LETRA Lagoons Improvements

Draft Environmental Assessment

Prepared For:

American Water Enterprises

February, 2015

GARVER

GarverUSA.com

ENIVIRONMENTAL ASSESSMENT

LETRA LAGOONS IMPROVEMENTS
FORT SILL, OKLAHOMA

AMERICAN WATER ENTERPRISES

FCU 154.2

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February 2015

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2010	10,105	16,838	14,687	17,870	13,508	5 Month
2011	15,057	15,788	15,804	15,752	9,143	Avg Daily
2013	9,474	20,020	10,392	13,865	13,650	GPD
Avg Daily GPD	**11,431**	**17,071**	**15,257**	**15,632**	**11,320**	**14,142**

List of Appendices

1.0 Purpose, Need, and Scope

1.1 Introduction

This Environmental Assessment (EA) analyzes and documents the potential environmental consequences which could result from expanding the existing wastewater treatment system for the Lake Elmer Thomas Recreational Area (LETRA), located on Fort Sill, Comanche County, Oklahoma. LETRA is an area on Fort Sill that offers camping, RV sites, a no-wake lake, fishing, swim beaches and other recreational activities to visitors, staff, and residents of Fort Sill.

The existing wastewater treatment system consists of two lagoons that are no longer compliant with the construction standards regulated by the Oklahoma Department of Environmental Quality (ODEQ). Additionally, LETRA's renewed Oklahoma Pollution Discharge Elimination System (OPDES) permit was reissued in 2014 with more stringent limits. The existing lagoons cannot meet these limits without improvements. Because these improvements will be occurring on federal property that has previously identified environmentally sensitive areas, an EA is necessary per the National Environmental Policy Act (NEPA).

1.2 Background

Fort Sill is located approximately 90 miles southwest of Oklahoma City off Interstate 44 and borders Lawton, Oklahoma to the south and the Wichita Wildlife Refuge to the north and west. Refer to Figure 1. The installation itself totals an estimated 94,000 acres and is one of the five locations for Army Basic Combat Training in the United States. LETRA is located on the northwest side of base and along with recreational activities, includes fifty-eight (58) RV sites, ten (10) tent sites, eight (8) cabins, as well as bath houses, a country store, and a lodge.

Flow to the LETRA lagoons is composed of filter backwash from the nearby water treatment plant (WTP) and domestic type sewage from the recreational area. The collection system conveys flow to the two lagoons and consists of two pump stations, 6-inch and 8-inch diameter gravity lines, two force mains consisting of 2-inch and 3-inch diameters, and approximately 24 manholes. See Appendix A for an illustration of the collection system.

The LETRA lagoons consist of two flow-through lagoons that operate in series. They discharge to Deer Creek. These lagoons were constructed in 1987 and have been in operation for nearly 30 years. Until recently, they have not required any improvements. In August 2012, AWE received notice that LETRA's OPDES permit was updated by ODEQ during its renewal period. The draft permit included several new requirements for the final limits including no allowable discharge during the months of May-October. During November-April, new restrictions were also added which included disinfection requirements and inorganic metals monitoring. While interim limits for the new permit are authorized until July 31, 2016, without improvements, the system will likely be non-compliant at the adoption of final limits. Furthermore, current ODEQ construction standards for flow-through lagoons have been updated since their construction and they are no longer compliant with the current standards.

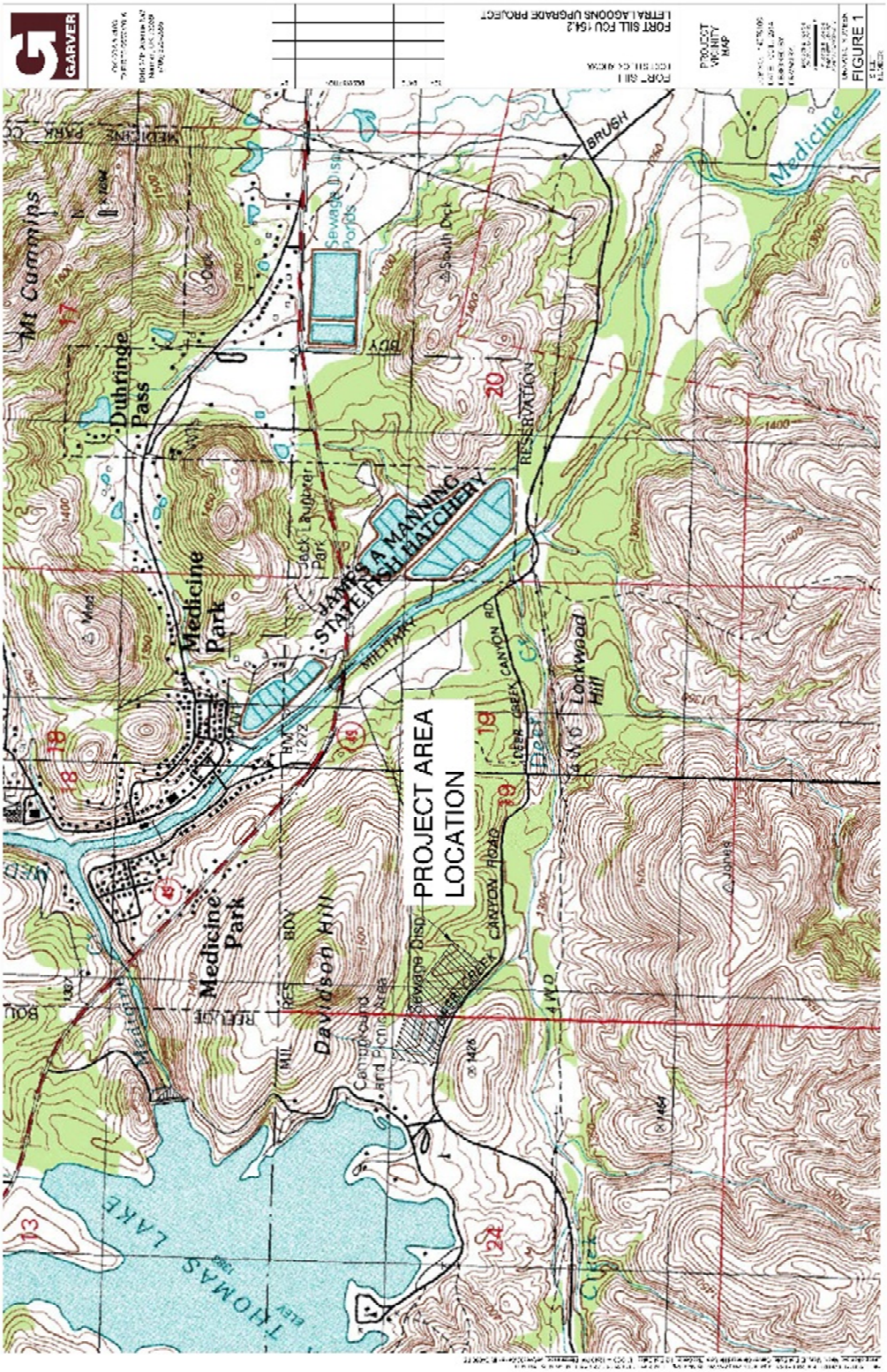

Figure 1 - Vicinity Map

1.3 Purpose of the Proposed Action

The purpose of the proposed action is to design and construct facilities for the LETRA wastewater treatment lagoon system that are compliant with the ODEQ construction standards and the recently renewed OPDES permit. The permits and standards issued by the ODEQ are done so to protect the waters of the State of Oklahoma and other valuable environmental resources. Adherence to those standards is the goal of the improvements proposed herein.

1.4 Need for the Proposed Action

The renewed OPDES permit for the facility has new, more stringent requirements. Currently, the lagoons operate as a flow-through, facultative system which has a discharge flow rate of 20,000 gallons per day (GPD). Under the final permit limitations, no discharge during the months of May – October is permitted, effectively making the system a total retention lagoon system during these months. To prevent a discharge and thus a violation from occurring, additional hydraulic holding capacity must be added in the form of more storage or a land application system.

In addition, the existing facility does not meet the most current construction standards required for flow-through lagoons or total retention lagoons. Furthermore, the two existing lagoons are operating outside of the design water level and are not maintaining the 3-ft minimum freeboard requirement.

ODEQ requires that the LETRA lagoon facility modify their plant and operations to:

- Meet ODEQ construction standards
- Meet more stringent effluent quality standards, or eliminate discharge entirely
- Maintain no discharge from May to October, regardless of operational type
- Incorporate handling for filter backwash water from the LETRA water treatment plant

If the lagoon's discharge to the surface waters of the State of Oklahoma are deemed to be out of compliance with the new permit, the entire recreation area may be subject to partial or complete closure.

1.5 Scope for the Environmental Assessment

This EA has been developed in accordance with the National Environmental Policy Act of 1969 (NEPA), which implements regulations issued by the Council on Environmental Quality (CEQ), and Army Regulation (AR) 200-2, *Environmental Effects of Army Actions.* Its purpose is to inform decision makers of the likely potential consequences of implementation of the proposed action and alternatives. This EA identifies, documents, and evaluates the human and natural environmental effects of expanding the wastewater treatment system at LETRA on Fort Sill. The project area is described in Section 2. The proposed action and alternatives, including a "no-action" alternative are described in Section 3. Biological, archaeological, cultural, tribal, environmental resources have been analyzed as a result of the proposed action and the impacts upon these resources are described in Section 5.

1.6 Public Involvement

Executive Order (EO) 12372, Intergovernmental Review of Federal Programs, requires intergovernmental notifications prior to making any detailed statement of environmental consequences. Through the process of Interagency and Intergovernmental Coordination for Environmental Planning, the proponent must notify concerned federal, state, and local agencies and allow them sufficient time to evaluate potential

environmental consequences of a proposed action. Comments from these agencies are subsequently incorporated into the environmental analysis. The U.S. Army and its contract with American Water Enterprises is the proponent of LETRA's wastewater system expansion and are the lead agencies for the preparation of this EA.

The U.S. Army encouraged and invited public/agency, tribal and other participation in the NEPA process. Consideration of the views and information of all interested persons promotes open communication and enables better decision making. All agencies, organizations, and members of the public having a potential interest in the proposed action, including minority, low-income, disadvantaged, and Native American groups, were encouraged to participate in the decision-making process during the 30-day draft EA public review period. Public participation opportunities with respect to this EA and decision making on the proposed action are guided by 32 CFR Part 651. The draft EA was made available to the public and others at the Lawton Public Library and XXXX libraries for 30 days between XXXXXXXXX and XXXXXXX 2015.

During the 30-day draft EA public review period, XXX comments were received. A summary of these comments follows:
XX

These comments, along with the newspaper advertisement notifying the public and others of the 30-day draft EA public review period and availability of the draft EA, are contained in Appendix I.

2.0 Project Area

2.1 Existing Conditions

Fort Sill is a United States Army post in Lawton, Oklahoma, about ninety (90) miles southwest of Oklahoma City. LETRA is a military campground and recreational area located 12 miles northwest of the main Fort Sill Post at 34.719768, -98.515. The campground is operated year-round on Lake Elmer Thomas, with the summer season from May 28 through September 10 hosting additional water activities.

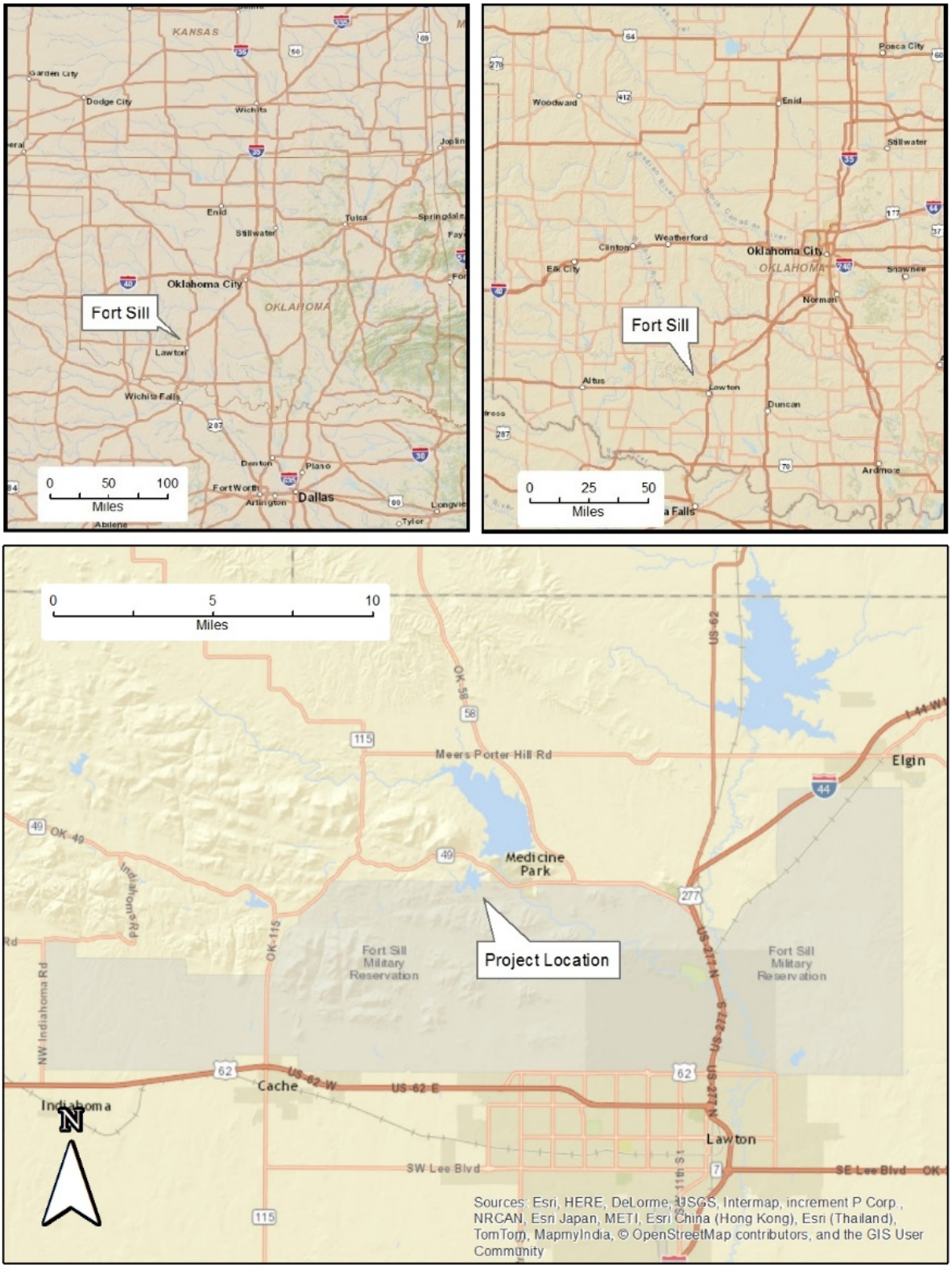

Figure 2 - General Vicinity Map

The park has fifty eight (58) RV sites and ten (10) tent sites, eight (8) cabins, as well as a large day use area with water slide, bath houses, a country store, and a lodge.

A regional vicinity map showing the project site and service area boundary is shown in Figure 2. The general area drains to the southeast toward Deer Creek, which confluences with Medicine Creek further downstream. LETRA is located within the Wichita Mountains and approximately 1 mile west of the James Arthur Manning State Fish Hatchery. The area is characterized by scrub/shrub trees with predominantly rocky ground.

Flow to the LETRA lagoons is composed of filter backwash from the nearby water treatment plant (WTP) and domestic type sewage from the recreational area. The collection system conveys flow to the two lagoons and consists of two pump stations, gravity 6-inch and 8-inch diameter lines, two force mains consisting of 2-inch and 3-inch diameters, and approximately 24 manholes. See Appendix A for an illustration of the collection system.

There are two existing wastewater lagoons that are each rectangular and approximately 290-ft x 135-ft in area at the top of the existing dikes. Flow progresses from the northernmost to the southernmost lagoon before discharging through a V-notched weir at the eastern edge of the southernmost lagoon. Designed as a facultative flow-through lagoon system, oxygen near the surface of the lagoons promote the growth of facultative aerobic bacteria. Anaerobic conditions near the floor of the lagoons result in sludge fermentation and reduction.

The facility as currently constructed is not in compliance with hydraulic retention requirements due to only having one primary cell and one secondary cell. The current ODEQ design criteria for this type of facility require two primary and two secondary cells, 120 days of hydraulic retention time, and three feet of freeboard from the highest water level. This facility is not compliant with these criteria. The organic loading requirement for facultative lagoons is compliant with the current design criteria.

2.2 Current and Projected Sewer Flow Data

The LETRA system is classified as a transient non-community system, which defines systems that provide water to places where people do not remain for long periods of time. Further, because no expansion plans or expectations for increased transient populations exist, the equivalent service population is expected to remain stable for the next 20 years.

No influent data to the facility exists, so water production records were used to determine the design flow. The water treatment plant (WTP) at LETRA is the only water supply to the area. Flow measurements from the plant output were analyzed from 2009 to 2013 and summarized in the following table.

Table 1 – LETRA Water Treatment Plant Output

LETRA Water Treatment Plant Output (Includes Filter Backwash)						
High Use Season	May	June	July	Aug	Sept	
2009	11,086	15,636	20,146	15,040	8,978	
2010	10,105	16,838	14,687	17,870	13,508	5 Month
2011	15,057	15,788	15,804	15,752	9,143	Avg Daily
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Avg Daily GPD	**11,431**	**17,071**	**15,257**	**15,632**	**11,320**	**14,142**

The average daily flow from the WTP for all four years is 10,126 gallons per day. However, to properly size multiple options for the wastewater system improvements the peak use months for the WTP were analyzed (May to Sept) for 2009 – 2013, which resulted in an average daily flow of 14,142 GPD. Because the water cannot be discharged during this period, 14,142 GPD was determined to be the design flow. This approach is outlined in the ODEQ approved Engineering Report (provided by others).

3.0 Alternatives

3.1 Introduction

The Proposed Action will convert the existing facility to a total retention facility. The alternatives evaluated in this section of the EA are as follows:

- Flow Through (Facultative) Lagoon (Upgrade to Current System)
- Total Retention Lagoon
- Land Application
- No Action

3.2 Design Criteria

Design alternatives were evaluated based on the following assumptions, constraints, and/or given conditions:

- Each alternative must be designed to meet the current OPDES discharge permit final requirements:

  a. May – October:
  No Discharge.

  b. November – April:
  See Table 2 on following page.

Table 2 – OPDES Permit Limits for November through April

Effluent Characteristics	Discharge Limitations			Monitoring Requirements	
	Mass (lbs/d)	Concentration (mg/L)		Frequency	Sample Type
	Monthly Avg.	Monthly Avg.	Weekly Avg.		
BOD_5	5.0	30	45	1/month	Grab
TSS	15.0	90	135	1/month	Grab
Aluminum	0.17	1.0	2.0 daily max	1/month	Grab
Iron	0.17	1.0	2.0 daily max	1/month	Grab
Manganese	0.17	1.0	2.0 daily max	1/month	Grab
Total Residual Chlorine	--	Report monthly avg. and daily max		1/week	Grab
pH	--	6.5 – 9.0		2/week	Grab
Flow	Report monthly avg. and daily max.			2/week	Instant.

- All inflows are based on peak month WTP production of 14,142 gallons per day
- No influent pollutant loadings of the wastewater is available. Therefore, wastewater composition is assumed to be consistent with medium strength domestic wastewater of 220 mg/L and 220 mg/L for BOD5 and TSS respectively, per Metcalf & Eddy, 2nd Edition, Table 2 "Typical Composition of Untreated Domestic Wastewater". The water is likely somewhat dilute due to a significant amount of volume attributed to filter backwash water; nevertheless, typical wastewater strengths were used to provide a conservative design.
- No industrial waste is disposed of in the lagoons (other than the WTP)
- The lagoon area has significant underlying bedrock, thus deepening the existing lagoons has potentially high cost implications.
- Flow-through lagoon alternative:
    - must include two primary and two secondary cells (current design has one of each).
    - requires year-round discharge, and therefore would require testing, reporting, and the installation of new disinfection facilities.
- Total retention alternative:
    - entails modifying the existing two lagoons' piping and constructing a third cell.
    - eliminates the need for testing and reporting of effluent and requires no disinfection.
    - sizing is based on local evaporation rates.
- Land application alternative:
    - entails pretreatment and the purchase of land application equipment.
    - is approvable as land application of wastewater from total retention lagoons is common in Oklahoma where access to the site is restricted.

