- Split flow chamber improvements.

In addition to these improvements, a new 65-foot diameter primary clarifier will need to be constructed in a portion of the existing sludge lagoon. The estimated cost to refurbish all four clarifiers as described above and install the new clarifier is $1,035,200.

Option No. 2

Two 85-foot diameter clarifiers (see Appendix E for clarifier details) will be required to provide adequate clarifier surface area for the 20-year planning period, a surface settling rate of 1,200 gallons-per-day per square foot, and a 30 percent BOD_5 removal. The estimated cost of two new clarifiers, sludge piping and valves, aluminum handrail system, sidewalks, site improvements, and primary pump improvements is $990,000.

The selected primary clarifier option is No. 2, based on a lower construction cost and anticipated lower O & M costs for the two new 85-foot diameter clarifiers.

7.5.1.2 Secondary Clarifiers

The following two options were considered for improving and expanding the secondary clarifier system (see Appendix F for clarifier details).

- Option No. 1 – Refurbish the existing clarifiers and construct an additional clarifier to add the required capacity to meet the 20-year projected loading.
- Option No. 2 – Construct new secondary clarifiers to replace the existing clarifiers and to meet the projected wastewater loading.

Option No. 1

The north and south clarifier mechanism and structures are not in adequate condition, without significant refurbishing, to have a 20-year useful life. Based on the initial tank design as a "package" treatment system, utilizing the clarifier without continuing the use of the treatment compartments surrounding the clarifier would require structural enhancement to the clarifier walls. This is a significant factor due to the fact that abandonment of the other treatment compartments is inevitable as the plant capacity is expanded.

Due to the structural limitations of the tanks, the condition of the mechanism, and the requirement to construct a fourth clarifier (space requirements are limited at STP #1), this option has not been considered further.

Option No. 2

This option includes the replacement of the secondary clarifiers with two 130-foot diameter clarifiers. The existing clarifier No. 3 would remain and could be used as additional clarifier capacity during periods of high flow. The new clarifiers are sized for a peak flow rate of 15.39 MGD with a surface settling rate (SSR) of 800 gallons/day/square foot, a solids loading rate of 50 pounds/day/square foot, and a weir loading rate of 30,000 gallon/day/lineal foot.

The following improvements are included in this option, in addition to the two 130-foot diameter clarifiers.

- Scum pump station and forcemain
- WAS/RAS pump station and piping
- Influent and effluent piping
- Site and road improvements

The estimated construction cost of Option No. 2 is $1,000,000.

7.5.1.3 Disinfection System

An evaluation of disinfection system options was performed for STP #1. The options considered include:

- Expansion of the existing chlorination system; and
- UV disinfection.

Several factors were considered in the evaluation, including:

- Safety;
- Construction cost;
- O & M cost; and
- Compatibility with the treatment system and final plant effluent.

Currently, the plant personnel maintain a minimum number of 150-pound chlorine cylinders to prevent exceeding the OSHA threshold that requires a risk management plan. According to the plant personnel, this is a difficult task and results in frequent chlorine cylinder deliveries, requiring additional plant personnel time to assist with the cylinder delivery. Once the plant is expanded, this process would become excessive and a risk management plan would be required. An inherent advantage to the UV disinfection system is in the area of safety. Therefore, from a safety issue, the UV would be the system of choice.

Construction costs for both options are listed in Table 7.5. While the concrete contact basin cost is higher for the chlorination system, the UV equipment cost is quite high which results in a higher overall construction cost for the UV system.

Table 7.5
Wastewater System Options Evaluation
Disinfection System

Alternatives	Capital Costs	Annual O & M Costs	Present Worth
Chlorination System	$325,800		
-Chlorine		$34,300	
-Labor		$10,920	
-Feeder Repairs		$ 1,000	
System Total – CL2	$325,800	$46,220	$855,900
UV Disinfection System	$530,000		
-Power		$18,900	
-Labor		$ 1,560	
-Lamp Replacement		$ 6,350	
System Total – UV	$530,000	$26,810	$837,500

Based on current chlorine gas costs, provided by United Water, power usage, bulb life, and bulb costs, provided by INFILCO for their Aquaray ® 40, the O & M costs are less for the UV system than they are for the chlorination system. Calculating the present worth of both systems over 20 years at a six percent discount rate, the UV system has the lower present worth of $837,500. (See Appendix G for additional UV information).

Based on these considerations, the UV system is included in all of the treatment options for the proposed disinfection system.

7.5.1.4 Sludge Thickening and Dewatering

There were multiple options considered for primary and waste activated sludge thickening, as well as sludge dewatering. Sludge thickening options evaluated include:

- Addition of a second gravity belt thickener;
- Installation of a belt press to serve as a thickener and sludge dewatering unit; and
- Installation of a centrifuge to serve as a thickener and a sludge dewatering unit.

Option No. 1

The existing Envirex GBT has performed very well for thickening both primary and waste activated sludge. But since the GBT is operated nearly every day, a backup system is advisable. Installation of a second GBT, slightly larger than the existing 2.5 meter thickener, has been evaluated. The new GBT would serve as the main thickener, and the 2.5 meter thickener would serve as a backup unit. The

estimated cost to install a new 3.0 meter Envirex/JWI GBT in the existing Drying Bed Building, including piping, polymer feed, pumps, controls and building revisions is $280,000.

Based on an analysis of sludge disposal costs, the present method of sludge disposal appears to be the least expensive. The plant currently utilizes the sludge lagoons for digested sludge storage and contracts for the sludge to be land applied at a cost of $0.034 per gallon, plus lime costs if required. Currently the vacuum-assisted drying bed serves as a backup disposal system be in-place should problems develop with the lagoon space or land availability.

Operating staff experience has not been good relative to the vacuum assisted drying bed system. The labor costs are considerable for cleaning the beds, the drying results unpredictable and the polymer costs also higher than anticipated. Based on these issues, replacement of this system as a backup to the sludge lagoon and land application disposal process is advisable.

Under Option No. 1, installation of either a belt press or a centrifuge has been considered. The dewatering equipment will be installed in the existing Drying Bed Building.

