Review of Vegetative Condition and Effective Root Zone Study on the Henning Management, LLC Property in Jefferson Davis and Calcasieu Parish, Louisiana

IN THE MATTER:
Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Parish of Jefferson Davis
State of Louisiana

Prepared for:

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ERM Project 0526033

HENNING MANAGEMENT PROPERTY
EFFECTIVE ROOT ZONE STUDY

Jefferson Davis Parish, Louisiana

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List of Acronyms

DAREM	Direct Antecedent Rainfall Evaluation
E&P	Exploration and Production
ERM	Environmental Resources Management Southwest, LLC
ERZ	Effective Root Zone
GPS	Global Positioning System
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
RSH	Root Study – Henning
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

1.0 INTRODUCTION

1.1 OVERVIEW

Henning Management, LLC filed a lawsuit against current and 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 Hayes oil and gas field. Consultants of the plaintiff conducted an investigation of the property from October 2019 through August 2021 which consisted of soil, groundwater and ecological assessments. A soil restoration plan was developed by plaintiff consultant, ICON Environmental Services, Inc. (ICON), proposing soil excavation to a maximum depth of 16 feet below ground surface (ICON, 2021). The restoration plan would remove soils alleged to be impacted for offsite disposal and/or amended onsite. Excavated soils would be replaced and backfilled with offsite soil from an unidentified source at a proposed cost in excess of 51.1 million dollars.

Chevron U.S.A. Inc. (Chevron), a named operator in the suit, retained Holloway Environmental Services, Inc. (Holloway Environmental) and Environmental Resources Management, Inc. (ERM) to consider the characteristics of the vegetative communities and the rooting habits of agricultural, herbaceous and woody species located on the plaintiff's property. Also considered are characteristics of the vegetation communities for root penetration in order to determine depths of the effective root zones (ERZs) of rice, tree and other plant species growing on the property area. This consideration is very important to determine the true depth of remediation for propagation of primarily herbaceous grass-type species for rice production on the tract.

This report describes the methodology and results of the ERZ study that was conducted in Jefferson Davis Parish, Louisiana (Appendix A, Figure 1) on November 30 – December 3, 2021 by Holloway Environmental and ERM. This study included the determination of root depths and ERZ of plants growing around areas of alleged oil and gas E&P impacts within the plaintiff property (Appendix A, Figure 2). Representative herbaceous and woody plant communities were investigated in order to evaluate the depth for root penetration and density of roots throughout the soil profile in order to determine appropriate depth of soil remediation to facilitate agricultural production and natural vegetative communities on the tract. This evaluation and data presented in this report represent a site-specific study which may be used to facilitate both review of the property and the development of proposed soil remediation by the Louisiana Department of Natural Resources Office of Conservation (LDNR OC).

1.2 RETENTION OF HOLLOWAY ENVIRONMENTAL SERVICES, INC. AND ENVIRONMENTAL RESOURCES MANAGEMENT, INC.

For the litigation recorded as Henning Management LLC v. Chevron USA Inc. et al. 31st JDC Division "C", Civil Action No. 73318, Parish of Jefferson Davis, State of Louisiana, Holloway Environmental Services, Inc. and Environmental Resources Management, Inc. have been retained by Chevron USA, Inc. to provide expert services in the case.

1.3 REPORT FORMAT

This report consists of five report sections and three appendices that follow this introduction:

- Section 2 provides a general description of the Root Zone Study Area that includes a summary of existing and historical land uses together with desktop research of wetlands, waterbodies and soils information 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 seven figures (Figures 1 through 7) providing various maps, background/desktop information and Geographic Information System (GIS) data overlays for the Henning Management property and the Study Area. Appendix B contains the Root Zone Study Forms including site photographs documented during fieldwork and referenced throughout the report. Representative site photographs of the observation areas are included in Appendix C.

2.0 SITE DESCRIPTION AND EXISTING CONDITIONS

2.1 SITE LOCATION

The Henning Management property is located within the Hayes Field, immediately south of the unincorporated community of Hayes and approximately 16 miles southeast of the city of Lake Charles, Louisiana (Figure 1). The property described in the lawsuit is situated within Sections 16, 17, 18, 19, 20, 21 of Township 11 South, Range 5 West and Section 24 in Township 11 South, Range 6 West all in Calcasieu and Jefferson Davis Parishes (Property or Site). The property consists of approximately 1262 acres bisected by Louisiana State Highway 14 (Hwy 14), west of Bayou Lacassine.

2.2 EXISTING AND HISTORICAL LAND USE

The Henning Management property is located in a rural area of southwest Louisiana where the historical land use of the Site has been agriculture, oil and gas E&P operations and hunting. The portion of plaintiff property east of Hwy 14 is almost exclusively rural farmland with parcels planted in rice during the 2021 assessment activities with the northern and eastern-most area used for hunting. Plaintiff property west of Hwy 14 was previously planted for rice production, but was fallow during the authors' field investigation. One oil and gas well remains shut-in on site for future production (SN213760) and a Texas Gas Transmission, LLC natural gas pipeline crosses the central portion of the site with the associated mainline valve site located just off of Hwy 14. There are no dwellings or other structures located on the Study Area and the only access is by gravel access roads. Surrounding land use is a mix of agricultural, pastureland and rural residential.

2.3 GEOLOGY AND PHYSIOGRAPHY

The underlying geology for a large portion of the Site is mapped by the U.S. Geologic Survey as Pleistocene prairie terrace of the Prairie Allogroup, Early Sangamon. The Prairie

Allogroup, Early Sangamon is an older of the Prairie Allogroup temporal phases. The soil substrate is derived from a diverse depositional sequence of floodplain, meander-belt, and back swamp or cutoff channel deposits of the middle-Pleistocene ancestral Mississippi River, Red River, local fluvial equivalents of tributary streams and coastal-plain streams. Where this unit is mapped near the Mississippi River floodplain, it is blanketed by Peoria Loess or loess-derived colluvium. The unit dips into the subsurface beneath the Prairie Allogroup, Late Sangamon in the coast-parallel region, but is commonly terraced above it in stream valleys. The sediments deposited by the fluvial and loess parent materials result in soils consisting of clay, silty clay loam, or sandy clay loam, but may include some sand and gravel in deposits of relict channels. The site lies within the Beaumont Alloformation, "a stratigraphic sequence underlying the oldest and topographically highest of the Prairie surfaces west of the Mississippi alluvial valley. It exhibits the relict channels of the Red River, and includes deposits of the Ingleside barrier trend west of the Crowley quadrangle. It is composed of coastal plain deposits of late-to-middle Pleistocene streams consisting of light gray to light brown clay, sandy clay, silt, sand, and some gravels" (USGS).

The area adjacent to Bayou Lacassine and remnant tributary consists of Holocene undifferentiated alluvium of small upland streams. These alluvial deposits of minor creeks and streams filled valleys cut into older deposits where the modern flood plain within these valleys constitutes the surface of these deposits. Figure 3 presents the Site on the Crowley 30 x 60 Minute Geologic Quadrangle map.

2.4 SOIL SURVEY

The plaintiff's property extends across two parishes, Calcasieu to the north and Jefferson Davis to the south resulting in soils mapped by the U.S. Department of Agriculture (USDA) in two parish-wide soil surveys. These survey areas may have been mapped at different scales with a different land use in mind, at different times, or at different levels of detail. The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey online tool was utilized for reference to support field investigation. USDA NRCS soil data is shown on Figure 6.

2.4.1 Jefferson Davis Parish Soil Survey

The following seven soil mapping units within the Root Zone Study Area are: Allemands muck, 0 to 0.2 percent slopes, very frequently flooded (AEA), Arat mucky silt loam (ARA), Crowley-Vidrine complex, 0 to 1 percent slopes (CrA), Ged clay (GDA), Midland silty clay loam, 0 to 1 percent slopes, rarely flooded (MdA), Edgerly loam, 0 to 1 percent slopes, rarely flooded (MoA), Mowata-Vidrine complex, 0 to 1 percent slopes, rarely flooded (MwA). The following descriptions generally follow those of the NRCS soil survey of Jefferson Davis Parish (Soil Survey Staff, 2003):

Allemands muck is a level, very poorly drained organic soil. The organic material is typically about 50 inches thick with very fluid dark brown muck in the upper part which becomes dark grayish brown to black in the lower part. A fluid, gray clay underlies the muck to about 80 inches. The soil is ponded or flooded with several inches of freshwater most of the time which can reach up to 2 feet deep during storms with a high water table ranging from 1 foot above the surface to 0.5 foot below the surface. The soil is well suited as wetland wildlife habitat with low potential for crops, pasture or woodland.

The Arat mucky silt loam map unit is level, very poorly drained, very fluid occurring in ponded and flooded swamps most of the time. The typical surface layer is very dark grayish brown, very fluid mucky silt loam about 6 inches thick. The subsoil extends to a depth of about 60 inches and is dark grayish brown, very fluid silt loam in the upper part and dark grayish brown, very fluid silty clay loam in the lower part. This soil is not suited for crops and too soft and boggy for grazing by livestock.

The Ged clay map unit is level and very poorly drained, occurring in freshwater marshes and is frequently flooded and ponded most of the time. Typically, the surface layer is dark gray, very fluid clay about 8 inches thick. The next layer is very dark gray, slightly fluid clay about 8 inches thick. The subsoil extends to about 62 inches. The subsoil is dark gray, mottled clay in the upper part and gray, mottled silty clay in the middle and lower parts. This soil is used mainly as habitat for wetland wildlife. A small total acreage of this map unit is used as rangeland. Unless drained and protected from flooding, these soils are not suited for cropland, pasture, or woodland. If water control is maintained with a system of dikes, ditches, and water pumps, this map unit can be used to grow rice. Ged clay is not suited to urban uses. The main limitations of this soil map unit include: wetness, very slow permeability, low strength on sites for local roads and streets, the high shrink-swell potential, and flooding hazards.

The Midland silty clay loam, 0 to 1 percent slopes, rarely flooded map unit consists of level and poorly drained soils occurring on broad flats and in slightly concave areas on terraces of the Gulf Coast Prairies. It is subject to rare flooding. Map units are irregular in shape and range from 75 to 800 acres. The slope within this map unit is less than 1 percent. Typically, the surface layer is dark gray, mottled silt loam approximately 6 inches thick. The subsoil extends to a depth of 75 inches. It is dark gray, mottled silty clay loam in the upper part and gray, mottled silty clay in the middle and lower parts. This soil is mainly used as cropland and moderately well suited to cultivated crops, mainly rice and soybeans.

The Edgerly loam soil has slopes 0 to 1 percent with rare flooding and no ponding. Soil consists of loam from surface to 31 inches with an underlying clay loam from 31 to 80 inches. Drainage is poor with a water table located from about 18 to 30 inches below ground surface.

The Crowley-Vidrine soil consists of silt loams with 1 to 3 percent slopes that are somewhat poorly to moderately well drained. The complex consists of Crowley and Vidrine soils situated on the side slopes of broad convex ridges of terraces that contain many small convex mounds, many of which have been smoothed. The soils in this map unit are moderately well suited to cultivated crops, mainly rice and soybeans.

Mowata-Vidrine complex is poorly drained, rarely flooded silt loams occurring on broad flats on terraces of the Gulf Coast Prairies. The soils in this map unit are moderately well suited to cultivated crops, mainly rice and soybeans. The main limitations are wetness and potentially toxic levels of exchangeable aluminum within the root zone. Soils are also moderately well suited for woodland and pasture soils, though they may be compacted if equipment and cattle are run while wet.

2.4.2 Calcasieu Parish Soil Survey

The following five soil mapping units within Calcasieu Parish, include: Arat mucky silt loam (AR), Crowley-Vidrine complex, 0 to 1 percent slopes (Cr), Midland silty clay loam, 0 to 1 percent slopes, rarely flooded (Mn), Edgerly loam, 0 to 1 percent slopes, rarely flooded (Mr), and Mowata-

Vidrine complex, 0 to 1 percent slopes, rarely flooded (Mt). The descriptions of the Soil Conservation Service soil survey of Calcasieu Parish (Soil Survey Staff, 1998) generally follow those of the Jefferson Davis Parish survey.

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 5). Elevation within the Study Area ranges from approximately 0.0 to 6.0 feet above mean sea level (msl). Higher elevations occur on the western and north-central portions of the Site. Elevation decreases to the east of the property near Bayou Lacassine. Higher elevations are typically associated with roads, berms and other man-made features supporting agriculture. Elevation and relief influence the frequency and duration of inundation or the degree of soil saturation

2.6 HYDROLOGY

Hydrology is contingent on numerous factors such as precipitation, soil stratigraphy, soil permeability, topography, and plant cover type and abundance. Hydrology, as discussed in this report, is focused particularly on water flow and inundation and the relationship with vegetation on Site. Site hydrologic influence can be man-made (e.g. berm, pumping, etc.) or weather-related (flooding), or due to a combination of both factors. When evaluating the ecological health and rooting habits of vegetation, a review of current hydrologic conditions at the time of the investigation is valuable. The current site hydrology has been altered from its natural condition by roads, ditches, berms, and other features installed to facilitate the present land usage. Natural Site hydrology has been modified to support rice production. Parcels located east of Hwy 14 and east of Bayou Lacassine are currently used for rice production. The areas to the west and southwest of the property were fallow at the time of the investigation, but still retained remnants of hydrologic modification (i.e., water well and pump, berms, ditches) used for rice farming.

In addition to investigation of anthropogenic factors influencing hydrology, an evaluation of antecedent precipitation in the recent past (generally three months prior to the site visit) has been completed to determine whether normal precipitation conditions are present. Rainfall data from the Jennings weather station located in Jefferson Davis Parish, Louisiana, was used to determine rainfall normality using direct antecedent rainfall evaluation (DAREM) calculations. Historic climate data, also from the Jennings weather station, was used to determine a measure of normality based on the measured rainfall for the 3 months prior to the survey event. The DAREM calculations for August 2021, September 2021, and October 2021 were calculated using observed rainfall data. Based on these calculations the survey area had normal precipitation conditions.

