Kansas State University

Natural Resources and Environmental Science

The Farmers Elevator Company Preliminary Investigation Report

Former Nitrogen Fertilizer Distribution Center and Current Grain Elevator Company

Sylvan Grove, Kansas

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December 4, 2011

This is a summary of finding for the former Farmers Elevator Company Site, located at 129 South Main Street, Sylvan Grove, Kansas.

Introduction

High concentrations of nitrate in groundwater are a common occurrence Kansas. We have executed a Work Plan to produce this Preliminary Investigation Report for the Sylvan, Grove Farmers Elevator Company Site. We have included the Work Plan in the appendix. This report will outline the activities onsite and include a summary of findings.

Historical Evaluation and Site Description

The Site is located at 129 S Main St. Sylvan Grove, KS 67481. The town of Sylvan, Grove is located in the west half of Section 13, Township 12 South, Range 10 West and the east half of Section 14, Township 12 South, Range 10 West. The site has been used as a grain storage facility for over a century. In the past the site was used to sell dry and liquid fertilizer. Currently, the site is used for grain storage, and is under the ownership of Glenn P. Ringler and Gregory J. Ringler.

Citation of Work Plan

When the current owners purchased the site they conducted a Phase 1 Environmental Assessment. Subsequently, KDHE has performed a Site Reconnaissance & Evaluation on 05/01/2008. During their investigation they reported nitrate levels ranging from 2.5-35 mg/L in the groundwater.

The Work Plan outlines the procedures used to drill four proposed, flush mount wells, MW-1 through MW-4 (map 1). The wells were drilled with an air rotary drilling rig. Well MW1 was

drilled to depth of 30 feet encountering water at depth of 23.11ft, MW2 at a depth of 33ft with water at 22.85, MW3 at a depth of 30ft with water at 23.8 and MW4 at a depth of 35 with water at 24.25ft. The well samples were collected using the purge-and-bail method. Approximately eight liters was collected from each well for analysis. Each sample was analyzed twice as to increase the accuracy of the results. On Friday afternoon all samples were taken and stored using methods outlined in the work plan to protect the quality of the sample. Samples for nitrate and ammonium analysis from each well were sent to the KSU Soil Labs, and were received on Monday afternoon. Samples for nitrate, ammonium, and atrazine analysis from MW-1 and MW-3 were sent to Continental Analytical Services via FedEx, and received in Salina, KS on Tuesday morning Samples for atrazine analysis were also sent to KSU Biological and Agricultural Engineering Lab, and were received by Phil Barnes.

For more information on the site history, description, and the proposed Work Plan refer to the Work Plan in the appendix.

Field Activities and Analysis

i. Distribution of wells

Well locations were originally planned based on an expected flow direction of SW and placed down the gradient from potential sources. For more information of well location selection see map 1. When we arrived at the site it was clear that adjustments had to be made to well locations to accommodate for obstacles such as underground utility lines. The final

monitoring well locations along with original proposed locations can be seen in map 1 and coordinates can be found in Table1.

ii. General Groundwater properties

General groundwater properties were collected using a hydo lab on site. The properties collected were: pH, oxidation-reduction potential (mV), specific conductivity (μS/cm), temperature (□C), Total Dissolved Solids (mg/L), and level of dissolved oxygen (mg/L). A summary of these values can be found in the appendix on table 3.

iii. Results of sample analysis

Laboratory results from the KSU Labs for nitrate and concentrations can be seen in Table 2 and atrazine concentrations in Table 4. Laboratory results from Continental Analytical Laboratories can be found in Table 4. Laboratory results from the two labs are consistent. Atrazine concentrations were not found above the limit of quantification and therefore will not be discussed in depth. Nitrate levels in wells 1,3 and 4 were found to be above the Environmental protection agency limit of 10 parts per million. NO3 and NH4 concentrations can be seen plotted on maps 3 and 4.

iv. Lithological Log

A Lithological log, derived from well MW-3 can be found in the appendix. This log shows the soil and geology of the area, as well as the static depth of water.

viii. Groundwater flow model (3 point problem)

Groundwater flow direction was determined by taking the depth to groundwater for 3 wells and subtracting it from the relative elevation of the well head (calculated using the formula **Well elevation= 100+((survey height of benchmark)-(survey height of well head)) (**Table 6**).** Two sets of three wells were used in two different 3 point problems and compared. Wells 1,2 and 4 yielded a flow direction of SSW and wells 2,3 and 4 a flow direction of SW (Maps 1 and 2). The flow direction calculated from wells 2, 3 and 4 will be used for further discussion. This decision was made due to disagreement between the two flow maps, when wells 1, 2 and 4 were used the location of well 3 was predicted by the map to have a lower water level than it actually did. This is indicative of an unconstraint groundwater elevation change between wells 1 and 4.

ix. Hydrological conductivity

In order to determine the hydrological conductivity we used a slug test wherein the water level in the well was raised and the time it took to drop back down was measured. For calculations see appendix. The recharge in linear feet was found to be approximately 47 feet per day. With a 4in diameter well this translates to 96 gallons per day which does not meet the 150 gallon per day requirements of KDHE to be considered a potable water source.

Potential Hazards and Receptors

i. Nitrates

Nitrate, which is a common nitrogenous compound created during the natural processes of the nitrogen cycle can have ill effects on both humans and the environment. Anthropogenic sources have greatly increased nitrate concentration, particularly in groundwater. The largest

anthropogenic sources of nitrates are septic tanks, application of nitrogen-rich fertilizers to turf grass and agricultural processes. Rural and private wells are of particularly susceptible of accumulating dangerous levels of nitrates. Methemoglobinemia, or blue baby syndrome, is positively correlated to increased levels of nitrate in drinking water. Blue baby syndrome occurs when infants ingest excess nitrates, which reduces the oxygen-carrying capacity of blood and starves the body of oxygen. This causes the skin to turn various shades of blue, gray or lavender. The level Maximum Contaminant Level (MCL) of nitrates in drinking water is measured by the occurrence that methemoglobinemia may arise in infants less than 6 months of age. The average human ingests approximately 20-70 mg of naturally occurring nitrate-nitrogen per day through foods such as lettuce, beets, celery and spinach. Currently the EPA's MCL for nitrates in drinking water is 10 mg L-1 (equivalent of 10 ppm).

Excessive or long-term consumption of nitrates is believed by some experts to increase the risk of certain types of cancer. Those with heart or lung disease, certain inherited enzyme defects, or cancer may be more sensitive to the toxic effects of nitrate than others. Women, especially who are pregnant or nursing, should exercise extreme caution when consuming water that may have excess levels of nitrogen. Nitrates consumed by mothers who are pregnant or nursing can be passed to offspring during development or through breast milk. While there are no confirmed cases of blue baby syndrome associated with nitrate in breast milk, there has been some evidence suggesting that women who drink nitrate-contaminated water during pregnancy are more likely to have babies with birth defects.

ii. Atrazine

Studies have shown that atrazine contamination has led to human birth defects in humans and to hermaphroditic, demasculinized frogs. Live births conceived in months when surface water agrichemicals, such as atrazine, are highest were investigated in hopes of correlating a greater risk for birth defects. Concentrations of agrichemicals were discovered to be the highest from April-July. The likelihood of total birth defects and eleven of twenty-two birth defect subcategories also increased between April and July (Gary et.al., 1996). The results showed a significant correlation between agrichemicals and birth defects. Also, the effects of atrazine on the sexual development of African clawed frogs were examined in a study by Alran et.al. in 2001. This study was accomplished through larvae immersion to different concentrations of atrazine solution. Increased atrazine exposure led to hermaphroditism and demasculinized the larynges of exposed males. The researches hypothesize that atrazine induces aromatase which promotes the conversion of testosterone to estrogen.

In conclusion, the atrazine contamination will not hold potential hazards to human as long as the water doesn't penetrate into drinking water supplies. The public should be aware of potential hazards to amphibian life in the area, which could suffer the consequences of atrazine contaminated water if any was allowed to the surface where frogs or like creatures may reside.

iii. Discussion of Sylvan Grove Hazards.

With respect to atrazine the risks for the sylvan grove site are minimal atrazine was not found above the limit of quantitation in either of the wells tested (Table 4). It should be noted however that the original characterization of the site by KDHE did find atrazine in trace amounts and therefore parties involved should be cognizant of its hazards. Nitrate however was found in concentrations above 10 ppm in 3 wells, 10 ppm is the EPA standard for nitrate. It is interesting

to note that the north eastern most well had one of the highest NO3 concentrations. Considering a groundwater flow direction of SW, calculated using a 3 point problem discussed later, it is unlikely that this particular contamination is from the sylvan grove site. It should also be noted however the two other above 10 ppm readings are directly SW of bins used for dry fertilizer storage on site in the past. For more discussion on the potential sources of contamination see the NRES soils group preliminary report. Due to the potential hazards of nitrate the major concerns for the site would be if the groundwater nitrate were in end up in surface water supplies or drinking water. Based on our hydrological conductivity test we found the potential yield of the well to be approximately 96 gal per day. KDHE considers a yield below 150 gal per day to be non-potable so drinking water concerns can be considered as minimal. The flow direction of calculated from the 3 point problem indicates a south westerly flow. Public water wells as seen in map 5 are directly west of the site approx. 1/2 mile. The flow direction as described by the 3 point problem does not show flow going toward the public wells. Private wells may be of more concern especially if used for watering livestock which are also susceptible to nitrate poisoning, however we do not have any data on private wells in the area at this time.

Conclusions and Recommendations

As previously mentioned the groundwater yield at the site is insufficient based upon the KDHE criterion for potable drinking water and the direction of flow does not indicate the water will contaminate local public wells. Therefore the immediate danger to the public is minimal when it comes to drinking water. The high levels of nitrate at the site however do pose certain environmental concerns which should be considered. The potential of private well contamination may still exist. If private wells are found or if other concerns arise we suggest

education of the citizens of Sylvan Grove about the potential environmental and health concerns. Along with education we believe it is important to continue the investigation of the site. We suggest the installation of another well down-gradient to access the extent of movement of the contamination. Lastly, the review of several remediation techniques including pump and treat, bioremediation, or pumping and application to farmland, is recommended.

