EXPERT REPORT AND VEGETATION ROOT STUDY, NEW 90 LLC PROPERTY, ST. MARY PARISH, LOUISIANA

IN THE MATTER:

LOUISIANA WETLANDS, LLC ET AL.

VERSUS

ENERGEN RESOURCES CORPORATION ET AL.

CASE NO. 130-527

16TH JUDICIAL DISTRICT COURT, DIV. "B"

PARISH OF ST. MARY

STATE OF LOUISIANA

PREPARED BY:

HOLLOWAY ENVIRONMENTAL SERVICES, INC.

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OCTOBER 22, 2020

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1.0 Introduction, Description and Land Use of the Property

1.1 Introduction

For the litigation, recorded as Louisiana Wetlands, LLC et al. v. Energen Resources Corporation, et al., Case No. 130527, Division "B", 16th JDC, Parish of St. Mary, State of Louisiana, Holloway Environmental Services, Inc. has been retained by BP America Production Company, Energen Resources Corporation, Southern Natural Gas Company, LLC and Chevron U.S.A., Inc. Dr. Luther F. Holloway visited the New 90 LLC Property five times. He conducted a site review of the property on August 30, 2018 and October 1, 2019 and conducted a root study on tree and herbaceous plant roots June 1-5, 2020. He also visited the property on September 16, 2020 and October 7, 2020 to conduct additional reviews of the property.

The defendants in this case have been sued by the plaintiffs for various allegations of damages to their property including soil and groundwater contamination. Experts for the plaintiffs (Miller and Prejean, 2020) have proposed options for remediation of alleged soil contamination on the New 90 property. The authors provided remediation plans for restoring soils to a maximum depth of 10 feet below ground surface to an EC of 1.7 mmhos/cm for sugarcane crop growth, to background for metals, ESP, SAR, and to LDEQ RECAP standards for petroleum hydrocarbons. Costs were prepared for restoration to depths of 4, 8 and 10 feet below ground surface. Costs of ICON's plans ranged from approximately 3.7 to 8.8 million dollars.

This report considers the characteristics of vegetative communities for root penetration in order to determine depths of trees and herbaceous species growing on the LA Wetlands property. Also considered are characteristics of the vegetation communities for root penetration in order to determine depths of the effective root zones (ERZs) of plant species growing on the property area. This consideration is very important to determine the appropriate depth of remediation for propagation of the trees and other vegetative communities growing on the property. These data represent a site specific study which relates directly to the property under investigation and at issue in this litigation. Other defense experts will address the groundwater and Naturally Occurring Radioactive Material (NORM) issues in the case.

1.2 Location and Site Description of the New 90 Property

Figure A-1 shows the general location of the property while the general property boundaries are shown in Figure A-2. The property is located on the southwest edge of the town of Franklin, Louisiana. The property comprises approximately 300 acres located in Section 2 in T14S R9E and Sections 3 and 38 in T15S R9E in the Franklin Oil Field. The property is bisected by US Highway 90 toward the southwest side of the tract. Figure A-3 is an aerial photograph of the tract.

1.3 Previous, Present and Future Land Use

The New 90 property has historically been used for sugarcane production with some rotation primarily to soybeans and for oil field exploration and production activities (E&P). The area southwest of US Highway 90 contains bottomland hardwood timber lands that are transected by several pipelines. A small section of farmland is located on the northwest corner of the tract. Present day use is primarily for sugarcane production. There are no dwellings or other structures located on the property.

2.0 Geology, Physiography, Soils, Vegetation

2.1 Geology and Physiography

As shown in Figure A-4, the Louisiana Geological Survey has mapped the New 90 property as Hml3u1, upper deposits – deposits composing low natural natural levees flanking the younger (Bayou Teche) of two occupations of Mississippi River meander-belt No. 3. The area west of US Highway 90 is mapped as Htd, deposits of the Teche Delta Lobe, Mississippi River.

2.2 Elevation and Relief

Figure A-4 is a LIDAR (Light Detecting and Ranging) ground surface elevation model that shows the elevations within the New 90 property to range from 9 to 10 feet NGVD on the east side of the property with a gradual slope to 2 feet NGVD to US Highway 90. Areas west of the highway are at mostly 0 feet NGVD with a small area at the southwest corner of -1 feet NGVD.

2.3 Soils

The Soil Survey of St. Mary Parish posted on the USDA Web Soil Survey site (Soil Survey Staff, 2020) shows six types of soil map units on the New 90 property

(Figure A-6). The following descriptions generally follow those of the Web Soil Survey and the Soil Surveys of St. Mary Parish, Louisiana (Soil Survey Staff, 1959 & 2007):

Baldwin silty clay loam (BbA), 0 to 1% slopes that generally parallel Bayou Teche. Baldwin soils developed in the Bayou Teche alluvium make up the majority of cultivated soils in St. Mary's Parish. Baldwin soils are made up of the gray silty clay loam surface layer that grades into a gray silty clay subsoil layer. Permeability of these soils is slow, is poorly drained and has a very high shrink-swell potential level. Slow permeability and clay content of the subsoil often restricts root growth at these depths. Major land uses are for cropland, urban and some rural residential purposes.

