

KANSAS GEOLOGICAL SURVEY

1930 Constant Ave., Campus West
The University of Kansas
Lawrence, Kansas 66047-3726
Phone: 785-864-3965
Fax: 785-864-5317

Ms. Donna J. Crawford, Project Director
Governmental Assistance Services
905 Joseph Dr.
Lawrence, KS 66049

March 16, 2005

Dear Ms. Crawford:

I have reviewed the sanitary sewer collection system plans for the City of Reserve, KS. Based on the information available to me the overall the project looks satisfactory and the recommendations for a bentonite lining in addition to the compacted soil layer seems satisfactory for decreasing potential leakage from the lagoon system.

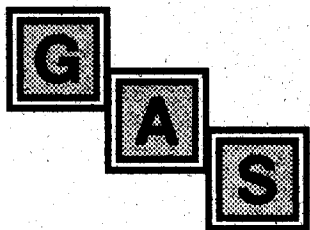
My main concern with the study is that there was no mention of how the failing septic systems were to be addressed. A conversation with you last week indicated that a plan is underway for removal of the failed systems upon completion of the new sewage system. As long as the systems are closed correctly and current waste is removed and disposed of correctly there should not be a problem. My concern arises from the description in the project that the city has had previous problems with nitrate in the drinking water. If the septic systems are not removed and closed properly there may be additional problems in the future as the waste moves downward to the water table. The Uniform Plumbing Code, Sec. 722, states that *every cesspool, septic tank, and seepage pit that has been abandoned or is not used shall have the contents and top removed, and then be filled with earth, sand, gravel, concrete or other approved material. When abandoned in conjunction with connecting to a public sewer, filling shall occur within 30 days* (Rogers and Powell, 1998, Plugging Cisterns, Cesspools, Septic Tanks, and Other Holes, MF-2246 July 1998, <http://www.oznet.ksu.edu/library/h20ql2/mf2246.pdf>).

My recommendation is that the project should go forward provided that information concerning the septic tank removal plan is included in the package.

If you have questions or comments concerning this review please contact me at the above address.

Sincerely,

Margaret A. Townsend
Hydrogeologist



Governmental Assistance Services

905 Joseph Drive

Lawrence, Kansas 66049

785-832-2141 • Fax 785-832-1111

Toll Free 888-832-3335

e-mail: gasdonnaa@aol.com

March 7, 2005

Dr. William Harrison
KS Geological Survey
University of Kansas
1930 Constant Ave.-Campus West
Lawrence, KS 66047

RE: Environmental Review – Reserve, KS – Sanitary Sewer Improvements

Dear Dr. Harrison:

The City of Reserve, Kansas currently does not have a sanitary sewer collection system with a centralized treatment facility. All homes are serviced by septic tanks and drain into a central, common lateral field. Septic systems are in various stages of failure with sewage at the ground surface in several backyards.

The city plans to construct a 3-cell gravity flow sanitary sewer collection and treatment system. The project location is within the city limits of Reserve along Kansas Highway 73/159, 10 miles north of Hiawatha. (See attached maps.) Alternatives are also attached for the construction process.

The city will request financial aid as follows:

KDOC CDBG Grant - \$194,000
KDHE Hardship Grant - \$331,000
Rural Development Grant/Loan - \$661,000
Sac & Fox - \$100,000

Please submit your response to Governmental Assistance Services, 905 Joseph Dr., Lawrence, KS 66049.

If you have questions please call me at 888-832-3335.

Sincerely,

A handwritten signature in cursive script that reads "Donna J. Crawford". The signature is written in black ink and is positioned above the printed name and title.

Donna J. Crawford
Project Coordinator

Enc/ Partial Engineering Report
Topo Map
Project Map

SECTION 5: ALTERNATIVES

5.1 NO ACTION

The City of Reserve realized the need for a city-wide sanitary sewer collection system and lagoon many years ago. In 1990, an engineering report was prepared for that purpose. At that time, water system improvements proved to be the priority (excessive nitrates in the well and leaky distribution lines and water tower) and the sewer improvements were put on hold. Since that time, the city has seen further degradation to the septic tank system infrastructure and increased construction costs. The city realizes that the sanitary sewer improvements cannot be put on hold any longer.

5.2 COLLECTION SYSTEM

Alternatives for the collection system include type of materials and layout. Both will greatly influence the cost of the project. A preliminary layout of the collection system is shown on an aerial map in Appendix B as part of the Collection System and 3-Cell Lagoon Plan. This preliminary layout includes 7,200 feet of 8" sanitary sewer main and 22 manholes. Materials of construction will likely be PVC sewer main and standard concrete manholes as reflected in the cost estimates of Appendix D. Two (2) bore holes were drilled in the town of Reserve, B-3 and B-4 in Appendix C, and illustrate that no rock was found within the 20' depth of the drill, good news for construction of the collection system. The total construction cost for the collection system is estimated at \$652,800.00.