Table 1: Well Locations

	Latitude		Longitude	
Well ID	Deg	d. min	Deg	d. min
MW1	39	0.582	-98	23.466
MW2	39	0.589	-98	23.63
MW3	39	0.559	-98	23.627
MW4	39	0.553	-98	23.649

Table 2: KSU lab results

Sample ID	NH_4-N ppm	NO_3-N ppm
MW-1	0.05	45.75
MW-2	0.03	7.13
MW-3	0.01	19.4
MW-4	0.06	45.05
Sump	31.69	3.62

Table 3: General groundwater properties

Well	pH	ORP(mV)	Sp. Cond. (µS/cm)	Temp. (°C)	TDS (mg/L)	LDO (mg/L)
MW-1	6.54	414	1536	16.44	0.98	7.71
MW-2	6.44	420	172	17.33	1.1	9.2
MW-3	6.48	404	1930.6	18.98	1.23	8.11
MW-4	6.3	418	2059.3	16.33	1.32	8.19

Table 4: Continental Labs Results

Sample	NH_4-N ppm	NO_3-N ppm	Atrazine
MW1	ND	45	ND
MW4	ND	37	ND

Table 5: KSU BAE lab results for atrazine

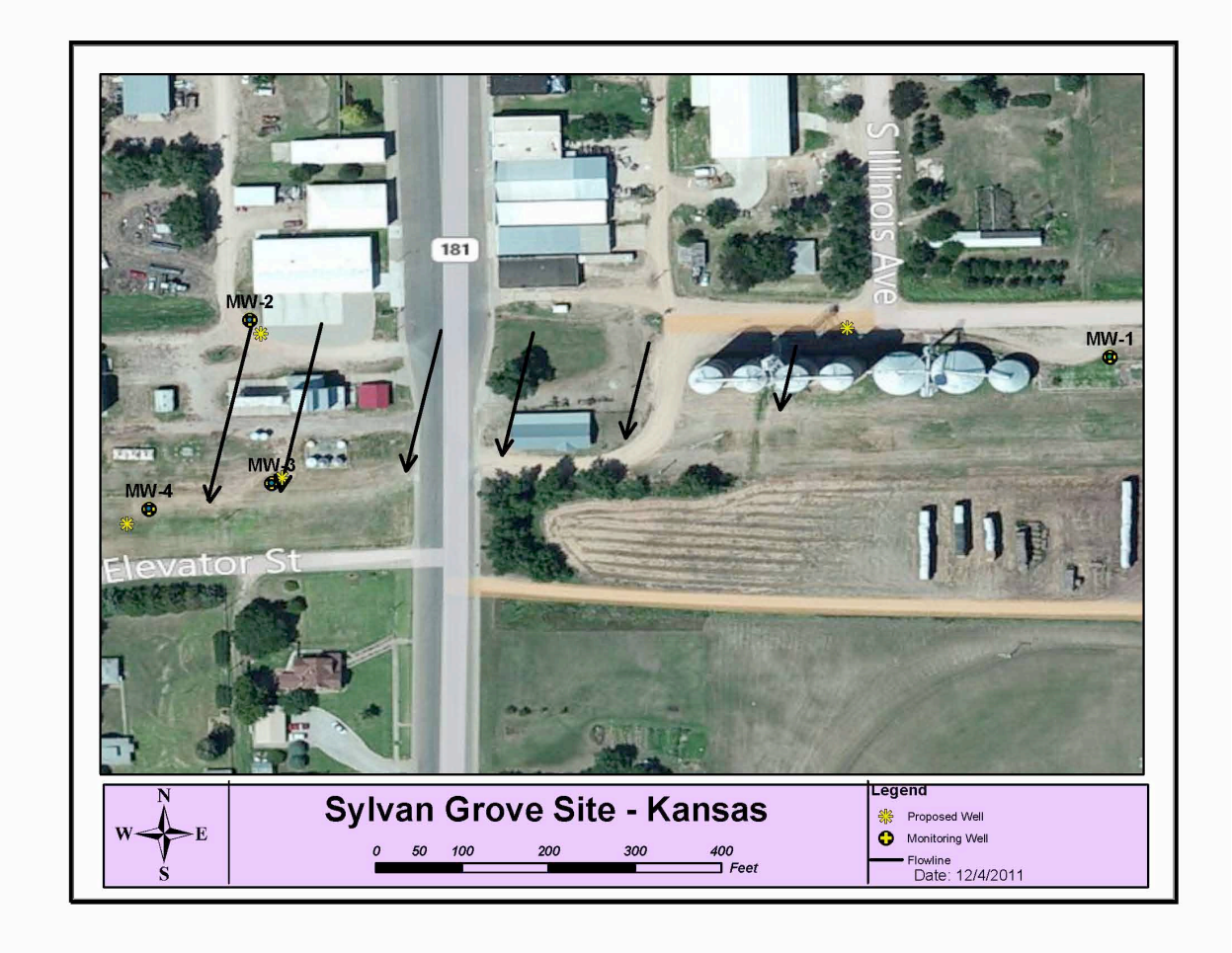
Location	Date Collected	Time Collected	Atrazine Concentration (µg/l)
MW1	11-11-11	2 PM	No Detect
MW2	11-11-11	11:45 AM	0.18
MW3	11-11-11	12:30 AM	0.06
MW4	11-11-11	11:30 AM	No Detect
Sump	11-10-11	None	7.0
Duplicate			0.09
Blank			No Detect

Table 6: Survey Results

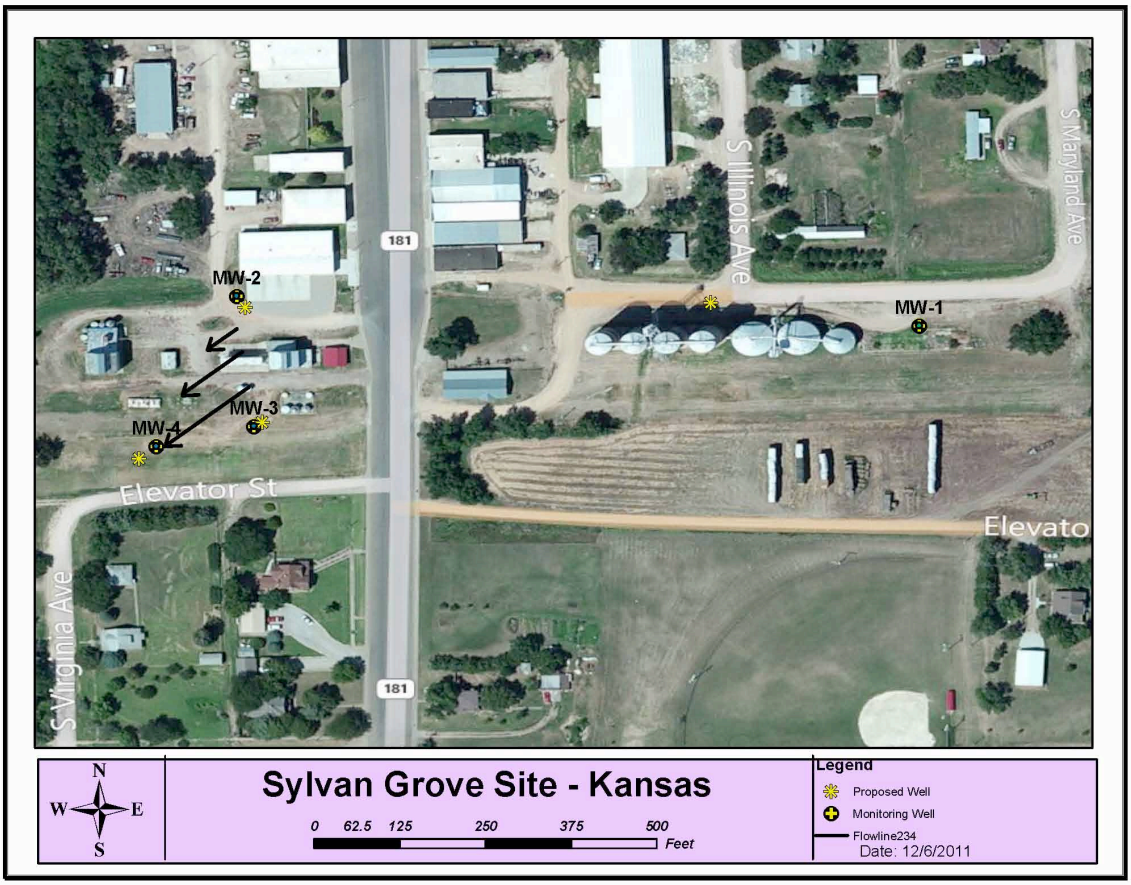
Well	Survey	Head Elevation	Depth to GW	GW Elevation
MW1	2.44	102.96	23.11	79.85
MW2	5.3	100.1	22.85	77.25
MW3	5.59	99.81	23.8	76.01
MW4	6.53	98.87	24.75	74.12
Central pt	5.4	100		