Galvez silt loam (GaA), 0 to 1% slopes makes up a small component of the soils on the LA Wetlands tract. These somewhat poorly drained soils occur in land positions of convex areas on the Bayou Teche natural levee. The areas generally exhibit little flooding or ponding and exhibit moderate shrink-swell potential. The surface layer consists of dark grayish brown silt loam while subsoil layers consist of grayish brown silty clay loams and grayish brown silty clay. The major uses of Galvez soil is for cropland, urban and residential uses.

Harahan and Allemands soil, drained (HAS), 0 to 1% slopes make up a small component of the soils on the tract. These soils are located in the far southwest corner of the property. HAS soils formed in backswamp areas of Mississippi River Alluvium and are poorly drained with high shrink-swell potential. The surface layer consists of a dark gray silty loam that grades to a dark gray nonfluid clay. HSA soils are classified as hydric soils and have a depth to water table of about 0-26 inches. Major land uses are pasture, woodlands and recreation.

Iberia clay (IbA), 0 to 1% slopes formed in backswamps on the delta plain. These poorly drained soils have a water table that ranges from 0-24 inches and have a very high shrink-swell potential. Available water capacity is high. A typical profile shows a surface layer of black clay with a subsoil of olive gray clay. Rooting depth of crops may be restricted by the high clay content. Major land uses are cropland, pasture and woodlands.

Loreauville silt loam (LoA), 0 to 1% slopes occur on higher elevations on the Teche natural levee of the delta plain. These soils are somewhat poorly drained and have

moderate shrink-swell potential. Hydraulic conductivity is moderately slow with a high available water capacity of about 13 inches. The surface layer consists of very dark gray silt loam with a subsurface layer of very dark grayish brown silty clay loam. Major land uses are cropland and pasture.

Schriever clay (ShA), 0 to 1% slopes occurs on the southwest side of the property and developed in clay alluvium in backswamps of the Mississippi River natural levees. Permeability of these soils is very slow and drainage is very poor. Shrink-swell potential is very high. A typical profile of Schriever clay consists of clay from 0 to 80 inches in depth. Major land uses are cropland, pasture and woodlands.

2.4 Vegetation on the New 90 Property

At the present time all of the cropland on the New 90 property is planted to sugarcane (*Saccharum officinarum*). The northeast field supports a stand of second year cane while the southeast and northwest areas were recently planted. Turnrows and ditches in the cane fields support a mixed stand of weedy species and grasses. The southwest portion of the tract on the west side of US Highway 90 is vegetated by bottomland hardwood species consisting of water oak (*Quercus nigra*), sugarberry *(Celtis laevigata*), Chinese tallow (*Triadica sebifera*), red maple (*Acer rubrum var.* drummondii), sweetgum (*Liquidambar styraciflua*), tupelo gum (*Nyssa aquatic*), green ash (*Fraxinus* pennsylvanica), American elm (Ulmus americana), honey locust (Gleditsia triacanthos), an occasional bald cypress (*Taxodium* distichum) and black willow (*Salix* nigra) in wetter areas. Understory consists of reproduction of the overstory, green haw (*Crataegus viridis*), roughleaf dogwood (*Cornus drummondii*), deciduous holly (*Ilex decidua*), dwarf palmetto (*Sabal minor*) and Chinese privet (*Ligustrum sinense*).

Ground cover in the understory consists of mostly herbaceous plants along with young overstory seedlings and woody vines. Plants in this category include poison ivy (*Toxicondendron radicans),* peppervine (*Nekemias arborea),* grapes (*Vitis* spp.), cross vine (*Bignonia capreolata*), Virginia creeper (*Parthenocissus quinquefolia*), ladies' eardrops (*Brunnichia ovata*), trumpet creeper (*Campsis radicans*), blackberries (*Rubus* spp.), lizard's tail (*Saurus cernuus*), smartweeds (*Pologonum* spp.) and greenbriars (*Smilax* spp.).

Herbaceous plants in pipeline areas include swamp mallow (*Hibiscus* moscheutos), sedges (*Carex* and *Cyperus* spp.), peppervine (*Nekemias arborea*), giant ragweed (*Ambrosia trifida*), balloon vine (*Cardiospermum halicacabum*), southern dewberry (*Rubus trivialis*), climbing hemp vine (*Mikania scandens*), goldenrod (*Solidago* spp.),

spiny thistle (*Cirsium horridulum*), docks (*Rumex* spp.), Brazilian vervain (*Verbena brasiliensis*), annual ragweed (*Iva annua*), goldenrod, jungle rice (*Echinochloa colona*), frog fruit, sow thistle (*Sonchus asper*) and Savannah panicum (*Thanopyrum gymocarpon*) in wet drains. Dotted around these areas were also young woody species such as Chinese tallow (*Triadica sebifera*), silverling (*Baccharis halimifolia*), roughleaf dogwood (*Cornus drummondii*) and young common persimmon (*Diospyros virginiana*).

