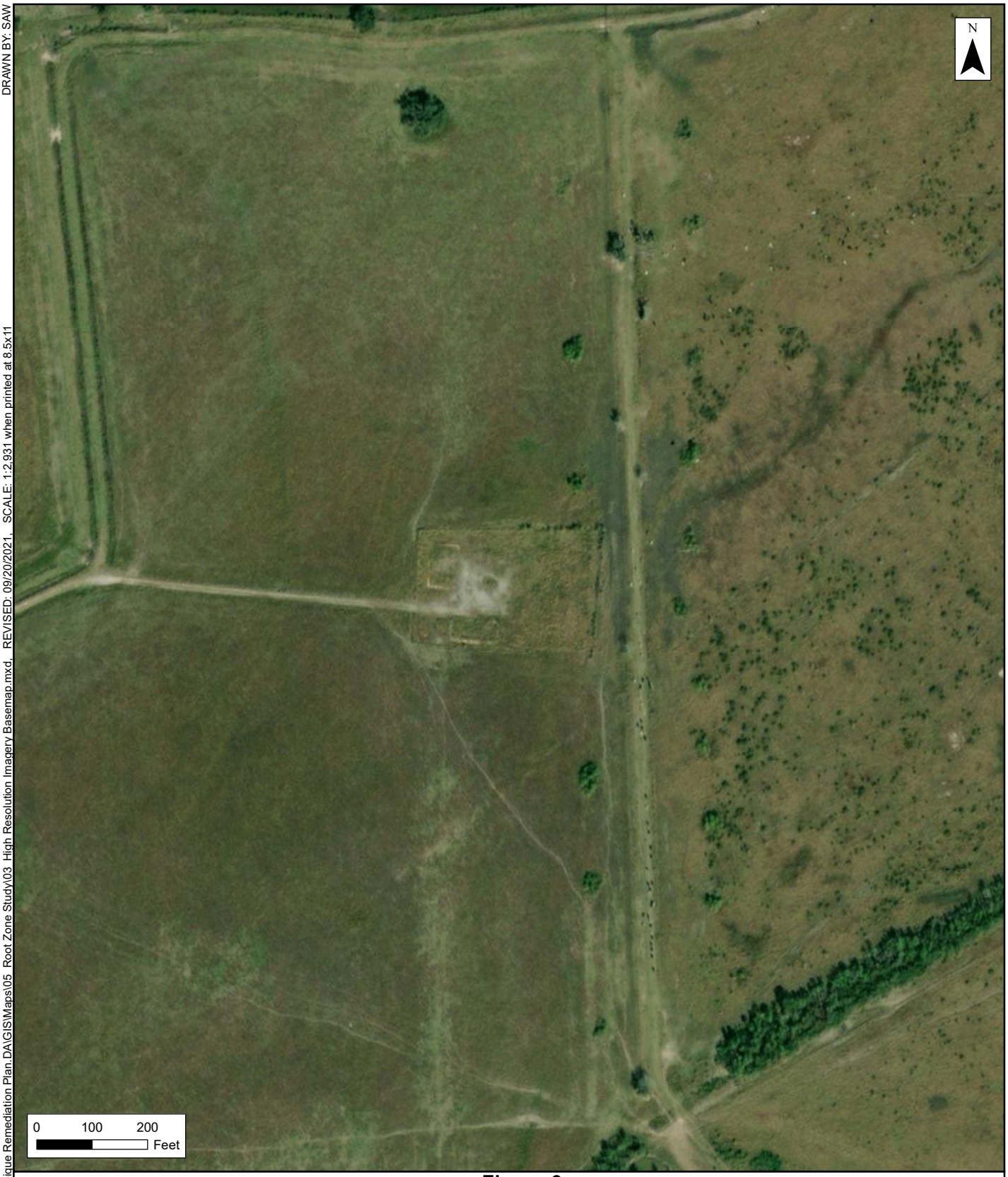