*ppm - parts per millions

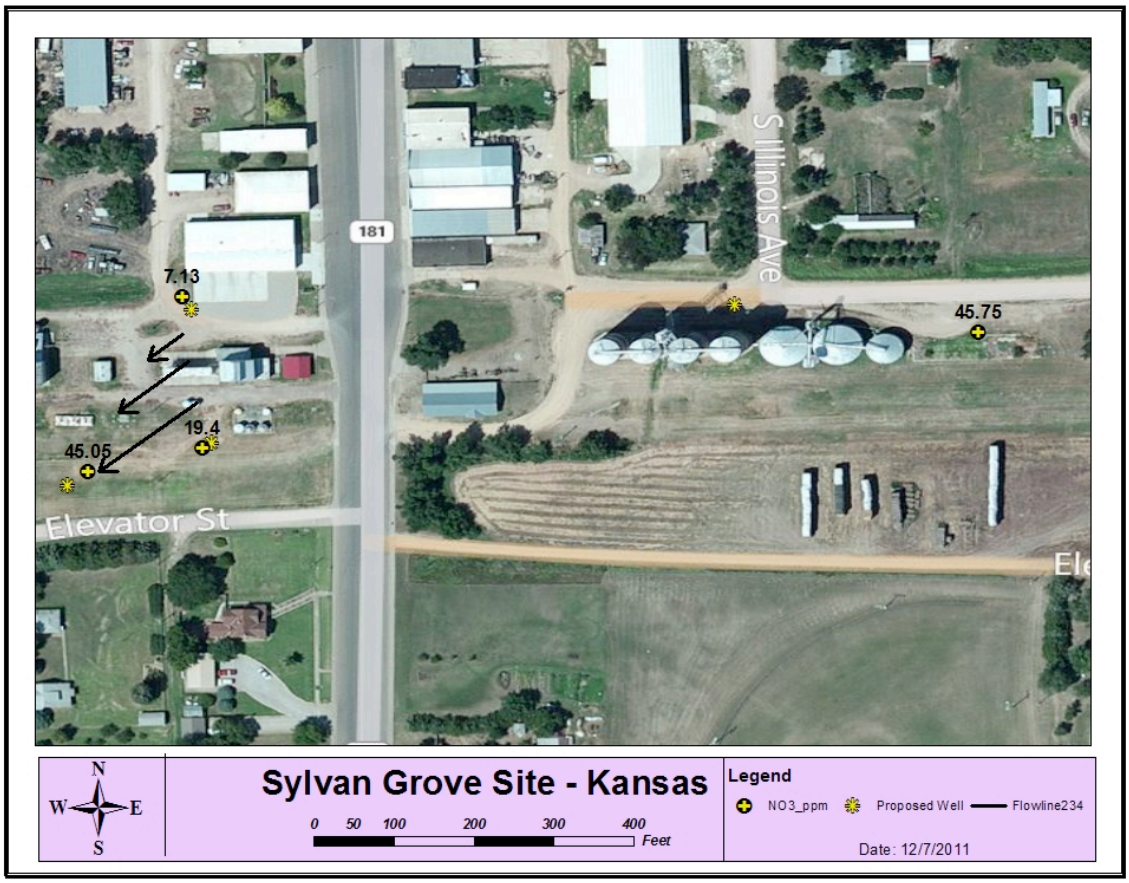
ND – non detect



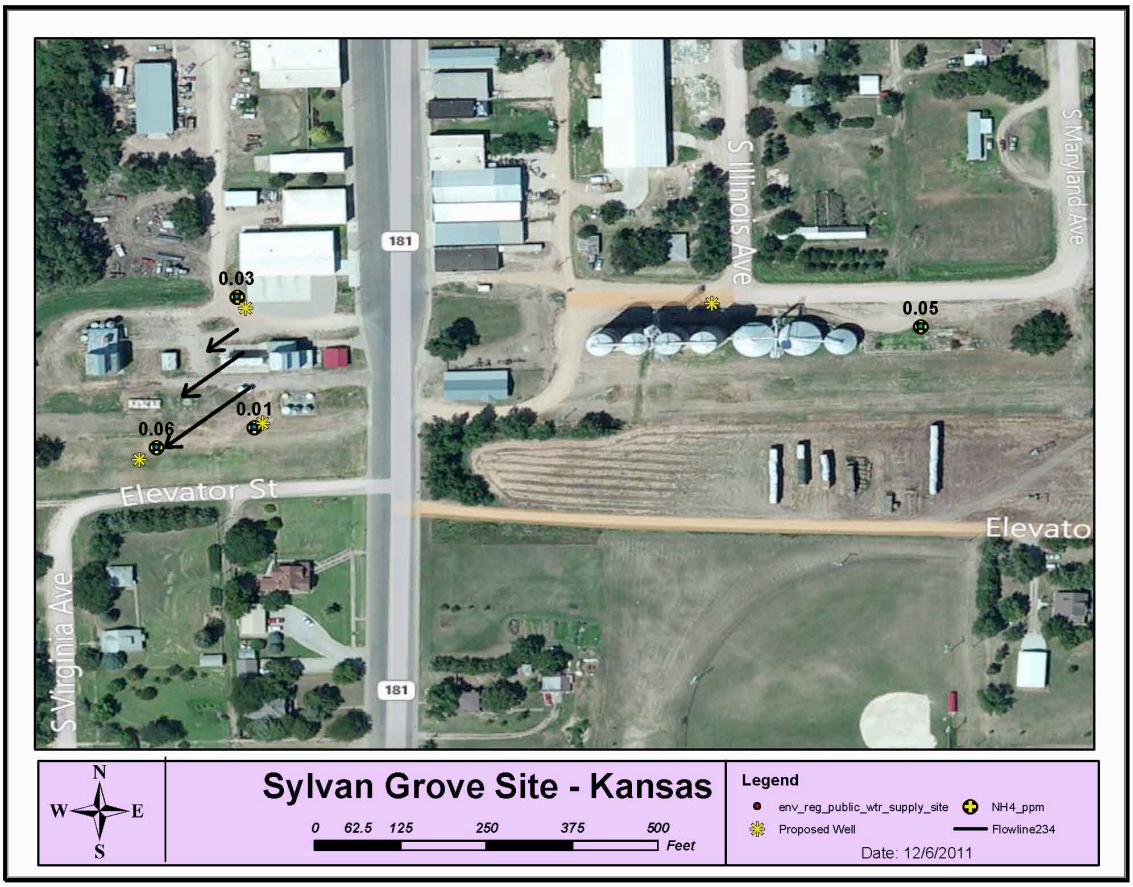
Map 1: Proposed and final monitoring well locations with flow lines calculated from a 3 point problem using wells 1,2 and 4



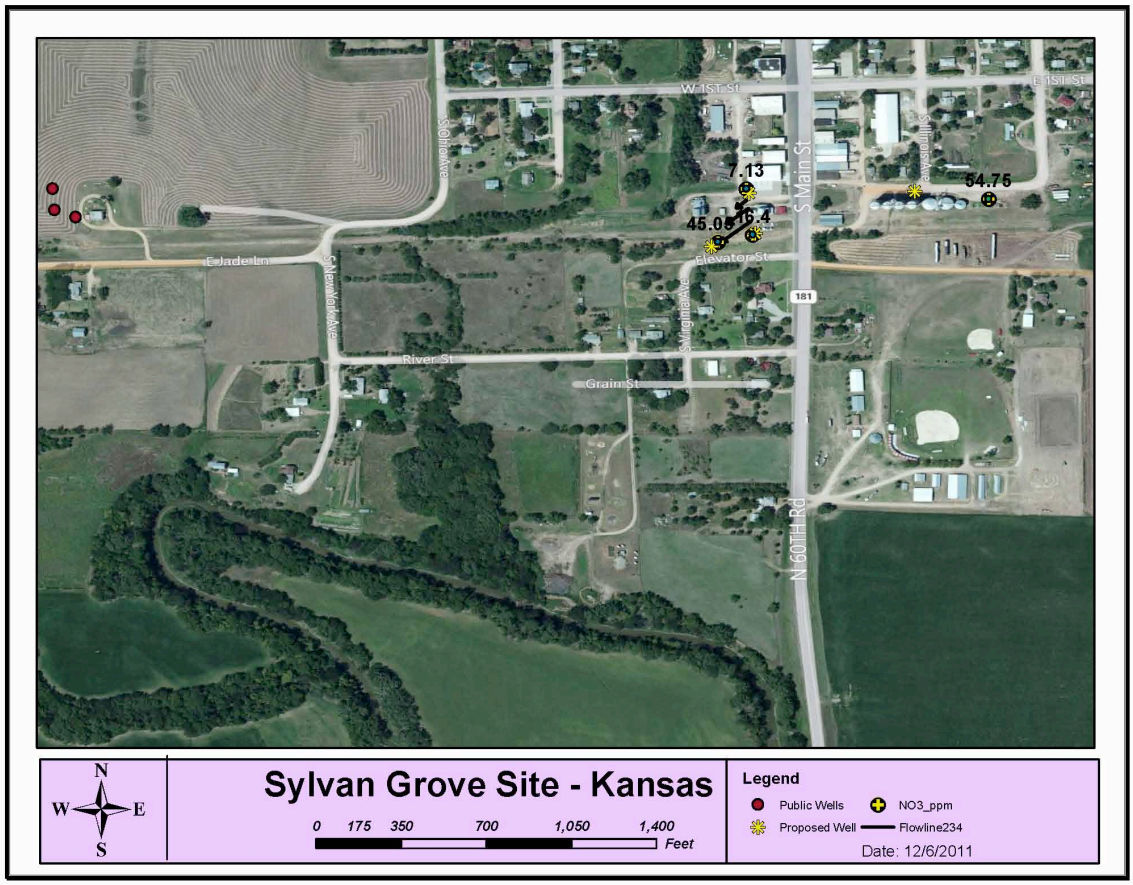
Map 2: Proposed and final monitoring well locations with flow lines calculated from a 3 point problem using wells 2,3 and 4



Map 3: NO3 concentrations for all wells plotted with flow lines.

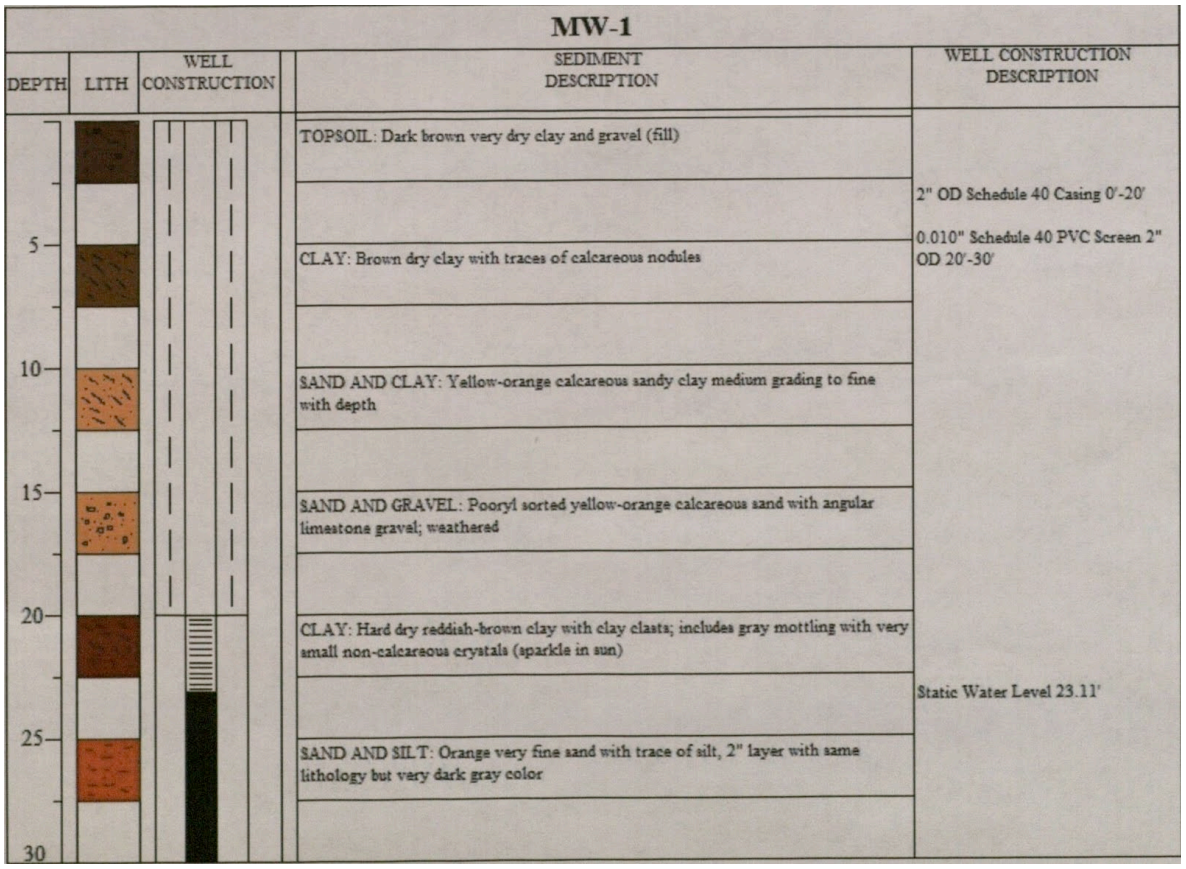


Map 3: NH4 concentrations for all wells plotted with flow lines.

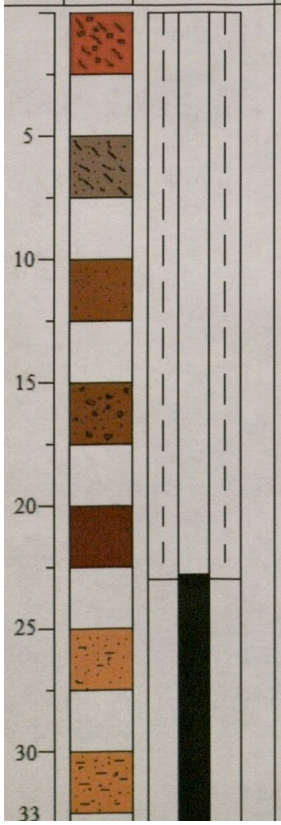


Map 5: Sylvan grove site and surrounding area showing flow lines and nearby public wells.

Lithological logs:

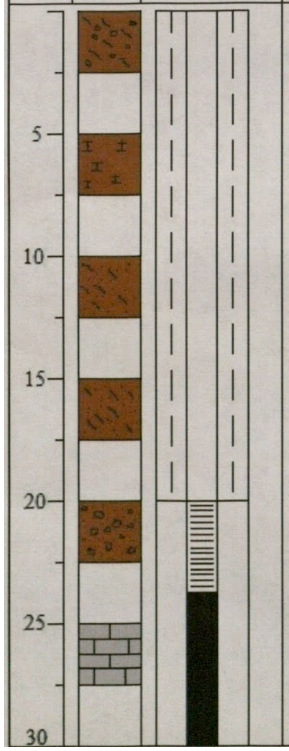


MW-2



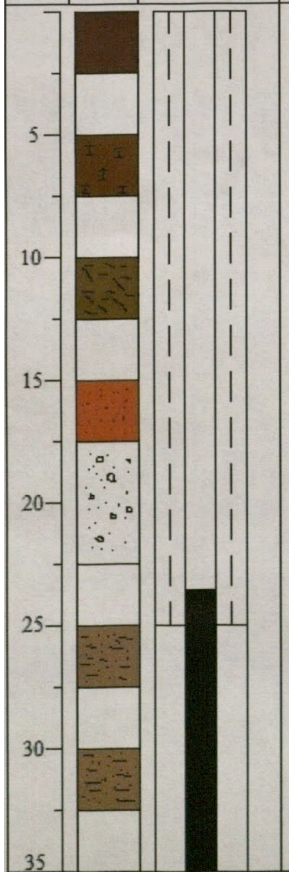
SEDIMENT DESCRIPTION	WELL CONSTRUCTION DESCRIPTION
CLAY AND GRAVEL: Orange clay-gravel mix (fill)	
	2" Schedule 40 Casing 0'-23'
CLAY AND SAND: Tan-gray clayey sand with trace of gravel	0.010" Schedule 40 PVC Screen 2" OD 23'-33'
SAND: Sand with trace of silty clay and calcareous nodules	
SAND AND GRAVEL: Poorly sorted calcareous sand and limestone gravel	
SANDSTONE: Rusty brown poorly sorted sandstone with conglomerate and clacite cement	
	Static Water Level 22.85'
SAND: Very oxidized sand with traces of silt	
SAND AND SILT: Very fine tan sand with silt and small amount of orange-tan gravel	