3.0 Plant Root Study

3.1 General Aspects

Since scant literature exists in the area of the effects of oil field E&P activities on plant roots, the author, and with others, has undertaken numerous site specific investigations to determine root depths and effective root zones (ERZs) of plants growing in and around areas of alleged oil field impacts. During the course of these investigations, he has found that root densities and penetrations in various soil types have varied greatly from site to site. This is particularly important with the changes in soil types, disturbance factors, area hydrology and the intended future use for various properties. As such, it is imperative to tailor an investigation that is specific to the plants and soils of the areas of alleged impact and surrounding areas in order to determine the particular depths at which plant roots grow and for the potential formulation of depths where remediation measures may be required.

Another important consideration that the author has found in many studies is that depths or depth intervals of soil samples for salt parameters such as electrical conductivity (EC), exchangeable sodium percentage (ESP) and sodium adsorption ratio (SAR) generally overestimate (at many times grossly so) these parameters. For example, soil samples extracted from the 0 to 2 foot and 0 to 4 foot depths below ground surface, which is mixed for analysis, can show levels that are much higher than those within the ERZs that only extend to 6 to 12 inches in depth. To be accurate for salt parameters in root zones, soil samples should reflect specific depths of the ERZs and/or root zones, not deeper depths where roots do not occur or occur in only negligible quantities.

3.2 Methods

To determine the root depths of sugarcane growing on the New 90 property four locations were selected for study (S-1 to S-4). The locations of these plant stands are shown in Figure A-7. At each observation site a pit was dug with a

sharpshooter hand spade to a depth to where the overwhelming majority of roots were visible along the soil profile under the plant stand. At deeper depths a hand auger was used to carefully bore down to 55 or 60 inches with the soil laid out for observation of any additional roots. At each observational area, photographs were taken of the sugarcane stand at the site and the soil profile (Appendix B). At each site the prevalence of the roots was recorded and the data are shown in Appendix C. They consisted of a rating scheme of very abundant, abundant, common, sparse, very sparse and none for the root distributions along the soil profile.

To determine the root depths and distributions of the woody vegetation on the west side of US Highway 90, four trees were selected for study (T-1 to T-4). The locations of these plants are shown in Figure A-7. The general distribution of the typical plants that grow in the area were chosen for study and represent a general mix of the most abundant species that occur on the New 90 property. Trees selected for the study were measured at diameter breast high (dbh). The dominant roots extending from the trees were measured for depth to top of root at various distances along their lengths. They were also measured from the bole (trunk) of the tree to the deepest depth of the most cases. These data were entered on a root form along with species name and coordinates showing the location of the plant. Extensive reviews were conducted of the dominant roots on the trees by probing with steel rods to determine the general depths of all of the major roots around the tree.

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 factors watched for were epicormic branching, witches' brooms, dieback and other known features of salt or petroleum hydrocarbon impacts. Where applicable, this information is given in the results section below for various observation points. Photographs of individual trees, root distributions and surrounding plant communities are shown in Appendix B while root depths and other important information for the trees are shown on the tree root forms in Appendix C. This root study for both sugarcane and trees was conducted in conformance with traditionally accepted methodologies (Schuurman and Goedewaagen, 1971).

In my study, I use ERZ to mean the depth of the roots that are necessary for the plants to grow and complete their life cycles. The ERZ does not normally represent the deepest roots but comprises the depth where the majority of the roots that sustain the plants through growth and reproductive phases reside. While some

researchers (U.S. EPA, 2015. Herrera and Sammis, 2001) may use ERZ to mean the area where eighty percent of the roots reside beneath the plants and from where the plants receive their nutrients, this definition generally underestimates the depth of the ERZs, therefore, the former method was used to evaluate roots on the New 90 property. My depths represent more inclusive and deeper ERZ levels for the roots observed in my study.

3.3 Results

In order to determine root depths, 8 observational areas were set up across the LA Wetlands property as described above. Locations of these areas are shown in Figure A-7. These include typical and healthy sugarcane stands and hardwood trees. Appendix B shows the photographs of the plants that were observed along with plant stands in surrounding areas, where applicable. The data for each of the root systems observed at each location shown in the root forms is also located in Appendix C with data showing down to various depths. Each root observational area that was investigated is described in the following section.

