Environmental Assessment

QUARRY ISLAND COVE
NUTRIENT INACTIVATION PROJECT

8 July 2014

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FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, including guidelines in 33 Code of Federal Regulations, Part 230, the Tulsa District has assessed the environmental impacts of the Quarry Island Cove Nutrient Inactivation Project.

The proposed action would result in application of 16,000 – 32,000 gallons of liquid alum and between and from 8,000 – 16,000 gallons of liquid sodium aluminate at a ratio of 2:1 (alum:sodium aluminate) to 100 surface acres of Quarry Cove, Wister Lake, Oklahoma for the purpose of nutrient inactivation. Nutrient inactivation is an in-lake water quality restoration technique that lowers the phosphorus content of a lake by both (1) directly removing phosphorus from the water column and (2) reducing the recycling of mobile phosphorus from lake sediments to the water column. The goal of the proposed action is removing biotic and abiotic suspended organic matter from the water column of Quarry Cove to reduce disinfection by-product formation during potable water treatment by the Poteau Valley Improvement Authority (PVIA). Precipitate (floc) formation created through this chemical process will not result in a loss of reservoir capacity within Wister Lake.

The PVIA would initiate water quality monitoring of Quarry Cove to assess effectiveness of chemical treatment of the cove and to assess potential changes in water quality, sediment quality, and zooplankton and phytoplankton community composition. Additionally, the PVIA will initiate post-treatment collections of largemouth bass to assess the potential effects increased water clarity and increased sulfate concentrations may have on the methylation rate of mercury in Wister Lake, Oklahoma. Additional precautions would include:

1. Application would begin each day in the very early morning, just after daylight, before a high number of users are at the lake. Application would not occur on a weekend or holiday.
2. No alum would be applied in the swim area itself, or in the nearshore area of the boat ramp where boaters sometimes enter the water.
3. The Quarry Island boat ramp and swim beach are adjacent on the north shore of Quarry Island (south shore of the cove). On the day that this portion of the cove receives its alum application, it would be done first, to provide maximum opportunity for the floc to settle before day use of the area begins.
4. PVIA staff would be stationed at the boat ramp and swim beach area each day to direct boaters away from the areas scheduled for treatment that day and explain the alum application to lake users.
5. PVIA would station a pontoon boat in the cove in the application area to further direct boaters to other areas of the cove during application.

The environmental review of the proposed project, which is documented in the enclosed environmental assessment, indicates that no significant adverse environmental impacts on the natural and human environments would result from the proposed action. Therefore, an environmental impact statement will not be prepared.

29 Jul 14
Date

Richard A. Pratt
Colonel, U.S. Army
District Commander

Enclosure
Environmental Assessment

ENVIRONMENTAL ASSESSMENT ORGANIZATION

This Environmental Assessment (EA) evaluates the effects of nutrient inactivation via the application of alum (aluminum sulfate) and sodium aluminate in Quarry Island Cove, Lake Wister, located in LeFlore County Oklahoma. This EA will facilitate the decision process regarding the proposed action and alternatives.

SECTION 1	*AUTHORITY, PURPOSE, AND SCOPE* provides the authority for the proposed action, summarizes the project purpose, provides relevant background information, and describes the scope of the EA.
SECTION 2	*ALTERNATIVES* examines alternatives for implementing the proposed action.
SECTION 3	*PROPOSED ACTION* describes the recommended action.
SECTION 4	*AFFECTED ENVIRONMENT* describes the existing environmental and socioeconomic setting.
SECTION 5	*ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION* identifies the potential environmental and socioeconomic effects of implementing the proposed action and alternatives.
SECTION 6	*MITIGATION PLAN* summarizes mitigation actions required to enable a Finding of No Significant Impact for the proposed alternative.
SECTION 7	*FEDERAL, STATE, AND LOCAL AGENCY COORDINATION* provides a listing of individuals and agencies consulted during preparation of the EA.
SECTION 8	*REFERENCES* provides bibliographical information for cited sources.
SECTION 9	*APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS* provides a listing of environmental protection statutes and other environmental requirements.
SECTION 10	*LIST OF PREPARERS* identifies persons who prepared the document and their areas of expertise.

APPENDICES	*A*	Coordination/Correspondence
	B	Section 404 Permit (if required)
	C	Fish and Wildlife Coordination/Correspondence
	D	Cultural Resources Coordination/Correspondence
	E	Public Comments (if applicable)
	F	Newspaper Public Notice (if applicable)

Additional copies of this document may be viewed or downloaded from the PVIA website: pvia.org/ea

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1 AUTHORITY, PURPOSE, AND SCOPE

1.1 AUTHORITY

Wister Lake is a U.S. Army Corps of Engineers (USACE) facility authorized by the Flood Control Act of 1938 and completed in 1949. Authorized purposes include flood control, water supply, flow augmentation, water conservation, and sediment reduction. The reservoir and adjacent lands are also used for recreation, fishing, hunting, and wildlife.

The Poteau Valley Improvement Authority (PVIA) is a State of Oklahoma-chartered trust whose mission is to produce and distribute water to 16 member municipalities and rural water districts in LeFlore County, Oklahoma and portions of adjacent Haskell and Latimer Counties (Figure 1-1). Wister Lake (Figure 1-2) is the source of water that PVIA treats and distributes. PVIA currently treats an average of 5.5 million gallons of water a day (mgd), or a little over 6,000 acre-feet per year. In the summer, the daily treatment rises to 9-10 mgd.

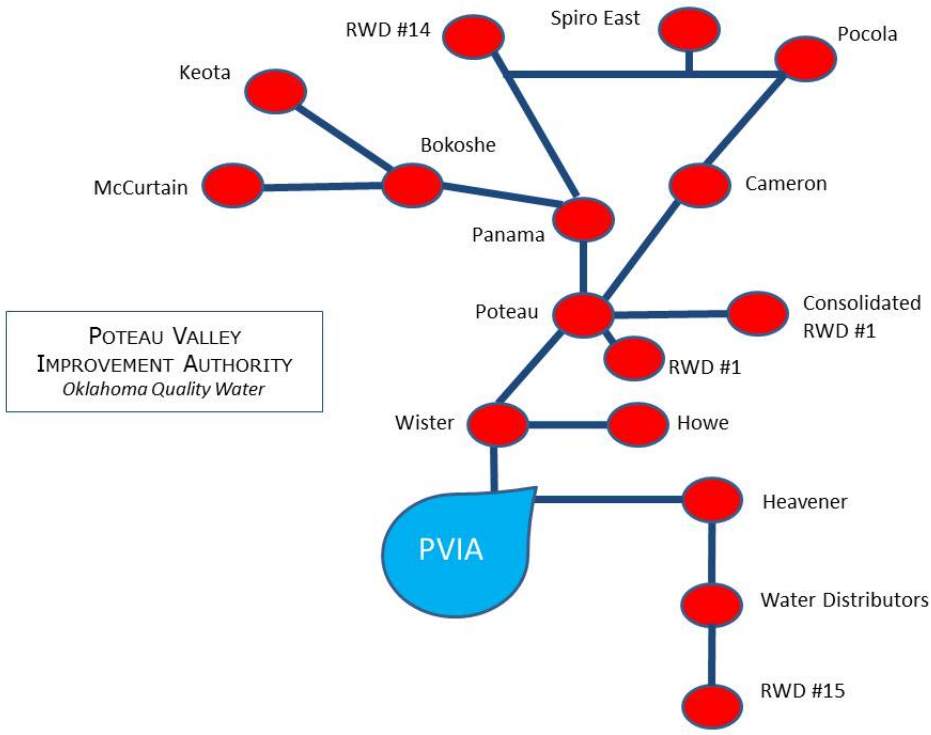

Figure 1-1. PVIA Service Area, LeFlore, Latimer, and Haskell Counties, OK

1.2 PURPOSE

The purpose of the Quarry Island Cove Nutrient Inactivation Project is to reduce the concentrations of disinfection by-products (DBPs) in treated water produced by PVIA during the time of year (late summer) when those concentrations are typically at their highest and to contribute to long-term reduction of phosphorus levels in Quarry Island

Cove. Nutrient inactivation will also reduce the concentration of potentially harmful cyanobacteria in Quarry Island Cove at the time of year when those concentrations are at their highest and recreational use of the cove is high.

Figure 1-2. Wister Lake, LeFlore County, Oklahoma
(Google Earth imagery date: 10-5-2013. Lake elevation was 477.5 ft., 0.5 ft. below conservation pool elevation of 478 ft.)

The PVIA raw water intake is located on the north shore of Quarry Island Cove in the northeast corner of the lake (Figure 1-3).

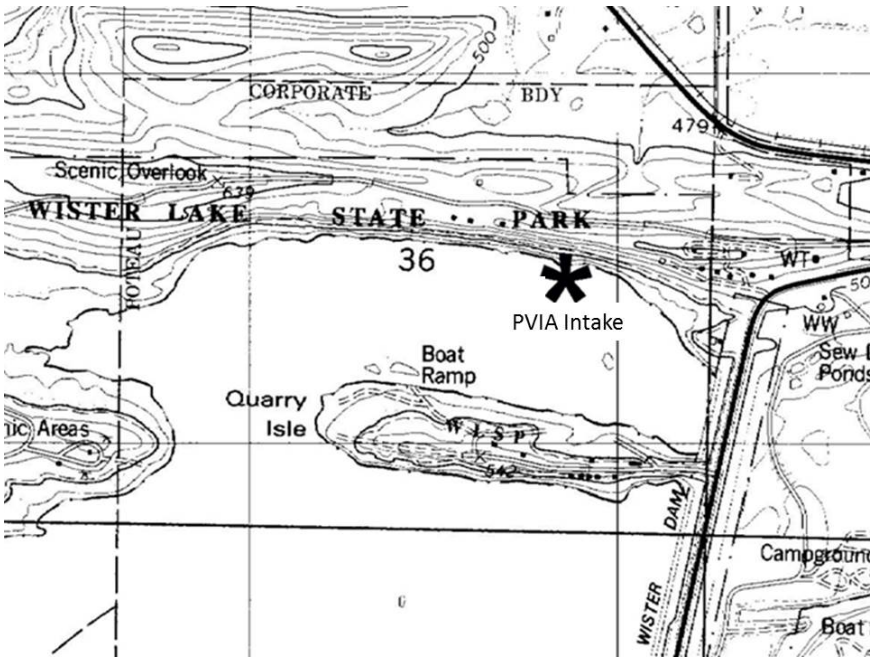

Figure 1-3. Quarry Island Cove, Lake Wister

High algae and cyanobacteria levels in raw water from Wister Lake make water treatment more difficult and costly, and can interact with chlorine, used as a disinfectant, to produce potentially harmful disinfection by-products (DBP) in treated water. Cyanobacteria have been implicated as precursors of the class of DBPs known as trihalomethanes (THMs), which are occasionally found in elevated concentrations in treated water distributed from Wister Lake.

High cyanobacterial levels are also of potential concern for water contact recreation. Monthly sampling at Wister Lake in 2013 found that in seven of 12 months cyanobacteria counts exceeded 100,000 cells/ml, the Oklahoma state threshold of concern. However, cyanobacterial toxin levels did not exceed state guidelines.

Nutrient inactivation will be conducted via the application of alum (aluminum sulfate) and sodium aluminate to the surface of the water in Quarry Island Cove. As the chemicals settle they clear the water column of particles in the water as well as dissolved phosphorus. When they reach the lake bottom the alum and sodium aluminate create a chemical barrier that intercepts soluble phosphorus when it is released from lake bottom sediments. Since phosphorus is generally regarded as the nutrient limiting algal growth, a reduced concentration of phosphorus in lake water should in turn reduce the concentrations of cyanobacteria and algae. A reduction in cyanobacteria and algal levels means there will be less organic material in the raw water and therefore a reduced opportunity for DBP forrmation when the water is treated.

Alum is used safely on a daily basis in most water treatment plants in the United States and has been used safely and successfully in lakes and reservoirs across the United States, though this will be the first application of this scale in an Oklahoma reservoir and the first application of this kind in a USACE managed reservoir.

1.3 Scope

This environmental assessment (EA) will evaluate the potential impacts of the application of nutrient inactivating chemicals to the environment in the Wister Lake project area. The geographic scope of the EA is waters of Quarry Island Cove, connected waters of the lake, and adjacent lands surrounding the cove and lake (Figure 1-2).

This EA was developed to ensure that implementation of the proposed project complies with the intent of the National Environmental Policy Act (NEPA) of 1969 (Public Law 91-190). NEPA requires Federal agencies to address the environmental impacts of any major Federal action on the natural and human environment. Guidance for complying with NEPA is contained in Title 40 of the Code of Federal Regulations (CFR), Parts 1500 through 1508, and in Engineering Regulation (ER) 200-2-2, Procedures for Implementing NEPA. The primary intent of NEPA is to ensure that environmental information is made available to public officials and citizens regarding major actions taken by Federal agencies.

2 ALTERNATIVES

Alternatives evaluated include a No Action plan that would maintain existing conditions, the Proposed Action plan, which would apply alum and sodium aluminate to the surface water of Quarry Island Cove, and a Whole Lake Treatment alternative which would apply alum and sodium aluminate to the surface of the entire lake.

2.1 NO ACTION

Under the No Action alternative water quality within the Quarry Island Cove portion of Wister Lake will remain in its current eutrophic state, or continue to decline. Excessive phosphorus loads would continue to be released from lake sediments. Nutrient inputs from the watershed and lake sediments would continue to support high cyanobacteria and algae levels. Organic carbon derived from cyanobacteria and algae would continue to be present in high levels in raw water treated by PVIA, creating the potential for high levels of disinfection by-product formation during water treatment.

2.2 PROPOSED ACTION

Under the Proposed Action alternative, alum (aluminum sulfate) and sodium aluminate would be applied to the water surface in Quarry Island Cove. After application to the water surface, these chemicals dissociate to form aluminum hydroxide [$Al(OH)_3$] precipitates (referred to as floc), that bind with dissolved phosphorus and promote the coagulation of fine suspended particles. The floc and the particles captured settle to the lake bottom. When they reach the bottom the alum and sodium aluminate create a chemical barrier that will intercept soluble phosphorus when it is released from lake sediments. A reduced concentration of phosphorus in lake water in turn will very quickly reduce the concentrations of cyanobacteria and algae in the water. A reduction in cyanobacteria and algal levels means there will be less organic material in the raw water and therefore a reduced opportunity for disinfection by-product formation during water treatment.

The proposed alum application will occur in early August 2014, during the time of typically highest cyanobacteria concentrations and DBP production. Alum and sodium aluminate will be applied by boat, sprayed onto the water surface.

Some benefits of nutrient inactivation treatment are temporary and some are permanent. Clearing of the water column is temporary. As water evaporates from the cove and PVIA withdraws water from the cove, phosphorus-rich water from the untreated portions of the lake will enter the cove, eventually restoring water column nutrient concentrations to the same level as found in the larger lake. This will take some time to occur, however, and is expected to be after the season of maximum concern has passed. The capture and binding of phosphorus by the aluminum found in alum and sodium aluminate results in a permanent loss of that phosphorus as a nutrient for algal growth. The chemical barrier created on the surface the lake sediments will continue to intercept and bind phosphorus as long as there are aluminum atoms available to do so. Additional applications of alum

and sodium aluminate during subsequent seasons would again clear the water column at the time of application and contribute further to the permanent reduction of internal loading of phosphorus from cove sediments.

Several studies suggest that dosing a lake over several years at a low rate may be more efficient (more effective per quantity of material) than one large dose (Cooke et al. 2005). For the proposed project, PVIA anticipates that low dose alum applications may occur as frequently as annually over the next five years (2014-2018). Decisions about whether to treat again and with what quantities will be determined based on the level of success from the first application in reducing phosphorus, algae and cyanobacteria, and disinfection by-product concentrations.

The consequences of the proposed project for nutrient, cyanobacteria, and algae levels will be carefully monitored. The results of this monitoring will be used to guide decision-making regarding possible future applications.

2.3 Whole Lake Treatment

Under the Proposed Action alternative, alum treatment of Quarry Island Cove will only temporarily reduce phosphorus concentrations. As water evaporates and PVIA withdraws water from the treated cove, phosphorus-rich water from the untreated portions of the lake will enter the cove. A whole lake treatment with alum would reduce phosphorus levels throughout the lake, and therefore reduce levels entering Quarry Island Cove from the rest of the lake.

2.4 Alternatives Evaluation

The objectives of the proposed project are to reduce cyanobacteria and algal levels in the water of Quarry Island Cove during the season they typically occur at their highest levels, and consequently reduce the levels of disinfection by-products in treated water.

The No-Action alternative will not accomplish these objectives. Cyanobacteria and disinfection byproduct levels will continue to be high.

The Whole Lake Treatment alternative would achieve project objectives, but at a much higher cost. The cost to treat 6,000-plus acres of the whole lake would be some 30-40 times the cost to treat the 100-acre cove (depending upon how much of the whole lake actually could be treated). The Whole Lake alternative would have the potential to provide a longer period of reduced phosphorus levels in the cove through a reduction in internal loading throughout the entire lake. Eventually, however, phosphorus-rich water entering the lake from its watershed would restore high phosphorus levels to lake water. Long-term reduction of phosphorus loads entering the lake from the watershed is necessary, in conjunction with reduction of internally generated loads, to provide a long-term reduction in cove and lake water phosphorus levels, cyanobacteria and algae levels, and disinfection byproduct formation.

3 PROPOSED ACTION

3.1 CHEMICAL APPLICATION

Nutrient inactivation would be conducted by the application of liquid alum and sodium aluminate to 100 surface acres of Quarry Island Cove, Lake Wister, Oklahoma. The chemicals would be applied over a three day period beginning August 4, 2014; unless delayed by excessive wind, unfavorable water temperatures, unfavorable pH conditions, or other severe weather delays. Figure 3-1 shows the area to be treated.

The estimated treatment rate would be between 16,000 and 32,000 gallons of liquid alum and 8,000 to 16,000 gallons of liquid sodium aluminate. The two chemicals will always be applied at a 2:1 ratio (alum:sodium aluminate). The actual application quantity will be determined based upon the results of jar tests conducted with water taken from the cove near the time of application. Additional jar tests will be conducted immediately prior to each day's application.

The application quantity was calculated by combining an estimate of annual loading of phosphorus from cove sediments (Haggard et al. 2012) with an estimate of the total quantity of phosphorus that will be present in cove water at the time of application. Those two quantities added together became the target quantity of phosphorus to be inactivated. Theoretically each atom of aluminum applied could bind with one atom of phosphorus to form aluminum phosphate ($AlPO_4$), but in reality many factors reduce the actual effectiveness. Ratios of 5:1 to 100:1 (aluminum:phosphorus) are often used to set treatment quantities (Cooke et al. 2005; NALMS 2012). A relatively conservative 10:1 ratio was used to estimate a target of aluminum to be applied to Quarry Island Cove. Based upon the results of the first application, the treatment may be repeated in future years to result in a higher ratio ultimately being applied.

The application quantity calculated through this process is 16,000 gallons of alum and 8,000 gallons of sodium aluminate. This quantity would be adjusted based upon the results of jar tests conducted near the time of application. Wister Lake can at times have high concentrations of suspended sediment and of cyanobacteria. Quantities present vary over time. Both suspended sediment and cyanobacteria interfere with the effectiveness of alum in phosphorus removal. A sufficient quantity of alum and sodium aluminate must be applied to form a floc of sufficient size to sink to the bottom and to remove the phosphorus present in the water at the time of application. The jar tests will be used to determine the treatment quantity required to achieve these outcomes.

Jar tests are conducted by filling containers with lake water and applying alum and sodium aluminate to the surface. It is anticipated that these tests may be conducted multiple times at a range of application rates. The size of floc formed will be observed, along with its rate of fall through the water column. In some of these tests, post-treatment phosphorus concentrations will be measured after 24 hours. Based upon the results of these tests, the final application volumes will be determined.

Jar tests conducted on application days would have a different purpose. These tests will be made with the target application rate to ensure that pH will stay within the targeted safe range (6.5 to 8). Since the application will be well buffered by the inclusion of sodium aluminate, pH problems are not anticipated. The daily jar tests are included as an additional safeguard.

Alum consumes approximately 0.24 mg/L of alkalinity ($CaCO^3$) for each mg/L of alum. Sodium aluminate provides approximately 0.4 to 0.6 mg/L of alkalinity (CaCO3) for each mg/L of sodium aluminate. Therefore, in lakes naturally low in alkalinity, like Wister Lake, alum and sodium aluminate are often applied in a 2:1 ratio by volume. The sodium aluminate buffers the pH lowering effect of alum and prevents lowering pH or alkalinity to potentially damaging levels (NALMS 2012; Cooke et al. 2005; Dominie 1980).

Jar tests conducted each morning prior to the application of alum and sodium aluminate will evaluate the potential effects of the treatment that day of lake pH. Tests will be conducted on 20 gallons of lake water, which will be dosed with planned rates of alum and sodium aluminate. The effects of the dose on lake water pH will be monitored. The lowest pH level is reached within minutes after application and mixing, after which pH gradually rises, so these tests only require a few minutes to complete.

Samples for the daily jar tests will be collected one meter below the lake surface: (1) before each day's treatment at a station along the center line of the cove, and (2) one hour following each day's application at a station along the center line of that day's specific treatment location.

Alum and sodium aluminate will be applied from a 8' x 32' modified pontoon boat (Figure 3-2). The vessel is powered with twin 60 horsepower outboard motors, is equipped with a 39' application boom, and has two thrust balanced, sealless, mag-drive pumps. The vessel has a total capacity of 2,750 gallons, and an application rate of approximately 30,000 gallons per day. The minimum application water depth is three feet.

Alum and sodium aluminate will be applied simultaneously from the application vessel. Alum and sodium aluminate are stored onboard in separate tanks. One onboard pump will be used to pump the alum and a second to pump sodium aluminate. Separate hoses will supply the alum and sodium aluminate to separate application ports on the spray bars. All piping is stainless steel or heavy duty HDPE tubing. Type 316 stainless-steel fittings are used in areas where contact with liquid alum is anticipated. All couplings and connectors for alum distribution lines, storage tanks, pump and injector units are resistant to corrosion from alum and sodium aluminate.

