Site Investigation Report & Closure Plan – Neumin Limited Admission

H. C. Drew Estate vs Neumin Production Company
North Choupique Field
Calcasieu Parish, Louisiana

10 November 2021

Project No.: 0494259

The business of sustainability

ERM

Signature Page

10 November 2021

Site Investigation Report & Closure Plan – Neumin Limited Admission

H. C. Drew Estate vs Neumin Production Company
North Choupique Field
Calcasieu Parish, Louisiana

David G. Angle, P.G., CGWP
Associate

Angela M. Levert
Associate

Lance R. Cooper, PhD, P.E. (LA)
Partner

Environmental Resources Management Southwest, Inc.
CityCentre Four
840 West Sam Houston Parkway North, Suite 600
Houston, Texas 77024-3920
281-600-1000 (T)
281-520-4625 (F)

CONTENTS

APPENDICES

List of Tables

List of Figures

1. INTRODUCTION

On behalf of Neumin Production Company (Neumin), Environmental Resources Management (ERM) is pleased to submit this Site Investigation Report and Closure Plan – Neumin Limited Admission (Plan) to the Louisiana Department of Natural Resources (LDNR) Office of Conservation in support of Neumin's October 14, 2021 limited admission to the court under La. R.S. 30:29.

The focus of this Plan is the HC Drew Manual Estate "15" No. 1 former oil and gas production facility located in the North Choupique oil and gas field in Calcasieu Parish, Louisiana that is the subject of a lawsuit filed in November 2019 in which Neumin and Stokes and Spiehler are being sued for alleged environmental damage that the plaintiff, H.C. Drew Estate, assert has been caused by historical oil and gas exploration and production (E&P) operations.

Previous equipment removal activities have been conducted by Davies Construction and investigations of the property have been conducted by Acadian Engineers & Environmental Consultants, Inc. (Acadian) in 2016 and 2018 on behalf of Neumin and Southland Environmental, LLC (Southland) in 2018 on behalf of the landowner. Soil and groundwater sampling data gathered by Acadian and Southland, as well as field documentation and sampling data collected by ERM, have been compiled and the results are presented in this report.

1.1 Scope and Objectives

The scope and objectives of this report and Plan include the following:

- Summarize the available soil and groundwater data gathered to date;
- Present the results of the Statewide Order 29-B and RECAP evaluation; and,
- Present a most feasible plan for the site.

2. SITE SETTING

The former H.C. Drew 15 #1 well site operational area consists of approximately one acre of rural agricultural land located approximately six miles west of the town of Sulphur in Calcasieu Parish, Louisiana (Figure 1). The property surrounding the former operational area is used primarily for cattle grazing.

The surface topography of the site is generally flat with a typical elevation of approximately 13 feet above Mean Sea Level (MSL). The United States Geological Survey (USGS) topographic map and Light Detection and Ranging (LiDAR) elevation model are provided in Figures 2 and 3, respectively.

2.1 Hydrology

The surface water features near the site are shown on Figure 4. The nearest down-gradient surface water body is an unnamed stream that is approximately 2,000 feet south-southwest from the former operational area.

The site is located within Louisiana Department of Environmental Quality (LDEQ) drainage basin subsegment #031001 – Bayou Choupique – From headwaters to ICWW (Estuarine) (Figure 5). The LDEQ-designated water uses for this subsegment are Primary Contact Recreation, Secondary Contact Recreation, and Fish and Wildlife Propagation. This subsegment is not designated for use as a drinking water source. There are no chloride or total dissolved solids (TDS) water quality criteria for subsegment #031001 in LAC 33: IX because the subsegment is classified as estuarine (LDEQ, 2021).

LDEQ Subsegment No. 031001 has been designated as impaired by the LDEQ by low dissolved oxygen and enterococcus bacteria as a result of natural sources and “treatment systems” (septic systems and similar decentralized systems) (LDEQ, 2021).

A portion of the former operational area, along with the majority of the surrounding property, is located within the Federal Emergency Management Agency (FEMA) 100-year floodplain (Figure 6). A narrow area mapped as outside the 100-year flood plain extends from the south and through the center of the former operational area.

Drainages and canals near the former operational area (greater than approximately 1,000 feet) are mapped as riverine wetlands by the US Fish and Wildlife Service (USFWS) (Figure 7). Features located to the east and west of the former operational area are mapped in the USGS National Hydrography Dataset as perennial streams (see Figure 4), but are not identified as riverine wetlands by USFWS. These features were observed in the field to be shallow drainages that were dry during ERM’s field activities.

2.2 Soil Characteristics

The composition of surface soils underlying the former operational area consists of silt loam based on the United States Department of Agriculture (USDA) soils map provided as Figure 8. A description of the soil type is provided below (USDA, 1988, 2016, & 2019):

- Lt – Prarieland silt loam, 0 to 1 percent slopes, rarely flooded – consists of poorly drained, slowly permeable soils on drainageways and broad flats on coastal plains. Maximum salinity ranges from nonsaline to slightly saline (0.0 to 4.0 mmhos/cm). The listed use for this soil type is rice and soybean production, rotated with crawfish aquaculture or pasture. Native vegetation consists of tall grasses and sedges.

2.3 Geology

The surface geology underlying the site consists of the following based upon the Louisiana Geological Survey (LGS) map (Figure 9):

- Ppbe – Beaumont Alloformation – stratigraphic sequence underlying the oldest and topographically highest of the Prairie surfaces west of the Mississippi alluvial valley. It is composed of coastal-plain deposits of late-to-middle-Pleistocene streams.

The locations of cross sections depicting the shallow geology beneath the site are shown on Figure 10. Cross sections A to A' and B to B' are shown on Figures 11 and 12. The soil boring logs and monitor well construction details prepared by ERM, Acadian, and Southland, including locations provided on the cross sections, are included in Appendices A through C. The cross sections document that the subsurface soils down to a depth of approximately 24-feet below the ground surface (bgs) consist primarily of clay with some silt. Shallow groundwater is present in an approximately three foot silt to sand zone that is encountered between approximately 7 and 15 feet bgs.

2.4 Hydrogeology and Groundwater

The uppermost approximately 120 to 160 feet of soil beneath the site is identified by Sargent (2004) as the Chicot Aquifer System Surficial Confining Unit, which consists predominantly of clay (Figure 13) that is reported as relatively impermeable (Stanley and Maher, 1944). A hydrogeologic cross section (USGS, 2017) depicts the clay-confining unit beneath the site (Figure 14). Water well drillers logs obtained from LDNR document that the soils within the confining unit on the property are predominantly clay. Copies of the drillers' logs are provided in Appendix D.