The estimated cost to construct the belt press system is $352,000. This cost includes:

- One Model GRS-2 Series III Kompress-Komline Sanderson 2.2 meter, 120 GPM, 1,800 pounds of dry solids/hour belt press, or equal;
- One Stranco polymer feed system;
- Sludge pump and piping revisions;
- Building and drain piping modifications; and
- Screw conveyor system for dried sludge handling.

The estimated cost to construct the centrifuge system is $357,000. This cost includes:

- One Model CA405 Westfalia centrifuge;
- One Stranco polymer feed system;
- Sludge pump and piping revisions;
- Building and drain piping modifications; and
- Screw conveyor system for dried sludge handling.

O & M costs are comparable for either the belt press or the centrifuge, according to information provided by the manufacturers of the equipment. Since the system costs are comparable, the selection of the process should be determined through a joint effort of the City, United Water and the consulting engineer. For cost comparisons of the treatment system options, the higher cost system will be used. (See Appendix H for additional information on the filter press and centrifuge).

The estimated construction cost for Option No. 1 is $637,000.

Option No. 2

Since the thickening system and the dewatering system are being proposed as a backup to the existing facility, one piece of equipment to serve both purposes merits consideration. Option No. 2 considers the use of a belt press for this purpose. Komline Sanderson manufactures a filter press/thickener unit that can be operated to thicken or dewater sludges. The estimated construction cost for this system, including the equipment, is $580,000.

Option No. 3

A centrifuge can also serve both as a thickener and a dewatering unit. The centrifuge is considered in this option. The Westfalia CA405, as proposed in Option No. 1, has the ability to both thicken and dewater. A similar unit is currently operating at a wastewater facility at Freeport, Illinois. The estimated construction cost for this system, including the equipment is $357,000.

Option No. 3 is the selected option for sludge thickening and dewatering. This option and its related costs are included in the treatment system improvement options presented later in this report.

7.5.2 STP #1 Upgrade-Conventional Activated Sludge Process

An upgrade of STP #1 to meet the projected hydraulic, organic, and solids loading for the next 20 years will require improvements to the existing processes, plus the addition of treatment capacity. Table 7.5.2 contains a list of the wastewater treatment systems at STP #1, each systems current treatment capacity, the 20-year projected loading requirement, and the additional capacity needed to meet the projected wastewater flow.

Based on the condition of several of the treatment plant systems and the additional treatment capacity required, replacement of the following components is recommended.

- Bar screen and channel grinder with two mechanical coarse bar screens
- Grit system with an aerated grit and grease removal system
- Primary clarifiers with two 85-foot diameter clarifiers
- Activated sludge process with new aeration tanks, fine bubble diffusers, blowers, return and activated sludge pumps, and appurtenances.
- Secondary clarifiers with two 130-foot diameter clarifiers
- Chlorine disinfection system with a ultraviolet (UV) light system
- Sludge vacuum assisted drying bed system with a centrifuge or gravity belt press, for backup to the existing sludge lagoons

Improvements to the remaining systems will be required to meet the 20-year projected wastewater flows.

Table 7.5.2
STP #1 - Existing
Wastewater Treatment Capacity

Description	Design Average	Additional Capacity Required	Theoretical Peak Hourly	Additional Capacity Required
Planning Projection	**6.84 MGD**	**N.A.**	**15.39 MGD**	**N.A.**
Pre-Treatment	5.7 MGD	.14 MGD	12.00 MGD	3.39 MGD
Primary Settling	N.A.	N.A.	9.50 MGD	5.89 MGD
Activated Sludge Process	4.99 MGD	1.85 MGD	9.70 MGD	5.69 MGD
Secondary Settling	N.A.	N.A.	14.86 MGD	0.53 MGD
Anaerobic Digestion	7.5 MGD	(0.7 MGD)	N.A.	N.A.

These improvements will include:

- Upgrade of the primary effluent pumping system;
- Addition of a second WAS pump;
- Installation of an additional 150 KW dual-gas engine generator; and
- Construction of an effluent pumping station.

The estimated cost of upgrading STP #1 is listed in Table 7.5.3. A conceptual layout of the improved and expanded plant is shown in Figure 7.5.1. The cost estimate of the system improvement is based on the following components:

- Schreiber front load duplex screen system, or equal, to be located in the existing modified influent channels that presently contain the bar screen and channel grinder, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD.
- One Schreiber SFB-440 grit and grease removal system, or equal, at 53 feet in length, two-GM 4S 5.0 Hp grit blowers and appurtenances, providing a potential DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. The grit washer installed in 1999 will be reused.
- Replacement of all four primary clarifiers with two 85-foot diameter WESTECH, or equal, primary clarifiers, providing a total surface area of 11,325 square feet. A surface settling rate (SSR) of 1,200 gallon/day/square foot of tank area and 30 percent BOD removal is expected through the primary clarifier system at a peak hourly rate of 15.39 MGD. System replacement includes:

  - Concrete structures, including aluminum handrails;
  - Clarifier mechanisms;
  - Split flow chamber;
  - Wastewater and sludge piping, valves and fittings;

- Flow meters;
- Sludge and primary effluent pumping improvements;
- Sidewalks;
- Site improvements; and
- Street replacement.

