Conceptual Design and Cost Estimate for a Phased Wastewater Collection and Treatment System

Prepared for

Clearwater River Watershed District

June 2006

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Wenck

June 14, 2006

Mr. Marvin Brunsell
Chairperson, Board of Managers
Clearwater River Watershed District
P.O. Box 481
Annandale, MN 55302

Re: Conceptual Design and Cost Estimate for a Phased Wastewater Collection and Treatment System

Dear Mr. Brunsell:

Wenck Associates, Inc. was retained by the Clearwater River Watershed District to complete a conceptual design and cost estimate for a phased wastewater collection and treatment system. Wenck respectfully submits our findings herein.

INTRODUCTION

The system is based on a hypothetical location within the District. The system design is based on the following assumptions:

- 300 homes
- 30,000 lineal feet of sewer
- A third of the collection system will be installed in each of three phases
- The treatment system will be installed over 12 phases with 25 homes in each
- Peak flow = 450 gallons per day per home (gpd/home)
- Homeowners provide individual septic tank, pump, and service connection as required.

The project considers the following alternatives:

- Wastewater collection system (gravity and pressure)
- Primary treatment (individual or common septic tanks)
- Secondary treatment (sandfilter, textile filter or aeration), and
- Disposal (drainfield).

Other assumptions:

- Estimated cost based on recent bids and updated to 2006
- No inflation is considered for future phases
- 20 acres of land for treatment site is included in the first phase
- STEP pipe is plowed in with no road restoration required — Generally
- Gravity pipe is trenched with road restoration required.

COLLECTION SYSTEM DESCRIPTION

Several wastewater collection system alternatives were considered. Three alternatives are included in this report and described below:

Option 1 - Septic Tank Effluent Pump (STEP) System

A STEP system consists of an individual septic tank at each home with an effluent pump to direct the wastewater to the treatment system as shown in Figure 1. The STEP system is essentially a pressure sewer system that will utilize a High Density Polyethylene (HDPE) pipe as the collection system.

Depending on its location, the effluent is pumped into either a 4, 5 or 6-inch HDPE forcemain and directed to the wastewater treatment and disposal area. Each service would have a double check valve and shut-off valve to isolate the service for maintenance. The homeowner would be responsible for the cost and installation of the individual septic tank and effluent pump. Existing septic tanks can be used if in good conditions and could be retrofitted with an effluent pump.

Option 2 - Gravity Sewer and Common Septic Tanks

Option 2 consists of a 4" service line at each home connecting to an 8" Polyvinyl Chloride (PVC) gravity sewer pipe. Manholes would be located every 400 linear feet. Pumps would be required at some of the homes in order to convey the wastewater to additional lift stations. Due to the hilly terrain, approximately 15-lift stations would be required. A final lift station routes the wastewater to several large, common septic tanks prior to entering the treatment system. For this project, a total of 400,000 gallons of septic tank storage would be required. This will be accomplished by installing 1-33,000 gallon septic tank in each of 12 phases.

Option 3 - Gravity Sewer with Individual Septic Tanks

Option 3 consists of an individual septic tank at each home with a 4" service line connecting to an 8" Polyvinyl Chloride (PVC) gravity sewer pipe. Manholes would be located every 400 linear feet. Pumps would be required at some of the homes in order to lift the wastewater to the sewer. Due to the hilly terrain, approximately 15-lift stations would be required. The final lift station would route the wastewater to the treatment system.

TREATMENT SYSTEM DESCRIPTION

Recirculating sand filters, recirculating textile filters and aeration systems were analyzed as secondary treatment systems. A recirculating sand filter is an open granular-media filter bed. Wastewater from the septic tanks flows into a recirculating/dilution tank where a timer controlled pump periodically releases effluent to a distribution system on top of the sand filter bed. Each time effluent is released over the filter; the effluent percolates through the sand filter media and is treated by naturally occurring microorganisms that populate the filter. Effluent is collected at the bottom of the filter. The collected effluent is then divided and four-fifths is sent back into the dilution tank to be retreated and one-fifth is sent to disposal system. In this way, the effluent, on average, should be treated in the sand filter five times before being released to the disposal system.