Direct Antecedent Rainfall Evaluation Calculations

Weather Station	Prior Month (2021)		NRCS WETS Table 30-Year Extreme Rainfall Distribution Percentiles (in) 30	70	Prior Month Rainfall	Month Condition [a]	Month Weight [b]	Month Score [c]
Jennings, LA	1st	October	2.29	5.34	2.5	2	3	6
	2nd	September	3.42	5.77	13.42	3	2	6
	3rd	August	3.95	7.29	2.76	1	1	1
						DAREM Score (i.e., Sum) =		**13**

DAREM Score Explanation

DAREM Score (Observed Score)	6	7	8	9	10	11	12	**13**	14	15	16	17	18
DAREM Wetland Hydrologic Condition	Drier than normal				**Normal**					Wetter than normal			

[a] Month Conditions are 1 for Prior Month Rainfall that were less than the 30-Year Extreme Rainfall Distribution 30th percentile, 2 for Prior Month Rainfall that were between the 30-Year Extreme Rainfall Distribution 30th and 70th percentiles, and 3 for Prior Month Rainfall that were greater than the 30-Year Extreme Rainfall Distribution 70th percentile.

[b] Month Weights are 3 for the month just prior, 2 for the second prior month, and 1 for the third prior month.

[c] Month Scores are the product of the Month Condition and Month Weight.

During the site visit, vegetation observed at the observation areas had no visible evidence of stress. Recent precipitation was normal and no long term drought conditions were recorded for the area.

2.7 VEGETATION

Vegetation on the Henning Management property consists mostly of unmanaged weedy species and cultivated rice crops. Areas of the property have been out of cultivation for several years based on historical aerial imagery with the cultivated rice (*Oryza sativa*) having been harvested prior to the field investigation with rice stubble remaining in the fields. Rice levees and edges of drainage ditches in the rice fields were vegetated by species such as Johnson grass (*Sorghum halepense*), maidencane (*Panicum hemitomon*) and numerous other weedy species. Forested areas were located adjacent to man-made ditches and Bayou Lacassine to the east with some fallow areas undergoing succession to mostly Chinese tallow (*Triadica sebiferum*), occasional black willow (*Salix nigra*) and waxmyrtle (*Morella cerifera*). Overstory species on some wooded areas on the property consisted of primarily Chinese tallow, Drummond red maple (*Acer rubrum* var. *drummondii*), sweetgum (*Liquidambar styraciflua*) and occasional sugarberry (*Celtis laevigata*) and small water oaks (*Quercus nigra*). Understory consisted of mostly Chinese tallow, sweetgum and an occasional persimmon (*Diospyros virginiana*) and possumhaw (*Ilex decidua*). A few dwarf palmetto (*Sable palmetto*) and dogwood (*Cornus* sp.) were noted in the general area. Observation areas in old field succession sites consisted primarily of non-woody species including spikerushes (*Eleocharis* spp.), asters (*Symphotrichum* sp.), annual marsh-elder (*Iva annua*), bushy bluestem (*Andropogon glomeratus*), seaside goldenrod (*Solidago sempervirens*), winged loosestrife (*Lythrum alatum*), softrush (*Juncus effusus*), southern dewberry (*Rubus trivialis*), Brazilian vervain (*Verbena brasiliensis*), smartweeds (*Polygonum* spp.), seaside goldenrod (*Solidago sempervirens*), dotted smartweed (*Persicaria punctata*) and nutsedges (*Cyperus* spp.). An occasional distribution of rattlebox (*Sesbania drummondii*) with dense stands of common reed (*Phragmites australis*) were occurring along the east and southern boundary of the Study Area.

A few waxmyrtles and eastern baccharis (*Baccharis halimifolia*), sugarcane plumegrass (*Saccharum giganteum*) and sugarcane (*Saccharum officinarum*) were mixed in the herbaceous stands. A detailed review of the Site and surrounding areas showed all of the vegetation to be in excellent condition with no evidence of any kind of impacts from oil field E&P operations. Large tracts of the Henning Management property are fully functioning agricultural land devoted to the cultivation of rice.

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 decades of field investigations to assess the effects of oil field E&P activities on plant roots. The study approach follows techniques and methodologies that are accepted by the scientific community for conducting root studies (Schuurmand and Goedewaagen, 1971). These methodologies have also been recognized by the LDNR OC for effective root zone investigations. The authors of this report have substantial experience documenting root depth and distribution condition of agriculture crops and native and introduced woody and herbaceous species. The experience gained from these field investigations supports the understanding that root densities and penetrations vary based on vegetation, soil types, disturbance factors, area hydrology and when considering the intended future use for various properties (i.e., agriculture, raising cattle, etc.). Differences in rooting ability depend on the species and genetically determined capacity of roots to tolerate varying degrees of soil compaction, aeration, fertility and moisture. These site specific considerations are why it is important to conduct an investigation specific to the plants and soils of the areas of alleged impact and surrounding areas 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. The following sections describe the methods utilized during ERZ study of the Henning Property.

3.2 OBSERVATION AREA SELECTIONS

The Site consists of active and fallow agriculture land with minor areas of forested habitat (Figure 3). As necessary, observation areas were positioned to document significant spatial variation in plant communities within the Site.

A visual survey was conducted to select observation area locations representative of the diverse vegetative communities of the Henning Management property. As described in Section 2.4 of this report, soils located on the property are moderately well suited for rice cultivation. Due to the current and future potential use of the property for this purpose, five observation areas were selected to observe rooting characteristics of rice. Areas to the west of Hwy 14 are demonstrating a typical ecological succession following agriculture and oil and gas field operations with annual and perennial grasses, rushes and sedges intermixed with light-seeded shrubs. Four herbaceous observation areas were selected to represent this current ecological habitat. Additionally, two trees were selected between S Ward Line Road and the large man-made drainage ditch which extends west to east across the central portion of the property toward Bayou Lacassine. The observation areas are illustrated on Figure 7.

3.3 METHODOLOGY

At each observation area location, a general description of vegetative species, soil profile, root system depth and density, and photographs were collected to determine the Effective Root Zone (ERZ). This method follows profile techniques of (Schuurmand and Goedewaagen, 1971). 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 of the majority of roots that sustain the plants growth and reproduction. Several techniques are employed based on vegetation type and habitat conditions, including: excavation, profile wall, and auger method.

At the same time that the roots were viewed or probed, a review was made of the existing plants around the sample point to determine the plant conditions and the notation of any impacts such as leaf scorch, leaf burning and dieback from any potential E&P impacts such as soil saline and sodicity conditions. Other indicators of salt or petroleum hydrocarbon impact include epicormic branching, witches' brooms and dieback. These conditions, if present, and general observations are summarized in Section 4.

3.3.1 Herbaceous/Non-woody Plant Method

To evaluate root penetration and density of herbaceous plants, a trench was hand-dug or specimen excavated with shovels to a depth where roots were either no longer or minimally visible within the soil profile. A trench is dug perpendicular to the subject specimen or extracted for observation. To confirm that the complete extent of the root system was adequately assessed, a hand auger was advanced below the bottom of the trench to document the presence or absence of additional roots. Root density or "prevalence" were recorded based upon the description in Schuurman and Goedewaagen (1971) from greatest to least occurrence within the soil profile: very abundant, abundant, common, sparse, very sparse, and none. Ground level photographs of observations and profiles are shown in Appendix B while root prevalence was recorded on Root Study Field Forms provided in Appendix C.

3.3.2 Woody Plant/Tree Method

An individual specimen was selected outside of areas of alleged contamination that is in good health and representative of the dominant species occurring in the stand. The tree is identified by species and diameter at breast height (DBH) is measured. Large lateral roots extending from the bole of the tree are identified, numbered and excavated. A diagram of the observed roots is drawn with length and depth measurements recorded on Root Study Field Forms provided in Appendix C.

3.4 DATA RECORDING

Global Positioning System (GPS) data were collected to document observation areas and photograph locations. Sample plot data and field observations were recorded on Root Study Field Forms. Sample plots were designated by letter abbreviations and number identifier (e.g. R-01). Observation area locations are provided in Figure 7.

4.0 ERZ STUDY RESULTS

To determine the ERZ, where the majority of moisture and nutrients used by the main body of the plant are absorbed, for vegetation occurring on the Henning Management property, five rice, four herbaceous, and three tree observations were conducted. These observations included typical growth in the varying plant communities across the Site. A general description, observations and the documented ERZ depth are described for each sample point location in the following sections.

4.1 AGRICULTURE OBSERVATIONS

A selection of five rice specimens were observed on the subject property which represent the current farming land use east of Hwy 14. A detailed description of each observation is presented in subsequent sections of this report.

4.1.1 Observation R-01 – Rice (*Oryza sativa*) ERZ = 6.0”

Observation R-01 is a rice specimen sampled in the southeast portion of the subject property located on the Crowley-Vidrine complex soil series (Figure 7). The field is a monoculture of rice growing on approximately 50 acres surrounded on all sides by levees with smaller topographic levees throughout the field. At the time of sampling, the field had been drained and was dry with no surface water present. The rice had been harvested with only rice stubble, cut stem and leaf parts remaining. Due to the timing of the field observation, it is possible the rice had been harvested twice, meaning the plant had completed its life cycle and the root system observed is indicative of mature vegetation. There is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties that maybe affecting the vegetation stand at this.

The root profile documented at Observation R-01 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The root density decreases with depth to abundant from 2.0 to 3.5 inches and common from 3.5 to 5.0 inches below the ground surface (bgs). The ERZ extends 6.0 inches bgs where the root prevalence becomes very sparse to a dotted distribution at 6.0 to 7.0 inches bgs. Soils were examined from 7.0 to 25.0 inches in depth with root prevalence of none or no observable roots present. Photos B-1 and B-2 show the aboveground structure of the rice and observed soil profile, respectively. The roots in this area were healthy, living, and showing no evidence of stress or impacts. Photos B-3 to B-6 show the soil profile on down to 25 inches in depth. Based on the investigation of the root profile, the ERZ was determined to be a depth of 6.0 inches below ground surface for the cultivated rice growing at this sample plot.

4.1.2 Observation R-02 – Rice (*Oryza sativa*) ERZ = 5.5”

The second root observation, R-02, is a rice specimen sampled in the field approximately 20 acres in size located in the east-central portion of the subject property located on the Mowata-Vidrine complex soil series (Figure 7). The field is a monoculture of rice surrounded on all sides by levees with smaller topographic levees throughout the field and large drainage ditches to the north and east. At the time of sampling, the field had been drained and was dry with no surface water present. The rice in this field had also been harvested with only rice stubble, cut stem and leaf parts approximately four to six inches in height remaining. Due to the timing of the field observation, it is possible the rice had been harvested twice, meaning the plant had completed

its life cycle and the root system observed is indicative of mature vegetation. There is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties that maybe affecting the vegetation stand at this site.

The root profile documented at Observation R-02 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The abundance of roots becomes abundant at 1.5 inches and continues to 3.0 inches. Common to sparse abundance occurs between 4.0 to 5.0 inches bgs with sparse to very sparse abundance from 6.0 to 7.0 inches. Soils were examined from 7.0 to 25.0 inches in depth with root prevalence of none or no observable roots present. Photos B-7 and B-8 show the aboveground structure of the rice and observed soil profile, respectively. The roots in this area were healthy, living and showing no evidence of stress or impacts. Several dead roots, not associated with the specimen, were observed between 4.0 to 5.0 inches bgs. Photos B-9 to B-10 show the profile down to 25 inches in depth. Based on the investigation of the root profile, the ERZ was determined to be a depth of 5.5 inches below ground surface for the cultivated rice growing at this sample plot.

4.1.3 Observation R-03 – Rice (*Oryza sativa*) ERZ = 5.0”

Observation R-03 is a rice specimen located southwest of R-02, south of the farm road on the Midland soil series (Figure 7). The field is a monoculture of rice surrounded on all sides by levees with smaller topographic levees throughout the field and large drainage ditches to the south, west and east. The current farmer appears to be using intermittent irrigation as this field had also been drained with no surface water present. The rice in this field had been harvested with only rice stubble, cut stem and leaf parts approximately four to six inches in height remaining. Due to the timing of the field observation, it is possible the rice had been harvested twice, meaning the plant had completed its life cycle and the root system observed is indicative of mature vegetation. There is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties that maybe affecting the vegetation stand at this site.

The root profile documented at Observation R-03 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The root density becomes abundant at 2.0 inches and continues to 3.0 inches. Sparse to very sparse root density occurs between 5.0 to 8.0 inches bgs. Total root depth is 9.0 to 10.0 inches with very sparse to none. Soils were examined from 10.0 to 24.0 inches in depth with root prevalence of none or no observable roots present. Photos B-11 and B-12 show the aboveground structure of the rice and observed soil profile, respectively. The roots in this area were healthy, living and showing no evidence of stress or impacts. Photos B-13 to B-14 show the profile down to 24 inches in depth. Based on the investigation of the root profile, the ERZ was determined to be a depth of 5.0 inches below ground surface for the cultivated rice growing at this sample plot.

4.1.4 Observation R-04 – Rice (*Oryza sativa*) ERZ = 5.0”

A fourth rice observation, R-04, was made on the Midland soil series west of R-03 in an approximate 28-acre field (Figure 7). The field is a monoculture of rice surrounded on all sides by levees with a farm access road to the north. At the time of sampling, the field had been drained and was dry with no surface water present. The rice in this field had been harvested with only rice stubble, cut stem and leaf parts approximately four to six inches in height remaining. Due to the timing of the field observation, it is possible the rice had been harvested twice, meaning the plant had completed its life cycle and the root system observed is indicative of mature vegetation. There is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties

that maybe affecting the vegetation stand here at this site. The herbaceous vegetation observed and root profile for this area are shown in Photos B-15 and B-16.

The root profile documented at Observation R-04 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The root density becomes abundant to common from 2.0 inches to 4.0 inches bgs. The root abundance decreases significantly between 5.0 to 10.0 inches with few dotted distribution of fine roots. Photos of the soils were examined from 11.0 to 27.0 inches in depth with root prevalence of none or no observable roots present (Photos B-17 to B-19). The roots in this area were healthy, living, and showing no evidence of stress or impacts. Dead roots, not associated with the specimen, were observed from 5.0 to 10.0 inches bgs and are typical of accretion areas or burying from land leveling operations. Based on the investigation of the root profile, the ERZ was determined to be a depth of 5.0 inches below ground surface for the cultivated rice growing at this sample plot.