- Replacement of the secondary treatment activated sludge process with Sanitaire, or equal, conventional activated sludge process (data on the Sanitaire system is included in Appendix E). The system will provide adequate aeration tank volume (525,000 cu. ft.) for an organic loading of 15 pounds BOD_5/day per 1,000 cu. ft. of volume for the projected 20-year BOD_5 loading rate of 7,870 ppd (total influent BOD_5 loading of 11,238 ppd x 70% = 7,870 ppd assumes 30% BOD_5 removal through the primary clarifiers). Oxygen requirements will be met to provide a dissolved oxygen concentration of 2.0 mg/l, satisfying the oxygen requirements for BOD_5 and ammonia removal. The system replacement includes:

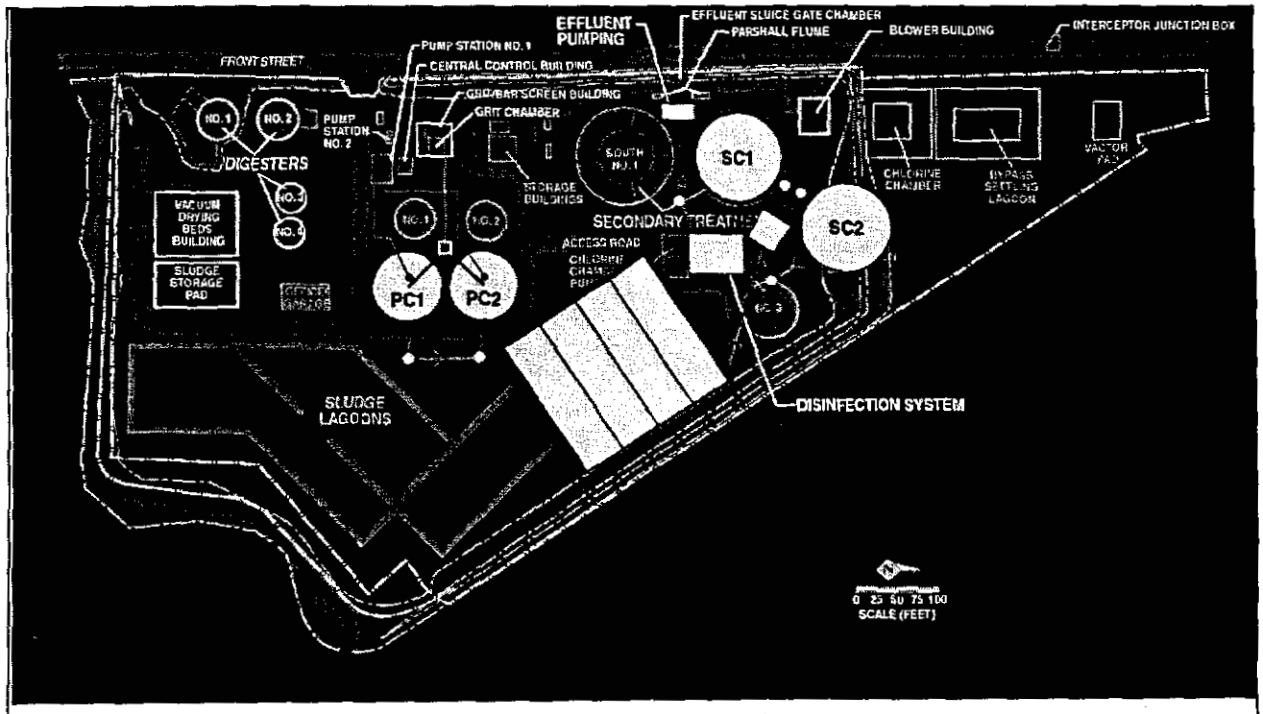

Figure 7.5.1 - Sewage Treatment Plant No. 1 - Conventional Activated Sludge

- Four 50-feet-wide by 175-feet-long by 15-feet-deep basins;
- Sanitaire, or equal, ceramic disc diffusers (3,744 discs) with diffuser cleaning system;
- Stainless steel and PVC air header system;
- Air supply piping;
- Three 125-horsepower Continental blowers, or equal, sized for half load service of 2,504 SCFM @ 7.3 PSIG, two primary and one back-up, including valves, filters, silencers, etc.

- Split flow chamber;
- Weirs and gates; and
- Influent and effluent piping.

- Secondary treatment system-clarifier replacement to provide for a peak flow rate of 15.39 MGD with a SSR of 800 gallon/day/square foot, a solids loading rate of 50 pounds/day/square foot, and a weir loading rate of 30,000 gallon/day/lineal foot. The proposed system will include the following components:

  - Two 130-foot diameter concrete structures;
  - Two 130-foot diameter WESTECH, or equal, clarifier mechanisms, including bridge and aluminum peripheral hand rail system;
  - Scum pump station and forcemain;
  - WAS/RAS pumping system and piping;
  - Influent and effluent piping; and
  - Site and road improvements.

- Replacement of the chlorination system used for final effluent disinfection with an INFILCO low pressure/high output ultraviolet light (UV) disinfection system, or equal. The UV system will include:

  - Two 24.5-inch-wide by 26-inch-long by 60-inch-deep concrete channels;
  - INFILCO Aquaray ® 40, with 320 lamps total assuming 65% UV transmission and a dosage at peak flow of 40,500 watt secs/cm^2 or equal;
  - In-channel air scrubbing system, including blower assembly;
  - Overhead lifting device;
  - Channel grating; and
  - Slide gates.

- Improvements to the anaerobic digester system, including:

  - Addition of a gravity belt press, 2.2 meter Komline-Sanderson Model G-GRSL Series III combination belt filter press and gravity belt thickener, or equal, or a Model CA 405 Westfalia centrifuge or equal, for backup to the existing GBT and sludge lagoons;
  - Installation of a second 150 KW dual-gas engine-generator with transfer switch;
  - Replacement of the G-1 engine-generator transfer switch;
  - Digester gas room improvements, including pipe replacement; and
  - Building improvements.

- Effluent pump station installation for pumping of final effluent during periods of high Illinois River water levels. The pump station will include:

- Two 11,000 gpm, 50 hp, vertical turbine solids handling pumps with variable speed drives;
- Concrete pumping chamber;
- Diversion chamber/valve vault; and
- Connection to the existing piping.

Table 7.5.3
STP #1 Upgrade
Conventional Activated Sludge

Item	Estimated Cost
Preliminary Treatment	$ 452,000
Primary Settling	$ 990,000
Activated Sludge Process	$2,850,000
Secondary Clarifiers	$1,000,000
Disinfection	$ 500,000
Sludge Digestion	$ 372,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 300,000
Subtotal	$7,170,500
Contingency	$ 717,050
Engineering & Admin.	$1,075,575
Estimated Total Construction Cost	$8,963,125

The estimated total capital cost to construct the conventional activated sludge treatment system is approximately $8,963,125. For purposes of comparison with other types of secondary treatment systems, the estimated total annual operation and maintenance (O&M) costs have been calculated for the improved and expanded conventional activated sludge treatment system operating at a DAF of 6.84 MGD. The major components of the O&M costs were considered and included, smaller components that would be fairly consistent with all of the evaluated processes have not been included in the calculated O&M costs. The estimated annual O&M cost is $768,310, as listed in Table 7.5.4.

