Project for Community Development Block Grant and Kansas Department of Health and Environment Water Pollution Control Loan

Applicant: City of :Princeton, Kansas
Wastewater Treatment System Improvements

Contact Person: Donna J. Crawford

Address: Governmental Assistance Services
905 Joseph Drive
Lawrence, KS 66049

Phone: 785-832-2141

Original and supplemental information sent to the Kansas Geological Survey for environmental review.

Agency Review Comments:

The rehabilitation of the lagoon system for wastewater treatment appears to be appropriate, given that the Kansas Department of Health and Environment agreed to let the City continue using the existing lagoons even though the minimum elevation of the dikes are less than the 100-year flood level. For the long-term, option number 3 appears to have definite advantages, especially that a new cell would will not be located in the 100-year floodplain area. The benefits are not only removal of the potential problem of lagoon dike erosion on the new cell but also the removal of the slug of wastewater from the cell that could enter floodwaters in Middle Creek overtopping the lagoon and be carried downstream to impact aquatic systems and water supplies. In general, the long-term benefits of the improvements to the wastewater treatment system should offset any short-term adverse environmental impacts during construction.

Recommended Action:

__X__ Clearance of project should be granted

____ Clearance of project should not be granted

____ Clearance of project should be delayed until the issues or questions have been clarified

____ Clearance of project should not be delayed, but the applicant (in the application) should address or clarify the questions or concerns indicated above

Donald Whittemore	Geohydrology Section, Kansas Geological Survey	7/25/05
Reviewer's Name	Division/Agency	Date

Donald W Whittemore
Reviewer's Signature

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Toll Free 888-832-3335
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June 27, 2005

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

RE: Supplemental to Princeton, KS Environmental Review Request

Dear Dr. Harrison:

The attached Princeton supplemental Report is for the purpose of clarifying the scope of work and cost figures for the planned sanitary sewer upgrade.

Sincerely,

Donna J Crawford

Donna J. Crawford
Project Coordinator

Enc/ Supplemental

March 3, 2005

City of Princeton
Council Members
P.O. Box 58
Princeton, KS 66078

Re: Sanitary Sewer System Facility Plan
Supplemental Report
Project No.: 12237.501

Dear Council:

In February, 2005 a Sanitary Sewer System Facility Plan was completed by Bartlett & West Engineers, Inc. This report was inconclusive in the recommendation for the improvement of the City of Princeton's Wastewater Treatment System because of the datum inconsistencies between the original facility drawings and the Flood Insurance Rate Map. A brief topographic survey was completed to confirm relevant elevations and to determine the existing lagoon water depths. The result of this survey, in conjunction with advice from the Kansas Department of Health and Environment, allows this Supplemental Report to provide recommendations for the improvement of the wastewater system operation. This Supplement Report should be reviewed in concurrence with the Sanitary Sewer System Facility Plan.

Based on the Flood Insurance Rate Map (20056501501B- June 1991) the existing City of Princeton wastewater lagoon system is located within the 100-year flood plain. The results of the wastewater system survey, as illustrated in Figure 1, indicates the minimum dike elevation of 938.36 feet is approximately 3 feet below the estimated 100-year flood elevation of 941.5 feet. The potential exists for the submergence of the lagoon system during a rain event of less than a 100-year magnitude. However, based upon the minimal damage caused by the flood waters encountered in 1993, the structural system is apparently capable of withstanding a flooding situation. Therefore with the KDHE's concurrence, it is recommended that the existing system remain active and that the lagoons be rehabilitated to improve operation.

The Sanitary Sewer Facility Plan outlined initial and final phase improvements. To receive maximum points under one category of the Community Development Block Grant (CDBG) rating system, the City must contribute at least 50 percent of the required funds. Any work completed ahead of the CDBG grant acceptance date will not count as local match dollars. With KDHE's concurrence, it is recommended the initial phase improvements described in the original Facility Plan not be completed immediately but should be included in the overall project improvement costs. Doing so will increase the overall amount of grant funds the City might receive.

The rehabilitation option (Option 1) described in the final phase improvements of the Sanitary Sewer System Facility Plan included the sludge removal and bottom rebuilding in all three cells, as well as, the construction of interconnect structures for cell flow manipulation. The completed survey information indicated that the lagoon water depth averages five feet (4.80-5.24 feet). Therefore, the capacity losses indicated in Table 2 (Page 4 of the Facility Plan) are accurate and the volume losses due to sludge buildup in Cells 1 & 2 accounts

for over 45% of the total capacity. The sludge removal in Cells 1 & 2 will provide the City with an additional 25 days of detention time resulting in a total of 137 days detention. The rehabilitation of Cell 3 will only gain the City 4 days of detention and is, therefore, not considered at this time. If the sludge removal process for Cells 1 & 2 is easily executed, the sludge removal in Cell 3 may be considered. The placement of rip-rap for dike erosion control in all three cells is recommended.

The original 1964 construction plans indicate the 8-inch gravity sewer line approaching the lagoons was to be installed at minimum slopes of 0.30-0.40 percent. The recent survey indicates that these slopes actually range from 0.06-0.25 percent. This less than minimum slope does not provide adequate head differential to install bypass structures between Cell 1 and Cell 2 or Cell 2 or Cell 3. Therefore, the influent diversion will be the only new line installed. This will allow flow to be diverted to Cell 1 or Cell 2. Pumping from cell to cell will need to be implemented during the rehabilitation of the cells.