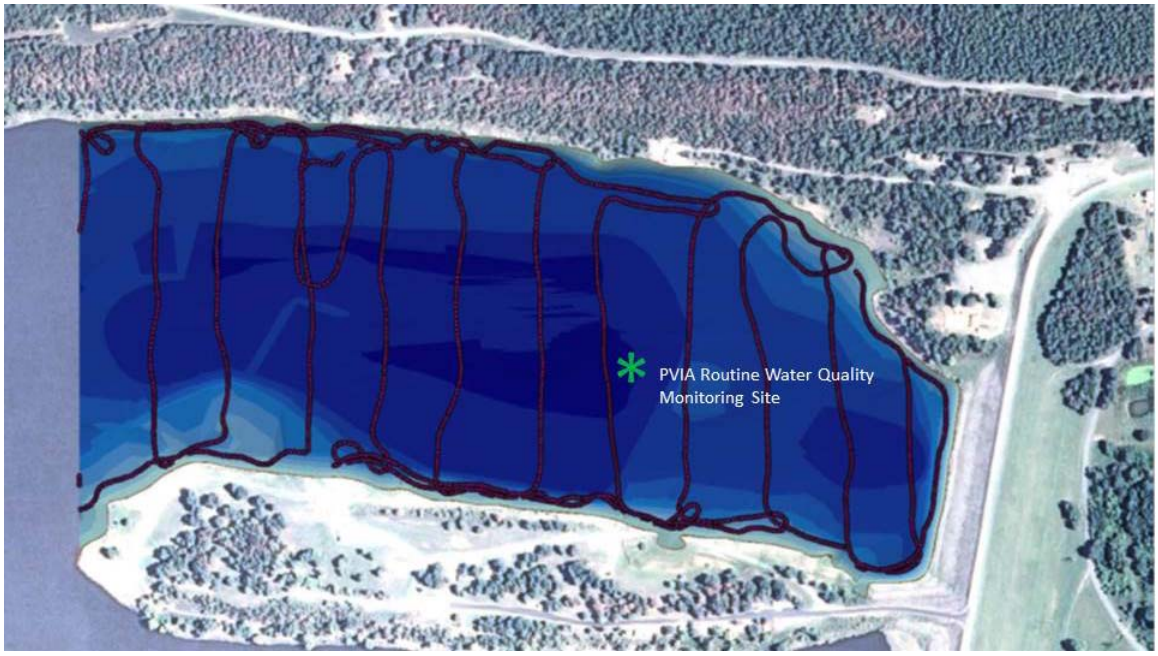

Figure 3-1. Quarry Island Cove Treatment Area
(107 surface acres with a volume of 1,418 acre-feet at conservation pool elevation of 478'.

Figure 3-2. Application vessel (8' x 32'; 39' application boom.)

The pumping system on the application vessel is automatically controlled by computerized GPS systems that vary the pumping rate with boat speed and bathymetric measurements to ensure an effective dose of the two chemicals (2 gallons alum to one gallon sodium aluminate). Water depth is measured from the vessel by sonar. Duplicate

back-up copies of the daily application data are downloaded at the end of each day. The two storage devices are stored in separate locations overnight. A third copy of the data will remain on the hard drive of the on-board computer.

3.2 Onshore Staging Area

All chemical products (liquid alum and sodium aluminate) use will be suitable for water treatment and meet NSF 60 specifications. The chemicals will be delivered to the site the day of application or day prior to application in 5,000-gallon tanker trucks. The chemicals will be transferred to temporary lakeshore chemical storage tanks from air-pressurized delivery tankers through enforcer suction discharge hose. Chemical transfer pumps will also be on-site if needed. The lakeshore chemical storage tanks will be secured (locked) when chemical is stored overnight. In addition, a security guard will be present overnight at the project staging area. Approximately 4 tankers of alum and two tankers of sodium aluminate will be delivered to the site each day of the project. Deliveries will occur approximately every 2 hours and each truck will be on-site for 1-1.5 hours.

Staging area alum and sodium aluminate storage tanks will consist of polyethylene tanks with a one-foot high chemical spill guard. The onshore storage tanks will be located at the staging area (Figure 3-3).

Figure 3-3. Staging area and truck route

3.3 Safety and Spill Prevention

The alum application contractor will follow the procedures outlined in the project Spill Prevention, Control, and Contingency Plan. A copy of that plan is provided as Appendix G.

3.4 Monitoring

Monitoring of effectiveness of the chemical application in meeting project objectives and of its other chemical consequences for water quality is an integral component of this project. PVIA currently conducts routine monthly monitoring in Wister Lake for a range of water quality parameters including alkalinity, total and soluble reactive phosphorus, chlorophyll-a, total suspended solids, total volatile suspended solids. Samples for analysis are collected 0.5 meters below the surface and 0.5 meters above the lake bottom. Measurements are also made every 0.5 meter along a profile from surface to bottom of a range of parameters including water temperature, dissolved oxygen, pH, and oxidation-reduction potential. PVIA also takes routine monthly samples for analysis for cyanobacteria numbers and identification and microcystin toxin concentration.

All these parameters will be sampled at the routine station (Figure 3-1) in Quarry Island Cove within a few days before application begins. On the subsequent application days, and the day following, samples will be taken both at the routine sampling location and in the center of the previous day's application zone. Samples will be taken at the routine site one week following the application, and again three weeks following application.

To assess potential changes to zooplankton populations, tow samples will be taken for zooplankton identification and enumeration prior to and following alum application, and will continue to be taken monthly at the routine monitoring site for one year following treatment.

Sediment cores will be taken in Quarry Island Cove before and after application and analyzed for phosphorus fractions, including aluminum phosphate. This will help to determine the proportion of aluminum applied that effectively bound phosphorus.

ODEQ suggests that a mercury monitoring program be implemented as a part of the proposed project. Per their suggestion, PVIA will implement a fish tissue mercury monitoring component as a part of the proposed project. Ten largemouth bass will be collected prior to project implementation and in years 1, 3, and 5 following implementation and sent to the ODEQ laboratory for analysis for mercury. In each sampling year, five bass will be collected from Quarry Island Cove and five from the upper, shallower area of the lake.

PVIA and its member agencies will conduct sampling for disinfection byproducts approximately two weeks after the alum application is completed.

4 AFFECTED ENVIRONMENT

4.1 LOCATION

Wister Lake is located in central LeFlore County in eastern Oklahoma. The town of Wister is approximately 2 miles to the north and the LeFlore County seat of Poteau is approximately 10 miles to the northeast.

Wister Lake is located in the Arkansas Valley Plains Ecoregion (Figure 4-1) (US EPA 2014). The Arkansas Valley ecoregion is a mixture of hills and plains, geologically and biologically a transition zone between the Ozark Plateau to the north and the Ouachita Mountains to the south, and between the oak-hickory and pine forests to the east and the prairies to the west.

Wister Lake was formed by the impoundment of the Poteau River just downstream from its former confluence with Fourche Maline Creek. The Poteau River begins in the Ouachita Mountains east of Waldron, Arkansas and flows west to Wister Lake. Leaving the lake, the Poteau River flows north to the Arkansas River at Fort Smith, near the Oklahoma-Arkansas state line. The Fourche Maline rises in the hills above Wilburton, Oklahoma and flows generally east to Wister Lake.

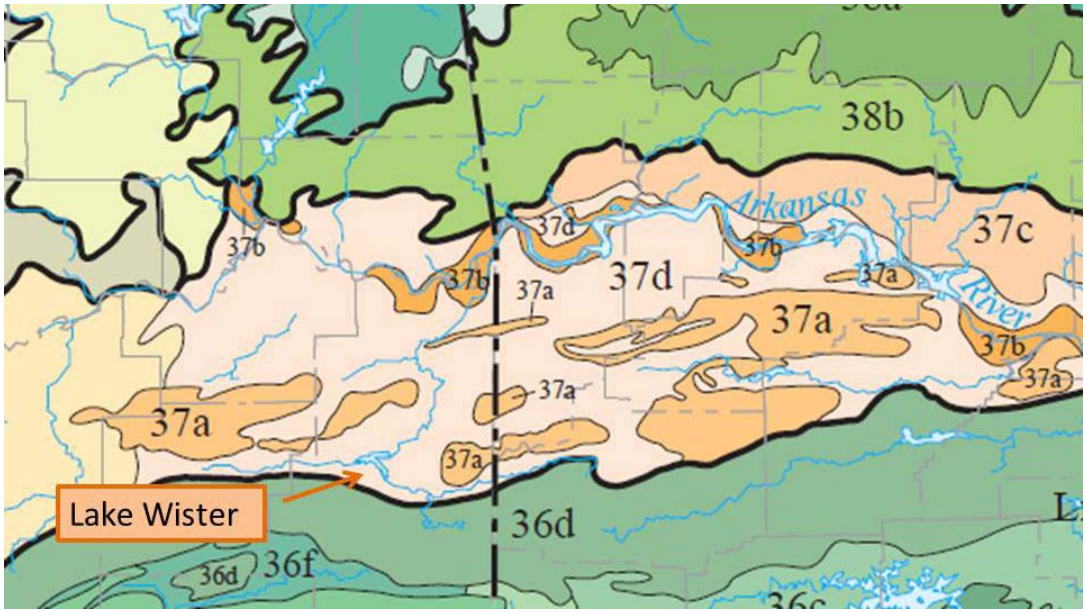

Figure 4-1. USEPA ecoregions in the vicinity of Wister Lake. Region 37 is the Arkansas Valley ecoregion, 37d is Arkansas Valley Plains (USEPA 2014).

4.2 GEOLOGY AND SOILS

The Poteau River Basin lies within two major geologic provinces: (1) the Arkoma Basin, and (2) the Ouachita Mountain Uplift (Lindsay et al 1974). Wister Lake itself is located in the Arkoma Basin, though the border with the Ouachita thrust belt is immediately south of the lake. All the exposed rocks in the Poteau River Basin are sedimentary in

origin and late Mississippian or early Pennsylvanian in age. They are primarily marine shales interbedded with sandstone and coal.

The U.S. Department of Agriculture Soil Conservation Service Soil Survey of LeFlore County (USDA 1983) identifies four soil associations surrounding Wister Lake. The northernmost portion of Wister Lake is underlain by the Bengal-Clebit-Pirum association. The Neff-Kenn-Cede association underlies Fourche Maline Creek and the Poteau River up and downstream from Wister Lake. The Kamie-McKamie and Stigler-Shermore-Wister associations underlie the remaining portions of Wister Lake. The Bengal-Clebit-Pirum association consists of very gently sloping to steep soils on ridges and mountains. These soils are moderately deep to shallow, well drained, loamy soils that have loamy subsoil over shale or sandstone. The Neff-Kenn-Cede association consists of nearly level to very gently sloping soils on floodplains. These soils are moderately well-drained to well drained, loamy soils that have loamy subsoil or that have cobbly and loamy underlying layers. The Kamie-McKamie association consists of gently sloping to strongly sloping soils on stream terraces. These soils are deep, well drained, and sandy soils that have loamy or clayey subsoil. The Stigler-Shermore-Wister association consists of nearly level to sloping soils on uplands. These soils are deep, moderately well drained, and loamy soils that have loamy or clayey subsoil over colluviums or shale.

4.3 CLIMATE

The average annual temperature in LeFlore County ranges from 50 to 74 degrees Fahrenheit. July and August are usually the warmest months and January the coldest. Winds are predominantly from the south to southwest and average approximately five miles per hour (eight kilometers per hour). Relative humidity is highest in June and lowest in March and April, ranging, on average, from 41 to 97 percent during the day. Thunderstorms occur predominantly in the spring and summer, occurring, on average, about 55 days per year. LeFlore County receives approximately 87 days of precipitation per year with 49 inches (124.5 cm) of average annual rainfall.

4.4 SOCIAL AND ECONOMIC CONDITION

4.4.1 Demography

The social and economic context of Wister Lake and the proposed project is a predominantly rural region, with a relatively low population density. The US Census Bureau estimates that in 2013 the population of LeFlore County was 49,774, which is a decrease of 1.2% from 2010 (US Census Bureau 2014a). The annual per capita annual income (based on 2008-2012 data) was $18,033. Table 4-1 provides selected population characteristics for LeFlore County compared to the State of Oklahoma as a whole.

Table 4-1. Population characteristics

Characteristic	LeFlore County	Oklahoma
Population, 2013	49,774	3,850,568
Population, 2010	50,384	3,751,351
Land area (square miles)	1,589.21	68,594.92
Persons per square mile, 2010	31.7	54.7
Unemployment rate,		
Poverty rate, 2008-2012	22.3%	16.6%
Median household income, 2008-2012	$36,084	$44,891
Per capita annual income (2012 dollars), 2008-2012	$18,033	$24,046
Median value of owner-occupied housing	$76,400	$110,800
High school graduate or higher, percent of persons age 25+, 2008-2012	80.0%	86.2%
Bachelor's degree or higher, percent of persons age 25+, 2008-2012	12.4%	23.2%

(US Census Bureau 2014a)

The 2012 census estimate shows LeFlore County as 78.3% white and 13% Native American (Table 4-2).

4.4.2 Employment and Education

Table 4-3 describes the composition of the labor market in LeFlore County and the State of Oklahoma by business-type categories. The total civilian employed labor force in LeFlore County based on 2008-2010 data was 18,903. The largest employment sector was educational services, health care, and social assistance, with the manufacturing and retail trade sectors nearly equal in number as the second and third most populated sectors.

12.4 percent of LeFlore County residents have a bachelor's degree or higher, compared to over 24 % of Oklahoma residents as a whole.

Table 4-2. Population characteristics by age and race

Characteristic	LeFlore County	Oklahoma
Persons under 5 years, percent, 2012	6.0%	6.9%
Persons under 18 years, percent, 2012	24.2%	24.6%
Persons 65 years and over, percent, 2012	16.1%	14.0%
Female persons, percent, 2012	49.9 5	50.5%
White alone, percent, 2012	78.3%	75.5%
Black or African American alone, percent, 2012	2.2%	7.6%
American Indian and Alaska Native alone, percent, 2012	13.0%	9.0%
Asian alone, percent, 2012	0.5%	1.9%
Native Hawaiian and Other Pacific Islander alone, percent, 2012	0.1%	0.2%
Two or More Races, percent, 2012	5.8%	5.8%
Hispanic or Latino, percent, 2012	6.9%	9.3%
White alone, not Hispanic or Latino, percent, 2012	72.5%	67.9%

(US Census Bureau 2014a)

Table 4-3. Employment and education characteristics

Characteristic	LeFlore County	Oklahoma
Agriculture, forestry, fishing and hunting, and mining	1,618	80,403
Construction	1,355	124,876
Manufacturing	2,460	165,749
Wholesale trade	555	46,448
Retail trade	2,417	195,502
Transportation and warehousing, and utilities	1,221	89,275
Information	133	31,705
Finance and insurance, and real estate and rental and leasing	746	98,737
Professional, scientific, and management, and administrative and waste management services	925	135,553
Educational services, and health care and social assistance	4,325	380,357
Arts, entertainment, and recreation, and accommodation and food services	1,353	147,878
Other services, except public administration	880	87,715
Public administration	915	105,767
High school graduate or higher, percent of persons age 25+, 2008-2012	80.0%	86.2%
Bachelor's degree or higher, percent of persons age 25+, 2008-2012	12.4%	23.2%

(US Census Bureau 2014b)

4.4.3 Water Supply

Wister Lake serves as the primary water supply for approximately 80% of the residents of LeFlore County, and therefore plays an essential role in the region's economy, providing water for industrial and commercial use as well as residential. For most residents, there is no feasible alternative water supply. The degradation of water quality in the lake threatens the future economic health of the region and must be considered in the evaluation of alternatives.

4.4.4 Executive Order 12898, Environmental Justice

Executive Order 12989 requires each Federal agency to make environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.

Under NEPA, the identification of a disproportionately high and adverse human health or

environmental effect on a low-income population, minority population, or Indian tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect serves to heighten agency attention to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population.

Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Bureau of the Census Reports on Income and Poverty. In identifying low income populations, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a set of individuals (such as migrant workers or Native Americans), where either type of group experiences common conditions of environmental exposure or effect.

Minorities are comprised of individual(s) who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Minority populations are identified where either: (a) the minority populations of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. In identifying minority communities, agencies may consider as a community either a group of individuals living in geographic proximity to one another, or a geographically dispersed/transient set of individuals (such as migrant workers or Native American), where either type of group experiences common conditions of environmental exposure or effect. The selection of the appropriate unit of geographic analysis may be a governing body's jurisdiction, a neighborhood, census tract, or other similar unit that is to be chosen so as to not artificially dilute or inflate the affected minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds. Population, race, and employment statistics are presented in Tables 4-2 and 4-3.

Disproportionately high and adverse human health effects: When determining whether human health effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable: (a) Whether the health effects, which may be measured in risks and rates, are significant or above generally accepted norms. Adverse health effects may include bodily impairment, infirmity, illness, or death; and (b) Whether the risk or rate of hazard exposure by a minority population, low-income population, or Indian tribe to an environmental hazard is significant and appreciably exceeds or is likely to appreciably exceed the risk or rate to the general population or other appropriate comparison group; and (c) Whether health effects occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposures from environmental hazards.

Disproportionately high and adverse environmental effects: When determining whether

environmental effects are disproportionately high and adverse, agencies are to consider the following three factors to the extent practicable: (a) Whether there is or will be an impact on the natural or physical environment that significantly and adversely affects a minority population, low-income population, or Indian tribe. Such effects may include ecological, cultural, human health, economic, or social impacts on minority communities, low-income communities, or Indian tribes when those impacts are interrelate to impacts on the natural or physical environment; and (b) Whether environmental effects are significant and are or may be having an adverse impact on minority populations, low-income populations, or Indian tribes that appreciably exceeds or is likely to appreciably exceed those on the general population or other appropriate comparison group; and (c) Whether the environmental effects occur or would occur in a minority population, low-income population, or Indian tribe affected by cumulative or multiple adverse exposure from environmental hazards.

There is a significant minority population in the project area. Thirteen percent of the population in LeFlore County is Native American. Project alternatives must be evaluated to determine if these communities would be disproportionately adversely affected.

4.4.5 Executive Order 13045, Protection of Children from Environmental Health and Safety Risks

On 21 April 1997, President Clinton issued Executive Order 13045 (EO 13045), Protection of Children From Environmental Health Risks and Safety Risks, which notes that children often suffer disproportionately from environmental health and safety risks, due in part to a child's size and maturing bodily systems. The executive order defines environmental health and safety risks as risks to health or to safety that are attributable to products or substances that the child is likely to come in contact with or ingest (such as the air we breathe, the food we eat, the water we drink or use for recreations, the soil we live on, and the products we use or are exposed to). Executive Order 13045 requires Federal agencies, to the extent permitted by law and mission, to identify and assess environmental health and safety risks that may affect children disproportionately. The Order further requires Federal agencies to ensure that its policies, programs, activities, and standards address these disproportionate risks. Executive Order 13045 is addressed in this NEPA document to examine the effects this action will have on children.

The Census Bureau reported that in 2012 24.2 % of the population of LeFlore County was under the age of 18 and 6.0% under the age of 5.

4.5 NATURAL RESOURCES

4.5.1 Topography

Like the rest of the Arkoma Basin of which it is a part, the topography surrounding Wister Lake is composed of relatively flat plains, rolling hills, and scattered low mountains. The conservation pool elevation of Wister Lake is 478 feet above mean sea

level. The surface elevation adjacent to the Poteau River below the dam drops to approximately 440 feet. Low hilltops on the north side of the lake reach approximately 800 feet.

4.5.2 Hydrology

Wister Lake is located in the Poteau River watershed [Hydrologic Unit Code (HUC) 11110105], which is part of the Lower Arkansas subregion of the Arkansas-White River watershed. The Poteau River originates several miles east of the City of Waldron in Scott County, Arkansas. The river flows westward through Scott County in western Arkansas and across the Oklahoma/Arkansas state line into LeFlore County, Oklahoma where it continues to where it is impounded to form Wister Lake. Discharge from Wister Lake flows north into the Poteau River. The Poteau River continues north to where it enters the Arkansas River at Fort Smith, Arkansas. Significant tributaries to the Poteau River above the Wister Dam include the Black Fork of the Poteau River. Fourche Maline Creek rises in the hills above the City of Wilburton in Latimer County, Oklahoma and flows generally east to Wister Lake. Significant tributaries to Fourche Maline Creek include Holson Creek. Wister Lake is near the midpoint of the Poteau River watershed. The Poteau River watershed encompasses some 1,888 square miles; about half, 996 square miles, are above Wister Lake, and half below.

4.5.3 Terrestrial Biological Resources

The land surrounding Wister Lake is predominantly forested. Much of it is managed by the Oklahoma Department of Wildlife Conservation for hunting and conservation purposes. Immediately along the lake shoreline the most commonly occurring plant species is buttonbush (*Cephalanthus occidentalis*), growing along with water elm (*Planera aquatic*), and black willow (*Salix nigra*). Further upland, the dominant vegetation types are oak-hickory-pine forests, with bottomland forests found in moister and more frequently flooded areas. Dominant oak species in the uplands include post oak (*Quercus stellata*) and blackjack oak (*Quercus marilandica*). Common hickory species include mockernut hickory (*Carya alba*). The pine native to this area is shortleaf pine (*Pinus echinata*), though loblolly pine (*Pinus taeda*) has been planted in some locations. Native grasses may be found as understory in more open areas of woodland, along roadsides and in some pastures, and in remnant areas of former prairie. Common species include little bluestem (*Schizachyrium scoparium*), big bluestem (*Andropogon gerardii*), switch grass (*Panicum virgatum*), and Indian grass (*Sorghastrum nutans*). Several species of briar (Smilax spp.) including greenbrier (*Smilax rotundifolia)* and catbriar (*Smilax bona-nox*) are commonly occurring vines. Both winged sumac (*Rhus copallinum*) and smooth sumac (*Rhus glabra*) are common shrubs in woodland openings, edges, and disturbed areas.

The area around Wister Lake is home to over 300 species of animals, including 13 species of turtles, 11 species of lizards, and 31 species of snakes. Some of the most common reptile species observed are the copperhead (*Agleistrodon contortrix mokason*), ribbon snake (*Thamnopphis sauritus*), five-lined skink (*Eunrecis fasciatus*), eastern box

turtle (*Terrapene carolina carolina*), and pond sliders (*Psedemys scripta*). In addition to these reptilian species, the Wister Lake region also has several species of salamanders and 15 species of frogs. The most common frog species in the area are the American toad (*Bufo americanus*), spring peeper (*Pseudacris crucifer*), cricket frog (*Acris gryllus*), gray tree frog (*Hyla versicolor*), American bullfrog (*Rana catesleiana*), and the leopard frog (*Rana sphenocephala*) (USACE 1993).

A total of 293 bird species inhabit Wister Lake during some portion of the year, including wintering waterfowl and resident herons and egrets. Some of the common heron species are the great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), and green heron (*Butorides virescens*). Wintering birds include the gadwall (*Anas strepera*), green-winged teal (*Anas crecca*), blue-winged teal (*Anas dicors*), pintail (*Anas acula*), mallard (*Anas platyrhynchos*), Canadian snow goose (*Anser caerulescens caerulescens*), and lesser scaup (*Aythya affinis*). Many varieties of gulls and terns can also be observed using the lake during the winter and spring months (USACE 1993). Bald eagles (*Haliaeetus leucocephalus*) are commonly observed winter residents.