The drillers' log for water well 12299Z, the rig supply well formerly located in the operational area documents the presence of clayey soils extending from the ground surface to approximately 140 feet below the ground surface. The other drillers' logs within a 1-mile radius show similar or greater thicknesses of clayey soils. These drillers' logs demonstrate the lack of a viable shallow water-bearing zone for potential future water supply in the vicinity of the former operational area.

The Chicot Aquifer underlies the confining unit. The site is located over an area that has a low potential to recharge the Chicot aquifer system based on the LGS Louisiana Aquifer Recharge Potential map as shown on Figure 15. The Chicot aquifer system is recharged primarily by rainfall on parishes located to the north.

ERM has conducted a one-mile radius search of LDNR's Strategic Online Natural Resources Information System (SONRIS) database to identify registered water wells located within the area (Figure 16). The active water wells are reported to be screened in the Chicot Aquifer at depths ranging from 160 to 325 feet below the ground surface. There is one reported plugged and abandoned rig supply well, 12299Z in the former operational area. The well was screened to 160 feet bgs. There is one reported active domestic water well located approximately 4,000 feet southwest of the former operational area, screened to 254 feet bgs.

The groundwater within the Chicot Aquifer near the site is fresh (chloride <250 mg/L) based upon USGS data from water wells in the area as shown on Figure 17. However, salt water is present in both local and widespread areas within the Chicot aquifer system in Calcasieu Parish (USGS, 2017).

Shallow groundwater is encountered underlying the former operational area in a silt to sand zone encountered between approximately 7 and 15 feet bgs (Figures 10-12). The thickness of this shallow water-bearing zone ranges from approximately one to seven feet, with an average thickness of approximately three feet. This zone is both overlain and underlain by soils predominantly composed of clay. The shallow water-bearing zone does not appear to have been used as a water source on the site

and does not represent a viable future source of potable or irrigation water due to low yield and naturally poor water quality [i.e. concentrations of iron and manganese naturally exceed EPA secondary drinking water standards]. There are no registered water wells within a one-mile radius of the site that are reported to be screened in the shallow water-bearing zone (Figure 16).

2.4.1 Groundwater Classification

The shallow water-bearing zone underlying the site is RECAP Class 3A groundwater based upon the results of ERM's slug test analyses completed in three wells. These results document that the shallow water-bearing zone is not able to sustain a yield of greater than 800 gallons per day, the RECAP Class 2 criterion. The slug test results are summarized on Table 1, and the individual slug test evaluation reports are provided in Appendix E. The overall yield of the shallow water-bearing zone is 103 gallons per day. In addition, multiple monitoring wells installed by both Acadian and Southland in the shallow water-bearing zone (TW-1, TW-2, TW-3, TW-4, TW-5, TW-6, SE-SB02, and SE-SB03) went dry or produced low yield during the well purging and sampling process. The monitoring wells that purged dry are shown on Figure 18.

2.4.2 Groundwater Flow

Groundwater level data were collected on September 10, 2021 from the monitoring wells present on the site at that time. The well survey data and water elevations are provided on Table 2. The potentiometric surface map for the shallow water-bearing zone is provided on Figure 19. The shallow groundwater flow direction is generally to the southwest. Based on the potentiometric map, the groundwater flow has a gradient of approximately 0.0013.

2.5 Oil and Gas Exploration and Production

Neumin entered into a lease agreement with the Drew Manual Estate to drill and produce hydrocarbons from the F RA SUA; HC Drew Manual Estate "15" No. 1 well (SN225207) that was initially completed as an oil well in February 2001 (Figure 20). The well was recompleted multiple times in 2002, 2009, and 2011 then plugged and abandoned in 2015.

Historical aerial photographs from 1998 through 2020 showing the historical development of the Neumin Production facility, which included the wellhead, a tank battery, and production area, are provided on Figures 21 through 30.

3. REGULATORY FRAMEWORK

The oil and gas E&P operations that have been conducted on the site are regulated by LDNR's Office of Conservation. LDNR rules for environmental protection are presented in Louisiana Administrative Code, Title 43, Part XIX (LAC 43: XIX), Subpart I, commonly referred to as Statewide Order 29-B.

3.1 Soil

The applicable or relevant and appropriate standards for soils are Statewide Order 29-B Chapter 3 pit closure criteria and LDEQ RECAP standards. The Statewide 29-B pit closure regulations establish standards for metals, salts and hydrocarbons (oil & grease) in soils at E&P sites. RECAP was developed by LDEQ based on EPA guidance to provide a framework for evaluating risks to human health and the environment from chemical constituents in impacted media (e.g., soil and groundwater).

The soil data gathered from the property have been compared to the following Statewide Order 29-B criteria (adopted in 1986) and to RECAP standards (adopted in 2003) where appropriate:

- Range of pH: 6-9
- Total metals (mg/kg wet weight, unless noted):
  - Arsenic: 10
  - Cadmium: 10
  - Chromium: 500
  - Lead: 500
  - Mercury: 10
  - Selenium: 10
  - Silver: 200
  - Zinc: 500
  - True Total Barium: 40,000 (Upland)
    20,000 (Wetland) (dry weight)
- Oil and Grease: <1 percent (dry weight)
- Electrical Conductivity: <4 mmhos/cm (Upland)
  <8 mmhos/cm (Wetland)
- Sodium Adsorption Ratio: <12 (Upland)
  <14 (Wetland)
- Exchangeable Sodium Percentage: <15 percent (Upland)
  <25 percent (Wetland)

Per Statewide Order 29-B Section 313 Part D., "Pits containing E&P Waste may be closed onsite by mixing wastes with soil from pit levees or walls and adjacent areas provided waste/soil mixtures at completion of closure operations do not exceed the following criteria, as applicable, unless the operator can show that higher limits for EC, SAR, and ESP can be justified for future land use or that background analyses indicate that native soil conditions exceed the criteria." Although pits were not used to manage

produced water or waste at the site, the soil data were evaluated using the Statewide Order 29-B criteria, consistent with LDNR management of E&P sites.

Based on a site-specific root study performed by Dr. Luther Holloway and Mr. Patrick Ritchie on the site, the maximum effective root zone is ten to twelve inches in depth for plants (trees and herbaceous species) growing on the tract (Appendix F). Statewide Order 29-B salt parameters in soil are agronomic standards established to promote the growth of crops and other vegetation; therefore, it is appropriate to apply them only to soils within the effective root zone. Because of the presence of elevated gravel roadways in some areas, a slighter deeper excavation depth could be warranted in some of these gravel areas. For delineation purposes only, 29-B salt parameter data in soil deeper than one foot (i.e., regardless of depth) were also evaluated.