3.3 Alternatives

3.3.1 Option 1: Treatment of Effluent with Disinfection

It is possible that the existing lagoon system is capable of meeting the discharge requirements in terms of BOD_5 and TSS of the new permit. However, because the new permit has added fecal coliform requirements, bacterial disinfection must be added. This option would consist of adding a vault and piping to the secondary lagoon effluent stream and exposing it to ultraviolet light. Additionally, the top of berms will be raised to create a 3-foot freeboard above the current operating level for both existing lagoons.

A flow schematic of this option is shown as the Effluent Treatment Option in Appendix G. The estimated construction cost for this option is $204,000. A breakdown of the cost estimate is also included in Appendix H.

This option includes low initial costs and moderate ongoing costs. However, Option 1 does not address the low hydraulic retention time of the two-lagoon system which is a minimum of 120-days per ODEQ regulations. It is also likely that the ODEQ will require other construction standards to be met for discharging lagoons, such as two primary and two secondary cells for discharging lagoons. By only addressing the new disinfection requirement in the renewed permit will likely result in noncompliance for the facility as a whole. This could lead to the partial or complete closure of LETRA if wastewater treatment is found inadequate.

3.3.2 Option 2: Facultative Flow Through

This option would consist of increasing the capacity of the two existing lagoons by the addition of two more lagoon cells, a flow schematic that would be compliant with current ODEQ design criteria for facultative lagoon systems. Not only would this add an additional primary and secondary cell that ODEQ requires, the hydraulic retention time would meet the 120-day (60 days in two primary cells, 60 days in two secondary cells) requirement. In addition, this option would also include effluent flow measurement and recording systems and disinfection facilities, as well as increasing the existing dike elevations to maintain a 3-ft freeboard. The mode of disinfection chosen for this facility is ultraviolet (UV) disinfection as this option does not require bulk chemical storage or dechlorination equipment and chemicals if chlorine, for example is utilized.

A Design Criteria summary and flow schematic of this option is shown as a Flow-Through Option in Appendix G. The estimated construction cost for this option is $719,000. A breakdown of the cost estimate is also included in Appendix H.

Option 2 includes moderate-to-high initial costs and moderate ongoing costs. This option addresses the deficiencies observed in the existing lagoons, while also proposing lagoon improvements with provisions for a system compliant with the renewed OPDES discharge permit and ODEQ construction regulations. Thus, Option 2 has a low risk of noncompliance.

3.3.3 Option 3: Total Retention

This option includes modifying the existing lagoons to a total retention system and adding an additional cell so that no discharge, limited monitoring, and no effluent disinfection are necessary. Included in this option is to rehab the existing cells to build up the height of the dikes to obtain the ODEQ freeboard minimum of three feet as well as adding a new 8-inch gravity to the north of the existing lagoons.

Option 3 consists of adding one additional cell to the two existing cells to provide sufficient hydraulic holding capacity to allow the facility to operate in a non-discharging or total retention fashion. The lagoons are sized based off local evaporation rates as compared to the daily influent flow to prevent any discharge from occurring. A new 8-inch diameter gravity line is proposed for connection upstream of the existing manholes and collection system to run along the existing utility road on the north side of the existing lagoons in order to convey wastewater flows to the new lagoon. The discharge of the new gravity line is planned for the northeastern side of the new lagoon. From the new lagoon, wastewater will then flow in series through the existing lagoons. Provisions will allow for flow into either lagoon from the new lagoon; however, under normal operations, wastewater will flow from the new lagoon, to the northern lagoon, and then to the southern lagoon to make best use of natural grades. The existing 8-inch diameter lines that currently convey flow to the existing northern and southern lagoons will operate as a bypass system. As a total retention lagoon, no effluent will be leaving the lagoons; thus, this option would have no effluent monitoring or measurement, no effluent disinfection, and would minimize operations and reporting.

A Design Criteria summary and flow schematic of this option is shown as a Total Retention Option in Appendix G. The estimated construction cost for this option is $842,000. A breakdown of the cost estimate is also included in Appendix H. This option includes high initial costs but very low ongoing costs. It entails a very low risk of noncompliance as it includes no regulatable discharge.

3.3.4 Option 4: Land Application

This option is similar to Option 2 described above where two new lagoons would be added to the existing two lagoons to increase the hydraulic retention time and provide the correct number of both primary and secondary cells. However, under this option a land application system is proposed to irrigate effluent onto grasslands instead of discharging to the waters of the State of Oklahoma. Irrigation system components and an irrigation field would be developed and the site would also require fencing to prevent public access of the irrigation field per ODEQ regulations for reuse.

A Design Criteria summary and flow schematic of this treatment option is shown as Land Application Option in Appendix G. The estimated construction cost for this option is $885,000. A breakdown of the cost estimate is also included in Appendix G. This option includes high initial costs due to the need for all new equipment, and high ongoing costs due to treatment and additional pumping. It entails a very low risk of noncompliance as the effluent is not discharged to the Waters of the State of Oklahoma.

3.3.5 Option 5: Take No Action

CEQ regulations implementing the provisions of the National Environmental Policy Act of 1969 (NEPA) require a "no action" alternative be considered. These regulations define the "no action" alternative as the continuation of existing conditions and their effects on the environment, without implementation of a

proposed action. This alternative represents the existing condition and serves as the baseline against which to compare the effects of the other alternatives.

If no actions were to be taken for the LETRA lagoons, deficiencies identified with regard to conformance with current ODEQ construction standards will continue. These include the lack of sufficient freeboard and an inadequate number and hydraulic capacity of the existing cells.

With regard to the renewed permit and the more stringent discharge requirements, two potential scenarios will result if no action is taken. If an attempt to adhere to the permit is made by preventing discharge during the months of May through October, the discharge structure or pipe could be temporarily plugged. However, these months experience the highest flows from LETRA. This would result in a further reduction of available freeboard as no water would be leaving the facility, despite it continuing to enter, therefore causing the water level to rise. This scenario could lead to additional operations violations for the facility and an increase of erosion of the dikes at the water surface as the surface area increases. A worst case scenario could be that the lagoons overtop the dikes, resulting in an unpermitted bypass which would also undermine the integrity of the dikes.

Another scenario involves allowing the lagoons continuing to discharge during May through October, despite the OPDES permit allowing no discharge. Thus, discharging during these months would result in direct and immediate violations of the OPDES permit. These deficiencies would continue to increase in severity under this Option. This option has no direct immediate or ongoing costs, but non-compliance for both operations and discharge are very likely, which could result in the partial or complete closure of LETRA.

This alternative would retain the existing condition and would not result in any project-related environmental impacts or losses of fish and wildlife habitat. It would not result in any measures to restore or protect wildlife habitat in the project area.

3.4 Cost Estimate

Engineering and construction cost estimates for each option are summarized in the table below.

Table 3 – Cost Estimates for Treatment Alternatives

Alternative	Total Expected Engineering & Construction Costs[1]
Option 1 - Effluent Treatment	$205,000
Option 2 - Facultative Flow Through	$719,000
Option 3 - Total Retention	$1,042,000
Option 4 - Land Application	$885,000
Option 5 – No Action	$0
[1]Does not include ongoing operations & maintenance, or cost of future upgrades	

4.0 Preferred Alternative

Option 3: Total Retention is the preferred alternative.

4.1 Reasoning for Chosen Alternative

The total retention alternative was expected to provide the best value at the lowest risk to LETRA and to the waters of the State of Oklahoma.

- Of all the proposed alternatives, total retention likely presents the best net present value when ongoing operation and maintenance costs over a 20 year design life are taken into account:
    - No discharge requirements or associated testing
    - No daily flow discharge or associated monitoring
    - No recurring chemical costs
    - Reduced operations and maintenance as compared to the other options
- The total retention alternative will provide adequate treatment of WTP filter backwash water.
- New permit requirements prohibit any discharge during peak months. The current lagoons cannot operate under these conditions, and could be subject to partial or complete closure due to non-compliance.
- Total retention has the advantage of not discharging to waters of the State of Oklahoma. This protects the waters of the State, but also insulates the owner from potential future permit changes and regulations which may require upgrades and treatment modifications. Thus, this option removes the costs of meeting existing as well as potential increasingly stringent discharge requirements.

4.2 Detailed Feasibility

The Detailed Feasibility section evaluates whether the option described can actually be implemented from a constructability standpoint, which includes compatibility with accepted wastewater treatment standards, construction sequencing, and keeping the wastewater system in compliance during construction.

Option 1 and Option 5 do not maintain compliance with ODEQ construction standards, as the existing structures are not compliant with the number of cells required for discharging lagoons nor have adequate freeboard. Additionally, while Option 1 addresses some changes implemented during the permit renewal such as disinfection, it cannot adequately contain flow during the summer months. Option 5 is a no action option and will result in permit violations and continued operations violations due to the operational level of the lagoons not providing sufficient freeboard. As minor construction activities are necessary for Options 1 and 5, constructability is not an issue and little or no environmental impacts can be expected as a result.

Option 2 and Option 4 are similar in that they both propose additional cells (one primary and one secondary) to be compliant with the two primary and two secondary cell requirement of the ODEQ construction standards for flow through lagoons. Adding these two cells target the 120-day detention time as well, which provides additional time for the nutrients in the wastewater to be degraded. With respect to the construction of the new primary and new secondary lagoon, additional land will be required for construction. These lagoons are proposed to be built adjacent to the existing lagoons and once they are complete, wastewater flows are anticipated to gravity flow through the new cells for treatment. The existing lagoons are capable of meeting the interim limits of the permit while the construction of the two new lagoons is occurring, so little interruption of the existing treatment system is anticipated.

It is anticipated that construction of the new lagoons will encounter rocky soils or seams of rock that may create difficulties during construction. If rock is encountered at an elevation that is too high to allow for gravity flow, fill from offsite may be brought it to raise the lagoons to maintain proper separation between the bottom of the lagoons and bedrock. To account for this, a lift station may be required to accommodate flows through the new lagoons.

While Option 2 allows for ultraviolet disinfection for a discharging scenario, little additional space and construction is necessary to complete the proposed design. A new pipe with an in-pipe UV treatment system is proposed and the discharge outfall will need to be relocated as the proposed lagoons are currently on top of the existing outfall. This will require an amendment to the existing discharge permit. Option 4, however, will require significant additional land in order to irrigate wastewater effluent. Additional piping and pumping will be necessary to lay an irrigation field as well. Similar construction issues may exist with respect to rock during pipe laying activities to allow for the irrigation activities. The presence of rocky soils creates additional concerns that the irrigation field adjacent to the lagoons (as proposed by the Engineering Report) is suitable to receive irrigation of effluent. The presence of rock and rocky soils creates additional concerns that irrigation may not have a chance to infiltrate the soil before creating runoff, which is an operations violation.

Option 3 is the preferred alternative and is the conversion of the existing system to a total retention lagoon system. This option entails constructing a new cell to create the necessary surface area for sufficient evaporation to occur. A total retention system meets ODEQ standards for treatment of wastewater. The new lagoon will be built as the existing cells operate under the interim limits of the renewed permit. Once the new lagoon is complete, wastewater flows will be directed into it to fill while any work to upgrade the existing lagoons can be completed. The new cell is proposed on land immediately adjacent to the existing lagoons. Similar concerns with regard to construction exist for this option as for Option 2 and 4, as rocky soils and seams of rock and cobble may create construction difficulties. However, soils from nearby are proposed to be brought in to build up the lagoons as opposed to excavation if bedrock is encountered.

Because of the elevation of bedrock encountered during the geotechnical investigation, the water elevation of the new lagoon must be higher than the existing lagoons. Therefore, a new gravity line has been proposed to first convey wastewater to the new lagoon and then flow to the existing lagoons. This new line will tie into the existing collection system upstream of the existing termination manhole in order to achieve sufficient slope and ground cover over the pipe. The new gravity line will be full constructed while the existing line remains in service. Once the new lagoon and gravity line are complete, the final connection will be made to route sewer flows to the new lagoon. Thus, Option 3 allows the existing system to remain fully functional during construction.

4.3 Cost Estimate

A summary of the cost estimate for Option 3 is presented in Table 3.

5.0 Affected Environment and Environmental Consequences

The affected environment includes the natural and built environment in the area of the proposed action. Descriptions of these resources and the consequences of the proposed action are included below. The resources are discussed in order of the magnitude for potential impacts.

5.1 Water Quality

5.1.1 Affected Environment

The project has the potential to provide positive permanent impacts to water quality by eliminating an existing wastewater discharge that can likely no longer maintain compliance with its OPDES permit. The permit's requirements are based upon the assimilative capacity of the receiving stream and anticipated activities with respect to human activities, fish, and wildlife. Therefore, by eliminating a discharge that may no longer be able to meet its permit has the potential to provide permanent and positive impacts.

Lake Elmer Thomas is included on ODEQ's 303(d) list for impaired waterbodies for Dissolved Oxygen. Additionally, Deer Creek is an intermittent stream that flows from west to east within 0.25 mile south of the project site and is the receiving stream for the current effluent treatment. There is not a defined aquifer directly below the project site. However, the boundary for the Hennessey-Garber aquifer is approximately 1 mile to the north and approximately 2 miles east of the project site. The Post Oak aquifer is also downstream from the project site approximately 3.75 miles to the southeast (Appendix C).

5.1.2 Environmental Consequences

No negative permanent impacts to the water quality of the area are anticipated; however, temporary impacts to water quality associated with construction activities related to storm water may occur for Options 1-4. Best Management Practices (BMPs) would be included in a storm water pollution prevention plan (SWPPP) that will be implemented prior to construction to help prevent any potential impacts during the construction phase. A National Pollutant Discharge Elimination System (NPDES) permit will be obtained prior to construction activities. No additional storm water discharge outfalls will be produced. Any storm water leaving the site would not enter Lake Elmer Thomas.

Option 1 – Treatment of Effluent with Disinfection
This option would have some construction-related impacts associated with raising existing berms. Additionally, this option would continue to allow a wastewater discharge from the site. This option includes disinfection upgrades, but does not present a solution for the low hydraulic retention time of the existing facility. This option would not likely meet OPDES and ODEQ construction regulations. Refer to Section 3 for a description of the water treatment process for this proposed option.

Option 2 – Facultative Flow Through
This option would have some construction-related impacts associated with raising existing berms and adding two new cells for wastewater treatment. This option would include the construction of a primary and secondary cell/lagoon, improvements to the existing lagoons to increase retention times and provide for the use of bulk chemical storage or dechlorination equipment and

chemicals. This option would likely meet OPDES and ODEQ construction regulations. Refer to Section 3.

Option 3 – Total Retention
This option would have construction-related impacts associated with raising existing berms, laying new sewer gravity lines, and adding a large new cell for wastewater treatment. Water quality in the area downstream of the site would be improved by the elimination of the existing wastewater discharge under Option 3. This option requires the construction of an additional cell/lagoon that would be sized to prevent any discharge from occurring. Refer to Section 3.

Option 4 – Land Application
This option would have construction-related impacts associated with raising existing berms and adding two new cells for wastewater treatment. This option would include the addition of two new lagoons and proposed pumping and piping to irrigate the effluent onto grasslands instead of discharging to a waters of the State. The construction-related activities would be higher due to the creation of a second lagoon, irrigation system, fencing and irrigation field. Currently a grassed field does not exist in the area and would need to be constructed. Refer to Section 3.

Option 5 – Take No Action
Impacts to water quality regarding the no-build or no action alternative are similar to those discussed in Option 1; however, no disinfection would occur and the facility would be left as is, thereby continuing to be in noncompliance and incurring violations. Refer to Section 3.

5.2 Biological

The Biological section of this EA includes discussions on federal and state-listed plant and animal species. Under NEPA, federal actions are required to comply with the Endangered Species Act (ESA) of 1973, as amended, the Migratory Bird Treaty Act (MBTA) of 1918, and other federal acts and executive orders. The ESA provides for the conservation of ecosystems that threatened and endangered species depend on and prohibits the unauthorized taking, possession, sale and transport of endangered species. The MBTA prohibits actions resulting in the pursuit, hunting, capture, killing, attempting to take, and/or possession of any protected migratory bird, nest, egg, or parts thereof. The USFWS maintains a list of designated migratory birds occurring in various regions of the United States. A listing of federally-listed threatened and endangered species and migratory birds as identified by the USFWS is provided in Appendix D. According to the USFWS Critical Habitat Mapper, there is no designated critical habitat for any of the federally-listed species within Comanche County.

According to The Nature Conservancy's (TNC) *Wind, Wildlife, Untilled Landscaped, and Protected Areas* map (August, 2005), the project site is located in an area of TNC conservation significance. Refer to Appendix D.

Wichita Mountains Wildlife Refuge (WMWR) was established in 1901 and is 59,020-acres in size. It is located northwest of the project area. The WMWR provides habitat to more than 50 mammal, 240 bird, 64 reptile and amphibian species, 36 fish species, and 806 plant species (USFWS, http://www.fws.gov/refuge/Wichita_Mountains/about.html). Refer to Appendix D.

5.2.1 Affected Environment

There are no perennial streams within the project area and therefore limited to no natural aquatic animal and plant assemblages within the project area. Erosional features within the project area may contain pools of water after rain events, but are not likely to provide suitable habitat for aquatic species. Additionally, the site is located approximately 1,500 feet east of Lake Elmer Thomas and its associated shoreline. The project site contains Johnson grass, sunflower, eastern redcedar, Chickasaw plum, common ragweed, Bermuda grass, thistle, bluestem species, cottonwood, willow, osage orange, and oak species. Many of the tree species extend to the ground.

The following threatened, endangered, and candidate species have been identified in the Trust Resources List as provided by the US Fish and Wildlife Service (USFWS) Information Planning, and Conservation (IPaC) as potentially being in the project area. Refer to Appendix D.

- Black-capped vireo (*Vireo atricapilla*)
- Piping plover (*Charadius melodus*)
- Red knot (*Claidris canutus rufa*)
- Whooping crane (*Grus Americana*)
- Least tern (*Sterna antillarum*)

Black-Capped Vireo

The scrub-shrub composition of the woody species within the project area comprise potentially preferred habitat for the black-capped vireo. The preferred habitat of black-capped vireos include shrub land with small to intermediate sized trees and shrubs with vegetative cover extending to the ground level. The largest breeding population of black-capped vireos and the greatest amount of suitable habitat in the State of Oklahoma occurs in the WMWR adjacent to the LETRA. The vegetative characteristics of the WMWR is characteristic of that surrounding and on the project site. The WMWR black-capped vireo population is estimated to be over 5,000 birds, which is the largest breeding colony in the state of Oklahoma.

Under Army Regulation (AR) 200-1, an Endangered Species Management Plan (ESMP) for Fort Sill, was prepared, which provides guidelines for maintaining and enhancing populations and habitats of the species on the military Installation, while maintaining mission readiness consistent with Army and federal environmental regulations. In managing the species on the Installation, Fort Sill also complies with the MBTA, which prohibits harming the birds, their nests, or their eggs.

Piping Plover, Red Knot, Least Tern

Both piping plovers and interior least terns use sparsely vegetated sandy or gravelly shorelines and islands associated with major river systems as well as salt and mudflats associated with reservoirs for breeding and foraging. Sandy, gravelly, and/or mudflat beaches may be found along the shorelines of Elmer Thomas Lake to the west of the project site. The red knot also prefers mudflats associated with reservoirs.