Many mammals also inhabit the lake and its adjacent lands. Some of the most common nongame mammal species found within this area are the beaver (*Castor canadensis*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), and muskrat (*Ondatra zibethicus*) (USACE 1993).

4.5.4 Aquatic Resources

4.5.4.1 Limnology

Wister Lake is a polymictic reservoir (that is, it may stratify and mix irregularly throughout the year) with a surface area of approximately 6,288 acres at its conservation pool elevation of 478 feet, a volume of 50,529 acre-feet, a shore line length of approximately 75 miles, and a mean depth of eight feet. The maximum depth for Wister Lake is 37.8 feet at the conservation pool elevation (Figure 4-2) (OWRB 2011).

Water quality in Wister Lake has deteriorated since construction of the reservoir, and especially over the last several decades (PVIA 2009; OWRB 1996; OWRB 2004). Pollution from both point and nonpoint sources in the watershed has created a eutrophic lake ecosystem, high in nutrients and turbidity. The Oklahoma Department of Environmental Quality (ODEQ) includes Lake Wister on the 303(d) list of impaired water bodies, considering the lake impaired for chlorophyll-a, total phosphorus, turbidity, mercury, color, and pH (Table 4-1) (ODEQ 2012).

Table 4-4. Status of Wister Lake beneficial uses

Beneficial Use	Status	Cause
Public and Private Water Supply	Not Supporting	Chlorophyll-a
Warm Water Aquatic Community (Fish & Wildlife Propagation)	Not Supporting	Turbidity pH
Aesthetic	Not Supporting	Total Phosphorus Color
Fish Consumption	Not Supporting	Mercury
Agriculture	Supporting	

(ODEQ 2012)

Wister Lake is identified by the State of Oklahoma as a Sensitive Water Supply (OAC 785:45). Sensitive Water Supplies are water bodies considered to be particularly sensitive to pollution by excessive nutrient inputs. The State has set a chlorophyll-a maximum of 10 µg/L for sensitive water supplies. Chlorophyll-a is a measure of the quantity of algae and cyanobacteria in the water.

The Wister Lake watershed has been identified by the State of Oklahoma as a Nutrient Limited Watershed (OAC 785:45). A Nutrient Limited Watershed designation recognizes that excessive nutrients enter a waterbody from its watershed and requires poultry feeding operations within the watershed to make annual soil nutrient tests and apply chicken litter to fields at a lesser rate than allowed in non-nutrient limited watersheds.

Since March 2011, PVIA has conducted routine monthly monitoring of water quality parameters at Wister Lake. Prior to the initiation of this sampling program, the Oklahoma Water Resources Board conducted quarterly sampling of the lake approximately every three years, beginning in 2000. The first quantitative assessment of Wister Lake water quality occurred in 1974, by the US EPA as part of the National Eutrophication Survey (USEPA 1977). Various other sampling efforts occurred in the intervening years; that sampling history is reviewed in PVIA 2009.

The concentration of total phosphorus in the lake is high, ranging from around 50µg/l to over 120µg/l over the last three years (Figure 4-3).

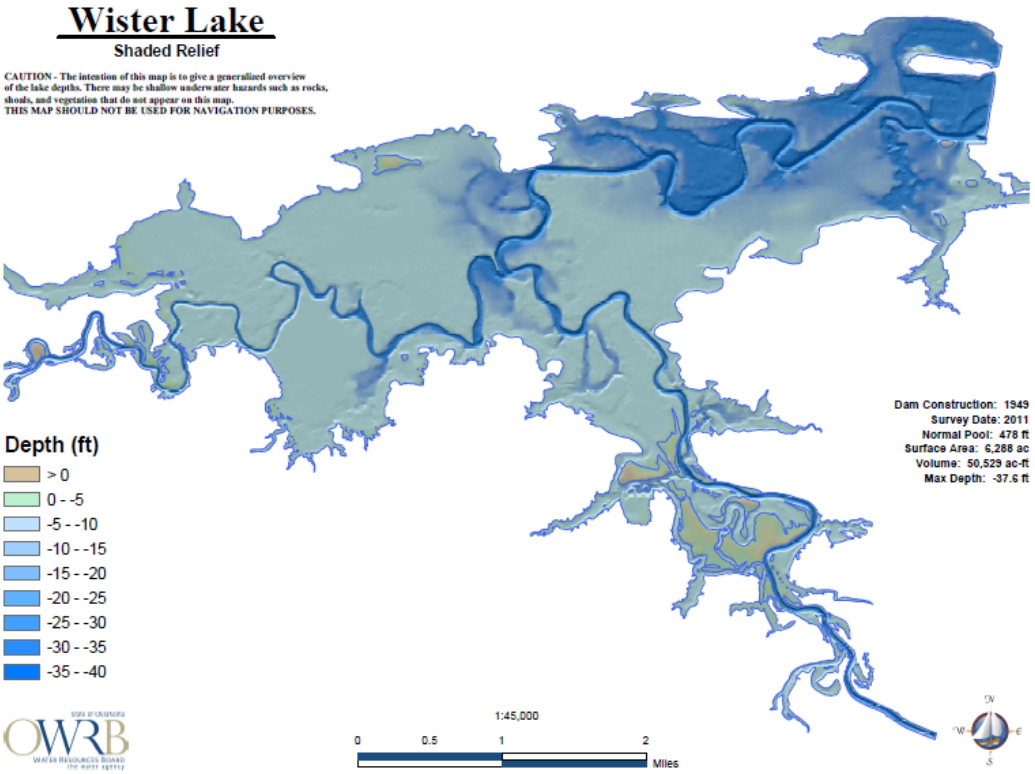

Figure 4-2. Wister Lake bathymetry

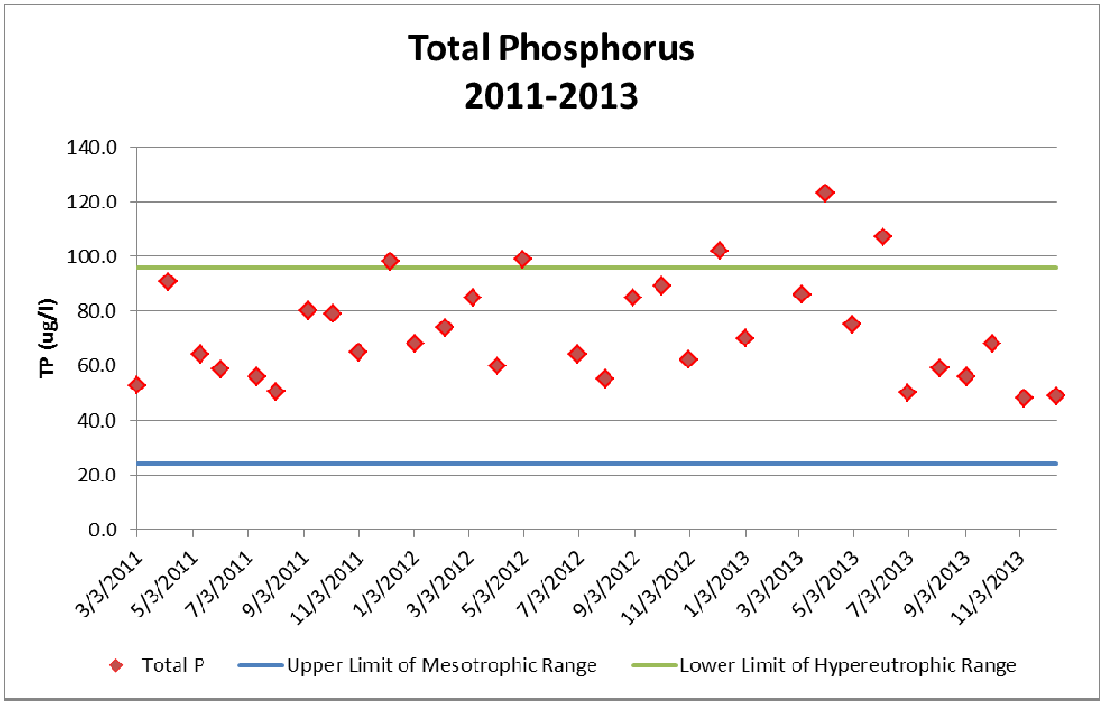

Figure 4-3. Monthly average total phosphorus concentrations

Phosphorus in lake water has two sources. It enters the lake as water flows in from the watershed and it is also released from lake bottom sediments. The phosphorus in lake bottom sediments is primarily accumulated from watershed sources. The US Geological Survey has recently analyzed three years of watershed load data. The average phosphorus load to Lake Wister over the last three years was 205 tons (135 tons in 2011; 202 tons in 2012; 278 tons in 2013) (USGS 2014). In 2010, scientists from the University of Arkansas took sediment cores from Lake Wister into the lab and measured phosphorus release rates. The highest release rate they measured was approximately 3.3 mg/m^2/day under anoxic conditions (Haggard et al. 2012).

Both sources of phosphorus drive algae and cyanobacteria growth in the lake. Highly productive lakes like Wister Lake are labeled as *eutrophic*. Wister Lake was considered eutrophic in 1974 based on the USEPA sampling effort. However, chlorophyll-a levels at that time were much lower than in recent years. Sampling in 1974 took place in two lake locations four different times during the year. The highest chlorophyll-a value measured was 8.4 µg/l and the mean of all (eight) samples was 4.8 µg/l (USEPA 1977). All those values are below the 10 µg/l Oklahoma standard for sensitive water supplies; almost all samples in the last three years were three to four times higher (Figure 4-4).

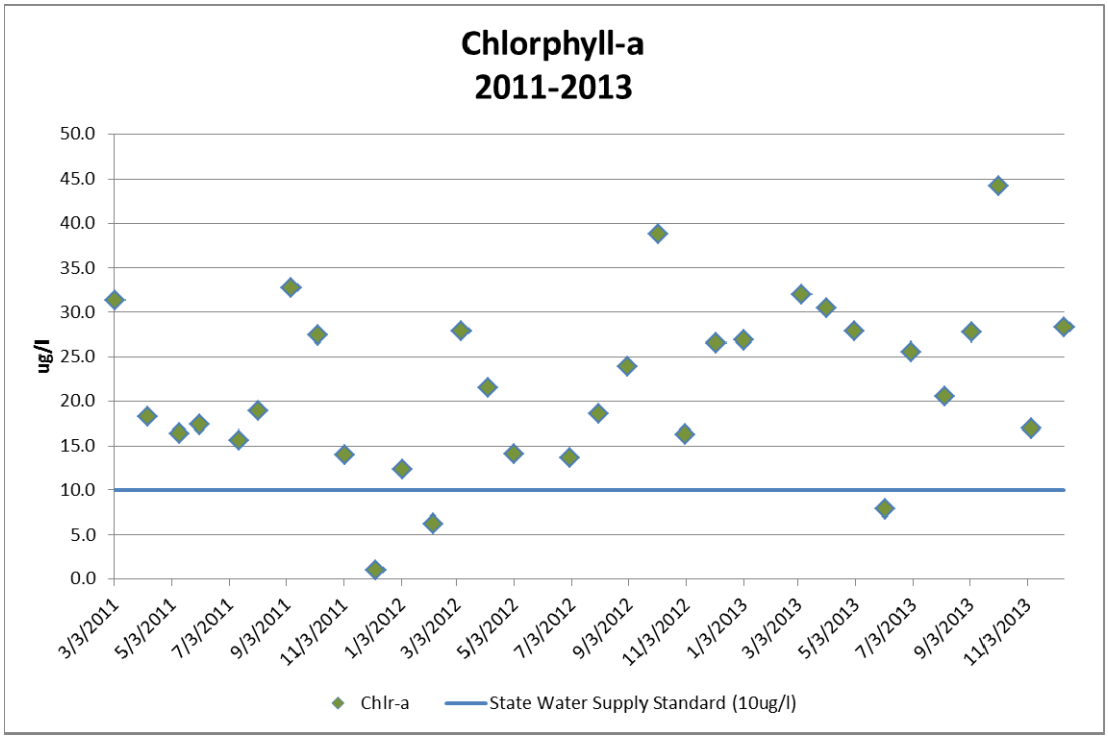

Figure 4-4. Wister Lake monthly average chlorophyll-a concentrations

The nutrient and light conditions at Wister Lake favor the growth of cyanobacteria. While visible surface scums have not been common in recent years (the last major bloom was 2005), cyanobacteria counts are high. PVIA has been making monthly cyanobacteria counts since August 2012 (with some missing months because of funding issues). Those count totals are shown in Figure 4-5.

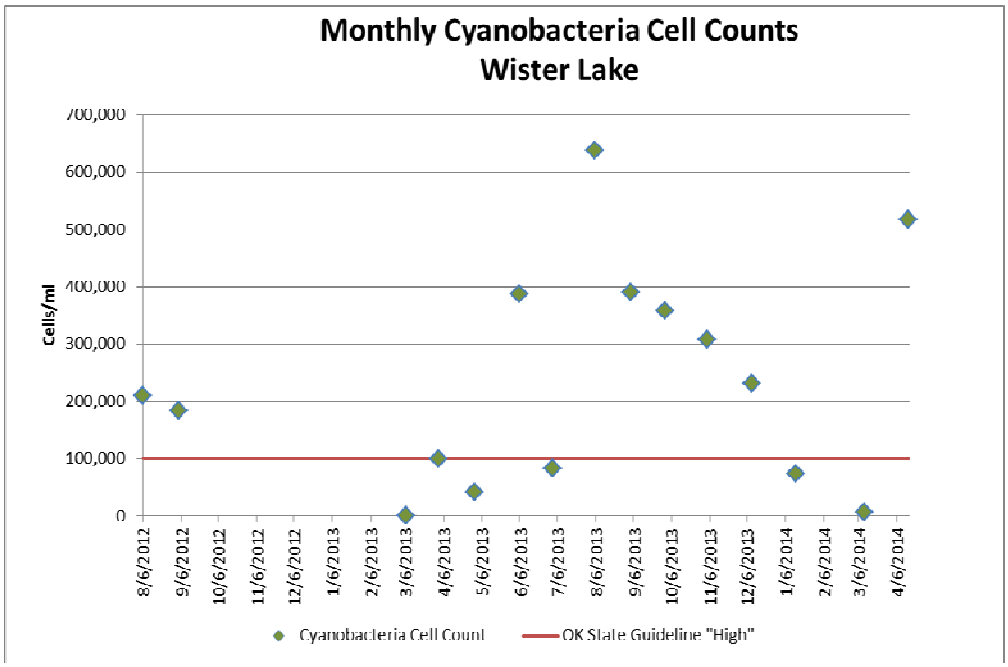

Figure 4-5. Monthly cyanobacteria counts at Wister Lake

The algae and cyanobacteria that grow in the lake contribute the amount of organic carbon in the water. Total organic carbon levels at Lake Wister have ranged from 1.4 mg/L to 8.4 mg/l over the last two years; typical values are 3.5 to 4.5 mg/L.

In treating raw water from Wister Lake to make it safe to drink, PVIA utilizes chlorine as a disinfectant. Chlorine does an excellent job of killing pathogens in the water, but in recent years it has been recognized that chlorine can interact with organic carbon materials in the water to produce what are known as disinfection by-products (DBPs). Some of these DBPs, in high doses, have been shown to be potential carcinogens. Therefore, they (DBPs) have come under increasing scrutiny. Beginning in October 2013, PVIA and its member purchased water systems must meet stricter standards and undertake more extensive sampling for DBPs. DBP concentrations increase with time, so water that travels a greater distance tends to build up higher concentrations. This means that some of PVIA's member agencies that are a greater distance from the treatment plant will have a harder time meeting these new standards. PVIA is implementing a range of projects to reduce DBPs in its treated water, including new equipment to make better use of activated carbon in treatment, and aerators in its water storage towers. The proposed project to use alum to reduce algae and cyanobacteria levels in the cove during their peak production time is another of these measures.

Turbidity

As noted above, Wister Lake is considered impaired by excess turbidity. Turbidity has two components, an organic component consisting of living algae and cyanobacteria cells, and the non-living organic particles derived from them, and an inorganic component consisting of suspended mineral particles. Organic detritus derived from

watershed rather than in-lake sources may also be present. Wister Lake frequently has a relatively high mineral turbidity, due in part to the nature of the sediments through which its tributary streams flow and also to its large area of relatively shallow depths. This high mineral turbidity contributes to somewhat lower chlorophyll-a levels than would be expected given the total phosphorus levels recorded (PVIA 2009; OWRB 2012). Reduced light levels due to turbidity limit algae and cyanobacteria growth.

The average turbidity measured in Quarry Island Cove in July, August, and September over the past three years is shown in Table 4-5.

	2011	2012	2013
	(NTU)	(NTU)	(NTU)
July	16.1	17.9	20.2
Aug	13.2	8.58	8.83
Sept	33.8	26.7	7.57
Whole Lake Annual Average	24.3	28.1	28.3

Table 4-5. Late summer Quarry Island Cove turbidities

August turbidities are frequently low because storms and winds that would re uspend sediments and create turbidity are infrequent that time of year. In 2011 and 2012 the lake mixed in late August, reflected in the high turbidities recorded in early September of those years.

pH and alkalinity

Proper management of pH and alkalinity is essential to the safe application of alum and other aluminum salts to the lake (See Section 5.2.2 for a discussion of how they will be managed in the proposed project). The average pH of Quarry Island Cove over the last three years based on monthly sampling was 8.01 one-half meter below the surface and 7.33 in the hypolimnion. The average August pH was 8.49 one-half meter below the surface and 7.22 in the hypolimnion.

The average alkalinity in Quarry Island cove over the last three years (2011-2013) based on monthly sampling was 19 mg/L one-half meter below the surface and 20 mg/L in the hypolimnion. The average alkalinity in August was somewhat higher, 25 mg/L in both the epilimnion and hypolimnion (PVIA 2014).

Quarry Island Cove

The proposed project will take place in Quarry Island Cove (Figures 1-2 and 1-3). Previous studies have noted that while the cove is clearly connected to the main body of the lake, it is also somewhat hydrologically isolated (OWRB 2003). Water depths in the proposed project area average around 12-15 feet at conservation pool lake levels, somewhat deeper than the average depth of the lake as a whole. One of PVIA's regular

lake sampling locations is located in the cove, so the three-year-plus data set from routine monitoring has documented conditions in the cove.

4.5.4.2 Fisheries

Lake Wister serves as an important resource to the regional economy through recreational fishing. Fish habitat in Wister Lake is primarily comprised of rock and some flooded timber. Additional habitat includes man-made structures such as rip-rap, brush piles, and tires. Emergent vegetation is limited due to fluctuating water levels. The absence of aquatic vegetation can impact fish recruitment.

The major sportfish found in Wister Lake include largemouth bass (*Micropterus salmoides*), spotted (Kentucky) bass (*Micropterus punctulatus*), white bass (*Morone chrysops*), white crappie (*Pomoxis annularis*), black crappie (*P. nigromaculatus*), channel catfish (*Ictalurus punctatus*), blue catfish (*I. furcatus*), and flathead catfish (*Pylodictis olivaris*). The primary forage species include bluegill sunfish (*Lepomis macrochirus*), gizzard shad (*Dorosoma cepedianum*), and threadfin shad (*D. petenense*).

The eutrophic condition of the lake (Section 4.5.4.1) can limit fish health and productivity. During periods of summer stratification, dissolved oxygen levels in the hypolimnion (near bottom waters) may drop to near zero. This limits the use of these cooler waters by many desirable sport fish species. Other fish such as carp, gar, drum, and shad are more tolerant of lower DO and higher temperatures may increase in number.

The Oklahoma Department of Wildlife Conservation (ODWC) assessed fish numbers in Lake Wister by gill netting in the fall of 2008 and electrofishing in the spring of 2009 (ODWC 2009). Additional gill netting was conducted in 2010 and 2011 (James 2014).

Wister Lake has a low total abundance and low number of quality-size largemouth bass. Largemouth bass numbers collected were too low for valid statistical analysis. Nevertheless, relative weights in the >14-inch length group were below desirable values, while those of largemouth bass in other size classes were acceptable (ODWC 2009). Relative weight is the ratio of the weight of a fish compared to a standard weight for a fish of the same length. Overall age and growth were judged acceptable (ODWC 2009).

Wister Lake offers some of the best crappie fishing in the region. Anglers typically target crappie around standing timber and brushy cover. In the spring, crappie move into shallow areas to spawn, and later move off to 15 or more feet deep. 2008 gillnetting results show an overall high abundance and an extremely high abundance of quality crappie ($\geq$ 8 inches) with a catch rate of 5.8 quality fish per 24 hours; > 3.6 is considered high. Age, growth, and relative weights for crappie were well above acceptable values (ODWC 2009).

Channel catfish are omnivorous, feeding on a wide variety of organic matter, dead and alive. Some of the more common foods are fish, mussels, snails, insects and crayfish.

Wister Lake sampling results show a high abundance of channel catfish. Relative weights are good (ODWC 2009).

Blue catfish can reach trophy size (>100 lbs.). Wister Lake has a high abundance of quality sized blue catfish (>16 inches) (ODWC 2009).

According to 2000 electrofishing results, bluegill sunfish are present in high total abundance and low quality sized (> 6 inches) abundance (ODWC 2009).

Gizzard shad provide forage for most game species. The species is often used by anglers as bait for other fish species. Size structure at Wister Lake is good (ODWC 2009).

Mercury

The Oklahoma Department of Environmental Quality (ODEQ) analyzed fish tissue from Wister Lake for mercury levels in 2008 and 2009. Elevated concentrations were found in several species. The highest concentrations were found in largemouth bass, which is not unexpected given their top-of-the-food-chain status. Mercury accumulates in their tissue over time as they consume other fish. Largemouth bass mercury concentrations in 2008 ranged from 0.67 to 0.91 µg/g (ODEQ n.d). A larger sample in 2009 found more variation, ranging from 0.33 to 0.96 µg/g. By comparison, bluegill concentrations in 2009 ranged from 0.09 to 0.28 (ODEQ n.d.). These results prompted a fish consumption advisory by ODEQ and the listing of Wister Lake on the 2012 303(d) as not supporting fish consumption beneficial use. The details of the ODEQ fish consumption advisory are provided in Table 4-6.