In addition to the promulgated LDNR salt standards, LDEQ established guidelines for salt parameters in a 2012 document entitled, “How should a release of brine (sodium chloride) be addressed under RECAP?” [Commonly referred to as the RECAP Frequently-asked-questions (FAQ) on salt]. The RECAP FAQ adopts the Statewide Order 29-B standards for salt parameters for soils within the effective root zone as a screening tool and utilizes a synthetic precipitation leaching procedure (SPLP) approach for determining salt concentrations in deeper soils that are protective of groundwater. To assess salt parameters in soils below the effective root zone, RECAP utilizes a comparison of soil SPLP leachate results to standards for chloride appropriate to the specific groundwater classification.

3.2 Groundwater

There are no direct comparative groundwater standards provided in Statewide Order 29-B; therefore, the groundwater data have been evaluated in accordance with LDEQ’s RECAP regulation. EPA’s Maximum Contaminant Levels (MCLs) and Secondary Maximum Contaminant Levels (SMCLs) are used in RECAP in the screening step and to evaluate groundwater zones that are classified as a drinking water resource. MCLs are enforceable standards established by EPA to protect the public against consumption of drinking water contaminants that present a risk to human health. An MCL is the maximum allowable concentration of a contaminant in drinking water supply which can be delivered to the consumer. SMCLs are non-enforceable standards that are used as guidelines to assist public water systems in managing their drinking water for aesthetic considerations, such as taste, color, and odor. MCLs and SMCLs do not apply to RECAP Class 3 groundwater.

LAC 43.XIX.303.C identifies that “Contamination of a groundwater aquifer or a USDW with E&P Waste is strictly prohibited.” However, a February 25, 2011 Memorandum of Understanding (MOU) between LDNR and LDEQ establishes a mechanism for the use of RECAP procedures for the evaluation or remediation of groundwater at E&P sites. This interagency agreement recognizes that RECAP contains groundwater evaluation and remediation standards and protocols that are applicable and appropriate for E&P sites.

Groundwater within the shallow water-bearing zone is RECAP Class 3A based on low yield and is naturally poor quality based on laboratory analytical results. The shallow groundwater zone is not currently being used, has never been used, and is not a viable drinking water or irrigation source due to its naturally poor water quality and low yield.

3.2.1 Louisiana Title 51 Public Health-Sanitary Code and LAC Title 56 Regulations

In addition to the natural limitations on use of the shallow groundwater due to low yield and quality, any attempted use of groundwater in the shallow water-bearing zone for potential potable supply use could/would result in non-compliance with the Louisiana Title 51 Public Health-Sanitary Code regulation. The Part XII. Water Supply §327.A regulations specify the following regarding all potable water supplies:

- "The earth formations above the water-bearing stratum shall be of such character and depth as to exclude contamination of the source of supply by seepage from the surface of the ground." (No. 5)
- "private supply wells shall be cemented from a minimum depth of 10 feet to the ground surface." (No.8)

Furthermore, Louisiana Administrative Code (LAC) Title 56 Part I. Section 319 regulations pertinent to small diameter (<4-inches) water wells located in coastal areas prone to flooding as a result of direct impact of storm surge events shall be constructed with:

"5. grouting down to a depth of at least 50 feet below ground surface."

The top of the shallow groundwater-bearing zone is as shallow as approximately seven feet below the ground surface beneath the site. Potable water could not be obtained from this zone based upon the Sanitary Code and LAC Title 56 regulations cited above.

4. DESCRIPTION OF INVESTIGATION ACTIVITIES

Soil and groundwater investigations have been conducted at the site by Acadian in 2016 and 2018, Southland in 2018, and ERM in 2021. The soil and groundwater analytical data are summarized on Tables 3 and 4, respectively. The field parameters recorded during the groundwater sampling events are provided on Table 5. Sample location maps are provided as Figures 31 through 34. ERM soil boring logs and monitoring well construction diagrams are provided in Appendix A. Acadian field screening results and well records are provided in Appendix B. Southland boring logs and photographs are provided in Appendix C. Laboratory reports are provided in Appendix G. Field notes and photographs and photo logs recorded by ERM during site investigation activities are provided in Appendices H and I. LDNR well registration documents for the monitoring wells installed by ERM are included in Appendix J. A summary of work performed and materials relied upon by ERM is included in Appendix K.

4.1 Acadian Soil and Groundwater Investigation

Acadian conducted a soil and shallow groundwater investigation in November-December 2016 and February 2018. Acadian identified three areas within the former operational area that were the focus of their sampling program (Production Area, Wellhead Area, and Tank Battery Area, shown on Figures 32 and 34). Acadian's field investigations consisted of the following:

- Installation of 31 soil borings and collection of 48 soil samples from depths between the ground surface and up to 18 feet below the ground surface. The soil borings were installed using a GeoProbe Model No. 6712DT hydraulic direct push drilling rig equipped with five foot long by two inch diameter steel sampling tubes. Electrical conductivity (EC) measurements were made in the field by Acadian using a handheld EC meter to record the EC of water resulting from the mixture of equal volumes of soil and distilled water.
- The soil samples collected in 2016 were analyzed by SGS Accutest (Accutest) in Lafayette, Louisiana, a Louisiana Environmental Laboratory Accreditation Program (LELAP) accredited laboratory, for Statewide Order 29-B salt parameters [electrical conductivity (EC), sodium adsorption ratio (SAR), and exchangeable sodium percentage (ESP)]. The soil samples collected in 2016 were also analyzed for bicarbonate alkalinity, chloride, sulfate, and pH. The soil samples collected in 2018 were analyzed by Element Materials Technology (Element) in Lafayette, Louisiana, a LELAP accredited laboratory. The soil samples collected in 2018 were analyzed for 29-B salt parameters, and select samples were also analyzed for 29-B metals and HEM Oil and Grease (O&G).
- Six temporary monitoring wells, including one located approximately 1,000 feet northwest of the former operational area (Acadian-selected background location), were installed at total depths ranging from 15 to 20 feet below the ground surface. The groundwater samples collected in June 2016 were analyzed by Element for specific conductivity and SAR. The groundwater samples collected in December 2016 were analyzed by Accutest for metals, chloride, specific conductivity, pH and HEM O&G. The groundwater sample collected in February 2018 was analyzed by Element for chromium, zinc, chloride, pH, chemical oxygen demand, total dissolved solids (TDS), total suspended solids (TSS), and HEM O&G.
- Acadian conducted a bail down test on temporary monitoring well location TW-6.