Whooping Crane

The project site is within the 75% migration corridor (Appendix D) of the whooping crane as identified by the USFWS. Whooping cranes use shallowly-submerged sandbars in large river channels, emergent wetlands, and croplands as food sources along their migration routes. The project area contains two

small lagoons, but are not anticipated to be considered suitable foraging habitat due to the routine maintenance and activities associated with wastewater treatment.

Bald eagles have been known to utilize WMWR lakes for feeding and roosting during winter months. The number of eagles varies from year to year.

State-listed species of concern as identified by the Oklahoma Natural Heritage Inventory (ONHI) in 2003 for Comanche County include the following species. Coordination with the ONHI regarding state-listed species would identify any records of these species within the project area.

- spotted bass *(Micropterus punctulatus*)
- texas horned lizard (*Phrynosoma cornutum*)
- ferruginous hawk (*Buteo regalis*)
- whooping crane (*grus americana*)
- burrowing owl (*Athene cunicularia*)
- black-capped vireo (V*ireo atricapillus*)
- desert shrew (N*otiosorex crawfordi*)
- black-tailed prairie dog (*Cynomys ludovicianus*)
- texas kangaroo rat (*Dipodomys elator*)
- mountain lion (*Puma concolor*)

According to The Nature Conservancy's (TNC) *Wind, Wildlife, Untilled Landscaped, and Protected Areas* map (August, 2005), the project site is located in an area of TNC conservation significance. Refer to Appendix D.

Specific species occurrences in the area may be accomplished through literature reviews and coordination with appropriate regulatory agencies.

5.2.2 Environmental Consequences

Regarding impacts to the biological resources within and adjacent to the project area, Options 1-4 will have similar effects to the federally-listed species due to proposed ground disturbance activities. The most notable affect or loss of habitat for the black-capped vireo. New construction beyond the existing footprint of the current lagoon system would result in a reduction of preferred habitat. A Biological Assessment of the area may be warranted prior to consultation with the USFWS, which would provide a detailed analysis of project area, provide an effects determination, and note any sightings within immediate area. Fort Sill should continue to adhere to their ESMP.

Option 5 – Take No Action
The no action alternative would have no effect on listed species or migratory birds.

5.3 Natural Resources Impacts

5.3.1 Affected Environment

The project area lies within the Wichita Mountains Level IV Ecoregion of Oklahoma and within 1,500 feet of the boundary of the WMWR. Refer to other sections of this EA for descriptions pertaining to WMWR. The elevation of the general area ranges from 1,100 to 2,400 feet above sea level with high peaks and boulders and rock outcrops on hillsides. The geology of the area, according to the Level IV Ecoregions of Oklahoma, is mantled by quaternary feldspathic sandy fine grus and clayey colluvium (containing shale

clasts), and is underlain by Cambrian-age granite, gabbro, rhyolite flows, tuffs, conglomerate beds, and diabase sills. Geology is exposed in valleys bottoms and include Permian-age limestone conglomerate (Appendix C). The geology of the area is included in the Cwg series. Refer to the Geotechnical Engineering Report in Appendix B for additional information.

Soils in the project area likely include the Brico-rock outcrop complex, 15-50 percent slopes. These soils are comprised of a very cobbly loam to extremely cobbly clay loam, have a high runoff classification, are considered well-drained and fall under the Hydrologic Soil Group (HSG) C. The rock-outcrop (0-24" in depth) portion of this complex is considered bedrock, has very high runoff classification, and HSG of D Surface characteristics reveal stony and gravelly surface layers. Other soil series descriptions in the areas northeast and off of the Fort Sill property include Lawton, Foard, Rockland soils on uplands, and Port on narrow floodplains.

The natural vegetation in the surrounding area includes scrub/shrub woody plant species such as blackjack oak and post oak, with eastern redcedar, little bluestem, and prickly pear cactus. Lower valley areas contain oaks, hackberry, black walnut, American elm, and ash species.

There are no FEMA-mapped 100-year floodplains located within the project area. Refer to the FIRM provided in Appendix E.

5.3.2 Environmental Consequences

Options 1-3 would have relatively similar impacts on the geology, vegetation, and soils of the project area in that excavation and modifications to the existing facility would encounter the same soil conditions. The potential exists to encounter bedrock composed of granite, weathered sandstone, and/or dolomite Refer to Appendix B.

Option 4 – Land Application
This option has the potential to create rill erosion due to the high and very high runoff classification of the area, which would be cause from irrigating a newly installed grass field. The well-drained nature of the surface soils in the area should help minimize runoff potential.

Option 5 – Take No Action
There would be no impacts to natural resources associated with the no action alternative.

5.4 Socioeconomics and Environmental Justice

The 1994 enactment of EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations directs federal agencies to address disproportionate environmental and human health effects in minority and low-income communities. In addition, EO 13045, Protection of Children from Environmental Health Risks and Safety Risks, which was enacted in 1997, directs federal agencies to identify and assess environmental health and safety risks that may disproportionately affect children. These factors were taken into consideration when relating to the proposed action to Fort Sill and the area's economic activity.

5.4.1 Affected Environment

Fort Sill is located in Comanche County, north of the city of Lawton. According to the 2013 U.S. Census, the population of Comanche County in 2013 was 124,937. The median household income was $46,036, which is slightly higher than the state median of $45,339. The per capita income for the county was $22,363 compared to the state per capita income of $24,208. The percentage of the population below the poverty level was 17.3 percent for the county and 16.9 percent for the state. Percentages by race include white (66.8 percent), black of African American (17.6 percent), and American Indian or Alaska Native (6.2 percent). Persons reporting Hispanic or Latino origin were 12.5 percent. Oklahoma percentages include white (75.4 percent), black or African American (7.7 percent), American Indian or Alaska Native (9.0 percent), and persons of Hispanic or Latino origin (9.6 percent) (Census Bureau 2013).

5.4.2 Environmental Consequences

Options 2-4 would have relatively the same effect on the socioeconomic aspects of the LETRA area. The current recreation activities would continue to function as normal. There would be no impacts to residential or commercial areas, minority groups or other sensitive or disadvantaged groups, including populations near Ft. Sill. The existing lagoons would continue to operate under their current design while improvements are being constructed.

Options 1 and 5 like-wise would have similar outcomes regarding impacts to the LETRA area. Continued noncompliance would cause a portion or all of the LETRA area to close, thereby having a potential adverse effect on the economics of the immediate area, including Medicine Park, which is located approximately 1.0 mile northeast of the LETRA facility.

5.5 Cultural Resources

Cultural resources include archaeological findings, architecture, paintings, buildings, tangible items, intangible culture, among other resources. These also include historical aspects of the given area and the significance of any findings associated with research and surveys. Significant historical properties may be listed in the National Register of Historic Places (NRHP). Examples of cultural properties in the general area include the original Fort Sill structures, Quanah Parker homestead, and Medicine Bluff. Archaeological sites are either historic or prehistoric in nature. As noted in an EA for Airspace Clearance for Fort Sill (2014), “Existing cultural resources in the ROI include NRHP structures, historic and prehistoric archaeological sites, and National Historic Landmarks. The NRHP includes structures such as the Ingram House, the Medicine Park Hotel, and the Fort Sill Historic Landmark District. Fort Sill historic district, erected in 1870, is the most prominent historic property in the ROI. Other properties registered on the NRHP include Indian Cemeteries, Medicine Bluffs, Camp Comanche, HPAAF, and Chiefs Knoll. All of these NHRP properties are located on Fort Sill. Medicine Buffs is a historic traditional cultural property that is still in use today. Chiefs Knoll and Indian Cemeteries contain the graves of Native American chiefs, warriors, and citizens. Notably, Geronimo was buried in one of the Indian Cemeteries.”

5.5.1 Affected Environment

The closest NRHP-listed resource is in Medicine Park. There are no visible structures within the proposed site boundary. Native American or Tribal jurisdiction outside of boundaries of Fort Sill resides with the Kiowa, Comanche, Apache, and Fort Sill Apache Tribes. Tribal jurisdiction is the area over which the tribe has legal political and civil control.

5.5.2 Environmental Consequences

Options 1-4 would incur similar consequences relating to the presence of cultural remains. These options include disturbance of new undisturbed lands outside the existing facility. It is likely that coordination with the State and Tribal Historic Preservation Offices (SHPO/THPO) and the Oklahoma Archeological Survey (OAS) would require a Phase I Cultural Resources Survey (CRS) be conducted to assist in determining impacts to otherwise unknown cultural resources. Tribal coordination would also be required for these options to solicit and inform Tribes of the proposed action.

Option 5 would have no impacts associated with cultural resources and would likely not have any tribal concerns.

That Oklahoma State Historic Preservation Society was provided a project description and a map showing the Area of Potential Effect and have found that no historic properties will be affected. See enclosed correspondence under Appendix J.

5.6 Air Quality

5.6.1 Affected Environment

No threat to the National Ambient Air Quality Standards (NAAQS) as regulated under the Clean Air Act (CAA) are anticipated in association with the project. NAAQS are the maximum allowable atmospheric concentrations and relate to six pollutants: ozone, nitrogen, particulate matter (PM) 2.5, PM 10, lead, and sulfur dioxide. The Environmental Protection Agency (EPA) determines areas of the country that are in attainment of NAAQS air quality standards or in non-attainment of those standards. The project area is in an attainment area. A review of the Oklahoma counties found in 40 CFR 81.337 indicated that the entire area is designated as attainment (i.e., meeting or exceeding national standards or unclassifiable) for all six criteria pollutants.

5.6.2 Environmental Consequences

Short term and temporary impacts to air quality is anticipated due to proposed construction activities. Additionally, general conformity to state air quality regulations do not apply. Options 1-4 would carry similar impacts to air quality, primarily due to the generation of dust and vehicle emissions. The duration of the construction activities is anticipated to extend for 2 months for Option 1, 8-9 months for Options 2-3, and 1 year for Option 4. BMP's would be included as part of the construction SWPPP in reference to wind erosion.

The no action option would not incur any air quality impacts.

5.7 Section 6(f) Resources

5.7.1 Affected Environment

The proposed project is located approximately 1,500 feet southeast of the Wichita Mountains Wildlife Refuge (WMWR), which is owned by the US Fish and Wildlife Service (USFWS) and therefore considered federal land that could be afforded Section 6(f) protection if Land and Water Conservation Funding (LWCF) was utilized at WMWR.

5.7.2 Environmental Consequences

All five options would have no effect on the WMRW.

5.8 Noise

5.8.1 Affected Environment

Currently there are minimal noise sources in the immediate area of the LETRA facilities. This include traffic noise. Noise is the unwanted or undesirable sound that interferes with normal activities.

5.8.2 Environmental Consequences

Public annoyance is the most common effect associated with elevated noise levels. Due to the relatively isolated nature of the site and the transient nature of the population anticipated at LETRA, noise impacts to the general public and those utilizing the LETRA facilities is anticipated to be minimal. No permanent or long-term noise impacts are anticipated in association with the project. Minor and temporary construction-related noise impacts may occur during the duration of construction activities.

5.9 Hazardous, Toxic, or Radiological Waste

5.9.1 Affected Environment

No records of hazardous, toxic, or radiological waste sites within 1 mile of the project site are reported by the Oklahoma Department of Environmental Quality.

5.9.2 Environmental Consequences

All five options are not expected to create any hazardous, toxic or radiological wastes and would therefore not affect the surrounding area. Options 1-5 would include construction activities where the storage of on-site fuel and diesel may occur. Any and all fuel and chemical storage would need to comply with local, state, and federal regulations pertaining the location and handling of hazardous materials.

5.10 Wetlands

5.10.1 Affected Environment

Based on a desktop review of the project area that included site photographs, soils data, National Wetland Inventory (NWI) maps and interviews with project design engineers resulted in no wetlands determined to be present. Erosional drains located within the project area drain to the south off-site to Deer Creek.

5.10.2 Environmental Consequences

None of the options are determined to have any impacts on wetlands.

5.11 Cumulative Impacts

Cumulative effects include past, present, and foreseeable actions including the proposed action and its alternatives within the same area. A cumulative effects analysis involves both the geographic area and

the timeframe of when potential effects could be expected to occur. This section describes the direct, indirect and cumulative impacts associated with the proposed project.

5.11.1 Direct Effects

The proposed action will have direct effects including improving water quality of the effluent and potential habitat alteration associated with a threatened and endangered species. Positive impacts associated directly with water quality as it relates downstream natural systems and aquatic environments (Deer Creek) is the most notable effect of the project. The proposed action will also allow for the continued operation of the LETRA facilities. Construction impacts associated with Options 1-4 will directly affect black-capped vireo potential habitat.

Option 1 direct impacts may include land disturbance activities and the treatment of the wastewater stream. Options 2-4 will also include direct impacts associated with construction activities as noted above; however, the benefits provided by eliminating a wastewater discharge that cannot meet its existing permit associated with the Proposed Action - Option 3 is also considered a direct effect.

The Proposed Action - Option 3 will improve biological degradation of wastewater in the lagoons through providing adequate storage capacity and more surface area for evaporation.

Option 4 includes direct effects related to treated water being land applied that would have a beneficial impact on the grass, soil, and organisms living within the application zone. As additional land irrigation sites are proposed, vegetation could benefit from the available water and over a larger area with the proposed plan. The additional lagoons will provide more time to degrade wastewater thereby improving its quality.

Construction activities will require earth disturbance, which could result in some temporary noise, air quality, and water quality impacts. However, BMPs will be used to control erosion and storm water runoff. Also these direct impacts to the soil and air quality are short term and only during the construction phase, which could be 2 months for Option 1, 8-9 months for Options 2-3, possibly 1 year for Option 4. No impacts or earth disturbances are required for Option 5.

According to CEQ regulations, cumulative effects analysis should consider the potential environmental impacts resulting from “the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions” (40 CFR 1508.7).

5.11.2 Indirect Effects

Indirect effects associated with the proposed action include the water quality improvements associated with a cleaner waste stream (provided for Options 1, 2 and 4). Greater infiltration of irrigated wastewater is also associated with Option 4 due to the land application aspect of that option. Option 3 would also have indirect effects associated with reducing the amount of a potentially unpermitted discharge flow continuing downstream to Deer Creek.

5.11.3 Cumulative Effects Analysis

As described in this EA, the proposed action (Option 3) would eliminate the wastewater discharge associated with the LETRA facilities. Water quality and continued growth and maintenance of the LETRA facilities would continue. Ground disturbing activities would include the destruction of potential black-capped vireo habitat and could have an adverse effect. All build options would have a potentially adverse effect on the black-capped vireo. The reduction in flow to downstream environments would be minimal as the receiving stream, Deer Creek, is considered intermittent. As identified in the environmental consequences sections of this EA, the proposed action would produce very limited to no impacts to the noise, air quality, cultural resources, hazardous materials and waste, and infrastructure. Therefore, no cumulative impacts to any of these resources would be anticipated as a result of implementing the proposed action.

Therefore, the incremental effects of the proposed action, in combination with potential impacts associated with reasonably foreseeable future actions associated with the LETRA facility, would not be expected to create significant cumulative effects to regional resources beyond those described in the environmental consequences sections of this EA.

6.0 Findings and Conclusions

The Proposed Action - Option 3 will meet the purpose and need for meeting ODEQ regulations for updating the LETRA lagoons, which will bring the facility into compliance with the ODEQ permit regulations. Evaluation of the alternatives included review of the estimated costs, evaluated in the Engineers Report, and potential environmental impacts. The recommended alternative best meets the needs of Fort Sill and the Lake Elmer Thomas Recreation Area, while also minimizing potential environmental impacts. Agency coordination should include the USFWS, who could have potentially significant comments associated with the loss of potential black-capped vireo habitat. Pending agency comments, a finding of no significant impact should be warranted.

APPENDIX A

Site Layout

REMOVE EXISTING MANHOLE
CONSTRUCT NEW DIVERSION STRUCTURE W/GATES

REMOVE EXISTING 8" S.S. LINE
INSTALL APPROX. 215 L.F.
NEW 12" S.S. LINE

INSTALL NEW 12" VALVE & BOX
INSTALL 20 L.F. NEW
12" S.S. LINE AT 4.68%
FL=1344.63

INSTALL NEW 12" VALVE & BOX
INSTALL 20 L.F. NEW
12" S.S. LINE AT 0.45%
FL=1335.71

REMOVE EXISTING 8" S.S. LINE
INSTALL APPROX. 240 L.F.
NEW 12" S.S. LINE

INSTALL NEW 4' DIA. MANHOLE
TR=1344.00
FL=1335.64

INSTALL 175 L.F. NEW
12" S.S. LINE AT 0.45%

INSTALL 35 L.F. NEW
4" S.S. FORCE MAIN

INSTALL NEW 4' DIA. MANHOLE
TR=1352.00
FL=1343.69

INSTALL 83 L.F. NEW
12" S.S. LINE AT 4.68%

FL=1337.84
FL=1334.85

INSTALL NEW 6' DIA. WET WELL
W/ CONCRETE VALVE VAULT
TOP OF PAD=1350.00
BOTTOM=1330.00

INSTALL NEW 4' DIA. MANHOLE
TR=1359.00
6" FM FL=1355.5
12" SS FL=1350.18

INSTALL 40 L.F. NEW
12" S.S. LINE AT 0.45%

SPLASH PAD
FL=1350.00

543.8' WATER SURFACE
ELEV. 1355.00

200' WATER SURFACE
ELEV. 1355.00

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00

N

0 50' 100' 200' 300'

(IN FEET)

ALL TOP OF RIMS, FLOWLINES AND PIPE LENGTHS ARE APPROXIMATE

LAGOON FLOW 14,142 GPD

GARVER

OK COA # 4193
EXPIRES 06/30/2016

1016 24th Avenue NW
Norman, OK 73069
(405) 329-2555

REV.	DATE	DESCRIPTION	BY

FORT SILL
FORT SILL, OKLAHOMA

FORT SILL FCU 154.2
LETRA LAGOONS UPGRADE PROJECT

PROJECT LAYOUT PLAN

JOB NO.: 14078100
DATE: OCT., 2014
DESIGNED BY:
DRAWN BY:

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRAWING NUMBER
FIGURE 2

SHEET NUMBER

File: L:\2012\12078110 - Fort Sill LETRA Lagoon Improvements\Drawings\SURVEY\Letra_Proposed_Plan_FIGURE2.dwg Last Saves: 11/19/2014 2:44 PM Last saved by: Mrhall
Last plotted by: Hall, Michael R. Plot Style: Garver Standard Half.ctb Plot Scale: 1:2 Plot Date: 11/19/2014 2:44 PM Plotter used: \\gfyvdc02\Canon iR C4080 PS

APPENDIX B

Geotech Engineering Report

Geotechnical Engineering Report

Proposed Sewer Lagoon
Lake Elmer Thomas Recreation Area
Deer Creek Canyon Road and North Boundary Road
Fort Sill, Oklahoma

June 10, 2014
Terracon Project No. 03145122

Prepared for:
Evans & Associates
Lawton, Oklahoma

Prepared by:
Terracon Consultants, Inc.
Oklahoma City, Oklahoma

June 10, 2014

Terracon

Evans & Associates
2208 F Avenue
Lawton, Oklahoma 73501

Attn: Mr. Randy Combest
P: [580] 351 1800
E: rcombest@evans-assoc.com

Re: Geotechnical Engineering Report
Proposed Sewer Lagoon
Lake Elmer Thomas Recreation Area
Deer Creek Canyon Road and North Boundary Road
Fort Sill, Oklahoma
Terracon Project No. 03145122

Dear Mr. Combest:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our Proposal No. P03140261 dated April 29, 2014. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of the new sewer lagoon cell.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Cert. Of Auth. #CA-4531 exp. 6/30/15

Cassa C. Hume, E.I.
Staff Geotechnical Professional

Jeremy Basler, P.E.
Oklahoma No. 20233

REGISTERED PROFESSIONAL ENGINEER
JEREMY BASLER
6-10-14
20233
OKLAHOMA

CCH:JB\srs\n:\projects\2014\03145122\project documents\jun2014

Copies to: Addressee (1 via email)

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Geotechnical engineering services have been performed for the proposed sewer lagoon to be located at Lake Elmer Thomas Recreation Area in Fort Sill, Oklahoma. Terracon's geotechnical scope of work included four test borings to approximate depths of 25 feet below existing site grades or until auger refusal. Auger refusal was generally encountered at depths ranging from 3 to 20 feet.