Table 4-6. Fish consumption advisory for Wister Lake

Largemouth bass			
Sensitive population	No restrictions on eating fish under 14" in length	The sensitive population is children under 15 and women of childbearing age (15-45)	
	No more than 2 meals per month of fish 14" and over in length		
General population	No restrictions		
Note: bluegill sunfish, channel catfish, spotted bass, white bass, and white crappie were sampled and found to be safe for consumption			

4.5.4.3 Wetlands

In the spring, during the optimum time for plant growth, Wister Lake is routinely flooded 15-20 feet above its conservation pool elevation as the result of normal flood control

operation of the project and limited downstream capacity. As a result, the reservoir shoreline supports little to no vegetation, and in many areas, the denuded zones extend well above the conservation pool elevation (Figure 4-6).

Figure 4-6. Wister Lake shoreline Note buttonbush at far right of the second image.

For several years in the late 1990s and early 2000s the Oklahoma Water Resources Board, in partnership with USACE, PVIA, and other groups made several attempts to introduce potentially valuable plant species into shallow areas of the lake, with limited success. Though some plantings persisted for more than one year, ultimately all failed to survive repeated, prolonged spring flooding (Figures 4-7 and 4-8).

Figure 4-7. Planting bulrush in the west end of Quarry Island Cove Note existing buttonbush shrubs. Photo by Owen Mills.

Figure 4-8. Dead bulrush in the Lewis Creek area of Wister Wister after two seasons of prolonged spring flooding

The plant species that appears most tolerant of this prolonged spring flooding is buttonbush (*Cephalanthus occidentalis*). It often occurs alone in fringing areas near the conservation pool elevation. Buttonbush is considered an obligate wetland species (USACE 2014), so some of the lake fringe areas could be jurisdictional wetlands (cf. USACE 2012).

The USFWS letter (USFWS 2014 and Appendix A) notes that National Wetland Inventory mapping identifies a large area of potential lacustrine wetlands at the lake. As described above, most of the shallow water areas of the lake that would likely support emergent vegetation under different water management are mostly unvegetated today.

4.5.5 Prime and Unique Farmland

"Prime farmland," according to the USDA, Natural Resource Conservation Service (NRCS) is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt content, and few or no rocks. They are permeable to air and water, are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.

Unique farmland is land other than prime farmland that is used for the production of specific high value food and fiber crops. It has a special combination of soil quality, location, growing season, and moisture supply needed to produce economically sustained

high quality and/or high yields of a specific crop when managed according to acceptable farming methods. Examples of crops grown on unique farmland include nuts, olives, cranberries, citruses, and other fruits and vegetables.

Areas of prime farmland occur along the boundary of Wister Lake. These include Cupco silt loam, Pirum-Clebit complex, Sallisaw loam, Stigler silt loam, and Tamaha silt loam (USDA 1983).

4.5.6 Wild and Scenic Rivers

Pursuant to the Wild and Scenic Rivers Act, Wild River Areas are defined as those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. Scenic river areas are defined as those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads. In order to be eligible for inclusion as a wild and scenic river, a river segment must be free-flowing and possess one or more outstandingly remarkable value such as geologic, scenic, recreational, fish, wildlife, historic, ecologic, or cultural resource quality. Neither the Poteau River nor its tributaries are listed as wild and scenic rivers.

4.5.7 Executive Order 12962 and 13474, Recreational Fisheries

Executive Orders 12962 and 13474 (an amendment to Executive Order 12962) require Federal agencies, to the extent permitted by law and where practicable, to improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities in cooperation with States and Tribes and ensure that recreational fishing shall be managed as a sustainable activity in national wildlife refuges, national parks, national monuments, national marine sanctuaries, marine protected areas, or any other relevant conservation or management areas or activities under any Federal authority, consistent with applicable law.

4.5.8 Executive Order 13112, Invasive Species

On February 3, 1999, President Clinton issued Executive Order 13112 (EO 13112), Invasive Species, which notes that invasive species annually cause significant economic, ecological, and alien species whose introduction does or is likely to cause economic and environmental harm or harm to human health. EO 13112 requires Federal agencies to not authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States; and that all feasible and prudent measure to minimize risk or harm will be taken in conjunction with the actions.

4.5.9 Executive Order 13186, Responsibility of Federal Agencies to Protect Migratory Birds

On January 10, 2001, President Clinton issued Executive Order 13186 (EO 13186), Responsibility of Federal Agencies to Protect Migratory Birds, which notes that migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats. EO 13186 requires, in part, Federal agencies to integrate conservation principles, measures, and practices into agency activities and prevent or abate the pollution or detrimental alteration of the Environment for the benefit of migratory birds, as practicable.

The U.S. Fish and Wildlife Service manages for migratory birds based on specific migratory route pathways within North America (the Atlantic, Mississippi, Central, and Pacific flyways). Based on those migratory routes, state and federal agencies created four Administrative Flyways for management purposes. Wister Lake is located within the Central Flyway, both biologically and administratively, though the densest migration routes in this zone lie to the west of the lake. The lake itself attracts and supports migratory bird use. American white pelicans (*Pelecanus erythrorhynchos*) make use of the lake each spring and fall, as do many waterfowl species. Common migratory birds in the Wister Lake area include woodcock (*Scolopax minor*), common snipe (*Gallinago gallinago*), blue-winged teal (*Anas discors*), mallard (*Anas platyrynchos*), snow goose (*Anser caerulescens*), red-shouldered hawk (*Buteo lineatus*), killdeer (*Charadrius vociferous*), common yellowthroat warbler (*Geothylipus trichas*), American crow (*Corvus brachyrynchos*), Lincoln's sparrow (*Melospiza lincolnii*), Brewer's blackbird (*Euphagus cyanocephalus*), and the common grackle (*Quiscalus quiscula*).

4.6 THREATENED AND ENDANGERED SPECIES

The US Fish and Wildlife Service (2014) identified six species classified as threatened or endangered as having the potential to occur in the area of the proposed project (Table 4-7 and see USFWS letter in Appendix A). Those species are:

- Scaleshell mussel, *Leptodea leptodon*
- Winged mapleleaf mussel, *Quadrula fragosa*
- American burying beetle, *Nicrophorus americanus*
- Least tern, *Sterna antillarum*
- Piping plover, *Chadradruis melodus*
- Indiana Bat, *Myotis sodalis*

Scaleshell mussel

The scaleshell mussel is a small freshwater mussel with a thin, fragile shell and faint green rays. It typically grows to one to four inches in length. The inside of the shell is pinkish white or light purple and highly iridescent. The scaleshell gets its name from the scaly appearance of the outer shell, seen in females. Scaleshell occurs in riffles with

moderate to high gradients in creeks to large rivers. Though it formerly it may have had a wider distribution, it is currently restricted to rivers with good water quality (NatureServe 2014). Scaleshells historically occurred across most of the eastern United States. During the last 50 years this species became increasingly rare with a reduced range. Of the 55 historical populations, 14 remain scattered across the Mississippi River basin in Arkansas, Missouri, and Oklahoma (USFWS 2010).

In the project vicinity, the historical distribution of the scaleshell mussel is in southern LeFlore County in the Kiamichi River watershed. This is a stream-dwelling mussel species and it is unlikely that scaleshell mussels exist in Wister Lake.

Winged mapleleaf mussel

Winged mapleleaf mussels grow up to four inches long. They have thick shells that are greenish brown, chestnut, or dark brown in color. Their shell, similar to several other native freshwater mussel species, has several rows of bumps running from the hinge to the edge of the shell. This species is quite similar to and has often been confused with *Quadrula quadrula* (NatureServe 2014). Winged mapleleaf may be found in riffles with clean gravel, sand, or rubble bottoms and in clear, high quality water. In the past, it may also have been found in large rivers and streams on mud, mud-covered gravel, and gravel bottoms. In Oklahoma the winged mapleleaf occurs in the Little River.

The winged mapleleaf mussel (*Quadrula fragosa*) may occur in southern LeFlore County in the Kiamichi River watershed, but the historical records are uncertain. It is unlikely that the winged mapleleaf mussel exists in Wister Lake.

American burying beetle

The American burying beetle is currently known to occur in 20 counties in eastern Oklahoma. The beetle has been found in various types of habitat including oak-pine woodlands, open fields, oak-hickory forest, open grasslands, and edge habitat. Research indicates that American burying beetles are feeding habitat generalists. American burying beetles are nocturnal and have a life span of about one year. Soil characteristics are important to the beetle's ability to bury carrion. Extremely xeric, saturated, or loose sandy soils are unsuitable for these activities (NatureServe 2014).

The American burying beetle has been documented in LeFlore County. Potentially suitable habitat for the beetle exists in upland areas around Lake Wister. Neither the lake itself, nor Quarry Island Cove, is habitat. All project activities on Quarry Island will be restricted to existing roads and parking lots.

Piping plover

The piping plover is a small shorebird that nests on sandy beaches or sand bars along the Atlantic coast, the Northern Great Plains, and around the Great Lakes. They winter along

the southern Atlantic and Gulf coasts, and in the Bahamas and West Indies, and migrate through Oklahoma each spring and fall (USFWS 2012). Nest sites are simple depressions or scrapes in the sand (NatureServe 2014).

Piping plovers are found on mudflats, sandy beaches and shallow wetlands with sparse vegetation. They may be found along the margins of lakes and large rivers where there is exposed (bare) sand or mud. There are two nesting records for the piping plover in the Oklahoma panhandle, but this species is normally a spring and fall migrant through Oklahoma. Most records for migrating piping plovers occur across the main body of the state; recent records have come from Woodward, Alfalfa, Oklahoma, Cleveland, Tulsa and Washington counties. Spring migration occurs in April and early May; fall migration occurs between the last week of July and late September (ODWC 2014).

Based on the presence of the lake and riverine conditions upstream and downstream of the lake, potentially suitable habitat for the piping plover may exist in the vicinity of Wister Lake. Quarry Island Cove has no sandy beaches, nor does Wister Lake itself. This species is unlikely occur in the proposed project area.

Interior least tern

Interior least tern populations nest mainly on riverine sandbars or salt flats that become exposed during periods of low water. As a result of vegetational succession and/or erosion, preferred nesting habitat typically is ephemeral. Since least terns always nest near water, they are vulnerable to flood inundation and seem to seek high ground. In Oklahoma, interior least tern nests along large rivers, including the Arkansas. They favor islands or sandbars for nesting. The sand must be mostly clear of vegetation. Shallow water is preferred for fishing, and water levels must remain low enough so that nests stay dry. Interior least terns arrive at breeding sites in late April to early June where they typically spend four to five months. Nests are small scrapes in the sand and typically contain two to three eggs. Both parents feed the young, traveling four or more miles from the breeding colony to find small fish that make up the major part of their diet, and remain with the young until fall migration (USFWS, 2012).

The interior least tern is documented to occur in LeFlore County. Wister Lake habitat is not ideal for the species though it may migrate through the area. It is unlikely to occur in the proposed project area.

Indiana bat

Indiana bats spend the summer months living solitarily or in small groups of less than10 individuals, usually in forested habitats. During the summer, they live in hollow tree cavities, spaces underneath loose tree bark, abandoned buildings, abandoned mines, or in caves. During the winter, they hibernate in colonies in caves. Oklahoma is on the western edge of the Indiana bat's geographic range and it is a very rare species here. Indiana bats have only been detected a few times in Oklahoma – primarily during the fall

and winter in forested parts of the Ozark and Ouachita Mountains along the state line with Arkansas (ODWC 2014).

Potentially suitable habitat for the Indiana bat may occur in the vicinity of Wister Lake, though the species has not been identified there. The proposed project will not disturb upland areas around Quarry Island Cove.

Table 4-7. Federally- and State-listed species in the proposed project area
Endangered, threatened, candidate, recovered, proposed, or of special concern.

Scientific Name	Common Name	Federal Status	Oklahoma State Status
Invertebrates			
Leptodea leptodon	Scaleshell mussel	E	SS2
Quadrula fragosa	Winged mapleleaf mussel	E	--
Nicrophorus americanus	American burying beetle	E	E
Birds			
Chadradruis melodus	Piping plover	T	T
Sterna antillarum	Interior least tern	E	E
Mammals			
Myotis sodalis	Indiana Bat	E	E

Federal Status: E—Endangered; T—Threatened; C—Candidate
Oklahoma State Status: E—Endangered; T—Threatened; SS2 Species of Special Concern.

4.7 CULTURAL RESOURCES

Significant archaeological resources occur on the lands surrounding Wister Lake. Some known sites are located below the top of the conservation pool. Archaeological investigations in the area began in the late 1930s by the WPA, before the lake was created. An intensive survey and excavation of four sites was conducted by the University of Oklahoma in the mid-1940s, in advance of the construction of Wister Dam. In the 1970s, systematic surveys covering large areas were performed prior to the seasonal increase in conservation pool elevation to 478.0 feet (145.7 m). In 1975, the Wister Lake Archaeological Project, consisting of Federally-owned lands at Wister Lake, was listed on the National Register of Historic Places (NRHP). The 39,139-acre district included 18 prehistoric sites as contributing members. Between 1975 and 2008, a number of surveys were conducted to record sites in un-surveyed areas, to relocate previously recorded sites, and to assess the conditions of sites potentially affected by inundation or fluctuating pool levels in order to determine National Register eligibility. The surveys done around Wister Lake recorded 207 sites, including 180 prehistoric sites, 16 historic sites, 4 multi-component (historic/prehistoric sites), and 7 sites of unknown age (USACE 2008). Cultural surveys performed more recently in connection with a

seismic survey of the Fourche Maline Arm of the lake added 119 new sites to this total (Shingleton 2014).

Wister Lake sites cover the full sweep of North American prehistory, conventionally divided into five major periods: Paleo-Indian (12,000–8,000 years ago), Archaic (8,000–2,300 years ago), Woodland (2,300–1,200 years ago), Arkansas Valley Caddoan (1,100–400 years ago), and Historic (400 years ago to present). Early periods of prehistory, especially Paleo-Indian and Archaic, are poorly known. Starting in the late Archaic, groups extensively used riparian environments such as were provided by the Poteau River and Fourche Maline Creek. This usage continued into the Arkansas Valley Caddoan time period, when large-mound ceremonial centers, large habitation sites, and farmsteads were developed. All of these types of sites tended to be located on or adjacent to floodplains. The most significant site in the region belonging to the Arkansas Valley Caddoan tradition is the Spiro site, a large, ceremonial mound center approximately 30 miles (48.3 km) north of Wister Lake. Spiro phase sites along Wister Lake are considered outlying members of this ceremonial-political center (Owens et al. 2000 *in* USACE 2002). The Historic phase in the Wister Lake area began in the early nineteenth century. "Indian Territory" was created in what is now eastern Oklahoma and the forced relocation of tribes from the east (Cherokee, Creek, Seminole, Choctaw, and Chickasaw). The Wister Lake area is part of the area that became the Choctaw Nation of Oklahoma.

4.8 AIR QUALITY

The primary legislation governing Federal air quality standards is the Clean Air Act Amendments (CAAA) of 1990. The Clean Air Act establishes standards to protect the public and the environment from adverse health and welfare effects of air pollution. These standards, National Ambient Air Quality Standards (NAAQS), define the maximum permissible concentrations for certain pollutants, known as criteria pollutants. The CAAA delegates primary responsibility for clean air to the U.S. Environmental Protection Agency (USEPA). The USEPA published a conformity rule on November 30, 1993, requiring all Federal actions to conform to appropriate State Implementation Plans (SIPs) established to improve ambient air quality. Areas are classified as either "attainment" or "nonattainment" with respect to State and Federal ambient air quality standards. The classifications are made by comparing actual monitored air pollutant concentrations to State and Federal standards. The Conformity Rule applies to Federal actions in nonattainment areas.

NAAQS currently exist for six criteria pollutants: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), ozone (O3), sulfur dioxide (SO2), and particulate matter (PM). There are two categories of PM, particulate matter less than 10 micrometers (PM-10) and particulate matter less than 2.5 micrometers (PM-2.5). ODEQ monitors air quality stations in Oklahoma for both criteria pollutants and air toxins, however there are currently no air quality monitoring stations in LeFlore County.

USEPA has designated LeFlore County as an attainment area that meets National Ambient Air Quality Standards (NAAQS) for all criteria pollutants.

4.9 HAZARDOUS, TOXIC, AND RADIOLOGICAL WASTE

The proposed project will entail no ground disturbing activities. The potential for hazardous, toxic, or radiological waste (HTRW) discovery or problems related to HTRW during the implementation of alum treatment is anticipated to be very low. Neither waste alum nor waste sodium aluminate are listed as Resource Conservation and Recovery Act (RCRA) hazardous wastes. Both liquid alum and liquid sodium aluminate are considered hazardous by the OSHA Hazard Communication Standard which means that they must be appropriately labeled and employers must provide appropriate safety training. A Spill Prevention, Control, and Contingency Plan for the proposed project is included in Appendix G, along with Material Data Safety Sheets for alum and sodium aluminate. For transportation purposes, liquid alum and sodium aluminate are listed as hazardous Class 8: Corrosive. Liquid alum is considered Packing Group III: Minor Danger in shipping. Liquid sodium aluminate is listed in Packing Group II: Moderate Danger in shipping. These classifications indicate that care must be taken in shipping and handling; the Poteau Valley Improvement Authority regularly receives and handles shipments of liquid alum as part of their routine operations.

4.10 RECREATION

Recreational activities at Wister Lake on the water and on the surrounding lands are managed by the USACE, Tulsa District, the Oklahoma Tourism and Recreations Department Division of State Parks Wister Lake State Park, and the Oklahoma Department of Wildlife Conservation (ODWC). Visitors to Wister Lake enjoy recreational activities in areas managed by all three entities. Activities include boating, fishing, water skiing, swimming, camping, hunting, and hiking. Fishing is the most common activity on the lake, though water skiing and jet skis are also popular.

Wister Lake offers eight public-use areas for vacationers. Park facilities include cabins, campsites (developed and undeveloped), showers, a group campground, picnic pavilions, recreational vehicle hook-ups, a gift shop and a nature center. A public hunting area, approximately 35,000 acres [14,164 hectares (ha)], with deer, turkey, squirrel, rabbit, and bobwhite quail is located in the flood pool areas of the and managed by ODWC. A 2,000-acre (809 ha) state waterfowl refuge is located adjacent to the western lake boundary also managed by ODWC.

The Quarry Island Cove area where the proposed project is located is one of the more heavily utilized areas of the lake with a boat ramp located on Quarry Island on the south shore of the cove.

5.0 ENVIRONMENTAL IMPACTS OF PROPOSED ACTION

5.1 SOCIAL AND ECONOMIC CONDITIONS

5.1.1 Demography

Population trends of the past decade would continue in the county, with population remaining flat (+/- 1% growth or decline). Improved water quality in Wister Lake and improved ability to meet treated water standards would make the region a more viable home for business and people.

5.1.2 Employment and Education

The project itself would not impact employment in the county. Long-term, the project may contribute to an improved ability to meet evolving drinking water quality standards which would put the region into a better position to successfully recruit new businesses and the employment that comes with them.

5.1.3 Water Supply

The project would result in an improved understanding of the potential for water quality improvement both in the lake itself and in the treated water produced by PVIA. An enhanced water quality would contribute to confidence that an adequate and safe water supply for the region would remain available in the coming decades.

5.1.4 Executive Order 12898, Environmental Justice

There would be no adverse impacts to minority and low-income populations from the proposed project. The populations served by the PVIA would benefit from improved water quality.

5.1.6 Executive Order 13045, Protection of Children from Environmental Health and Safety Risks

The proposed project would not have a significant adverse effect on children. Improved water quality in Quarry Island, and in particular the reduction of cyanobacteria concentrations in the most frequently used portion of Wister Lake would have an positive benefit to children's environmental health by reducing their potential exposure to cyanobacterial toxins.

5.2 NATURAL RESOURCES

5.2.1 Terrestrial Biological Resources

The proposed project would have no significant adverse impact to terrestrial biological resources. Project support activities on the land will take place on existing roads and parking lots.

5.2.2 Aquatic Resources

5.2.2.1 Limnology

Nutrient inactivation is an in-lake water quality restoration technique that lowers the phosphorus content of a lake by both (1) directly removing phosphorus from the water column and (2) reducing the recycling of mobile phosphorus from lake sediments to the water column. The most recent comprehensive review of alum treatment procedures and potential benefits and potential adverse consequences is provided in Cooke et al. (2005). Additional background on in-lake alum use and safety is provided in NALMS (2004). A recent case study evaluating in-lake alum effectiveness is provided by Huser et al. (2011). A recently published study of the effectiveness of alum application in reducing cyanobacteria numbers and microcystin concentration is Harris et al. (2014).

On January 23, 2013, PVIA, in cooperation with the USACE Tulsa District, convened an informational meeting regarding a potential alum application at Quarry Island Cove at the USACE office in Tulsa. The meeting was attended by over 28 individuals representing 11 state and federal agencies, universities, and businesses. In addition, pre-environmental assessment coordination was undertaken with agencies and groups potentially affected by the proposed project (see Section 7 and Appendix A).

Questions that were raised at the meeting and in pre-assessment coordination included:

- Will alum treatment lower the pH of Quarry Island Cove to a level that could harm people or fish and wildlife?
- Is alum-treated water safe for human body contact—will it harm a swimmer's or wader's skin or eyes?
- Does the alum floc build up on the lake bottom? How much floc is produced? Does alum application constitute a "fill" under Section 404 of the Clean Water Act?
- What are the consequences for dissolved oxygen when algae and cyanobacteria in the water column are taken to the lake bottom by alum?
- What happens to the sulfate that is released when aluminum sulfate disassociates? Are there adverse consequences associated with an addition of sulfate? Could an increase in lake clarity coupled with the addition of sulfate increase the methylation of mercury in lake sediments, and lead to increases in mercury concentrations in fish tissue in Lake Wister?

Each of these issues is discussed below.

pH and alkalinity

Alum has been used to safely treat drinking water by coagulating and settling material for over 200 years. It is probably the most commonly used drinking water treatment in the world (Cooke et al. 2005). The importance of pH and alkalinity to the safe and effective application of alum (aluminum sulfate) in lakes is well-understood (Cooke et al. 2005). Adding alum to water consumes alkalinity. Sodium aluminate, on the other hand, adds alkalinity and can be used to buffer the alum reactions and maintain a safe and appropriate pH range. In the proposed project alum and sodium aluminate would be added to the lake simultaneously in a 2:1 ratio.

When alum or other aluminum salts are added to water they dissociate, forming aluminum ions. These ions are immediately hydrated through a series of reactions leading to the formation of aluminum hydroxide. Aluminum hydroxide is a visible, colloidal floc with high coagulation and phosphorus adsorbing properties. The floc is heavier than water, and immediately begins settling to the lake bottom where it continues to intercept and bind phosphorus released by lake sediments. The aluminum ions also bind with soluble phosphorus in the water and form aluminum phosphate (Cooke et al. 2005).