5.3 MECHANICAL PLANT

A Mechanical plant is more desirable for communities larger than the size of Reserve. The initial construction and monthly operational cost of a mechanical plant prohibits this option. In addition, the effluent permit limits for a mechanical plant are more stringent than those for a discharging lagoon.

5.4 CONTINUOUSLY DISCHARGING 3-CELL SYSTEM, 120 DAY DETENTION

The continuously discharging waste stabilization lagoon is designed based on: 1.) 120 days of hydraulic detention (or storage), and 2.) organic (BOD₅) loading of the primary cells.

a. 120 days Detention Time:

$$19,250 \text{ gpd} \times 120 \text{ days} = 2,310,000 \text{ gallons} \\ (308,802 \text{ ft}^3)$$

Volume
Required for
Total Treatment
Facility

b. BOD₅ Loading:

Primary Cells 1 and 2 must provide enough surface area for a loading rate = 34 lbs./BOD₅/acre/day.

$$28 \text{ lb./day} \div 34 \text{ lb./acre/day} = 0.82 \text{ acres} \\ (35,719 \text{ ft}^2)$$

Water Surface Area
Required for
Primary Treatment

c. Geometry: (Ref. Appendix B)

TABLE 5.1: 3-CELL SUMMARY				
	Depth (ft)	Side Slopes	Surface Area (Acres)	Volume (ft ³)
Cell 1	5	3:1	0.83	149,625
Cell 2	5	3:1	0.55	97,500
Cell 3	10	3:1	0.28	63,750
Total:			1.66	310,875

d. Site: (Ref. Appendices A & B)

A preliminary site has been chosen on the northeast corner of the town between the Union Pacific Railroad and a county road. The 3-cell lagoon geometrically fits well in this area and the topography is favorable. The ground is currently cultivated farmland. There are no residential habitations within a 500' radius of the lagoon. The receiving watercourse is an unnamed, dry tributary to Walnut Creek located on the east side of the Union Pacific Railroad. The tributary runs parallel to the railroad and flows to the north. Boring underneath the railroad will be required and a permit from Union Pacific must be obtained to do so.

e. 100-yr. Flood Elevation

The preliminary site is not part of the FEMA flood insurance mapping. The 100-yr. flood elevation was calculated by first determining the drainage area (approximately 114 mi²) using the USGS Regression Method to calculate flow ($Q_{100} = 20,000$ cfs). A cross section through Walnut Creek across from the preliminary site was plotted and Manning's equation was utilized to determine a 100-yr. flood elevation of 902.35. This elevation is well below the expected top of dike elevation (approx. 910.00).

f. Geology: (Ref. Appendix C)

On January 24, 2005, two (2) Bore Holes, B-1 and B-2, were drilled on the preliminary lagoon site. No rock was found but the ground water elevation is at 14.4' and 17.2', respectively, below ground level at B-1 and B-2. This may pose a problem for meeting the 10' separation requirement between the bottom of pond and the water table, particularly for a gravity flow design directly into the

lagoon. The depth of the third cell may not be able to be 10'. This will not be determined until surveying has been completed and the project is in design. On a preliminary basis, there is a 2-3' difference in elevation between B-1 and B-2. The design of the lagoon floor will be at the higher elevation (B-2) with a fill section down to the other hole (B-1). In this way, the complete gravity flow system *may* be possible without breaching the 10' separation requirement.

The average hydraulic conductivity at B-1 is 1.4×10^{-5} cm/sec. Utilizing the hydraulic conductivity, the rate of loss of wastewater through the soil is 2.38 inches/day for a 5' depth (Cells 1 and 2) with a 1' layer of compacted soil in the pond bottom. Additionally, the rate of loss of wastewater through the soil is 4.76 inches/day for a 10' depth (Cell 3) with a 1' layer of compacted soil in the pond bottom. This does not meet the KDHE maximum requirement of 0.25 inches/day of allowable seepage. Pond Sealing with Bentonite will be required and bench tests for optimum application rates will be performed prior to design. The results must also include the optimum application rate for zero seepage, or 1/64 inch/day, if a variance for breaching the 10' separation requirement as discussed above is needed and acquired. The zero seepage requirement will be met not only by the application of additional bentonite, but also by constructing the pond bottom with a 1.5' layer of compacted soil.

g. Opinion of Probable Cost: (Appendix D)

Option 1: Gravity Flow

This Option assumes that the complete gravity flow system can be constructed but will violate the 10' separation requirement. The quantity for Pond Sealing assumes an 18" inch thick layer of compaction with Bentonite in three 6" lifts for zero seepage. The construction cost of this 3-Cell, 120-day detention, discharging lagoon is estimated at \$241,590. With the Collection System construction cost and all contingencies, a total project cost of \$1,291,000 can be expected.

If during design it is found that the elevation of the lagoon bottom will not breach the 10' separation requirement, less Bentonite will be needed and a 12" thick layer of compaction in two 6" lifts can be constructed to meet the 0.25 inches/day of seepage requirement. It may also be possible that zero seepage will only be required for Cell 3.