MW-3



SEDIMENT DESCRIPTION	WELL CONSTRUCTION DESCRIPTION
CLAY AND GRAVEL: Brown clay with gravel and brownish-tan clay with silt (fill)	
	2" OD Schedule 40 Casing 0'-20'
CLAY AND SILT: Brownish-tan clay with silt and white calcareous nodules	0.010" Schedule 40 PVC Screen 2" OD 20'-30'
SAND AND CLAY: Light brown very fine sand with clay that decreases with depth	
SAND AND CLAY: Sand with traces of clay; 3" silty zone atop 3" of poorly sorted weathered rock at bottom	
CONGLOMERATE: Brown-tan calcite cemented conglomerate with broken fragmented limestone and sand intermix	
	Static Water Level 23.8'
LIMESTONE: Fragmented limestone with small amount of clay	

MW-4



SEDIMENT DESCRIPTION	WELL CONSTRUCTION DESCRIPTION
TOPSOIL: Dark brown clay with rock and brick fragments (fill)	
	2" OD Schedule 40 Casing 0'-25'
CLAY AND SILT: Brown silty clay with nodules	0.010" Schedule 40 PVC Screen 2" OD 25'-35'
CLAY AND SAND: Yellow-brown to tan sandy clay with calcareous nodules, 3" cleaner sand zone at ~ 12'	
SAND: Yellow-orange moist sand with trace of silt and clay (cleaner with depth)	
ROCK: Hard drilling, split spoon attempted at 20' with small amount of calcareous cemented poorly sorted sandstone and conglomerate	
	Static Water Level 24.75'
SAND AND SILT: Gray and light brown-yellow mottled sandy silt with trace of clay	
SAND AND SILT: Wet gray and tan mottled sandy silt with trace of clay	

Kansas State University
Department of Geology & Agronomy

The Farmers Elevator Company Investigation Work Plan

Former Nitrogen Fertilizer Distribution Center and Current Grain Elevator Company
Sylvan Grove, Kansas

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November 1, 2011

This is a proposal for an environmental investigation plan for the former Farmers Elevator Company Site, located at 129 South Main Street, Sylvan Grove, Kansas.

Objective

The objective of this project is to investigate and characterize the extent and sources of potential nitrate- and ammonium-nitrogen contamination in soil and groundwater at the Farmers Elevator Company - Sylvan Grove site. Stable isotope analysis will be used to determine if the possible source of nitrate in groundwater is inorganic or organic in nature.

Introduction

Nitrate contamination is a problem affecting groundwater in many agricultural areas in Kansas. The Kansas Department of Health and Environment (KDHE) has performed an initial reconnaissance of the Farmers Elevator Company site. Their findings indicate nitrate in the groundwater up to 35 mg/l (REF 5). A maximum contaminant level (MCL) has been set by the United States Environmental Protection Agency (EPA) for nitrate at 10 mg/l (REF 1). During this investigation, soil sampling of the area also indicated nitrate contamination. KDHE's Risk-based Standards for Kansas (RSK) are set at 85 mg/kg for nitrates in the upper 8 inches of soil; soil surface samples collected onsite indicated contamination levels of up to 5,700 mg/kg.

HISTORICAL EVALUATION AND SITE DESCRIPTION

Location

The Farmers Elevator Company Site is located at 129 S Main St. Sylvan Grove, KS 67481 in the west half of Section 13, Township 12 South, Range 10 West and the east half of Section 14, Township 12 South, Range 10 West. The geographic coordinates of the site are 39.00954º North latitude and 98.39398º West longitude. A former sale barn was located to the north adjacent to the site. Stockyards were historically located to the east of the property. They have expanded since the early 1900s and are currently to the east and northeast of the property. Land use around the Sylvan Grove area is shown in Fig. 4.

History

The Sylvan Grove site has been used as a grain storage facility since the early 1900's. The site is now used by the owners for personal grain storage. In 2003, Glenn P. Ringler and Gregory J. Ringler purchased the property. Three to five years prior to the purchase of the property, 150 to 200 truckloads of soil in the fertilizer loading area were removed and replaced.

For more site history, refer to the Farmers Elevator Company Site Reconnaissance Evaluation (SRE) conducted by KDHE in 2008 (REF 5).

STUDY AREA INVESTIGATION

Geology

Sylvan Grove is located in the physiogeographic province of the Smoky Hills in Kansas, which is located in the north-central region of the state. Rock outcrops throughout this region are of Cretaceous age. The sedimentary units are characteristic of deep-sea environments. Sylvan Grove lies specifically in the Dakota Formation (REF 7). This formation is made up of varying beds of kaolinitic claystone, mudstone, siltstone, and shale inter-fingered with sandstones. The lenticular beds are commonly cemented by iron oxide and calcite (REF 3).

Groundwater within the Sylvan Grove site flows to the south-southwest (REF 2). This groundwater, as well as agricultural areas surrounding this site, has been seen to contain high levels of nitrates (REF 5). Nitrate contamination is common not only in the Corn Belt, but also in Lincoln County (Fig. 1; REF 2). Lenses of volcanic ash exist at varying depths (0-135 feet) throughout Lincoln County. The full extent of this ash has not been mapped, but there are areas of sufficient amount of volcanic ash for mining (REF 2). This is worth noting, because volcanic ash has been shown to release nitrates into the groundwater system (REF 8).

Soils

According to the National Cooperative Soil Survey, the soils at the Sylvan Grove contamination site are classified as Hord silt-loam, Geary-Lancaster complex, and Roxbury silt-loam. Roxbury silt-loam is the underlying soil type to the west of the grain elevator and Hord silt-loam is found directly south. At KDHE's Boreholes 1 and 2 (and also between the elevator and the former stockyard), Geary-Lancaster complex is present. These soils are all formed from either calcareous parent material or loess. Typically, these soil types are well-draining, and readily transmit water through the soil profile. See Fig. 3 for geologic formations and soil types surrounding Sylvan Grove.

Hydrogeology

The surface topography of the site is relatively flat. The Saline River is located approximately 2,500 feet south of the site. The general groundwater flow direction is to the south-southwest at the site (REF 2). Groundwater data from Feldkamp Brothers underground storage tank (UST) site located at Fourth Street and Main, indicates groundwater flowing southwest to south. Possible nitrate contamination in the underlying aquifer, both in the Pleistocene and Gulfian series, may be migrating in the direction of the groundwater flow. The properties of the underlying soils, the geological formations and location on a flood plain, provides an easy migration for nitrate to leach into an underlying aquifer, creating a concern for the extent of nitrate contamination.

During KDHE's 2008 SRE of the site, groundwater was encountered at approximately 26 feet below ground surface in temporary boreholes.

SOURCE CHARACTERIZATION

In 1997, the Farmers Elevator Company used the site for grain storage, storage of dry fertilizer, and sale of chemicals and farm supplies. Between 1997 and 2008 a fertilizer tank battery was added to the site (REF 5). The dry and liquid fertilizer storage, and operations associated with the transfer of these materials into and out of the storage containers, represents a potential source of contamination. Aerial photos indicate dead vegetation on the southwestern corner of the property for consecutive years. This scarred area is located west of the sump. High nitrates were detected in soils of the scarred area during prior KDHE investigations.

A sale barn was located just north of the elevator property until the 1950's. After that time it was moved farther north. The stockyards which were historically located east of the site have since expanded and are currently northeast and east of the site.. No known investigations have been carried out to distinguish the potential nitrate contamination on the elevator property as organic or inorganic in origin.

NATURE AND EXTENT OF CHARACTERIZATION

Soil Sampling Method

According to KDHE's Site Reconnaissance and Evaluation at the Sylvan Grove site, the area on the eastern most side of the property displayed soil nitrate levels below the (RSK) values established for the state of Kansas. At Boreholes P-3 and P-5 of KDHE's 2008 investigation, the nitrate concentrations were also below RSK. Additionally, the area immediately surrounding the dry fertilizer storage container has been excavated in the past. Because these areas have either been tested by KDHE and deemed acceptable, or have already been excavated, they will not be included in this sampling program.

This plan's area of focus is that which lies south of the elevator and west of the sump. This general area revealed the highest nitrate contamination in 2008, and appears to have "scarring" typical of a synthetic nitrogen fertilizer spill. To determine the extent to which the nitrogen contamination is dispersed, a sampling plan has been devised as follows:

A. A Giddings truck-mounted direct-push probe (properly decontaminated, according to guidelines in Bureau of Environmental Remediation BER-05) will be used to collect samples from suspect areas. Samples will be taken from eight identified locations on the property (Fig. 1). Each location will generate 4 subsamples; one interval sample for soil between 0-8 inches, another for 1-2 feet, a third sample for 4-5 feet, and a final for soil between 8-9 feet. This will allow for analysis of the contamination extent in both width and depth. Thus, the intention of this sampling plan is to determine both the boundaries of the contamination as well as the nitrate concentrations present at various depths. Soil samples will be field tested for nitrate using a modified KCl extraction and nitrate test strips. The field-screening technique will be used to determine if the maximum depth and location of soil samples adequately encompasses the potentially contaminated area.

B. Probe sites 5 and 6 will also have samples collected for texture analysis to help determine the hydraulic properties of the soil. A detailed particle size analysis will be used to estimate the hydraulic conductivity potential of the soil, which will be of aid when assessing future risk.

Handling of Soil Samples

A team of senior undergraduate students from Kansas State University (KSU) will carry out the collection of samples under the supervision of Professor Nathan Nelson and an agent appointed by KDHE. These samples will be collected following KDHE's Standard Operating Procedures (SOPs) as outlined in BER-03 and BER-07. Samples will be stored in coolers chilled to 4^{o}C, and delivered to laboratories within 48 hours. Samples will all be analyzed by the soils lab of KSU for nitrate levels and ammonia levels. Samples collected will additionally be sent to Continental Analytical Services of Salina, Kansas, for purposes of quality assurance. Please see Table 1 for summary.

Methodology of Installation of Monitoring Wells

Monitoring wells will be installed using an air rotary drilling rig. Well borings will be advanced to five to six feet below groundwater, bedrock, or refusal (whichever occurs first). Maximum well depth will be 35 ft below surface, as was done in previous investigations by KDHE (REF 5). Wells will be screened at a 10-ft interval, spanning 5 feet above and below the depth at which saturated soils are encountered. All wells will be flush-mount and constructed of 2-inch schedule 20 PVC. After installation, monitoring wells will be developed and sampled per KDHE guideline as provided in the SOPs.

The proposed locations for the installation of monitoring wells are identified in Figure 1. Monitoring well, MW-1 (Fig. 2) was selected to provide an up-gradient point to assist in the determination of the hydraulic gradient at the site. Another aspect to the groundwater data obtained from MW-1 is to determine if any groundwater nitrate impacts found previously on the site may have migrated on site (following the flow of groundwater) from unidentified source locations north of the site boundary. Monitoring wells MW-2 and MW-3 (Fig. 2) will provide insight to the groundwater conditions located directly under the site, and both locations will allow cross-gradient determination of the east/west components of groundwater flow. Finally, monitoring well MW-4 (Fig 2) will be located down gradient from the site to allow the determination of off-site migration of any impacted groundwater. Exact locations of the wells may be adjusted based on an on-site evaluation. A slug test using EPA 2046 method and a permeability test will be performed at MW-3 to determine the permeability of the water and the rate of flow of the aquifer (REF 9).