4.1.5 Observation R-05 – Rice (*Oryza sativa*) ERZ = 7.0”

The final rice specimen observed, R-05, was located on the Edgerly loam soil series on the south central portion of the property to the east of Hwy 14. The field is a healthy monoculture of rice surrounded on all sides by levees. This field had been drained, but held approximately one inch of surface water in depressions and ruts. The rice in this field had been harvested with only rice stubble, cut stem and leaf parts approximately four to six inches in height remaining. Due to the timing of the field observation, it is possible the rice had been harvested twice, meaning the plant had completed its life cycle and the root system observed is indicative of mature vegetation. There is no evidence of any kind of dieback or other symptoms associated with saline or sodic properties that maybe affecting the vegetation stand here at this site. The rice stubble and root profile for this area are shown in Photos B-20 and B-21.

The root profile documented at Observation R-05 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The root density becomes abundant to common from 2.0 inches to 4.0 inches bgs. Common to sparse root abundance was observed from 5.0 inches to 9.0 inches bgs. Soils were examined from 11.0 to 24.0 inches in depth with root prevalence of none or no observable roots present (Photos B-22 to 23). The roots in this area were healthy, living and showing no evidence of stress or impacts. Based on the investigation of the root profile, the ERZ was determined to be a depth of 7.0 inches below ground surface for the cultivated rice growing at this sample plot.

4.2 HERBACEOUS OBSERVATIONS

A selection of four herbaceous specimens were observed representing a selection of dominant plants on the subject property. A detailed description of each observation is presented in subsequent sections of this report.

4.2.1 Observation H-01 – Bushy bluestem (*Andropogon glomeratus*) ERZ = 5.0”

Observation H-01 is located west of oil and gas well location VUA; Hayes U1 (SN105169) in the central portion of the property west of Hwy 14. H-01 is a healthy specimen of bushy bluestem found commonly throughout the property (Photo B-24). The observation was made in a mixed herbaceous-shrub successional stand established following oil field and agricultural activity which includes seaside goldenrod, eastern baccharis, some occasional southern dewberry, Brazilian vervain and waxmyrtle. To the west, woody vegetation occurs along higher elevations

created from spoil material from ditching including pioneer species such as Chinese tallow and black willow. An occasional sugarcane individual was observed in the area remaining from previous agricultural use of this parcel. All of these species are healthy showing no indications of any kind of impacts or indicia of soil sodic properties. The herbaceous vegetation observed and root profile for this area as shown in Photos B-25 and B-26.

The root profile documented at Observation H-01 begins at the soil surface from 0.0 to 3.5 inch in depth with abundant root prevalence. From 3.5 inches to 5.0 inches bgs, the root density becomes common to sparse. The roots in this area were healthy, living, and showing no evidence of stress or impacts. Very sparse root abundance observed from 6.0 inches to 9.0 inches bgs. Soils were examined from 10.0 to 22.0 inches in depth with a root abundance of none, with only a few small, live root hairs between 10.0 to 14.0 inches bgs (Photos B-27 to B-28). Based on the investigation of the root profile, the ERZ was determined to be a depth of 5.0 inches bgs.

4.2.2 Observation H-02 – Sand spikerush (*Eleocharis montevidensis*) ERZ = 9.0”

A healthy stand of sand spikerush was selected for Observation H-02 (Photo B-29). This location is south of Observation H-01 in a similar mixed stand of successional vegetation. This species is commonly found in disturbed, open wetlands, wet pastures and wet grazed coastal prairies (USGS, 2022). The herbaceous vegetation observed and root profile for this area are shown in Photo B-30 and B-31.

The root profile documented at Observation H-02 begins at the soil surface from 0.0 to 2.0 inch in depth with very abundant root prevalence. The root density decreases to common from 3.0 inches to 7.0 inches bgs. Sparse root abundance was observed from 8.0 inches to 16.0 inches bgs. Additionally, soils were examined from 17.0 to 25.0 inches in depth with root prevalence of none *or* no observable roots present (Photos B-32 to B-33). The roots in this area were healthy, living and showing no evidence of stress or impacts. Dead roots, not associated with the subject specimen, were observed from 11.0 inches to 16.0 inches below ground surface that is typical of accretion or burial by land leveling operations. Based on the investigation of the root profile, the ERZ was determined to be a depth of 9.0 inches below ground surface for this sample plot.

4.2.3 Observation H-03 – Common rush (*Juncus effuses*) ERZ = 8.0”

Observation H-03 is a common rush specimen located north of H-02 on the Edgerly soil series (Figure 7). This area consists of robust vegetation of mixed herbaceous and shrub species similar to those listed in H-01. Similar to the previous herbaceous observations, H-03 is in an early ecological succession stage. Species observed include various grasses, seaside goldenrod, eastern baccharis, bushy bluestem and sugarcane plumegrass (*Saccharum giganteum*) with a healthy stand of common rush extending to the north. The herbaceous vegetation observed and root profile for this area are shown in Photo B-34 and B-35.

The root profile documented at Observation R-03 begins at the soil surface from 0.0 to 1.0 inch in depth with very abundant root prevalence. The root density becomes abundant at 2.0 inches and continues to 3.0 inches bgs. A common distribution of roots occurs from 4.0 inches to 7.0 inches bgs. At a depth of 8.0 inches to 10.0 inches the root distribution is sparse with few live roots present. The root density becomes very sparse to none between 11.0 to 17.0 inches bgs. Soils were examined from 18.0 to 24.0 inches in depth with root prevalence of none or no observable roots present (Photos B-36 to B-39). The roots in this area were healthy, living, and showing no evidence of stress or impacts. Dead roots, not associated with the subject specimen,

were observed from 9.5 inches to 17.0 inches below ground surface that is typical of accretion or burial from land leveling. Based on the investigation of the root profile, the ERZ was determined to be a depth of 8.0 inches below ground surface.

4.2.4 Observation H-04 – Sugarcane plumegrass (*Saccharum giganteum*) ERZ = 7.0”

Observation H-04 is a sugarcane plumegrass specimen located south of the former well pad area of VUA; Hayes U1 (SN206344) on the Edgerly soil series (Figure 7). This area also consists of robust vegetation of mixed herbaceous and shrub species in an early ecological succession stage. Species observed at this location were similar in composition to other herbaceous observation locations in this study. The herbaceous vegetation observed and root profile for this area are shown in Photo B-39 to B-41.

The root profile documented at Observation H-04 begins at the soil surface from 0.0 to 2.0 inch in depth with very abundant root prevalence. The root density becomes abundant from 3.0 inches to 6.0 inches bgs. A common distribution of roots occurs from 5.0 inches to 6.0 inches bgs. A very sparse distribution of roots was observed from 7.0 inches to 12.0 inches bgs. Soils were examined from 13.0 to 21.0 inches in depth with root prevalence of none or no observable roots present (Photos B-42 to B-44). The roots in this area were healthy, living, and showing no evidence of stress or impacts. Dead roots, not associated with the subject specimen, were observed from 7.0 inches to 12.0 inches below ground surface. Based on the investigation of the root profile, the ERZ was determined to be a depth of 7.0 inches below ground surface.

4.3 TREE OBSERVATIONS

A selection of three tree specimens were observed representing a selection of dominant plants on the subject property. The trees were located in a stand in the central portion of the property, immediately south of S Ward Line Road. A detailed description of each observation is presented in subsequent sections of this report.

4.3.1 Observation T-01 – Red Maple (*Acer rubrum* var. *drummondii*) ERZ = 8.0”

Observation T-01 is a red maple in excellent condition with no evidence of dieback or stress from oil and gas E&P operations or damage from recent hurricanes. The area includes second growth timber consisting of red maple, Chinese tallow, sweetgum and sugarberry. The understory consists of reproduction of the overstory, possumhaw, waxmyrtle, eastern baccharis, narrow plumegrass (*Saccharum baldwinii*), southern dewberry, sugarcane plumegrass and several species of *Cyperus* spp. The general area at this observation location appears to receive significant inundation during the year as evident by water marks and moss lines approximately six to eight inches on the trees. The stand is showing some evidence of stress from water such as adventitious branching along the trunks.

A majority of the leaves of T-01 were remaining in the crown with only some minor evidence of autumnal abscission or leaf drop (Photo B-45). T-01 has a diameter at breast height (DBH) of 10.19 inches (Photo B-46). A diagram depicting the eight major roots branching from the bole of the tree is presented in Attachment C (Page C-10). All observed roots were healthy and varied in length from 56 inches (Root No. 6) to 178 inches (Root No. 8c). The root system was shallow, occurring in the upper six inches of the soil profile with the deepest root measured 10.5 inches bgs (Root No. 1D) (Photos B-47 to B-48). Based on the distribution of the roots at this site, an ERZ of 8.0 inches would be generous for this tree.

4.3.2 Observation T-02 – Sweetgum (*Liquidambar styraciflua*) ERZ = 10.0”

Observation T-02 is a sweetgum in excellent condition with no evidence of dieback, bark sloughing, or stress from oil and gas E&P operations or damage from recent hurricanes. The observation was made in the same second growth timber as Observation T-01 with similar vegetation. Photos B-49 and B-50 show the general area at this observation location which appears to receive significant inundation during the year as evident by water marks and moss lines approximately 6 to 8 inches on the trees. The stand is showing some evidence of stress from the water such as adventitious branching along the trunks with some evidence of dieback in the top of trees in the area. Additionally, some trees in the general area appear to have been affected by recent hurricane activity.

T-02 has a DBH of 11.78 inches (Photos B-51 to B-52) and eight major roots extending laterally from the bole of the tree. A diagram depicting the major roots is presented in Attachment C (Page C-12). All observed roots were healthy and varied in length from 64 inches (Root No. 3d) to 182 inches (Root No. 3a). The root system was shallow with the deepest root measured being 18.5 inches bgs (Root No. 7) (Photos B-53 to B-56). Based on the distribution of the roots at this site, an ERZ of 10.0 inches would be generous for this tree.

4.3.2 Observation T-03 – Chinese tallow (*Triadica sebifera*) ERZ = 10.0”

Although Chinese tallow is a known invasive species, a specimen was observed to ascertain the rooting depth of dominant vegetation currently located on site. The Observation T-03 is in excellent condition with no impact observed from oil and gas E&P or hurricane activity. The area surrounding the observation was very wet with and consisted of smaller sugarberries water oak, possumhaw, sedge (*Carex* sp.), manyflower marshpennywort (*Hydrocotyle umbellata*), smartweed, red maple, sweetgum, persimmon blackberry (*Rubus* sp.), dwarf palmetto and dogwood (*Cornus* sp.).

T-03 has a DBH of 12.10 inches (Photos B-57 and B-58) and seven major roots extending laterally from the bole of the tree. A diagram depicting the major roots is presented in Attachment C (Page C-14). All observed roots were healthy and varied in length from 66 inches (Root No. 6d) to 142 inches (Root No. 5b). The root system was shallow with the deepest root measured being 9.0 inches bgs (Root No. 1) (Photos B-59 to B-62). Based on the distribution of the roots at this site, an ERZ of 10.0 inches would be generous for this tree.

Table 4.1. Effective Root Zone (ERZ) of plant species

Site ID	Common Name	*Scientific Name*	ERZ (in)
R-01	Rice	*Oryza sativa*	6.0
R-02	Rice	*Oryza sativa*	5.5
R-03	Rice	*Oryza sativa*	5.0
R-04	Rice	*Oryza sativa*	5.0
R-05	Rice	*Oryza sativa*	7.0
H-01	Bushy bluestem	*Andropogon glomeratus*	5.0
H-02	Sand spikerush	*Eleocharis montevidensis*	9.0
H-03	Common rush	*Juncus effuses*	8.0
H-04	Sugarcane plumegrass	*Saccharum giganteum*	7.0

T-01	Red maple	*Acer rubrum var. drummondii*	8.0
T-02	Sweetgum	*Liquidambar styraciflua*	10.0
T-03	Chinese tallow	*Triadica sebifera*	10.0

5.0 DISCUSSION

Even though the rice had been cut and stubble was visible, some regrowth and small spots not combined was growing in a typical fashion to many of the areas that we have investigated in surrounding parts of south Louisiana. As shown in the root studies for the rice stands in Table 4.1, the ERZs of the five stands that were observed (R-01 to R-05) showed very shallow root zones ranging from 5.0 to 7.0 inches in depth. These figures match very closely with all of the areas that the authors have investigated in surrounding areas. All of the roots were healthy with no sign of impacts from sodicity factors or petroleum hydrocarbons. The soils on which the rice are growing on the Henning property are very suitable for growing rice due to the heavier clays that are found in the soil profile.

The herbaceous observation areas were located in sites that were previously farmed but allowed to go fallow for the past few years. As shown in Table 4.1, herbaceous plant species showed a range of 5 to 9 inches for ERZs at these locations and generally coincided with the findings for the cropped areas that were growing rice. All of the roots were healthy with no sign of impacts from sodicity factors or petroleum hydrocarbons. Many of these sites over the property have numerous wetland species that are growing in these areas that were previously cropped. The growth of the four species that were chosen for investigation showed excellent stands that were healthy and growing in a typical fashion to those for the soil types in south Louisiana where oil production has not occurred. As we have noted in other areas of prairie terraces of south Louisiana, little variation in root depth was noted for the different soil types.

The three trees that were investigated (T-01 to T-03) all showed very shallow root systems that were very close to the soil surface with roots in a few spots extending to shallow depths. The ERZs for these trees ranged from 6 to 10 inches in depth with the overwhelming majority of the roots occurring within the first 4 to 5 inches of the soil. All of the roots were healthy with no sign of impacts from sodicity factors or petroleum hydrocarbons. In general all of the trees were in good condition except that they had suffered from some loss of limbs from a recent hurricane. Like the rice stands that we have investigated over much of Louisiana, these tree root depths were typical of the shallow rooting trees that we have found over the prairie terrace soils of the types found on the Henning property.