Erosion has impacted the Middle Creek stream bed and bank stabilization is required to prevent the stream flow from washing out the lagoon system. The stream bank top is currently located approximately 16 feet from the lagoon fence line and nearly 33 feet from the lagoon dike edge. It is proposed that bank protection be installed to provide the necessary stabilization. A Corps of Engineers permit will need to be acquired to complete this part of the project.

The updated total project cost estimate for the revised rehabilitation option is outlined in Table 1 below. The stream bed and top of bank elevations were estimated in the original Facility Plan. This estimate was based on a bank height less than the actual height which is greater than 10 feet. Therefore, the cost estimate for the bank stabilization has been increased to accommodate installation. Additionally, other modifications to unit pricing and quantities have made to accommodate several categorical changes.

Table 1: Project Cost Analysis

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
OPTION 1 - *Rehabilitation (Revised)*				
Solar Mixer	2	EA	20000	40,000
Duck Weed Harvest	4	EA	3600	14,400
Sludge Removal & Disposal	3,700	CY	12.25	45,325
Rebuild Clay Liner	96,500	SF	0.25	24,125
8-inch DIP	50	LF	50	2,500
8-inch Valve & Structure	2	EA	2500	5,000
Bypass Pumping	2	LS	6000	12,000
Discharge Structure Grating	1	LS	5000	5,000
Rip-Rap	12,100	SF	5.00	60,500
Bank Stabilization	1	LS	26000	26,000
Mobilization	1	LS	5000	5,000
SUBTOTAL				239,900
Engineering, Permitting, & Grant Administration				*60,000*
TOTAL PROJECT COST				**$ 299,900**

The City Council recently voted to raise the sewer fee to $13.50 per month. This is a $5.00 per month increase and will start on June 1, 2005. Based on the 2003-2005 sewer budget provided in the Appendix of the Sanitary Sewer System Facility Plan, the City has been operating with an approximate $3,300 deficit. A loan application for 50% of the total project cost ($150,000) should be completed and submitted to the KDHE for Kansas Water Pollution Revolving Loan Fund consideration. For the City to remove the existing deficit and begin repayment of the Kansas Water Pollution Revolving Loan a monthly sewer rate of approximately $16.50 will likely be required. This will be an additional rate increase of $3.00 per month per user.

The implementation of this revised Facility Plan will improve the lagoon circulation, will increase the lagoon detention time to nearly 140 days, and should result in compliance with the NPDES permit requirements under normal operating conditions. It is recommended that the City begin the KDHE and CDBG loan and

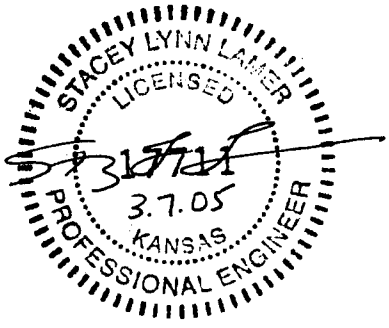
grant processes. The loan matching requirements must be completed prior to submitting the October 15, 2005, CDBG grant application. In order to qualify for CDBG funding, the City will likely have to complete an income survey. The services for completing the income survey are typically completed by the City's grant writer. The City is encouraged to select a qualified grant writer to promptly begin the process.

Upon your approval of this Sanitary Sewer Facility Plan Supplemental Report, it will be forwarded to KDHE. Please contact me if you have any questions or concerns regarding this information.

Sincerely,

Stacey L. Lamer, P.E.

Enclosures (Figure 1)



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June 21, 2005

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

RE: Environmental Review – Princeton, KS – Sanitary Sewer Collection & Treatment System Improvements

Dear Dr. Harrison:

The City of Princeton, Kansas is proposing to upgrade their sanitary sewer collection & treatment system. The total project is estimated to be $554,255. The scope of work is construction of a new cell, removal of sludge, upgrade of valve discharge structure, bank stabilization and rip-rap.

The new cell construction is to be completed with KDHE and CDBG funds, a total of $356,167 of which will be funded half by CDBG grant funds and half KDHE loan. The other part of the project, sludge removal, etc., is expected to be funded by KDHE in the amount of $198,088.

The project is located in Section 14, Range 19, Township 18. Based on the Flood Insurance Rate Map (20056501501B-June 1991) the existing City of Princeton wastewater lagoon system is located within the 100-year floodplain. The results of the wastewater system survey, as illustrated in Figure 1 (next page), indicates the minimum dike elevation of 938.36 ft. is approximately 3 ft. below the estimated 100-year flood elevation of 941.5 ft. The potential exists for the submergence of the lagoon system during a rain event of less than a 100-year magnitude. However, based upon the minimal damage caused by the flood waters encountered in 1993, the structural system is apparently capable of withstanding a flooding situation. Therefore, with KDHE's concurrence, it is recommended that the existing system remain active and that the lagoons be rehabilitated to improve operation.

Please submit all comments to Governmental Assistance Services, 905 Joseph Dr., Lawrence, KS 66049.

If you have questions please call me at 888-832-3335 or Stacey Lamer, P.E. of Bartlett & West Engineers at 785-272-2252.