4.2 Southland Soil and Groundwater Investigation

Southland conducted a soil and shallow groundwater investigation of the site in September 2018 that consisted of the following:

- Installation of 22 soil borings and collection of 85 soil samples from depths between the ground surface and up to 20 feet below the ground surface. The soil borings were installed using a GeoProbe Model No. 7822DT hydraulic direct push drilling rig. Soil cores were field screened for EC and soil core descriptions were recorded. The soil samples were submitted to Element and analyzed for 29-B salt parameters (EC, ESP, and SAR). Soil samples from boring SE-SB22 were also analyzed for HEM O&G.
- Installation of six temporary monitoring wells, including one located approximately 1,000 feet northwest of the former operational area (Acadian-selected background area), at total depths ranging from 13 to 14.5 feet below the ground surface. Groundwater samples were collected from each of the monitoring wells and submitted to Element for chlorides analysis.

4.3 ERM Soil and Groundwater Investigation

ERM conducted a soil and shallow groundwater investigation of the site in September 2021. Southland was present during this investigation and collected split samples. ERM's investigation consisted of the following:

- Installation of 11 soil borings and collection of 16 soil samples from depths between the ground surface and up to 24 feet below the ground surface. Soil boring/monitoring wells were installed with a hydraulic direct push Geoprobe® rig equipped with a dual tube sampling system to collect continuous soil cores in acetate lined core barrels. Walker Hill Environmental (WHE), a Louisiana-licensed water well driller, performed the drilling. Soil borings where monitoring wells were not installed were grouted to the ground surface using a Portland/powdered bentonite grout mixture consistent with LDEQ/Louisiana Department of Transportation and Development (LDOTD) specifications.

  Soil samples were collected continuously in four-foot long, new, dedicated acetate liners from each boring to the total depth. The soil samples were logged in the field by an ERM geologist, including field screening with a Photo Ionization Detector (PID), and handheld EC pen. Soil samples were collected for laboratory analysis in new laboratory-provided containers and immediately placed on ice. Soil samples were sent to Element in Lafayette, Louisiana and Pace Analytical in Baton Rouge Louisiana for analysis. Both laboratories are LELAP accredited laboratories. Southland was present during ERM's investigation and collected splits of ERM's soil samples.
- EC was measured at three locations using a direct push Geoprobe® electrical conductivity probe. EC was measured continuously from the ground surface to depths of up to 28 feet. EC probe logs are shown on Figure 35.
- Installation and sampling of four monitoring wells. Monitoring well installation was performed by WHE, a Louisiana-licensed environmental driller. The monitoring wells were installed in or adjacent to the boreholes used to continuously collect soil samples for visual description purposes. Upon completion of each soil boring, a 1-inch diameter Schedule 40 polyvinylchloride (PVC) monitoring well equipped with a prepacked screen (0.01-inch slot) was installed in the borehole. A 20/40 grain size silica sand pack was placed in the annular space and extended to approximately 2-feet above the top of the screen. An approximate 2-foot bentonite pellet plug was placed on top of the sand pack. The remainder of each borehole was tremie-grouted to the ground surface using a Portland/powdered bentonite grout mixture consistent with LDEQ/LDOTD specifications. A locking cap was installed on each monitoring well.

  Each permanent monitoring well was completed with a flush-mounted protective casing. The protective casing was set in an approximate two-foot by two-foot, approximate 4-inch thick concrete pad and guard posts were installed around each concrete pad. The monitoring wells were installed in

accordance with the LDEQ/LDOTD Construction of Geotechnical Boreholes and Groundwater Monitoring Systems Handbook.

- Representative groundwater samples were collected from each ERM well following the procedures outlined below. Dedicated polyethylene tubing was lowered to the approximate middle of the well screen and a peristaltic pump was used to develop, purge and sample each well. Each monitoring well was developed to remove fine-grained sediment and prepare the well for the collection of water samples representative of the actual groundwater quality at each location. Well development was accomplished by pumping and surging. Groundwater was purged at EPA-recommended rates of 0.1 to 0.5 liters/minute. Field geochemical parameters including pH, temperature, specific conductance (SC), dissolved oxygen, turbidity and oxidation-reduction potential (ORP) were measured during the well purging process. A graduated bucket was used to measure the volume of water removed. Development and purging was determined to be complete when water quality parameters had stabilized and water clarity showed no further improvement. The field parameters recorded during the groundwater sampling events are provided on Table 5.

  Following stabilization of field parameters, the groundwater input tubing was disconnected from the flow-through cell, and laboratory-supplied sample bottles were filled at the purge rate. Each groundwater sample was directly discharged to the laboratory supplied sample bottles. Samples were placed on ice immediately following collection and submitted under proper chain-of-custody to Pace Analytical, a LELAP accredited laboratory for analysis. Southland was present during ERM's investigation and collected splits of ERM's groundwater samples.

- M. P. Mayeux Surveying and Boundary Consulting, L.L.C., a Louisiana-licensed professional land surveyor based in Lafayette, Louisiana surveyed the location, top of casing, and ground surface elevation of ERM's wells on September 9, 2021. The survey data is included in Appendix L. ERM conducted water level measurements in the surveyed monitoring wells on September 10, 2021. Water levels were measured in each well using an electronic tape, which was slowly lowered down the center of the casing and the water level was recorded to the nearest hundredth of a foot. The survey data and groundwater elevation measurements are presented in Table 2. A potentiometric surface map is provided on Figure 19.

- Slug tests were performed on three of ERM's monitoring wells (MW-2, MW-3, and MW-4). The slug tests were performed with a solid polyethylene slug. Water levels in the wells were continuously recorded using an In-Situ Level Troll 700.

- A root zone study was concurrently conducted by Dr. Luther Holloway and Mr. Patrick Ritchie. The results of the root zone study are presented in Appendix F.

5. INVESTIGATION RESULTS

The results of the Acadian, Southland, and ERM field investigations are presented below. A RECAP evaluation of these results is included as Section 6 of this report.

5.1 Soil

5.1.1 Metals

Arsenic was detected in the wellhead area in Acadian's B29-S5 sample at 10-12.5 feet bgs with a concentration of 13.6 mg/kg, which exceeds the Statewide Order 29-B standard (10 mg/kg) and the RECAP Soil SSni standard (12 mg/kg). ERM resampled this interval (B-29R 10-12.5'), and the arsenic exceedance was not confirmed in ERM's sample (2.73 mg/kg) or Southland's split sample (8.55 mg/kg).