The potential danger for aquatic life comes if the aluminum ions do not hydrolyze and remain as free aluminum ions. These free ions can be toxic to aquatic life. At typical lake pH's of 6-8, aluminum hydroxides dominate. At pHs below 6 various soluble intermediate forms occur, and below pH 4 aluminum ions dominate (Cooke et al. 2005). By buffering the alum application with sodium aluminate, an appropriate and safe pH between 6 and 8 can be maintained. At the same time as it provides a buffer, sodium aluminate also is providing aluminum for treatment.

Alum consumes approximately 0.24 mg/L of alkalinity ($CaCO^3$) for each mg/L of alum added. Sodium aluminate provides approximately 0.4 to 0.6 mg/L of alkalinity (CaCO3) for each mg/L of sodium aluminate. Therefore, in lakes naturally low in alkalinity, alum and sodium aluminate are often applied in a 2:1 ratio by volume, as proposed here. The sodium aluminate applied buffers the pH lowering effect of alum and prevents lowering pH or alkalinity to potentially damaging levels (NALMS 2012; Cooke et al. 2005; Dominie 1980).

For added safety, a jar test will be performed each day prior to beginning application, to confirm that the planned application rate will not lower pH below 6.5 (See Section 3.1).

Human safety

Based on typical visitor use patterns at Quarry Island Cove, potential human contact with alum treated water could occur from swimming, water skiing, jet ski use, or from wading during boat launching.

Direct contact with undiluted liquid alum can irritate the skin or eyes. Treatment consists of flushing with water. A material safety data sheet for liquid alum is provided in Appendix G. The alum application contractor will be required to take appropriate safety precautions for handling alum, including the use of gloves and eye protection, as detailed in the project work and safety plan (Appendix G).

The dilution of alum would begin immediately as soon as it is applied to the water in the cove, providing minimal opportunity for human contact with undiluted chemicals. Once alum is delivered to the lake water, floc formation begins instantaneously. Settling begins immediately as well; the floc will settle out of the upper water column within minutes.

Because of this, direct contact of swimmers or boaters with the floc is not a safety concern. Direct contact with the floc could only occur seconds after the passing of the treatment barge. As it is not desirable to have boats or citizens in close proximity to the treatment barge because of potential physical contact hazards, boats would be directed away from each day's application area, and the likelihood of individual contact will be extremely small.

Several steps would be taken during implementation of the proposed project in Quarry Island Cove to ensure that there is no body contact with newly applied chemicals:

1. Application would begin each day in the very early morning, just after daylight, before a high number of users are at the lake. Application would not occur on a weekend or holiday.

2. No alum would be applied in the swim area itself, or in the nearshore area of the boat ramp where boaters sometimes enter the water.

3. The Quarry Island boat ramp and swim beach are adjacent on the north shore of Quarry Island (south shore of the cove). On the day that this portion of the cove receives its alum application, it would be done first, to provide maximum opportunity for the floc to settle before day use of the area begins.

4. PVIA staff would be stationed at the boat ramp and swim beach area each day to direct boaters away from the areas scheduled for treatment that day and explain the alum application to lake users.

5. PVIA would station a pontoon boat in the cove in the application area to further direct boaters to other areas of the cove during application.

Floc quantities

As discussed above under pH and alkalinity, when alum is added to water the aluminum sulfate molecules dissociate, forming aluminum ions that are immediately hydrated—that

is, they combine with water. This hydration process produces a visible floc with high coagulation and phosphorus adsorbing properties. Even though the floc is visible, it is mostly water. As the floc settles toward the lake bottom, it binds with dissolved phosphorus and with particles (both organic and inorganic) in the water column and clears the water column.

The quantity of floc produced is related to the quantities of alum and sodium aluminate applied. The proposed project will add an estimated combined quantity of 24,000 gallons liquid alum and sodium aluminate to Quarry Island Cove, though the actual amount applied will be adjusted depending on the results of jar tests conducted each day (Section 3.1). The volume of Quarry Island Cove is 1,418 acre-feet, which is equal to about 462,057,323 gallons. The total volume of chemical that would be applied is therefore approximately 0.005% of the volume of the cove, and much of that volume is water. The material that the floc collects as it moves to the bottom is sediment and organic material that is already present in the lake, it is not being added by the treatment process. Much of that material is already destined to settle to the bottom over time. The treatment process only affects the material in the water at the time of application. Typical, on-going, sedimentation rates at Wister Lake have not been measured. However, a very large quantity of sediment enters the lake each year. The most recent estimate is that over 230,000 tons of sediment entered Wister Lake in 2013 (USGS 2014) and that approximately 475 acre-feet of lake capacity is lost each year due to sedimentation.

When first deposited, the floc would likely be visible on the lake bottom for a short period time. Over time, weeks to months, the floc settles further into and becomes integrated with the lake sediments (Cooke et al. 2005). In a review of 21 lakes that had received an alum treatment, Welch and Cooke (1999) stated that the added aluminum was not generally visible as distinguishable layer. In West Twin Lake, for example, one of the cases examined by the authors, the floc had been integrated to a depth of 20 cm over a 16 year period (Welch and Cooke 1999). In a recently published report on a pond receiving a more-or-less *continuous* application of alum Osgood (2012) reported that after 14 years there was no observable floc in the pond. Single alum applications to lakes have been documented as high as >80 gAl/m^2 with no reports of alum floc accumulation (Osgood et al. 2010 *in* Osgood 2012).

The proposed project would not have a significant impact to the Wister Lake ecosystem due to floc accumulation nor would a significant material addition occur.

Fish and invertebrates

The most important factor in maintaining fish health is to keep the pH within a desirable range, as described above. In addition, the nature of the proposed project would allow fish to escape and avoid alum application areas. Alum would be applied to approximately one-third the surface area of the cove each day. Thus fish would have the opportunity to leave the treatment area and escape to other areas of the cove and the lake. For example, Exley (2000) demonstrated that trout would avoided aluminum concentrations as low as 27 ug/L. Boyd (1979) found alum floc was not toxic to fathead

minnows as long as appropriate alkalinity was maintained. In over 130 recorded in-lake alum treatments there has never been a reported fish kill (Cooke et al. 2005).

The impacts to zooplankton reported in the literature are more variable. Zooplankton can be taken to the lake bottom along with other particles in water column as the floc settles. This does not necessarily kill them, but does reduce their numbers in the water column temporarily. In most cases numbers rebound within a few weeks, and sometimes zooplankton numbers are reported as higher in the weeks following alum treatment (Cooke et al. 2005).

Doke et al. (1995) examined the changes in benthic macroinvertebrates following alum treatment. There was no evidence that benthic macroinvertebrates were adversely affected by the alum treatment. Several days after treatment densities were similar to those recorded in previous years (Doke et al. 1995).

The continuous application of high quantities of alum has been reported to have had a negative impact on zooplankton numbers (Barbiero et al. 1988). This negative effect resulted from weeks of continuous dosing, a situation very different than that of the proposed project. Potential exposure to an alum floc is relatively short-lived in a treatment such as the proposed project.

To assess potential changes to zooplankton populations, tow samples will be taken for zooplankton identification and enumeration prior to and following alum application, and will continue to be taken monthly at the routine monitoring site for one year following treatment.

Dissolved oxygen

There is little discussion in the alum treatment literature of any negative impacts to dissolved oxygen conditions resulting from alum application. Several factors may contribute to this apparent lack of a significant negative impact. Sediment oxygen demand is based on an accumulation of organic matter in the sediments, not the quantity of organic material being added daily or over the course of a few weeks. Since algae and cyanobacteria are continuously dying and falling to the bottom, the quantity moved to the bottom from an alum application represents only the quantity that would have been deposited anyway over a few days or weeks. Second, although taken to the bottom, the algae and cyanobacteria do not all die immediately, again spreading the potential impact out over time. In fact, some cyanobacteria with the ability to regulate their buoyancy may float back up, at least temporarily. With reduced nutrient availability, many would die in time, and overall concentrations would be reduced. This means future (days to weeks) oxygen demand would be reduced because the quantity of algae and cyanobacteria being produced and subsequently dying and contributing to oxygen demand are reduced.

Dissolved oxygen levels in the hypolimnion would be one of the items carefully monitored following alum application in Quarry Island Cove to determine if any measurable changes occur, and inform any future applications.

Turbidity

Wister Lake frequently has a relatively high mineral turbidity. This high mineral turbidity contributes to somewhat lower chlorophyll-a levels than would be expected given the total phosphorus levels recorded (PVIA 2009; OWRB 2012). Reduced light levels due to turbidity limit algae and cyanobacteria growth.

Both mineral and organic components of Wister Lake turbidity will be directly affected by the proposed project. Mineral and organic particles in the water would be captured by the aluminum hydroxide flocs and be carried to the lake bottom. Thus Quarry Island Cove would be expected to achieve clarity levels rarely seen under normal conditions. This increase in clarity will allow increased depth of light penetration. It may also alter the thermal regime of the cove. The typically brown waters of the cove absorb significant solar energy and surface temperatures in August can reach 98° Fahrenheit (36.7° C). With less turbidity, surface water temperatures may be reduced and temperatures at depth increase. Greater clarity and altered thermal and light conditions would be expected to affect aquatic life in the cove. For example, Holz and Hoagland (1999) reported that *Daphnia* biomass declined during the first year following alum application in a small Nebraska lake. This was attributed partly to precipitation by the alum floc but also to increased predation due to the increase in water clarity. Similar processes may occur in Wister Lake following alum treatment.

Altered light conditions would be accompanied by significantly lowered nutrient levels. Therefore, while increased light penetration may have the potential to enhance algal growth, lowered nutrient levels should inhibit such growth. Also, August turbidities are frequently already low, ranging from 8.5 to 13 NTU over the last three years (Section 4.5.4) due to the lack of storms usual for that time of the year.

How long the altered turbidity and nutrient regime will persist following the application of nutrient-inactivating chemicals is not known, but it is expected to be temporary. Observing and documenting how quickly the cove returns to pre-treatment conditions is one of the key aspects of monitoring for the proposed project.

Sulfate and mercury

Wister Lake is not in attainment for fish consumption beneficial use due to excessive concentrations of mercury in the tissue of some fish (Section 4.5.4.1 and 4.5.4.2). The Oklahoma Department of Environmental Quality (ODEQ) has raised questions about the potential impact of alum applications on mercury concentrations in Wister Lake fish (see their letter in Appendix A).

Two interactive concerns are mentioned: (1) that improved clarity of the water could increase the rate of methylation of mercury, and (2) that an increase in sulfate concentrations resulting from the alum application could increase the rate of methylation.

Sources of inorganic (elemental) mercury to lakes are primarily from atmospheric deposition and on a global basis about half the mercury comes from deposition of coal-fired power plant emissions. A portion of the inorganic mercury deposited could be converted to methylmercury (CH_3Hg^+) by bacteria under anoxic conditions.

Because methyl mercury is slow to be eliminated from organisms (though it can be eliminated over long time periods), it tends to accumulate in aquatic organisms, and accumulate to higher concentrations at higher levels in the food chain. That is, predator fish species, and larger and older individuals of those species, tend to have higher concentrations of mercury in their tissues than younger and smaller. Fish and other aquatic species are the only significant source of human methylmercury exposure. Largemouth bass have the highest concentrations at Wister Lake (Section 4.5.4.2).

ODEQ suggests that a mercury monitoring program be implemented as a part of the proposed project. Per their suggestion, PVIA will implement a fish tissue mercury monitoring component as a part of the proposed project. Ten largemouth bass will be collected prior to project implementation and in years 1, 3, and 5 following implementation and sent to the ODEQ laboratory for analysis for mercury. In each sampling year, five bass will be collected from Quarry Island Cove and five from the upper, shallower area of the lake.

5.2.2.1 Fisheries

The proposed project would not have a negative environmental impact to Wister Lake fisheries. The potential of the project to significantly increase the concentration of mercury in fish tissue in the lake is considered to be small, however a monitoring program to track fish tissue mercury concentration for five years following project implementation would be conducted. Reduction in cyanobacteria concentrations would have a beneficial impact on cove fish.

5.2.2.2 Wetlands

The proposed project would not have a significant adverse environmental impact on wetlands. With the possible exception of the littoral fringe of the cove, no jurisdictional wetlands exist in the project area. The actual quantities of material introduced through application of alum and sodium aluminate are small, and the floc becomes incorporated into lake sediments over time, further reducing its physical quantitative impact (see discussion in Section 5.2.2.1).

5.3 Prime and Unique Farmland

There would be no significant adverse impact on prime farmland in the Wister Lake area.

5.4 Wild and Scenic Rivers

There are no streams within the project area classified as wild and scenic, and therefore no adverse impact would occur to such streams.

5.5 Executive Order 12962 and 13474, Recreational Fisheries

There would be no adverse environmental impact to recreation fisheries by the proposed project. The potential of the project to improve water quality in the cove by reducing nutrient concentrations and cyanobacteria numbers could lead to improved conditions for fish and fishermen.

5.6 Executive Order 13112, Invasive Species

The proposed project would have no impact on the introduction or spread of invasive species. No ground disturbing activities will occur.

5.7 Executive Order 13186, Responsibility of Federal Agencies to Protect Migratory Birds

The proposed project would have no adverse impacts to migratory birds. No ground disturbing activities would occur and no habitat would be lost.

5.8 Threatened and Endangered Species

No threatened or endangered species occur in the project area. The proposed project would not have a significant adverse environmental impact to threatened or endangered species.

5.9 Cultural Resources

The proposed project would not have a significant environmental impact on cultural resources. No ground disturbing activities would occur. All project activities on land would take place on existing roads and parking lots.

5.10 Air Quality

The proposed project would not have a significant environmental impact on air quality. LeFlore County is currently classified as in attainment for air quality purposes.

5.11 HAZARDOUS, TOXIC, OR RADIOLOGICAL WASTE

No ground disturbing activities would occur. All project activities on land would take place on existing roads and parking lots. No significant adverse environmental impacts due to hazardous, toxic, or radiological waste would occur as a result of the proposed project. A Spill Prevention, Control, and Contingency Plan for the proposed project has been prepared and is included in Appendix G, along with Material Data Safety Sheets for alum and sodium aluminate.

5.12 RECREATION

The proposed project would not have a significant adverse impact to recreation. Minor, localized, short-term displacement of recreation from the shoreline area in the vicinity of the swim beach and boat ramp will occur. This displacement would be limited to one-half day. The long-term consequences of the proposed project could result in an improvement in recreation due to an improvement in water quality in Quarry Island Cove.

6.0 MITIGATION PLAN

The Recommended Action, nutrient inactivation in Quarry Island Cove through application of alum and sodium aluminate, is intended to benefit the aquatic environment of Quarry Island Cove. No significant adverse impacts are expected, and no mitigation plan is required.

7.0 FEDERAL, STATE, AND LOCAL AGENCY COORDINATION

Pre-Environmental Assessment (EA) coordination letters were sent to the following agencies and tribes. Copies of correspondence from the agencies and tribes that provided comments and planning assistance for preparation of the draft EA are included in Appendix A.

Choctaw Nation of Oklahoma
Oklahoma Conservation Commission
Oklahoma Department of Environmental Quality
Oklahoma Department of Wildlife Conservation
Oklahoma State Parks
Oklahoma Tourism and Recreation Department
Oklahoma Water Resources Board
US Army Corps of Engineers, Tulsa District

The Draft Environmental Assessment (EA) was coordinated with the same set of agencies and tribes. Copies of correspondence from the agencies that provided comments on the draft EA are included in Appendix A. The mailing list for the 30-day public review period for this draft EA is also included in Appendix A.

8.0 REFERENCES

Barbiero, R., R.E. Carlson, G. D. Cooke, and A.W. Beals. 1988. The effects of a continuous application of aluminum sulfate on lotic benthic invertebrates. Lake and Reservoir Management 4(2): 63-72.

Boyd, C.E. 1979. Aluminum sulfate (alum) for precipitating clay turbidity from fish ponds. Transactions of the American Fisheries Society 108:307-313.

Cooke, G.D., E.B. Welch, S.A. Peterson, S.A. Nichols. 2005. Restoration and management of lakes and reservoirs. Boca Raton, FL: CRC Press.

Doke, J.L., W.H. Funk, S.T.J. Juul, and B.C. Moore. 1995. Habitat availability and benthic invertebrate population changes following alum treatment and hypolimnetic oxygenation in Newman Lake, Washington. Journal of Freshwater Ecology 10(2): 87-102.

Dominie, D.R. 1980. Hypolimnetic aluminum treatment of softwater Annabessacook Lake. pp. 417-423, *in* Restoration of Lakes and Inland Waters. US EPA: Washington, D.C. December 1980. EPA 440/5-81-010.

Exley, C. 2000. Avoidance of aluminum by rainbow trout. Environmental Toxicology and Chemistry 19: 933-939.

Haggard, B.E., J.T. Scott, and S. Patterson. 2012. Sediment phosphorus flux in an Oklahoma reservoir suggests reconsideration of watershed management planning. Lake and Reservoir Management 28: 59-69.

Harris, T.D., F.M. Wilhelm, J.L. Graham, and K.A. Loftin. 2014. Experimental additions of aluminum sulfate and ammonium nitrate to in situ mesocosms to reduce cyanobacterial biovolume and microsystin concentration. Lake and Reservoir Management 30: 84-93.

Holz, J.C. and K.D. Hoagland. 1999. Effects of phosphorus reduction on water quality: comparison of alum-treated and untreated portions of a hypereutrophic lake. Journal of Lake and Reservoir Management 15(1): 70-82.

Huser, B., P. Brezonik, and R. Newman. 2011. Effects of alum treatment on water quality and sediment in the Minneapolis Chain of Lakes, Minnesota, USA. Lake and Reservoir Management 27: 220-228.

James, K. 2014. Pers. Comm. Kyle James, Oklahoma Department of Wildlife Conservation.

Lindsay, H.L., S.J. Bellovich, E. Dale, and E. Smith. 1974. An environmental inventory of the Poteau River Basin. Prepared for: the Department of the Army, US Army Corps of Engineers, Tulsa District. December 1974.

NALMS. 2012. Lake & Pond Phosphorus Inactivation & Interception Workshop Manual. North American Lake Management Society: Madison, WI. November 6, 2012.

NALMS. 2004. Position Statement 2. The use of alum for lake management. North American Lake Management Society. Adopted by the NALMS Board of Directors February 26, 2004. Online at: http://www.nalms.org/media.acux/b0c9e3a3-3016-419b-8065-5b6ad8f72075
NatureServe. 2014. NatureServe, online at: http://explorer.natureserve.org/ Accessed May 6, 2014.

OAC 785:45. Oklahoma Administrative Code, Title 785, Chapter 45. Oklahoma's Water Quality Standards.

ODEQ. 2012. Water quality in Oklahoma. Integrated report. 2012. Oklahoma Department of Environmental Quality.

ODEQ. n.d. Mercury in fish tissue lake summary Wister Lake. Oklahoma City, OK: Oklahoma Department of Environmental Quality.

ODWC 2014. Piping plover. Oklahoma Department of Wildlife Conservation website. http://www.wildlifedepartment.com/wildlifemgmt/endangered/plover.htm

ODWC. 2009. Wister Lake management plan. Oklahoma Department of Wildlife Conservation.

Osgood, R.A. 2012. Controlling *Wolffia* using alum in a pond. Lake and Reservoir Management 28: 27-30.

Osgood, D., H. Gibbons, T. Eberhardt, P. Eberhardt, A. Shortelle. 2010. Alum for phosphorus inactivation and interception workshop. Oklahoma City (OK): North American Lake Management Society, 2 Nov. 2010. Cited in: Osgood, R.A. 2012.

Owens, J. D., F.B. Largent Jr., and M. J. Guccione. 2000. Relocation and Reinvestigation of 45 Archaeological Sites at Wister Lake, LeFlore County, Oklahoma. U.S. Army Corps of Engineers, Tulsa District.

OWRB. 2012. 2012 Oklahoma Lakes Report. Beneficial Use Monitoring Program. Oklahoma Water Resources Board. Oklahoma City, OK.

OWRB. 2011. Wister Lake Shaded Relief. Survey date: 2011. New bathymetry survey of Wister Lake, unpublished. Oklahoma Water Resources Board.

OWRB. 2004. Lake Wister Historical Water Quality Comparison. Prepared for: Poteau Valley Improvement Authority. Prepared by: Oklahoma Water Resources Board. November 2004.

OWRB. 2003. Lake Wister Water Quality, Bathymetry, and Restoration Alternatives. Prepared for: US Army Corps of Engineers. Prepared by: Oklahoma Water Resources Board. September 2003.

OWRB. 1996. Diagnostic and Feasibility Study of Wister Lake. Phase I of a Clean Lakes Project. Prepared by: Oklahoma Water Resources Board. 26 November 1996.

PVIA. 2014. Unpublished water quality monitoring data. Poteau Valley Improvement Authority. Wister, OK.

PVIA. 2009. Restoring Lake Wister. PVIA's Strategic Plan to Improve Water Quality and Enhance the Lake Ecosystem. Poteau Valley Improvement Authority. Wister, OK. November 3, 2009.

Shingleton, Kenneth. 2014. Pers. Comm. US Army Corps of Engineers, Tulsa District.

USACE. 2014. National wetland plant list, version 3.2. US Army Corps of Engineers Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, NH. Available online at: http://wetland_plants.usace.army.mil/

USACE. 2012. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0, ed. J.F. Berkowitz, J.S. Wakely, R.W. Lichvar, C.V. Noble. ERDC/EL TR-12-9. Vicksburg, MS: US Army Engineer Research and Development Center.

USACE. 2009. Wister Lake, Oklahoma Aquatic Ecosystem Restoration Study, Le Flore County, Oklahoma. Final Environmental Assessment. September 2009. Project Number 121601. Prepared by SAIC. Prepared for: USACE Tulsa District, Tulsa, OK.

USACE. 2008. Historic Properties Management Plan. Wister Lake. US Army Corps of Engineers, Tulsa District. June 2008.

USACE. 2002. Draft Supplement to the Final Environmental Statement for the Operation and Maintenance Program at Wister Lake and Poteau River, Oklahoma. Prepared for: US Army Corps of Engineers, Tulsa District. June 2002.

USACE. 1993. Wister Lake Oklahoma Reconnaissance Study. U.S.Department of the Army, Tulsa District Corps of Engineers, Oklahoma.

US Census Bureau. 2014a. Quick Facts. Last accessed May 3, 2014. http://quickfacts.census.gov/qfd/states/40/40079.html

US Census Bureau. 2014b. Fact Finder. Last accessed May 3, 2014. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

USDA 1983. Soil Survey of LeFlore County Oklahoma. United States Department of Agriculture Soil Conservation Service. August 1983.