Option 2: Pump Station

This option assumes that the complete gravity flow system is not feasible and a pump station will be needed to lift the sewage into the lagoon. The lagoon shall be constructed at a higher elevation keeping the 10' separation requirement intact. The construction cost of this 3-Cell, 120-day detention, discharging lagoon with pump station is estimated at \$310,640. With the Collection System construction cost and all contingencies, a total project cost of \$1,390,000 can be expected.

5.5 IRRIGATION

Wastewater irrigation is intended to irrigate crops that are not produced for direct human consumption. The City should consider and discuss with the adjoining landowners the possibility of intermittent short-term irrigation around the facility, including the existing grassed dikes and waterways. During hot summer days the water level may be lowered by irrigation, resulting in less of a discharge in the fall and spring.

The following management and monitoring requirements apply for treated wastewater from the treatment facility utilized for irrigation purposes at the dikes and waterways.

- Irrigation shall be limited in such a manner as to avoid runoff of effluent to adjacent landowners.
- Control tailwater to prevent runoff to surface waters of the State
- Draw water only from the final cell in the treatment process.
- Irrigation using treated wastewater shall occur only at times when public access to the irrigated area is restricted.
- No ponding of wastewater on the ground surface.
- All monitoring of the treated wastewater shall be conducted using EPA approved methods and KDHE certified laboratories.
- The results of the analyses shall be reported quarterly to the address shown on the standard discharge monitoring report.