5.1.2 Hydrocarbons

There were no exceedances of the Statewide Order 29-B HEM oil and grease (O&G) one percent standard in the soil samples collected during Acadian and Southland's field investigations. Southland's boring log for SE-SB09 in the wellhead area reported a slight odor from 1.6' to 7.6' bgs, but soil samples from that location were analyzed for 29-B salt parameters only. ERM resampled this location (SE-SB09R) and collected samples from the 4-6', 6-8', and 8-10' intervals based on field observations (odor) and PID readings. HEM O&G was analyzed in the 4-6' and 8-10' intervals and was well below the 29-B standard (0.06% and <0.05%, respectively). Southland analyzed split samples for TPH-D and TPH-O and reported concentrations above the RECAP screening standards in the 4-6' and 6-8' intervals. ERM's samples were analyzed for the RECAP-recommended TPH fractions, and all fraction results were below RECAP screening standards[1]. ERM's split samples were also analyzed for polycyclic aromatic hydrocarbons (PAHs). Naphthalene was detected in the 4-6' interval at 1.57 mg/kg, slightly above the RECAP Soil SSGW screening standard of 1.5 mg/kg. This interval was further analyzed for SPLP naphthalene, with a result of 0.0106 mg/L, demonstrating protection of groundwater. The remaining PAH analyses in the 4-6', 6-8', and 8-10' intervals were below the RECAP screening standards.

5.1.3 29-B Salt Parameters

There were two locations (B12 in wellhead area and B19 in tank battery area) that exhibited laboratory exceedances of the Statewide Order 29-B EC, SAR and ESP upland standards in the upper one foot of soil. B12 was resampled by ERM (B12R) and the 29-B salt parameter exceedances were not confirmed in either split sample. 29-B salt parameter data in the upper two feet of soil (i.e., the effective root zone and the interval immediately beneath) are presented on Figure 36.

To further evaluate vertical delineation of 29-B salt parameters in soil, ERM resampled soil at the boring location with the highest laboratory EC detection in each of the three areas (B7 in the production area, B12 in the wellhead area, and SE-SB19 in the tank battery area. An EC probe was advanced at each of these locations for continuous vertical EC data and was used to guide sampling intervals. Samples were collected from the interval exhibiting the maximum field EC detection, and beneath salt impacts based on field EC readings and were analyzed for 29-B salt parameters and SPLP chloride. EC probe logs are shown on Figure 35. 29-B salt parameter data in soil from all depth intervals is presented for the stepout

[1] ERM samples from SE-SB09R were sent to Pace for analysis of total petroleum hydrocarbon (TPH) fractions and polycyclic aromatic hydrocarbons (PAHs). These samples were mixed up by the laboratory during sample logging and the depth intervals could not be conclusively distinguished. The samples were logged by the lab as "A", "B", and "C". Based on photos of the samples provided by the lab (included with lab reports in Appendix G), and comparison of sample results with field observations, results from samples analyzed by Element, and split sample results, ERM identified that sample "A" is 8-10', "B" is 4-6', and "C" is 6-8'.

locations on Figure 37, the production area on Figure 38, the wellhead area on Figure 39, and the tank battery area on Figure 40.

Soil sampling in and around the approximately 1-acre former operational area has been extensive, including 165 soil samples submitted for laboratory analysis from 55 boring locations. Detected exceedances of 29-B salts in soil are relatively few, limited in extent, and generally only slightly exceed the 29-B standards. Based on the extensive laboratory data, 29-B salt parameters in soil have been vertically and horizontally delineated in each investigation area. The following data address vertical delineation of salt parameters below the effective root zone in each study area (Figures 38 through 40):

- In the production area, locations B7, B9, B-22, and B26 included elevated salt indicators at the maximum depth sampled by prior investigators. The samples are in close proximity and vertical delineation to below standards is provided by laboratory data for this group of samples in ERM's boring B-7R and Southland's boring SE-SB13. Vertical delineation is also provided in the production area by Southland borings SE-SB-10, SE-SB-11, SE-SB12, SE-SB14, and SE-SB15.
- In the wellhead area, sampling by ERM at B-12R provided vertical delineation of salt indicators detected by Acadian (and unconfirmed) in the deepest and only sample with salt indicators above 29-B standards (B-12 2.5').
- In the tank battery area, locations B5, B16, B-17, and SE-SB19 included elevated salt indicators at the maximum depth sampled by prior investigators, and vertical delineation to below standards was performed for this closely spaced group of samples in ERM's boring SE-SB19R. Vertical delineation is also provided in the tank battery by Acadian boring B19 and Southland borings SE-SB16, SE-SB17, SE-SB18, SE-SB20, SE-SB21, and SE-SB22.

The extensive field EC readings (see Appendices A through C) further support that vertical and horizontal delineation of salt parameters has been achieved.

5.2 Groundwater

5.2.1 Groundwater Classification

ERM analyzed the slug test data by uploading the water level data into AQTESOLV Version 4.5, a commercially available and widely used software program. The water level displacement data collected during the tests were plotted electronically on a logarithmic scale vs. elapsed time on a linear scale. As specified in RECAP Appendix F, the Hvorslev (1951) curve-matching method for confined aquifers was used to calculate the hydraulic conductivity. The yield for each well was calculated based upon LDEQ's RECAP Appendix F equations. The overall yield was calculated as specified in RECAP by taking the geometric mean of all wells screened in the shallow water-bearing zone. The overall yield of the shallow water-bearing zone is 103 gallons per day (gpd) and falls within the range specified by LDEQ as Class 3 groundwater (less than 800 gpd). The slug test results are presented in Table 1. Slug test reports are presented in Appendix E. The baildown test performed by Acadian was not analyzed due to a lack of necessary data to complete the analysis (i.e., no detailed boring log available, test ended before water level equilibration achieved). Eight wells went dry or exhibited low yield during the sampling events, supporting the LDEQ RECAP Class 3 determination (Figure 18)

5.2.2 Hydrocarbons

Southland reported odors and/or a sheen on SE-SB22 soils (former tank battery area), including a sheen in the saturated zone. In order to further evaluate hydrocarbons in groundwater at this location, ERM installed a well (MW-4) at the SE-SB22 location. Southland's split groundwater sample at this location contained concentrations of TPH-D and TPH-O slightly above their RECAP screening standards.

However, the associated laboratory report (Element Lab Report 21090354; see Appendix G) indicates "two distinct contaminant peaks" in the TPH-D and TPH-O aqueous analyses, and the laboratory "traced the source of the contaminants back to the sample containers". Therefore, the results are not reliable as representative of site conditions. ERM's sample at the MW-4 location, along with samples collected at ERM's stepout locations (MW-1 through MW-3) were analyzed for RECAP-recommended TPH fractions. TPH fractions were not detected in any groundwater samples.