USEPA 2014. Level III and IV Ecoregions of the Continental United States. US Environmental Protection Agency. Online at: http://www.epa.gov/wed/pages/ecoregions/level_iii_iv.htm

USEPA. 1977. Report on Wister Reservoir, LeFlore County, Oklahoma, EPA Region VI. Working Paper 595. National Eutrophication Survey. March 1977.

USFWS. 2014. Letter. March 14, 2014. Consultation Tracking Number: 02EKOK00-2014-SLI-0629. List of threatened and endangered species that may occur in your proposed project location. US Fish and Wildlife Service. Oklahoma Ecological Services Field Office. Tulsa, OK.

USFWS. 2012. Species Profile. Piping Plover (Charadrius melodus). Online at: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079

USFWS.2010. Scaleshell mussel recovery plan (Leptodea leptodon). Fort Snelling, MN: U.S. Fish and Wildlife Service, 2010. Online at: http://www.fws.gov/ecos/ajax/docs/recovery_plan/100407_v2.pdf

Welch, E.B. and G.D. Cooke. 1999. Effectiveness and longevity of phosphorus inactivation with alum. Lake and Reservoir Management 15(1): 5-27.

9.0 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

Table 9-1. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Policies	Compliance of Alternatives[1]
Federal	
Archeological and Historic Preservation Act, 1974, as amended, 16 U.S.C 469, et seq.	All plans in full compliance
Clean Air Act, as amended, 42 U.S.C. 7609, et seq.	All plans in full compliance
Clean Water Act, 1977, as amended (Federal Water Pollution Control Act, 33 U.S.C. 1251, et seq.	All plans in full compliance
Endangered Species Act, 1973, as amended, 16 U.S.C. 1531, et seq.	All plans in full compliance
Farmland Protection Policy Act, 7 U.S.C. 4201, et seq.	All plans in full compliance
Federal Water Project Recreation Act, as amended, 16 U.S.C. 460-1-12, et seq.	All plans in full compliance
Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq.	All plans in full compliance
Land and Water Conservation Fund Act, 1965, as amended, 16 U.S.C. 4601, et seq.	All plans in full compliance
National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq.	All plans in full compliance
National Historic Preservation Act, 1966, as amended, 16 U.S.C. 470a, et seq.	All plans in full compliance
Native American Graves Protection and Repatriation Act, 1990, 25 U.S.C. 3001-13, et seq.	All plans in full compliance
Rivers and Harbors Act, 33 U.S.C. 401, et seq.	All plans in full compliance
Water Resources Planning Act, 1965	All plans in full compliance
Watershed Protection and Flood Control Act, 16 U.S.C. 1001, et seq.	All plans in full compliance
Wild and Scenic Rivers Act, as amended, 16 U.S.C. 1271, et seq.	All plans in full compliance
Protection of Wetlands (E.O. 11900)	All plans in full compliance
Floodplain Management (E.O. 11988)	All plans in full compliance
Environmental Justice (E.O. 12898)	All plans in full compliance
Protection of Children from Environmental Health Risks and Safety Risks (E.O. 13045)	All plans in full compliance

[1] Full Compliance—having met all requirements of the statutes, Executive Orders, or other environmental requirements for the current stage of planning

10.0 LIST OF PREPARERS

The following personnel contributed to the preparation of this document:

Steven Patterson, Ph.D., Restoration Ecologist, Bio x Design, Poteau, Oklahoma

APPENDICES

APPENDIX A. Coordination/Correspondence

The Draft Environmental Assessment was released for public review on June 2, 2014 and distributed to the following individuals and organizations. Availability of the Draft EA was advertised in the Poteau Daily News on June 4, 2014 and a public information meeting was held at Wister Lake on June 17, 2014. No comments were received on the Draft EA by the end of the 30-day review period.

Representative
James Lockhart
District 3
2300 N. Lincoln Blvd.
Room 505
Oklahoma City, OK 73105

Representative
Brian Renegar
District 17
2300 N. Lincoln Blvd.
Room 504
Oklahoma City, OK 73105

Representative
Ed Cannaday
District 15
2300 N. Lincoln Blvd.
Room 546
Oklahoma City, OK 73105

Senator Mark Allen
District 4
2300 N. Lincoln Blvd.
Room 415
Oklahoma City, OK 73105

Senator Larry Boggs
District 7
2300 N. Lincoln Blvd.
Room 522B
Oklahoma City, OK 73105

Representative
Markwayne Mullin
1113 Longworth House Office
Building
Washington, DC 20515

Senator Tom Coburn
172 Russell Senate Office
Building
Washington, DC 20510

Senator James M. Inhofe
205 Russell Senate Office
Building
Washington, DC 20510-3603

Derwin Gist
LeFlore County District 1
PO Box 607
Poteau, OK 74953

Lance Smith
LeFlore County District 2
PO Box 607
Poteau, OK 74953

Ceburn Scott
LeFlore County District 3
PO Box 607
Poteau, OK 74953

Mayor Jeff Shockley
City Hall
111 Peters Street
Poteau, OK 74953

Richard Hatcher
Executive Director
Oklahoma Department of
Wildlife Conservation
PO Box 53465
Oklahoma City, OK 73152

Kris Marek
Director
Oklahoma State Parks
120 N. Robinson Ave.
Suite 600
Oklahoma City, OK 73102

Gary Batton
Chief
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74702

Deby Snodgrass
Executive Director
Oklahoma Tourism and
Recreation Department
120 N. Robinson Ave.
Suite 600
Oklahoma City, OK 73102

J.D. Strong
Executive Director
Oklahoma Water Resource
Board
3800 N. Classen
Oklahoma City, OK 73118

Scott Thompson
Executive Director
Oklahoma Department of
Environmental Quality
PO Box 1677
Oklahoma City, OK 73101-1677

Mike Thralls
Executive Director
Oklahoma Conservation
Commission
2800 N. Lincoln
Suite 160
Oklahoma City, OK 73105

US Fish and Wildlife Service
Oklahoma Ecological Services
Field Office
9014 E. 21st Street
Tulsa, OK 74129

Pre-Environmental Assessment coordination was undertaken with organizations potentially concerned with the proposed project. Copies of pre-coordination letters and responses follow.

POTEAU VALLEY IMPROVEMENT AUTHORITY
Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124

March 24, 2014

Richard Hatcher
Executive Director
Oklahoma Department of Wildlife Conservation
P.O. Box 53465
Oklahoma City, OK 73152

Dear Mr. Hatcher,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

PVIA treats water from Lake Wister and distributes it to 16 member municipalities and rural water districts in LeFlore County and adjacent portions of Haskell and Latimer Counties. The PVIA raw water intake is located on the north shore of Quarry Island Cove. Figure 1 shows the project location. High algae and cyanobacteria levels in the raw water make water treatment more difficult and costly, and can interact with disinfection chemicals to produce potentially harmful disinfection by-products in treated water. High cyanobacterial levels are also of potential concern for water contact recreation. Monthly sampling at Lake Wister in 2013 found that in seven of 12 months cyanobacteria counts exceeded 100,000 cells/ml, the Oklahoma state threshold of concern. However, cyanobacterial toxin levels did not exceed state standards.

Nutrient inactivation will be conducted via the application of alum (aluminum sulfate) and sodium aluminate to the surface of the water. As the chemicals settle they clear the water column. When they reach the lake bottom they create a chemical barrier that intercepts phosphorus released from bottom sediments. A reduced nutrient concentration, in particular phosphorus, will in turn reduce the concentrations of cyanobacteria and algae. A reduction in

cyanobacteria and algae means less organic material in the raw water and therefore a reduced opportunity for disinfection by-product formation when the water is treated.

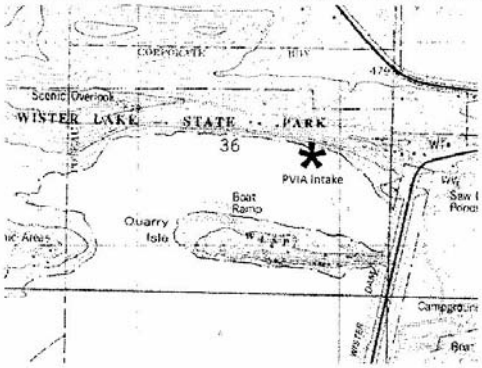

Figure 1. Quarry Island Cove & PVIA Intake Location

Alum application will occur in late July or early August 2014, during the time of typically highest cyanobacterial concentrations. Although every effort will be made in coordination with Oklahoma State Parks to minimize impacts on Wister State Park users, some staging of materials and equipment, and some short-term direction of boat traffic away from treatment areas may be required. Alum is used safely on a daily basis in most water treatment plants in the United States and has been used safely and successfully in lakes and reservoirs across the United States, though this will be the first application of this scale in an Oklahoma reservoir.

PVIA would appreciate receiving any pertinent information or concerns you may have regarding this proposed project for inclusion in the draft EA. Your agency will have the opportunity to comment on the draft EA during the 30-day public and agency review period.

If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

for Ken Hammond
Chairman, PVIA Board of Trustees

POTEAU VALLEY IMPROVEMENT AUTHORITY
Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124
March 24, 2014

Kris Marek
Director
Oklahoma State Parks
120 N. Robinson Avenue, Ste. 600
Oklahoma City, OK 73102

Dear Ms. Marek,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

PVIA treats water from Lake Wister and distributes it to 16 member municipalities and rural water districts in LeFlore County and adjacent portions of Haskell and Latimer Counties. The PVIA raw water intake is located on the north shore of Quarry Island Cove. Figure 1 shows the project location. High algae and cyanobacteria levels in the raw water make water treatment more difficult and costly, and can interact with disinfection chemicals to produce potentially harmful disinfection by-products in treated water. High cyanobacterial levels are also of potential concern for water contact recreation. Monthly sampling at Lake Wister in 2013 found that in seven of 12 months cyanobacteria counts exceeded 100,000 cells/ml, the Oklahoma state threshold of concern. However, cyanobacterial toxin levels did not exceed state standards.

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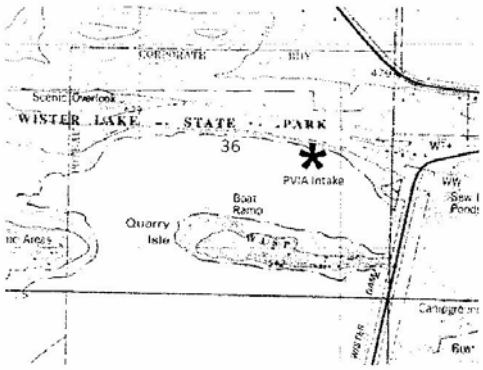

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If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

Ken Hammond
Chairman, PVIA Board of Trustees

Subject: FW: PVIA Alum Treatment Proposal
From: Kris Marek <Kris.Marek@travelok.com>
Date: 4/30/2014 6:49 AM
To: "Steve Patterson (spatterson@bioxdesign.com)" <spatterson@bioxdesign.com>

Mr. Patterson,
I miss typed on the e-mail address for your originally. My apologies.
Kris Marek

From: Kris Marek
Sent: Wednesday, April 30, 2014 6:39 AM
To: 'spatterson@bioxdeesign.com'
Cc: Debra Tautfest; Merle Cox
Subject: PVIA Alum Treatment Proposal

Mr. Patterson,
This note is in response to the Poteau proposal for alum treatment in later July or early August. The Oklahoma Tourism and Recreation Department, Division of State Parks supports this trial and will assist in efforts to coordinate the work with park use as needed. We believe that this trial will provide beneficial data regarding the use of alum for the purposes you describe. Thank you for including us in this discussion.
Sincerely,
Kris Marek

Kris Marek, Director
Oklahoma State Parks
Oklahoma Tourism and Recreation Department
120 North Robinson, Suite 600
Oklahoma City, OK 73102
phone: 405-230-8476
fax: 405-230-8676

POTEAU VALLEY IMPROVEMENT AUTHORITY
Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124
March 24, 2014

Gregory E. Pyle
Chief
Choctaw Nation of Oklahoma
PO Drawer 1210
Durant, OK 74702

Dear Chief Pyle,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

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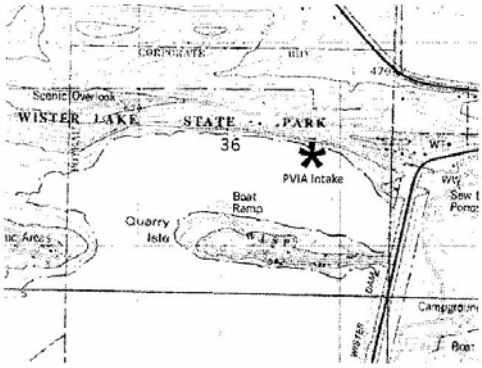

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PVIA would appreciate receiving any pertinent information or concerns you may have regarding this proposed project for inclusion in the draft EA. The Choctaw Nation will have the opportunity to comment on the draft EA during the 30-day public and agency review period.

If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

for Ken Hammond
Chairman, PVIA Board of Trustees

Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124
March 24, 2014

Deby Snodgrass
Executive Director
Oklahoma Tourism and Recreation Department
120 N. Robinson, Ste. 600
Oklahoma City, OK 73102

Dear Ms. Snodgrass,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

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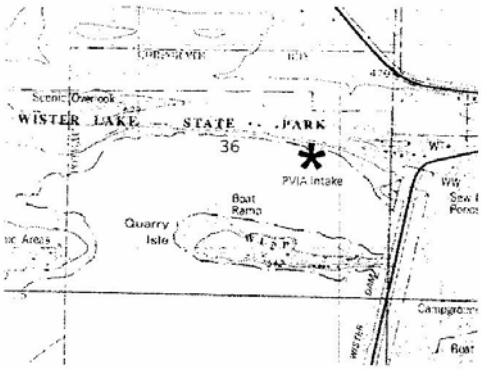

Figure 1. Quarry Island Cove & PVIA Intake Location

Alum application will occur in late July or early August 2014, during the time of typically highest cyanobacterial concentrations. Although every effort will be made in coordination with Oklahoma State Parks to minimize impacts on Wister State Park users, some staging of materials and equipment, and some short-term direction of boat traffic away from treatment areas may be required. Alum is used safely on a daily basis in most water treatment plants in the United States and has been used safely and successfully in lakes and reservoirs across the United States, though this will be the first application of this scale in an Oklahoma reservoir.

PVIA would appreciate receiving any pertinent information or concerns you may have regarding this proposed project for inclusion in the draft EA. Your agency will have the opportunity to comment on the draft EA during the 30-day public and agency review period.

If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

for Ken Hammond
Chairman, PVIA Board of Trustees

POTEAU VALLEY IMPROVEMENT AUTHORITY

Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124

March 24, 2014

J.D. Strong
Executive Director
Oklahoma Water Resources Board
3800 N. Classen
Oklahoma City, OK 73118

Dear Mr. Strong,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

PVIA treats water from Lake Wister and distributes it to 16 member municipalities and rural water districts in LeFlore County and adjacent portions of Haskell and Latimer Counties. The PVIA raw water intake is located on the north shore of Quarry Island Cove. Figure 1 shows the project location. High algae and cyanobacteria levels in the raw water make water treatment more difficult and costly, and can interact with disinfection chemicals to produce potentially harmful disinfection by-products in treated water. High cyanobacterial levels are also of potential concern for water contact recreation. Monthly sampling at Lake Wister in 2013 found that in seven of 12 months cyanobacteria counts exceeded 100,000 cells/ml, the Oklahoma state threshold of concern. However, cyanobacterial toxin levels did not exceed state standards.

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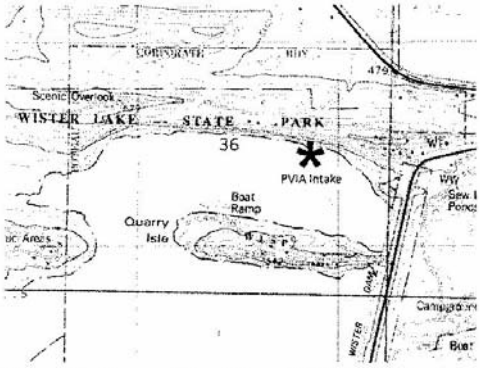

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If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

for Ken Hammond
Chairman, PVIA Board of Trustees

POTEAU VALLEY IMPROVEMENT AUTHORITY
Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124
March 24, 2014

Scott Thompson
Executive Director
Oklahoma Department of Environmental Quality
P.O. Box 1677
Oklahoma City, OK 73101-1677

Dear Mr. Thompson,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

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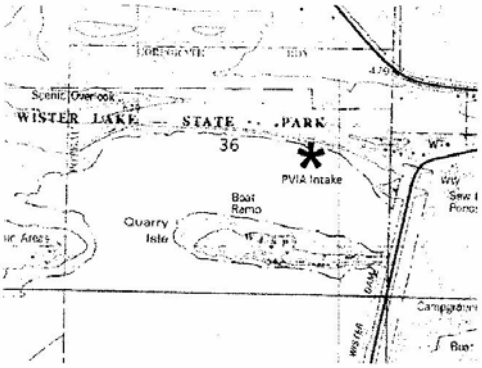

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If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

for Ken Hammond
Chairman, PVIA Board of Trustees

SCOTT A. THOMPSON
Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN
Governor

April 3, 2014

Ken Hammond
Chairman, PVIA Board of Trustees
25768 US Highway 270
Wister, Oklahoma 74966-9124

Dear Mr. Hammond,

Thank you for the opportunity to offer input and suggestions for potential inclusion in the draft Environmental Assessment for the nutrient inactivation project in Quarry Island Cove on Lake Wister, as described in your letter dated March 24, 2014.

Based on your description of the project, a permit from DEQ is not required. DEQ's acknowledgement of the project cannot and does not protect PVIA if an upset to the lake occurs. DEQ offers the following specific recommendations to reduce the potential for adverse effects:

- Partial lake treatments conducted without prior jar tests should not exceed 50 µg/L dissolved aluminum in the lake.
- Powdered alum should be mixed with water to form a slurry prior to application. Lake water may be used to make the slurry and for spray applications.
- The application should begin as early as possible each morning to avoid complications due to the natural decrease in pH after nightfall.
- Buffering material such as sodium carbonate or sodium aluminate should be available to use with alum if a decrease in pH is observed.
- If any fish are killed or distressed during application, treatment should cease immediately and the local DEQ office should be notified.
- The lake pH should remain between 6.5 and 9.0 during the application.
- Only aluminum compounds suitable for water treatment and meeting NSF 60 (i.e., containing low concentrations of heavy metals) may be used.

707 NORTH ROBINSON, P.O. BOX 1677, OKLAHOMA CITY, OKLAHOMA 73101-1677

Additionally, we note that Lake Wister currently has a fish consumption advisory in place due to elevated levels of mercury. The application of large amounts of aluminum sulfate raises questions about how that practice might affect mercury levels in the fish of Lake Wister.

Mercury enters waterbodies after being deposited out of the atmosphere during precipitation events. It is deposited in the form of elemental mercury and must be converted to methyl mercury for it to become biologically available and enter the food web. The methylation process is facilitated by sulfate-reducing bacteria and one of the factors that positively affects the efficiency of the process is the presence of light. Adding aluminum sulfate to the lake will provide an additional source of sulfate and may enhance the growth of sulfate-reducing bacteria. It will also greatly increase the clarity of the water which could positively increase the methylation rate. Together, this could increase the mercury uptake into the food web, resulting in higher levels of mercury in the fish of Lake Wister.

It is DEQ's suggestion that as part of the project a study be conducted of mercury values in fish. Fish could be collected and analyzed for mercury from both treated and untreated areas of the lake prior to treatment and annually after treatment for a period of five years. Mercury values would be corrected for length and trends and would be tracked to determine if mercury values change over that time period. This would provide information that would serve as a guide for further projects of this type in the future.

Again, thank you for the opportunity to offer input on the draft EA.

Sincerely,

Scott A. Thompson
Executive Director

POTEAU VALLEY IMPROVEMENT AUTHORITY
Phone (918) 655-7500 25768 US HIGHWAY 270 Fax (918) 655-7502
WISTER, OKLAHOMA 74966-9124
March 24, 2014

Mike Thralls
Executive Director
Oklahoma Conservation Commission
2800 N. Lincoln, Ste. 160
Oklahoma City, OK 73105

Dear Mr. Thralls,

The Poteau Valley Improvement Authority (PVIA) is in the process of developing an Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County. Important consequences of nutrient reduction should be a reduction in the concentrations of potentially harmful cyanobacteria (aka blue-green algae) in the waters of Quarry Island Cove and of disinfection by-products (DBPs) in the treated water produced by PVIA.

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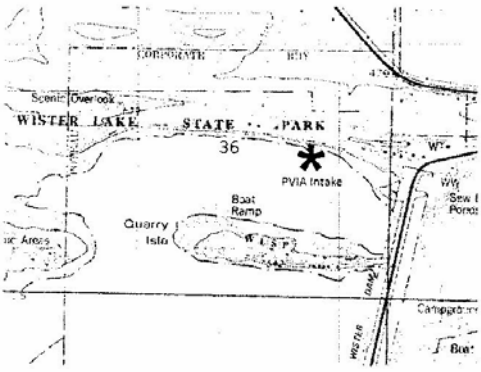

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If you have any questions on this matter, please contact Dr. Steve Patterson at 918-839-7084 or spatterson@bioxdesign.com.

We would appreciate receiving your comments within 10 days of the date of this letter.

Sincerely,

Steve Patterson

for Ken Hammond
Chairman, PVIA Board of Trustees

GOVERNOR

TODD LAMB
LIEUTENANT GOVERNOR

CONSERVATION COMMISSION

EXECUTIVE DIRECTOR

BEN POLLARD
ASSISTANT DIRECTOR

Responsible Care For Oklahoma's Natural Resources

April 1, 2014

Ken Hammond
Chairman, PVIA Board of Trustees
25768 US Highway 270
Wister, OK 74966-9124

Mr. Hammond:

On behalf of the Oklahoma Conservation Commission, I would like to thank you for the opportunity to offer comment prior to the completion of the draft Environmental Assessment (EA) for the US Army Corps of Engineers for a nutrient inactivation project in Quarry Island Cove at Lake Wister, in LeFlore County.

Quarry Island Cove is likely the most suited portion of Wister Lake and of many potential project locations in Oklahoma for the use of aluminum sulfate (alum) and sodium aluminate. As you probably know, the effect of the addition of the alum would be dampened if excessive nutrient rich water entered a treatment area. This cove should receive less direct runoff and thus should have relatively lower direct impacts than other portions of the reservoir. This should allow the alum to continually bind with freed phosphorus from lake sediments that would otherwise result in internal phosphorus loading.