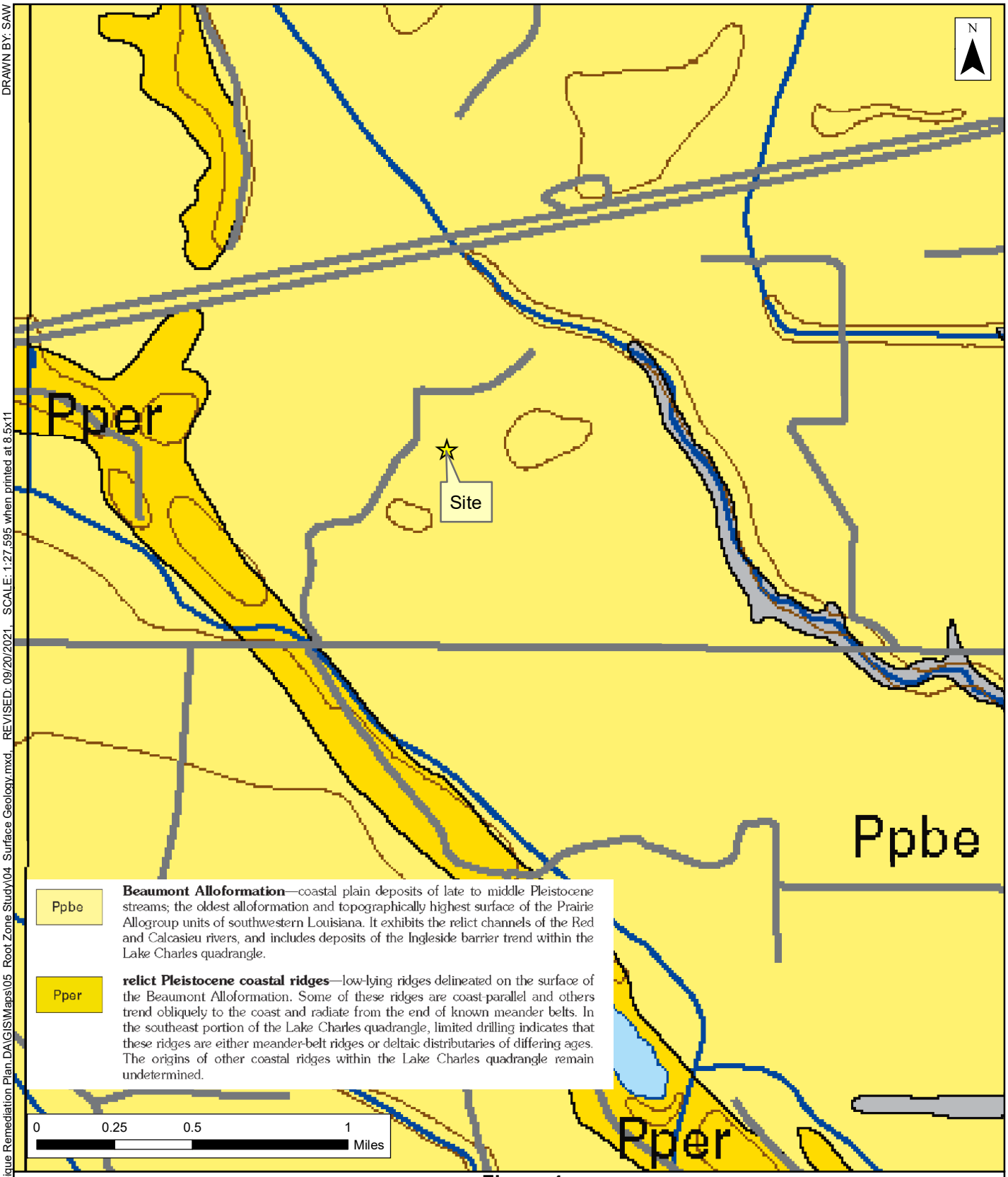