Sincerely,

Donna J Crawford

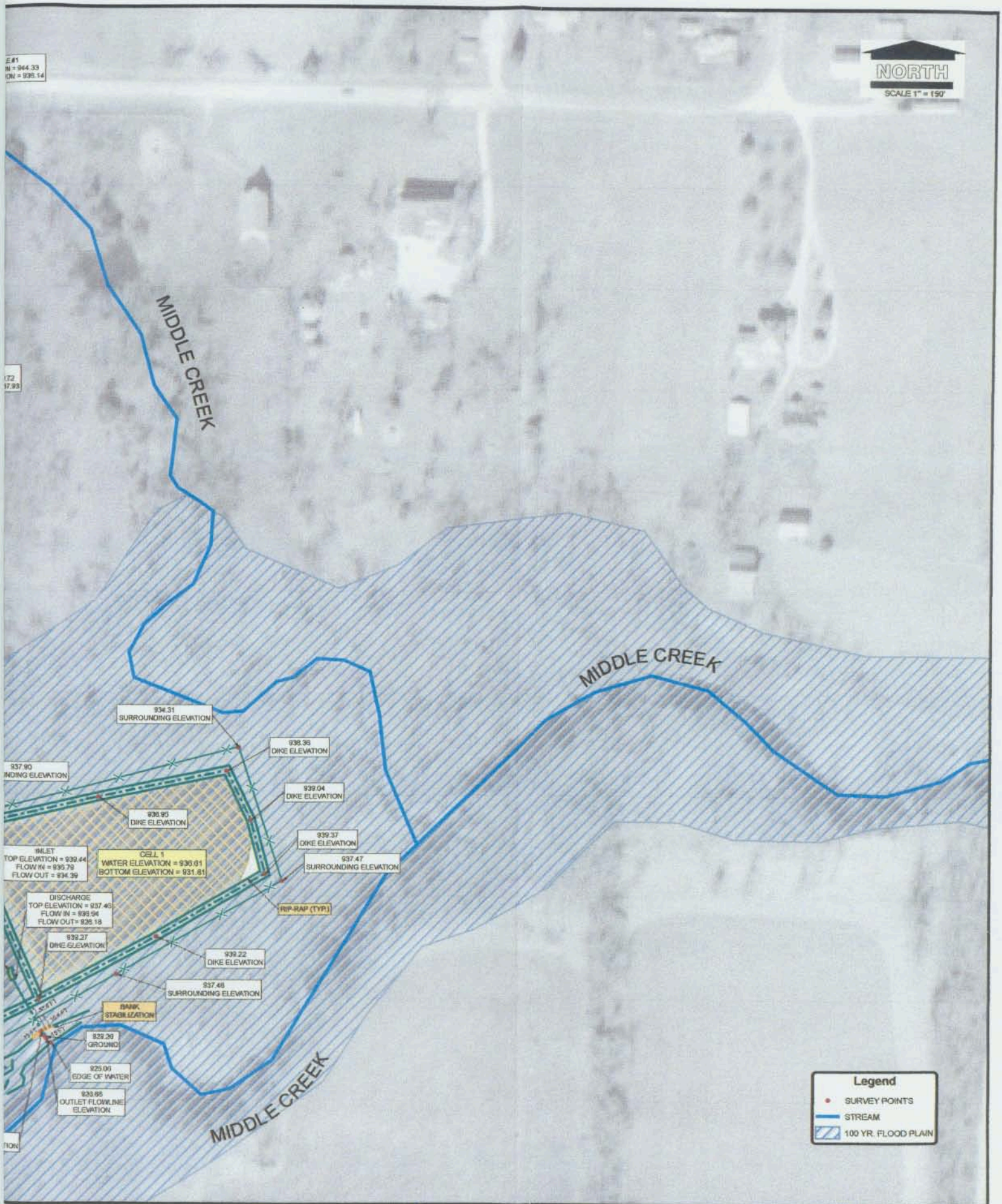
Donna J. Crawford
Project Coordinator

Enc/ Project Map
Topo Map
Eng. Info

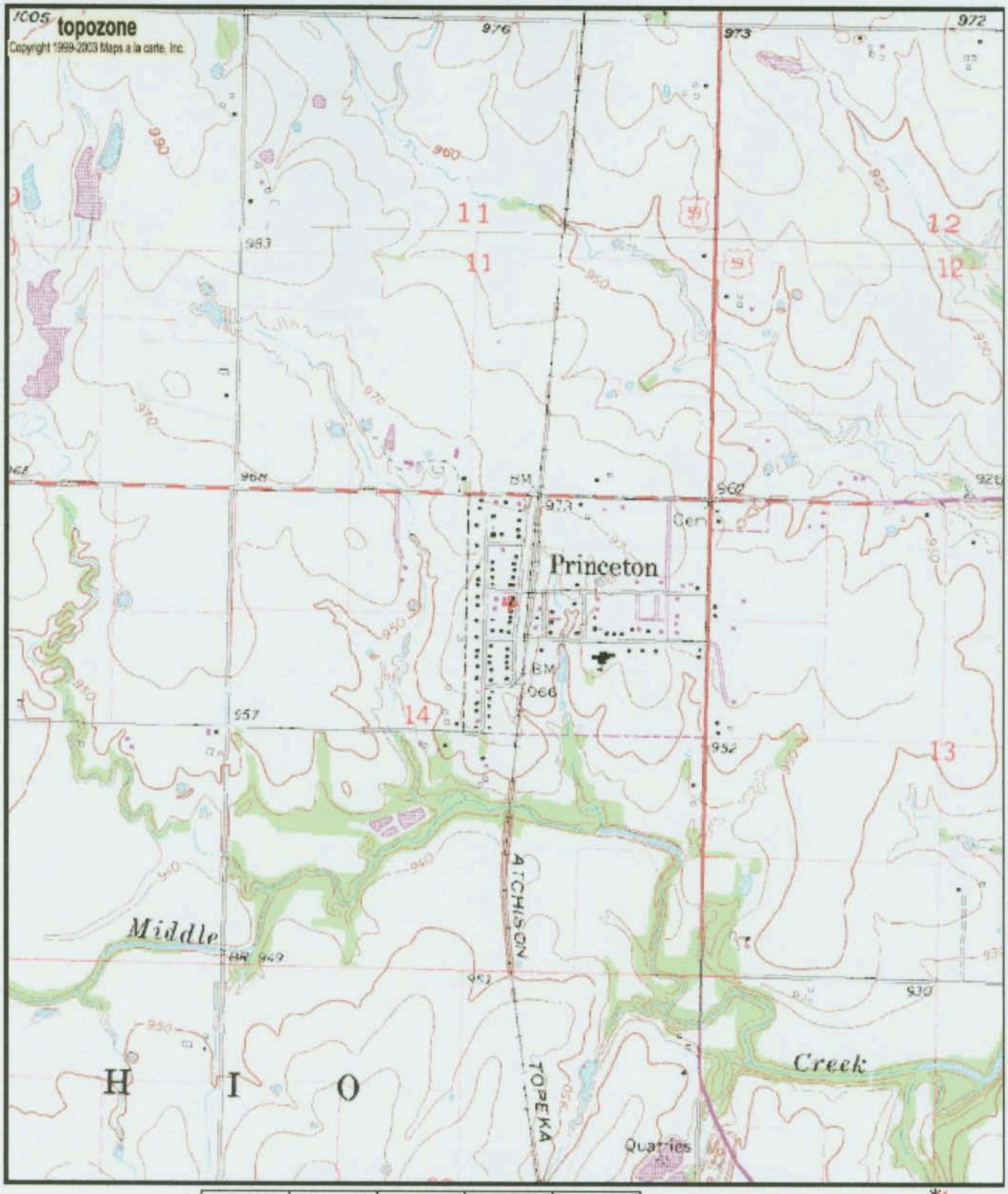
REV.	DATE	DESCRIPTION

DRAWN BY: CAR
DESIGN BY: SLL
CHECKED BY: SLL

BARTLETT & WEST
ENGINEERS
1200 EXECUTIVE DRIVE - TOPEKA, KANSAS
PHONE 785.272.2252 - FAX 785.272.7349
WWW.BARTWEST.COM



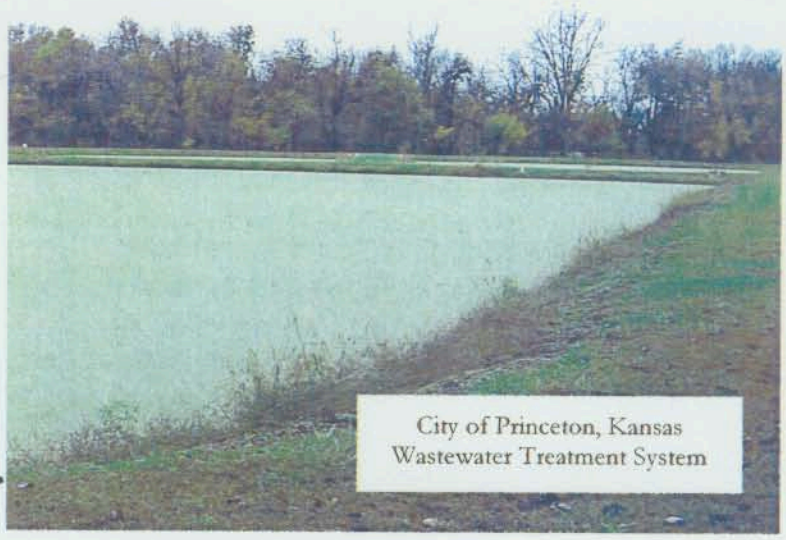
CITY OF PRINCETON FRANKLIN COUNTY, KS	FIGURE 1: REVISED WASTEWATER TREATMENT FACILITY PLAN	PROJ NO: 12237.500 SCALE: AS NOTED DATE: 03/2025	SHEET NUMBER 1 OF 1



Map center is UTM 15 301561E 4262515N (WGS84/NAD83)
Richmond quadrangle
Projection is UTM Zone 15 NAD83 Datum