Based on the effective root zones and the conditions of the soils on the Henning property and the high water table in the areas, if any soil remediation is necessary, depths should not exceed 12 inches for any of the sites that were investigated on the property.

6.0 OPINIONS AND CONCLUSIONS

a. Extensive reviews of the vegetative communities across the Henning property in the study area showed healthy stands of vegetation that are not experiencing any observed impacts from the historical oil and gas E&P activities that have occurred on the property. No sodicity factors or petroleum hydrocarbon impacts were noted for any of the vegetation.

b. Study of the rice growing on the property was typical for that of soils on the prairie terraces of Louisiana and showed very shallow effective root zones. These root zones were commensurate with other rice stands from surrounding study areas.

c. Data from the root studies also show that the three tree species growing on the tract have shallow rooting depths very similar to the agricultural crops and herbaceous species that are growing on the property.

d. Many of the soils on the Henning property exhibited saturation at shallow depths indicating a shallow water table and saturated zones at shallow depth through the soil profile. This is a naturally occurring phenomenon as typical of the soils with shallow clay pans that are excellent for growing rice.

e. Effective root zones for all of the observed plants were very shallow with no effective root zone extending past 10 inches with most of the root zones on all of the species investigated occurring within the first 5 to 6 inches of the soil surface. From the detail investigations presented herein, all plants that are growing within the study area have very shallow root systems. If required, remediation levels to a depth of 12 inches for trees, crops and herbaceous plants that are growing in the area is a generous depth and is site specific for the soil types that occur on the Henning property.

f. Even if E&P constituents are found at greater depths than 12 inches, remediation below the effective root zone cited in this report would be pointless with regard to vegetative sustainably for growth and reproduction.

In December 2021, Holloway Environmental and ERM conducted an Effective Root Zone study of the Henning Management, LLC property. The scope of this study was to document and ascertain, in the best professional judgement the depth of the ERZ for vegetation occurring on the property. The study determined the vegetation within the Henning Property shows healthy stands that are not experiencing observed impacts from the historical oil and gas E&P activity. Observations made from five rice, four herbaceous and three tree specimens show shallow rooting depths. Based on the results of this ERZ study, if required, soil remediation treatment to a depth of 12 inches would be appropriate for the potential future use of the property.

Holloway Environmental 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. The authors of this report reserve the right to supplement and/or amend this report should additional information become available.

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7.0 REFERENCES

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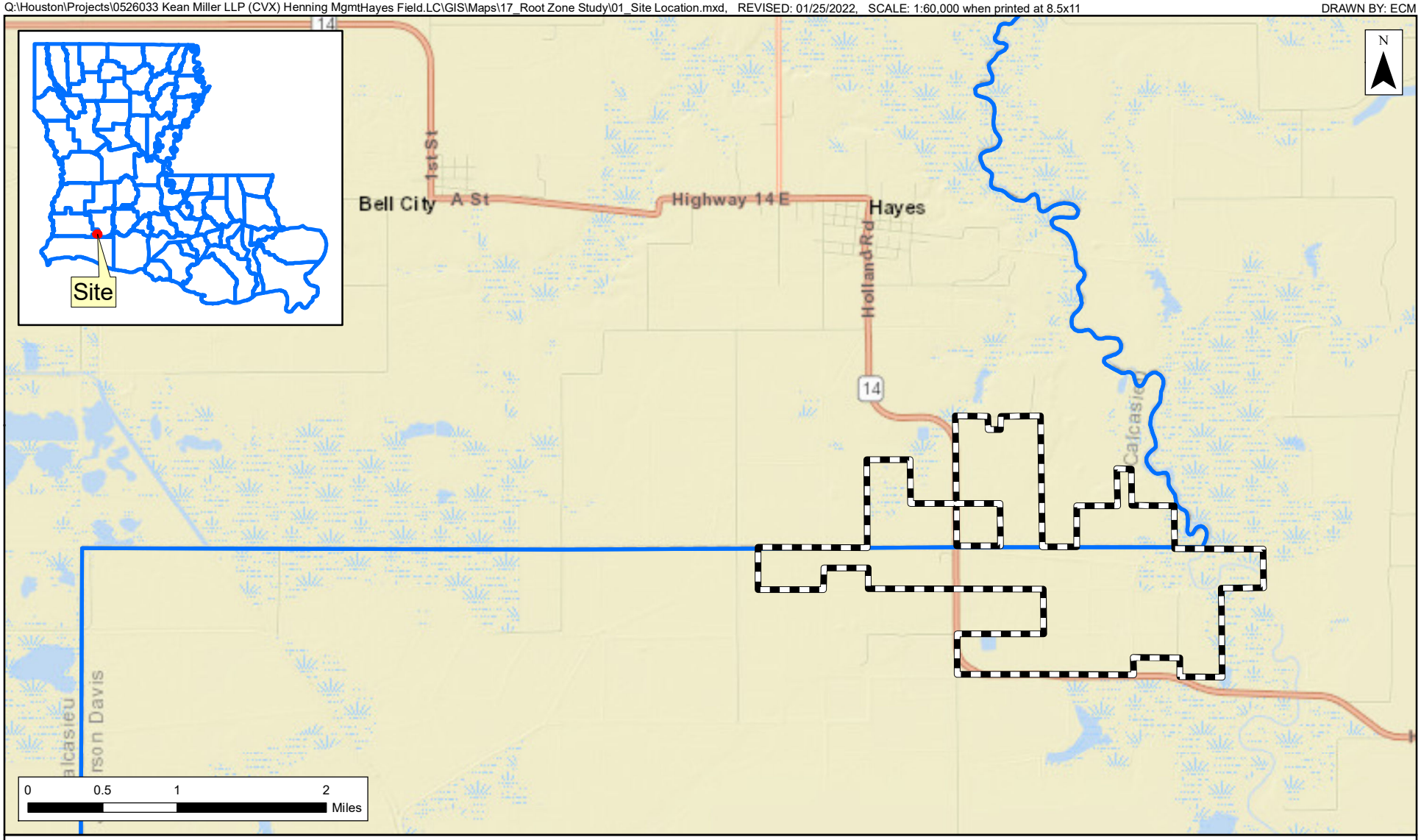
Review of Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
Parishes of Calcasieu and Jefferson Davis, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix A
Figures

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
State of Louisiana

Q:\Houston\Projects\0526033 Kean Miller LLP (CVX) Henning MgmtHayes Field.LC\GIS\Maps\17_Root Zone Study\01_Site Location.mxd, REVISED: 01/25/2022, SCALE: 1:60,000 when printed at 8.5x11 DRAWN BY: ECM



Property
Parish Boundary

Notes:
World Street Basemap via ArcGIS Online.

Figure 1
Site Location
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

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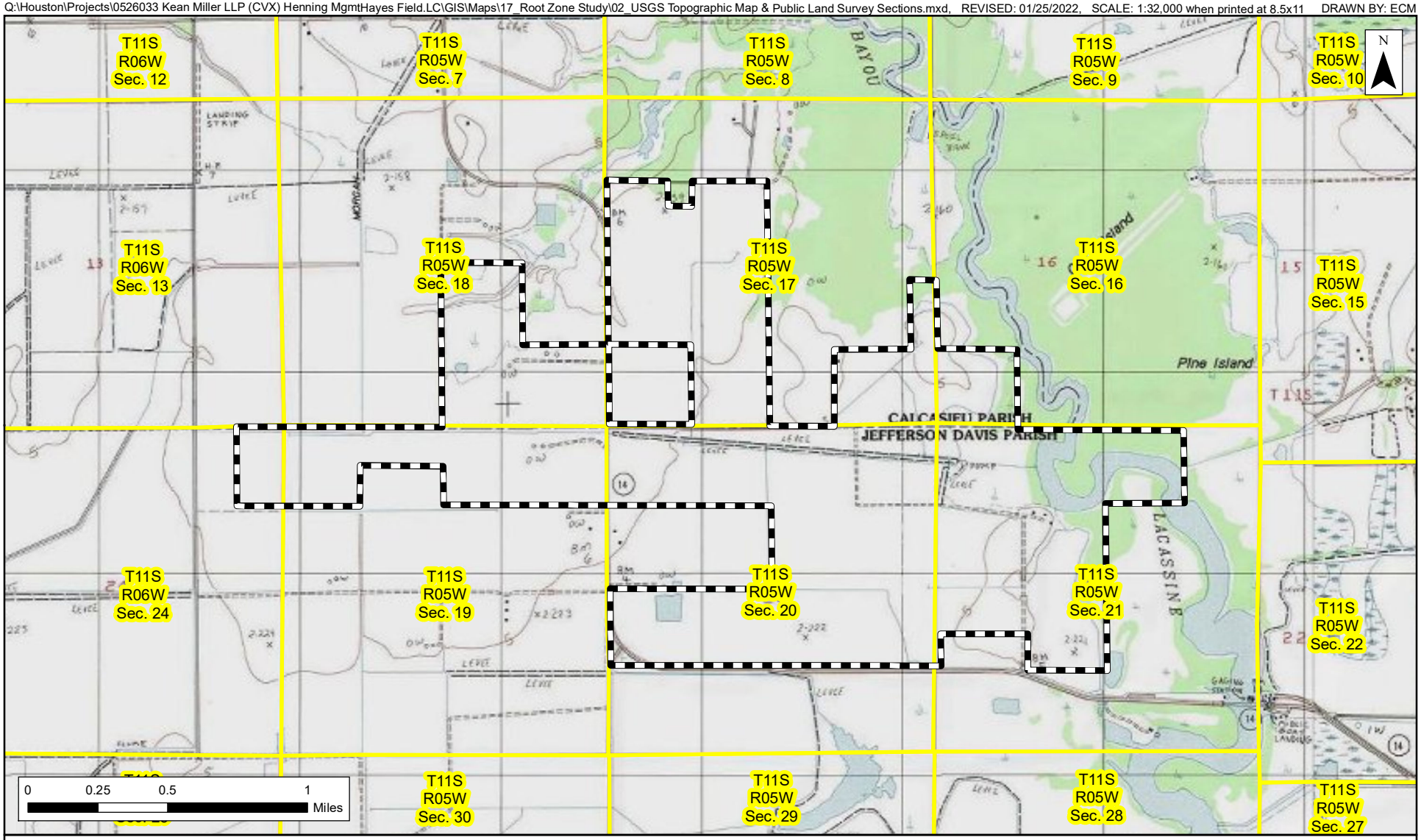

Property
Public Land Survey Sections

Notes:
USGS Topographic Map via ArcGIS Online.

Figure 2
USGS Topographic Map & Public Land Survey Sections
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

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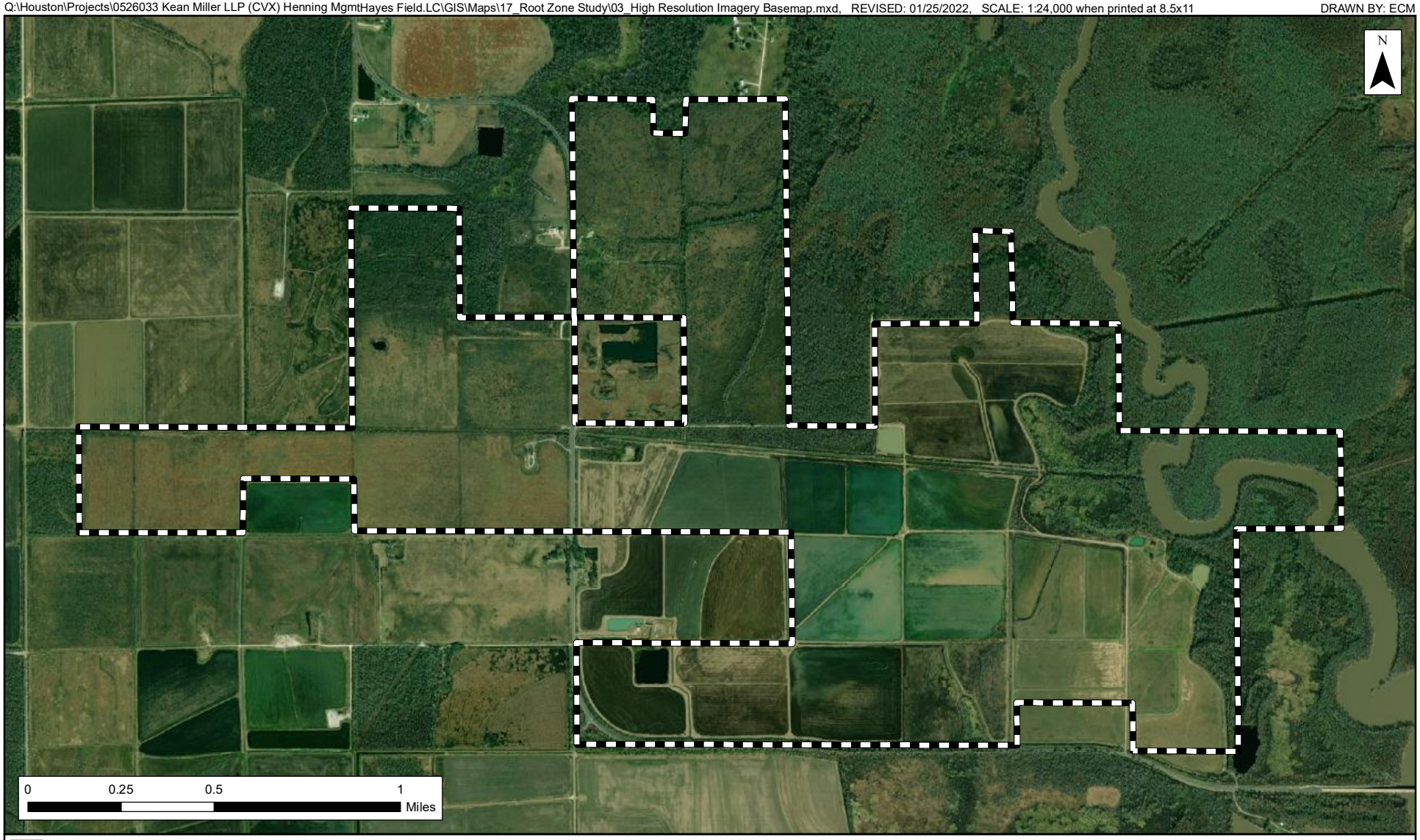