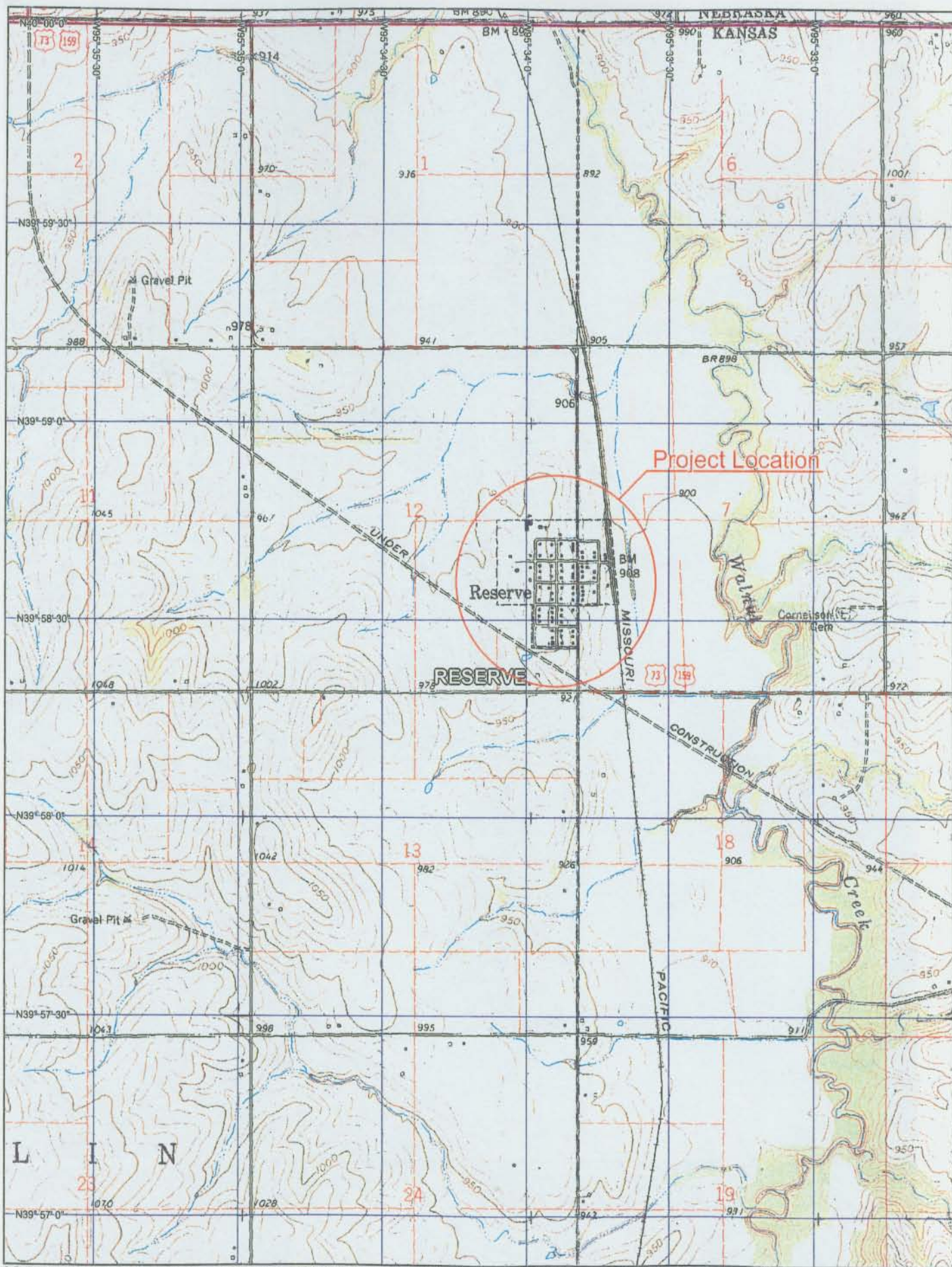
SECTION 6: RECOMMENDATIONS

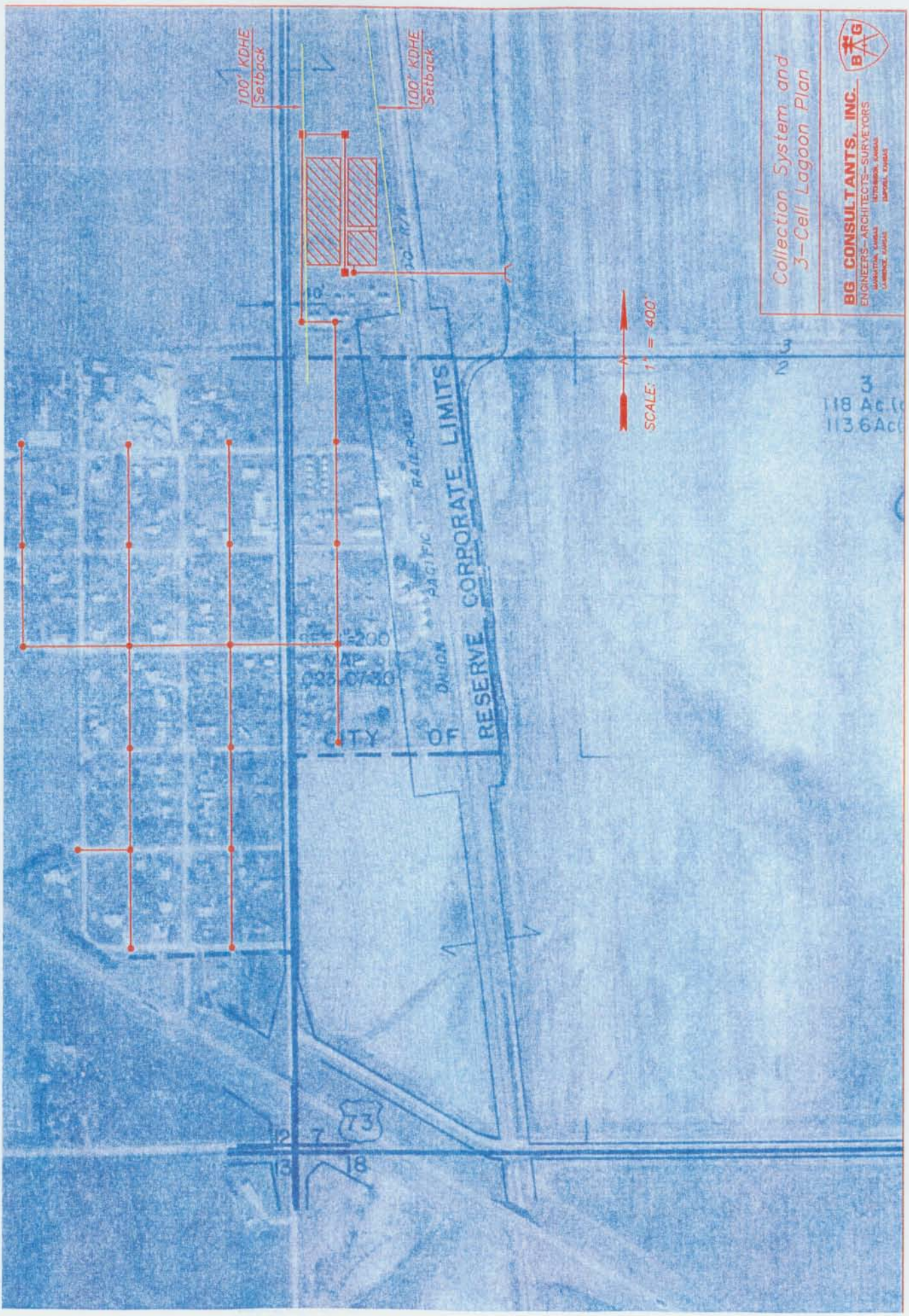
6.1 FINAL RECOMMENDATION

It is our final recommendation that Option 1: Gravity Flow into the 3-Cell, 120-day detention, discharging lagoon from a new city-wide sanitary sewer collection system is the most cost effective option for the City of Reserve. It will not be fully realized whether the complete gravity flow system will be feasible until the project is in design with accurate surveying data. The increased operation, maintenance, and replacement (OM&R) costs, along with the increased construction cost, make Option 2: Pump Station the more expensive option. Maintenance of the pump station will require more time, effort, and repairs. Electrical costs were also considered and are included in the OM&R costs. Table 6.1 summarizes the 20-year Present Worth Cost Analysis.