3.3.1 Observation S-1 – Sugarcane (Saccharum officinarum) ERZ = 10”

Sugarcane S-1 is shown in Figure A-7. Photo B-1 shows the sugarcane at the site that is a healthy stand of cane showing no impacts. The sugarcane at this site has a good color and is growing vigorously. As shown in Photo B-1, there are no indicia of any kind of leaf burning or any other indications of any kind of E&P impacts at this location. Photo B-2 shows the pit that was dug at S-1 to show the soil root profile for the cane growing at this area. As shown in Photo B-3 and Form Observation ID: S-1 of Appendix C, the roots in the first inch are abundant and abundant to common down to 3 inches as is shown in this photograph. Photo B-4 shows the root distribution to be abundant to common from 3 inches down to 10 inches. All of these roots are in excellent condition and are typical for the root profiles of sugarcane that I have investigated in several areas in Louisiana. Photo B-5 shows the root distribution from 10 to 15 inches with distribution of roots sparse in spots from 10 to 12 inches and very sparse to none in 13 to 14 inches. Photo B-6 shows the root distribution from 15 down to 24 inches to be very sparse to none with very few roots in the profile. Photos B-7 and B-8 show the root profile. Photos B-7, B-8 and B-9 show the root profile from 24 to 53 inches with basically no roots in these areas. Again, all of these roots are very healthy in the root profile with the vast majority occurring in the first 10 inches of the profile. Based on these considerations, an ERZ of 10 inches would be appropriate for Sugarcane S-1.

3.3.2 Observation S-2 – Sugarcane (Saccharum officinarum); ERZ = 10”

Sugarcane S-2 is located near US Highway 90 northeast of the road. Photo B-10 shows this stand of cane facing to the east at this site. This is an excellent stand of cane showing no impacts from E&P activities. Photo B-11 shows the observation pit and the profile that was dug for the S-2 site. As shown in Observation ID: S-2 of Appendix C and in Photos B-12 and B-13, the roots are abundant in the first one inch and common to sparse down to 8 inches. Photos B-14 through B-15 shows the roots in the profile from 9 inches down to 24 inches. Root distribution in this area showed a sparse distribution from 9 to 10 inches and very sparse to none from 11 to 16 inches. There was a root that was noted in the profile that ran from approximately 11 inches down to 16 inches in a crack where the soil had dried out and separated. Roots in the range of 17 to 24 inches were very sparse to none. Photos B-16, B-17 and B-18 show the soil profile from the core that was taken below 24 inches. This area showed no roots at all in the profile. Based on these considerations, an ERZ of 10 inches would be very generous for Sugarcane S-2.

3.3.3 Observation S-3 - Sugarcane (Saccharum officinarum); ERZ = 10.5”

Sugarcane S-3 is located on the east side of the tract as shown in Figure A-7. Soils at this site are more indicative of the higher areas of the terrace along Bayou Teche. Photo B-19 shows the stand of sugarcane at S-3 facing to the west in the field. This cane is in excellent condition and shows no impacts from any kind of oil field operations that occurred in the area west of this location. Photo B-20 shows the observation pit and part of the profile at S-3. As shown in Observation ID: S-3 and in Photos B-21, Photo B-22 and Photo B-23, the root distribution in the first two inches is common and abundant to common down to 10.5 inches. Photo B-23 clearly shows the point where the roots drop out of the profile. Photo B-24 shows the area from 11 inches down to 24 inches with a sparse distribution from 11 to 13 inches and a very sparse to none between 15 and 24 inches. The distribution along the profile clearly shows that the overwhelming majority of the roots are located within the first 10 inches at this site. All of these roots were very healthy showing no evidence of any kind of impacts in this area. Photos B-25 through B-28 show the soil profile from 24 to 60 inches. There were no roots observed in this area. Based on the root distribution within the profile, an ERZ of 10.5 inches would be very appropriate for Sugarcane S-3.

3.3.4 Observation S-4 - Sugarcane (Saccharum officinarum); ERZ = 10”

Sugarcane S-4 is located on the north central area of the cane field that is east of U S Highway 90. Soils in this area are heavier in nature than those encountered at Sugarcane S-3. Photo B-29 shows the stand at S-4 facing toward Bayou Teche to the east. This stand of cane is in excellent condition showing no evidence of any kind of impacts from E&P activities that may have occurred in the general area. Photo B-30 shows the pit that was dug at this site along with the profile that was observed inside the pit. Photo B-31 shows the pit profile at 0 to 10 inches with the root distribution in Observation ID: S-4 showing an abundant to common distribution from 1 to 10 inches at this site. As can be seen in Photo B-31, there is an abrupt change in the root distribution at approximately 9 to 10 inches for this location. Photo B-32 shows the profile at 10 to 24 inches with a distribution in this area of only a few roots through this entire section of the profile. There was one root in a crack that extended down from approximately 11 to 18 inches at this site, however, this small root represented only a tiny fraction of the profile at this location. Roots in the area from 19 to 24 inches were very sparse to none in the profile. Photos B-33 through B-36 show the soil profile from 24 to 60 inches. There were no roots observed in this section. Based on the abundant to common distribution of the roots down to approximately 10 inches, an ERZ of 10 inches is appropriate for Sugarcane S-4.