Pods
2 for 25 home

A recirculating textile filter system operates the same only that in place of the sand, textile (fabric) sheets are used as shown in Figure 2. A textile filter system consists of "pods" that can be added, as additional wastewater treatment is needed.

An aeration system followed by settling is an alternative secondary treatment system. This system consists of two tanks. The first, the aeration tank, bubbles air through the effluent to increase microorganism activity and speed the natural treatment of the effluent by the microorganisms. After traveling through the aeration tank, the effluent drains to the settling tank where the treated sludge is allowed to settle. The effluent is then pumped to the final disposal system.

It was determined that a textile filter system works best for a phased approach although other systems could be considered in the final design.

DISPOSAL SYSTEM DESCRIPTION

The drainfield treatment system analyzed is a trench design similar to that used for individual septic systems. The treated effluent is distributed over the natural soil allowing the existing soil microorganisms to further reduce the levels of phosphorus and nitrate that are eventually released to the groundwater.

For this project, the drainfield is designed and expanded each phase in order to accommodate the additional 25 homes that are connecting to the wastewater treatment system. The drainfield is will ultimately be designed to treat 135,000 gallons per day of wastewater.

1
2 - similar to CW Harbor
3 - " " H. River

SUMMARY

Based on this conceptual analysis, three types of collection systems were evaluated. Other options could be considered in the final design phase.

Table 1 is a cost comparison of the three options. The total estimated cost for Option 1 is $2,730,000. The total estimated cost for Option 2 is $7,020,000. The total estimated cost for Option 3 is $6,180,000.

The STEP system is the lowest cost and lends itself best to a phased approach and maximizes the use of existing infrastructure (i.e., enclosed septic tanks).

The collection system (sewer) could be installed for an estimated average cost of $3,500/lot. An additional assessment of $1,400/lot would be required assuming the initial treatment system is assessed to the total assumed service area.

We are available to review the results of this analysis with the Board of Managers and provide additional assistance as requested.

Respectfully submitted,

WENCK ASSOCIATES, INC.