TABLE 6.1: 20-YEAR PRESENT WORTH COST ANALYSIS				
	Opinion of Probable Construction Cost	2005 Annual OM&R (3% Inflation)	20-yr. Salvage Value	Present Worth Cost
Option 1: Gravity Flow	\$1,286,000	\$2,962	\$645,500	\$684,567.00
Option 2: Pump Station	\$1,385,000	\$4,640	\$687,500	\$766,531.00

The designer must first exhaust all efforts to make Option 1 work. If it is ultimately found that the project cannot occur without a pump station, Option 2 will be pursued. The City of Reserve will be informed throughout the design process and the financial implications of both options will be fully known as discussed in the next Section.



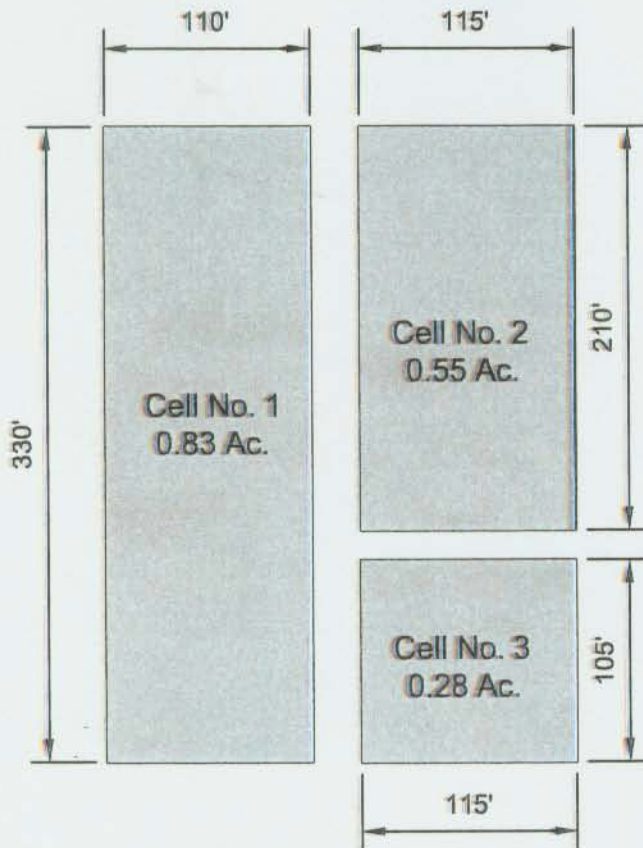


Collection System and
3-Cell Lagoon Plan



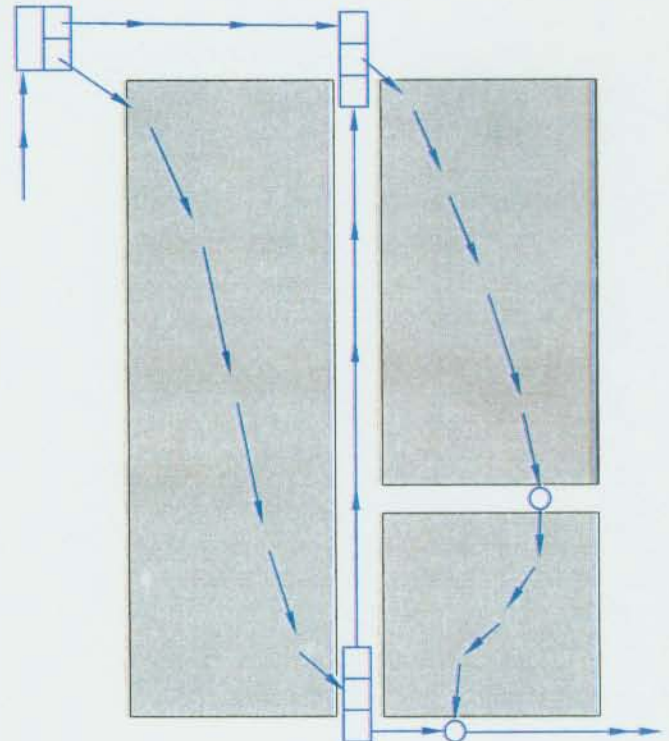
BIG CONSULTANTS, INC.
ENGINEERS-ARCHITECTS-SURVEYORS
LAND SURVEYING
CIVIL ENGINEERING
ARCHITECTURE
PLANNING
LANDSCAPE ARCHITECTURE

Treatment Cell Summary			
	Depth	Side Slopes	Volume
Cell 1	5'	3:1	149,625 ft. ³
Cell 2	5'	3:1	97,500 ft. ³
Cell 3	10'	3:1	63,750 ft. ³
Total			310,875 ft. ³



Water Surface Area

Total Acreage = 1.66 Ac.



Flow Schematic

Scale: 1"=100'

3-Cell Lagoon Option 120-Day Detention

BG CONSULTANTS, INC.

ENGINEERS - ARCHITECTS - SURVEYORS

MANHATTAN, KANSAS
LAWRENCE, KANSAS

HUTCHINSON, KANSAS
EMPORIA, KANSAS





ASSOCIATED ENVIRONMENTAL, INC.