The estimated capital cost and annual O&M cost were used to calculate a present worth for the conventional activated sludge system of $17,775,560. The present worth cost was calculated for 20 years at a six percent discount rate.

Table 7.5.4
STP #1 Upgrade - Conventional Activated Sludge
Annual Operation and Maintenance Cost

Item	Estimated Cost
Labor (See Note 1)	$ 340,000
Electric (See Note 2)	$ 122,029
- Primary effluent pumps - $22,721	
- WAS/RAS pumps - $4,760	
- Blowers for aeration system - $77,398	
- Anaerobic digester system - $9,737 (See Note 3)	
- Primary sludge pumps - $2,595	
- Effluent pumps - $1,038 (See Note 4)	
- Miscellaneous electric loads - $26,280	
- Savings from G-1 power generation - $22,500	
Polymer (See Note 5)	$ 29,286
Sludge disposal (See Note 6)	$ 259,000
UV disinfection, including power costs	$ 17,995
Estimated Total Annual O&M Cost	$ 768,310

Notes:
1. Labor costs for five full time positions (cost estimate provided by United Water)
2. Electric cost based on $0.06/KWH
3. Anaerobic digester equipment includes two gas compressors, two sludge re-circulation pumps, GBT, and one brown water pump.
4. Effluent pump power cost assumes operation of one pump five percent of the year.
5. Polymer cost = $1.05 per pound for the GBT and centrifuge or belt press. Digested sludge de-watering of 50 percent of the sludge with the centrifuge or belt press.
6. Sludge disposal costs include 50 percent land application and 50 percent de-watered and landfilled. Land application cost = $0.034 per gallon; landfill disposal cost = $0.023 per pound dry weight.

7.5.3 Counter Current Aeration without Primary Treatment

The Counter Current aeration system, shown in Figure 7.5.2 and 7.5.3, designed to provide full treatment without primary clarifiers was evaluated as an alternative to the conventional activated sludge process. Staff from the City of Pekin, United Water and Harding ESE visited a Counter Current treatment system in Clayton County, Georgia, shown in Figure 7.5.3, as part of the system evaluation. This system, manufactured by Schreiber Corporation, Inc., located in Trussville, Alabama, diffuses air into the wastewater through submerged fine bubble diffusers attached to a rotating bridge. The air bubbles are dispersed in a uniform pattern throughout the aeration reactor, eliminating the formation of a vertical updraft of water which would carry the air bubbles quickly to the surface. The manufacturer claims a high oxygen transfer rate occurs from moving the diffusers through the wastewater, resulting in power savings of 35 to 50 percent compared with conventional and mechanical aeration systems.

With Counter Current aeration, the liquid contents of the tank are aerated in subsequent sections by the rotating bridge moving around the tank. The rotating aeration bridge brings the light medium (air) to the heavy medium (water) instead of the usual way of bringing the water to the air. This results in good mixing and low power requirements for the mixing operation.

With the rotating bridge and diffuser system providing the mixing, the functions of aeration and mixing are separated. This process matches the oxygen input to the varying organic loads while maintaining an adequately mixed basin. This has the potential to result in an energy savings through the use of an organic load monitoring blower control. (Additional information on the Schreiber Counter Current System is included in Appendix F.)

Since this treatment alternative does not include primary clarifiers, a more intensive preliminary treatment system is being proposed. A fine screen system (gap width of ¼ inch) is being proposed along with replacement of the existing grit system with a separate grit and grease channel system. This preliminary treatment system will provide a wastewater to the aeration system relatively free of grit, floating debris and large inorganic solids.

The Counter Current system without primary clarifiers will produce only waste activated sludge (WAS). Due to potential operational issues associated with anaerobically digesting only WAS, this treatment alternative will include modification of the existing anaerobic digesters to convert them to aerobic digesters. The major operational issues of anaerobic digestion using only WAS considered include potential foaming, and low digester gas production resulting in the need to heat sludge with natural gas.