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

- The borings generally encountered lean clay with varying amounts of sand and gravel to depths of about 1.5 to 4 feet and weathered sandstone or weathered sandy shale to depths of 3 to 20 feet. The overburden soil and weathered rock in boring B-1 was underlain by a granite conglomerate to a depth of approximately 15 feet and dolomite to below the boring termination depth.

- Based on the shallow depth of rock, we consider the on-site materials unsuitable for construction of the lagoon liner. We recommend importing clay soils meeting the recommended permeability requirements, or using an impervious high density polyethylene geomembrane.

- Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during construction.

- Groundwater was not encountered in test borings B-2 to B-4 at the time of drilling. Boring B-1 was not monitored due to the introduction of water for coring. It is important to note that the designer of the lagoon should comply with the state regulatory requirements for separation of the bottom of the clay liner and the groundwater table.

- We anticipate construction excavations will encounter weathered bedrock. Auger refusal was encountered in the borings at depths ranging from 3 to 20 feet below the existing ground surface. We anticipate blasting will be necessary to construct the lagoon.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED SEWER LAGOON
LAKE ELMER THOMAS RECREATION AREA
DEER CREEK CANYON ROAD AND NORTH BOUNDARY ROAD
FORT SILL, OKLAHOMA

Terracon Project No. 03145122

June 10, 2014

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed sewer lagoon cell to be located at Lake Elmer Thomas Recreation Area in Fort Sill, Oklahoma. Four borings were advanced to a depth of approximately 25 feet or auger refusal. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil and rock conditions
- Groundwater conditions
- Earthwork
- Lagoon liner recommendations

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Exhibit A-1 in Appendix A.
Project	This project will include the construction of a new lagoon cell.
Grading	Based on the plans provided, we anticipate 5 to 30 feet of cut will be required for the lagoon cell and the anticipated bottom of lagoon elevation is about 1,331 to 1,335 feet. Anticipated berm heights were not provided at the time of this report.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The site is located approximately 1 mile west of the Deer Creek Canyon Road and North Boundary Road intersection at the Lake Elmer Thomas Recreation Area, in Fort Sill, Oklahoma.
Current ground cover	Moderate to dense growth of trees and surface vegetation.

ITEM	DESCRIPTION
Existing topography	The site generally slopes downward from north to south with about 22 feet of maximum elevation difference between the borings.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs included in Appendix A. Stratification boundaries on the boring logs represent the approximate location of changes in soil and rock types; in-situ, the transition between materials may be gradual. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum*	Material Encountered	Consistency/Hardness
Stratum 1	1.5 to 4 feet	Lean clay with varying amounts of sand and gravel	Very stiff to hard
Stratum 2	3 to 13.5 feet	Weathered sandstone	Very weak
	13 to 20 feet	Weathered sandy shale	Very weak
Stratum 3	15 feet	Granite conglomerate	Weak
	Not determined	Dolomite	Weak to medium strong

*Auger refusal was encountered in the borings at depths ranging from 3 to 20 feet.

Laboratory tests were conducted on selected soil and rock samples and the test results are presented on the boring logs in Appendix A.

3.2 Groundwater

The borings were monitored while drilling and immediately after completing the drilling activities for the presence and level of groundwater in borings B-2 to B-4. As reported in the lower left corner of the boring logs, groundwater was not encountered in borings B-2 to B-4 at these times. Boring B-1 was not monitored due to the introduction of water for coring.

To obtain more accurate groundwater level information, longer observations in a monitoring well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered natural drainage paths, and other factors not evident at the time the borings were advanced. Consequently, the designer and contractor should be aware of this possibility while designing and constructing this project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The borings generally encountered lean clay with varying amounts of sand and gravel to depths of about 1.5 to 4 feet and weathered sandstone or weathered sandy shale to depths of 3 to 20 feet. The overburden soil and weathered rock in boring B-1 was underlain by a granite conglomerate to a depth of approximately 15 feet and dolomite to below the boring termination depth. Groundwater was not encountered in test borings B-2 to B-4 at the time of drilling. Boring B-1 was not monitored due to the introduction of water for coring. It is important to note that the designer of the lagoon should comply with the state regulatory requirements for the separation of the bottom of the clay liner and the groundwater table.

Excavations at this site will extend into bedrock or cemented soils and will likely require the use of specialized heavy-duty equipment, pneumatic breaking equipment and blasting to remove.

Based on the shallow depth of rock, we consider the on-site materials unsuitable for construction of the lagoon liner. We recommend importing clay soils meeting the recommended permeability requirements, or using an impervious high density polyethylene geomembrane.

Geotechnical engineering recommendations for lagoon liner construction and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

The following presents recommendations for site and subgrade preparation, and placement and compaction of engineered fill on the project.

Earthwork should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Site preparation for the proposed project should include removing the vegetation, trees, topsoil, and other unsuitable materials encountered on-site. Actual removal depths should be determined at the time of construction by a representative of the geotechnical engineer.

4.2.2 Excavations

Excavations at this site will extend into bedrock or cemented soils and will likely require the use of specialized heavy-duty equipment, together with drilling and blasting to facilitate rock break-up and removal. Consideration should be given to obtaining a unit price for difficult excavation in the contract documents for the project.

The individual contractor is responsible for designing and constructing stable, temporary excavations as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local and federal regulations, including current OSHA excavation and trench safety standards.

4.2.3 Subgrade Preparation

After stripping the site and performing the lagoon excavation, we recommend the exposed subgrade be proofrolled under the observation of Terracon personnel with a loaded, tandem-axle dump truck weighing at least 25 tons (under the observation of Terracon personnel) to locate any soft or unstable zones. The proofrolling should involve overlapping passes in mutually perpendicular directions. Where rutting or pumping is observed during proofrolling, the unstable soils should be overexcavated and replaced with an approved low volume change soil as described in following sections if it cannot be effectively compacted in-place. In areas where bedrock is encountered, proofrolling will not be required.

After a successful proofroll, we recommend scarifying the exposed subgrade soils to a depth of 8 inches in the lagoon area. The scarified soil should be adjusted to a workable moisture content that is within 2 percent of its optimum value, as determined by test method ASTM D-698 (standard Proctor), prior to being compacted to at least 95 percent of its maximum dry density. In areas where bedrock is exposed, it will not be necessary to scarify and compact the bedrock.

4.2.4 Fill Materials and Placement

All fill required to develop the design subgrade elevation should be an approved cohesive material that is free of organic matter and debris as outlined in the following table.

Fill Type [1]	Acceptable Location for Placement
Cohesive soils (with hydraulic conductivity ≤ 1.0×10^{-7} cm/s)	Clay liner
On-site materials[2] (Sandy lean clay, weathered sandstone, and weathered sandy shale)	All fill not requiring low permeability

1. Prior to any filling operations, samples of the proposed borrow materials should be obtained for laboratory moisture-density testing. The tests will provide a basis for evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-

Fill Type [1]	Acceptable Location for Placement

place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

2. Maximum particle size should not exceed 3 inches.

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift. We recommend effective erosion control consisting of vegetation or other appropriate measures be installed to prevent erosion of the slopes and top of berms during and following construction.

4.2.5 Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows:

ITEM	DESCRIPTION
Fill Lift Thickness	9-inches or less in loose thickness
Compaction Requirements	At least 95% of the material's maximum dry density as determined by the standard Proctor test method, ASTM D-698.
Moisture Content[1]	**Clay Liner Material** - Workable moisture content that at least 2 percent above the material's optimum value as determined by the standard Proctor test method (ASTM D 698) prior to compaction **On-Site Material** - Within 2 percent of the material's optimum value as determined by the standard Proctor test method (ASTM D 698) prior to compaction

1. For materials intended to be used as clay liners these requirements should be verified based on hydraulic conductivity test results.

4.3 Clay Liner Construction

Due to the shallow depth of rock, it appears the on-site soils are not suitable for construction of the lagoon liners. We recommend importing clay soils meeting the permeability requirements, or using an impervious high density polyethylene geomembrane.

We recommend compacting the clay liner fill at a moisture content adjusted to at least 2 percentage points above the material's optimum water content, as determined by ASTM D-698. Compaction should be to at 95 percent of the material's maximum dry density. Each lift of the lagoon liner soils should be tested for density and moisture content at a rate of at least one test

for every 2,500 square feet of compacted material. Additional hydraulic conductivity tests should be performed on samples obtained from the in-place liner bottom to verify compliance with the project specifications and appropriate governmental regulations.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

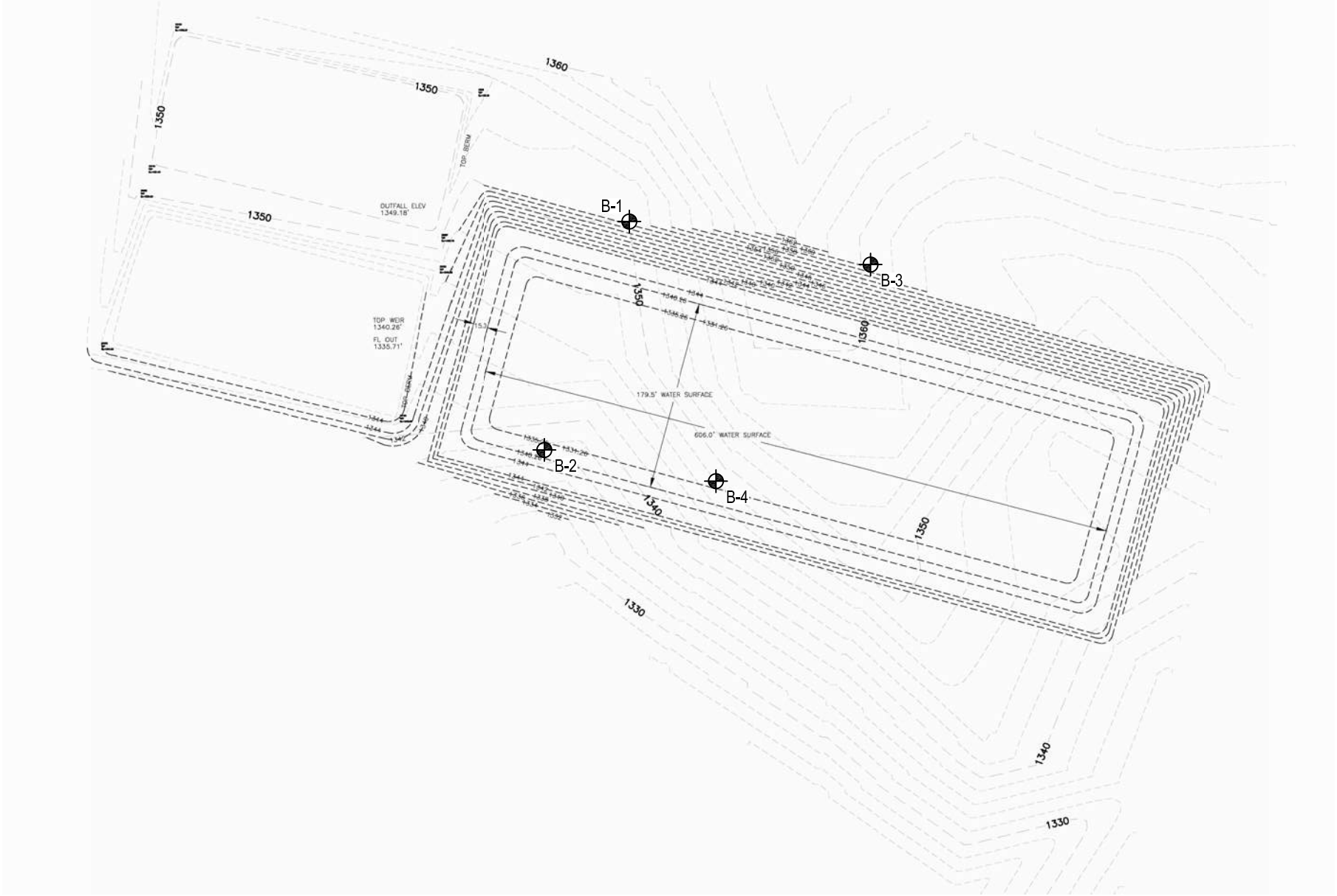
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



LEGEND

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

Project Mngr: CCH	Project No. 03145122
Drawn By: DWT	Scale: NTS
Checked By: CCH	File No. 03145122 (A1)
Approved By: JWB	Date: JUNE 2014

Terracon
Consulting Engineers and Scientists
4701 N STILES AVE OKLAHOMA CITY, OKLAHOMA 73105
PH. (405) 525-0453 FAX. (405) 557-0549

BORING LOCATION PLAN

PROPOSED SEWER LAGOON
LAKE ELMER THOMAS RECREATION AREA
FORT SILL, OKLAHOMA

EXHIBIT

A1

Field Exploration Description

Four test borings were drilled at the site on May 22, 2014. The borings were drilled to depths of approximately 25 feet below the ground surface or until auger refusal at the approximate locations shown on the attached Boring Location Plan, Exhibit A-1.

The borings were located in the field by a representative from Evans & Associates and Terracon personnel using a handheld GPS unit. The coordinates of each boring are shown on the boring logs. Surface elevations at the boring locations were estimated from the plans provided by Evans & Associates. The surface elevations at the boring locations ranged from 1,337 to 1,359 feet, approximately. The locations and elevations of the borings should be considered accurate only to the degree implied by the methods used to define them.

An all-terrain rotary drill rig used continuous flight augers to advance the boreholes. Representative samples were obtained by the split-barrel sampling procedures. The bedrock was cored in the borings with an NX-sized, double-walled core barrel.

The split-barrel sampling procedure uses a standard 2-inch, O.D. split-barrel sampling spoon that is driven into the bottom of the boring with a 140-pound drive hammer falling 30 inches. The number of blows required to advance the sampling spoon the last 12 inches, or less, of an 18-inch sampling interval or portion thereof, is recorded as the standard penetration resistance value, N. The N value is used to estimate the in-situ relative density of granular soils and, to a lesser degree of accuracy, the consistency of cohesive soils and the hardness of weathered bedrock. The percent recovery and Rock Quality Designation (RQD) for each core run was determined. These values are reported on the boring logs. The sampling depths, penetration distances, N values and drill progress rates are reported on the boring logs. The samples were tagged for identification, sealed to reduce moisture loss and returned to the laboratory for further examination, testing and classification.

An automatic Standard Penetration Test (SPT) drive hammer was used to advance the split-barrel sampler. The automatic drive hammer achieves a greater mechanical efficiency when compared to a conventional safety drive hammer operated with a cathead and rope. We considered this higher efficiency in our interpretation and analysis of the subsurface information provided with this report.

Field logs were prepared as part of the drilling operations. These boring logs included visual classifications of the materials encountered during drilling and the field personnel's interpretation of the subsurface conditions between samples. The final boring logs included with this report may include modifications based on observations and tests of the samples in the laboratory.

As required by the Oklahoma Water Resources Board, any borings deeper than 20 feet, or borings that encounter groundwater or contaminated materials must be grouted or plugged in accordance with Oklahoma State statutes. One boring log must also be submitted to the Oklahoma Water Resources Board for each 10 acres of project site area. Terracon grouted boring B-1 at depths of 4 to 14 feet and submitted a log in order to comply with the Oklahoma Water Resources Board requirements.

BORING LOG NO. B-1

PROJECT: Proposed Sewer Lagoon

CLIENT: Evans & Associates
Lawton, Oklahoma

SITE: Lake Elmer Thomas Recreation Area
Fort Sill, Oklahoma

LOCATION See Exhibit A-1

Latitude: 34.72003° Longitude: -98.50936°

Approximate Surface Elev: 1350.0 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	REC / RQD (%)	WATER CONTENT (%)
1.5	1348.5+/-						
SANDY LEAN CLAY WITH GRAVEL (CL), yellowish-brown							
			X	10	17-50/4"		7
+WEATHERED SANDSTONE, yellowish-brown, very weak							
			X	8	20-50/1"		6
5.0	1345+/-	5					
****GRANITE CONGLOMERATE**, very dark gray and pink, weak						100 / 40	
		10				100 / 65	
15.0	1335+/-	15					
****DOLOMITE**, dark gray, medium strong						100 / 38	
-weak at 20'		20				100 / 58	
25.0	1325+/-	25					
Boring Terminated at 25 Feet							

LABORATORY TORVANE/HP (psi)	UNCONFINED COMPRESSIVE STRENGTH (psi)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	3280			
	1220			
	4240			
	2370			

Stratification lines are approximate. In-situ, the transition may be gradual.

**Classification estimated from core samples. Petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Backfilled with cuttings above 4'; grouted 4' to 14'; backfilled with cuttings from 14' to termination depth.

See Exhibit A-2 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:
Vegetation At Surface

WATER LEVEL OBSERVATIONS

Terracon
4701 North Stiles Avenue
Oklahoma City, Oklahoma

Boring Started: 5/22/2014 Boring Completed: 5/22/2014

Drill Rig: 960 Driller: S. Becker

Project No.: 03145122 Exhibit: A-3

BORING LOG NO. B-2

PROJECT: Proposed Sewer Lagoon

CLIENT: Evans & Associates
Lawton, Oklahoma

SITE: Lake Elmer Thomas Recreation Area
Fort Sill, Oklahoma

LOCATION See Exhibit A-1

Latitude: 34.71931° Longitude: -98.50963°

Approximate Surface Elev: 1337.0 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
SANDY LEAN CLAY WITH GRAVEL (CL), yellowish-brown and brown, hard						
				6	20-30-40 N=70	4
3.5	1333.5+/-					
+WEATHERED SANDSTONE, yellowish-brown, very weak				4	50/5"	6
		5		3	50/3"	7
				4	50/4"	10
		10				
13.5	1323.5+/-					
+WEATHERED SANDY SHALE, dark gray, very weak				5	50/5"	6
		15				
				5	50/6"	5
20.0	1317+/-	20				
Auger Refusal at 20 Feet						

GRAPHIC LOG | WATER LEVEL OBSERVATIONS | LABORATORY TORVANE/HP (psi) | UNCONFINED COMPRESSIVE STRENGTH (psi) | REC / RQD (%) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

+Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-2 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:
Vegetation At Surface

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
4701 North Stiles Avenue
Oklahoma City, Oklahoma

Boring Started: 5/22/2014 | Boring Completed: 5/22/2014

Drill Rig: 960 | Driller: S. Becker

Project No.: 03145122 | Exhibit: A-4

BORING LOG NO. B-3

PROJECT: Proposed Sewer Lagoon

CLIENT: Evans & Associates
Lawton, Oklahoma

SITE: Lake Elmer Thomas Recreation Area
Fort Sill, Oklahoma

LOCATION See Exhibit A-1

Latitude: 34.71995° Longitude: -98.50856°

Approximate Surface Elev: 1359.0 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	RECOVERY (In.)	FIELD TEST RESULTS	WATER CONTENT (%)
SANDY LEAN CLAY (CL), dark brown, very stiff			8	8-15-12 N=27	5
4.0	1355+/-		10	20-50/3"	7
+WEATHERED SANDSTONE, yellowish-brown, very weak		5			
6.0	1353+/-		14	26-50/2"	13
+WEATHERED SANDY SHALE, dark gray, very weak					
		10	12	39-50/5"	11
13.0	1346+/-				
Auger Refusal at 13 Feet					

GRAPHIC LOG | WATER LEVEL OBSERVATIONS | SAMPLE TYPE | LABORATORY TORVANE/HP (psi) | UNCONFINED COMPRESSIVE STRENGTH (psi) | DRY UNIT WEIGHT (pcf) | ATTERBERG LIMITS LL-PL-PI | PERCENT FINES

Stratification lines are approximate. In-situ, the transition may be gradual.

+Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-2 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:
Vegetation At Surface

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
4701 North Stiles Avenue
Oklahoma City, Oklahoma

Boring Started: 5/22/2014 | Boring Completed: 5/22/2014

Drill Rig: 960 | Driller: S. Becker

Project No.: 03145122 | Exhibit: A-5

BORING LOG NO. B-4

PROJECT: Proposed Sewer Lagoon

CLIENT: Evans & Associates
Lawton, Oklahoma

SITE: Lake Elmer Thomas Recreation Area
Fort Sill, Oklahoma

LOCATION See Exhibit A-1

Latitude: 34.71933° Longitude: -98.50912°

Approximate Surface Elev: 1348.0 (Ft.) +/-

GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	REC / RQD (%)	LABORATORY TORVANE/HP (psi)	UNCONFINED COMPRESSIVE STRENGTH (psi)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
DEPTH ELEVATION (Ft.)												
+WEATHERED SANDSTONE, yellowish-brown, very weak				4	50/4"				4			
3.0 1345+/-												
Auger Refusal at 3 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

+Classification estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Hammer Type: Automatic

Advancement Method:
Power Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-2 for description of field procedures

See Appendix B for description of laboratory procedures and additional data (if any).

See Appendix C for explanation of symbols and abbreviations.

Notes:
Vegetation At Surface

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
4701 North Stiles Avenue
Oklahoma City, Oklahoma

Boring Started: 5/22/2014 Boring Completed: 5/22/2014

Drill Rig: 960 Driller: S. Becker

Project No.: 03145122 Exhibit: A-6

APPENDIX B

LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. Samples of bedrock were classified in accordance with the Description of Rock Properties described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil and bedrock samples and the test results are presented on the boring logs in Appendix A. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil and bedrock samples obtained from the site were tested for the following engineering properties:

- In-situ Water Content
- Unconfined Compressive Strength

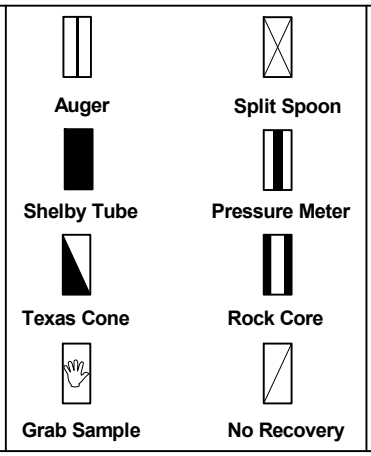
APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer
(TCP)	Texas Cone Penetrometer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

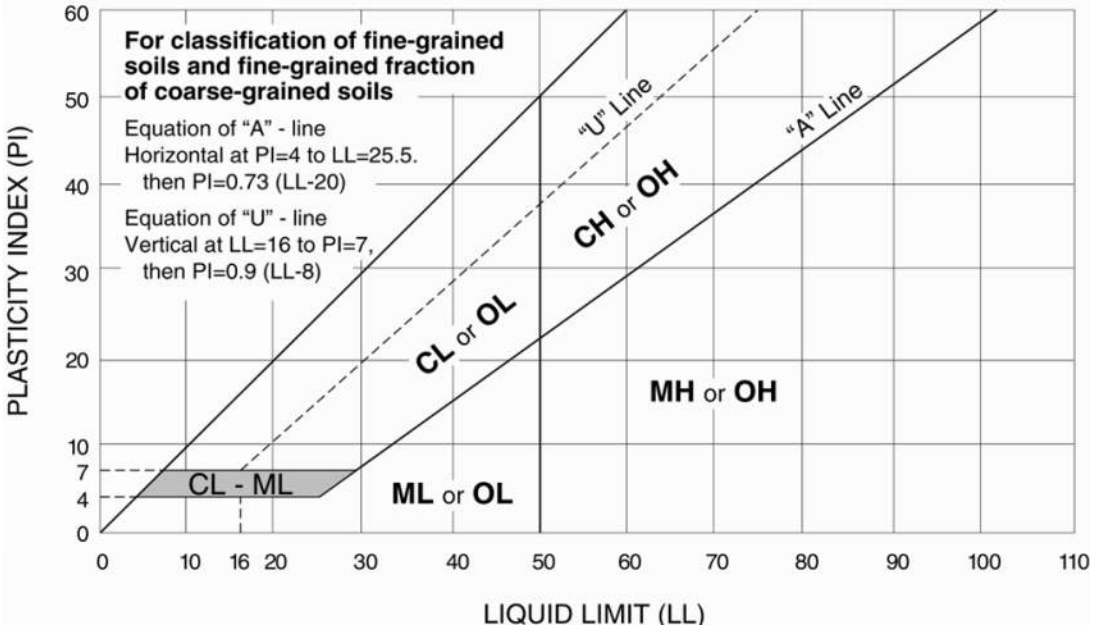
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

Exhibit C-2

DESCRIPTION OF ROCK PROPERTIES

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, PSI (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft (50 – 300 mm)
Moderate	8 in – 2 ft (200 – 600 mm)	**Medium**	1 ft – 3 ft (300 – 900 mm)
Wide	2 ft – 6 ft (600 mm – 2.0 m)	**Thick**	3 ft – 10 ft (900 mm – 3 m)
Very Wide	6 ft – 20 ft (2.0 – 6 m)	**Massive**	> 10 ft (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0 degree angle.

ROCK QUALITY DESIGNATION (RQD*)	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

*The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

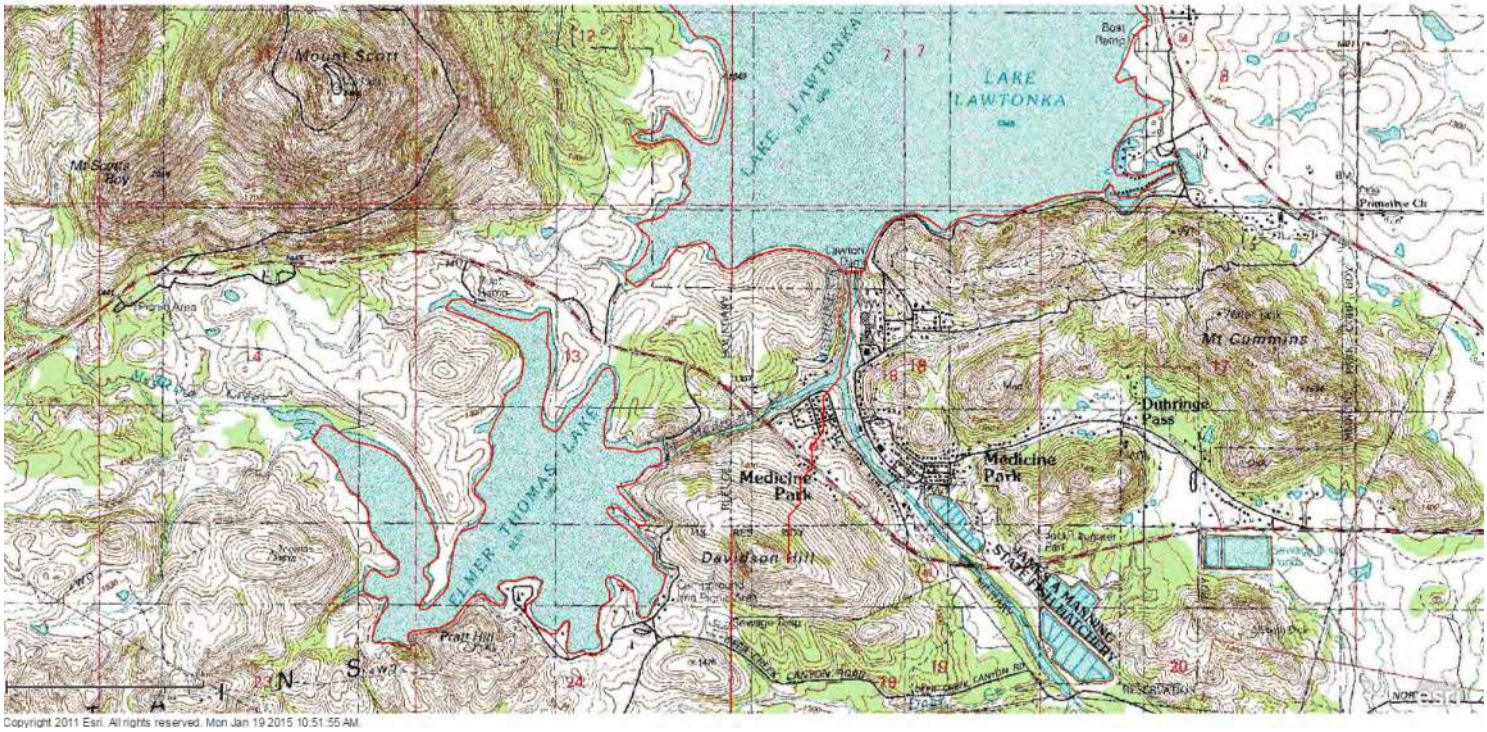
Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009 Technical Manual for Design and Construction of Road Tunnels – Civil Elements

APPENDIX C

Water Quality

LETRA Lagoons Improvements

303(d) Waterbodies



APPENDIX D

Biological Resources Exhibits

GARVER

WHOOPING CRANE MIGRATION CORRIDOR

Lake Elmer Thomas Recreational Area (LETRA) Lagoons Improvements
Fort Sill, Oklahoma

2013 ESRI Aerial Image
ESRI GIS INFORMATION

0 10 20 30 40
Miles

Figure 5.3A

GARVER

THREATENED AND ENDANGERED SPECIES HABITAT

Lake Elmer Thomas Recreational Area (LETRA) Lagoons Improvements
Fort Sill, Oklahoma

2013 ESRI Aerial Image
ESRI GIS INFORMATION

0 500 1,000 1,500 2,000
Feet

Figure 5.3B

U.S. Fish and Wildlife Service

Trust Resources List

This resource list is to be used for planning purposes only — it is not an official species list.

Endangered Species Act species list information for your project is available online and listed below for the following FWS Field Offices:

Oklahoma Ecological Services Field Office
9014 EAST 21ST STREET
TULSA, OK 74129
(918) 581-7458
http://www.fws.gov/southwest/es/Oklahoma/

Project Name:

LETRA

U.S. Fish and Wildlife Service

Trust Resources List

Project Location Map:

Project Counties:

Comanche, OK

Geographic coordinates (Open Geospatial Consortium Well-Known Text, NAD83):

MULTIPOLYGON (((-98.5115938 34.7215585, -98.5090618 34.7203592, -98.5067444 34.7197066, -98.5044484 34.7193009, -98.5045343 34.7169199, -98.5058647 34.7169199, -98.5077744 34.7170963, -98.5122161 34.7189306, -98.5115938 34.7215585)))

Project Type:

Wastewater Facility

U.S. Fish and Wildlife Service

Trust Resources List

Endangered Species Act Species List (USFWS Endangered Species Program).

There are a total of **5** threatened or endangered species on your species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fishes may appear on the species list because a project could cause downstream effects on the species. Note that **1** of these species should be considered only under certain conditions. See the second table below for a list of these species and the conditions under which effects should be considered. Critical habitats listed under the **Has Critical Habitat** column may or may not lie within your project area. See the **Critical habitats within your project area** section below for critical habitat that lies within your project area. Please contact the designated FWS office if you have questions.

Species that should be considered in an effects analysis for your project:

Birds	Status		Has Critical Habitat	Contact
Black-Capped Vireo (*Vireo atricapilla*) Population: Entire	Endangered	species info		Oklahoma Ecological Services Field Office
Piping Plover (*Charadrius melodus*) Population: except Great Lakes watershed	Threatened	species info	Final designated critical habitat Final designated critical habitat	Oklahoma Ecological Services Field Office
Red Knot (*Calidris canutus rufa*) Population:	Threatened	species info		Oklahoma Ecological Services Field Office
Whooping crane (*Grus americana*) Population: except where EXPN	Endangered	species info	Final designated critical habitat	Oklahoma Ecological Services Field Office

Species that should be considered in an effects analysis for your project under specified conditions:

Birds					
Least tern (*Sterna antillarum*) Population: interior pop.	Endangered	species info	condition info		Oklahoma Ecological Services Field Office

Critical habitats within your project area:

There are no critical habitats within your project area.

U.S. Fish and Wildlife Service

Trust Resources List

FWS National Wildlife Refuges (USFWS National Wildlife Refuges Program).

There are no refuges found within the vicinity of your project.

FWS Migratory Birds (USFWS Migratory Bird Program).

The protection of birds is regulated by the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA). Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. For more information regarding these Acts see: http://www.fws.gov/migratorybirds/RegulationsandPolicies.html.

All project proponents are responsible for complying with the appropriate regulations protecting birds when planning and developing a project. To meet these conservation obligations, proponents should identify potential or existing project-related impacts to migratory birds and their habitat and develop and implement conservation measures that avoid, minimize, or compensate for these impacts. The Service's Birds of Conservation Concern (2008) report identifies species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become listed under the Endangered Species Act as amended (16 U.S.C 1531 et seq.).

For information about Birds of Conservation Concern, go to:
http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BCC.html.

To search and view summaries of year-round bird occurrence data within your project area, go to the Avian Knowledge Network Histogram Tool links in the Bird Conservation Tools section at: http://www.fws.gov/migratorybirds/CCMB2.htm.

For information about conservation measures that help avoid or minimize impacts to birds, please visit:
http://www.fws.gov/migratorybirds/CCMB2.htm.

Migratory birds of concern that may be affected by your project:
There are **22** birds on your Migratory birds of concern list. The underlying data layers used to generate the migratory bird list of concern will continue to be updated regularly as new and better information is obtained. User feedback is one method of identifying any needed improvements. Therefore, users are encouraged to submit comments about any questions regarding species ranges (e.g., a bird on the USFWS BCC list you know does not occur in the specified location appears on the list, or a BCC species that you know does occur there is not appearing on the list). Comments should be sent to the ECOS Help Desk.

U.S. Fish and Wildlife Service

Trust Resources List

Species Name	Bird of Conservation Concern (BCC)	Species Profile	Seasonal Occurrence in Project Area
Bald eagle (*Haliaeetus leucocephalus*)	Yes	species info	Wintering
Bell's Vireo (*Vireo bellii*)	Yes	species info	Breeding
Burrowing Owl (*Athene cunicularia*)	Yes	species info	Breeding
Cassin's Sparrow (*Aimophila cassinii*)	Yes	species info	Breeding
Chestnut-collared Longspur (*Calcarius ornatus*)	Yes	species info	Wintering
Dickcissel (*Spiza americana*)	Yes	species info	Breeding
Fox Sparrow (*Passerella liaca*)	Yes	species info	Wintering
Golden eagle (*Aquila chrysaetos*)	Yes	species info	Wintering
Harris's Sparrow (*Zonotrichia querula*)	Yes	species info	Wintering
Hudsonian Godwit (*Limosa haemastica*)	Yes	species info	Migrating
Lark Bunting (*Calamospiza melanocorys*)	Yes	species info	Wintering
Little Blue Heron (*Egretta caerulea*)	Yes	species info	Breeding
Loggerhead Shrike (*Lanius ludovicianus*)	Yes	species info	Year-round
McCown's Longspur (*Calcarius mccownii*)	Yes	species info	Wintering
Mississippi Kite (*Ictinia mississippiensis*)	Yes	species info	Breeding
Painted Bunting (*Passerina ciris*)	Yes	species info	Breeding
Red-headed Woodpecker (*Melanerpes erythrocephalus*)	Yes	species info	Year-round
Scissor-tailed Flycatcher (*Tyrannus forficatus*)	Yes	species info	Breeding
Short-eared Owl (*Asio flammeus*)	Yes	species info	Wintering

Snowy Plover (*Charadrius alexandrinus*)	Yes	species info	Migrating
Sprague's Pipit (*Anthus spragueii*)	Yes	species info	Wintering
Swainson's hawk (*Buteo swainsoni*)	Yes	species info	Breeding

NWI Wetlands (USFWS National Wetlands Inventory).

The U.S. Fish and Wildlife Service is the principal Federal agency that provides information on the extent and status of wetlands in the U.S., via the National Wetlands Inventory Program (NWI). In addition to impacts to wetlands within your immediate project area, wetlands outside of your project area may need to be considered in any evaluation of project impacts, due to the hydrologic nature of wetlands (for example, project activities may affect local hydrology within, and outside of, your immediate project area). It may be helpful to refer to the USFWS National Wetland Inventory website. The designated FWS office can also assist you. Impacts to wetlands and other aquatic habitats from your project may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal Statutes. Project Proponents should discuss the relationship of these requirements to their project with the Regulatory Program of the appropriate U.S. Army Corps of Engineers District.

Data Limitations, Exclusions and Precautions
The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery and/or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Exclusions - Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and

nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

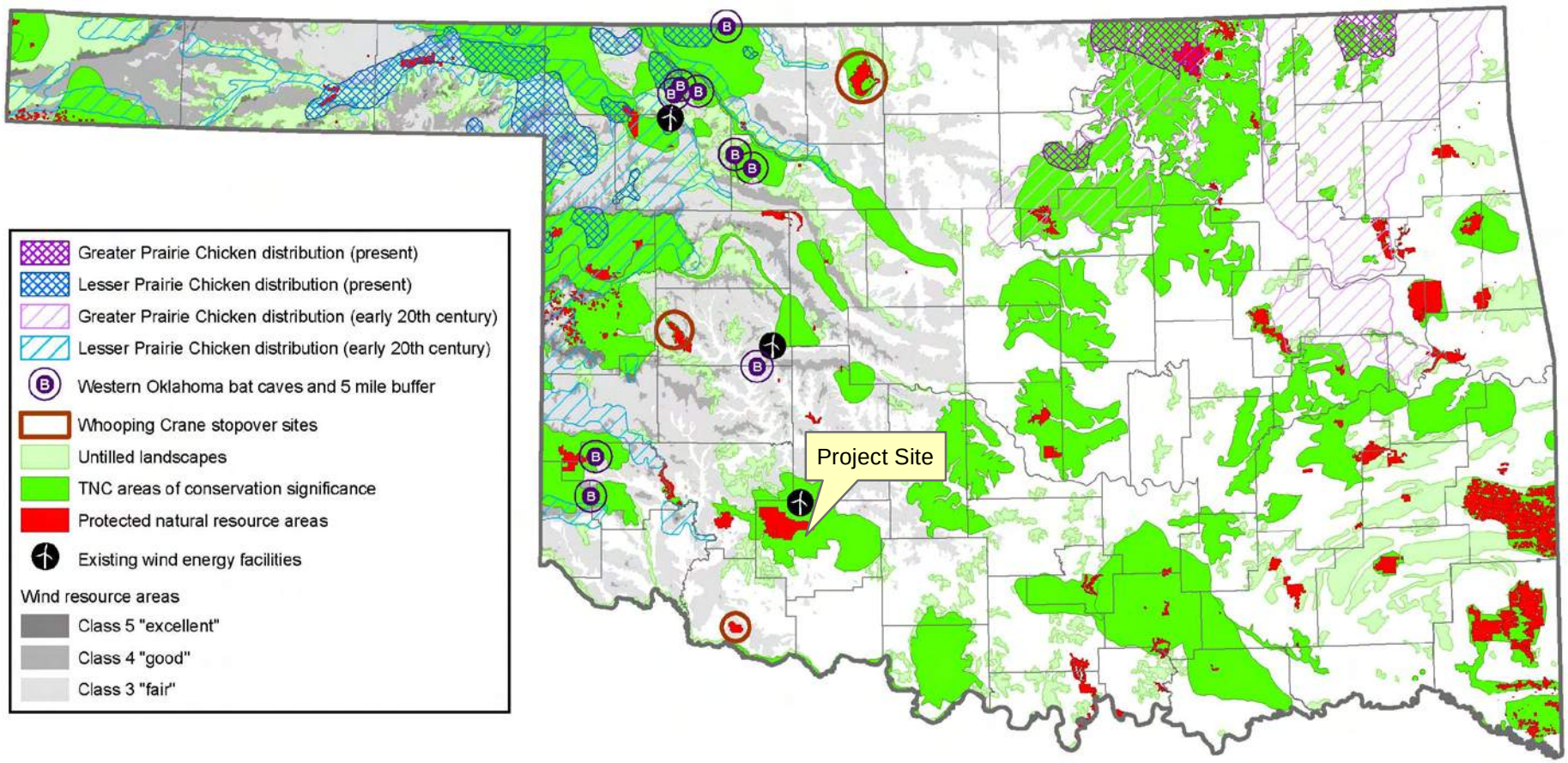
The following wetland types intersect your project area in one or more locations:

Wetland Types	NWI Classification Code	Total Acres
Freshwater Pond	PUBHx	1.432

Oklahoma Natural Resources:
Wind, Wildlife, Untilled Landscapes, and Protected Areas

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH
Oklahoma Chapter August 2005

This map depicts general areas of conservation sensitivity and is intended to provide general guidance for wildlife appropriate siting of wind farms, transmission lines and other landscape-altering structures.