3.3.5 Observation T-1- Red Maple (Acer rubrum); DBH = 11.5”; ERZ = 5”

Tree T-1 is an 11.5 inch dbh tree that is located in the southwest side of the property. Photo B-37 shows the canopy of the tree while B-38 shows the bole of the tree. This tree is in excellent condition showing no evidence of any kinds of impacts. There is no evidence of dieback, leaf damage, bark sloughing or any other indicia that could be attributed to E&P activities. Photo B-39 shows the vegetation in the area surrounding Tree T-1 facing north. The canopies of the trees in this area consist mostly of green ash, black willow and red maple. The understory is reproduction of the overstory with mostly young American elms and sugarberry. There is also an occasional laurel oak in this area. Dwarf palmetto is also dotted in the stand. Ground cover is very sparse consisting of mostly lizard’s tail, young dwarf palmetto and some poison ivy on the trees. Photo B-40 shows the vegetation at Tree T-1 facing to the east. Overstory is dominated by red maple, occasional green ash, occasional persimmon, small sugarberry, water oak and an occasional elm on some of the higher spots at this site. Understory is basically reproduction of the overstory with an occasional Nuttall oak, green ash and young sugarberries. Ground cover is dominated by blackberry, poison ivy, dewberry and seedlings of young oaks.

All of the vegetation is in excellent condition with no evidence of any kind of dieback. Photo B-41 shows the vegetation at Tree T-1 facing to the south. Vegetation in the overstory in this direction consists mostly of green ash and red maple. Understory is reproduction of mostly young red maple and American elm. There is a spotty distribution through the area of dwarf palmetto. Ground cover is mostly peppervine, poison ivy, young green ash and green briar. All of this vegetation is in good condition showing no evidence of any kind of dieback that may have been related to E&P activities. Photo B-42 shows the vegetation at Tree T-1 facing to the west. Vegetation in the overstory and understory are basically the same as for the vegetation shown in Photo B-41. Again, all of this vegetation is in excellent condition.

Photo B-43 shows the distribution of the roots at Tree T-1 facing north while Photo B-44 shows the distribution of the roots at Tree T-1 facing to the southwest. As shown in Appendix C, Observation ID: T-1, all of the roots are very shallow on Tree T-1 with all of them ranging from 0.5 to 4 inches in depth to the surface, only 1 root (4A) showed a depth to the top of 8.75 inches. Extensive probing around the tree showed that all of the roots on the tree were very shallow with most extending no more than 5 inches in depth. Based on these considerations, an ERZ of 5 inches would be generous for this tree.

3.3.6 Observation Tree T-2 – Green Ash (Fraxinus pennsylvanica); DBH = 12.4”; ERZ = 14”

Tree T-2 is a green ash with a dbh of 12.4 inches. Photos B-45 and B-46 show the crown and the bole of Tree T-2 respectively. This tree is in excellent condition showing no evidence of any kind of impact. Photo B-47 shows the vegetation at Tree T-2 facing to the north. Vegetation here consists of dominant red maple, occasional green ash and an occasional tupelo gum in the canopy. There are also a few water oaks and Chinese tallow at higher elevations. Understory at the site is mostly reproduction of the overstory along with red maple and young green ash with an occasional American elm and persimmon. All of this vegetation is in excellent condition. Some dwarf palmetto are dotted around the stand. Ground cover consists mostly of lizard’s tail and a lot of very young green ash along with trumpet creeper and American elm seedlings. All of this vegetation is in excellent condition. Photo B-48 shows the vegetation at T-2 facing to the east. Vegetation in the overstory here is the same as for Photo B-47 except for more green ash in the canopy. Understory is reproduction of the overstory. Ground cover is lizard’s tail, trumpet creeper, young water oak, dogwoods and dwarf palmetto. All of the vegetation at all levels in the vegetation to the east are in good condition showing no evidence of impacts. Photo B-49 shows the vegetation at Tree T-2 facing south.

The stand in this area is more open than that at the other two locations for Tree T-2. Overstory is red maple, green ash, sugarberry and an occasional water oak. Understory consists of reproduction of the overstory with green ash and water oak. Dwarf palmetto is dotted around the stand. Trumpet creeper, lizard's tail and some seedlings represent the ground cover. All of the vegetation in this area is in excellent condition showing no evidence of impacts. Photo B-50 shows the vegetation at Tree T-2 facing west. This stand is somewhat thinner than at the other areas, however, the vegetation is very similar to the vegetation found at the three other directions found around T-2 and all of the vegetation is healthy showing no impacts.