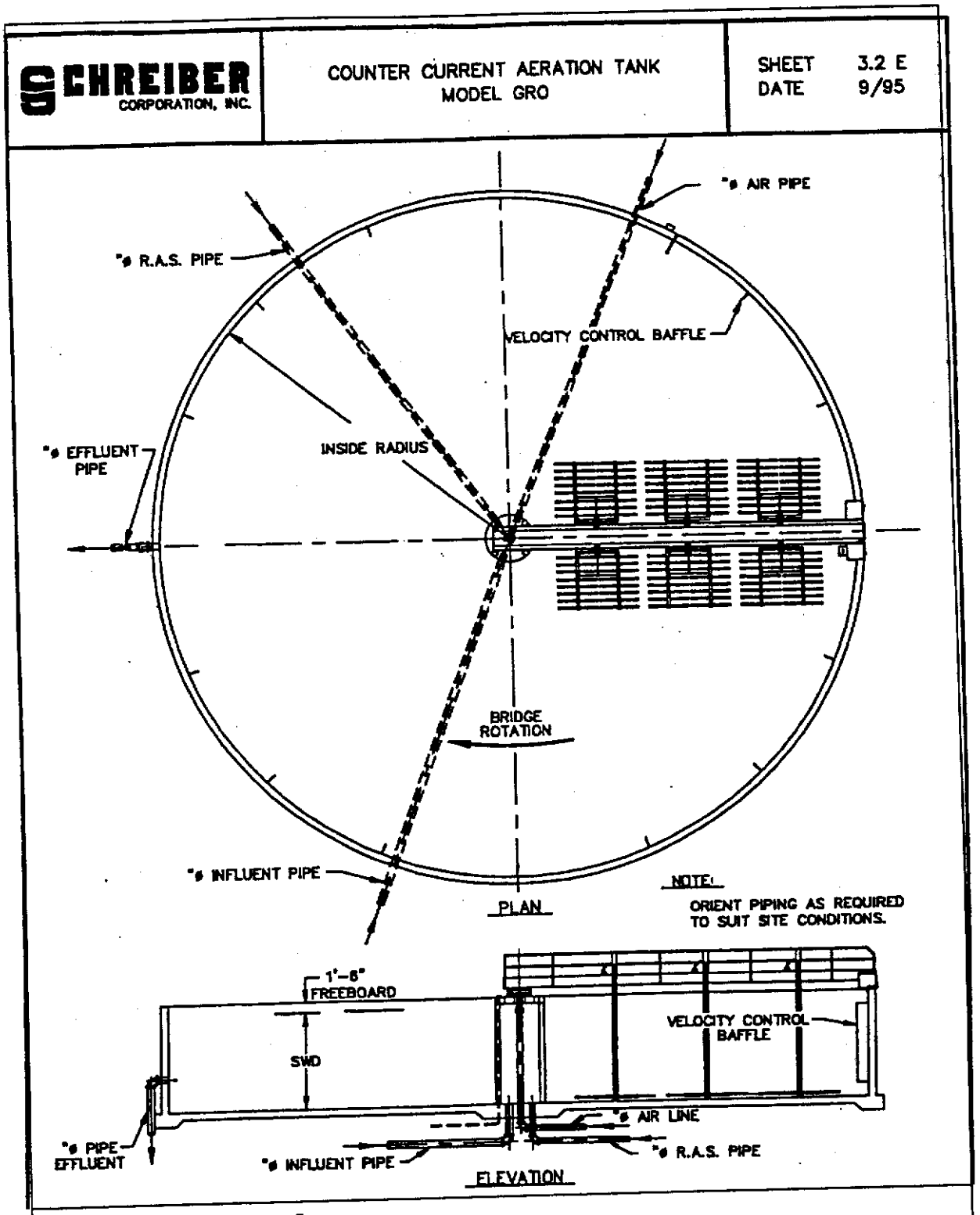

Figure 7.5.2 - Counter Current System

CA000073

The aeration system proposed by Schreiber includes the following components.

- Aeration System Model – GRO
- Number of units – 2
- Diameter of units – 150 feet
- Site water depth – 16 feet
- F:M ratio – 0.080
- MLSS concentration – 4,000 mg/l
- Hydraulic detention – 14.84 hours
- Biological loading rate – 19.84 pounds BOD/1000 cu.ft.
- Blower model – GM 50L
- Number of duty blowers – 6
- Number of standby blowers – 1
- Blower horsepower each – 75 HP
- ICFM each – 1,324 ICFM
- RAS pumps – tube mounted screwpumps
- Number of RAS pumps – 2
- Capacity of RAS pumps each – 5,020 gpm @ 5 feet lift

The estimated cost to construct the Counter Current treatment system is approximately $8,253,500, as detailed in Table 7.5.5. The Counter Current treatment system and other recommended treatment system improvements evaluated include the following components.

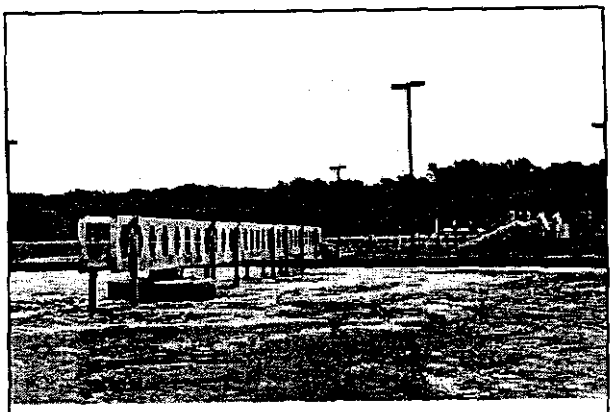

Figure 7.5.3 - Counter Current

- Two Schreiber Model DFR-100 Hydro-Grid fine screens, or equal, to be located in the existing modified influent channels that presently contain the bar screen and channel grinder, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. Two Schrieber RWP-120 Clean Squeeze washer compactors, or equal, are also proposed with this system.
- One Schreiber SFB-440 grit and grease removal system, or equal, at 53 feet in length, two-GM 4S 5.0 Hp grit blowers and appurtenances, providing a potential DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. The grit washer installed in 1999 will be reused.
- Replacement of all four primary clarifiers with two-85 foot diameter WESTECH, or equal, primary clarifiers, providing a total surface area of 11,325 square feet. At a surface settling rate (SSR) of 1,200 gallon/day/square foot of tank area, 30 percent BOD removal is expected through the primary clarifier system at a peak hourly rate of 15.39 MGD. System replacement includes:

- Concrete structures, including aluminum handrails;
- Clarifier mechanisms;
- Split flow chamber;
- Wastewater and sludge piping, valves and fittings;