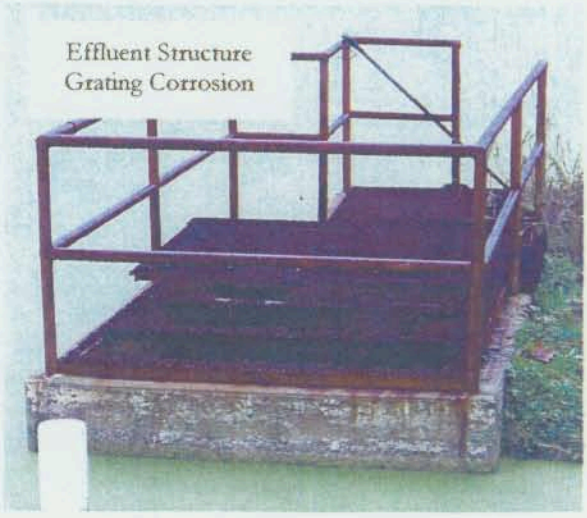
Background

The City of Princeton, Kansas is located in Franklin County approximately 10 miles south of Ottawa, Kansas on Highway 59. The City has approximately 300 residents that are served by the sanitary sewer system. This system consists of approximately 120 service lines that connect to approximately 16,000 feet of 8-inch vitrified clay pipe (VCP) sewer. The wastewater is transported by gravity into a 2.2 acre 3-cell lagoon system. The population has remained relatively unchanged over the past 10 years. The City currently has no industrial contributors to the wastewater system and there are no plans for industrial development in the near future.