Property

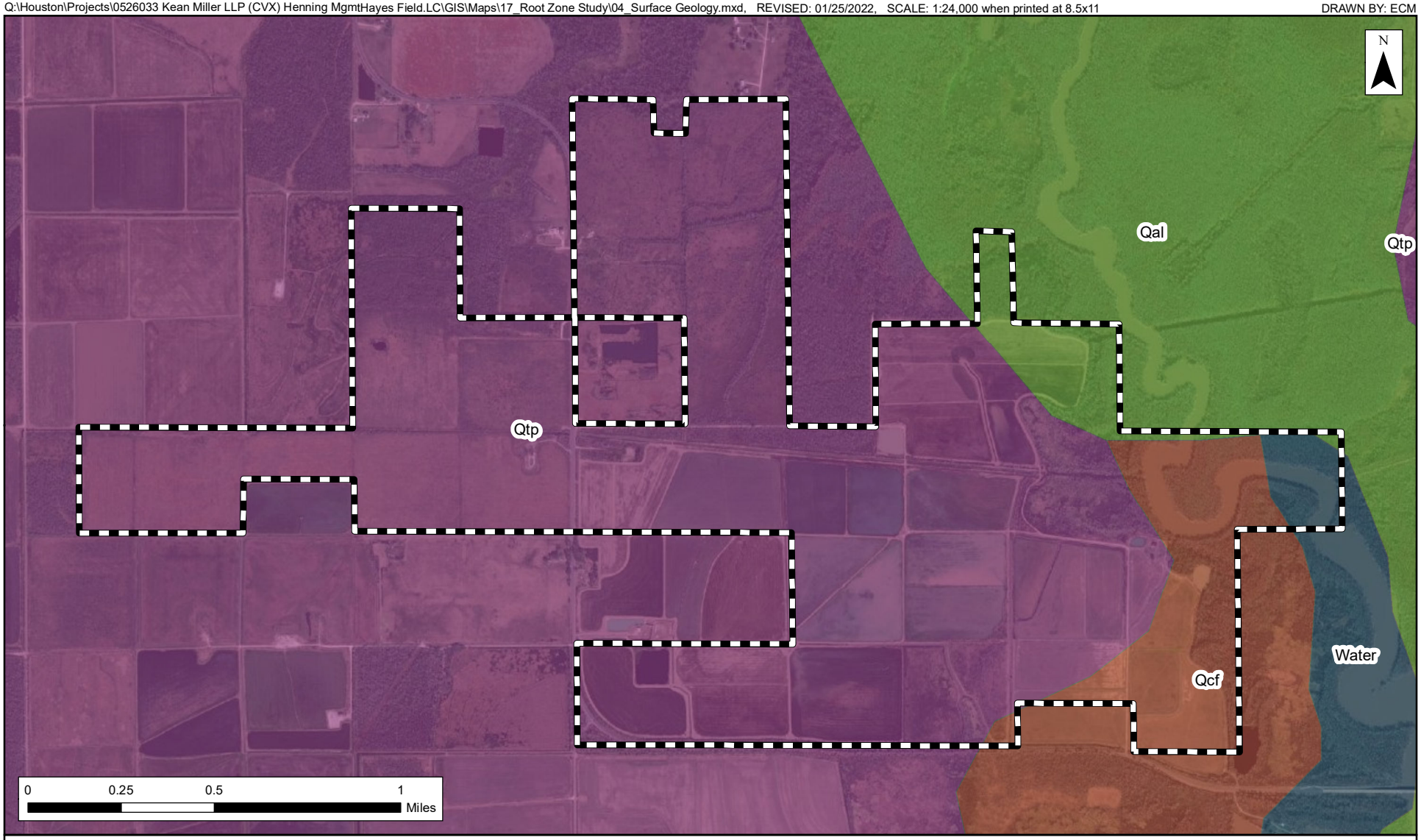
Notes:
Imagery Basemap via ArcGIS Online.

Figure 3
High Resolution Imagery Basemap
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

Q:\Houston\Projects\0526033 Kean Miller LLP (CVX) Henning MgmtHayes Field.LC\GIS\Maps\17_Root Zone Study\04_Surface Geology.mxd, REVISED: 01/25/2022, SCALE: 1:24,000 when printed at 8.5x11 DRAWN BY: ECM



Property
Qal - Alluvium
Qcf - Chenier Plain, Fresh Marsh
Qtp - Prairie Terraces
Water

Notes:
Imagery Basemap via ArcGIS Online.

Figure 4
Surface Geology
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

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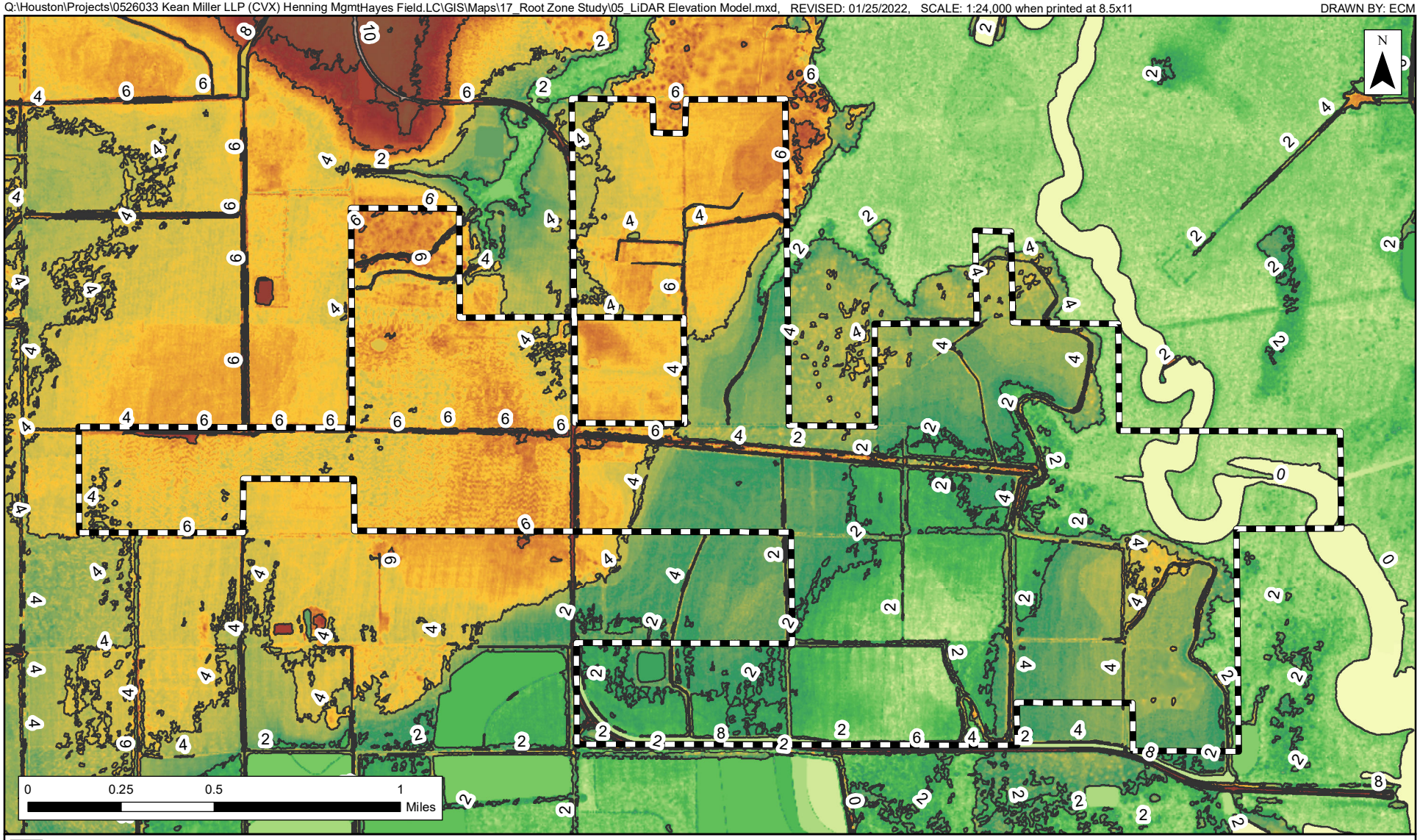

Property
LiDAR Elevation Contour

Lower Elevation — Higher Elevation

Notes:
Elevation model based on LiDAR data from LSU Atlas (http://atlas.lsu.edu/).

Figure 5
LiDAR Elevation Model
Henning Management, L.L.C. v. Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

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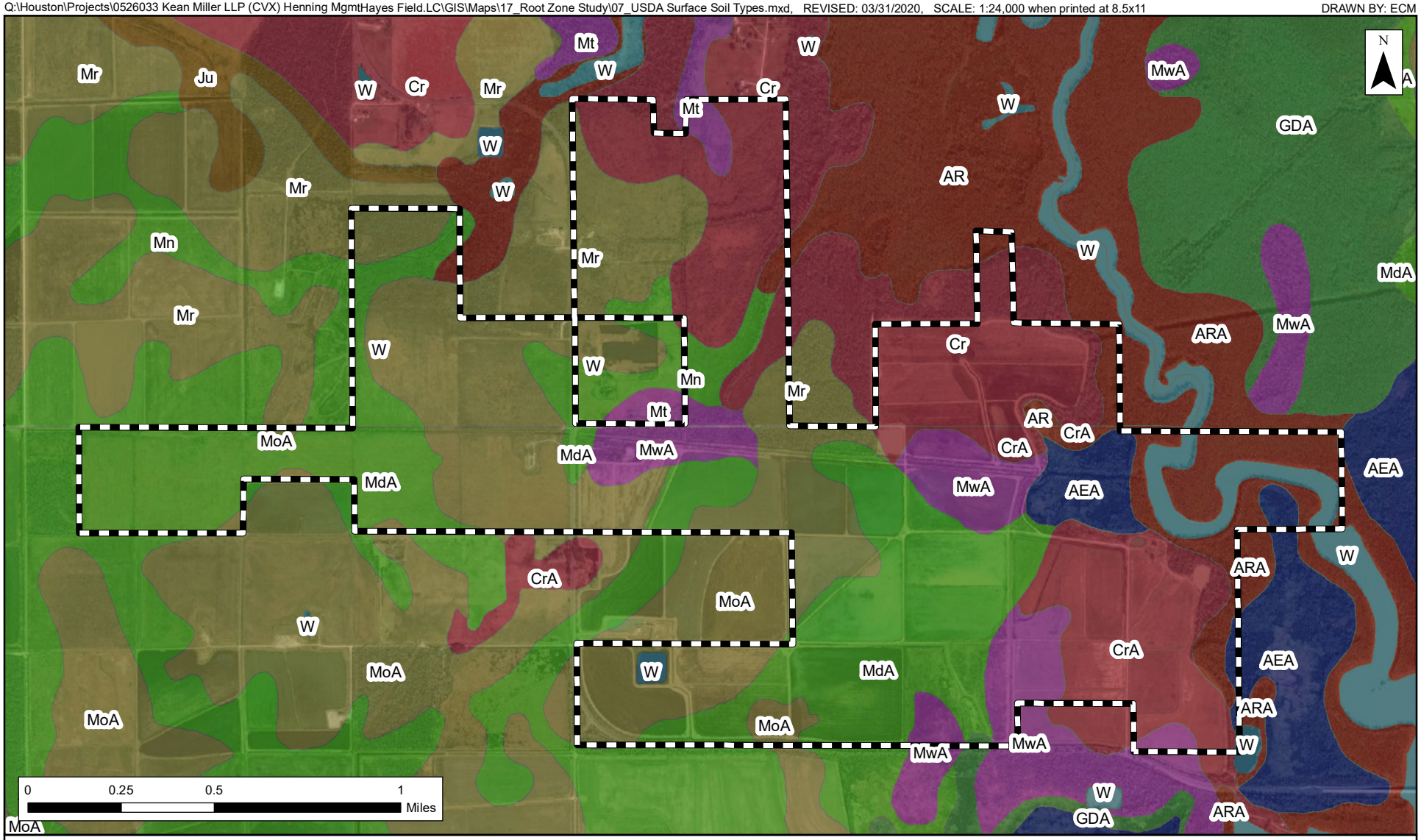

Property
AEA - Allemands muck, 0 to 0.2 percent slopes, very frequently flooded
ARA, AR - Arat mucky silt
CrA, Cr - Crowley-Vidrine complex, 0 to 1 percent slopes
GDA - Ged clay
JdA, Ju - Judice silty clay, 0 to 1 percent slopes, rarely flooded
MdA, Mn - Midland silty clay loam, 0 to 1 percent slopes, rarely flooded
MoA, Mr - Edgerly loam, 0 to 1 percent slopes, rarely flooded
Mt, MwA - Mowata-Vidrine complex, 0 to 1 percent slopes, rarely flooded
W -Water

Notes:
1- Soil data via the USDA Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx).
2- Imagery Basemap via ArcGIS Online.