Present Greater and Lesser Prairie Chicken distributions:
The Nature Conservancy, Oklahoma Chapter GIS,
with comments from the Sutton Avian Research Center and
the Oklahoma Department of Wildlife Conservation.
January 2005

Early 20th century prairie chicken distributions:
Digitized from Duck, L.G. and J.B. Fletcher. 1943.
Lesser and Greater Prairie Chicken distribution and densities.
in A Survey of the Game and Furbearing Animals of Oklahoma.
Oklahoma Game and Fish Commission.

Protected natural resource areas:
State parks, wildlife management areas;
National parks, grasslands/forests, wildlife refuges;
and Nature Conservancy preserves.
The Nature Conservancy, Oklahoma Chapter GIS,
February 2005

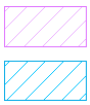
Untilled landscapes:
Central and Western Oklahoma -
Ostlie, Wayne. 2003. Untilled Landscapes of the Great Plains.
The Nature Conservancy, Midwest Science Center.
Eastern Oklahoma -
The Nature Conservancy, Oklahoma Chapter GIS,
January 2005

Western Oklahoma bat caves:
The Nature Conservancy, Oklahoma Chapter GIS,
January 2005

Whooping Crane stopover sites
Modified from U.S. Fish and Wildlife Service
Whooping Crane sightings, 1947-1999
The Nature Conservancy, Oklahoma Chapter GIS,
February 2005

Wind resource areas:
Oklahoma Wind Power Initiative
www.ocgi.okstate.edu/owpi
August 2005

Present Greater and Lesser Prairie Chicken distributions:
The Nature Conservancy, Oklahoma Chapter GIS, with comments from the Sutton Avian Research Center and the Oklahoma Department of Wildlife Conservation.
January 2005.



Early 20th century prairie chicken distributions:
Digitized from Duck, L.G. and J.B. Fletcher. 1943. Lesser and Greater Prairie Chicken distribution and densities. in A Survey of the Game and Furbearing Animals of Oklahoma. Oklahoma Game and Fish Commission.

Protected natural resource areas:
State parks, wildlife management areas; National parks, grasslands/forests, wildlife refuges; and Nature Conservancy preserves. The Nature Conservancy, Oklahoma Chapter GIS,
February 2005.

Untilled landscapes:
Central and Western Oklahoma –
Ostlie, Wayne. 2003. Untilled Landscapes of the Great Plains. The Nature Conservancy, Midwest Science Center.
Eastern Oklahoma - The Nature Conservancy, Oklahoma Chapter GIS,
January 2005.
These polygons represent landscape-scale areas with largely intact natural or semi-natural vegetation as identified through an interpretation of early 1990's Landsat Thematic Mapper (TM) satellite imagery. Landsat TM scenes were visually interpreted to delineate untilled landscape-scale areas, with landscape areas subsequently digitized and assembled into a GIS data layer for use in conservation planning.

TNC areas of conservation significance:
The Nature Conservancy, Oklahoma Chapter GIS,
January 2005.
Areas identified for high biodiversity significance by The Nature Conservancy and partner organizations. Sites in some ecoregions are preliminary and subject to change. These areas are generally considered important for conserving the native species, communities, and ecological systems of the state. The area polygons were delineated in ecoregional conservation assessments and site conservation plans by The Nature Conservancy and partners, and account for conservation "targets" across multiple scales (i.e. individual species as well as entire ecological systems).

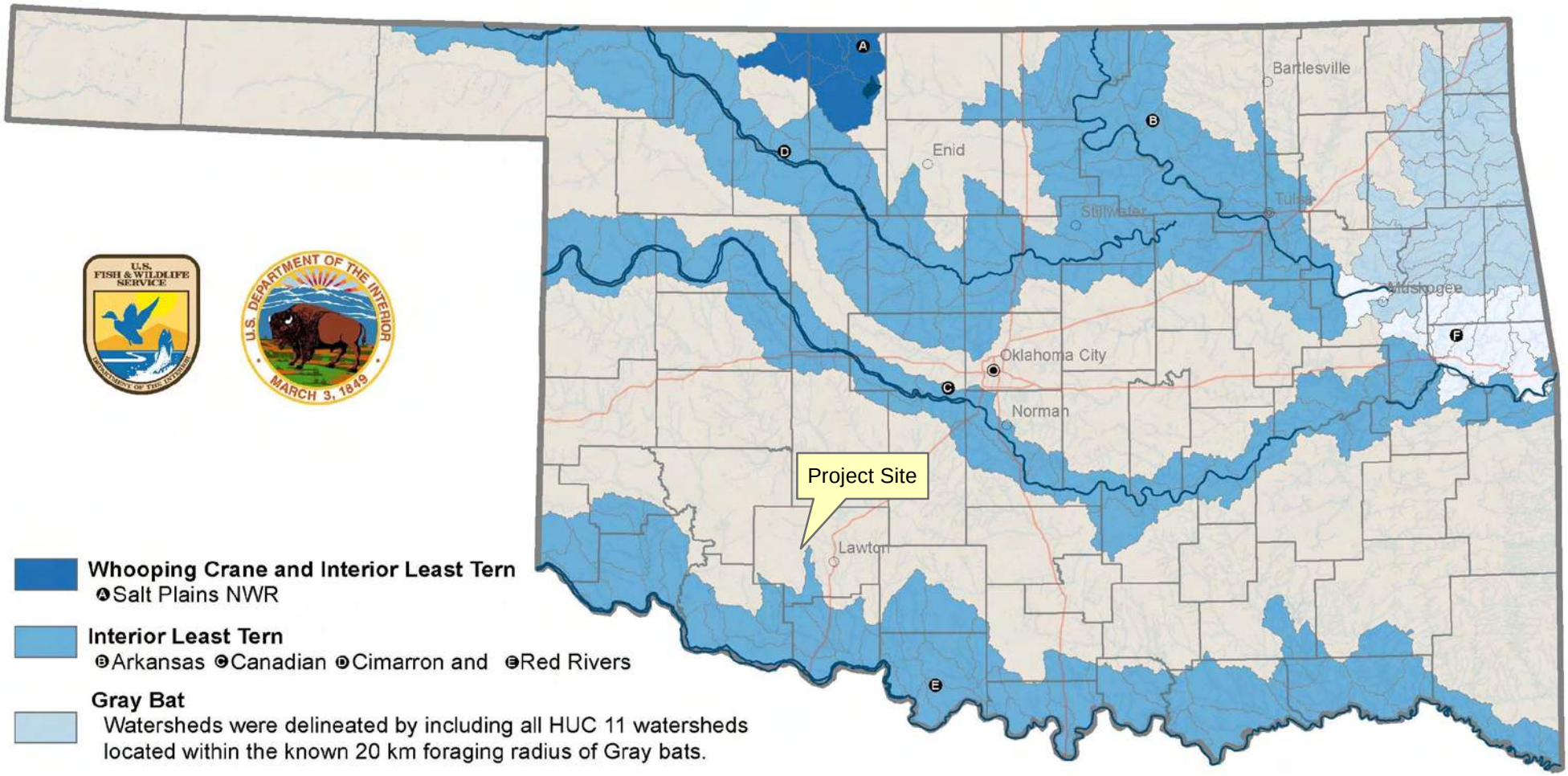
Western Oklahoma bat caves:
The Nature Conservancy, Oklahoma Chapter GIS,
January 2005.
These caves represent sites of conservation importance as identified in a 1993 report to The Nature Conservancy on caves of the gypsum karst region of western Oklahoma. Other caves exist across the state; however, many of these are not mapped. As most of Oklahoma's best wind potential sites are located in the western counties, the area in the vicinity of these caves likely represents the greatest potential risk of wind energy associated bat mortality in the state.

Wind resource areas:
Oklahoma Wind Power Initiative www.ocgi.okstate.edu/owpi
August 2005.

Whooping Crane stopover sites:
Modified from U.S. Fish and Wildlife Service Whooping Crane sightings, 1947-1999 The Nature Conservancy, Oklahoma Chapter GIS,
February 2005.

Federally-Listed Aquatic Dependent Species Watersheds of Oklahoma

These watersheds were delineated using 11 digit Hydrologic Unit Code (HUC) watersheds. All watersheds adjacent to water bodies occupied by federally-listed species are included in the delineation, as well as those 11 digit HUC watersheds within 10 miles of the occupied water body. Please note that not all 11 digit HUC watersheds that feed into sensitive occupied water bodies are included in this delineation and effects to those watersheds outside of this delineation could impact sensitive water bodies.



Whooping Crane and Interior Least Tern
Ⓐ Salt Plains NWR

Interior Least Tern
Ⓑ Arkansas Ⓒ Canadian Ⓓ Cimarron and Ⓔ Red Rivers

Gray Bat
Watersheds were delineated by including all HUC 11 watersheds located within the known 20 km foraging radius of Gray bats.

Interior Least Tern and Gray Bat
Ⓕ Canadian River (ILT) and HUC 11 Watersheds (GB)

Water Bodies Occupied by Federally-Listed Species

N W E S

0 25 50 100 Miles

USFWS - Oklahoma Ecological Services Field Office - April 2011

Federally-Listed Aquatic Dependent Species Watersheds of Oklahoma
11 Digit Hydrologic Unit Codes

Interior Least Tern

11050003080	11090204080	11130101050	11140101040
11060001030	11100302090	11130101060	11140101060
11060001040	11110101010	11130101070	11140102030
11060001050	11110101020	11130102010	11140103050
11060002040	11110101030	11130102020	11140103060
11060003030	11110101040	11130102030	11140104050
11060003040	11110101050	11130201010	11140105070
11060004010	11110101060	11130201020	11140105080
11060004020	11110102020	11130201030	11140106020
11060004030	11110102050	11130201040	11140106040
11060004040	11110102060	11130201050	11140106050
11060004100	11110102070	11130201060	
11060004110	11110103110	11130201070	
11060005080	11110104020	11130201090	
11060006020	11110104030	11130201100	
11060006030	11110104040	11130202050	
11060006040	11110104050	11130203030	
11060006050	11110104070	11130203040	
11060006060	11110104080	11130203050	
11060006080	11110105110	11130203070	
11060006090	11120105060	11130208040	
11060006100	11120202050	11130208050	
11060006110	11120202060	11130210010	
11070107020	11120202070	11130210020	
11070107030	11120303090	11130304050	
11070107040	11130101030	11140101010	
11090204070	11130101040	11140101020	

Gray Bat

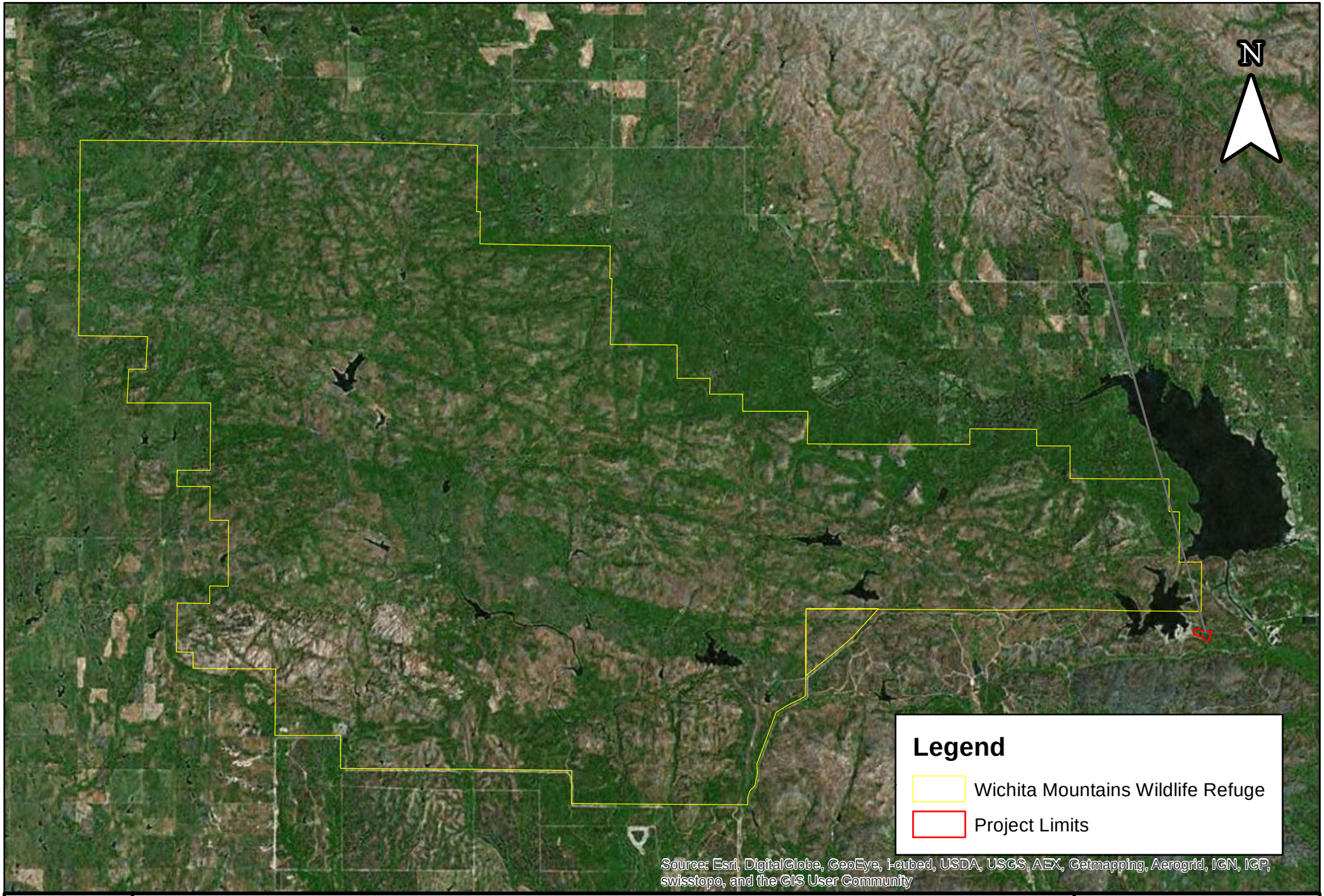
11070207190	11110102020
11070105040	11110102070
11070206020	11110103050
11070206030	11110103060
11070206040	11110103080
11070206050	11110103090
11070206060	11110103100
11070208070	11110103110
11070209020	11110104020
11070209030	11110104030
11070209040	11110104050
11070209050	11110104070
11070209060	
11070209070	
11070209100	
11070209110	
11070209120	
11110101060	
11110102010	

Whooping Crane

11060002040
11060003030
11060003040
11060004010
11060004020
11060004030
11060004040

APPENDIX E

Natural Resources Exhibits



GARVER

WICHITA MOUNTAINS WILDLIFE REFUGE

Lake Elmer Thomas Recreational Area (LETRA) Lagoons Improvements
Fort Sill, Oklahoma

2013 ESRI Aerial Image
ESRI GIS INFORMATION

0 1 2 3
Miles

Figure 5.2

S PANEL 0075

34°45'00.00"

R13W R12W

515000 FT

KEY TO NUMBERED STREETS

1 ..NW TACKLE BOX RD
2 ..E LAKE DR
3 ..E BOUNDARY RD
4 ..WATER ST
5 ..APPLE ALLEY
6 ..E ELM ST
7 ..HASKELL'S WAY
8 ..N SHERIDAN ST
9 ..LAWTON AVE
10 ..W LAKE DR
11 ..VINE ST
12 ..TAYLOR DR
13 ..OBSERVATION RD
14 ..FOREST AVE
15 ..PARK WAY DR
16 ..TIN CAN ALLEY

510000 FT

505000 FT

500000 FT

ZONE X
ZONE A
ZONE AE
(EL 1348)
Lake Lawtonka
LIMIT OF DETAILED STUDY
LAKE ELMER THOMAS BEACH RD
LAKE LAWTONKA VIEWPOINT ROAD
ELMER THOMAS DAM ROAD
MOUNT SCOTT ROAD
KETCH ROAD
DEER CREEK CANYON ROAD
SIGNAL
Little Medicine Creek Tributary 1
Little Medicine Creek
Little Medicine Creek Tributary 3
Deer Creek East Tributary 1
Deer Creek East
Blue Beaver Creek Tributary 10
Medicine Creek Tributary 2
Medicine Creek
Pond
Elmer Thomas Lake

EM0812 EM0818 EM0819 EM0820 EM0821 EM0825 EM0826 EM0827 EM0807 EM0815

COMANCHE COUNTY UNINCORPORATED AREAS 400489

TOWN OF MEDICINE PARK 400214

10 11 12 7 15 14 13 18 19 22 23 24 28 27 26 25 30

Project Location

MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

METE

NFIP

PANEL 0250E

FIRM

FLOOD INSURANCE RATE MAP

COMANCHE COUNTY, OKLAHOMA AND INCORPORATED AREAS

PANEL 250 OF 625

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
COMANCHE COUNTY	400489	0250	E
CACHE, TOWN OF	400048	0250	I
MEDICINE PARK, TOWN OF	400214	0250	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
40031C0250E

EFFECTIVE DATE
JULY 20, 2009

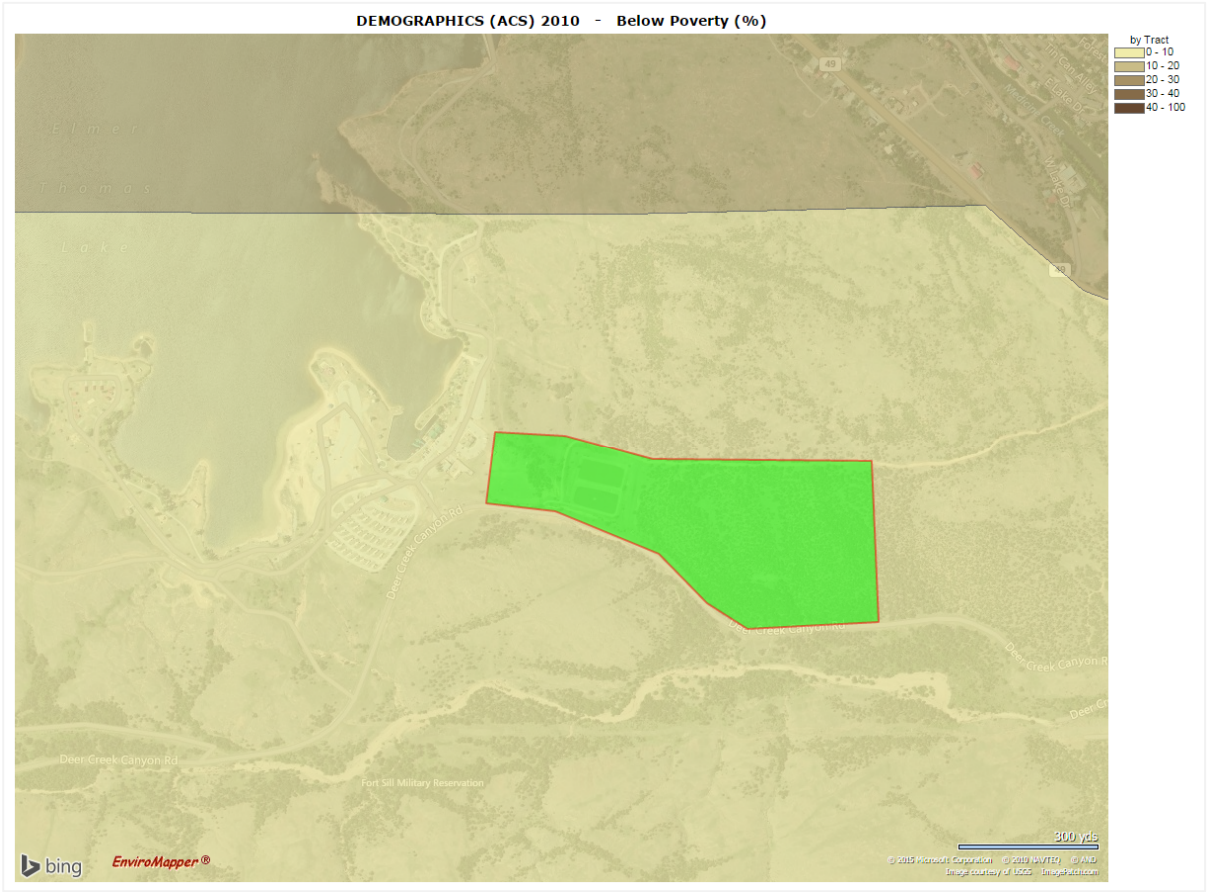
Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