404 Pottawatomie, Manhattan, Kansas 66502

Phone (785) 776-7755 * Fax (785) 776-0803

February 7, 2005

Mark Bachamp
BG Consultants
4806 Vue Du Lac Place
Manhattan, Kansas 66503

RE: Reserve, Kansas lagoon drilling.

Dear Mark:

On January 24, 2005, AEI drilled four soil borings to collect soil samples and determine the subsurface geology at those locations. Two of the soil borings, B-1 and B-2 were completed in an area designated to be a future site of waste water lagoons. Borings B-3 and B-4 were completed on city easements on the east end and west ends of the town of Reserve. The boring locations were determined by BG Consultants.

B-1 and B-2

The geology encountered in the B-1 and B-2 locations generally consisted of a brown clay loam soil from groundsurface to 1-foot below groundsurface (bgs). A brown grading to orange-brown silty clay was encountered from 1-foot bgs to the total depth of 20' bgs. The plasticity and moisture content varied with depth. A moist zone was encountered at an 11 to 12 foot depth. The borings were left open for 48-hours to see if the borings would produce groundwater. Static groundwater measurements were measured on January 26, 2005. Measurements were B-1 at 14.4 foot bgs and B-2 at 17.2 foot bgs.

Soils were collected from the 6' to 10' depth for laboratory determination of permeability and compaction. The hydraulic conductivity of the soil from the B-1 location was determined to be 1.4E-05 cm/s.

B-3

The geology encountered in the B-3 location generally consisted of a brown clay loam soil with gravel from ground surface to 1-foot below ground surface (bgs). A brown grading to orange-brown silty clay was encountered from 1-foot bgs to the total depth of 20' bgs. The plasticity and moisture content varied with depth. A moist zone was encountered at approximately 11 feet bgs. The boring was plugged upon completion of the drilling and groundwater was not present at that time.

B-4

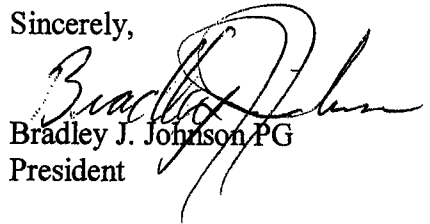
The geology encountered in the B-4 location generally consisted of a gravel with brown clay loam soil from ground surface to 1-foot below ground surface (bgs). A brown grading to orange-brown silty clay was encountered from 1-foot bgs to the total depth of 20' bgs. The plasticity and moisture content varied with depth. The boring was plugged upon completion of the drilling and groundwater was not present at that time.

Conclusion

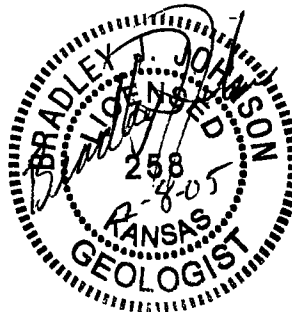
Based on the drilling activities and laboratory testing, the soils encountered at the depth of the proposed lagoon bottom may need the addition of bentonite to satisfy the KDHE infiltration requirements.

Associated Environmental, Inc. appreciates the opportunity to provide our geological services to BG Consultants. Please find attached copies of the completed boring logs, map depicting boring locations and laboratory report forms. If you have any questions or require additional information, please call me at 776-7755.