Figure 6
USDA Surface Soil Types
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
(318) 744-5638

Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

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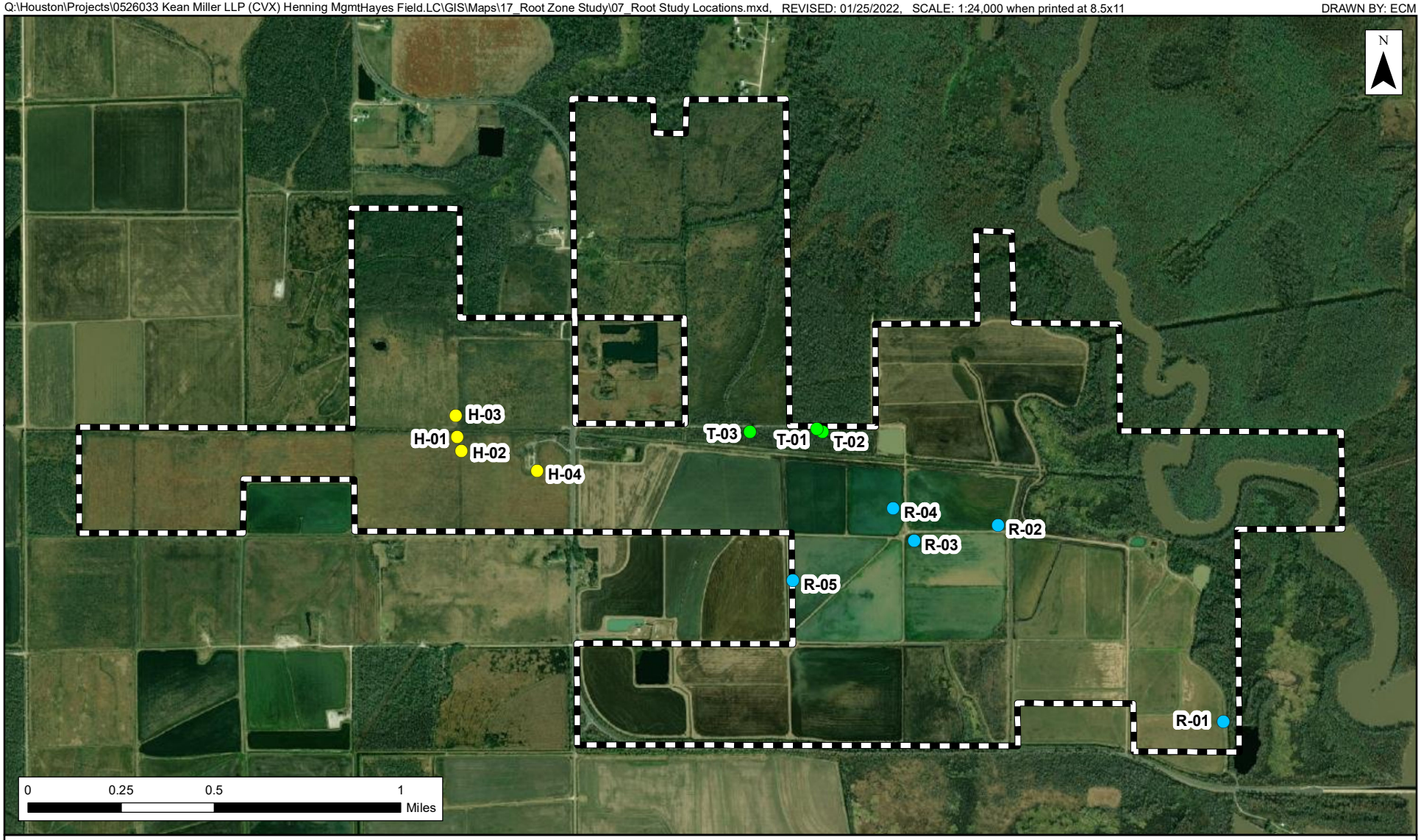

Root Zone Study Locations

- Herbaceous
- Rice
- Tree
- Property

Notes:
1- Imagery Basemap via ArcGIS Online.

Figure 7
Root Study Locations
Henning Management, L.L.C. v.
Chevron U.S.A. Inc., et al.
Hayes Oil & Gas Field
Calcasieu and Jefferson Davis Parishes, Louisiana

Holloway Environmental Services, Inc.
9269 Hwy 124
Harrisonburg, LA 71340
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Source: Esri - ArcGIS Online; WGS 1984 Web Mercator Auxiliary Sphere

Review of Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
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Luther F. Holloway
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Appendix B
Photographs

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
State of Louisiana

Photo B-1. Rice stubble and part of soil profile at R-01.

Photo B-2. Soil profile at 4 to 8 inches at R-01.

Photo B-3. Soil profile at R-01, 7 to 11 inches.

Photo B-4. Soil profile at R-02, 11 to 16 inches.

Photo B-5. Soil profile at R-01, 16 to 20 inches.

Photo B-6. Soil profile at R-01, 20 to 25 inches.

Photo B-7. Stubble and soil profile from surface to 9 inches at R-02.

Photo B-8. Soil profile from 7 to 15 inches at R-02.

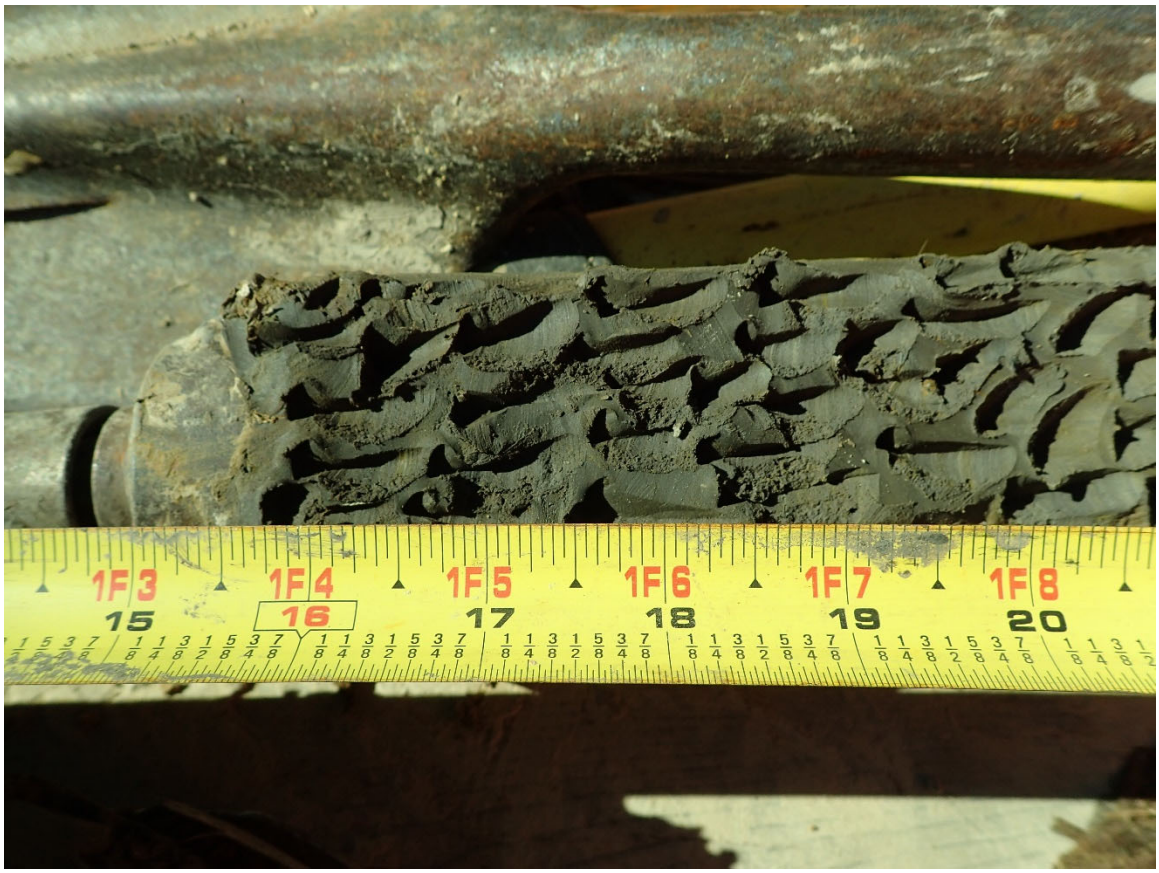


Photo B-9. Soil profile at R-02, 15 to 20 inches.

Photo B-10. Soil profile at R-02, 20 to 25 inches.

Photo B-11. Rice stubble and profile on R-03 to 10 inches.

Photo B-12. Profile at R-03, 5 to 16 inches.

Photo B-13. Soil profile at R-03, 15 to 21 inches.

Photo B-14. Soil profile at R-03, 17 to 24 inches.

Photo B-15. Rice stubble and profile at R-04.

Photo B-16. Soil profile at R-04, 5 to 12 inches.

Photo B-17. Soil profile at R-04, 8 to 17 inches.

Photo B-18. Soil profile at R-04, 17 to 22 inches.

Photo B-19. Soil profile at R-04, 20 to 27 inches.

Photo B-20. Rice stubble and profile at R-05.

Photo B-21. Profile at R-05, 6 to 13 inches.

Photo B-22. Profile at R-05, 13 to 19 inches.

Photo B-23. Soil profile at R-05, 18 to 24 inches.

Photo B-24. Stand of bushy bluestem at observation H-01.

Photo B-25. Root profile at H-01.

Photo B-26. Profile at H-01, 5 to 11 inches.

Photo B-27. Profile at H-01, 12 to 19 inches.

Photo B-28. Profile at H-01, 15 to 22 inches.

Photo B-29. Stand of sand spikerush at H-02.

Photo B-30. Profile of H-02, surface to 9 inches.

Photo B-31. Profile of H-02, 9 to 17 inches.

Photo B-32. Profile of H-02, 17 to 22 inches.

Photo B-33. Profile of H-02, 20 to 25 inches.

Photo B-34. Vegetation facing north at H-03.

Photo B-35. Root distribution at H-03.

Photo B-36. Root distribution at H-03.

Photo B-37. Root distribution at H-03.

Photo B-38. Root distribution at H-03.

Photo B-39. Vegetation facing north at H-04.

Photo B-40. Vegetation facing south at H-04.

Photo B-41. Root distribution at H-04.

Photo B-42. Root distribution at H-04.

Photo B-43. Root distribution at H-04.

Photo B-44. Root distribution at H-04.

Photo B-45. Canopy of T-01.

Photo B-46. Bole of T-01.

Photo B-47. Root distribution at T-01.

Photo B-48. Root distribution at T-01.

Photo B-49. Area surrounding T-02 facing north.

Photo B-50. Area surrounding T-02 facing west.

Photo B-51. Canopy of T-02.

Photo B-52. Bole of T-02.

Photo B-53. Root distribution facing north at T-02.

Photo B-54. Root distribution facing east at T-02.

Photo B-55. Root distribution at T-02 facing west.

Photo B-56. Root #7, the deepest root at T-02.

Photo B-57. Canopy of T-03.

Photo B-58. Bole of T-03.

Photo B-59. Root distribution at T-03.

Photo B-60. Root distribution at T-03.

Photo B-61. Root distribution at T-03.

Photo B-62. Root distribution at T-03.

Review of Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
Parishes of Calcasieu and Jefferson Davis, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix C
Root Data Forms

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
State of Louisiana

Date: 11/30/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **R-01**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 21.2" N 92° 53' 11.0" W

Notes: Dry field - no surface water. Rice cut - approx. 4" in height. Few dead roots @ 6.8"

Species: Rice (*Oryza sativa*) **ERZ:** 6"

Depth (In)	Abundance of Roots
0	Very Abundant
1	Very Abundant
2	Abundant
3	Abundant
3.5	Common
4	Common
5	Common
6	Very Sparse to Dotted
7	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
25	None

Date: 11/30/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **R-02**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 45.0" N 92° 53' 42.5" W

Notes: Dry field, recently cut 4-6" stubble. Several dead roots observed between 4-5".

Species: Rice (*Oryza sativa*) **ERZ:** 5.5"

Depth (In)	Abundance of Roots
0	Very Abundant
0.5	Very Abundant
1	Very Abundant
1.5	Abundant
2	Abundant
3	Abundant
4	Common to Sparse
5	Common to Sparse
6	Sparse to Very Sparse
7	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
25	None

Date: 11/30/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **R-03**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 43.1" N 92° 53' 54.2" W

Notes: Field drained - no surface water. Rice stubble ~4-6". Recently cut.

Species: Rice (*Oryza sativa*) **ERZ:** 5"

Depth (In)	Abundance of Roots
0	Very Abundant
1	Very Abundant
2	Abundant
2.5	Abundant
3	Abundant
4	Common
4.5	Common
5	Sparse to Very Sparse
6	Sparse to Very Sparse
7	Sparse to Very Sparse
7.5	Sparse to Very Sparse
8	Sparse to Very Sparse
9	Very Sparse to None
10	Very Sparse to 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: 11/30/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **R-04**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 47.0" N 92° 53' 57.1" W

Notes: Field drained - no surface water. Rice cut - stubble 4-6" in height.

Species: Rice (*Oryza sativa*) **ERZ:** 5"

Depth (In)	Abundance of Roots
0	Very Abundant
1	Very Abundant
2	Abundant to Common
3	Abundant to Common
3.5	Abundant to Common
4	Abundant to Common
5	Few Dotted Dead Roots
6	Few Dotted Dead Roots
7	Few Dotted Dead Roots
8	Few Dotted Dead Roots
9	Few Dotted Dead Roots
10	Few Dotted Dead Roots
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
25	None
26	None
27	None

Date: 12/1/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **R-05**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 38.3" N 92° 54' 11.1" W

Notes: Cut rice field. Stubble 4-6". ~1" of surface water in depressions/ruts.

Species: Rice (*Oryza sativa*) **ERZ:** 7"

Depth (In)	Abundance of Roots
0	Very Abundant
1	Very Abundant
2	Abundant to Common
3	Abundant to Common
4	Abundant to Common
5	Common to Sparse
6	Common to Sparse
7	Common to Sparse
8	Common to Sparse
9	Common to Sparse
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: 12/1/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-01**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 55.6" N 92° 54' 58.0" W

Notes: Fallow field. Mixed species dominated by broomsedge.

Species: Bushy bluestem (*Andropogon glomeratus*) **ERZ:** 5"

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

Date: 12/1/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-02**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 53.9" N 92° 54' 57.4" W

Notes: Dead roots observed from 11-16".

Species: Sand Spikerush (*Eleocharis montevidensis*) **ERZ:** 9"

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

Date: 12/2/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-03**

Property: Henning Management - Hayes Field

Geographic Coordinates: 30° 04' 58.2" N 92° 54' 58.2" W

Notes: Many dead roots from 9.5" to 17".