Although I have not been directly involved with this project, it seems as though precautions have been implemented to minimize the risk associated with the addition of alum. The addition of alum can create problems when employed in lake water having low alkalinity and low pH, as aluminum sulfate tends to further depress the pH. The addition of sodium aluminate in conjunction with alum can minimize or negate the effect of the alum treatment on pH. Detailed pH testing should accompany the use of alum and sodium aluminate and the two should be applied simultaneously to avoid any episodes of toxic conditions. Although many guidelines suggest an acceptable pH range of 5.5 to 9.0, the OCC recommends maintaining a pH of between 6.0 and 8.0. At a pH of 6.0 or less, free aluminum may become soluble and enter the lake water. Toxicity tests have indicated that aluminum concentrations in water above 50 µg/liter can be

STATE OF OKLAHOMA • OKLAHOMA CONSERVATION COMMISSION
2800 NORTH LINCOLN BOULEVARD, SUITE 160 • OKLAHOMA CITY, OKLAHOMA 73105-4210 • (405) 521-2384 • FAX (405) 521-6686 • WWW.CONSERVATION.OK.GOV

toxic to aquatic life. In addition, over application of sodium aluminate can cause the pH to rise above 8.0, which could result in the resolubilization of the aluminum ion.

Again, I would like to thank you for the opportunity to offer comment for the draft EA.

Sincerely,

Brooks Tramell
Director of Monitoring, Assessment, and Wetlands Programs
Oklahoma Conservation Commission
brooks.tramell@conservation.ok.gov
Phone: 405-522-6908

APPENDIX B. Section 404 Permit

-----Original Message-----
From: Charlson, Darren S (Shane) SWT
Sent: Monday, July 14, 2014 8:56 AM
To: Clyde, Gerard A (Tony) SWT
Cc: Commer, Andrew SWT
Subject: SWT-2014-501, Quarry Island Cove Nutrient Inactivation Project, Lake Wister, Le Flore County (UNCLASSIFIED)

Project Name: Quarry Island Cove Nutrient Inactivation Project, Lake Wister, Le Flore County

Corps Case No.: SWT-2014-501

Corps POC: Shane Charlson, 918-669-7395

Please reference your email regarding the above listed project.

The provided information does not indicate that a placement of dredged or fill material will be required, permanently or temporarily, into any "waters of the United States," including jurisdictional wetlands. Therefore, your proposal is not subject to regulation pursuant to Section 404 of the Clean Water Act, and a Department of the Army (DA) permit will not be required. Should your method of construction necessitate such a discharge into a water of the United States, we suggest that you re-submit that portion of your project so that we may determine whether an individual DA permit will be required.

Sláinte

Shane Charlson, PWS
Regulatory Transportation Program Manager
U.S. Army Corps of Engineers
1645 South 101st East Avenue
Tulsa, OK 74128-4609
918-669-7395 FAX 918-669-4306
Shane.Charlson@us.army.mil

You are invited to complete our Regulatory Service Survey at:
http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey
<http://corpsmapu.usace.army.mil/cm_apex/f?p=regulatory_survey>

APPENDIX C. Fish and Wildlife Coordination/Correspondence

U.S. Fish and Wildlife Service

Natural Resources of Concern

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:
PVIA Wister Lake Alum Application to Quarry Cove

U.S. Fish and Wildlife Service

Natural Resources of Concern

Project Location Map:

Project Counties:

Le Flore, OK

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

MULTIPOLYGON (((-94.7174796 34.9442709, -94.7252269 34.9459946, -94.7279724 34.9454142, -94.7284659 34.9446579, -94.728144 34.9433915, -94.7332939 34.9435322, -94.7328004 34.9443589, -94.7344311 34.9456956, -94.7358913 34.9462066, -94.7352701 34.9470851, -94.7337896 34.9473331, -94.7329098 34.9478423, -94.7300774 34.9490198, -94.7246271 34.9489671, -94.7202498 34.9479469, -94.717353 34.9463816, -94.7169024 34.9447458, -94.7174796 34.9442709)))

Project Type:

Water Quality Modification

U.S. Fish and Wildlife Service

Natural Resources of Concern

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

There are a total of **6** threatened, endangered, or candidate 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. 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
Least tern (*Sterna antillarum*) Population: interior pop.	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
Clams				
Scaleshell mussel (*Leptodea leptodon*)	Endangered	species info		Oklahoma Ecological Services Field Office
Winged Mapleleaf (*Quadrula fragosa*) Population: Entire; except where listed as experimental populations	Endangered	species info		Oklahoma Ecological Services Field Office
Insects				
American Burying beetle (*Nicrophorus americanus*) Population: Entire	Endangered	species info		Oklahoma Ecological Services Field Office
Mammals				

U.S. Fish and Wildlife Service

Natural Resources of Concern

Indiana bat (*Myotis sodalis*) Population: Entire	Endangered	species info		Oklahoma Ecological Services Field Office

Critical habitats within your project area:

There are no critical habitats within your project area.

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).

Most species of birds, including eagles and other raptors, are protected under the Migratory Bird Treaty Act (16 U.S.C. 703). Bald eagles and golden eagles receive additional protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668). 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.).

Migratory bird information is not available for your project location.

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.

The following wetlands intersect your project area:

Wetland Types	NWI Classification Code	Approximate Acres
Lake	L1UBHh	3774.398689

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Oklahoma Ecological Services Field Office
9014 EAST 21ST STREET
TULSA, OK 74129
PHONE: (918)581-7458 FAX: (918)581-7467
URL: www.fws.gov/southwest/es/Oklahoma/

Consultation Tracking Number: 02EKOK00-2014-SLI-0629 March 14, 2014
Project Name: PVIA Wister Lake Alum Application to Quarry Cove

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project.

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed and candidate species, as well as proposed and final designated critical habitat, that may occur within the boundary of your proposed project and/or may be affected by your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*).

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the ECOS-IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the ECOS-IPaC system by completing the same process used to receive the enclosed list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

A Biological Assessment is required for construction projects (or other undertakings having

similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to a Biological Assessment be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at:

http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

Non-federal entities conducting activities that may result in take of listed species should consider seeking coverage under section 10 of the ESA, either through development of a Habitat Conservation Plan (HCP) or, by becoming a signatory to the General Conservation Plan (GCP) currently under development for the American burying beetle. Each of these mechanisms provides the means for obtaining a permit and coverage for incidental take of listed species during otherwise lawful activities.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 *et seq.*), and projects affecting these species may require development of an eagle conservation plan (http://www.fws.gov/windenergy/eagle_guidance.html). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers.htm; http://www.towerkill.com; and http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow.html.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit through our Project Review step-wise process http://www.fws.gov/southwest/es/oklahoma/OKESFO%20Permit%20Home.htm.

If your species list does not contain the American burying beetle and your projects falls within Marshall, Love, Carter, Murray, Garvin, McClain, Cleveland, Pottawatomie or Adair counties,

the Service reccomends that you consider the American burying beetle in your project planning process. There is evidence to suggest (Crawford and Hoagland 2010), that the American burying beetle may occur in these counties.

Attachment

United States Department of Interior
Fish and Wildlife Service

Project name: PVIA Wister Lake Alum Application to Quarry Cove

Official Species List

Provided by:

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

Consultation Tracking Number: 02EKOK00-2014-SLI-0629
Project Type: Water Quality Modification
Project Description: Alum application on approximately 100 acres of Wister Lake, Oklahoma to 1)remove suspended organic and inorganic matter, 2) decrease internal phosphorous loading from lake sediments within Quarry Cove, and 3) reduce the impact of cyanobacterial harmful algae blooms in the vicinity of the PVIA water intake structure located in the Quarry Cove, Wister Lake, Oklahoma.

Project Location Map:

Project Coordinates: MULTIPOLYGON (((-94.7174796 34.9442709, -94.7252269 34.9459946, -94.7279724 34.9454142, -94.7284659 34.9446579, -94.728144 34.9433915, -94.7332939 34.9435322, -94.7328004 34.9443589, -94.7344311 34.9456956, -94.7358913 34.9462066, -94.7352701 34.9470851, -94.7337896 34.9473331, -94.7329098 34.9478423, -94.7300774 34.9490198, -94.7246271 34.9489671, -94.7202498 34.9479469, -94.717353 34.9463816, -94.7169024 34.9447458, -94.7174796 34.9442709)))

Project Counties: Le Flore, OK

Endangered Species Act Species List

There are a total of 6 threatened, endangered, or candidate 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 fish may appear on the species list because a project could affect downstream species. Critical habitats listed on the **Has Critical Habitat** lines may or may not lie within your project area. See the **Critical habitats within your project area** section further below for critical habitat that lies within your project. Please contact the designated FWS office if you have questions.

American Burying beetle *(Nicrophorus americanus)*
Population: Entire
Listing Status: Endangered

Indiana bat *(Myotis sodalis)*
Population: Entire
Listing Status: Endangered

Least tern *(Sterna antillarum)*
Population: interior pop.
Listing Status: Endangered

Piping Plover *(Charadrius melodus)*
Population: except Great Lakes watershed
Listing Status: Threatened
Has Critical Habitat: Final designated

Scaleshell mussel *(Leptodea leptodon)*
Listing Status: Endangered

Winged Mapleleaf *(Quadrula fragosa)*
Population: Entire; except where listed as experimental populations
Listing Status: Endangered

Critical habitats that lie within your project area

There are no critical habitats within your project area.

APPENDIX D. Cultural Resources Coordination/Correspondence

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT
Cultural Resources Field Survey Report Guidelines

GENERAL INFORMATION

Lake/Navigation Project: Wister Lake

Field Staff/Surveyor: Charles A. Schrodt

Title: Environmental Specialist

Date: March 7, 2014

Phone: 918-799-5843 X3123 Fax: 918-799-5147

Township/Range

____ 1/4 ____ 1/4 ____ 1/4 Sec. ____ T ____ R ____

____ 1/4 ____ 1/4 ____ 1/4 Sec. ____ T ____ R ____

USGS Topographic Quad Map:
Wister Oklahoma

Other Location Information:
Portion of Lake North of Quarry Island

PROJECT DESCRIPTION

Proposed Project of Gantee

PVIA Demonstration Project to Apply Alum to Quarry Cove to isolate nutrients and reduce BGA levels/

Is Project a Renewal? No

Describe Previous Project (i.e/. A-G lease, etc.):

This is a water quality project and is not a Real Estate action.

Current Land Use (i.e., recreation, habitat): The water portion is fisheries habitat. The staging area is zoned recreation.

Types of Existing Disturbance (i.e., roads, mines): There are park roads, boat ramp and campsites.

PROJECT/OUTGRANT AREA

150 Area (Acres)

0 Estimated Depth of Impact

____ Length

____ Linear Unit of Measurement

Outline Specific Project Area on Quad Map.

PROPOSED ACTIVITIES

Define, and Attach Topographic Quad Map with Specific Impacts Indicated.

PVIA plans to hire a contractor to apply an alum solution to this portion of Lake Wister. The contractor will need a staging area on land to park the truck that holds the alum solution. A parking lot will be used for this purpose.

COMPONENTS OF ACTIVITY

____ Facility Construction
____ Land Clearing
____ Road Construction
____ Electric/Water Sewer Line
____ Fence Removal/Construction
____ Pond/Earthwork Construction
☐ Other N/A

EQUIPMENT TO BE USED

____ Bulldozer
____ Grader
____ Ditch Witch
____ Backhoe/Trackhoe
Yes Heavy Trucks
____ Pond/Earthwork Construction
☐ Other

☐ No Equipment

SWT Form 1060-E
25 JAN 2010

PREVIOUS EDITIONS ARE OBSOLETE.

PROPONENT: CESWT-OD-TR
PAGE 1 of 2

U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT
Cultural Resources Field Survey Report Guidelines

SURVEY INFORMATION

Project/Outgrant Area Surveyed? ☐ Yes ☒ NO Surface Visibility (%) _____

Survey Methods (i.e., pedestrian walkover, transects) _____

Survey Conditions (i.e., wet, overcast, sunny) _____

Surface Coverage (i.e., thick grass; trees) _____

Observable Areas (i.e., cow paths, cutbanks, mole hills) _____

Outline Specific Survey Areas on Quad Map.

Comments:
Due to the area being under water no survey other than a map search was conducted. LI-270 is located near the parking lot to be used to store the alum solution.

SURVEY RESULTS

Cultural Materials Observed? ☐ Yes ☒ No

Material Types Observed (i.e., chipped stone, ceramics, metal, glass, etc.

Site(s) Present? ☒ Yes ☐ No

Site Number(s) LI-270

Area Previously Surveyed? ☒ Yes ☐ No If so, by whom? _____ Year? _____

Author/Date/Title of Report (send copy to CESWT-PE-E)

ADDITIONAL COMMENTS
There should be no impacts associated with this operation due to the land area being previously disturbed.

Archeologist: Ken Shingleton Date Reviewed: 3-7-2014

Signature: SHINGLETON.KENNETH.LEE.JR.1121927353 Digitally signed by SHINGLETON.KENNETH.LEE.JR.1121927353 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=SHINGLETON.KENNETH.LEE.JR.1121927353 Date: 2014.03.07 13:44:39 -06'00'

☒ **Approved**

☐ **Approved, with conditions:**

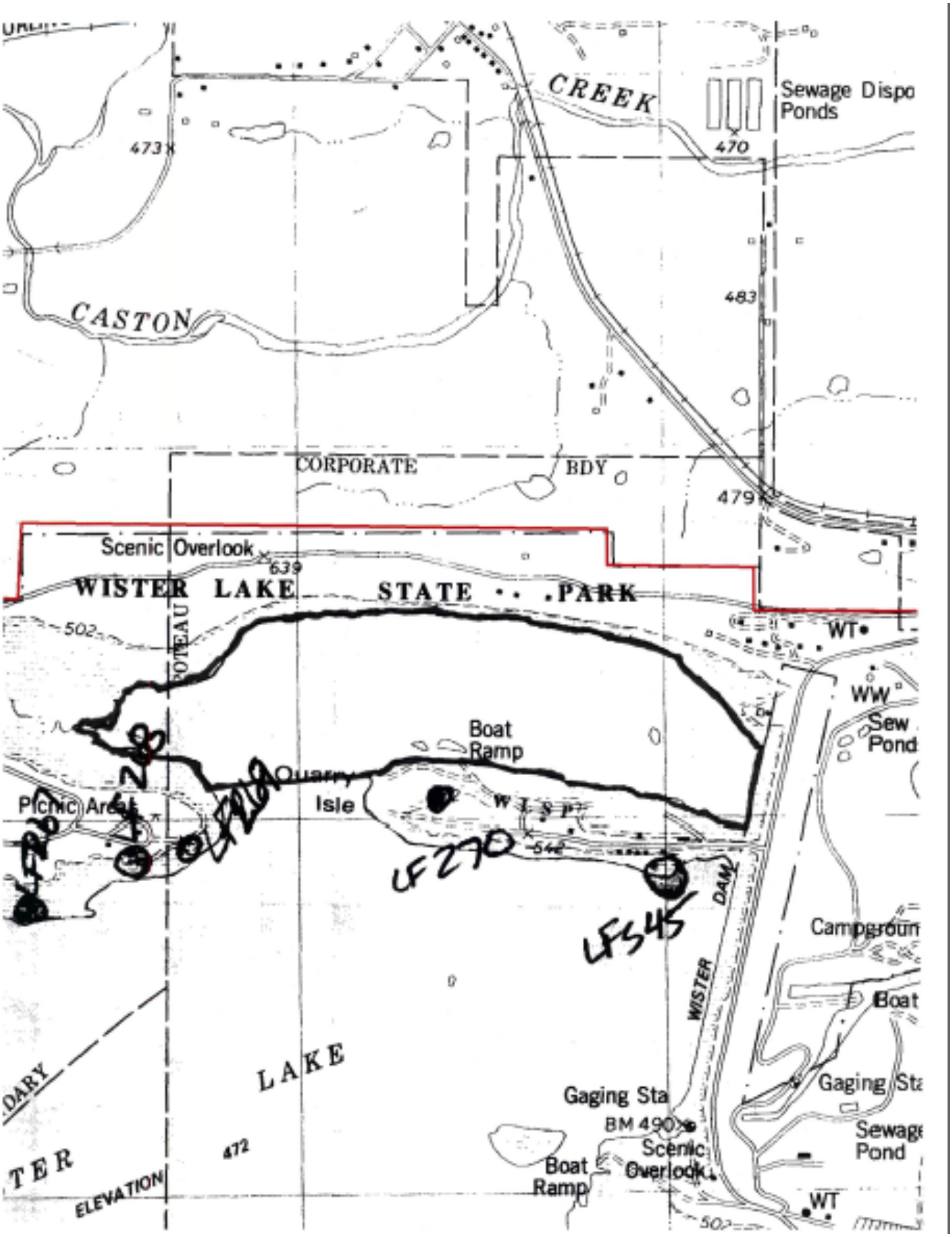
☐ **Not Approved**

☐ **Specific Actions:**

SWT Form 1050-E
25 JAN 2010

PREVIOUS EDITIONS ARE OBSOLETE.

PROPONENT: CESWT-OD-TR
PAGE 2 of 2


CREEK
Sewage Dispo
Ponds
470
473
483
CASTON
CORPORATE
BDY
479
Scenic Overlook
639
WISTER LAKE STATE . . PARK
502
WT
WW
Sew
Pond
Boat
Ramp
Quarry
Isle
Picnic Area
W I S P
544
LF270
LF545
DAM
WISTER
Campgroun
Boat
LAKE
Gaging Sta
BM 490
Scenic
Overlook
Boat
Ramp
Gaging Sta
Sewage
Pond
WT
472
ELEVATION

APPENDIX E. Public Comments

No public comments were received during the 30-day public review period.

APPENDIX F. Newspaper Public Notice

PROOF OF PUBLICATION
POTEAU DAILY NEWS

Case No. PUBLIC NOTICE
In the District Court of
LeFlore County, State of Oklahoma.

Affidavit of Publication

I, _____ of lawful age being duly sworn upon oath deposes and says: That she is the legal coordinator, an authorized agent of the Poteau Daily News, a daily newspaper printed and published daily in the City of Poteau, County of LeFlore and State of Oklahoma, and has personal knowledge of the facts hereinafter stated.

That a printed notice, copy of which is hereto attached, was published in the regular and entire issue of said newspaper, and not any supplement thereof, for 1 consecutive weeks.

1st Insertion JUNE 4 20 14
2nd Insertion _____ 20 _____
3rd Insertion _____ 20 _____
4th Insertion _____ 20 _____
5th Insertion _____ 20 _____

and that said notice was published in each successive weekly issue of said paper of the same day of the week between the dates of the first and last publication of said notice.

That said newspaper has been continuously and uninterrupted published in said county during a period of more than one hundred and four (104) weeks, consecutively and immediately prior to the first publication of the attached notice or advertisement; that the same is published in the English language, and has a paid general circulation within the county of aforesaid; that it has entrance into the United States mails as second-class mail matter, and is delivered to the United States mails in the city and county where published; that said newspaper comes within all of the prescriptions and requirements of House Bill No. 327 (an act amending Section 54 of the Compiled Oklahoma Statutes of 1931, as amended by Article 1, Chapter 1, Session of Laws of 1935), enacted by the Eighteenth Oklahoma Legislature, and effective May 31, 1941, and meets all other requirements of the laws of the State of Oklahoma with reference to legal publications.

Sharon Poor
Legal Coordinator

Publication Fee —$ _____
Additional Fee —$ _____
Total Fee —$ 17.20

Subscribed and sworn to before me this _____ day of JUNE

Notary Public

(SEAL)
My Commission Expires 03-13-2017

OFFICIAL PROOF ATTACHED

NOTICE
POTEAU VALLEY IMPROVEMENT AUTHORITY (PVIA) has filed a draft Environmental Assessment with the US Army Corps of Engineers regarding a proposed Alum project in the Quarry Island Cove, Lake Wister. There is a thirty (30) day review period for public comments beginning June 1, 2014. A draft of this proposal is available online at PVIA.org and hard copy at the Patrick Lynch Library, Poteau, OK. Comments should be addressed to Poteau Valley Improvement Authority Attention: Steve Patterson 25768 US Hwy 270 Wister, OK 74966
Published in the Poteau Daily News on June 4, 2014(25093)LPXLP

*** * * INVOICE * * ***

Date JUNE 4, 2014

PDN Publication No. 25093
Court Case No. PUBLIC NOTICE
Plaintiff PVIA ENVIRONMENTAL ASSESSMENT
Defendant _____
Attorney _____

10 Lines@ .70 = 7.00
68 Words@ .15 = 10.20
DISPLAY
_____ Inches@ _____ = _____

Typing Fee ($10.00 per page) –
CASH LEGAL TOTAL 17.20

PLEASE DETACH AND RETURN ONE STUB WITH PAYMENT...KEEP ONE FOR YOUR RECORDS

Poteau DAILY NEWS
SERVING LEFLORE COUNTY
P.O. Box 1237 • 804 N. Broadway • Poteau, Oklahoma
(918) 647-3188 • FAX 918-647-8198

IN ACCOUNT WITH

Hamilton, Warren & Bovos
P.O. Box 660
Poteau, OK 74953

APPENDIX G. Spill Prevention, Control, and Contingency Plan

Federal Water Pollution Control Act (33 U.S.C. Secs. 1251 et. Seq as amended to date) requires implementation of a spill response and prevention plan. Preventing spills of materials is a significant component of complying with these regulations. However, even with the best prevention efforts, spills may still occur. When they do, it is up to contracted personnel to respond quickly and effectively to cleanup the spilled material or notify someone who can. The plan should be kept in a central location that is easily accessible for employees.

Plan Implementation Date: August 1, 2014

Facility's Responsible Person(s) in charge of spill response planning, implementation and maintenance of this Plan:
Name Phone #'s

Tadd Barrow (HAB Aquatic Solutions) 402-430-6813

John Holz (HAB Aquatic Solutions) 402-430-0352

RESPONSIBILITIES

- The **Job Site Responsible Person** has primary responsibility for coordinating the response to emergencies, including chemical spills.

- **Supervisors** should ensure that employees are familiar with these procedures and receive any necessary training.

- **All employees** should follow these procedures in the event of a chemical spill.

EMERGENCY CONTACT NUMBERS

• Outside emergency services (police, fire department, ambulance service): 911

• Hospital: [Eastern Oklahoma Medical Center: 918-647-8635

• Facility Responsible Person: Tadd Barrow Phone #: 402-430-6813

• Project Oversight Consultant (Steve Patterson, Bio x Design): 918-839-7084

CLEAN-UP PROCEDURES
Spilled chemicals should be effectively and quickly contained and cleaned up. Employees should clean up spills themselves ***only if properly trained and protected.*** Employees who are not trained in spill cleanup procedures should report the spill to the Responsible Person(s) listed above, warn other employees, and leave the area.