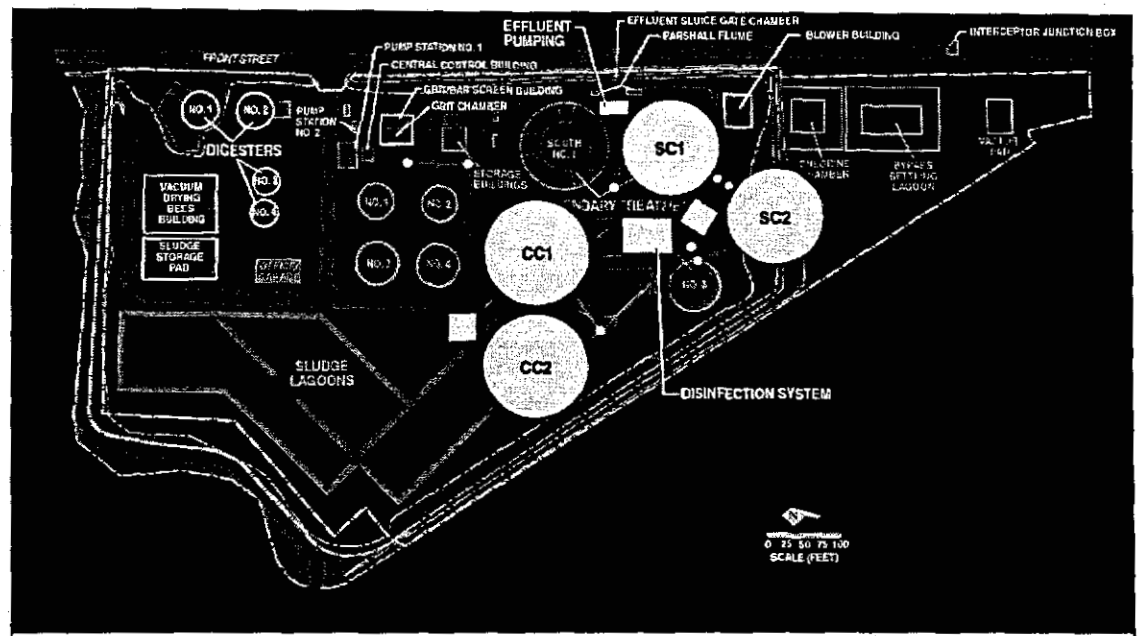

Figure 7.5.4 – Counter Current System without Primary Clarifiers

- Flow meters;
- Sludge and primary effluent pumping improvements;
- Sidewalks;
- Site improvements; and
- Street replacement.

- Replacement of the secondary treatment activated sludge process with a Schreiber Counter Current aeration system. The Schreiber system contains the components described previously in this section.

- Secondary treatment system-clarifier replacement to provide for a peak flow rate of 15.39 MGD with a SSR of 800 gallon/day/square foot, a solids loading rate of 50 pounds/day/square foot, and a weir loading rate of 30,000 gallon/day/lineal foot. The proposed system will include the following components:

  - Two 130-foot diameter concrete structures;
  - Two 130-foot diameter WESTECH, or equal, clarifier mechanisms, including bridge and aluminum peripheral hand rail system;
  - Scum pump station and forcemain;

- WAS/RAS pumping system and piping;
- Influent and effluent piping; and
- Site and road improvements.

- Replacement of the chlorination system used for final effluent disinfection with an INFILCO low pressure/high output ultraviolet light (UV) disinfection system, or equal. The UV system will include:

  - Two 24.5-inch-wide by 26-inch-long by 60-inch-deep concrete channels;
  - INFILCO Aquaray ® 40, with 320 lamps total assuming 65% UV transmission and a dosage at peak flow of 40,500 uwatt secs/cm^2 or equal;
  - In-channel air scrubbing system, including blower assembly;
  - Overhead lifting device;
  - Channel grating; and
  - Slide gates.

- Improvements to convert the anaerobic digester system, to an aerobic system including:

  - Addition of a gravity belt press, 2.2 meter Komline-Sanderson Model G-GRSL Series III combination belt filter press and gravity belt thickener, or equal, or a Model CA 405 Westfalia centrifuge or equal, for backup to the existing GBT and sludge lagoons;
  - Installation of a second 150 KW dual-gas engine-generator with transfer switch;
  - Replacement of the G-1 engine-generator transfer switch;
  - Digester gas room demolition;
  - Building improvements;
  - Digester No. 1, No. 2 and No. 3 conversion to aerobic digesters, including cover modifications, removal of gas mixing systems, addition of aeration systems and blowers (6-75Hp units) and other required modifications.

- Effluent pump station installation for pumping of final effluent during periods of high Illinois River water levels. The pump station will include:

  - Two - 11,000 gpm, 50 hp, vertical turbine solids handling pumps with variable speed drives;
  - Concrete pumping chamber;
  - Diversion chamber/valve vault; and
  - Connection to the existing piping.

Table 7.5.5
STP #1 Upgrade
Counter Current System without Primary Clarifiers

Item	Estimated Cost
Preliminary Treatment	$ 453,000
Primary Settling	$ -0-
Activated Sludge Process	$2,500,000
Secondary Clarifiers	$1,450,000
Disinfection	$ 500,000
Sludge Digestion	$ 650,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 310,000
Subtotal	$6,524,500
Contingency	$ 652,450
Engineering & Admin.	$1,076,500
Estimated Total Construction Cost	$8,253,450

The estimated total capital cost to construct the Counter Current System without primary clarifiers is approximately $8,253,500. For purposes of comparison with other types of secondary treatment systems, the estimated total annual operation and maintenance (O&M) costs have been calculated for the Counter Current treatment system operating at a DAF of 6.84 MGD. The major components of the O&M costs were considered and included, smaller components that would be fairly consistent with all of the evaluated processes have not been included in the calculated O&M costs. The estimated annual O&M cost is $893,951, as listed in Table 7.5.6.

Table 7.5.6
STP #1 Upgrade – Counter Current without Primary Clarifiers
Annual Operation and Maintenance Cost

Item	Estimated Cost
Labor (See Note 1)	$ 340,000
Electric (See Note 2)	$ 247,670
- Influent pumps - $22,721	
- WAS/RAS pumps - $4,760	
- Blowers for aeration system - $115,017	
- Aerobic digester system - $77,854 (See Note 3)	
- Effluent pumps - $1,038 (See Note 4)	
- Miscellaneous electric loads - $26,280	
Polymer (See Note 5)	$ 29,286
Sludge disposal (See Note 6)	$ 259,000
UV disinfection, including power costs	$ 17,995
Estimated Total Annual O&M Cost	$ 893,951

Notes: 1. Labor costs for five full-time positions (cost estimate provided by United Water)

2. Electric cost based on $0.06/KWH
3. Aerobic digester equipment includes two sludge re-circulation pumps, GBT, one brown water pump and blowers for aerobic digesters.
4. Effluent pump power cost assumes operation of one pump five percent of the year.
5. Polymer cost = $1.05 per pound for the GBT and centrifuge or belt press. Digested sludge de-watering of 50 percent of the sludge with the centrifuge or belt press.
6. Sludge disposal costs include 50 percent land application and 50 percent de-watered and landfilled. Land application cost = $0.034 per gallon; landfill disposal cost = $0.023 per pound dry weight.