Groundwater Sampling Methods

Groundwater sampling will be conducted to confirm nitrate contamination and determine if the source of the contamination is of organic (i.e., manure) or inorganic (i.e., fertilizer) origin. Confirming the presence of nitrate contamination will also involve reporting the levels of nitrate

present in the groundwater. Stable isotope analysis (^{15}N) will be used to determine if the potential nitrate contamination is primarily from an organic or inorganic source according to EPA nitrate source tracking methodologies (REF 10).

The locations of sampling wells were selected methodically with consideration of specific criteria (e.g., possible contamination sources, groundwater gradient, previous well locations), while using as few wells as possible. We will establish the background concentrations and determine if a contamination has occurred and is spreading. We will produce a groundwater flow map across the site with measured values of nitrates plotted in between. The wells will be sampled using EPA standard sampling protocol, as described below.

Sampling will be collected using the purge-and-bail method following the drilling of the wells by three trained hydrogeologists from the team in KSU Geology. Dr Saugata Datta will be supervising this groundwater sampling process in the field. The wells will be purged of three well volumes prior to sampling being completed. The samples will then be taken using disposable bailers, minimizing any disturbance of the water column to prevent outgassing or degassing during collection. Samples will be stored in sealed amber, 125 ml Nalgene® high-density polyethylene narrow-mouth bottles (Cat. No. 2006-0016) and stored at 4° C and shipped to the lab within 48 hours. Sample bottles will be filled to the top leaving no head space in the bottle. Filtered, unacidified samples will be collected in plastic 50 ml centrifuge tubes (Fisherbrand® Disposable Centrifuge Tube, Sterile, Polypropylene (PP), 50 ml; Cat. No. 06-443-20). Filtering will be done using disposable plastic syringes (25 ml) pushing the water through a 0.45 µm PP filter (Whatman syringe filter, 25 mm GD/X Disposable Filter Device, PP Filter Membrane and Housing, Cat. No. 6878-2504) into its respective sample bottles. Two samples will be collected from each well, for a total of 8 samples collected (4 proposed wells). Samples will be transported back to KSU Soil Testing Lab, where they will be analyzed using the Environmental Protection Agency (EPA) 353.2 method (Nitrate-Nitrite Colorimetric, automated, cadmium reduction) and EPA Method 350.1 (Ammonia). Please see Table 2 for summary.

Lab Methods

Ammonium and nitrate will be determined in soil samples by extracting with 2M potassium chloride (KCl) and analyzing the extract according to EPA methods 350.1 (automated phenate) and 352.2 (cadmium reduction) respectively. Current analytical methods for quantification of nitrate in water samples are described in EPA Method 352.2 by cadmium reduction. The analysis will be carried out twice on each sample. Duplication of the analysis will increase the accuracy of the results. The maximum holding time permitted by this analytical method is 48 hours for the sampling of nitrate. The media in which the NO_3-N will be sampled is water.

Nitrogen isotopic analysis will be vital in determining the source of the contamination. The isotope analysis will help to determine whether the nitrate found in the area is the nitrate generated from fertilizers or from nitrate organically generated by livestock activity. Studies completed on cattle urine show a depletion of 15N relative to their diet (REF 6). The nitrogen isotopic compositions can be carried out on the nitrogen in a gas mixture using compound-specific isotope analysis. In the present study area, in which the media is water, nitrate is extracted and converted into silver nitrate ($AgNO_3$) using ion exchange techniques. Samples will

be analyzed by the Delta Plus Mass Spectrometer in the Stable Isotope Mass Spectroscopy Lab at KSU.

Confirmation samples will be sent to Continental Analytical Services in Salina.

Tentative Timeline

Plan Proposal – 10/3/2011 [Revision – 11/01/2011]
Call Kansas One Call Dig-Safe – 11/7/2011
Drilling and soil sampling – 11/10/2011
Groundwater Sampling – 11/11/2011
Laboratory Results – 11/30/2011
Final Report and Recommendations – 12/15/2011

Quality Assurance

The group proposes the use of the KDHE Generic Site Assessment Quality Assurance Project Plan (QAPP) to meet KDHE BER quality assurance/quality control requirements for this project. Given the large amount of time and effort required to develop a "blanket" QAPP (done by most environmental consultants and consulting firms), as well as the relation of KSU and KDHE both being under the authority of the State of Kansas, using the KDHE Generic QAPP would put project quality and data management into a known accepted format. This would also allow our group to make site-conforming changes through the use of the QAPP Addendum Form, also identified as the Site-Specific Quality Assurance Project Plan Addendum (SSQA). A blank copy of the SSQA would be obtained from KDHE BER, completed using appropriate site data, and submitted to KDHE BER for approval prior to the initiation of site field activities. Additionally, KDHE BER SOPs would be used as guidance for all applicable field, analytical, and reporting activities. The initial list of SOPs used for this project is presented below; more may be added as project scope evolves.

BER-01 Collection of Groundwater Samples at Known or Suspected Groundwater Contamination Sites
BER-05 Decontamination of Equipment
BER-03 Collection of Soil Samples for Laboratory Analysis
BER-07 KDHE Geoprobe operations
BER-08 Characterization and Disposal of Investigative Derived Waste
BER-11 Evaluation and Validation of Data
BER-12 Collection of Quality Control Measures for Water-Quality Data Samples
BER-18 Field Safety Protocol
BER-19 Chain of Custody
BER-36 Water Level, Product, and Well Depth Measurements

Nitrate Health Adverse Effects

Previous investigations of the Farmers Elevator Company site pointed out that nitrates in the soil and groundwater exceeded RSK values. Likely exposure pathways include ingesting contaminated drinking water, most commonly of concern for private wells, or by ingestion of dirt, especially by children when they are playing around this site or in the nearby football field (600 feet from the site).

Exposure to nitrates and nitrites at levels above health-based risk values can cause some adverse health effects in animals and humans. The health effect of most concern is the “blue baby syndrome” (methemoglobinemia). Blue baby syndrome is an illness that arises when an infant’s blood is unable to carry enough oxygen to body cells and tissue. This happens when nitrates in the blood bind to hemoglobin to form methemoglobin, which impairs oxygen delivery to tissues. The most at risk for exposure are infants exposed to nitrate from drinking water used to make formula. Some adverse health effects have been noticed in infants following fetal exposure to nitrates in drinking water including intrauterine growth retardation, increased incidence of Sudden Infant Death Syndrome (SIDS), cardiac defects, and increased risk of nervous system defects. Other possible effects associated with nitrate exposure in children have been reported by a few studies, including recurrent diarrhea and respiratory tract infections, and increased incidence of childhood diabetes. Other investigations have reported that chronic exposure to nitrate in adults can cause frequent urination and spleen hemorrhaging, while acute exposure can cause abdominal pain, muscle weakness, blood in stools and urine, fainting, and death. In addition to these effects, nitrite exposure during pregnancy can increase incidence of intrauterine growth retardation.

Carcinogenicity of nitrate is still being studied, however, some studies pointed out the exposure to higher levels of nitrates or nitrites has been associated with increased incidence of cancer in adults and children.

Nitrate or nitrite can cause poisoning in all animals. Ruminants are the most susceptible to nitrate intoxication, because of the nitrate-reducing ability of rumen microbes. Ingestion of nitrate from soil or water also may cause gastrointestinal irritation in most animals, and methemoglobin formation in ruminants and monogastrics. Abortion and increasing the risk of premature delivery in ruminants are a sequela of sub-lethal nitrate intoxication that has been reported, as well.

References

1. EPA, 2009. Nitrates and Nitrites TEACH Chemical Summary. U.S. EPA, Toxicity and Exposure Assessment for Children's Health.

2. Berry, D.W., 1952. Geology and Ground-Water Resources of Lincoln County Kansas, University of Kansas Publication, State Geological Survey of Kansas, Bulletin 95. 96 pp.

3. USGS. Dakota Formation. Mineral Resources On-Line Spatial Data. http://tin.er.usgs.gov/geology/state/sgmc-unit.php?unit=KSKd;0

4. Rolston, D.G., Fogg, G.E., Decker, D.L., Louis, D.T., and Grismer, M.E., 1996. Nitrogen isotope ratios identify nitrate contamination sources. California Agriculture. 50 (2):32-36.

5. Site Reconnaissance and Evaluation, Farmers Elevator Company – Sylvan Grove, Kansas, Kansas Department of Health and Environment and Bureau of Environmental Remediation, 2008. State ID: C5-053-72293.

6. Steele, K.W. and Daniel, R.M., 1978, Fractionation of nitrogen isotopes by animals: a further complication to the use of variations in the natural abundance of 15N for tracer studies. Journal of Agricultural Science, 90:7-9.

7. Kansas Geological Survey, 1999. Smoky Hills: Rocks and Minerals. <http://www.kgs.ku.edu/Extension/smoky/SH_factsheet1.pdf.>

8. Shoji S. and Takahashi, T., 2002. Environmental and Agricultural Significance of Volcanic Ash Soils. Global Journal of Environmental Research. 6 (2):113-135.

9. U.S. Environmental Protection Agency (EPA), 1994, Environmental Response Team. Slug Tests. Standard Operating Procedure No. 2046.

10. GeoLogics Coorporation. 2004. EPA Regional Priority AFO Science Question Synthesis Document: Nitrate Source Tracking. http://www.manure.umn.edu/regulatory/3 Nitrogen Source Tracking.pdf

Appendix A

Tables and Figures

Table 1: Soil Sample Summary

Sample Number	Probe site	Depth	Holding Time	Preservation	Parameter	Laboratory
1-N1-K	1	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
1-N2-K	1	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
1-N3-K	1	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
1-N4-K	1	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
2-N1-K	2	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
2-N2-K	2	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
2-N3-K	2	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
2-N4-K	2	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
3-N1-K	3	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
3-N2-K	3	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
3-N3-K	3	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
3-N4-K	3	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
3-N1-C	3	0-8 inches	<48 hours	Cool to <4oC	Nitrate	Continental
3-N2-C	3	1-2 feet	<48 hours	Cool to <4oC	Nitrate	Continental
3-N3-C	3	4-5 feet	<48 hours	Cool to <4oC	Nitrate	Continental
3-N4-C	3	8-9 feet	<48 hours	Cool to <4oC	Nitrate	Continental
4-N1-K	4	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
4-N2-K	4	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
4-N3-K	4	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
4-N4-K	4	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU

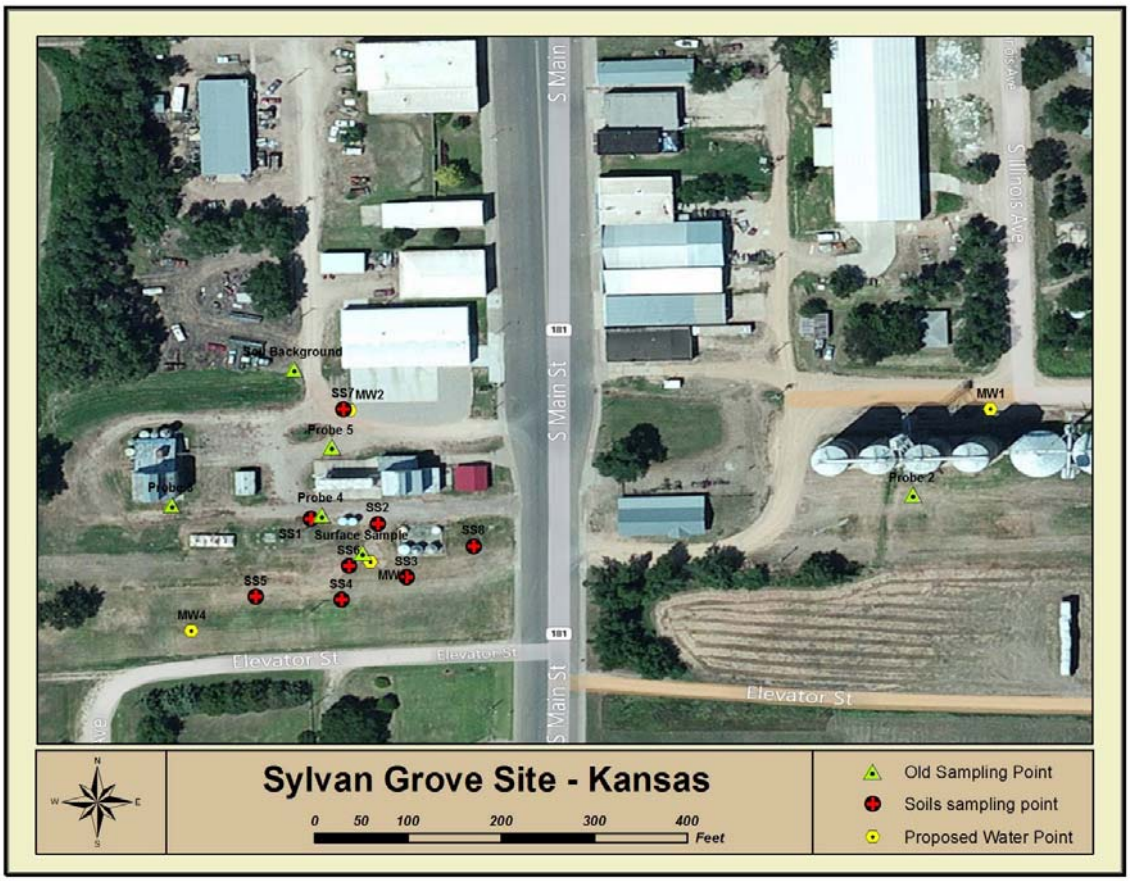
5-N1-K	5	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
5-N2-K	5	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
5-N3-K	5	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
5-N4-K	5	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
5-T1-K	5	1-2 feet	<48 hours	Cool to <4oC	Texture	KSU
5-T2-K	5	4-5 feet	<48 hours	Cool to <4oC	Texture	KSU
6-N1-K	6	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
6-N2-K	6	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
6-N3-K	6	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
6-N4-K	6	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
6-T1-K	6	1-2 feet	<48 hours	Cool to <4oC	Texture	KSU
6-T2-K	6	4-5 feet	<48 hours	Cool to <4oC	Texture	KSU
7-N1-K	7	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
7-N2-K	7	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
7-N3-K	7	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
7-N4-K	7	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU
8-N1-K	8	0-8 inches	<48 hours	Cool to <4oC	Nitrate	KSU
8-N2-K	8	1-2 feet	<48 hours	Cool to <4oC	Nitrate	KSU
8-N3-K	8	4-5 feet	<48 hours	Cool to <4oC	Nitrate	KSU
8-N4-K	8	8-9 feet	<48 hours	Cool to <4oC	Nitrate	KSU

Table 2: Groundwater Sample Summary

Well Location	Sample I.D.	Parameter	Analytical Method	Sample Containers	Sample Preservation	Holding Times	Laboratory
MW-1	1NSG	Nitrate	EPA 353.2	Cube (Bottle)	None	48 hours	Continental
	1ASG	Ammonia	EPA 350.1	Nutrient (Bottle)	Sulfuric Acid	28 days	Continental
MW-2	2NSG	Nitrate	EPA 353.2	Cube (Bottle)	None	48 hours	KSU
	2ASG	Ammonia	EPA 350.1	Nutrient (Bottle)	Sulfuric Acid	28 days	KSU
MW-3	3NSG	Nitrate	EPA 353.2	Cube (Bottle)	None	48 hours	KSU
	3ASG	Ammonia	EPA 350.1	Nutrient (Bottle)	Sulfuric Acid	28 days	KSU
MW-4	4NSG	Nitrate	EPA 353.2	Cube (Bottle)	None	48 hours	KSU
	4ASG	Ammonia	EPA 350.1	Nutrient (Bottle)	Sulfuric Acid	28 days	KSU

Sampling Plan

Figure 1: Existing Sample Points Locations and Proposed Water and Soil Sample Points Location



***NOTE following KDHE suggestion, MW1 may be moved east relative to the location in Figures 1 and 2. Adjustment of MW1 location will be based on on-site evaluation. (11/3/11)**

Figure 2: Proposed Water Sample Point Locations

Figure 3: Soil and Geologic Formations, Sylvan Grove, Kansas

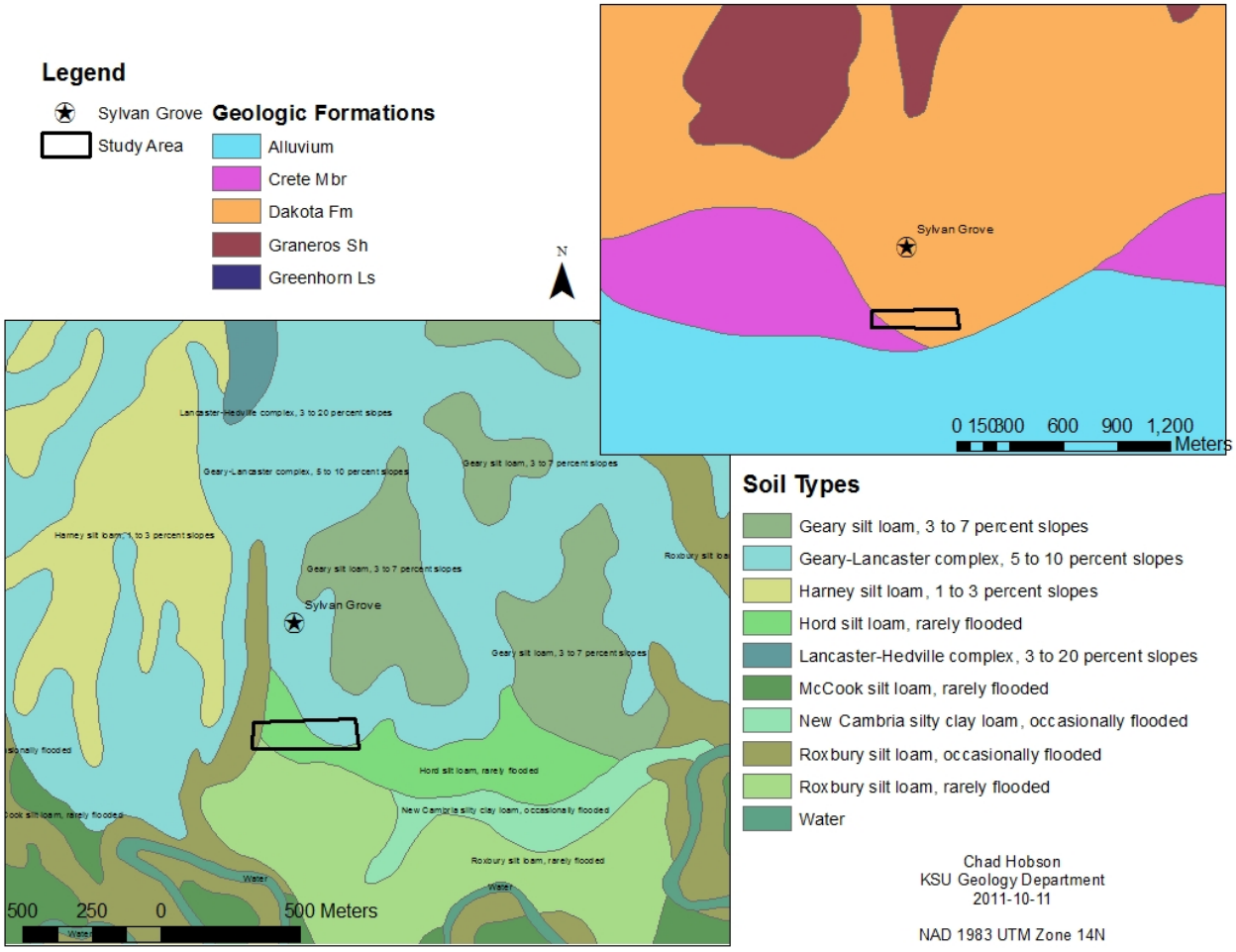
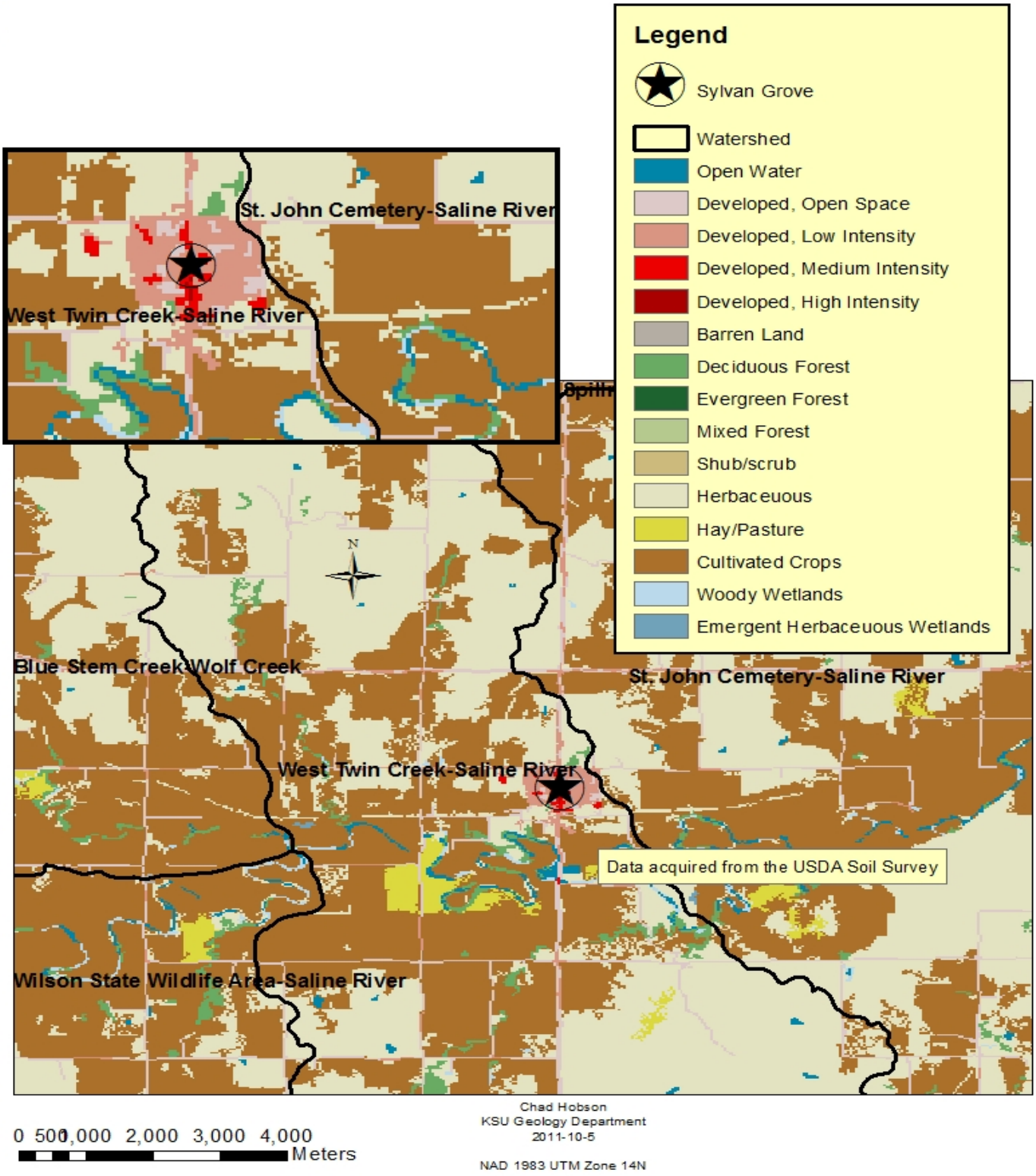


Figure 4: Land Use, Land Cover Around Sylvan Grove, Kansas



Appendix B

Health and Safety Plan

In order to minimize the potential for injury to site investigators, a health and safety plan has been devised. It includes a list of guidelines that must be followed by members of the sampling team, as well as directions and contact information for the local hospital.