Species: Common rush (*Juncus effusus*) **ERZ:** 8"

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

Date: 12/3/2021 **By:** L.F. Holloway & P.M. Ritchie **Observation ID:** **H-04**

Property: Henning Mngmt Hayes Field

Geographic Coordinates: 30° 04' 51.6" N 92° 54' 46.8" W

Notes: Observed many dead roots from 7-12".

Species: Sugarcane Plumegrass (*Saccharum giganteum)* **ERZ:** 7"

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

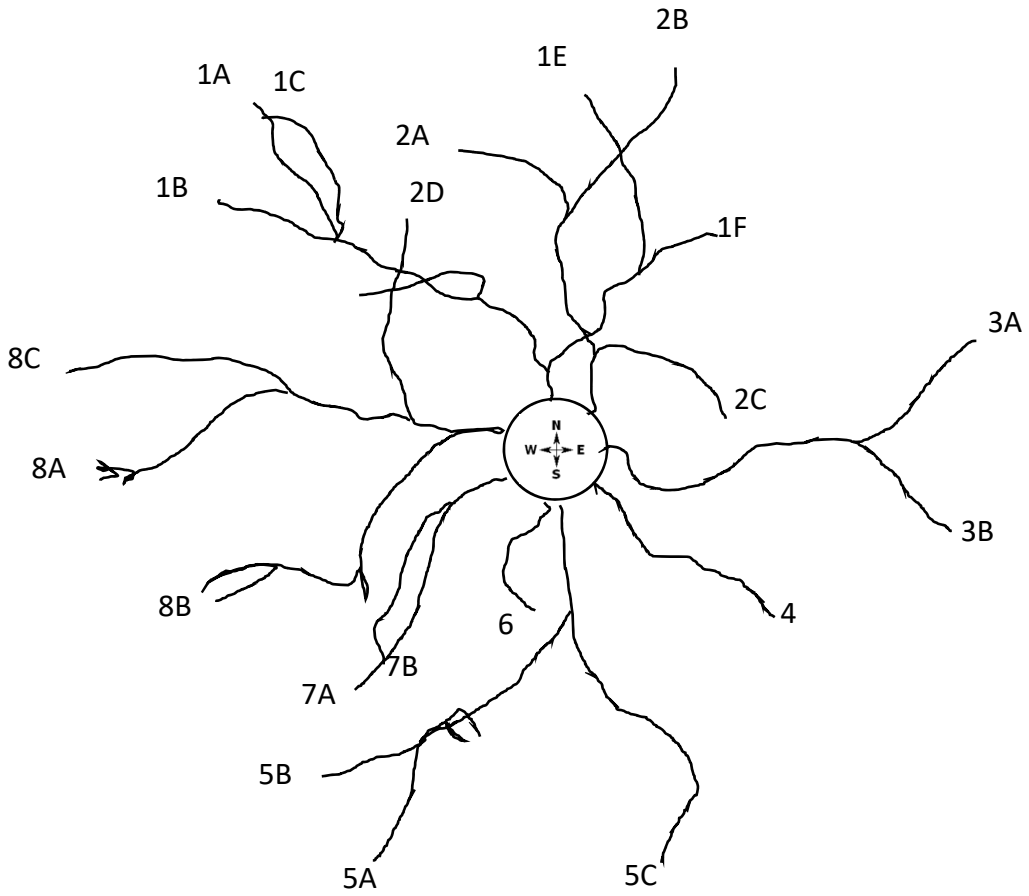
Date: 12/1/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-01**

Property: Henning Management Hayes Field

Geographic Coordinates: N 30° 04’ 56.3” W 92° 54’ 07.0”

Other Information:

Species: Red Maple (*Acer rubrum*)	Circ.= 32” DBH = 10.19”



*Not to scale

Date: 12/1/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-01**
Property: Henning Management Hayes Field		
Geographic Coordinates: N 30° 04’ 56.3” W 92° 54’ 07.0”		
Species: Red Maple (*Acer rubrum*)	Circ.= 32” DBH = 10.19”	

Root No.	Total Length	Depth In. Top	Depth In. Bottom	Depth Distance
1A	99”			
1B	86”			
1C	90”			
1D	63”		10.5”	50”
1E	93”			
1F	57”			
2A	73”			
2B	84”			
2C	59”			
3A	126”			
3B	72”		8”	72”
4	58.5”			
5A	97”			
5B	117”			
6	56”			
7A	76”			
7B	74”			
8A	119”			
8B	136”			
8C	178”			
8D	57”			

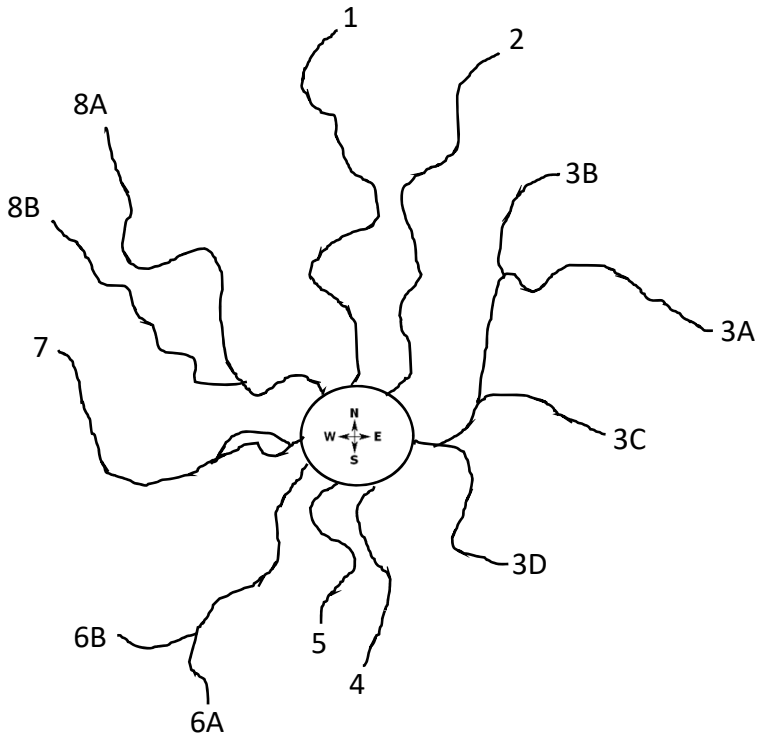
Date: 12/2/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-02**

Property: Henning Management Hayes Field

Geographic Coordinates: N 30° 04’ 56.6” W 92° 54’ 07.8”

Other Information:

Species:Sweet-gum (*Liquidambar styraciflua*)	Circ.= 37” DBH = 11.78”



*Not to scale

Date: 12/1/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-02**
Property: Henning Management Hayes Field		
Geographic Coordinates: N 30° 04’ 56.6” W 92° 54’ 07.8”		
Species:Sweet-gum (*Liquidambar styraciflua*)	Circ.= 37” DBH = 11.78”	

Root No.	Total Length	Depth In. Top	Depth In. Bottom	Depth Distance
1	139”	7”	9.5”	72”
2	147”	2”	4”	71”
3B	148”	8.5”	9.5”	148”
3A	182”			
3C	76”			
3D	64”			
4	89”			
5	91”			
6A	119”			
6B	117”			
7	168”	17”	18.5”	141”
8B	138”			
8A	152”	3”	3.5”	96”

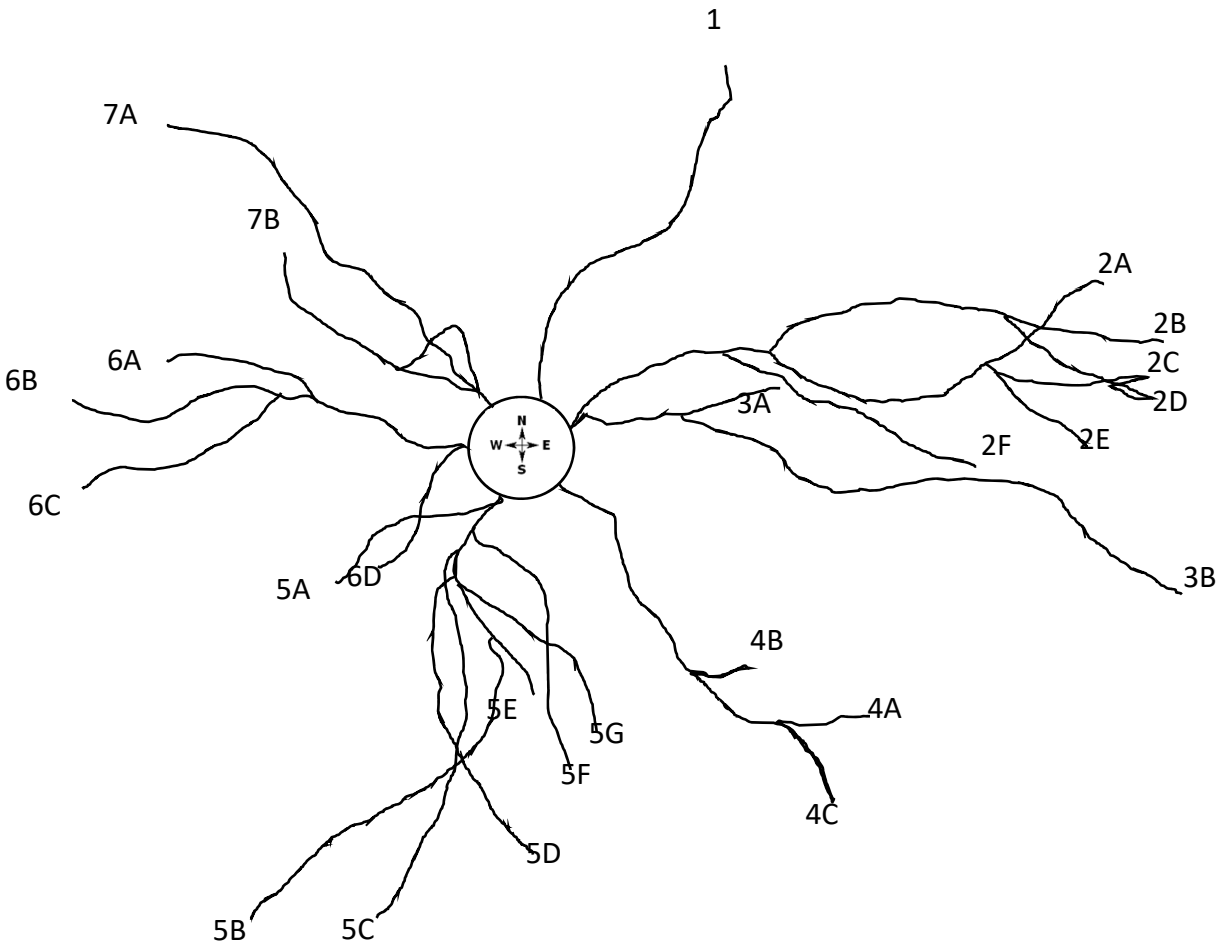
Date: 12/3/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-03**

Property: Henning Management Hayes Field

Geographic Coordinates: N 30° 04’ 56.3” W 92° 54’ 17.1”

Other Information:

Species: Chinese Tallow (*Triadica sebifera)*	Circ.= 38” DBH = 12.10”



*Not to scale

Date: 12/3/2021	By: L.F. Holloway & P.M. Ritchie	Observation ID: **T-03**
Property: Henning Management Hayes Field		
Geographic Coordinates: N 30° 04’ 56.3” W 92° 54’ 17.1”		
Species: Chinese Tallow (*Triadica sebifera)*	Circ.= 38” DBH = 12.10”	

Root No.	Total Length	Depth In. Top	Depth In. Bottom	Depth Distance
1	118”	9”		86”
2A	124”	5.5”	8.5”	112”
2B	128”			
2C	130”			
2D	125”			
2E	126”			
2F	117”			
3A	64”			
3B	134”	4.5”		134”
4A	92”	6”	8.5”	52”
4B	78”			
4C	72”			
5F	115”			
5D	103”			
5C	135”			
5B	142”	6”	7”	120”
6A	100”			
6B	122”	4.5”	5.5”	79”
6C	94”			
6D	66”			
7A	104”	4”	6.5”	27”
7B	87”			

Review of Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
Parishes of Calcasieu and Jefferson Davis, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix D
Resume and Compensation Schedule of Luther F. Holloway

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
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 Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
Parishes of Calcasieu and Jefferson Davis, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix E
Testimony in Last Four+ Years

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
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 Vegetative Condition and Effective Root Zone Study
on the Henning Management, LLC Property in the
Parishes of Calcasieu and Jefferson Davis, Louisiana
Luther F. Holloway
Patrick M. Ritchie

Appendix F
Resume and Compensation Schedule of Patrick Ritchie

Henning Management LLC v. Chevron USA, Inc. et al.
Docket No. 73318 (Div. C)
31st Judicial District Court
Calcasieu and Jefferson Davis Parishes
State of Louisiana

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.

Patrick M. Ritchie, PWS

Senior Scientist
3009 41st Street
Metairie, LA 70001

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
- American Society of Agronomy - #729744
- UF Graduate Certification - Wetland and Water Resource Management (2014)
- NORM Radiation Safety Officer
- 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.

Patrick M. Ritchie, PWS

Summary of Education and Training

Mr. Patrick Ritchie is a professional wetland scientist 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.