Figure 3
High Resolution Imagery Basemap
HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Notes:
December 1, 2017 aerial photo from Google Earth.

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

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



☆ Site Location

Figure 4
Surface Geology
HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Notes:
Geology basemap provided by
Louisiana Geological Survey.

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9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

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

DRAWN BY: SAW

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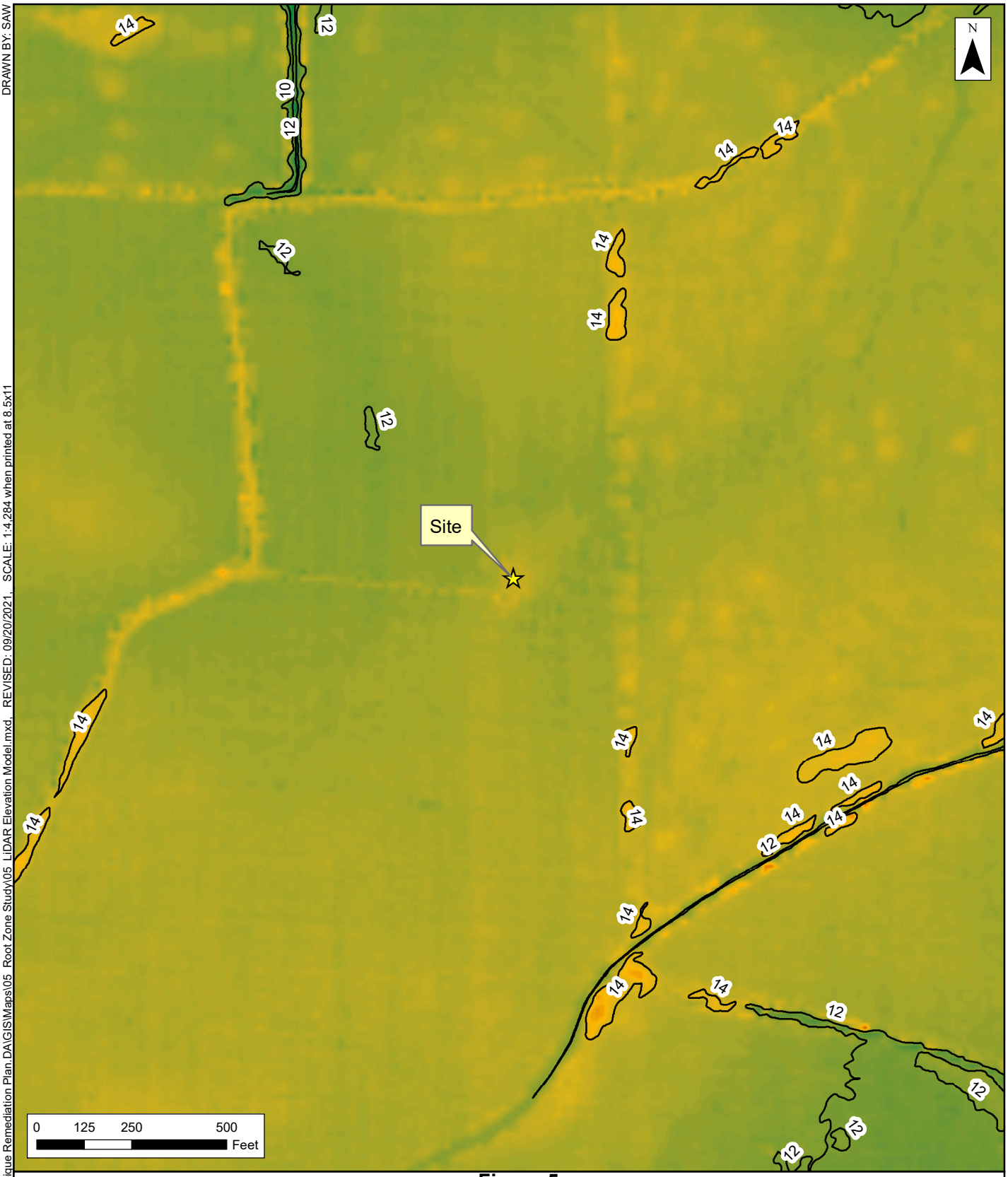

Figure 5
LiDAR Elevation Model
HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

Notes:
Elevation model based on LIDAR data from LSU Atlas.

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

DRAWN BY: SAW

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Figure 6
USDA Surface Soil Types
HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Notes:
Soil data from USDA Soil Data Mart NRCS Web Soil Survey
Imagery basemap via ArcGIS Online.

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

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

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DRAWN BY: SAW

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Root Zone Study Locations

- Herbaceous
- Tree

Figure 7
Root Study Locations
HC Drew Manual Estate "15" No. 1
Neumin Production Company
North Choupique Oil & Gas Field, Calcasieu Parish, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 1340
(318) 744-5638

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

Review of Plant Conditions and Vegetation Root Study on
The H.C. Drew Manual Estate "15" No. 1. in the
Parish of Calcasieu, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix B
Photographs

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana

Photo B-1. Crown of Live Oak (T-01).

Photo B-2. Bole of Tree T-01.

Photo B-3. Vegetation facing west at Tree T-01.

Photo B-4. Root distribution shown by spray-paint around Tree T-01..

Photo B-5. Surface roots extending from T-01.

Photo B-6. Crown of multistem Hackberry (Tree T-02).

Photo B-7. Bole of T-02.

Photo B-8. Vegetation facing southeast at T-02.

Photo B-9. Painted roots highlighting distribution around T-02.

Photo B-10. Painted roots highlighting distribution around T-02.

Photo B-11. Vegetation growing to north of H-01.

Photo B-12. Vegetation at H-01.

Photo B-13. Root distribution at H-01.