Photos B-51 and B-52 show the distribution of the roots at Tree T-2 facing east and west, respectively while C-6 of Appendix C shows the root distribution around the bole of the tree. Photo B-53 shows Root 4 at Tree T-2. As shown in Observation ID: T-2, depths to the top of the roots range from 1.0 inch to 11.5 inches for Tree T-2. Extensive probing around the tree showed that root depths generally ranged no deeper than 14 inches with most much shallower. Based on these considerations, an ERZ of 14 inches would be very generous for Tree T-2.

3.3.7 Observation Tree T-3 – American Elm (Ulmus americana); DBH = 14.8" ERZ = 5"

Tree T-3 is an American elm that has a dbh of 14.8 inches. Photos B-54 and B-55 show the canopy and bole of Tree T-3, respectively. A review of the canopy and the bole of the tree showed that this is a healthy tree showing no evidence of any kind of impacts from E&P activities. There is no bark sloughing, dieback, leaf burning or other features of saline or sodic properties noted on this tree. Photo B-56 shows the vegetation at Tree T-3 facing to the north. Vegetation consists of an understory of a mixed stand of water oak, sweetgum, green ash and red maple as the dominants. Understory is reproduction of the overstory along with some young American elms. There are many small chinese tallow trees dotted in the area. Ground cover is very sparse in this area except for some patches of carex. Other species include green briar, poison ivy and dwarf palmetto. All of the vegetation in this direction around Tree T-3 is in excellent condition showing no symptoms of impacts. Photo B-57 shows the vegetation at Tree T-3 facing to the east. Vegetation here consists of the same understory and ground cover. Farther out is an open area that is vegetated by weedy-type species and some grasses. Photo B-58 shows the vegetation around Tree T-3 facing to the south. Vegetation in the overstory is very similar to the vegetation looking north and east at the site. There are many younger water oaks coming into the understory at this site along with red maple, dwarf palmetto and some green ash. Ground cover is the same as that described for the

north and east locations. All of this vegetation is healthy showing no evidence of impacts. Photo B-59 shows the vegetation at Tree T-3 facing west. Vegetation in this area consists of very similar species as those found in the other areas around Tree T-3 and is all healthy. Photo B-60 shows the distribution of the roots around T-3 on the west side of the tree while Photo B-61 shows the distribution of the roots on the east side of the tree. Photo B-62 shows the roots facing northwest. Photo B-63 is a view of Root 3 on T-3 that is above ground at this site. This is typical for many American elms that usually have an extremely shallow root system in soils of the type that occur in this area. C-7 of Appendix C shows the root depths with many of them occurring on the surface of the soil. Other roots ranged from 1 to 3 inches in depth to the top. Extensive probing showed that very few of the roots on this tree extended any deeper than 6 inches into the soil with almost all of them sitting at or near the surface. C-7a shows the distribution of the roots. Based on the considerations of the very shallow root system, an ERZ of 5 inches would be generous for this tree.

3.3.8 Observation T-4 – Water Oak (Quercus nigra); DBH = 16.1”; ERZ = 10”

Tree T-4 is a water oak that has a dbh of 16.1 inches. Photo B-64 shows the canopy of Tree T-4 while Photo B-65 shows the bole of the tree. This tree is in excellent condition showing no evidence of any kind of dieback that may be indicative of E&P activities. All of this tree is leafed out very good showing no burn, no dieback, epicormic branching or bark sloughing that could occur if impacts were affecting this tree. Photo B-66 is a view of the vegetation at Tree T-4 facing to the north. Vegetation in this area is dominated in the overstory by sweetgum, American elm, water oak and an occasional sugarberry. All of this vegetation is in good condition. One tree in the area was apparently struck by lightning. Understory is reproduction of the overstory with a lot of young American elm, water oak and dwarf palmetto. The ground cover is very sparse in this area consisting of poison ivy, some carex and abundant poison ivy. Again, vegetation at all levels for this area is in excellent condition showing no impacts. Photo B-67 shows the vegetation at Tree T-4 facing east. Vegetation at all levels in this direction are very similar to that facing to the north at this site. All of the vegetation is in excellent condition. Photo B-68 shows the vegetation facing to the south. Overstory at this site consists of water oak, sweetgum, American elm and green ash. Understory is the same as for the other directions with young elm, some ash and patches of dwarf palmetto in the area. Ground cover is mostly poison ivy, carex and some green briar with an occasional very small common persimmon. All of the vegetation at all levels is in good condition at this site. Photo B-69 is the vegetation at T-4 facing west. Overstory consists of sweetgum, water oak, American elm and occasional sugarberry as the dominants. Understory is basically reproduction of the overstory with a lot of very small American elm and water oaks dotted around the stand. Dwarf palmetto is

abundant in patches here. Due to the extensive shading, there is basically no ground cover at this site due to the extensive stand of dwarf palmetto. No photos were taken of the root distribution for Tree T-4, however, C-8 of Appendix C shows the actual distribution of the root system around the tree. As shown in Observation ID: T-4, root depths for Tree T-4 generally range from 1 to 6.5 inches in depths to the tops of the roots. In general, most of the root depths were less than 4 inches. Extensive probing around the tree indicated that no roots extended past 10 inches. Based on these considerations, an ERZ of 10 inches would be extremely generous for this tree.