The following general guidelines should be followed for evacuation, spill control, notification of proper authorities, and general emergency procedures in the event of a chemical incident in which there is potential for a significant release of hazardous materials.

1. Evacuation
Persons in the immediate vicinity of a spill (including the public) will be *immediately evacuated* from the area by trained HAB employees (except for employees with training in spill response in circumstances described below).

2. Spill Control Techniques
Once a spill has occurred, the employee needs to decide whether the spill is small enough to handle without outside assistance. Only employees with training in spill response should attempt to contain or clean up a spill. These employees will include Tadd Barrow, John Holz and Bernie Ruppert.

NOTE: If you are cleaning up a spill yourself, make sure you are aware of the hazards associated with the materials spilled, have adequate ventilation, and proper personal protective equipment. Treat all residual chemical and cleanup materials as hazardous waste.
Spill control equipment should be located wherever significant quantities of hazardous materials are received or stored.

3. Spill Response and Cleanup
Response and cleanup procedures will vary depending on the size of the spill.

Training: Employees will be trained to respond to an incidental spill by use of the personal protective procedures in place. Training will focus on stopping and minimization of the spill to protect the environment.

Safety: Safety procedures vary with the material spilled, the location of the spill and the amount spilled. In general, stay out of the spill zone and avoid contact with all chemicals. People involved in containment and clean up must wear proper safety apparel as required by area safety rules for the material spilled. While it is important to stop and contain spills, it is more important to prevent injuries.

Equipment Available to Contain Spills: Most potential spills would be contained in the 1,750 gallon spill guards. Any spills outside of the spill guards will be hosed down with lake water immediately. HAB Aquatic Solutions will maintain pumps and hoses dedicated to wash down on site at all times. Spills are generally handled by internal personnel and usually do not require an emergency response by police or fire department HAZMAT teams.

- Quickly control the spill by stopping or securing the spill source. This could be as simple as uprighting a container and using water to rinse down area of spill. Wear gloves and protective clothing, if necessary.

REPORTING SPILLS

All chemical spills, regardless of size, should be reported as soon as possible to the Job Site Responsible Person. The Responsible Person will determine whether the spill has the potential to affect the environment outside of the job site and must be reported to 911or the National Response Center at 800-424-8802. Examples of spills that could affect the outside environment include spills that are accompanied by fire or explosion and spills that could reach nearby water bodies.

All spills must also be reported to Mr. Charles Schrodt (918-799-5843) with the US Army Corps of Engineers.

SPILLS (MATERIALS) THAT REQUIRE SPECIAL CLEANUP

Describe any materials used your facility that in require special materials and procedures for cleanup procedures beyond those listed above. Provide details regarding hazards associated with these (See Attachment F for Liquid Aluminum Sulfate MSDS sheet).

Material Amount	**(avg/max)**	**Location(s)**
Aluminum Sulfate	10,000 gallons	On shore storage tanks
Liquid Sodium Aluminate	5,000 gallons	On shore storage tanks

Material	**Maximum Volume to be cleaned**	**Disposal Method/Location**
Aluminum Sulfate	4,200 gallons (approx. volume of a delivery tanker)	Rinse into lake
Liquid Sodium Aluminate	4,000 gallons	Rinse into lake

EMPLOYEE TRAINING LOG

Identify the spill response training provided to each employee or contractor who is charged with responsibility for spill response:

EMPLOYEE NAME	INSTRUCTORS NAME	DATE OF TRAINING

Personal Protective Equipment Procedure

The utilization of personal protective equipment (PPE) is essential in providing a safe working environment at HAB Aquatic Solutions. In determining the type and extent of protective equipment required to work safely among chemical hazards associated with job duties, the management of HAB Aquatic Solutions shall conduct an assessment of the workplace prior to the start of the job.

It is the policy of HAB Aquatic Solutions, that protective equipment, including PPE for eyes, face, head, extremities and protective clothing shall be provided, used and mainained in a sanitary and reliable condition whenever it may be necessary by reasons of potential chemical hazards. Employees required to use PPE (Personal Protective Equipment) must be trained. The topics of PPE training shall include but are not limited to: when and what PPE is necessary, how to properly wear and adjust PPE, the proper care, maintenance and useful disposal of PPE.

Protective clothing and equipment includes chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact and chemical protective safety goggles.

Safety Policy

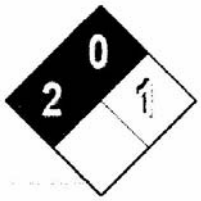
HAB Aquatic Solutions, LLC is committed to providing a safe work environment for all employees and contractors and conducting all operations in a safe and healthful manner. The health and safety of every employee and contractor is a fundamental consideration in every business decision and plan. HAB Aquatic Solutions, LLC is committed to protect the public, company property, and our customers from incidents that could cause harm or economic loss due to our operations.

Our goal is to prevent the occurrence of all work-related injuries, illnesses and property losses. The HAB Aquatic Solutions, LLC health and safety program contains specific requirements which are based on the following principles in providing and effective safety program:

- Managers and Supervisors are responsible for the safety of operations under their control and will be evaluated accordingly.
- HAB Aquatic Solutions, LLC strives to provide a safe work environment by eliminating or controlling hazards with appropriately designed equipment and facilities, safe operating procedures, and necessary personal protective equipment.
- All applicable safety regulations, codes and accepted work practices will be followed. Specific rules and procedures will be established and followed at every location.
- Each employee and contractor will be informed of hazards associated with his or her job and trained in safe work procedures, the use of personal protective equipment, and other means intended to provide personal protection.
- All employees and contractors are responsible for performing their job activities in a safe and reasonable manner and in accordance with safety related instructions given to them, and the training they have received. Failure to comply with these rules will result in disciplinary actions up to, and including termination.
- All unsafe acts, conditions and incidents must be reported to the site manager for investigation and prompt correction.
- All employees and contractors are expected to support and participate in the HAB Aquatic Solutions, LLC Health and Safety Program.

MATERIAL SAFETY DATA SHEET

CHEMTRADE

NFPA	HMIS	PPE	Symbol(s)
			 Regulated

Current Issue Date: February 18, 2014	Revision Number: 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name:	**Liquid Alum**
Other/Generic Names:	Aluminum Sulfate, Alum, Alun 48, Aluminum Sulphate 48%
Recommended Use:	Water treatment. Various industrial uses.
Manufacturer:	Chemtrade Solutions LLC 90 East Halsey Road Parsippany, NJ 07054 Chemtrade Chemicals Canada Ltd. 90 East Halsey Road Parsippany, NJ 07054
For More Information:	Customer Service US ONLY: 800-631-8050 (Monday – Friday 9:00AM – 4:30PM) Customer Service CANADA ONLY: 866-543-3896 (Monday – Friday 9:00AM – 4:30PM)
Emergency Telephone Number:	US ONLY - CALL CHEMTREC: 800-424-9300 (24 Hours/Day, 7 Days/Week) OUTSIDE THE US – CALL CHEMTREC: 1-703-527-3887 (24 Hours/Day, 7 Days/Week) CANADA ONLY - CALL CANUTEC: 613-996-6666 (24 Hours/Day, 7 Days/Week)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: A clear, light green or amber liquid with a negligible odor. Can irritate the skin and eyes. May be harmful if swallowed. Not flammable, but may release toxic vapors if decomposed in a fire.

OSHA Status:	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200)
Potential Health Affects	
Skin:	May cause skin irritation.
Eyes:	May strongly irritate or burn the eyes.
Inhalation:	Product mists may cause irritation to the respiratory tract.
Ingestion:	May irritate the gastrointestinal tract. Concentrated solutions may cause burns to the digestive tract.
Delayed Effects:	None known.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Component	CAS No	Weight %
Aluminum sulfate	10043-01-3	~48.5 (dry basis)
Water	7732-18-5	Balance

4. FIRST AID MEASURES

Eye Contact	Immediately flush eyes with water for at least 15 minutes. Get medical attention if irritation persists.
Skin Contact	Flush with plenty of water, removing contaminated clothing. If irritation develops, get medical attention.
Inhalation	Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get prompt medical attention.
Ingestion	Do not induce vomiting. Immediately give large quantities of water. Get medical attention immediately.
Notes to Physician	Treat symptomatically

5. FIRE-FIGHTING MEASURES

Flammable Properties

FLASH POINT:	Not Flammable
FLASH POINT METHOD:	Not Applicable
AUTOIGNITION TEMPERATURE:	Not Applicable
UPPER FLAME LIMIT (VOLUME % IN AIR):	Not Applicable
LOWER FLAME LIMIT (VOLUME % IN AIR):	Not Applicable
FLAME PROPAGATION RATE (SOLIDS):	Not Applicable
OSHA FLAMMABILITY CLASS:	Not Applicable
SUITABLE EXTINGUISHING MEDIA:	Water spray, foam, carbon dioxide or dry chemical
UNSUITABLE EXTINGUISHING MEDIA:	No information available

Explosion Limits

Hazardous Combustion Products	No information available
Impact sensitivity	No information available
Sensitivity to static discharge	No information available
Specific Hazards Arising from the Chemical	Keep product and empty container away from heat and sources of ignition.
Protective Equipment and Precautions for Firefighters	Wear self-contained breathing apparatus (SCBA) and full protective equipment. Use water spray to keep containers cool.

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE	Dilute small spills or leaks cautiously with plenty of water. Neutralize any further residue with alkali such as soda ash, lime or limestone. Adequate ventilation is required if soda ash or limestone is used, because of the consequent release of carbon dioxide gas. Large spills should be diked up with soda ash and neutralized as above. Collect liquid and/or residue and dispose of in accordance with applicable regulations.

7. HANDLING AND STORAGE

Handling	Keep container tightly closed when not in use. Avoid contact with skin, eyes, and clothing. Avoid breathing vapors or mists. Remove contaminated clothing and wash thoroughly after handling.
Storage	Keep storage container tightly closed. Store in a cool, dry, well-ventilated area or cabinet. Isolate from incompatible substances. Store and ship in plastic or rubber-lined containers.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Component	ACGIH TLV	OSHA PEL	Ontario TWAEV	Mexico OEL (TWA)	NIOSH IDLH
Aluminum sulfate	2 mg/m^3	2 mg/m^3		TWA: 2 mg/m^3	

Engineering Measures	Use local exhaust to keep airborne concentrations below the permissible exposure limits.

Personal Protective Equipment	
Eye/Face Protection	Wear hard hard (or other head covering) and chemical safety goggles. Do not wear contact lenses.
Skin Protection	Wear appropriate personal protective clothing to prevent skin contact. If prolonged or repeated contact is anticipated, all clothing should be impervious to liquid.
Respiratory Protection	A respiratory protection program that meets OSHA 1910.134 and ANSI Z88.2 or applicable federal/provincial requirements must be followed whenever workplace conditions warrant respirator use. NIOSH's "Respirator Decision Logic" may be useful in determining the suitability of various types of respirators.
General Hygiene Considerations	To identify additional Personal Protective Equipment (PPE) requirements, it is recommended that a hazard assessment in accordance with the OSHA PPE Standard (29CFR 1910.132) be conducted before using this product. Eyewash and safety showers are recommended.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	Clear, light green or amber liquid
Color	Clear, light green or amber
Chemical Formula	~48.5% $Al_2(SO_4)_3$ $14H_2O$ in water
Odor	None
Odor Threshold	No information available
Physical State	Liquid
pH	2.0-2.4
Flash Point	Not flammable
Autoignition Temperature	Not applicable
Boiling Point/Range	101 °C / 214 °F
Melting Point/Range	-16°C /4°F
Flammability Limits in Air	No information available
Explosive Properties	No information available
Oxidizing Properties	No information available
Evaporation Rate	Not determined
Vapor Pressure	Not applicable
Vapor Density	Not applicable
Specific Gravity	1.335
Partition Coefficient (n-octano/water)	No information available
Viscosity	No information available
Molecular Weight	594 for $Al_2(SO_4)_3$ $14H_2O$
Water Solubility	100%
VOC Content (%)	0

10. STABILITY AND REACTIVITY

Chemical Stability	Normally stable. If evaporated to dryness, residue should not be exposed to elevated temperatures (above 760°C), as this will yield toxic and corrosive gases.
Incompatible Products	Alkalis and water reactive materials such as oleum: causes exothermic reactions.
Hazardous Decomposition Products	At elevated temperatures, sulfur oxides may be formed. These are toxic and corrosive and are oxidizers. Sulfur trioxide is also a fire hazard. The loss of these gases leaves a caustic residue.
Possibility of Hazardous Reactions	Will not occur.

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Aluminum sulfate	1930 mg/kg (rat) 6207 mg/kg (mouse		

Irritation No information available
Corrosivity No information available
Sensitization No information available

Chronic Toxicity
Carcinogenicity There are no known carcinogenic chemicals in this product.
Mutagenic Effects No information available
Reproductive Effects No information available
Developmental Effects No information available
Teratogenicty No information available
Target Organ Effects No information available
Other Adverse Effects No information available
Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity
Contains no substances known to be hazardous to the environment or not degradable in waste water treatment plants.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Aluminum sulfate		LC50 = 100 mg/L Carassius auratus 96 h LC50 = 37 mg/L Gambusia affinis 96 h		EC50 = 136 mg/L 15 min

Persistence and Degradability No information available
Bioaccumulation No information available
Mobility in Environmental Media No information available
Other adverse affects **Aluminum sulfate component:**
14 ppm/36 hr/fundulus/fatal/fresh water; 240 ppm/48 hr/mosquito fish/TLm/water type not specified; TLm Mosquito fish, 235 ppm, 96 hours; LC50 Largemouth bass, 250 ppm, 96 hours

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Dispose of waste in accordance with all federal, state, and local regulations.
Contaminated Packaging Empty containers should be taken for local recycling, recovery or waste disposal.

14. TRANSPORT INFORMATION

DOT Regulated
Proper Shipping Name Corrosive liquid, acidic, inorganic, n.o.s. (contains aluminum sulfate)
Hazard Class 8
UN-No UN3264
Packing Group PGIII

TDG Regulated
Hazard Class 8
UN-No UN3264
Packing Group PGIII

15. REGULATORY INFORMATION

International Inventories

TSCA	Yes
DSL	Yes
ELINCS	No
EINECS	Yes
ENCS	Yes
CHIINA	Yes
KECL	Yes
PICCS	Yes
AICS	Yes

U.S. Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product contains the following chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372: None

SARA 311/312 Hazardous Categorization

Chronic Health Hazard	No
Acute Health Hazard	Yes
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA – Reportable Quantities	CWA – Toxic Pollutants	CWA – Priority Pollutants	CWA – Hazardous Substances
Aluminum sulfate	5000 lb			X

CERCLA

Component	CERCLA RQ (lb)	SARA TPQ (lb)
Aluminum sulfate	5000 lb	

U.S. State Regulations

California Proposition 65

This product does not contain any Proposition 65 chemicals.

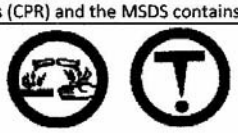
State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Aluminum sulfate	X	X	X		

Other International Regulations

Mexico	No information available
Canada	This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
E Corrosive material
D2B Toxic materials



16. OTHER INFORMATION

Current Issue Date:	February 18, 2014
Previous Issue Date:	November 30, 2012
Revision Summary:	New Chemtrade Template

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End of MSDS

Sodium aluminate

MSDS No. 132
4/30/2013

Safety Data Sheet

Section 1 - Chemical Product and Company Identification

Product/Chemical Name:	Sodium aluminate, solution
Chemical Family:	Inorganic salt
General Use:	Water Treatment Chemical
Emergency Contact:	800-282-5322

Manufacturer:
USALCO, LLC
2601 Cannery Ave
Baltimore, MD 21226
Phone 410-354-0100 (7:00am 5:00pm)
FAX 410-354-1021

HMIS	
H	3
F	0
R	0
PPE†	

†Sec. 11

Section 2 - Composition / Information on Ingredients

Ingredient Name	CAS Number	% wt
Sodium aluminate	1302-42-7	31-45
Sodium hydroxide	1310-73-2	3-9
Water	7732-18-5	52-66

	OSHA PEL		ACGIH TLV		NIOSH REL		NIOSH
Ingredient	TWA	STEL	TWA	STEL	TWA	STEL	IDLH
Sodium aluminate	none estab.	2 mg/m^3 *as aluminum*	none estab.	2 mg/m^3 *as aluminum*	none estab.	2 mg/m^3 *as aluminum*	none estab.

Section 3 - Emergency Overview

Description: Viscous colorless to amber liquid with no or very mild odor. Not flammable. Not volatile
Hazards: Corrosive; pH 14. Causes burns. Harmful by contact with skin and if swallowed. Risk of serious damage to eyes. Not flammable, but may release toxic vapors if decomposed in a fire.

Section 4 - First Aid Procedures

Overview:	Direct contact can cause corrosive burns and permanent injury.
Inhalation:	(mist or spray) Remove from exposure; seek medical treatment if any symptoms occur.
Eye Contact:	Immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention.
Skin Contact:	Remove contaminated clothing and flush contact area with large amounts of water for at least 15 minutes. Seek medical attention if any symptoms are present.
Ingestion:	Do not induce vomiting, drink milk or water and immediately seek medical attention.

After first aid, get appropriate in-plant, paramedic, or community medical support.

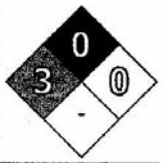
Section 5 - Physical and Chemical Properties

Physical State:	Liquid	Water Solubility:	Complete
Characteristics	Clear to amber liquid	Melting/Freezing Point:	0□to 12□F (-18□to -11□C)
Odor:	Odorless	Boiling Point:	220-240□F (104-116 □C)
Vapor Pressure:	Not applicable	% Volatile:	0.0
Specific Gravity (H2O=1, at 4 °C):	1.44-1.56	Viscosity:	>2000 cps. @ 20□F 200-800 cps. @ 68□F
Vapor Density (Air=1):	Not applicable	pH:	14.0

Section 6 - Fire-Fighting Measures

Flash Point:	NA
Burning Rate:	NA
Autoignition Temperature:	NA
LEL:	NA
UEL:	NA
Flammability:	Not flammable
Extinguishing Media:	NA
Unusual Fire or Explosion Hazards:	None
Hazardous Combustion Products:	None
Fire-Fighting Instructions:	Do not release runoff from fire control methods to sewers or waterways.

NFPA



Section 7 - Stability and Reactivity

Stability:	Will generate heat on contact with water and will hydrolyze to sodium hydroxide and aluminum hydroxide.
Polymerization:	Hazardous polymerization does not occur.
Chemical Incompatibilities:	Incompatible with acids.
Hazardous Decomposition Products:	None.

Section 8 - Health Hazard Information

Primary Entry Routes:	Ingestion, contact
Target Organs:	N/A
Acute Effects:	Chemical (caustic) burns
Eye:	Chemical burn
Skin:	Chemical burn
Ingestion:	Burns, nausea, vomiting, diarrhea, stomach pain
Carcinogenicity:	IARC, NTP, and OSHA do not list Sodium aluminate as a carcinogen
Medical Conditions Aggravated by Long-Term Exposure:	Skin rashes
Chronic Effects:	IARC, NTP, and OSHA do not list

Section 9 - Spill, Leak, and Disposal Procedures

Spill /Leak Procedures:	Wear appropriate personal protective equipment. Do not come in contact with spilled material.
Small Spills:	Neutralize with sodium bicarbonate or weak acid solution.
Large Spills:	Dike and transfer spill to container for reuse and reprocessing. Can flush contaminated areas with large amounts of water and direct rinsing to chemical sewer or collect for treatment.
Cleanup:	Recover liquid when possible. Wash impacted areas with water to remove residues.
Regulatory Requirements:	Waste Sodium aluminate is not a RCRA listed hazardous waste. Waste material can be a RCRA Characteristic Waste (D002) if not neutralized.
Disposal:	Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, State, and local regulations.
Container Cleaning and Disposal:	Rinse with water, dispose of containers in accordance with State and local regulations.

Section 10 - Regulatory Information

EPA Regulations:	
RCRA Hazardous Waste Classification:	D002 (Corrosive) if the pH of the waste is ≥ 12.5
CERCLA Hazardous Substance (40 CFR 302.4):	Not listed CWA, Sec. 311 (b)(4)
CERCLA Reportable Quantity (RQ):	Not listed
SARA 311/312 Codes:	Immediate (acute) health hazard
SARA Toxic Chemical (40 CFR 372.65):	Not listed
SARA EHS (Extremely Hazardous Substance) (40 CFR 355):	Not listed
OSHA Regulations:	
Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-1-A):	Not listed
OSHA Specifically Regulated Substance (29CFR 1910.):	Not listed
State Regulations:	USALCO, LLC has not determined regulatory requirements for individual states.

Section 11 - Exposure Controls / Personal Protection

Ventilation:	Under normal conditions, Sodium aluminate solution will not generate mists or vapors. No special ventilation is recommended.
Respiratory Protection:	Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. For emergency or non-routine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres. If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas.
Protective Clothing/Equipment:	Wear chemically protective gloves, boots, aprons, and gauntlets to prevent prolonged or repeated skin contact. Wear protective chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Contact lenses are not eye protective devices. Appropriate eye protection must be worn instead of, or in conjunction with contact lenses.
Safety Stations:	Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work area.
Contaminated Equipment:	Separate contaminated work clothes from street clothes. Launder before reuse. Remove this material from your shoes and clean personal protective equipment.
Comments:	Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 12 - Special Precautions and Comments

Handling Precautions:	Ensure that all containers are labeled in accordance with OSHA regulations. Avoid skin and eye contact. Wear appropriate protective clothing. Material is slippery; use caution if walking on spilled material.
Storage Requirements:	Keep containers tightly closed when not in use.

Section 13 - DOT Transportation Data (49 CFR 172.101)

Proper Shipping Name:	UN1819, Sodium aluminate, solution, 8, II	Packaging Authorizations	
		a) Exceptions:	173.154
		b) Non-bulk Packaging:	173.203
Shipping Symbols:	-	c) Bulk Packaging:	173.241
Hazard Class:	8	Quantity Limitations	
DOT No.:	UN1819	a) Passenger, Aircraft, or Railcar:	1 L
Packing Group:	II	b) Cargo Aircraft Only:	30 L
Label:	Corrosive	Vessel Stowage Requirements	
Special Provisions (172.102):	IB3,T4,TP1	a) Location:	A
2008 Emergency Response Guidebook:	Guide 154	b) Other:	52

Prepared By: Craig T. Owen
Effective Date: 2/1/2012 Supercedes: NA

Disclaimer: The information presented herein is believed to be accurate and reliable, but is given without guaranty or warranty, expressed or implied. The user should not assume that all safety measures are indicated so that other measures may not be required. The user is responsible for assuring that the product and equipment are used in a safe manner that complies with all appropriate legal standards and regulations.