The estimated capital cost and annual O&M cost were used to calculate a present worth for the Counter Current System without primary clarifiers of $18,507,000. The present worth cost was calculated for 20 years at a 6 percent discount rate.

7.5.4 Counter Current Aeration with Primary Treatment

This alternative includes a Schreiber Counter Current aeration system similar to the one evaluated in Section 7.5.3, but with the addition of primary clarifiers. (Additional Schreiber Counter Current System information is included in Appendix F.) Since primary clarifiers are included in the treatment scheme, a less intensive preliminary treatment system is proposed. The preliminary treatment system will include replacement of the existing bar screen and channel grinder with a duplex mechanical bar screen system and the installation of a second grit removal system, similar to the existing aerated grit system. Anaerobic sludge digestion will be utilized with this system for the primary and waste activated sludge. The

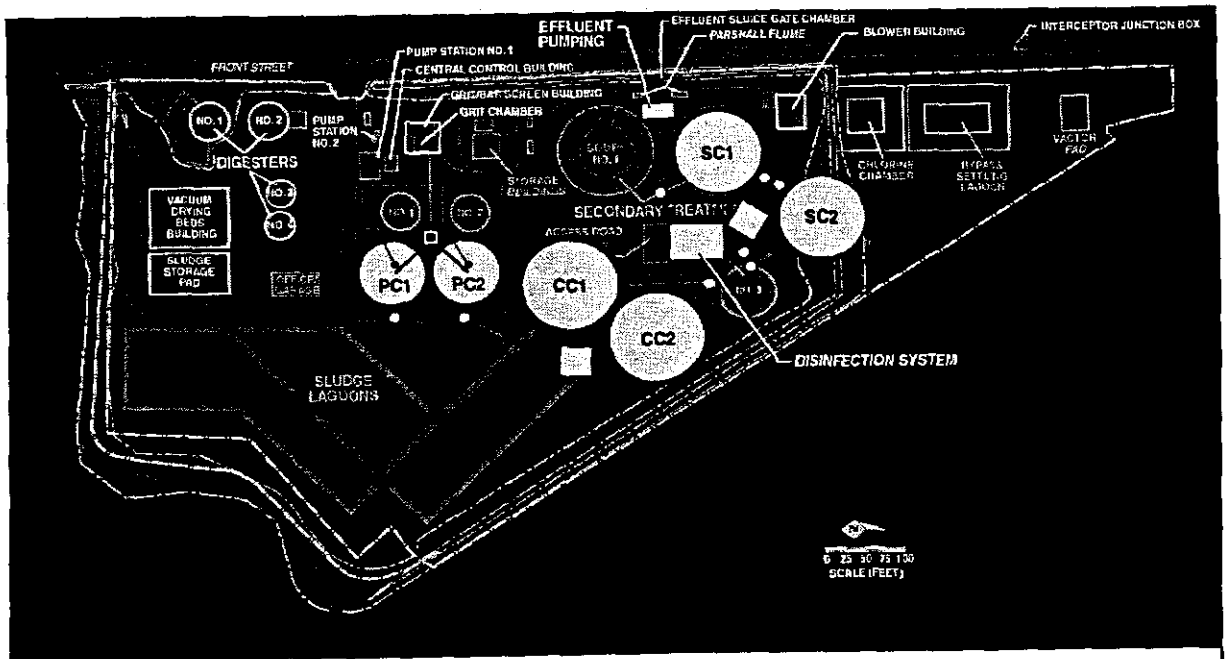

Figure 7.5.5 - Counter Current System with Primary Clarifiers

estimated cost of the Counter Current treatment system and other plant improvements is listed in Table 7.5.7. A conceptual layout of the treatment plant is shown in Figure 7.5.5. The conceptual layout and cost estimate are based on the following components.

- Schreiber front load duplex screen system, or equal, to be located in the existing modified influent channels that presently contain the bar screen and channel grinder, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD.
- One Schreiber SFB-440 grit and grease removal system, or equal, at 53 feet in length, two-GM 4S 5.0 Hp grit blowers and appurtenances, providing a potential DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. The grit washer installed in 1999 will be reused.
- Replacement of all four primary clarifiers with two 85-foot diameter WESTECH, or equal, primary clarifiers, providing a total surface area of 11,325 square feet. At a surface settling rate (SSR) of 1,200 gallon/day/square foot of tank area, 30 percent BOD_5 removal is expected through the primary clarifier system at a peak hourly rate of 15.39 MGD. System replacement includes:

  - Concrete structures, including aluminum handrails;
  - Clarifier mechanisms;
  - Split flow chamber;
  - Wastewater and sludge piping, valves and fittings;
  - Flow meters;
  - Sludge and primary effluent pumping improvements;
  - Sidewalks;
  - Site improvements; and
  - Street replacement.

- Replacement of the secondary treatment activated sludge process with the Schreiber Counter Current System. The system will provide adequate aeration tank volume for the projected 20-year BOD loading rate of 7,870 ppd (total influent BOD loading of 11,238 ppd x 70% = 7,870 ppd) complying with the IEPA requirement of 15 lbs. BOD per 1,000 cubic feet of aeration tank volume. Oxygen requirements will be met to provide a dissolved oxygen concentration of 2.0 mg/l, satisfying the oxygen requirements for BOD and ammonia removal. The system replacement includes:

  - Two Schreiber Model GRO overhang aeration units;
  - Two concrete structures: 142 feet diameter by 17.0 feet sidewater depth;
  - Hydraulic detention of 14.13 hours;
  - Stainless steel and PVC air header system;
  - Air supply piping;
  - Seven Model GM 35S Aerzen electric blowers; 60 Hp each @ 1,102 ICFM;
  - Split flow chamber;
  - Required weirs and gates; and
  - Influent and effluent piping.