Sincerely,


Bradley J. Johnson PG
President

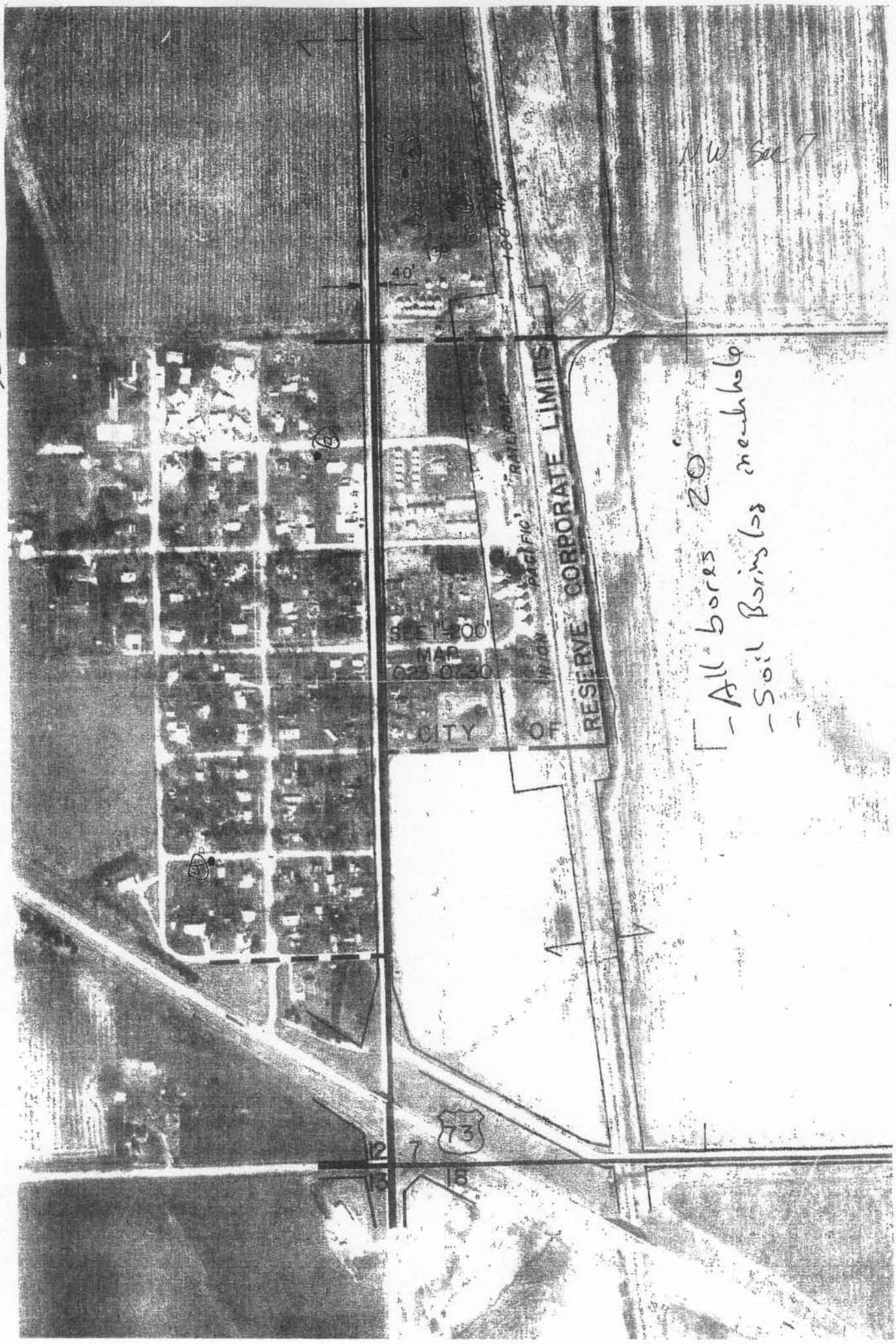
Attachments



TOWN COUNTY, KANSAS

DATE (

Reserve KS
Scale 1:200



- All bores 20'
- Soil Borings include



ASSOCIATED
ENVIRONMENTAL
INC.

404 Pottawatomie
Manhattan, Kansas 66502
(913)776-7755/Fax 776-9555

Page 1 of 1

Client: BG-Reserve		WO#: 1582	Boring/Well: B-1
Project: BG-Reserve		Well Construction Data	
Date Started: 1/24/05	Date Completed: 1/24/05	Screen:	From: - To:
Geologist: B. Johnson	TOC Elevation:	Pack:	From: - To:
Drilling Co.: AEI	Driller: B. Johnson	Seal:	From: - To:
Method: 4" SFA	Equipment: Simco 2800	Grout:	From: - To:
Boring Depth: 20.0	Ground Surface Elevation:	In/Out Casing:	
Initial GW Level: 12.0	GW Level: 14.4	Time/Date:	Static GW Elev.:

Depth	Sample	Sample Number	Blow Count Rec./RQD	Head Space (ppm)	Lithology	Description	Remarks	Well Construction
0						Brown clay loam, soil		
						Silty Clay (CL), brown, at plastic limic, firm		
5						, orange-brown, firm to soft, grades to		
10						, orange brown, gray, trace silt, at plastic limit, firm to soft	Permeability=1.4X10 ⁻⁶ cm/s	
15						, orange brown at plastic limit, soft-firm, more moisture		
20						, orange brown at plastic limit, firmer	Plugged with bentonite and soil	



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Manhattan, Kansas 66502
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Page 1 of 1

Client:		BG-Reserve		WO#:		1582		Boring/Well:		B-2	
Project:		BG-Reserve		Well Construction Data							
Date Started:		1/24/05		Date Completed:		1/24/05		Screen:		 From: - To:	
Geologist:		B. Johnson		TOC Elevation:				Pack:		 From: - To:	
Drilling Co.:		AEI		Driller:		B. Johnson		Seal:		 From: - To:	
Method:		4" SFA		Equipment:		Custom		Grout:		 From: - To:	
Boring Depth:		20.0		Ground Surface Elevation:				In/Out Casing:			
Initial GW Level:		11.0		GW Level:		17.2		Time/Date:		Static GW Elev.:	
Depth	Sample	Sample Number	Blow Count Rec./RQD	Head Space (ppm)	Lithology	Description			Remarks	Well Construction	
0						Soil, brown clay loam				0	
5						Silty Clay (CL), brown, at plastic limit, firm orange-brown, mottled gray, firm to soft, at plastic limit				5	
10						grades to more gray very moist				10	
15						orange brown, firmer, at plastic limit				15	
20						orange brown			plugged with bentonite and soil	20	