1. Kansas One Call Dig Safe will be notified before any drilling or soil sampling (call 811 or 1-800-DIG SAFE).
2. All investigators involved in the collecting of samples will use appropriate personal protection equipment (PPE), including:
    a. Disposable, latex (or latex substitute) gloves
    b. Safety glasses
    c. Closed-toed shoes.
3. All personnel working directly with the Giddings probe will be required to use a safety hardhat, and ear protection.
4. A basic first-aid will be kept on site.
5. Water will be provided to prevent dehydration.
6. Site investigators and supervisors will ensure emergency medical professionals are immediately notified in case of a medical emergency.

EMERGENCY CONTACTS:
Lincoln County Hospital
624 North Second Street
Lincoln, Kansas
785-524-4403

Directions:

1. Head north on KS-181 N/S Main St toward W 1st St	
Continue to follow KS-181 N	1.4 mi
2. Turn right onto KS-18 E/State Hwy 18	13.4 mi
3. Turn right onto KS-14 S/N 6th St	1.3 mi
4. Turn left onto W College Ave	0.4 mi
5. Take the 3rd left onto S 2nd St Destination will be on the left	400 ft

Sylvan Grove Ambulance
785-885-4565
Lincoln County Sheriff's Office
785-524-4479

Continental
Analytical Services, Inc.

11/29/2011 Page: 1

KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date and Time Received: 11/15/2011 10:15
Continental File No.: 6692
Continental Order No.: 59971
Project ID: Sylvan Grove GW

Dear Mr. Bulen:

This laboratory report containing the samples indicated below, includes 9 pages for the analytical report, 1 page(s) for the chain of custody and/or analysis request, and 1 page(s) for the sample receipt form.

CAS LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
11111267	MW1-1,2	Liquid	11/11/2011
11111268	MW2-1,2	Liquid	11/11/2011
11111269	MW3-1,2	Liquid	11/11/2011
11111270	MW4-1,2	Liquid	11/11/2011

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Continental is otherwise notified.

Continental is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Continental's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

This report may not be reproduced, except in full, without written approval from Continental Analytical Services, Inc.

Thank you for choosing Continental for this project.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Petra M. Craddock
Project Manager

525 N. Eighth St. - P.O. Box 3737 - Salina, KS 67402-3737
785-827-1273 800-535-3076 Fax 785-823-7830
KDHE Environmental Laboratory Accreditation No. E-10146

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Lab Number: 11111267
Sample Description: MW1-1,2

Date Sampled: 11/11/2011
Time Sampled: 1230

Analysis	Concentration	Units	Book/Page
Atrazine, EPA 507	ND(0.2)	µg/L	7151/55

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Atrazine, EPA 507	11/15/11 1400	11/23/11 1732	111115-1	1EX8327	LPL	507
507 Pesticides Preparation Method						507

Conclusion of Lab Number: 11111267

Lab Number: 11111268
Sample Description: MW2-1,2

Date Sampled: 11/11/2011
Time Sampled: 1205

Analysis	Concentration	Units	Book/Page
No Tests Assigned	on hold		COC/1

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
No Tests Assigned	N/A	11/11/11 1205	111111-1	111BLK1		N/A

Conclusion of Lab Number: 11111268

Lab Number: 11111269
Sample Description: MW3-1,2

Date Sampled: 11/11/2011
Time Sampled: 1145

Analysis	Concentration	Units	Book/Page
No Tests Assigned	on hold		COC/1

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
No Tests Assigned	N/A	11/11/11 1145	111111-1	111BLK1		N/A

Conclusion of Lab Number: 11111269

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Lab Number: 11111270
Sample Description: **MW4-1,2**

Date Sampled: 11/11/2011
Time Sampled: 1130

Analysis	Concentration	Units	Book/Page
Atrazine, **EPA 507**	ND(0.2)	µg/L	7151/55

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Atrazine, EPA 507	11/15/11 1400	11/23/11 1915	111115-1	1EX8327	LPL	507
507 Pesticides Preparation Method						507

Conclusion of Lab Number: 11111270

Appendix

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

ND(), where reported, indicates the analyte was not detected above the Limit of Quantitation (LOQ). The concentration of the LOQ is inside the parentheses.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Continental order.

Accreditation Summary

Client: KSU - Department of Geology
Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Continental is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and analysis performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Continental is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Continental's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Continental performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	CAS NELAP Accredited in Other Reg. Program
CL707	Atrazine, EPA 507	L-NPDES	507	Y

Quality Control Report
Batch Summary

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Test	Testname	QC Batch	Method Blank	LCS	MS Lab No.
CL707	Atrazine, EPA 507	111115-1	111115BLK1	111115LCS1	11111267MS
Lab numbers associated with this batch: 11111267 11111270					
GL100	No Tests Assigned	111111-1	111111BLK1	111111LCS1	
Lab numbers associated with this batch: 11111268 11111269					

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Analysis	Blank Data	% Rec LCS	Limits	Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	Limits	Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 111115-1	**For samples prepared on: 11/15/2011**					**Spiked sample: 11111267**						
Atrazine, EPA 507	ND(0.2)	85.8	62.0-122	1.0	µg/L	87.6	F	57.0-127	1.0	µg/L	**	20.0
Surrogates:												
DMNB(507)	94.3	90.0	70.0-130	10.0	µg/L	88.9		70.0-130	10.0	µg/L	**	

Data Qualifiers:

F - MS and/or MSD sample data are not available due to insufficient sample volume.

** - RPD cannot be calculated.

Quality Control Report
Sample Surrogate Data

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Surrogate	Date Prepared	Date Analyzed	Spike Level	Units	% Recovery	Acceptable % Limits
Lab Number: 11111267		**Sample Description:MW1-1,2**				
507 Pesticides						
DMNB(507)	11/15/2011	11/23/2011	10	µg/L	105	70.0-130
Lab Number: 11111270		**Sample Description:MW4-1,2**				
507 Pesticides						
DMNB(507)	11/15/2011	11/23/2011	10	µg/L	106	70.0-130

Quality Control Report
Continuing Calibration Data Summary

Client: KSU - Department of Geology
Attn: Casey Bulen
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/29/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59971

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Atrazine, EPA 507	11/23/2011	1EX8327	CCV recovery acceptable for this Instrument Batch.			
Atrazine, EPA 507	11/23/2011	2EX8327	CCV recovery acceptable for this Instrument Batch.			

- Laboratory Report Conclusion -

Continental Analytical Services, Inc.
525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: SP71

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Client/Reporting Information	Invoice Information
Company Name: Kansas State University	Company Name: Kansas State University
Address: 108 Thompson Hall	Address: 108 Thompson Hall
City: Manhatta State: KS Zip: 66506	City: manhattan State: KS Zip: 66506
Contact: Casey Bulen / Saugata Datta	Contact: Saugata Datta
E-mail: cabulen@ksu.edu/sdatta@ksu.edu	E-mail: sdatta@ksu.edu
Phone Number: 270-748-2740/785-532-2241 Fax Number:	Phone Number: 785-532-2241 Fax Number:
Sampler's Name:(Printed) Saugata Datta	Sampler's Name:(Signature) Saugata Datta
Project or File Number:	Project Name: Sylva-Grove - Groundwater
	Purchase Order Number:

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	Number of Preserved Bottles: HCl	NaOH	HNO3	H2SO4	NONE	OTHER:
mw1-1	GW	O	11/1/11	12:30		1					X	
mw1-2	GW	O	11/1/11	12:30		1					X	
mw2-1	GW	O	11/1/11	12:05		1					X	
mw2-2	GW	O	11/1/11	12:05		1					X	
mw3-1	GW	O	11/1/11	11:45		1					X	
mw3-2	GW	O	11/1/11	11:45		1					X	
mw4-1	GW	O	11/1/11	11:30		1					X	
mw4-2	GW	O	11/1/11	11:30		1					X	

Edits made prior to sample receipt
Discrepancies See C/S RF
mw (11-15-11)

Atrazine Only

Analyze only samples mw1-1, mw4-1 for atrazine.

We will contact you if we need additional analyses completed.

(MW-1 & MW-4)

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (2-3 working days)

RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY: Mark W Stafford	DATE: 11-15-11	TIME: 10:15	SHIPPED VIA: AIRBILL:	SEAL #: SEAL DATE:	

Shipping Order No:

White Copy to Laboratory

Yellow Copy to Client

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 59971

Client Name: KJU **CAS File No.:** 6692

Sample ID's in cooler: See COC

Cooler 1 **of** 1 **for this CAS Order No.**

Cooler Identification: CAS Cooler #: 2008 / Client's Cooler / Box / Letter / Hand-delivered
Other: _____

Date/Time Cooler Received: 11 / 15 / 11 10 : 15

Delivered By: UPS (FedX) / AB Express / Field Svcs / Mail / Walk-In / Other: _____

Custody Seal: (Present) (Intact) / Broken Absent: ____ Seal No: 1311
Seal Name: OFM Seal Date: 11-14-11
Seal matches Chain of Custody: Yes / No / (N/A)

Type of Packing Material: Blue Ice / Ice / (Melted Ice) / (Bubble) / Foam / Paper / Peanuts / Vermiculite / None / Other: _____

Cooler Temperature (°C): Original Reading (°C) 4.2 Corrected Reading (°C) 4.6
Temp. By: (Temp. Blank) Cooler Surface: Glass / Plastic /Metal /Other: _____
Thermo. ID No.: 585 Thermo. Correction Factor (°C): 0.4
☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☐ No ☒ Yes **(See below for discrepancies.)**

Note: **If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.**

- ☐ Chain of Custody not present - information taken from:
  - Cover Letter ☐ Container ☐
  - PO ☐ CAS Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☒ Missing relinquished information: (signature) (date) (time)
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample description on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: _____

Detail to discrepancies/comments:

Completed by: MWS **Date Completed:** 11-15-11

11/23/2011 Page: 1

KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date and Time Received: 11/15/2011 10:15
Continental File No.: 6692
Continental Order No.: 59965
Project ID: Sylvan Grove-GW

Dear Mr. Meyer:

This laboratory report containing the samples indicated below, includes 7 pages for the analytical report, 1 page(s) for the chain of custody and/or analysis request, and 1 page(s) for the sample receipt form.

CAS LAB ID #	SAMPLE DESCRIPTION	SAMPLE TYPE	DATE SAMPLED
11111255	MW-1	Liquid	11/11/2011
11111256	MW-4	Liquid	11/11/2011

The Appendix and Quality Control sections are integral parts of this laboratory report and may contain important data qualifiers.

All results are reported on a wet weight basis unless otherwise stated.

Samples will be retained for thirty days unless Continental is otherwise notified.

Continental is accredited by the State of Kansas through the National Environmental Laboratory Accreditation Program (NELAP). The results contained in this report were obtained using Continental's Standard Operating Procedures. These procedures are in substantial compliance with the approved methods referenced and the standards published by NELAP unless otherwise noted in the Appendix and Quality Control sections of this report.