Norman C. Wenck, P.E.
Engineer for the District

Table

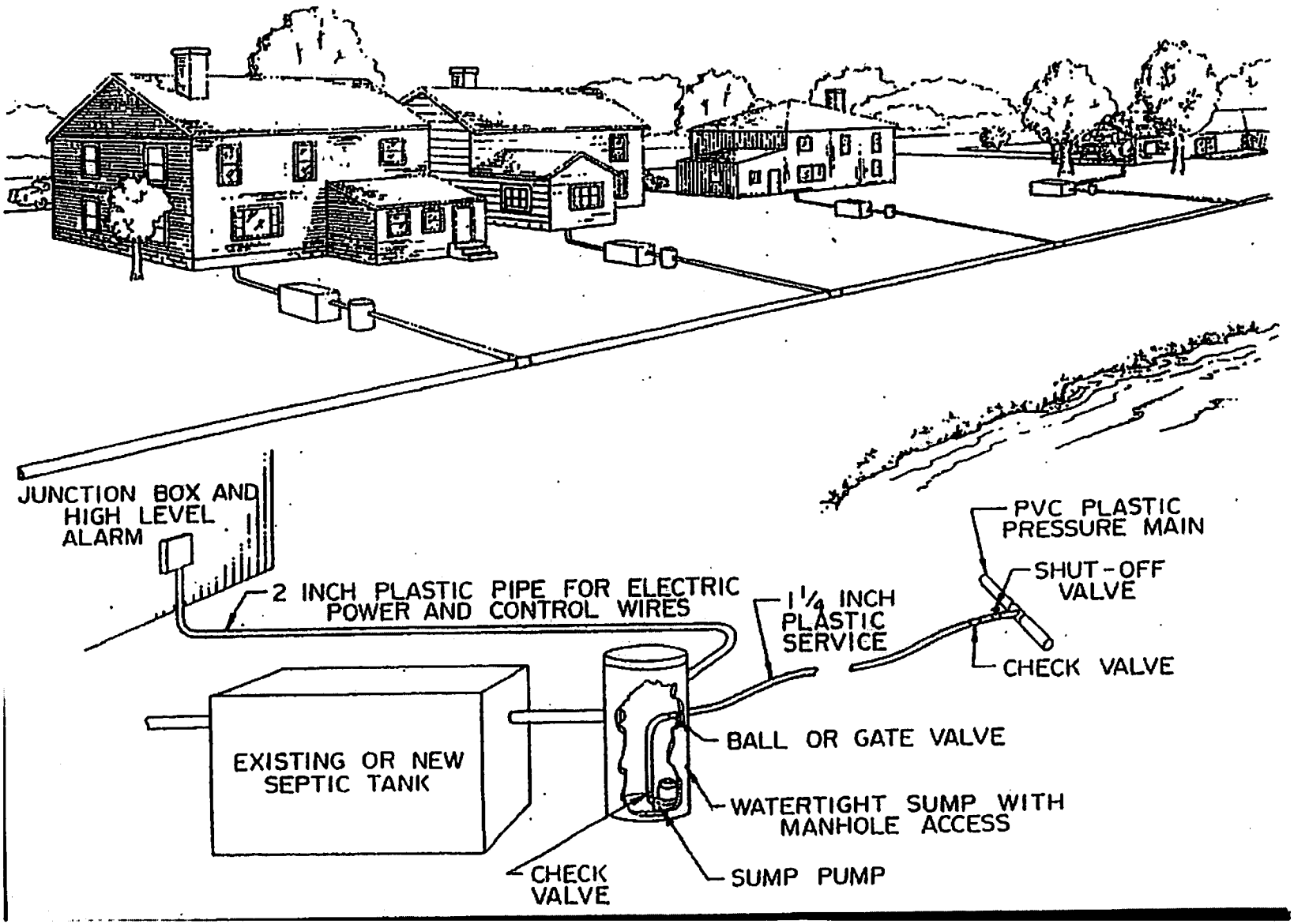
Table 1
Cost Comparison
Conceptual Design for a Phased Wastewater Collection and Treatment System

Phase	Total Homes	OPTION 1 Pressure System with Individual Septic Tank and Effluent Pump (STEP)		OPTION 2 Gravity System with Common Septic Tank(s)		OPTION 3 Gravity System with Individual Septic Tank(s)	
		Collection System	Treatment System	Collection System	Treatment System	Collection System	Treatment System
1	25	$400,000	$420,000	$1,600,000	$420,000	$1,500,000	$420,000
2	50	$0	$90,000	$60,000	$90,000	$0	$90,000
3	75	$0	$90,000	$60,000	$90,000	$0	$90,000
4	100	$0	$150,000	$60,000	$150,000	$0	$150,000
5	125	$350,000	$90,000	$1,600,000	$90,000	$1,500,000	$90,000
6	150	$0	$90,000	$60,000	$90,000	$0	$90,000
7	175	$0	$240,000	$60,000	$240,000	$0	$240,000
8	200	$0	$90,000	$60,000	$90,000	$0	$90,000
9	225	$300,000	$90,000	$1,600,000	$90,000	$1,500,000	$90,000
10	250	$0	$150,000	$60,000	$150,000	$0	$150,000
11	275	$0	$90,000	$60,000	$90,000	$0	$90,000
12	300	$0	$90,000	$60,000	$90,000	$0	$90,000
ESTIMATED COST		**$1,050,000**	**$1,680,000**	**$5,340,000**	**$1,680,000**	**$4,500,000**	**$1,680,000**
ESTIMATED COST PER LOT		**$3,500** [1]	**$5,600** [1]	**$17,800** [2]	**$5,600** [2]	**$15,000** [3]	**$5,600** [3]

[1] Requires each lot to have septic tank and effluent pump.
[2] Some lots may require grinder pump.
[3] Requires each lot to have septic tank and some will also require pumps.