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

Site ID	Common Name	*Scientific Name*	ERZ (in)
S-1	Sugarcane	*Saccarum officinarum*	10.0
S-2	Sugarcane	*Saccarum officinarum*	10.0
S-3	Sugarcane	*Saccarum officinarum*	10.5
S-4	Sugarcane	*Saccarum officinarum*	10.0
T-1	Red maple	*Acer rubrum*	5.0
T-2	Green Ash	*Fraxinus pennsylvanica*	14.0
T-3	American Elm	*Ulmus americana*	5.0
T-4	Water Oak	*Quercus nigra*	10.0

4.0 General Discussion

A review of the sugarcane fields growing on the New 90 property generally showed healthy stands across the areas with the exception of some sites that showed a thinner and shorter stand of cane. Cane growing in all of the proposed remediation areas of ICON was growing good and showed no visual impacts of dieback, leaf burn and other indicia that may indicative of E&P activities. Those areas that showed thinner and shorter stands were outside the areas "so-called" impact areas as outlined by Miller and Prejean (2020) in the ICON report and were not caused by E&P activities. The root investigation of the sugarcane on the New 90 tract consisted of four pits that were dug to observe the depths of the root systems from the soil surface down to approximately 60 inches in most cases. As shown in Table 3.1, the ERZs for the four sites that were investigated ranged from 10 to 10.5 inches with root abundances and penetrations were very similar from one observation site to the other. All of the sugarcane in the areas of the observations showed good healthy stands with no evidence of dieback. Roots along the profile also showed no evidence of any kind of E&P impacts.

A review of the stand of sugarcane growing on F. F. Bailey Et Al. No. 2 Production Pit Area

showed a healthy stand of cane that was very comparable to stands of sugarcane in the surrounding areas. Photo B-70 shows the sugarcane growing at the site. All of this sugarcane was healthy showing no impacts. A review of the sugarcane stand located in the eastern side of the tract at EN8, EN9 and EN10 of ICON showed no evidence of impacts from any E&P activities that have occurred in that area. The sugarcane in these areas showed excellent growth in with healthy canes throughout the stand. There were some areas to the southwest of the site outside of the alleged impacted area of ICON where the canes were weaker and thinner than those in the former production areas to the east. A review of historical aerial photograph showed no E&P activities ever occurring on these sites. The sugarcane growing in EN11, EN12 and EN27 areas in the east of US Highway 90 also showed healthy stands of sugarcane with no impacts. Areas EN17 and EN18 on the southwest corner of the sugarcane field east of US Highway 90 showed some evidence of water logging due to water backing up behind a 15 inch culvert that drained much of the southwestern portion of the sugarcane field at this site. No evidence of any kind of impacts related to sodicity or salinity factors was noted on any of the sugarcane. These impacts were related to standing water and soil saturation and not from E&P activities. All other smaller areas of concern in the ICON report for the sugarcane fields were investigated and no impacts were noted for any of the sugarcane growing in any of these areas including the small areas proposed for remediation.

At this time the sugarcane is growing good on the New 90 property and any potential remediation for the sites as proposed by ICON in their report would provide no benefits to those areas. Even though no remediation is recommended for any of the areas recommended by ICON, if required by regulatory agencies, a remediation depth of 2 feet would be appropriate for any of the sugarcane land on the New 90 property. This depth is deeper than needed for remediation at depths of the ERZs that occur in the sugarcane at the site, however, some farmers practice deep tilling to break up the fragipans or hard pans on their fields. A depth of 24 inches would provide more than a sufficient depth for these activities.

A review of the hardwood areas and the pipeline rights-of-way for the southwestern portion of the New 90 tract showed healthy stands of vegetation of both hardwood trees and the mostly herbaceous species that were growing along the pipeline corridors. No evidence of dieback, bark sloughing, epicormic branching or other indicia of E&P impacts were noted for any of the vegetation over the entire areas including the former E&P production sites.

Most of the vegetation in these areas consisted of older stands of hardwood trees that had

naturally regenerated over these areas and had produced productive forest communities in and around the areas of E&P activities. A detailed review of the EN15 area showed younger vegetation that had grown up in the old E&P production area at the site. All of this vegetation was healthy showing no impacts. Productive hardwood communities were also shown in the EN21, EN26 and EN25 areas where good hardwood growth had occurred at these sites. At areas EN13 and EN14, hardwood communities had become reestablished at these sites and were showing no impacts. Area EN22 just south of the St. Mary Parish shooting range showed healthy vegetation stands with one cypress tree having extended its roots and "knees" into a former small pit at this site. This tree was growing in an excellent fashion showing no sign of impacts.