5.2.3 Metals

Concentrations of arsenic, chromium, and/or lead were reported above their respective RECAP screening standards in samples TW-3, TW-4, and TW-5 collected by Acadian in December 2016. These samples were collected using temporary wells, and only analysis of total metals was performed (i.e., samples were not filtered for dissolved metals analysis) and the elevated metals results appear to be related to suspended solids (turbidity) in the Acadian samples and not reflective of groundwater quality. ERM's monitoring wells MW-1 through MW-4 were analyzed for both total and dissolved metals, and no exceedances of the RECAP screening standards were reported for these metals in the ERM or Southland split samples. ERM's MW-4 well was located less than 20 feet from Acadian's TW-4 well (where metals detected were generally highest), providing further evidence that Acadian's original elevated metals concentrations are not reflective of groundwater quality.

Iron and/or manganese exceeded the EPA SMCLs in all unfiltered samples where iron and manganese data were collected, and manganese remained above the SMCL in the filtered samples indicating the naturally poor quality of the shallow water-bearing zone.

5.2.4 Chloride

Chloride concentrations in groundwater are presented on Figures 41 and 42. Elevated chloride concentrations in the shallow groundwater beneath the site are limited to the area in and around the former operational area, with a maximum concentration of 7,200 mg/L in well TW-3 in the former production area. Concentrations decrease rapidly with distance, and chloride is horizontally delineated below the SMCL of 250 mg/L. The massive thickness of the clay-confining unit underlying the Class 3 shallow water-bearing zone is protective of the useable Chicot Aquifer underlying the property.

6. RECAP EVALUATION

The results of the soil and groundwater investigations were evaluated in accordance with RECAP, which provides LDEQ-recommended methods for identifying standards protective of human health and the environment. The quantitative assessment is provided for soil in Section 6.2.1 and for groundwater in Section 6.2.2 using a step-wise process, i.e., using a screening step to first identify potential constituents of concern, followed by site-specific assessment.

6.1.1 Summary of Exposure Pathway Analysis and Exposure Scenarios

Consistent with RECAP guidance, the current and potential future land use of the study area were considered in the evaluation of risk to human health from direct contact. The default RECAP standards relevant to potential soil contact under the current agricultural land use are the industrial standards. These standards apply to the agricultural use of the property in accordance with RECAP Appendix E [NAIC code 111 (agriculture, crop production)]. However, to address potential residential use of the property in the future, the risk evaluation was performed using the default non-industrial (residential) exposure scenario of RECAP. A non-industrial assessment provides the most conservative assessment under RECAP, and demonstration of compliance with non-industrial standards eliminates the requirement for conveyance notice for site soil.

There is currently no use of groundwater beneath the site for any purpose. Groundwater in the Chicot Aquifer was used for rig supply historically; the well located on site was screened to 160 feet bgs and was plugged and abandoned after use. The water well survey discussed in Section 2.4 confirms that all registered groundwater use within a mile of the site is from the Chicot Aquifer at total screen depths of 160 feet bgs or greater. There is no direct exposure to constituents in the shallow water-bearing zone investigated at the site; the zone is present to depths up to 15 feet bgs and is separated from the useable Chicot Aquifer by confining unit clay. The shallow groundwater zone beneath the site is Class 3 based on measured yield and is not a viable future water supply source. In accordance with RECAP requirements, the Class 3 groundwater was considered a potential source medium for surface water that could potentially receive discharge from shallow groundwater, and this pathway is evaluated in the site-specific RECAP assessment.

Based on the analysis of potential exposure pathways for the site, the human exposure scenarios that are quantitatively evaluated under the Screening and Management Options in accordance with RECAP include:

- Non-industrial exposure to soil ($Soil_{ni}$): exposure is assumed to include ingestion, dermal contact, and inhalation.
- Soil to groundwater protection ($Soil_{GW3NDW}$): transfer of constituents to the upper water bearing zone is evaluated, considering subsequent migration of constituents to surface water.
- Class 3 groundwater (GW3NDW): potential groundwater discharge to surface water is evaluated, with use of surface water assumed to include recreation, fishing, and fish ingestion.

The default exposure assumptions provided in RECAP for these scenarios are utilized in the following assessment of soil and groundwater. A Conceptual Site Model (CSM) is provided in Figure 43 based on the results of the site-specific exposure pathway analysis.

6.2 DEVELOPMENT AND COMPARISON TO RECAP STANDARDS

RECAP provides a tiered framework consisting of a Screening Option (SO) and three Management Options (MO-1, MO-2, and MO-3) to evaluate risks to human health and the environment posed by releases of chemical constituents to environmental media. The higher tiers of assessment offer the flexibility to derive standards more reflective of site-specific conditions.

The SO, for which generic criteria are provided by LDEQ, was used to identify preliminary constituents of concern (COCs) in soil and groundwater. Further evaluation was performed under MO-1. Supporting calculations are provided in Appendix M.

6.2.1 Soil

Soil samples collected by ERM, Acadian, and Southland were used in the RECAP evaluation. One soil boring in each area included analysis of metals, with samples collected from multiple discrete depth intervals (Table 6). Based on review of the boring logs prepared by Southland, ERM completed a boring in the location where odors had been observed in the wellhead area (SE-SB09), and samples were collected for hydrocarbon fraction and PAH analysis in accordance with Appendix D of RECAP. Analyses were performed using LDEQ-recommended methods supported by Quality Assurance/Quality Control (QA/QC) data, and the laboratory QA/QC results indicate that the soil data are definitive data as defined in RECAP, suitable for use in quantitative risk assessment.

Split samples analyzed for total petroleum hydrocarbons by Southland were analyzed using the hydrocarbon mixture method (Method SW-846 8015), with the results expressed as total petroleum hydrocarbons in the diesel and oil ranges (TPH-DRO and TPH-ORO). Because hydrocarbon fractionation data provide more specific information than TPH mixture data and a more detailed understanding of TPH concentrations, use of fractionation data is recommended instead TPH mixture data for conducting environmental risk assessments (LDEQ, 2003; TPHCWG 1997 and 1998; EPA, 2009), and fraction results were used in this risk analysis in accordance with RECAP Appendix D.[2]

Screening Evaluation: As the first step in the RECAP risk evaluation, soil concentrations were compared to non-industrial limiting screening standards to identify constituents warranting further site-specific evaluation. The limiting standards are the lower of the screening standard protective of non-industrial direct contact (Soilssni) and the groundwater protection screening standard (Soilssgw). Data from all depths were included in the comparison to health-protective screening standards. The comparison of maximum reported concentrations in soil to limiting screening standards is provided in Table 6.

Soil concentrations for metals in each area are below the screening standards. One hydrocarbon indicator constituent, naphthalene, was reported above the default screening standard for groundwater protection in one sample from the wellhead area. A site-specific demonstration of groundwater protection was performed on the sample using SPLP testing. Comparison of the leachate concentration in Table 6 to the screening level for leachate (protective of all classes of groundwater) demonstrates that the concentration complies with the RECAP screening standard. No further action is required for soil to protect human health and underlying groundwater or to comply with RECAP requirements.