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Page 1 of 1

Client: BG-Reserve		WO#: 1582	Boring/Well: B-3
Project: BG-Reserve		Well Construction Data	
Date Started: 1/24/05	Date Completed: 1/24/05	Screen: 	From: - To:
Geologist: B. Johnson	TOC Elevation:	Pack: 	From: - To:
Drilling Co.: AEI	Driller: B. Johnson	Seal: 	From: - To:
Method: 4" SFA	Equipment: Simco 2800	Grout: 	From: - To:
Boring Depth: 20.0	Ground Surface Elevation:	In/Out Casing:	
Initial GW Level: 11.0	GW Level:	Time/Date:	Static GW Elev.:

Depth	Sample	Sample Number	Blow Count Rec./RQD	Head Space (ppm)	Lithology	Description	Remarks	Well Construction
0						Soil, and gravel		
						Silty clay (CL), brown, at plastic limit, firm,		
5						, orange brown, firm to soft, at plastic limit		
						, moisture above plastic limit		
10						, brown to orange brown, soft, at plastic limit		
15						, brown to orange brown, firmer at plastic limit		
20						Plugged with cuttings		



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Page 1 of 1

Client: BG-Reserve		WO#: 1582	Boring/Well: B-4
Project: BG-Reserve		Well Construction Data	
Date Started: 1/24/05	Date Completed: 1/24/05	Screen: 	From: - To:
Geologist: B. Johnson	TOC Elevation:	Pack: 	From: - To:
Drilling Co.: AEI	Driller: B. Johnson	Seal: 	From: - To:
Method: 4" SFA	Equipment: Simco 2800	Grout: 	From: - To:
Boring Depth: 20.0	Ground Surface Elevation:	In/Out Casing:	
Initial GW Level:	GW Level:	Time/Date:	Static GW Elev.:

Depth	Sample	Sample Number	Blow Count Rec./RQD	Head Space (ppm)	Lithology	Description	Remarks	Well Construction
0						gravel, soil		
						Silty Clay (CL), brown, firm, at plastic limit		
5						,brown to orange brown, soft, at plastic limit		
10						,orange brown, firm-soft, at plastic limit		
15						,same		
20							Plugged with cuttings	

FIELD ACTIVITY DAILY LOG

DATE: 1-24-05

PG. OF

PROJECT MGR:

PROJECT NAME

BB - Reserve

PROJECT NO.

1582

FIELD ACTIVITY

Soil Borings

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

6-630 - Load & Gas

0915 Arrive site check utilities & locations

0930 Start drilling B-1 in Field

Shelly tube sample from 7-9'

Shelly tube sample from 7-9' B-2

Send Kenny on Wed. to measure wt's in B-1, B-2 & plug

1330 Finished drilling

1330-1600 Drive home unload

1-26-05

Kenny measured wt's in B-1, B-2

B-1 14.40

B-2 17.20

Plugged wells.

PERSONNEL ON SITE:

VISITORS ON SITE:

PHONE CALLS:

WEATHER CONDITIONS/REMARKS



ASSOCIATED
ENVIRONMENTAL
INC.

Manhattan, Kansas
Phone: 785/776-7755 • Fax 785/776-0803

Associated Environmental, Inc.
Soils Testing Laboratory

Laboratory Report
for

Determination of Hydraulic Conductivity Using a Flexible Wall Permeameter
Falling-Head Test Method
ASTM Test Method D 5084 - 90

Client:	<u>BG Consultants</u>	Date Received:	<u>Jan-26-05</u>
	<u>4806 Vue DuLac</u>	Date Completed:	<u>Feb-4-05</u>
	<u>Manhattan, KS 66503</u>	AEI Lab No.:	<u>0501002A</u>

Sample Identification: B-1 (7-9')

Special Sample Preparation Method Used: Sample tested as received.

Permeant Fluid:	<u>Deaired City Water</u>	Total Backpressure (psig):	<u>80.0</u>
Range of Hydraulic Gradients Used (dimensionless):		Maximum: <u>9.8</u> Minimum: <u>8.9</u>	
Degree of Saturation, Calculated from "B" Value (%):	<u>100</u>		

Initial Sample Measurements

Sample Diameter (cm):	<u>7.23</u>	Moisture Content (%):	<u>25.4</u>
Sample Height (cm):	<u>8.05</u>	Sample Volume (cm ³):	<u>330.49</u>
Sample Mass (grams):	<u>629.00</u>	Dry Unit Weight (lbs/ft ³):	<u>94.7</u>

Final Sample Measurements

Sample Diameter (cm):	<u>7.24</u>	Moisture Content (%):	<u>27.9</u>
Sample Height (cm):	<u>7.95</u>	Sample Volume (cm ³):	<u>327.29</u>
Sample Mass (grams):	<u>640.00</u>	Dry Unit Weight (lbs/ft ³):	<u>95.4</u>

Comments:

Average Hydraulic Conductivity: m/s: 1.4E-07 cm/s: 1.4E-05

[illegible]