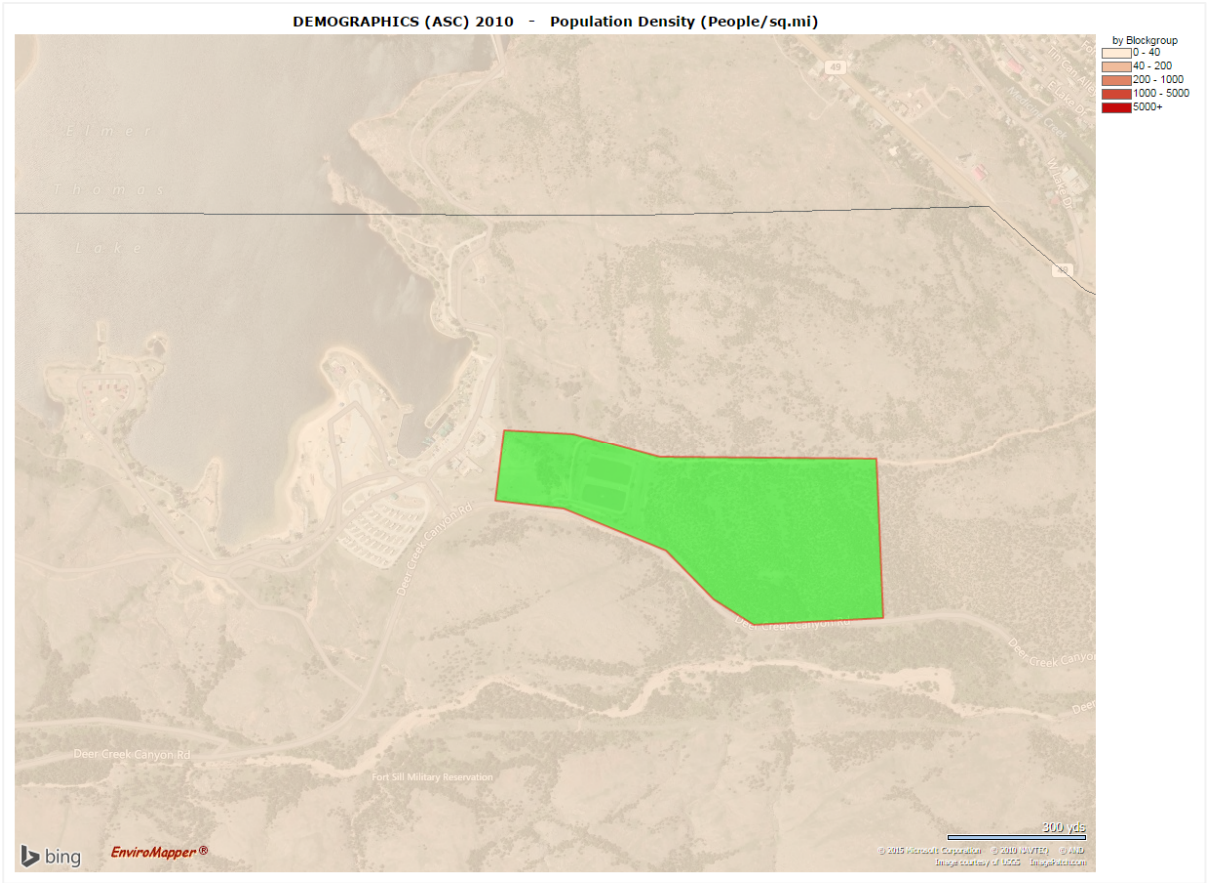
APPENDIX F

Environmental Justice

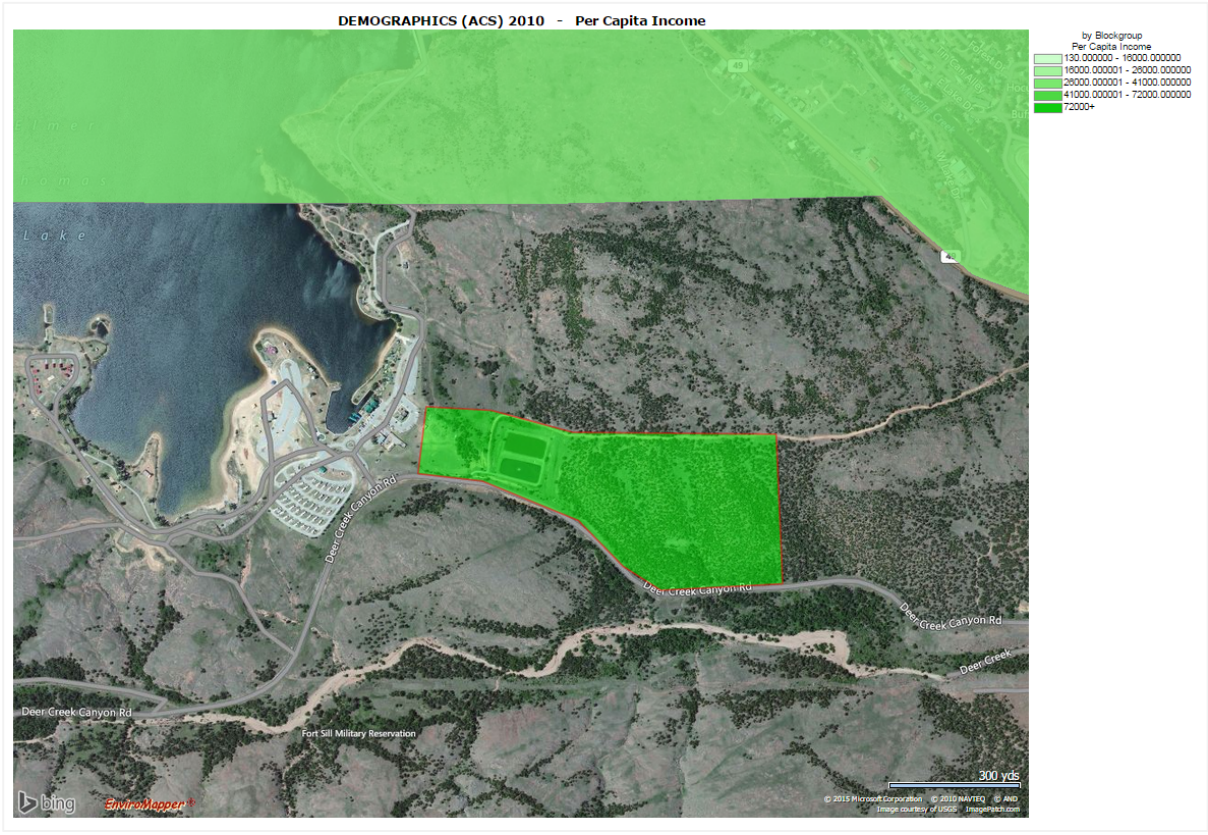
Environmental Justice – Demographics: Below Poverty



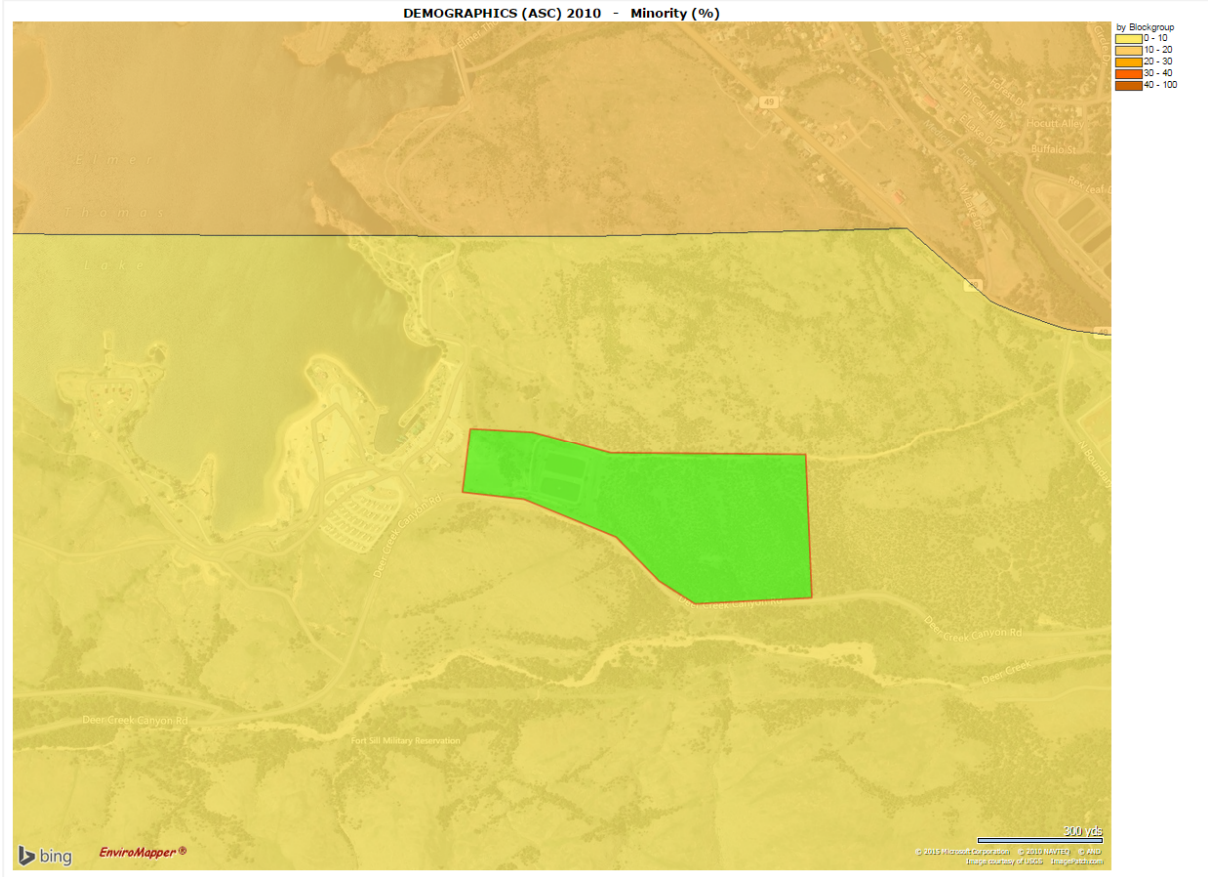
Environmental Justice – Demographics: Population Density



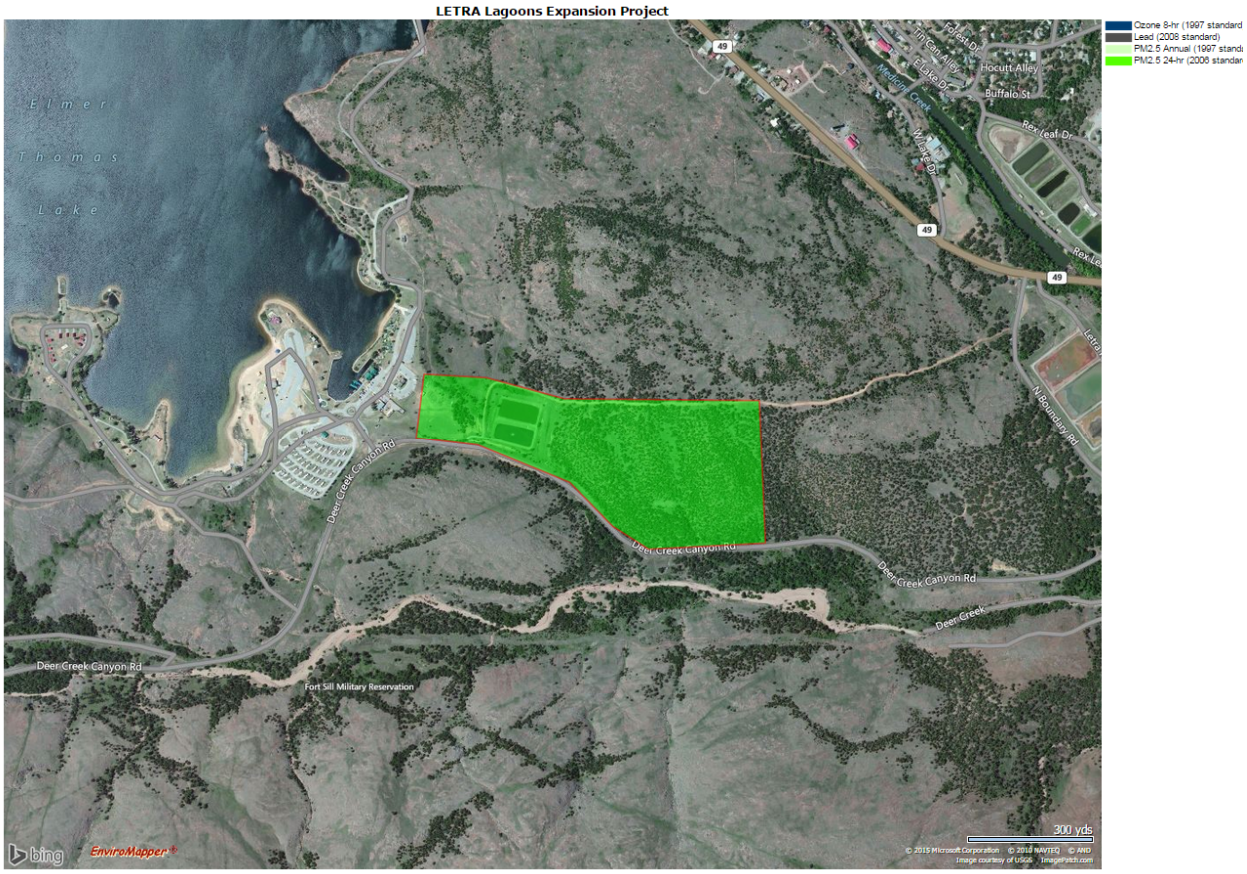
Environmental Justice – Demographics: Per Capita Income



Environmental Justice – Demographics: Minority



Environmental Justice - Air Quality



APPENDIX G

Treatment Options

Option 1 (without new Secondary Cells)

Option 2

N

1" = 100'

Flow Through Option

Ft SILL LETRA

60 Day Hydraulic Retention for Flow Through Lagoons & Land Application Lagoon Sizing

ODEQ 252:656-11-2 © *Organic Loading*
35lbs BOD/per surface acre /per day

MGD x 8.43 x 250

Flow (gpd)	MGD	C	BOD Loading (mg/l)	BOD lbs/day	Design Loading BOD lbs/day/acre
14,142	0.014142	8.43	250	29.80426395	35

Required Surface Area (Acres): 0.852

Annual Rainfall	42.08	days/year 365.00	daily total 0.12	60 day total 6.92	inches
Annual Evaporation	90.00	365.00	0.25	14.79	inches
			60 day net rainfall	-7.88	inches
			surface area x net rainfall	-281612.05	c.f.
			Primary Cell Total Cubic Feet	174706.67	c.f.
			Total Cubic Feet Required	-106905.38	c.f.
			2 - Primary Cells - CF EA.	-53452.69	c.f.

Lagoon Surface

Area S.F.	Rain C.F.	Gallons	GPD
106,330	61,268	458,286	7,638
Evap C.F.			
106,330	131,039	980,174	16,336
Net Evap GPD			-8,698

Primary Cells - 60 day Retention Time

Flow (gpd)	Days	Gallons	Gal/CF	Total Cubic Feet
14,142	60	1,306,806	7.48	174,706.67

Rainfall
7,638

Land Application

Flow (gpd)	days/year	Annual Flow - Gal			
14,142	365	5,161,830			
Net Rainfall (gpd)					
-8,698	365	-3,174,821			
Application Rate		Acre S.F.	Acre - C.F.	Gal / C.F.	
15	inches			7.48	
1.25	feet	43,560	54,450	407,286	Gal / Acre / Yr
Acres Required	4.88				

Existing Primary Cell Capacity

Elev.	Width	Length	Square Feet	CF
1345	99	240	23760	
1346	105	246	25830	
1347	111	252	27972	
1348	115	258	29670	
1349	121	264	31944	
1350	125	286	35750	148,775.00

Water Treatment Plant Output (includes filter backwash)

	May	June	July	Aug	Sept	
2009	11,086	15,636	20,146	15,040	8,978	
2010	10,105	16,838	14,687	17,870	13,508	
2011	15,057	15,788	15,804	15,752	9,143	
2013	9,474	20,020	10,392	13,865	13,650	
Avg Daily GPD	11,431	17,071	15,257	15,632	11,320	14,142

Existing Secondary Cell Capacity

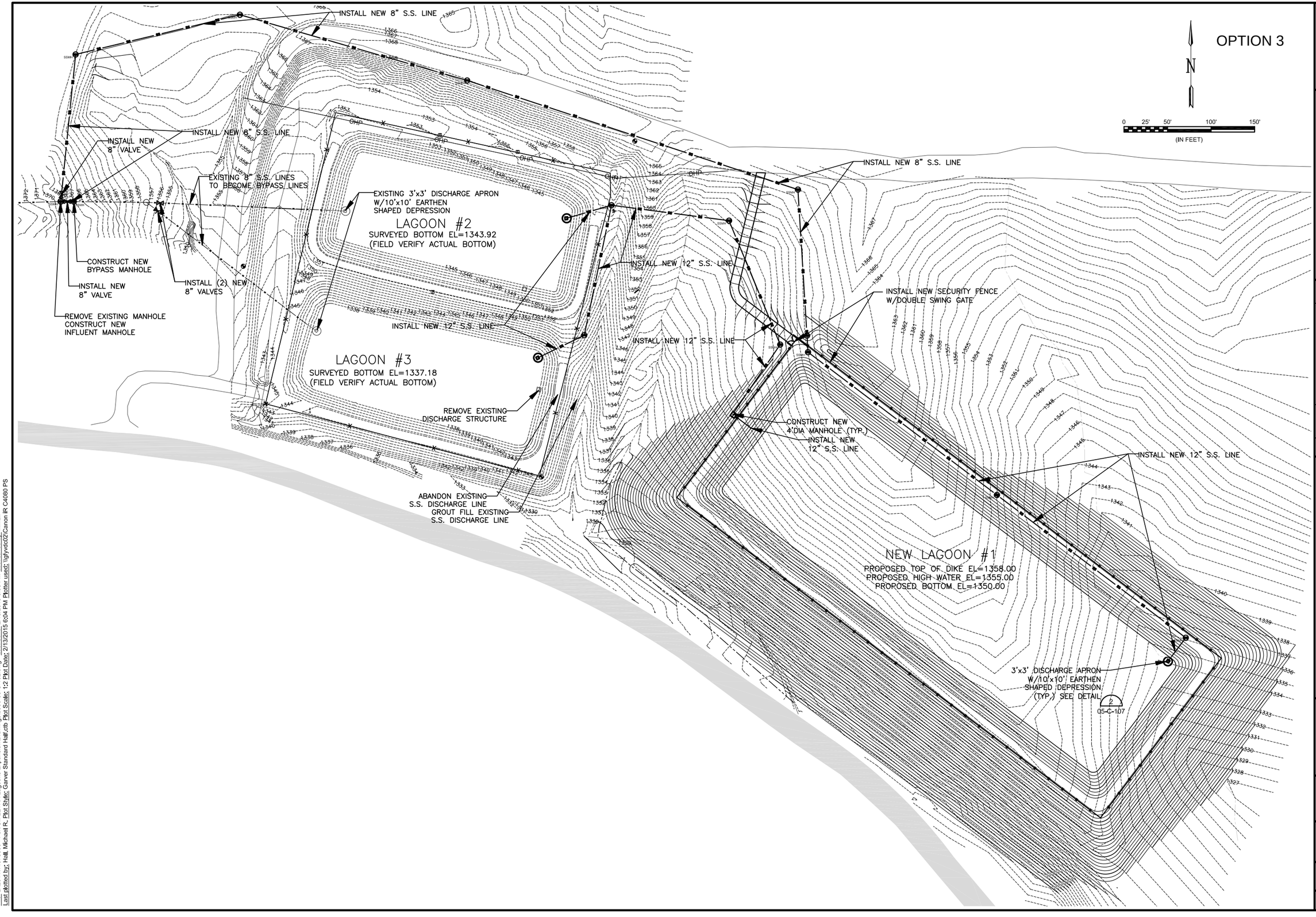
Elev.	Width	Length	Square Feet	CF
1345	99	240	23760	
1346	105	246	25830	
1347	111	252	27972	
1348	115	258	29670	
1349	121	264	31944	
1350	125	286	35750	148,775.00