A supporting MO-1 analysis of the soil to groundwater pathway was also performed for naphthalene. Table 7 provides the supporting assessment, and confirms that naphthalene is below the default MO-1

[2] RECAP Appendix D states: ""If TPH fractionation data and TPH mixture data have both been collected at an AOI and the two data sets yield different conclusions about management of the AOI, then management decisions shall be based on the fractionation data since the fractionation method yields more specific information regarding the TPH constituents present and thus more accurately characterizes site conditions."

standard protective of underlying Class 3 groundwater, prior to use of any applicable dilution-attenuation factors. No further action is required for soil to comply with RECAP requirements for groundwater protection.

Evaluation of Salt in Soil: In accordance with RECAP guidance for the nontraditional parameter sodium chloride, the presence of salt in soil is not a concern for adverse effects to human health upon direct contact, and the evaluation of this compound is focused on vegetation health (an agronomic standard) and the potential soil to groundwater migration pathway. The evaluation related to agronomic health is provided in Section 5.1.3. To assess the soil to groundwater pathway, LDEQ recommends the comparison of SPLP results from salt-affected soil to a standard developed for the appropriate classification of underlying groundwater. ERM identified the sample locations with maximum reported EC in each of the three study areas, replicated the location to the extent possible, and collected a sample for SPLP analysis of chloride in the same location/interval as well as a deeper interval in the same boring. The locations included SE-SB-19 in the tank battery area, B-7 in the production area, and B-12 in the wellhead area. All SPLP leachate concentrations of chloride were below the SMCL of 250 mg/L, indicating salt concentrations in the soil samples do not pose a threat to underlying groundwater of any classification. Further, the discussion provided in Section 6.2.2 demonstrates there is not a standard for chloride in the GW3NDW groundwater within this estuarine surface water subsegment.

6.2.2 Groundwater

Groundwater data collected by ERM, Acadian, and Southland were used in the RECAP evaluation. Samples were collected from sixteen monitoring wells and were analyzed for the salt indicators chloride or specific conductance. Samples from eight monitoring well locations were also analyzed for select metals. For the wells installed and sampled by ERM (MW-1 through MW-4), the samples were analyzed for total and dissolved metals, chloride/TDS, hydrocarbon fractions, and BTEX. The well locations selected by ERM included the single location identified by Southland to include an observation of potential sheen on groundwater (location SE-SB22). Analyses were performed using LDEQ-recommended methods with supporting QA/QC and appropriate detection limits.

Split groundwater sample analyses for hydrocarbons by Southland were performed using the mixtures method (SW-846 Method 8015), with the results expressed as TPH-DRO and TPH-ORO (as noted in Section 5.2.2, the laboratory identified equipment-related contamination in the mixture results). Because LDEQ recommends use of hydrocarbon fraction data when both types of data are available, the fraction results are used in this RECAP assessment.

Screening Evaluation: Groundwater concentrations were compared to screening standards, protective for all classifications of groundwater, to identify constituents warranting further site-specific evaluation. Table 8 presents a comparison of maximum reported groundwater concentrations to screening standards (GWss) from RECAP Table 1. The SMCLs for chlorides, TDS, iron, and manganese are also compared to the groundwater concentrations solely for reference in the screening assessment, as drinking water standards are not applicable to Class 3 groundwater.

The groundwater sample results indicate that chloride is the site-related COC in shallow groundwater. Hydrocarbon fractions and BTEX were not detected, and metals concentrations in representative samples are below screening standards. The screening evaluation provides the following conclusions:

- The natural occurrence of iron and manganese is documented in independent regional studies by the USGS and LDEQ and is confirmed in wells on the Property that are unimpacted by E&P activities (e.g., MW-3). They are not considered site-related COCs warranting further evaluation.
- Total arsenic, chromium, and lead were reported above their screening standards in samples collected from temporary wells TW#3, #4, and #5, and filtered (dissolved) analyses were not

performed by the investigator. MW-4 was installed as a properly constructed ("permanent") monitoring well to replicate the sampling at TW#4. The results demonstrate that the metals are not elevated in samples collected from a permanent well, in either the filtered or unfiltered samples. The constituents are not confirmed to be present in groundwater, are not elevated in soil samples, and are not identified as site-related COCs. However, for demonstration purposes, the concentrations of arsenic, chromium, and lead reported in the unfiltered samples from temporary wells are further evaluated under MO-1.

- Chloride and TDS were reported above the SMCL used for screening in wells closest to the former operational areas. Chloride concentrations are delineated to below the SMCL, and TDS is delineated to naturally elevated levels (see TW#6 and MW-1). The SMCLs (aesthetic guidelines for public water supplies) are not applicable standards for the Class 3 water-bearing zone, and the maximum concentrations are further evaluated under MO-1.[3]

MO-1 Evaluation: The groundwater concentrations above screening levels were evaluated for protection of surface water that could potentially receive discharge from the groundwater zone. Based upon the groundwater flow direction and review of surface water drainage features in the field, the nearest down-gradient surface water body is an unnamed stream approximately 2,000 feet south-southwest from the former operational area. The site and surrounding water features are located within the estuarine surface water subsegment #031001, designated for recreational uses. GW3NDW is therefore the applicable standard for metals and there are no promulgated standards for chloride and TDS due to naturally elevated salt levels. The derivation of the final GW3NDW standards (i.e., including x, Sd, DF3) is provided in Table 9. The maximum reported concentrations (Compliance Concentrations) for the metals detected above screening in unfiltered samples are compared to the final GW3NDW standards in Table 9.

The maximum groundwater concentrations are less than standards protective of surface water quality, including all LDEQ-designated uses.

6.3 RECAP EVALUATION CONCLUSIONS

The RECAP evaluation for soil demonstrates that metals and hydrocarbon concentrations reported in soil are below screening standards for non-industrial direct contact, and protective for residential and unrestricted land use. The concentrations reported in soil and SPLP leachate do not provide a residual source of constituents to the uppermost groundwater above applicable health-based standards. Corrective action is not required to protect human health or comply with RECAP.

Chloride is the single COC identified in representative groundwater samples. The groundwater is Class 3 non-drinking water based on very limited yield, and the potential to discharge to surface water was evaluated as required by RECAP. There is not a promulgated standard for chlorides in water bodies near the site because of naturally elevated salt levels in the area. The chloride concentrations (and all constituent concentrations) reported in groundwater do not pose a risk to human health or the environment. Corrective action is not required to protect human health or comply with RECAP standards for groundwater.