Education

Colby Community College (1998-2000)

Associates of Science – Accounting and Business Administration

Relevant Coursework:

- Calculus
- General Chemistry

University of Nebraska at Kearney (2000-2001)

Non-degree – Major: Biology

Relevant Coursework:

- Botany
- Microbiology
- General Biology

Tulane University (2001-2005)

Bachelor of Science – Major: Ecology and Evolutionary Biology

Relevant Coursework:

- Ecology
- Plant Systematics
- Plants and Human Affairs
- Forestry and Policy
- Oceanography
- Genetics
- Statistics
- Chemistry I and II
- Organic Chemistry I and II

University of Florida – College of Agriculture and Life Sciences (2013-2015)

Master of Science – Major: Soil and Water Science

Graduate Certification – Wetland and Water Resource Management (2014)

Relevant Coursework:

- Environmental Biogeochemistry
- Soil Contamination and Remediation
- Soils for Environmental Professionals
- Hydric Soils
- Wetlands and Watershed Seminar
- Biogeochemistry of Wetlands and Aquatic Systems
- Wetland Water Quality
- Urban Soil and Water Systems

Professional Certification

Professional Wetland Scientist [PWS] (#2780)
Society of Wetland Scientist Professional Certification Program
Requirements:

- Fifteen (15) semester hours in biological sciences;
- Fifteen (15) semester hours in courses in soils, chemistry, hydrology, physics, geology, sedimentology, oceanography, coastal processes, environmental engineering, and similar courses;
- Six (6) semester hours in courses in math, computer sciences, basic statistics, population dynamics, experimental statistics, and similar courses;
- Fifteen (15) semester hours of specialized wetland course work;
- Requires a minimum of five (5) years of full-time professional experience. Experience must demonstrate the application of current technical knowledge to problems and programs dealing with wetland resources and activities;
- Statement of expertise essay that best describes areas of expertise in wetland science; and
- Earn a minimum of 10 certification renewal points during a five-year period from the time of certification.

PWS Recognized Areas of Expertise:

- Delineations (Wetlands and Waters)
- Functional and Ecological Assessments
- Mitigation/Restoration/Enhancement/Creation (Planning and/or Design)
- Aquatic Resources Construction Management
- Monitoring (Mitigation projects: wetlands and/or other)
- Botanical
- Hydric Soils
- Hydrology
- Water Quality/Chemistry
- Remote Sensing and Interpretation/Spatial/Mapping/Landscape
- GPS Technologies (Mapping, Delineations, and/or other applications)
- Regulatory and/or Advisory Agency/Policy Liaison
- Stream Channel Assessment/Classification for Natural Stream Channel Design
- Cowardin Area of Expertise – Palustrine
- Cowardin Area of Expertise – Lacustrine

Work Experience

High School Science Teacher/Wrestling Coach – Archbishop Rummel High School
Metairie, LA 2005 – 2007

- Environmental Science
- Physical Science

Wetland Scientist – The Shaw Group
Houma, LA Summer 2007 – Winter 2008

Monitored success of coastal restoration projects and wetland ecosystem health in the Atchafalaya, Terrebonne, and Barataria hydrologic basins. Collaborated with and received training in plant identification by Dr. Lowell E. Urbatsch with LSU.

Collected data for the three components of wetlands: vegetation, soil, and hydrology

- Soils: soil characteristics and sampling, vertical accretion using Feldspar plots and cryogenic cores, marsh elevation change using rod surface elevation table
- Hydrology: soil porewater sampling, submersible data logger
- Vegetation: emergent and forested vegetation identification, percent cover, species richness, DBH, stem count, canopy cover using densitometer, marsh mat thickness and vertical mat movement
- Water Quality: used multiparameter sonde to measure salinity, temperature, electrical conductivity, pH, water level

Project Manager/Staff Scientist – Michael Pisani & Associates
New Orleans, LA 2008 – 2019

Managed, planned, and executed all phases of environmental site investigation. Work included research, data management, wetland and ecological assessments, vegetation root analysis; soil, sediment, groundwater, surface water and biota sampling; directed drilling operations of hydraulic push and sonic rigs for the purpose of soil sampling and water well installation; wetland delineation and vegetation transect sampling; groundwater yield and classification; and NORM surveying and sampling.

Collaborated with and trained by:

- Mike Pisani
- Dave Angle
- Dave Upthegrove
- Dr. Helen Connelly
- Angela Levert
- Dr. John Rodgers
- Dr. Luther Holloway
- Dr. John Frazier
- Arville Touchet
- Lance Fontenot
- Jerry Daigle

Total projects: over 100 across LA and the Gulf Coast including TX and MS

Senior Scientist/Project Manager – ERM
Metairie, LA 2019 – 2020

Principal Consultant – ERM
Metairie, LA 2020 – Present

Responsible for client development and project management related to upstream, midstream, downstream, manufacturing, chemical production, and renewable energy. Responsible for project execution and agency coordination related to Sections 404/10, Threatened and Endangered Species, Coastal Zone Management, and Federal Energy Regulatory Commission (FERC) regulated natural gas and renewable energy projects. Provides litigation support for oil and gas field legacy sites.

Adjunct Professor – Tulane University
School of Science and Engineering
Department of Earth and Environmental Sciences
New Orleans, LA 2021 – Present

Effective Root Zone Study Experience

Collaborated with Dr. Holloway on 25 total projects over the last seven years. Recent examples include:

- H.C. Drew Manual Estate v. Neumin Production Company and Stokes & Spiehler, Inc., 14th JDC, Docket No. 2019-4925F, Calcasieu Parish, Louisiana – *Co-authored report with Dr. Holloway*
- Durel J. Romaine and Lawrence C. Romaine v. Freeport-McMorRan Oil and Gas et al., 15th JDC, Docket No. 108131, Vermilion Parish, Louisiana – *Co-authored report with Dr. Holloway*
- Jeanerette Lumber & Shingle Co. LLC v. ConocoPhillips Co, Alta Mesa Holdings, LP, Chevron USA, Apache Corp, and Texas Petroleum Investment Co., 16th JDC, Docket No. 134307, Iberia Parish, Louisiana – *Co-authored report with Dr. Holloway*
- Henning Management LLC v. Anadarko OGC Company, et al., 31st JDC, Docket No. C-791-13, Jefferson Davis Parish, Louisiana – *Authored post-litigation report (pending)*
- Kern Broussard v. Texaco Exploration and Production Inc. and Hilcorp Energy Company, et al., 15th JDC, Docket No. 83126, Vermilion Parish, Louisiana – *Authored Effective Root Zone Study section of a combined expert report*

Supported projects:

- Bowie Lumber Associates v. White Oak Operation Company, L.L.C. et al., 17th JDC, Docket No. 129052, Lafourche Parish, Louisiana
- New 90, LLC and Louisiana Wetlands, LLC v. Grigsby Petroleum, Inc. and Chevron U.S.A., Inc., 16th JDC, Docket No 130528, Div. “E”, St. Mary Parish, Louisiana
- Louisiana Wetlands, LLC v. Energen Resources Corporation et al. Case No. 130527, Div. “B”, 16th JDC, St. Mary Parish, Louisiana
- Louisiana Farm and Livestock Company, Inc. et al. v. Adventures In Mining, Inc. et al., Docket No. 2015-3487, Div.”H”, 14th JDC, Calcasieu Parish, Louisiana
- Hero Lands Company, L.L.C. v. Chevron U.S.A. Inc. et al., Docket No. 64-320. Div. “A”, 25th JDC, Plaquemines Parish, Louisiana
- Jack Anthony Devillier et al. v. Chevron U.S.A. et al., 27th JDC, Docket No. 12-C-5530, St. Landry Parish, Louisiana
- Clyde Reese et al. v Carl Oil and Gas Co. et al., Case No. 84390-C, 15th JDC, Vermilion Parish, Louisiana
- Catahoula Lake Investments, LLC v. Hunt Oil Company et al., 28th JDC, Docket No. 40076, Division “A”, LaSalle Parish, Louisiana
- Elizabeth R. Creadeur, et al. v. Atlantic Richfield Co., et al. 5th Circuit. Western District of Louisiana Civil Action No. 6:14-cv-00695, Lafayette Division
- Lexington Land Development LLC v. Chevron Pipeline Co. et al., 19th JDC, Docket No. 561893, East Baton Rouge, Louisiana
- Pine Pasture, et al. v. Shell Oil Company, et al. Docket No. 10-19047 Cameron Parish, Louisiana
- Velma Humble Hebert, et al. v. Atlantic Richfield Company, et al. Docket No. 84,111, Division “K”, 15th JDC, Parish of Vermilion, State of Louisiana
- Louisiana TE Products Pipeline Co., LLC v. Michael Brown Simpson, Suzan Dupree Simpson and Louisiana Department of Environmental Quality. 19th Judicial District Court, Parish of East Baton Rouge, State of Louisiana
- David Currie, et al. v BP America Production Company, et al. 38th JDC, Docket No. 10-18837, Cameron Parish, Louisiana

- Two O'Clock Bayou Land Co. et al. v. Chevron U.S.A. Inc. et al.,27th JDC, Docket No. 12-C-5528, Div. "D", St. Landry Parish, Louisiana
- Michael D. Trahan, et al. v. ConocoPhillips Co., et al., 15th JDC, Docket No. C-20170847 L, Lafayette Parish, Louisiana
- Matthew Willis vs. Tennessee Gas Pipeline Company, LLC, et al., 16th JDC, Docket No. 82,88816TH Judicial District Court, Parish of Saint Martin, State of Louisiana
- Monique Gutierrez Inc. et al. v. Exxon Mobil Corp et al., 15th JDC, Docket No. 201610135 Division "A", Acadia Parish, Louisiana
- Agri-South Group, LLC et al. v. Exxon Mobil Corp. et al., 12th JDC, No. 2012-8260-A, Avoyelles Parish, Louisiana
- James Guilbeau v. 2H Inc. et al., USDC, Western District of Louisiana, Alexandria Div. Civil Action No. 14-CV-2867
- Justin Dale Tureau v. 2H Inc. et al., USDC, Western District of Louisiana, Alexandria Div. Civil Action No. 13-CV-2969
- Ritchie Grocer Co. v. 2H Inc. et al. USDC, Western District of Louisiana, Alexandria Division. Civil No. 14-CV-2868

Remediation Experience

Sweet Lake – Louisiana Department of Natural Resources (LDNR) Office of Conservation Compliance Order (EI& E-11-0635) and a Settlement Agreement. The soil remediation occurred in 2013 and the spring/summer of 2014. Shallow soil removal (1-2') in limited area with more extensive land treatment performed (Pelletized Fairway-grade gypsum or lime and hay). Mr. Ritchie developed the sampling plan, executed the initial site investigation, and assisted in the preparation of the prescribed remediation of the property.

Bayou Choctaw – During the course of the litigation the oil and gas companies funded a cleanup in 2013 to remove abandoned oilfield flowlines, tankage, vessels, hardware, trash, and debris. The cleanup also included removal of a tank battery and the removal of soils impacted with minor amounts of oil and Naturally Occurring Radioactive Material (NORM) within the footprint of the tank battery. Mr. Ritchie performed NORM screening of the area and oversaw soil remediation activities.

Texas Brine – Mr. Ritchie has assisted Texas Brine Company on several remediation projects involved in brine mining, storage, and transportation. Remediation projects have been part of TBC operations and associated with litigation.

McDermott – As part of a Phase II investigation conducted on the site, NORM was discovered throughout several areas of the property, which was being prepared for sale. Mr. Ritchie conducted a NORM survey/sampling and assisted in the preparation of a remediation plan.

Henry Hub Gas Plant – As part of decommissioning and litigation, Chevron conducted soil remediation for areas with soil exceedances of NORM. Mr. Ritchie conducted soil sampling and NORM screening of the property in support of the remediation.

Expert Report

Authored, co-authored, or assisted in the preparation of the following:

Review of Plant Conditions and Vegetation Root Study on the H. C. Drew Manual Estate "15" No. 1 in Calcasieu Parish, Louisiana – November 10, 2021

H.C. Drew Manual Estate v. Neumin Production Company and Stokes & Spiehler, Inc., 14th JDC, Docket No. 2019-4925F, Calcasieu Parish, Louisiana

Review of Plant Conditions and Vegetation Root Study on the Durel Joseph Romaine et al. Property in Vermilion Parish, Louisiana – October 15, 2021
Durel J. Romaine and Lawrence C. Romaine v. Freeport-McMorRan Oil and Gas et al., 15th JDC, Docket No. 108131, Vermilion Parish, Louisiana

Expert Report and Vegetation Root Study on the Jeanerette Lumber and Shingle Company, L.L.C. Property in Iberia Parish, Louisiana – April 2021
Jeanerette Lumber & Shingle Co. LLC v. ConocoPhillips Co, Alta Mesa Holdings, LP, Chevron USA, Apache Corp, and Texas Petroleum Investment Co., 16th JDC, Docket No. 134307, Iberia Parish, Louisiana

Expert Report of David G. Angle, P.G., CGWP, Melanie M. Hanks, Patrick M. Ritchie, PWS and Lance R. Cooper, PhD, P.E. Kern Broussard – Sections 21 and 28 – March 2021
Kern Broussard v. Texaco Exploration and Production Inc. and Hilcorp Energy Company, et al., 15th JDC, Docket No. 83126, Vermilion Parish, Louisiana

Effective Root Zone Study – August 2020
Henning Management LLC v. Anadarko OGC Company, et al., 31st JDC, Docket No. C-791-13, Jefferson Davis Parish, Louisiana

East White Lake Wetlands Functions, Value, and Services – May 2019
The Vermilion Parish School Board v. The Louisiana Land and Exploration Co. et al., 15th JDC, Docket No. 82162, Vermilion Parish, Louisiana

Supplemental Fishing Report – September 2016
LaBarre, et al vs. Occidental Chemical Company, et al., Division E 23rd JDC, Docket No. 033796, Assumption Parish, Louisiana

Ecological Assessment Report – June 2016
LaBarre, et al vs. Occidental Chemical Company, et al., Division E 23rd JDC, Docket No. 033796, Assumption Parish, Louisiana

Rapid Bioassessment of Streams Sampling Report – January 2016
City of Hattiesburg v. Hercules, Inc. et al. Civil Action No. 2:13-cv-208KS-MTP, USDC, Southern District of Mississippi, Eastern Division

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

Clyde A. Tucker, et al. v. Shell Oil Company et al. – 2014
Project components: Soil and Groundwater Investigation, Soil Remediation

The Sweet Lake Land and Oil Company, LLC v. Exxon Mobil Corporation – 2012
Project components: Soil and Groundwater Investigation, NORM Investigation, Soil Remediation

Vermilion Parish School Board v. The Louisiana Land and Exploration Co., et al. – 2010
Project components: Soil and Groundwater Investigation, Groundwater Remediation