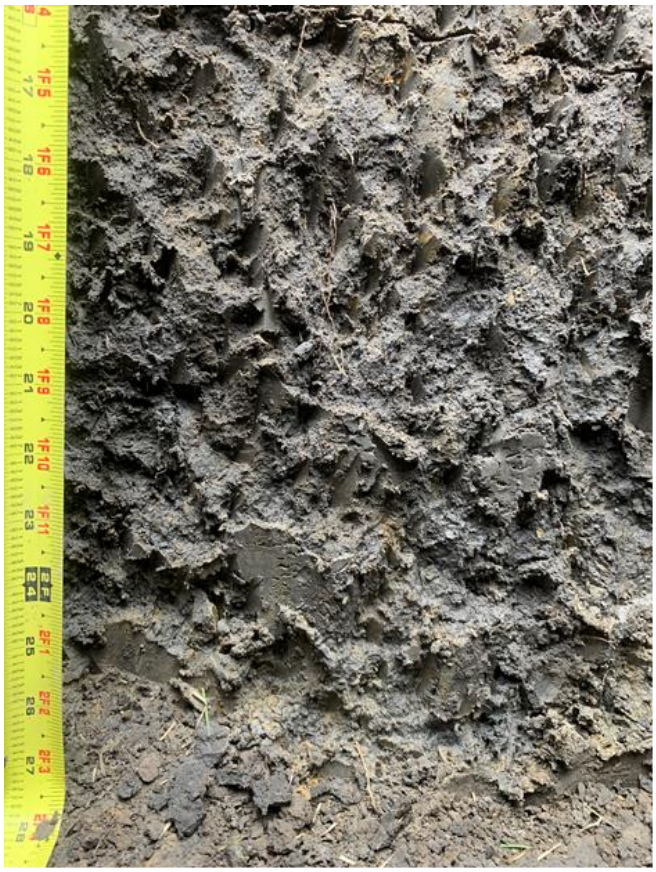


Photo B-14. Root distribution at H-01.

Photo B-15. Root distribution at H-01.

Photo B-16. Root distribution at H-01.

Photo B-17. Vegetation growing to southwest of H-02.

Photo B-18. Vegetation at H-02.

Photo B-19. Root distribution at H-02.

Photo B-20. Root distribution at H-02.

Photo B-21. Root distribution at H-02.

Photo B-22. Root distribution at H-02.

Photo B-23. Vegetation growing at H-03, facing north.

Photo B-24. Excavated soil at H-03.

Photo B-25. Root distribution at H-03 .

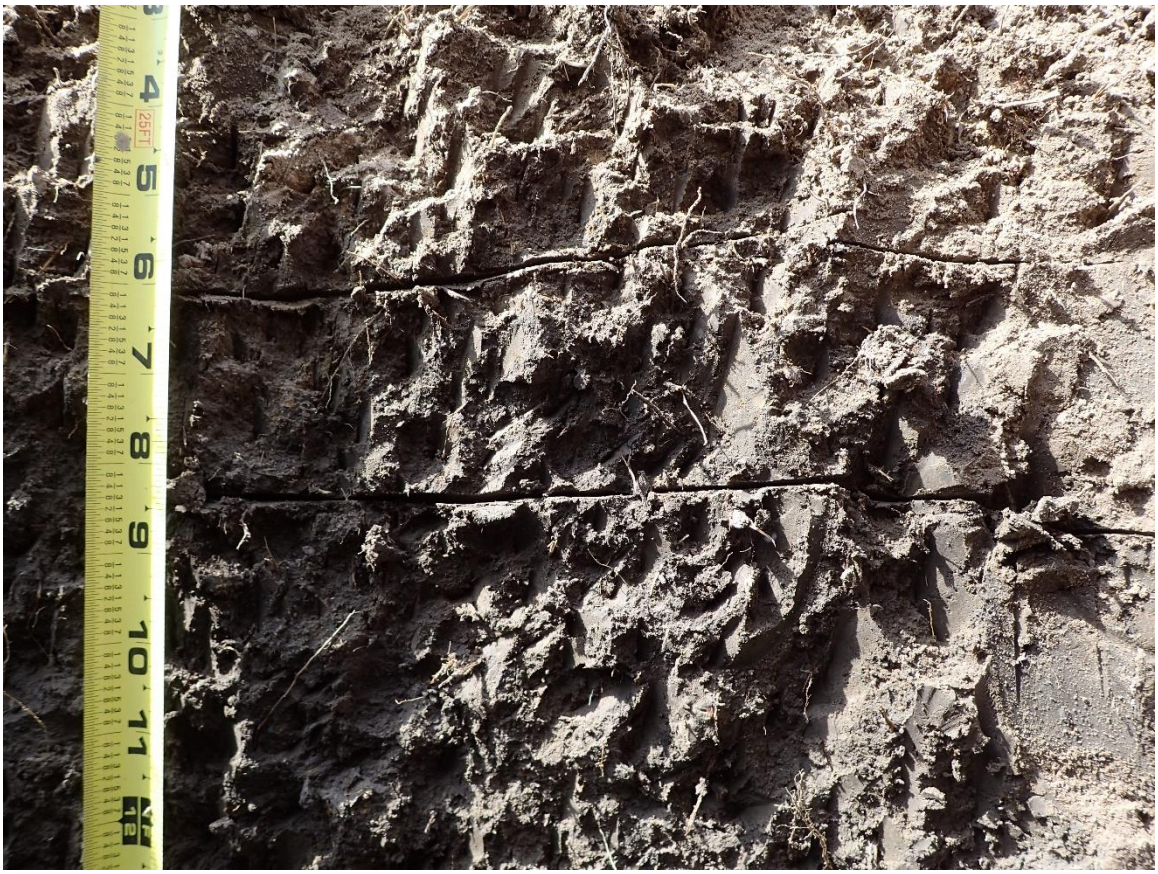


Photo B-26. Root distribution at H-03.

Photo B-27. Root distribution at H-03 .

Photo B-28. Root distribution at H-03.

Photo B-29. Vegetation at H-04.

Photo B-30. Vegetation growing to north of H-04.