Additional Primary Cell Capcity

Elev.	Width	Length	Square Feet	CF
1345	99	105	10395	
1346	105	111	11655	
1347	111	117	12987	
1348	117	123	14391	
1349	123	129	15867	
1350	129	135	17415	69,525.00

Additional Secondary Cell Capacity

Elev.	Width	Length	Square Feet	CF
1345	99	105	10395	
1346	105	111	11655	
1347	111	117	12987	
1348	117	123	14391	
1349	123	129	15867	
1350	129	135	17415	69,525.00



GARVER

OK COA # 4193
EXPIRES 06/30/2016

1016 24th Avenue NW
Norman, OK 73069
(405) 329-2555

REV.	DATE	DESCRIPTION	BY

FORT SILL
FORT SILL, OKLAHOMA

FORT SILL FCU 154.1
LETRA LAGOONS EXPANSION PROJECT

OPTION 3
PROPOSED
SITE PLAN

JOB NO.: 14078500
DATE: JAN., 2015
DESIGNED BY: JGC
DRAWN BY: MRH

BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRAWING NUMBER
05-C-102

SHEET NUMBER 5

File: L:\2014\14078500 - Fort Sill LETRA Lagoons Expansion\Drawings\8500-05-C-102.dwg Last Saved: 2/13/2015 6:03 PM Last saved by: Mrhall
Last plotted by: Hall, Michael R. Plot Style: Garver Standard Half.ctb Plot Scale: 1:2 Plot Date: 2/13/2015 6:04 PM Plotter used: \\gfyvdc02\Canon IR C4080 PS

Total Retention Lagoon Sizing - Water Surface Area

Total gallons per year	5,161,830.00	gallons	14,142	gpd		
Net Evaportaion(in)	90	inches				
Rain fall (in)	42.09	inches				
slope (ft)	30	feet		Evap/Gal	Net Gal	In Depth/Acre
constant-1	27200	gallons/acre-inch of water		1,303,152.00	3,858,678.00	141.86
constant-2	43560	ft^2/acre		3,570.28	10,571.72	

Equation

Step 1 Total gallons in a year/ (rainfall -net evap)*constant-1= 3.961034476 surface area acres

Step 2 surface area multiplied by constant-2 172,542.66 ft^2

Step 3 length of one side at water level 415.3825487 ft

Step 4 length of water level - slope= length of one side of bottom 385.3825487 feet

allowable seepage - 500 gal /day/acre =	1,980.52		
seepage / gal /year	722,888.79		
seepage acre-inch / day	0.0184	500.48	Gallons
seepage inch / acre /day	0.072883034		

Lagoon Dimensions, Depth, WSA and Volume

	Side Dim.	Depth	WSA = S.F.	C.F.	Gal	Gal / 10th ft
18	433.38	8.00	187,820.43	5,164.59	293,969.42	3,863.11
12	427.38	7.00	182,655.84	5,092.59	255,338.28	3,809.26
6	421.38	6.00	177,563.25	5,020.59	217,245.71	3,755.40
0	415.38	5.00	172,542.66	4,948.59	179,691.69	3,701.55
6	409.38	4.00	167,594.07	4,876.59	142,676.23	3,647.69
12	403.38	3.00	162,717.48	4,804.59	106,199.33	3,593.83
18	397.38	2.00	157,912.89	4,732.59	70,261.00	3,539.98
24	391.38	1.00	153,180.30	4,660.59	34,861.22	3,486.12
30	385.38	0.00	148,519.71			

	WSA = S.F.		
Existing Lagoon Cell 1	33738.0962		
Existing Lagoon Cell 2	30829.7105		
Existing Total	64567.8067	Ft/Ea/Side	
Proposed Lagoon Cell 3	107,974.86	328.595276	
Total	172,542.66		

LETRA Water Treatment Plant Output (Includes Filter Backwash)

	May	June	July	Aug	Sept	
2009	11,086	15,636	20,146	15,040	8,978	
2010	10,105	16,838	14,687	17,870	13,508	5 Month
2011	15,057	15,788	15,804	15,752	9,143	Avg Daily
2013	9,474	20,020	10,392	13,865	13,650	GPD
Avg Daily GPD	11,431	17,071	15,257	15,632	11,320	**14,142**

Option 4

N

1" = 100'

New Force Main

New Primary Cell

New Secondary Cell

Pump Station & Control Valve

Spray Field 4.88 Acres

100' Buffer

Fence

Land Application Option

APPENDIX H

Construction Cost Estimates

FT. SILL - LETRA WASTEWATER SYSTEM - EFFLUENT DISINFECTION

Feb-14

SUMMARY OF PAY ITEMS

Item	SPEC NUMBER	Description	Notes	Unit	QTY	Unit Cost	Extension
1		CLEARING AND GRUBBING		LS	1	3,125.00	3,125.00
2		UNCLASSIFIED EXCAVATION (INCLUDES ROCK EXCAVATION)		CY	500	10.00	5,000.00
3		UNCLASSIFIED BORROW		CY	3,300	12.50	41,250.00
4		TYPE B-SALVAGED TOPSOIL		CY	230	3.13	718.75
5		TEMPORARY SILT FENCE		LF	500	5.00	2,500.00
6		SEEDING METHOD "C"		AC	0.1	3,125.00	312.50
7		VEGETATIVE MULCH		AC	0.1	2,500.00	250.00
8		FERTILIZING, (10-20-10),METHOD 1		TON	0.1	1,250.00	125.00
9		MOBILIZATION		LS	1	6,250.00	6,250.00
10		CONTRACTOR CONSTRUCTION STAKING		LS	1	625.00	625.00
11		VALVE BOX EXTENSIONS AS REQUIRED		EA	3	437.50	1,312.50
12		RUN TIME METER, COMPLETE IN PLACE		EA	1	2,500.00	2,500.00
13		SEEPAGE COLLAR		EA	1	2,500.00	2,500.00
14		6" THICK AGREGATE BASE (maintenance roads)		CY	90	33.75	3,037.50
15		DEPTH STAFF, COMPLETE, INSTALLED IN PLACE		EA	2	625.00	1,250.00
16		WARNING SIGN, COMPLETE IN PLACE		EA	4	187.50	750.00
17		ULTRA VIOLET TREATMENT VAULT, COMPLETE		LS	1	81,250.00	81,250.00
							$152,756.25

st Estimate Plus 20% Contingency **$183,308.00**

Geothenincal Engineering		LS	1	1,200.00	1,200.00
Land Surveying		LS	1	3,500.00	3,500.00
Engineering		LS	1	15,275.63	15,275.63

$19,975.63

Total Eng & Construction Cost **$203,283.63**

FT. SILL - LETRA WASTEWATER SYSTEM - FLOW THROUGH LAGOON

Feb-14

SUMMARY OF PAY ITEMS

Item	SPEC NUMBER	Description	Notes	Unit	QTY	Unit Cost	Extension
1		CLEARING AND GRUBBING		LS	1	18,750.00	18,750.00
2		UNCLASSIFIED EXCAVATION (INCLUDES ROCK EXCAVATION)		CY	9,600	10.00	96,000.00
3		UNCLASSIFIED BORROW		CY	7,000	12.50	87,500.00
4		TYPE B-SALVAGED TOPSOIL		CY	1,400	3.13	4,375.00
5		TEMPORARY SILT FENCE		LF	500	5.00	2,500.00
6		SEEDING METHOD "C"		AC	2	3,125.00	4,687.50
7		VEGETATIVE MULCH		AC	2	2,500.00	3,750.00
8		FERTILIZING, (10-20-10),METHOD 1		TON	1	1,250.00	625.00
9		MOBILIZATION		LS	1	31,250.00	31,250.00
10		CONTRACTOR CONSTRUCTION STAKING		LS	1	6,250.00	6,250.00
11		2" DIA. DR-26 HDPE FORCE MAIN, COMPLETE IN PLACE		LF	600	18.75	11,250.00
12		8" DIA. ASTM D3034, SDR35, PVC, COMPLETE IN PLACE		LF	400	43.75	17,500.00
13		4 DIA. PRE-CAST MANHOLE, COMPLETE IN PLACE		EA	3	3,125.00	9,375.00
14		8" GATE VALVE, COMPLETE IN PLACE		EA	4	1,875.00	7,500.00
15		VALVE BOX FOR 8" VALVES		EA	4	625.00	2,500.00
16		VALVE BOX EXTENSIONS AS REQUIRED		EA	3	437.50	1,312.50
17		3'x3' REINFORCED CONC BOX - OUTLET STRUCTURE		EA	4	3,125.00	12,500.00
18		RUN TIME METER, COMPLETE IN PLACE		EA	1	2,500.00	2,500.00
19		SEEPAGE COLLAR		EA	8	2,500.00	20,000.00
20		12" THICK CLAY LINER		CY	2,700	27.50	74,250.00
21		6" THICK AGREGATE BASE (maintenance roads)		CY	175	33.75	5,906.25
22		DEPTH STAFF, COMPLETE, INSTALLED IN PLACE		EA	4	625.00	2,500.00
23		WARNING SIGN, COMPLETE IN PLACE		EA	4	187.50	750.00
24		ULTRA VIOLET TREATMENT VAULT, COMPLETE		LS	1	81,250.00	81,250.00
25		6' HIGH CHAIN LINK FENCE, COMPLETE IN PLACE		LF	787	47.50	37,382.50
26		72"H X 20' W CHAIN LINK GATE, COMPLETE IN PLACE		EA	1	1,875.00	1,875.00
							$544,038.75

Estimate Plus 20% Contingency **$652,847.00**

Geothenincal Engineering		LS	1	5,500.00	5,500.00
Land Surveying		LS	1	6,000.00	6,000.00
Engineering		LS	1	54,403.88	54,403.88

$65,903.88

Total Eng & Construction Cost **$718,750.88**

FT. SILL - LETRA WASTEWATER SYSTEM - LAND APPLICATION

Feb-14

SUMMARY OF PAY ITEMS

Item	SPEC NUMBER	Description	Notes	Unit	QTY	Unit Cost	Extension
1		CLEARING AND GRUBBING		LS	1	18,750.00	18,750.00
2		UNCLASSIFIED EXCAVATION (INCLUDES ROCK EXCAVATION)		CY	9,600	10.00	96,000.00
3		UNCLASSIFIED BORROW		CY	7,000	12.50	87,500.00
4		TYPE B-SALVAGED TOPSOIL		CY	1,400	3.13	4,375.00
5		TEMPORARY SILT FENCE		LF	500	5.00	2,500.00
6		SEEDING METHOD "C"		AC	2	3,125.00	4,687.50
7		VEGETATIVE MULCH		AC	2	2,500.00	3,750.00
8		FERTILIZING, (10-20-10),METHOD 1		TON	1	1,250.00	625.00
9		MOBILIZATION		LS	1	31,250.00	31,250.00
10		CONTRACTOR CONSTRUCTION STAKING		LS	1	6,250.00	6,250.00
11		2" DIA. DR-26 HDPE FORCE MAIN, COMPLETE IN PLACE		LF	600	18.75	11,250.00
12		8" DIA. ASTM D3034, SDR35, PVC, COMPLETE IN PLACE		LF	400	43.75	17,500.00
13		4 DIA. PRE-CAST MANHOLE, COMPLETE IN PLACE		EA	3	3,125.00	9,375.00
14		8" GATE VALVE, COMPLETE IN PLACE		EA	4	1,875.00	7,500.00
15		VALVE BOX FOR 8" VALVES		EA	4	625.00	2,500.00
16		VALVE BOX EXTENSIONS AS REQUIRED		EA	3	437.50	1,312.50
17		3'x3' REINFORCED CONC BOX - OUTLET STRUCTURE		EA	4	1,875.00	7,500.00
18		RUN TIME METER, COMPLETE IN PLACE		EA	1	2,500.00	2,500.00
19		SEEPAGE COLLAR		EA	8	625.00	5,000.00
20		12" THICK CLAY LINER		CY	2,700	27.50	74,250.00
21		6" THICK AGREGATE BASE (maintenance roads)		CY	175	33.75	5,906.25
22		DEPTH STAFF, COMPLETE, INSTALLED IN PLACE		EA	4	625.00	2,500.00
23		WARNING SIGN, COMPLETE IN PLACE		EA	4	187.50	750.00
		5 STRAND BARB WIRE FENCE (INCLUDES 2 GATES		LF	3,400	25.00	85,000.00
		LAND APPLICATION PUMP STATION (WETWELL, PUMPS, CONTROLS) COMPLETE		LS	1	41,250.00	41,250.00
24		LAND APPLICATION SPRAY FIELD (PIPE, SPRINKLERS, VALVES) COMPLETE		LS	1	112,500.00	112,500.00
25		6' HIGH CHAIN LINK FENCE, COMPLETE IN PLACE		LF	787	35.00	27,545.00
26		72"H X 20' W CHAIN LINK GATE, COMPLETE IN PLACE		EA	1	1,875.00	1,875.00
							$671,701.25

Estimate Plus 20% Contingency **$806,042.00**

Geothenincal Engineering		LS	1	5,500.00	5,500.00
Land Surveying		LS	1	6,000.00	6,000.00
Engineering		LS	1	67,170.13	67,170.13

$78,670.13

Total Eng & Construction Cost **$884,712.13**

FT. SILL - LETRA WASTEWATER SYSTEM - TOTAL RETENTION LAGOON OPTION

Feb-14

SUMMARY OF PAY ITEMS

Item	SPEC NUMBER	Description	Notes	Unit	QTY	Unit Cost	Extension
1		CLEARING AND GRUBBING		LS	1	18,750.00	18,750.00
2		UNCLASSIFIED EXCAVATION (INCLUDES ROCK EXCAVATION)		CY	21,055	10.00	210,550.00
3		UNCLASSIFIED BORROW		CY	9,700	12.50	121,250.00
4		TYPE B-SALVAGED TOPSOIL		CY	2,200	2.50	5,500.00
5		TEMPORARY SILT FENCE		LF	500	5.00	2,500.00
6		SEEDING METHOD "C"		AC	1.5	3,125.00	4,687.50
7		VEGETATIVE MULCH		AC	1.5	2,500.00	3,750.00
8		FERTILIZING, (10-20-10),METHOD 1		TON	1	1,250.00	625.00
9		MOBILIZATION		LS	1	31,250.00	31,250.00
10		CONTRACTOR CONSTRUCTION STAKING		LS	1	6,250.00	6,250.00
11		8" DIA. ASTM D3034, SDR35, PVC, COMPLETE IN PLACE		LF	60	43.75	2,625.00
12		8" GATE VALVE, COMPLETE IN PLACE		EA	1	1,875.00	1,875.00
13		VALVE BOX FOR 8" VALVES		EA	1	625.00	625.00
14		VALVE BOX EXTENSIONS AS REQUIRED		EA	1	375.00	375.00
15		RUN TIME METER, COMPLETE IN PLACE		EA	1	2,500.00	2,500.00
16		SEEPAGE COLLAR		EA	2	625.00	1,250.00
17		12" THICK CLAY LINER		CY	5915	27.50	162,662.50
18		6" THICK AGREGATE BASE (maintenance roads)		CY	155	33.75	5,231.25
19		DEPTH STAFF, COMPLETE, INSTALLED IN PLACE		EA	3	625.00	1,875.00
20		WARNING SIGN, COMPLETE IN PLACE		EA	8	187.50	1,500.00
21		6' HIGH CHAIN LINK FENCE, COMPLETE IN PLACE		LF	1,400	33.75	47,250.00
22		72"H X 20' W CHAIN LINK GATE, COMPLETE IN PLACE		EA	1	1,875.00	1,875.00
							$634,756.25

Estimate Plus 20% Contingency **$761,708.00**

Geothenincal Engineering		LS	1	5,500.00	7,500.00
Land Surveying		LS	1	6,000.00	9,000.00
Engineering		LS	1	63,475.63	63,475.63

$79,975.63

Total Eng & Construction Cost **$841,683.63**

APPENDIX I

Site Photographs

Photo 1 - Existing northernmost lagoon (looking east)

Photo 2 – Existing southernmost lagoon and entry drive (looking east)

Photo 3 – Existing Lagoon and dike (looking southwest)

Photo 4 – Existing northernmost lagoon (looking northwest)

Photo 5 – Existing power service road on west side of lagoons (looking north)

Photo 6 – Area east of lagoons (looking north)

APPENDIX J

Archaeological Surveys

APPENDIX K

Agency Coordination

And Public Comments

Oklahoma Historical Society *Founded May 27, 1893*
State Historic Preservation Office
Oklahoma History Center • 800 Nazih Zuhdi Drive • Oklahoma City, OK 73105-7917
(405) 521-6249 • Fax (405) 522-0816 • www.okhistory.org/shpo/shpom.htm

November 19, 2014

Mr. Kevin Christopher
Environmental Support Branch
DPW-EQD ATTN: IMSI-PWE/K.Christopher
2515 Ringgold Road
Fort Sill, OK 73503

RE: File #0245-15; Fort Sill Proposed AWE FY2015 Annual Capital Plan for Water System, #ZW40001-4P, Comanche County

Dear Mr. Christopher:

We have received and reviewed the materials for the referenced undertaking submitted with your letter dated October 31, 2014. We concur with the defined area of potential effect (APE) with respect to both direct and indirect impacts for this project and consider it appropriate for the scope of work.

We have no additional agencies or organizations to suggest as possible consulting parties for the proposed undertaking other than those noted in your letter.

Based on the information you have provided about this project and in keeping with your request that we consider this undertaking per expedited consultation, we find no historic properties affected by the undertaking.

Thank you for the opportunity to review this project. If you have any questions, please call Catharine M. Wood, Historical Archaeologist, at 405/521-6381. Please reference the above underlined file number when responding. Thank you.

Sincerely,

Melvena Heisch
Deputy State Historic
Preservation Officer

MH:pm

APPENDIX L

Finding of No Significant Impact


GARVER

Questions and Comments regarding this Environmental Assessment as well as requests for copies of the Black-capped Vireo and Archaeological surveys may be sent to:

US ARMY GARRISON FORT SILL
DPW Environmental Quality Division
(IMSI-PWE, ATTN: S. Sminkey)
2515 Ringgold Road
Fort Sill, OK 73503

PHONE: 1-580-442-2849

EMAIL: sarah.e.sminkey.civ@mail.mil