City of Princeton, Kansas
Wastewater Treatment System

The wastewater lagoon system was constructed in 1964. Many of the original structures show significant deterioration and are inoperable. The interior dikes are eroded and the requirement for the installation of rip-rap along each cell dike is anticipated by the City. The receiving stream bank stabilization that was installed several years ago, around the lagoon creek discharge, was eventually washed away as a result of multiple rain events. The structures connecting each cell were recently replaced with valved pipes through the dike.



Effluent Structure
Grating Corrosion

A 5-year water usage analysis was completed and the results are outlined in Table 1. Based on 100 percent of the average daily winter water usage the estimated wastewater flow to the lagoon system is nearly 27,000 gallons per day, or about 90 gallons per person per day.

Table 1: Water Usage Analysis

	2001 Monthly Water Usage (gallons)	2002 Monthly Water Usage (gallons)	2003 Monthly Water Usage (gallons)	2004 Monthly Water Usage (gallons)	2005 Monthly Water Usage (gallons)	Average Daily Water Usage (gallons)	Estimated Daily Wastewater Flow based on 80% of Water Usage (gallons)	Estimated Daily Wastewater Flow based on 100% of Winter Flow (gallons)
January	872,000	1,003,000	1,003,000	1,014,000	823,000	30,419	24,335	30,419
February		797,000	773,000	880,000	888,000	29,804	23,843	29,804
March		876,000	932,000	918,000	822,000	28,613	22,890	
April	806,000	923,000	967,000	962,000	1,070,000	31,520	25,216	
May		979,000	915,000	1,011,000	-	23,427	18,742	
June	990,000	983,000	999,000	998,000	1,295,000	35,100	28,080	
July	1,246,000	1,139,000	1,200,000	1,215,000	1,400,000	40,000	32,000	
August	1,357,000	1,159,000	1,165,000	1,202,000	914,000	37,400	29,920	
September	1,105,000	954,000	1,108,000	869,000	926,000	33,080	26,464	
October	1,010,000	898,000	880,000	855,000	-	23,503	18,803	
November	930,000	890,000	908,000	801,000	-	23,527	18,821	23,527
December	1,012,000	923,000	951,000	822,000	-	23,923	19,138	23,923
					Yearly Average	30,026	24,021	**26,918**
					2004 Maximum	51,000	40,800	

An evaluation of the collection and wastewater treatment systems is required to determine the potential causes for the City's inability to meet the NPDES discharge permit requirements. This evaluation will outline the structure of a facility plan to be adopted by the City for the improvement of the sanitary system operation.

Collection System

The 8-inch gravity sewer system was designed at minimum slopes (0.30% - 0.40%). This results in a flow velocity of less than the recommended design of two feet per second. Low flow velocity is common for small sewer systems. Accumulation of solids within the collection system can reduce capacity of the sewer system, cause odor issues, and can compromise the operation of the 40-year old vitrified clay pipe collection system. Periodic cleaning of the system is recommended if backup and odor complaints are experienced.

The Kansas Rural Water Association performed a sanitary sewer smoke test on the complete system on August 29, 2001. A total of 31 potential collection system problems were reported, many of which were located on private property. Rainfall data is illustrated in Figure 1 to analyze the potential impacts of water inflow and infiltration on the operation of the facility. The results were inconclusive regarding rainfall and system permit violations. The completion of a flow study is recommended to determine the severity of the inflow and infiltration on the system wastewater flows. Where problems were identified by the smoke testing, the collection system lines should also be televised to determine the extent of the problems reported and the best repair methods.

Treatment System

A lagoon biosolids depth analysis was performed by the Kansas Rural Water Association on November 10, 2004. Based on the study, summarized in Table 2, the lagoon system capacity is reduced by 21%. The KRWA report did not verify the liquid depths in the cells. With an estimated average wastewater flow of 27,000 gallons per day, the lagoon system has

a design detention time of 142 days based upon the original design drawings. At the reduced capacity, the detention time is 112 days. This is below the recommended design detention time of 120 days leaving the City no reserve capacity for any future growth. The completion of a geotechnical analysis would provide a more detailed profile of the lagoon system as operating and floor elevations must be verified in addition to the biosolids depths.