Photo B-31. Vegetation at H-04.

Photo B-32. Root distribution at H-04.

Photo B-33. Root distribution at H-04.

Photo B-34. Vegetation growing north of H-05.

Photo B-35. Vegetation at H-05.

Photo B-36. Root distribution at H-05.

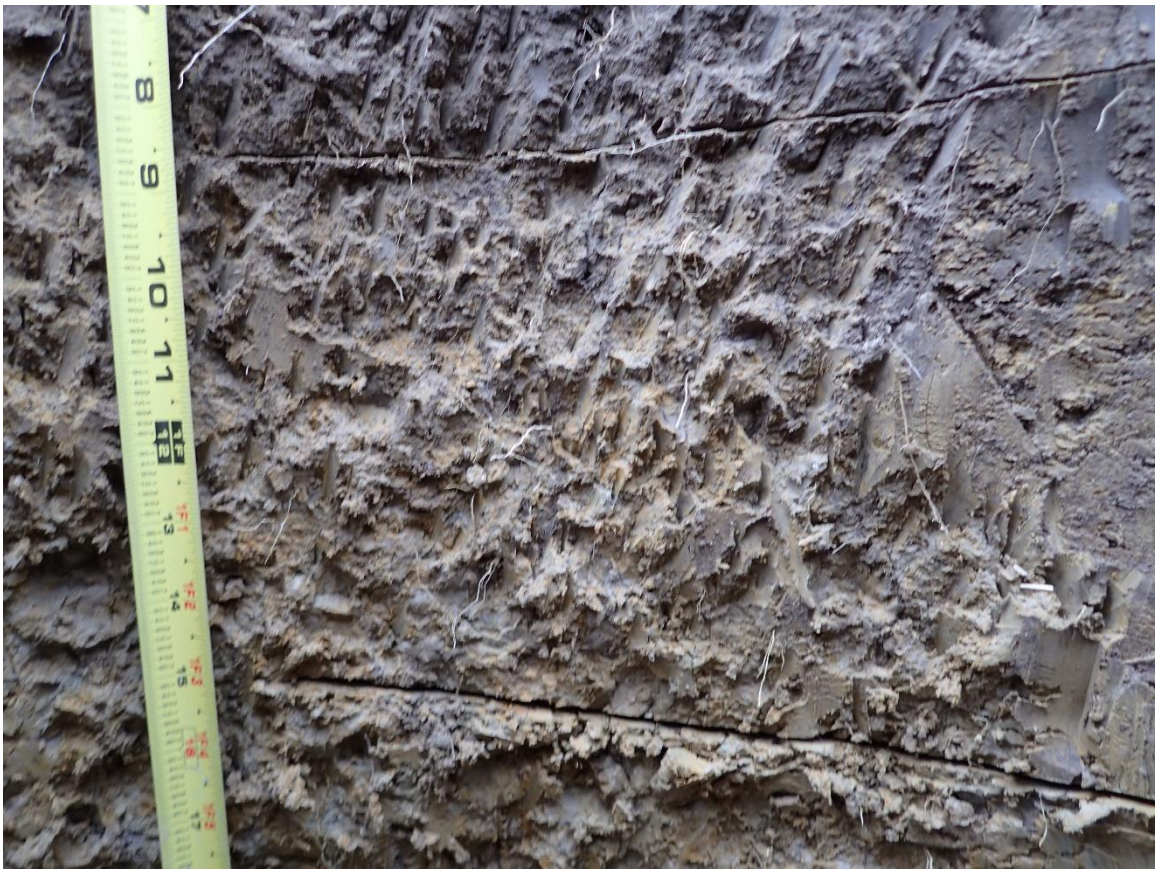


Photo B-37. Root distribution at H-05.

Photo B-38. Root distribution at H-05.

Photo B-39. Hand auger at H-05.

Photo B-40. Root distribution at H-05.

Review of Plant Conditions and Vegetation Root Study on
The H.C. Drew Manual Estate "15" No. 1. in the
Parish of Calcasieu, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix C
Root Data Forms