Trees in the surrounding areas that were selected for the root study in the hardwood area showed very shallow root systems for all of the trees that were investigated with many of the root systems on the trees at or very near the surface of the ground. All of the trees were healthy as were the canopies of the trees and other vegetation in the sites that were investigated.

As shown in Figure 43 of the ICON report, the proposed remediation areas at EN21, EN13, EN14, EN28 and EN22 would require total eradication of healthy stands of vegetation that are currently growing on the New 90 property in the area. Any amendment procedures would result in wholesale destruction of those plant communities and would provide no benefit to the vegetation since the trees are already growing vigorously without any remediation. In general, the harm caused by the proposed remediation plan would be far greater than the benefits that would accrue from the remediation process. Even after the thriving plant communities are destroyed and planted back after remediation, it would require many decades to establish a viable bottomland hardwood community like the one that is currently growing within the proposed remediation site. Any remediation in this area should be related to ditching of water and some minimal leveling of some of the holes in the swales in the area that are holding water.

Based on the review of the hardwood vegetation in the southwest side of the LA Wetlands property, a remediation depth of 18 inches would be appropriate for the ERZs for the sites, however, due to soil conditions and trafficability problems, a depth of 24 inches would allow for completing the remediation process.

5.0. Opinions and Conclusions

a. The sugarcane stands that are growing at present on the LA Wetlands property

are generally healthy and showing no typical impacts such as dieback, yellowing of plant tissue, leaf burning or other symptoms associated with oil field E&P activities that have occurred in the past on the sugarcane tracts. Some areas outside of the alleged impacted zones show thinner and weaker stands than those within the proposed remediation areas. These weaker areas are not caused by E&P activities.

b. Reviews of root profiles at four selected locations of healthy sugarcane on the tract showed very shallow root systems with almost all of the roots occurring within the top 10 inches of the soil. ERZs for the sugarcane crop ranged 10 to 10.5 inches in depth for the four observation sites.

c. Of the proposed remediation sites of ICON for the sugarcane, only one site showed any kind of impacts to the sugarcane. Areas at EN17 and EN18 showed water logging of the sugarcane from recent rains. These conditions were not caused by any E&P activities but were related to improper drainage.

d. No remediation is recommended for the sugarcane areas at this time based on the root studies and the conditions of the plants in the proposed ICON remediation areas, although I do understand that remediation of one area in the sugarcane field is recommended by ERM for compliance with RECAP regulations. Remediation activities can often result in disturbance of the soil conditions and a reduction in growth of the sugarcane in future years. No benefits would accrue to the sugarcane that is presently growing on the New 90 tracts.

e. The forest communities and the pipeline rights-of-way on the southwest side of the tract show healthy stands of bottomland hardwoods and herbaceous plant communities in open areas along the pipelines. None of the vegetation on the tract shows any signs of impacts to trees such as leaf dieback, branch dieback, epicormic branching, bark sloughing or any other activities associated with E&P activities from oil field operations.

f. All of the areas around old operation sites and proposed remediation sites by ICON show no impacts to the vegetation growing in these areas.

g. The root study of the healthy trees in the hardwood area showed very shallow and healthy root systems consistent with normal unimpacted stands of hardwoods. Most of the roots on the trees had roots at or very near the surface of the ground. ERZs for the trees that were observed ranged from 5 to 14 inches in depth.

h. Any remediation plan for the sites in the bottomland hardwood areas would require total destruction of the existing healthy plant communites that occur in those areas that are not being affected by any kind of previous oil field operations. Remediation activities would cause far more perturbations on the plant communites and would take decades to reestablish plant populations commensurate with the healthy plant stands that presently exist at the sites.

i. If required, a remediation depth of 24 inches would be more than adequate for covering the depth of the root zones on the existing vegetation, however, no benefits would accrue to these sites. Some filling of some small holes and increase in drainage would do more good than the drastic measures proposed by the plaintiffs in this case.

6.0 Basis for Opinions and Conclusions

The defendants in this case have been sued by the plaintiffs for various allegations of damages to their property, including soil and groundwater contamination. Experts for the plaintiffs have proposed expansive remediation depths for salts that could go to substantial distances below ground surface and greatly exceed root depths of sugarcane and soybean roots, the crops that are customarily grown on the tract. This report considers the characteristics of the vegetation at the property. A root study was conducted for root penetration in order to determine depths of the particular plant populations growing at each area. This consideration is very important to determine the appropriate depth of remediation, if required, for the propagation of the types of vegetation that grow in the area. These data represent a site specific study which relates directly to the New 90 property that is under investigation. Regulatory concerns for any proposed remediation activities, if any, will be addressed by other experts.

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

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