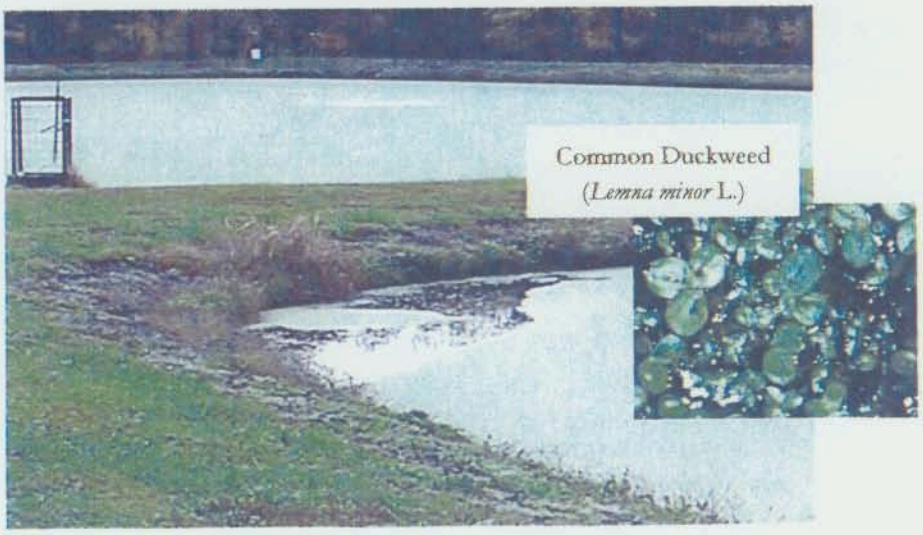
Table 2: Lagoon Capacity Analysis

	Average Sludge Depth	Capacity Loss*	Area		Design Volume	Design Detention Time**	Actual Volume w/Capacity Loss	Actual Detention Time**
	inches	%	ft2	acre	gal	days	gal	days
Cell I	15.83	26.4%	40,088	0.92	1,462,808	54	1,076,870	40
Cell II	11.45	19.1%	39,650	0.91	1,618,485	60	1,309,624	49
Cell III	8.5	14.2%	16,155	0.37	743,887	28	638,503	24
TOTAL			95,893	2.2	3,825,180	142	3,024,998	112

* Based on 5.0 foot operating depth from the original drawings.
** Based on average of 100% winter water usage (27,000 gpd)

The lagoon system is completely surrounded by dense tree cover. While the trees provide a screening curtain around the lagoon operation and enhance ground stabilization in the surrounding riparian area, they also block the sunlight and air flow required for proper lagoon operation. Both sunlight and wind provide the oxygen necessary for the lagoon microorganisms to treat the wastewater. Reduction in sunlight reduces algae growth. Controlled algae growth is good for proper lagoon operation as it reduces nutrient concentrations and produces oxygen for the system. Trees that are located too close to the lagoon system can also have roots that compromise the lagoon dike structures and falling leaves that contribute to biosolids accumulation. Decaying leaves can also impact the lagoon oxygen concentrations.

The existing lagoon system conditions are conducive to the excessive growth of duckweed (*Lemna minor* L.). The duckweed has covered the lagoon surface on all three cells. This excessive growth prevents oxygen transfer at the water surface and prevents sunlight penetration.


Common Duckweed (*Lemna minor* L.)

The management of aquatic plant life is essential to the proper operation of a lagoon system. The presence of aquatic plants, in moderation, can be beneficial to the lagoon. Like algae, duckweed also utilizes wastewater nutrients during growth but, rather than producing oxygen for the system, it utilizes the available oxygen. This can result in the oxygen starvation of the microbial growth in the pond. The death and decay of microbes and

aquatic plants can release the once utilized nutrients and can deplete the lagoon oxygen. The lagoon microbial and aquatic plants are in competition for the food (nutrients) and oxygen so it is essential that a population balance is reached. A fluctuating lagoon environment, as a result of varying weather and influent conditions, can make this balance very difficult to consistently maintain.

Lagoon Initial Phase Improvements

Solutions to the wastewater treatment operational issues including reduced lagoon capacity, lack of pond circulation, and excessive aquatic plant population, must be addressed in this facility plan. The latter issues can be rather quickly improved while an increase in lagoon capacity requires the investigation of several options and additional survey and geotechnical information will be necessary before a final recommendation can be made.

For the steady improvement of the system operation, an increase in the oxygen concentration of the lagoon water is required. The destabilization of the surrounding riparian area and the lack of funding available for this type of work results in the recommendation that deforestation is *not* considered. Therefore, improving oxygenation can be accomplished by (1) the control of the aquatic plants and, (2) the installation of a surface mixing system.

For the control of aquatic plants, the application of algicide and aquatic herbicides is *not* recommended. A floating weed harvester will be required for, at least, the initial aquatic plant removal. This can be accomplished by a qualified contractor. The cost for each harvest is estimated at $3600. Because the duckweed propagates and it is probable that water fowl will continue to support this reproduction, sustained growth is likely in the lagoon. Therefore, more than one mechanical harvest may be necessary. If the duckweed is kept at the lagoon edges, which may be facilitated by a mixing system, the City could harvest it in the future without contractor assistance.

The installation of a solar powered mixing system is recommended. One type of solar powered mixer is shown in the accompanying picture. Solar power mixers eliminate the need for an electrical supply, provide for more quiescent mixing, and can be moved around the lagoon system if necessary. A solar mixer provides horizontal and vertical circulation with laminar flow across the water surface where oxygen transfer is enhanced.

The initial phase of the lagoon improvements; the removal of the duckweed and the installation of two solar mixers, is estimated at $71,400. This cost includes four harvests of the duckweed from each cell by a qualified contractor and the installation of a solar mixer in the primary and secondary cells.

Lagoon Final Phase Improvements

In addressing the reduced lagoon detention time, as well as the improvement of the pond distribution piping, two long term options are considered: 1) the rehabilitation of the existing 3-cell lagoon system (Option 1) or, 2) the construction of a new primary cell (Options 2 & 3). The installation of rip-rap along the existing lagoon dikes for erosion control, the replacement of the discharge structure grating, and the bank stabilization of the receiving stream is included in all options. The utilization of the existing discharge structure is common for all construction options. Each option is illustrated in the attached Figure 3.

Option 1

The rehabilitation of the existing lagoon system includes the installation of new distribution piping and the 'dry' removal and disposal of the accumulated biosolids. As previously discussed, a geotechnical analysis should precede the beginning of the rehabilitation project. This analysis will verify the existing lagoon operating volume, will provide additional biosolids volume information, and will indicate whether additional volume can be gained by lowering the floor depth.

As indicated on the 1964 drawings, the top of lagoon dike elevation is 971 feet, the influent flow line elevation is 968.3, the maximum operating elevation is 968 feet, the floor elevation is 963 feet, and the discharge elevation at the stream is 960 feet. Unfortunately, the above information does not correspond to the current United States Geological Survey (USGS) topographical information. The datum for which the original 1964 drawings were generated doesn't match that of the USGS.