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana

Date: 9/9/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-01**

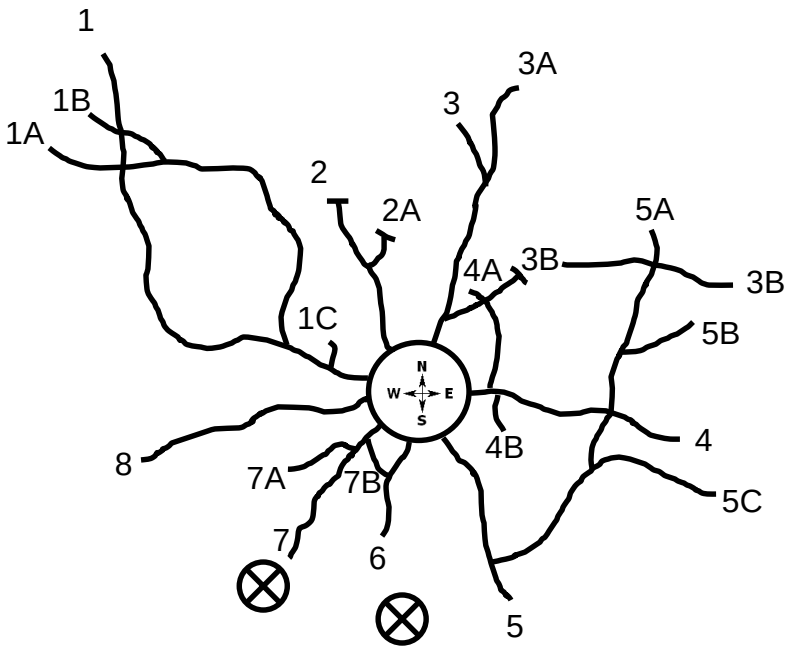
Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: N 30° 11’ 42.8” W 93° 28’ 39.8”

Other Information: Single live oak in pasture. Area built up from surrounding area. Sugarberry in area. Exposed several roots

Species: **Live Oak** DBH: **54.78”**

Root No.	Length	Depth to Top
1	**209”**	**10”**
5A	**340”**	**5”**

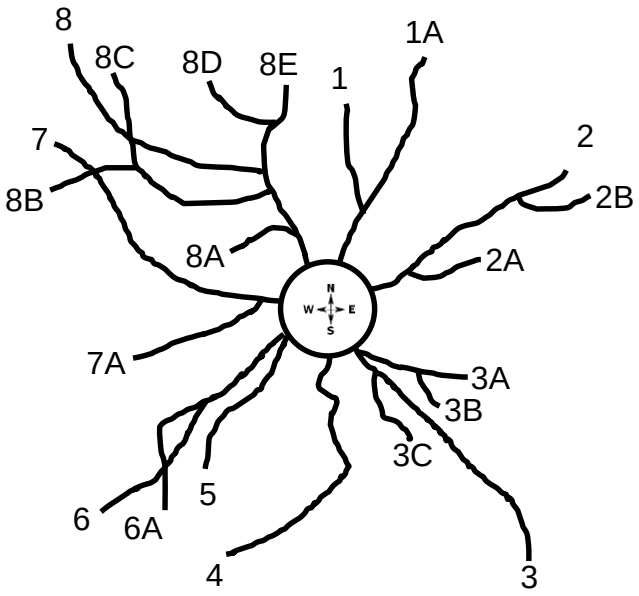


*Not to scale

⊗ Sugarberry

Date: 9/9/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-02**
Property: H.C. Drew Manual Estate "15" No. 1		
Geographic Coordinates: N 30° 11’ 42.9” W 93° 28’ 39.6”		
Other Information: Multi-trunk Sugarberry		

Species: **Sugarberry**	DBH: Bole 1 = 23.40” Bole 2 = 7.09” Bole 3 = 10.67”



*Not to scale

Date: 9/8/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-01**

Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: 30° 11' 25.1" N 93° 28' 36.2" W

Notes: Unmanaged pasture with cattle present. Pit dug to 26", hand auger to 50"

Species: Bermuda grass (*Cynodon dadctylon*) **ERZ:** 10"

Depth (In)	Abundance of Roots
0	Abundant
1	Common to Sparse
2	Common to Sparse
3	Common to Sparse
4	Common to Sparse
5	Common to Sparse
6	Common to Sparse
7	Common to Sparse
8	Common to Sparse
9	Common to Sparse
10	Sparse to Very Sparse, not uniform across profile (following 2 cracks)
11	Sparse to Very Sparse, not uniform across profile (following 2 cracks)
12	Sparse to Very Sparse, not uniform across profile (following 2 cracks)
13	Sparse to Very Sparse, not uniform across profile (following 2 cracks)
14	Sparse to Very Sparse, not uniform across profile (following 2 cracks)
15	Very Sparse to None
16	Very Sparse to None
17	Very Sparse to None
18	Very Sparse to None
19	Very Sparse to None
20	Very Sparse to None
21	Very Sparse to None
22	Very Sparse to None
23	Very Sparse to None
24	Very Sparse to None
25	Very Sparse to None
26 to 50	None

Date: 9/8/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-02**

Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: 30° 11' 36.9" N 93° 28' 37.6" W

Notes: Low area - wet with wetland species present

Species: Shortbristle Horned Beaksedge (*Rhynchospora corniculata*) **ERZ:** 7"

Depth (In)	Abundance of Roots
0	Abudant
1	Abudant
2	Abudant
3	Abudant
4	Abundant to Common
5	Abundant to Common
6	Abundant to Common
7	Sparse to Very Sparse
8	Sparse to Very Sparse
9	Sparse to Very Sparse
10	Dotted to None
11	Dotted to None
12	Dotted to None
13	Dotted to None
14	Dotted to None
15	Dotted to None
16	Dotted to None
17	Dotted to None
18	Dotted to None
19	Dotted to None
20	Dotted to None
21	Dotted to None
22	Dotted to None
23	Dotted to None
24	Dotted to None

Date: 9/8/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-03**

Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: 30° 11' 42.2" N 93° 28' 39.7" W

Notes: Disturbed soils, friable, no true horizon change, inclusion of live oak roots in profile (not measured) to 20". Spotted distribution of Vasey's grass, Cyperus spp.