Figures

STEP (SEPTIC TANK-EFFLUENT PUMP) PRESSURE SEWER SYSTEM



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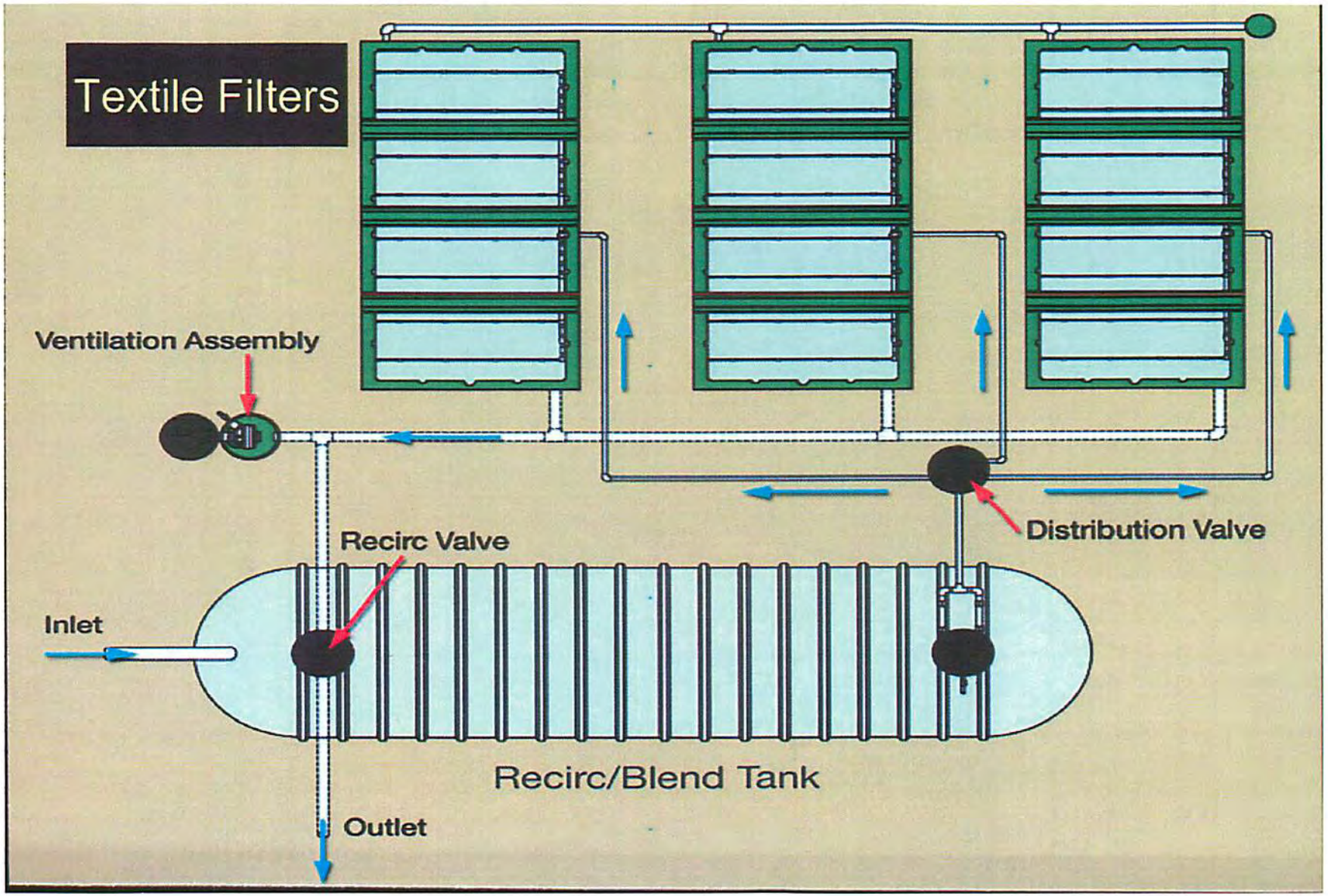
Pressure Sewer System		Figure 1



Clearwater River Watershed District	Wenck Associates, Inc. 1800 Pioneer Creek Center Environmental Engineers Maple Plain, MN 55359	JUNE 2006
Textile Filters		Figure 2

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