[3] Appendix D of RECAP references MO-2 for analysis of non-traditional parameters and the RECAP Frequently Asked Questions reference MO-1. The term MO-1 is used herein because the LDEQ-recommended default attenuation factors are used in this assessment as provided in RECAP Appendix H, Section H1.2.2.3.

7. REMEDIATION PLAN

The remediation plan proposed in this section complies with Statewide Order 29-B and RECAP, which is the State's risk-based protocol for environmental evaluation and remediation. A remediation plan that fully complies with Statewide Order 29-B without exceptions is included in Appendix N. Supporting contractor cost estimates are provided in Appendix O.

7.1 Proposed Soil Remediation Plan

The soil analytical data indicates only one location, B-19, slightly exceeds 29-B salt parameters within the effective root zone. However, no split sampling or resampling has been conducted at this location to confirm the detected 29-B standard exceedances. Additionally, gravel berms are still present on the site around the tank battery area and the production area. Remediation of soil at the site is not necessary to support the previous and anticipated future use of the property for cattle grazing. Soil conditions support grass across the site, and healthy vegetation was observed throughout the former operational area except on small portions of the berms and where apparently inhibited by vehicle traffic (i.e., the gravel road and the center of the gravel pad). However, the following is proposed to address the B-19 location and gravel berms:

- Resample B-19 in the 0-1', 1-2', and 2-3' intervals for EC, ESP, and SAR;
- Level gravel berms around the production area and tank battery area; and
- If resampling of B-19 confirms 29-B salt parameter exceedances, blend the upper two feet of soil in the tank battery area, and collect confirmation samples for EC, ESP, and SAR.

Locations of proposed berm removal and contingent soil blending areas are shown on Figure 44. The estimated cost of this plan is presented on Table 10, and is approximately $14,000.

7.2 Contingent Removal of Gravel Pad, Road, and Fence

It is our understanding that the existing gravel pad, gravel road, and fence may need to be removed and restored to use for cattle grazing based on conditions of the lease (Figure 45). Both the gravel pad and road are approximately one foot thick, and are also approximately one foot higher in elevation than the surrounding field. Therefore, it is anticipated that the ground surface would be approximately level with the surrounding field after removal of the gravel material. It is anticipated that the gravel removal and subsequent grading process would naturally blend the soil to levels below 29-B salt parameter standards. Although this work is not required to meet state regulations, the following is proposed contingent on the requirements of the lease:

- Removal of the approximate 1,000-foot barbed-wire fence surrounding the former operational area;
- Removal and relocation of the approximately 200' x 200' gravel pad and 15' x 580' gravel road to be used as fill by the landowner if desired, or otherwise removed from the site;
- Placement of backfill material, if needed, to level the area; and
- Reseeding the area.

The process of removing the gravel pad, if needed, would eliminate the need to perform the proposed work presented in Section 7.1. Removing the gravel pad would also expose the underlying material (i.e., the current approximate 1-2 foot interval would become the effective root zone). Soil sampling data indicate that only the B19 location slightly exceeds 29-B salt parameters in this interval. If the resampling at this location confirms 29-B salt parameter exceedances, this location would be blended with

surrounding soil during the gravel pad removal and confirmation samples would be collected for 29-B salt parameters.

Locations of the gravel pad, gravel road, and fence are shown on Figure 45. The estimated cost of the removal of the gravel pad, road, and fence is presented on Table 11 and is approximately $43,000.

7.3 Groundwater

The groundwater chloride results document that any impacts from former oil and gas operations have been horizontally delineated. Additionally, the site and nearest downgradient surface water body fall within an estuarine surface water subsegment, and the residual chloride concentrations in the shallow groundwater do not present a threat to surface water quality. The massive thickness of the clay-confining unit underlying the thin Class 3 shallow water-bearing zone is protective of the useable Chicot Aquifer underlying the site. The site soil and shallow groundwater conditions do not endanger a USDW. ERM proposes to plug and abandon the existing monitoring wells on the site (MW-1 through MW-4) at a cost of approximately $7,000 (Table 12).

8. SCHEDULE AND REPORTING

The implementation schedule for the proposed remediation activities is provided below. The following milestones for the implementation schedule have been established:

- Begin implementation of remediation activities within 60 days following LDNR approval of the plan. The estimated field activities are estimated to take approximately one to two months and the groundwater monitoring well plugging and abandonment activities can be performed within this same timeframe; and
- Submit letter report to LDNR documenting remediation activities completed within 60 days of completion and receipt of final analytical laboratory reports and field documentation.

TABLES

November 10, 2021

FIGURES

November 10, 2021

APPENDIX A ERM BORING LOGS

November 10, 2021

APPENDIX B ACADIAN ENGINEERS FIELD SCREENING RESULTS AND WELL RECORDS

November 10, 2021

APPENDIX C SOUTHLAND BORING LOGS AND PHOTOGRAPHS

November 10, 2021

APPENDIX D LDNR WATER WELL RECORDS

November 10, 2021

APPENDIX E SLUG TEST REPORTS

November 10, 2021

APPENDIX F EFFECTIVE ROOT ZONE STUDY

November 10, 2021

APPENDIX G ANALYTICAL LABORATORY REPORTS

November 10, 2021

APPENDIX H FIELD NOTES

November 10, 2021

APPENDIX I PHOTOS AND PHOTO LOGS

November 10, 2021

APPENDIX J LDNR WELL REGISTRATION DOCUMENTS

November 10, 2021

APPENDIX K WORK PERFORMED AND MATERIALS RELIED UPON

November 10, 2021

APPENDIX L SURVEY DATA

November 10, 2021

APPENDIX M RECAP SUPPORTING CALCULATIONS

November 10, 2021

APPENDIX N FULLY COMPLIANT HYPOTHETICAL 29-B PLAN WITHOUT EXCEPTIONS

November 10, 2021

APPENDIX O CONTRACTOR COST ESTIMATES

November 10, 2021

ERM has over 160 offices across the following countries and territories worldwide

Argentina
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
France
Germany
Ghana
Guyana
Hong Kong
India
Indonesia
Ireland
Italy
Japan
Kazakhstan
Kenya
Malaysia
Mexico
Mozambique
Myanmar
The Netherlands
New Zealand
Norway
Panama
Peru
Poland
Portugal
Puerto Rico
Romania
Russia
Senegal
Singapore
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Tanzania
Thailand
UAE
UK
US
Vietnam

ERM's Houston Office
840 W. Sam Houston Parkway North
Suite 600
Houston, Texas 77024

T: 832-786-4781
F: 281-520-4625

www.erm.com

The business of sustainability

ERM