Thank you for choosing Continental for this project.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Petra M. Craddock
Project Manager

525 N. Eighth St. - P.O. Box 3737 - Salina, KS 67402-3737
785-827-1273 800-535-3076 Fax 785-823-7830
KDHE Environmental Laboratory Accreditation No. E-10146

Client: KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

Lab Number: 11111255
Sample Description: MW-1

Date Sampled: 11/11/2011
Time Sampled: 1230

Analysis	Concentration	Units	Book/Page
Ammonia, Total, as N	ND(0.10) Y	mg/L	7061/212
Nitrate/Nitrite, as N (FIA)	45.0 Y	mg/L	7061/216

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Ammonia, Total, as N	N/A	11/16/11 1449	111116-3	111116-10	KJH	SM20-4500-NH3(G)
Nitrate/Nitrite, as N (FIA	N/A	11/23/11 1414	111123-2	111123-5	KJH	SM 4500-NO3(F)

Conclusion of Lab Number: 11111255

Lab Number: 11111256
Sample Description: MW-4

Date Sampled: 11/11/2011
Time Sampled: 1130

Analysis	Concentration	Units	Book/Page
Ammonia, Total, as N	ND(0.10) Y	mg/L	7061/212
Nitrate/Nitrite, as N (FIA)	37.0 Y	mg/L	7061/216

Analysis	Date/Time Prepared	Date/Time Analyzed	QC Batch	Inst. Batch	Analyst	Method(s)
Ammonia, Total, as N	N/A	11/16/11 1440	111116-3	111116-9	KJH	SM20-4500-NH3(G)
Nitrate/Nitrite, as N (FIA	N/A	11/23/11 1415	111123-2	111123-5	KJH	SM 4500-NO3(F)

Conclusion of Lab Number: 11111256

Appendix

Client: KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

ND(), where reported, indicates the analyte was not detected above the Limit of Quantitation (LOQ). The concentration of the LOQ is inside the parentheses.

All samples which require cooling were received at a temperature of less than 6 degrees Celsius.

No analysis with a holding time of seventy-two hours or less was performed in this Continental order.

Y - The recommended pH adjustment or chemical preservation procedure was not followed or was inadequate for this sample matrix.

Accreditation Summary

Client: KSU - Department of Geology
David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

NELAP accreditation is issued under each EPA regulatory program for a given matrix/analyte/method combination. Continental is NELAP accredited for each matrix/analyte/method and EPA program cited in this Laboratory Report, except for those listed in the table below and analysis performed in the field. For most of the analyses listed in the table, NELAP accreditation is not offered under the listed EPA program and Continental is NELAP accredited for the analysis, using the same analytical technology, but under a different EPA program. Continental's full NELAP accreditation status may be viewed at www.kdheks.gov/envlab. Note that unless qualified otherwise in the Laboratory Report, Continental performs all analyses, including each analysis listed in the table below, utilizing NELAP protocol.

Test	Analysis	Matrix-Regulatory Program	Method	CAS NELAP Accredited in Other Reg. Program

CAS is accredited for all analytes.

Quality Control Report
Batch Summary

Client: KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

Test	Testname	QC Batch	Method Blank	LCS	MS Lab No.
GL110	Ammonia, Total, as N	111116-3	111116BLK3	111116LCS3	11110871MS
Lab numbers associated with this batch: 11111255 11111256					
GL192	Nitrate/Nitrite, as N (FIA)	111123-2	111123BLK2	111123LCS2	11110879MS
Lab numbers associated with this batch: 11111255 11111256					

Quality Control Report
Method Blank, LCS, MS/MSD Data

Client: KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

Analysis	Blank Data	% Rec LCS	Limits	Spike Level	Units	Spiked Sample (% Recovery) MS	MSD	Limits	Spike Level	Units	Spiked Sample Precision Data RPD	Limit
QC Batch: 111116-3	**For sample analyzed on: 11/16/2011**					**Spiked sample: 11110871**						
Ammonia, Total, as N	ND(0.10)	101	91.3-113	1.0	mg/L	MN	MN	75.7-115	20.0	mg/L	**	8.3
QC Batch: 111123-2	**For sample analyzed on: 11/23/2011**					**Spiked sample: 11110879**						
Nitrate/Nitrite, as N (FIA)	ND(0.10)	94.5	88.5-111	2.0	mg/L	MN	MN	81.6-116	40.0	mg/L	**	5.8

Data Qualifiers:
MN - The MS/MSD sample analyses were not performed on a sample from this Continental order number.
** - RPD cannot be calculated.

Quality Control Report
Continuing Calibration Data Summary

Client: KSU - Department of Geology
Attn: David Meyer
108 Thompson Hall
Manhattan, KS 66506-3201

Date Reported: 11/23/2011
Date Received: 11/15/2011
Continental File No: 6692
Continental Order No: 59965

Analysis	Date of Analysis	Instrument Batch ID	Amount in Standard	Amount Detected	Units	Percent Recovery
Ammonia, Total, as N	11/16/2011	111116-10	CCV recovery acceptable for this Instrument Batch.			
Ammonia, Total, as N	11/16/2011	111116-11	CCV recovery acceptable for this Instrument Batch.			
Ammonia, Total, as N	11/16/2011	111116-9	CCV recovery acceptable for this Instrument Batch.			
Nitrate/Nitrite, as N (FIA)	11/23/2011	111123-5	CCV recovery acceptable for this Instrument Batch.			
Nitrate/Nitrite, as N (FIA)	11/23/2011	111123-6	CCV recovery acceptable for this Instrument Batch.			

- Laboratory Report Conclusion -

Continental Analytical Services, Inc.

525 N. 8th Street, Salina, KS 67401
(785)827-1273 (800)535-3076 Fax (785)823-7830
www.cas-lab.com

CHAIN OF CUSTODY RECORD

Continental Order Number: SP965

PAGE ___ OF ___

PLEASE NOTE THE ATTACHED CONTINENTAL SAMPLE ACCEPTANCE POLICY

Client/Reporting Information	Invoice Information
Company Name: Kansas State University	Company Name: Kansas State University
Address: 108 Thompson Hall	Address: 108 Thompson Hall
City: Manhattan State: KS Zip: 66506	City: Manhattan State: KS Zip: 66506
Contact: David Meyer / Sangata Datta	Contact: Sangata Datta
E-mail: dfmeyer@ksu.edu / sdatta@ksu.edu	E-mail: sdatta@ksu.edu
Phone Number: (316) 617-4785 / (785)-532-2241 Fax Number:	Phone Number: 785-532-2241 Fax Number:
Sampler's Name:(Printed) Sangata Datta	Sampler's Name:(Signature) Sangata Datta
Project or File Number:	Project Name: Sylvan Grove - Groundwater
Purchase Order Number:	

PARAMETERS/CONTAINER TYPE

Discrepancies See C/S RF mwr 11-15-11

COMMENTS: Shipping Order No: ___

SAMPLE IDENTIFICATION (30 Characters or less)	Matrix (Sample Type)	Regulatory Program	Date Sampled	Time Sampled	C-Composite G-Grab	Total Containers	Number of Preserved Bottles: HCl	NaOH	HNO3	H2SO4	NONE	OTHER:	
MW-1	GW	O	11/11/11	12:30		1					X		Sample for Nitrate and Ammonium.
MW-4	GW	O	11/11/11	11:30		1					X		

Matrix (Sample Type): DW=Drinking Water, GW=Ground Water, WW=Waste Water, W=Wipe, S=Solid/Soil, SL=Sludge, A=Air, OL= Oil/Organic Liquid, O=Other

Regulatory Program: N=NPDES, R=RCRA, D=Drinking Water, SL=503 Sludge, O=Other

(Please note if non-standard turnaround. Rush & Emergency subject to additional charge)
Standard TAT: (15 working days) Rush TAT: (5 working days) Emergency TAT: (2-3 working days)

RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
RELINQUISHED BY:	DATE:	TIME:	RECEIVED BY:	DATE:	TIME:
RECEIVED AT LAB BY: Mark W Shipley	DATE: 11-15-11	TIME: 10.15	SHIPPED VIA: AIRBILL:	SEAL #: SEAL DATE:	

White Copy to Laboratory

Yellow Copy to Client

Continental Analytical Services, Inc.
Cooler/Sample Receipt Form (C/S RF)

CAS Order No.: 59965

Client Name: ICSU

CAS File No.: 6092

Sample ID's in cooler: See COC

Cooler 1 of 1 for this CAS Order No.

Cooler Identification: CAS Cooler #: 3640 / Client's Cooler / Box / Letter / Hand-delivered
Other: _____

Date/Time Cooler Received: 11 / 15 / 11 10 : 15

Delivered By: UPS (FedX) / AB Express / Field Svcs / Mail / Walk-In / Other: _____

Custody Seal: (Present) (Intact) / Broken Absent: ____ Seal No: NA
Seal Name: DFM Seal Date: 11-14-11
Seal matches Chain of Custody: Yes / No / (N/A)

Type of Packing Material: Blue Ice (Ice) / Melted Ice / (Bubble) / Foam / Paper / Peanuts / Vermiculite / None / Other: _____

Cooler Temperature (°C): Original Reading (°C) 2.2 Corrected Reading (°C) 2.6
Temp. By: (Temp. Blank) Cooler Surface: Glass / Plastic /Metal /Other: _____
Thermo. ID No.: 535 Thermo. Correction Factor (°C): 0.4
☐ Evidence of Cooling and date received = date sampled

Sample Receipt Discrepancies: ☐ No ☒ Yes **(See below for discrepancies.)**

Note: If discrepancies are present, CAS will proceed with analyses until/unless directed otherwise by the client.

- ☐ Chain of Custody not present - information taken from: Cover Letter ☐ Container ☐ PO ☐ CAS Proj. Mgr. ☐
- ☐ Container label absent
- ☐ Chain of Custody incomplete [see detail below]
- ☐ Chain of Custody missing date/time sampled (excl. TB or Dup.)
- ☐ Date or Time sampled obtained from container label
- ☐ Chain of Custody missing sampler's name
- ☐ Chain of Custody missing matrix (sample type)
- ☒ Missing relinquished information: (signature) (date) (time)
- ☐ Sample excluded from Chain of Custody
- ☐ Sample listed on Chain of Custody, not received
- ☐ Sample description on container and Chain of Custody do not agree
- ☐ Air bubbles in Aqueous VOA vials larger than pea-size [approx. 6 mm]
- ☐ Cooler temperature exceeded 0.1 - 6.0 °C requirement [Do not mark if samples do not require cooling to 0.1 - 6.0 °C.]
- ☐ Broken or leaking containers (detail actions below)
- ☐ Sample container type or labeled chemical preservation inappropriate
- ☐ Other discrepancies: _____

Detail to discrepancies/comments:

Completed by: JMS Date Completed: 11-15-11

Works Cited:

Allran, J. W., & Karasov, W. H. (2001). Effects of Atrazine on Embryos, Larvae, and Adults of Anuran Amphibians. *Environmental Toxicology and Chemistry, 20*(4), 769-775.

Cisse, Ibrahim and Xumei Mao. 2008. Nitrate: Health Effect in Drinking Water and Management for Water Quality. Environmental Research Journal 2(6): 311-316.

Department of Natural Resources. University of Wisconsin, 28 Jan 2003. <http://www.dnr.state.wi.us/org/water/dwg/nitrate.htm> Accessed 3 Oct 2011.

Environmental Protection Agency. "Nitrate: Ag 101". <http://www.epa.gov/agriculture/ag101/impactnitrate.html> Accessed 5 Oct 2011.

Garry, V. F., Schreinemachers, D., Harkins, M. E., & Griffth, J. (1996). Pesticide Appliers, Biocides, and Birth Defects in Rural Minnesota. *Environmental Health Perspectives, 104*(4), 394-399.

Hayes, T. B., Collins, A., Lee, M., Mendoza, M., Noriega, N., Stuart, A. A., & Vonk, A. (2002). Hermaphroditic, demasculinized frogs after exposure to the herbicide atrazine at low ecologically relevant doses. [Research Support, Non-U.S. Gov't Research Support, U.S. Gov't, Non-P.H.S.]. *Proceedings of the National Academy of Sciences of the United States of America, 99*(8), 5476-5480. doi: 10.1073/pnas.082121499