Overlaying the current aerial and topographical information on the 1964 drawings indicates the 100-year flood elevation may be at least two-feet above the dike elevation shown on the drawings. The 100-year flood data was obtained from the Franklin County Appraisers Office. The City of Princeton was, in fact, impacted by the flood of 1993. Middle Creek flooded the entire existing lagoon system. The location of the system with respect to the 100-year flood plain will inevitably impact the final phase improvement decision and must be confirmed by field survey before any final recommendation can be made.

The rehabilitation of the existing system requires the installation of new water distribution piping and control structures. Improved piping will not only allow for flow bypassing of Cell 1 and Cell 2 during rehabilitation, but will also improve the flow distribution to reduce short circuiting and will allow for future parallel operation of the first two lagoon cells if desired.

Bypass pumping from Cell 2 to the discharge structure is required for the rehabilitation of Cell 3. The reduction in the lagoon detention time during construction must be approved by the KDHE. Taking each cell out of operation will facilitate the removal of the biosolids but the length of time the cells are out of service should be minimized. The liquid and solids contents will need to be disposed of in accordance with the KHDE and the Environmental Protection Agency (EPA) Part 503 Sludge Regulations.

The lagoon system discharges into a Middle Creek tributary that is located approximately 50 feet from the lagoon dike. It is recommended that bank erosion be corrected to reduce the impact on the lagoon structures in the future. The installation of rock gabions, as an example, will act as a more permanent bank stabilization device.

Option 2

The construction of a new lagoon cell located northwest of the existing facility was investigated for this option. Unfortunately, to utilize the existing gravity collection system and lagoon structures, part of this location is within the 100-year flood plain as illustrated in the attached Figure 3. Preliminary analysis of the gravity collection system indicates an influent pumping station may not be required for the operation of the new lagoon cell. The construction of this cell requires significant excavation and the budget estimate assumes that no rock will be encountered.

With an influent BOD concentration of 200 parts per million (ppm) the lagoon loading is 45 pounds per day. Assuming that the initial cell receives 100% of this loading, and with a recommended design loading of 34 pounds per day per acre, the primary cell should have a surface area of 1.5 acres.

The cell is located on partially forested farm ground. The State Water Resource Planning Act requires that Kansas riparian areas be maintained and enhanced. Verification that the area is considered riparian may impact the construction. Also, the cost of deforestation will not likely be covered by most funding agencies.

For proper water distribution between cells, while utilizing the existing discharge structure, a significant amount of piping must be installed. The piping is configured to provide a bypass of the primary cell to the existing Cell 1, or allows parallel operation of the new cell and Cell 1. The head loss associated with the increase in piping lengths, in addition to, the installation of an inlet screening structure may impact the ability to utilize the existing gravity system and discharge structure. Verification of the existing facility operation elevations will determine the feasibility of this option.

Option 3

The construction of a new 1.5 acre cell north of the existing facility was investigated to provide construction outside the 100-year flood plain and allows for expansion if the existing facility is abandoned in the future. This option requires the installation of a pumping station. The future abandonment of the existing facility would not only minimize the negative environmental impact the wastewater could have on the potential flood waters, but would also minimize the damage the flood waters could inflict on the lagoon system.

For the purpose of this preliminary analysis, a general north location was chosen for the installation of a new 1.5 acre lagoon cell. Determining the location requires the completion of a site selection study. The lagoon location and configuration, as well as, the land acquisition considerations should be carefully reviewed to account for possible future lagoon expansion.

The distribution system is configured to provide a bypass of the primary cell to the existing system. Backup power would not be necessary, as long as the existing system is in operation, as loss of power would temporarily divert the flow to the existing facility. Consideration must be taken for the operation and maintenance costs associated with the installation of a pumping station.

Cost Analysis

As reported above, the cost of the initial phase improvements is estimated at $71,400. The construction costs for the rehabilitation (Option 1), the northwest installation (Option 2), and the north installation (Option 3) are outlined in Table 3. This analysis does not include the costs for engineering design, survey, grant/loan applications, legal, and financing. These additional costs are typically approximately 25% of the total construction cost. The construction contingencies are estimated at 15% of the construction cost.

Table 3: Construction Cost Analysis

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
OPTION 1 - *Rehabilitation*				
Sludge Removal & Disposal	4,000	CY	12	48,000
Liner	126,000	SF	0.25	31,500
8-inch DIP	400	LF	50	20,000
8-inch Valve & Structure	5	EA	2500	12,500
Bypass Pumping	3	LS	2000	6,000
Discharge Structure Grating	1	LS	1000	1,000
Rip-Rap	4,500	SF	8.50	38,250
Bank Stabilization	1	LS	10000	10,000
Mobilization	1	LS	5000	5,000
SUBTOTAL				172,250
Construction Contingencies (15%)				*25,838*
TOTAL CONSTRUCTION COST				**$ 198,088**
OPTION 2 - *New Northwest Cell*				
Excavation, Backfill, & Compaction	32,000	CY	5	160,000
Liner	86,000	SF	0.25	21,500
8-inch DIP	700	LF	50	35,000
8-inch Valve	5	EA	1500	7,500
4-foot Manhole	1	EA	1000	1,000
Inlet w/Screening	1	EA	2000	2,000
Discharge Structure Grating	1	LS	1000	1,000
Rip-Rap	7,000	SF	8.50	59,500
Bank Stabilization	1	LS	10000	10,000
Site Clearing	0.5	ACRE	6000	3,000
Land Acquisition	2	ACRE	1500	3,000
Seeding	2,100	SY	0.10	210
Fencing	500	LF	2	1,000
Mobilization	1	LS	5000	5,000
SUBTOTAL				309,710
Construction Contingencies (15%)				*46,457*
TOTAL CONSTRUCTION COST				**$ 356,167**