Species: Annual Marsh-Elder (*Iva annua*) **ERZ:** 6"

Depth (In)	Abundance of Roots
0	Abundant
1	Common
2	Common
3	Common
4	Common
5	Common
6	Very Sparse to None
7	Very Sparse to None
8	None
9	None
10	None
11	None
12	None
13	None
14	None
15	None
16	None
17	None
18	None
19	None
20	None
21	None
22	None
23	None
24	None

Date: 9/8/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-04**

Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: 30° 11' 39.7" N 93° 28' 39.1" W

Notes: Unmanaged pasture

Species: Smooth Crabgrass (*Digitaria ischaemum*) **ERZ:** 6"

Depth (In)	Abundance of Roots
0	Abundant
1	Abundant
2	Abundant
3	Common to Sparse
4	Common to Sparse
5	Common to Sparse
6	Very Sparse to None (in cracks)
7	Very Sparse to None (in cracks)
8	Very Sparse to None (in cracks)
9	Very Sparse to None (in cracks)
10	None (Few isolated root hairs)
11	None (Few isolated root hairs)
12	None (Few isolated root hairs)
13	None (Few isolated root hairs)
14	None (Few isolated root hairs)
15	None (Few isolated root hairs)
16	None (Few isolated root hairs)
17	None (Few isolated root hairs)
18	None (Few isolated root hairs)
19	None (Few isolated root hairs)
20	None (Few isolated root hairs)
21	None (Few isolated root hairs)
22	None (Few isolated root hairs)
23	None (Few isolated root hairs)
24	None (Few isolated root hairs)

Date: 9/9/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-05**

Property: H.C. Drew Manual Estate "15" No. 1

Geographic Coordinates: 30° 11' 44.0" N 93° 28' 37.7" W

Notes: Dug pit to 24" and hand auger to an additional depth of 38"

Species: Bermuda Grass (*Cynodon dadctylon*) **ERZ:** 7"

Depth (In)	Abundance of Roots
0	Abundant
1	Abundant
2	Common (incomplete across profile)
3	Common (incomplete across profile)
4	Common (incomplete across profile)
5	Common (incomplete across profile)
6	Common (incomplete across profile)
7	Sparse to Very Sparse
8	Sparse to Very Sparse
9	Sparse to Very Sparse
10	Sparse to Very Sparse
11	Sparse to Very Sparse
12	Sparse to Very Sparse
13	Sparse to Very Sparse
14	Very Few to None (Dotted distribution)
15	Very Few to None (Dotted distribution)
16	Very Few to None (Dotted distribution)
17	Very Few to None (Dotted distribution)
18	Very Few to None (Dotted distribution)
19	Very Few to None (Dotted distribution)
20	Very Few to None (Dotted distribution)
21	Very Few to None (Dotted distribution)
22	Very Few to None (Dotted distribution)
23	Very Few to None (Dotted distribution)
24	Very Few to None (Dotted distribution)
25	Very Few to None (Dotted distribution)
26 to 38	None

Review of Plant Conditions and Vegetation Root Study on
The H.C. Drew Manual Estate "15" No. 1. in the
Parish of Calcasieu, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix D
Resume and Compensation Schedule of Luther F. Holloway

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana

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 lntracoastal 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 <u>days past</u> 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 payment …….	One 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.

Review of Plant Conditions and Vegetation Root Study on
The H.C. Drew Manual Estate "15" No. 1. in the
Parish of Calcasieu, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix E
Testimony in Last Four+ Years

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana

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.

3. Trial Testimony

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

Review of Plant Conditions and Vegetation Root Study on
The H.C. Drew Manual Estate "15" No. 1. in the
Parish of Calcasieu, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix F
Resume and Compensation Schedule of Patrick Ritchie

H.C. DREW MANUAL ESTATE
versus
NEUMIN PRODUCTION COMPANY AND STOKES & SPIEHLER, INC.
Civil Action No. 2019-4925 (Div. F)
14th Judicial District Court
Parish of Calcasieu
State of Louisiana

Patrick M. Ritchie, PWS

Senior Scientist

Mr. Patrick Ritchie has over 14 years of environmental consulting experience in the ecological sciences with an emphasis on wetlands, ecological evaluations, and effective root zone studies. Key project experience includes effective root zone assessment; soil, groundwater, and surface water assessments; habitat evaluation; wetland evaluation, restoration, and permitting; terrestrial and aquatic ecosystem evaluations; human health and ecological risk assessments; natural resource damages assessments; environmental permitting; and wetland mitigation.

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

Experience: Over 12 years' experience in oil & gas litigation support

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
- UF Graduate Certification - Wetland and Water Resource Management (2014)
- 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 and Delineations
- Effective Root Zone
- 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
- Power

Key Projects

Effective Root Zone Study of Agriculture Crop
Coordinated, successfully executed, and authored an Effective Root Study to ascertain root system depth, critical root zone area, and effective root zone depth of herbaceous vegetation located in a former oil and gas field with alleged soil contamination. The report was part of a post-settlement plan produced by former operator consultants to be submitted to the LDNR. Effective root zone depth was measured for the dominant agricultural crop of the property – rice.

Effective Root Zone Study of Pastureland
Conducted an Effective Root Zone Study of dominant herbaceous vegetation for several pastures in south Louisiana. Authored the Effective Root Zone section of the expert report and opinions on the condition of current vegetation and the potential remedial options for the property allegedly impacted by oil and gas operations.

Effective Root Zone Study Support
Supported over 25 Effective Root Zone Studies to ascertain the root system depth, critical root zone area, and effective root zone depth of vegetation occurring in former oil and gas fields throughout Louisiana. ERZ studies were conducted across a diverse assemblage of natural habitats, such as fresh, intermediate, brackish, and salt marsh; baldcypress-tupelo swamp; bottomland hardwood forest; coastal live oak-hackberry forest, and longleaf pine forest. Agricultural crops evaluated include corn, rice, soybeans, sugarcane, and turfgrasses. Site-specific root zone depth was used in formulation of soil remediation strategies where applicable. Constituents of concern included parameters typical of oil and gas exploration and production activities.

Site Investigation of Brine Spill in Sugarcane Field
Developed a sampling plan and executed an investigation of a brine spill in a sugarcane field. Made a determination of a passive remedy which was agreed upon by the client and the landowner. After a year of observation, it was determined there were no impacts to the sugarcane and the investigation was closed.

Ecological Assessment of Wetlands and Waterways near Hydrocarbon 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 assessment evaluated fish and vegetative communities as indicators of ecological community health. 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 report in support of litigation providing an evaluation of wetland functions, value, and ecological services.

Wetlands Rapid Assessment, Cypress-Tupelo Swamp
Conducted a Wetlands Rapid Assessment of a cypress-tupelo swamp to identify functional value and habitat condition based on vegetative ecological metrics.

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. Deposed as a fact witness for this case.

Rapid Bioassessment of Four Waterways
Researched, planned, successfully executed, and assisted in preparation of report for a Rapid Bioassessment of four waterways located in Hattiesburg, Mississippi. The Rapid Bioassessment

evaluated the condition of the 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. Also responsible for data collection, management, and submittal to the Louisiana Department of Natural Resources.

Environmental Assessment, Brine Mining Facility
Performed field sampling, reporting, and assessment activities associated with a salt dome cavern collapse at a brine mining facility, including: shallow and deep groundwater sampling; groundwater well installation, 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; H_2S 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 worked as a liaison to numerous contractors and expert consultants. Project site included bayous, cypress-tupelo swamp, and industrial, commercial, and residential areas.

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 Standard Operating Procedures I developed. Trained personnel to conduct the monitoring program.

Site Closure, Oil Transport Pipeline Release Site
Completed a RECAP evaluation for submittal to the LDEQ in which I evaluated multiple lines of evidence, including Mann Kendall statistical analysis, to support the monitored natural attenuation of benzene in groundwater at an oil transport pipeline release site.

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 Closure of a 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) was deemed necessary at the site.

Liquefied Natural Gas Terminal and Pipeline Projects in Coastal Louisiana

Responsible for regulatory permitting support of four liquefied natural gas terminal and pipelines in Louisiana. Permitting support involves regular consultation with FERC, USACE, EPA, USFWS, NOAA, NMFS, LDNR, LDEQ, and LDWF.

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.

Permitting Support for Solar Development

Conducted a Critical Issues Analysis and provided permitting support for nine solar development projects. Performed the wetland delineation and threatened and endangered species habitat surveys in support of renewable energy infrastructure projects in Louisiana. Acted as the subject matter expert for all federal, state, and local agency permitting.

Wetland Mitigation

Provided all levels of support for wetland mitigation, including: development and design of wetland mitigation bank, Louisiana Rapid Assessment Method determination, and Section 404 mitigation compliance. Brought in as a subject matter expert for an atypical site to evaluate the presence and appropriate mitigation for a Site. My determination was accepted and agreed upon by the U.S. Army Corps of Engineers.

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

Case	Year	Description	Area of Testimony
VPSB v Louisiana Land, et al. (b)(c)(e)	2010	Soil and Groundwater Investigation and Groundwater Remediation[a]	Site investigation
Tucker, et al. v. Shell, et al. (c)	2014	Soil & Groundwater Investigation & Remediation[a]	Site investigation

Notes:
(a) Deposition only.