ITEM	QUANTITY	UNIT	UNIT COST	TOTAL COST
OPTION 3 - *New Northern Cell*				
Excavation, Backfill, & Compaction	10,000	CY	5	50,000
Liner	86,000	SF	0.25	21,500
8-inch DIP	950	LF	50	47,500
8-inch Valve	5	EA	1500	7,500
4-foot Manhole	2	EA	1000	2,000
Distribution Structure w/Screening	1	LS	7000	7,000
Discharge Structure	1	LS	10000	10,000
Rip-Rap	7,000	SF	8.50	59,500
Bank Stabilization	1	LS	10000	10,000
Site Clearing	0.3	ACRE	6000	1,500
Land Acquisition	5	ACRE	1500	7,500
Pump Station	1	LS	75000	75,000
Seeding	10,500	SY	0.10	1,050
Fencing	1,200	LF	2	2,400
Mobilization	1	LS	5000	5,000
SUBTOTAL				307,450
Construction Contingencies (15%)				*46,118*
TOTAL CONSTRUCTION COST				**$ 353,568**

The completion of the rehabilitation option (Option 1) for the final phase will allow the continued use of an upgraded wastewater treatment system. This option is the least expensive and requires no land acquisition but, the system location is not ideal as flood waters may again impact its operation. A possible consideration for Option 1 is to increase the existing dike and operating elevations if, in fact, the 100-year flood elevation is determined to be above the operating elevation of the lagoon. This would require the installation of a pump station. The reduced detention time and the biosolids removal and disposal during construction are issues that impact project execution.

Options 2 & 3 are very close in estimated construction costs at approximately $355,000. This is approximately $157,000 greater than the cost of the rehabilitation Option 1. The

extensive excavation costs in Option 2 are offset by the installation cost of the pump station in Option 3. The pump station operation and maintenance costs must be considered.

In evaluating the advantages and disadvantages of each option, outlined in Table 4 below, Option 3 provides the most advantageous situation. It offers a primary cell located outside the 100-year flood plain and a system that is capable of future expansion. This incorporates the eventual abandonment of the existing lagoon system. In fact, the construction of a complete lagoon system and the abandonment of the existing system may need to be considered as well. The estimated construction cost of an entire 4-acre 3-cell lagoon system is $575,000.

Table 4: Option Comparison

	Advantages	Disadvantages
OPTION 1 - *Rehabilitation*	Least Expensive.	Difficult Execution.
	Significant Improvement to Existing System.	Biosolids Disposal.
		Located in Flood Plain.
		Minimized Detention Time during Construction.
OPTION 2 - *New Northwest Cell*	Increased Capacity.	Site Clearing.
	Detention Time not Reduced during Construction.	Property Acquisition.
	Improved Exposure to Wind/Sun.	Significant Piping and Excavation.
		New Construction in Flood Plain.
		Minimal Improvements to Existing System.
OPTION 3 - *New North Cell*	Detention Time not Reduced during Construction.	Property Acquisition.
	Improved Exposure to Wind/Sun.	Minimal Improvements to Existing System.
	Increased Capacity.	Pump Station Installation, Operation, and Maintenance.
	Cell Located Outside the 100-year Flood Plain.	Significant Piping.
	Future Expansion.	

As indicated in Figure 3, the existing wastewater system is located within the 100-year flood plain. It is not known how this flood plain will impact the option analysis. Unfortunately, without the existing lagoon system elevation data with respect to the 100-year flood elevation, a recommendation cannot be made.

Project Funding

There are several grant and loan opportunities available for making improvements to community wastewater facilities: Community Development Block Grant Program (CDBG), KDHE's Kansas Water Pollution Control Revolving Loan Fund (SRF), and USDA Rural Development (RD). The community's per capita income and unemployment rate impacts some grant and loan eligibility. For example, the low- and moderate-income (LMI) for the City of Princeton is currently estimated as 50.3. This value must be at least 51.0 to qualify

Review of Project Design by Funding Agencies	May 2006
Advertisement of Project	June 2006
Opening of Bids	July 2006
Award of Contracts	August 2006
Construction Completion	Summer 2007

The KDHE schedule of compliance indicates that the City shall achieve compliance with the NPDES permit by no later than December 31, 2007.

Conclusion

The completion of the initial phase of this facility plan, the aquatic plant removal and mixing improvement, might result in meeting the NPDES permit requirements. It is important to make timely corrections to the existing system in attempts to improve the effluent quality. If necessary, immediate loan funding may be available for this phase of the plan. If the City can meet NPDES discharge criteria for one year, it is likely KDHE will consider returning to quarterly testing. The implementation of these initial improvements provides time for the acquisition of funding for the final phase of the facility plan.

All of the options outlined for the final phase of this facility plan require the additional acquisition of geotechnical, engineering, surveying, and site information before a final recommendation can be made. This information could significantly change the feasibility and cost of each option as well as provide additional options for consideration. Coordination of this project with the Kansas Department of Health and Environment and the Kansas Department of Agriculture, Division of Water Resources is important and will clarify the ability to maintain or construct within the 100-year flood plain. Monthly sewer rate increases must be addressed when investigating the attainment of the funding required for the execution of this facility plan.