- Secondary treatment system-clarifier replacement to provide for a peak flow rate of 15.39 MGD with a SSR of 800 gallon/day/square foot, a solids loading rate of 50 pounds/day/square foot, and a weir loading rate of 30,000 gallon/day/lineal foot. The proposed system will include the following components:

  - Two 130-foot diameter concrete structures;
  - Two 130-foot diameter WESTECH, or equal, clarifier mechanisms, including bridge and aluminum peripheral hand rail system;
  - Scum pump station and forcemain;
  - WAS/RAS pumping system and piping;
  - Influent and effluent piping; and
  - Site and road improvements.

- Replacement of the chlorination system used for final effluent disinfection with an INFILCO low pressure/high output ultraviolet light (UV) disinfection system, or equal. The UV system will include:

  - Two 24.5-inch-wide by 26-inch-long by 60-inch-deep concrete channels;
  - INFILCO Aquaray ® 40, with 320 lamps total assuming 65% UV transmission and a dosage at peak flow of 40,500 uwatt secs/cm^2 or equal;
  - In-channel air scrubbing system, including blower assembly;
  - Overhead lifting device;
  - Channel grating; and
  - Slide gates.

- Improvements to the anaerobic digester system, including:

  - Addition of a gravity belt press, 2.2 meter Komline-Sanderson Model G-GRSL Series III combination belt filter press and gravity belt thickener, or equal, or a Model CA 405 Westfalia centrifuge or equal, for backup to the existing GBT and sludge lagoons;

Table 7.5.7
STP #1 Upgrade
Counter Current System with Primary Clarifiers

Item	Estimated Cost
Preliminary Treatment	$ 452,000
Primary Settling	$ 990,000
Activated Sludge Process	$2,500,000
Secondary Clarifiers	$1,000,000
Disinfection	$ 500,000
Sludge Digestion	$ 372,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 300,000
Subtotal	$6,820,500
Contingency	$ 662,050
Engineering & Admin.	$1,023,075
Estimated Total Construction Cost	$8,465,625

- Installation of a second 150 KW dual-gas engine-generator with transfer switch;
- Replacement of the G-1 engine-generator transfer switch;
- Digester gas room improvements, including pipe replacement; and
- Building improvements.

- Effluent pump station installation for pumping of final effluent during periods of high Illinois River water levels. The pump station will include:

  - Two 11,000 gpm, 50 hp, vertical turbine solids handling pumps with variable speed drives;
  - Concrete pumping chamber;
  - Diversion chamber/valve vault; and
  - Connection to the existing piping.

The estimated total capital cost to construct the Counter Current system with primary clarifiers is approximately $8,465,625. For purposes of comparison with other types of secondary treatment systems, the estimated total annual operation and maintenance (O&M) costs have been calculated for the Counter Current System operating at a DAF of 6.84 MGD. The major components of the O&M costs were considered and included, smaller components that would be fairly consistent with all of the evaluated processes have not been included in the calculated O&M costs. The estimated annual O&M cost is $807,480, as listed in Table 7.5.8.

Table 7.5.8
STP #1 Upgrade – Counter Current with Primary Clarifiers
Annual Operation and Maintenance Cost

Item	Estimated Cost
Labor (See Note 1)	$ 340,000
Electric (See Note 2)	$ 161,199
- Primary effluent pumps - $22,721	
- WAS/RAS pumps - $4,760	
- Blowers for aeration system - $116,097	
- Anaerobic digester system - $9,737 (See Note 3)	
- Primary sludge pumps - $2,595	
- Effluent pumps - $1,038 (See Note 4)	
- Miscellaneous electric loads - $26,280	
- Savings from G-1 power generation - $22,500	
Polymer (See Note 5)	$ 29,286
Sludge disposal (See Note 6)	$ 259,000
UV disinfection, including power costs	$ 17,995
Estimated Total Annual O&M Cost	$ 807,480

Notes:
1. Labor costs for five full-time positions (cost estimate provided by United Water)
2. Electric cost based on $0.06/KWH
3. Anaerobic digester equipment includes two gas compressors, two sludge re-circulation pumps, GBT, and one brown water pump.
4. Effluent pump power cost assumes operation of one pump five percent of the year.
5. Polymer cost = $1.05 per pound for the GBT and centrifuge or belt press. Digested sludge de-watering of 50 percent of the sludge with the centrifuge or belt press.
6. Sludge disposal costs include 50 percent land application and 50 percent de-watered and landfilled. Land application cost = $0.034 per gallon; landfill disposal cost = $0.023 per pound dry weight.

The estimated capital cost and annual O&M cost were used to calculate a present worth for the Counter Current system with primary clarifiers of $17,727,340. The present worth cost was calculated for 20 years at a six percent discount rate.

7.5.5 Sequence Batch Reactor (SBR)

For purposes of evaluation and comparisons with other systems, the Aqua SBR, manufactured by Aqua-Aerobics Systems, Inc., located in Rockford, Illinois has been chosen. Staff from the City of Pekin, United Water and Harding ESE visited a SBR plant in Clear Lake, Iowa, shown in Figure 7.5.6, as part of the system evaluation.

Each Aqua SBR unit acts as an equalization basin, aeration basin, and clarifier within a single reactor, significantly reducing the amount of area required for the treatment system. Normally, the process follows basic operational steps that include fill, react, settle and decant. The SBR has the ability to create aerobic or anoxic conditions within the reactor resulting in flexible operation (Additional Aqua SBR

information is presented in Appendix H.) Aqua-Aerobics Systems, Inc. claim numerous system features and benefits including the following.

- Tolerates variable hydraulic loads
- Tolerates variable organic loads
- Controls filamentous growth
- Separate aeration and mixing systems
- All components retrievable and accessible
- Return activated sludge pumping eliminated
- Low installation costs

The SBR produces a waste activated sludge that will be most efficiently digested by aerobic digestion. Operational issues discussed in Section 7.5.1.3 related to anaerobic digestion of WAS, also apply to the SBR process. The cost estimate of this alternative includes modification of the anaerobic digesters to convert them to aerobic digesters.

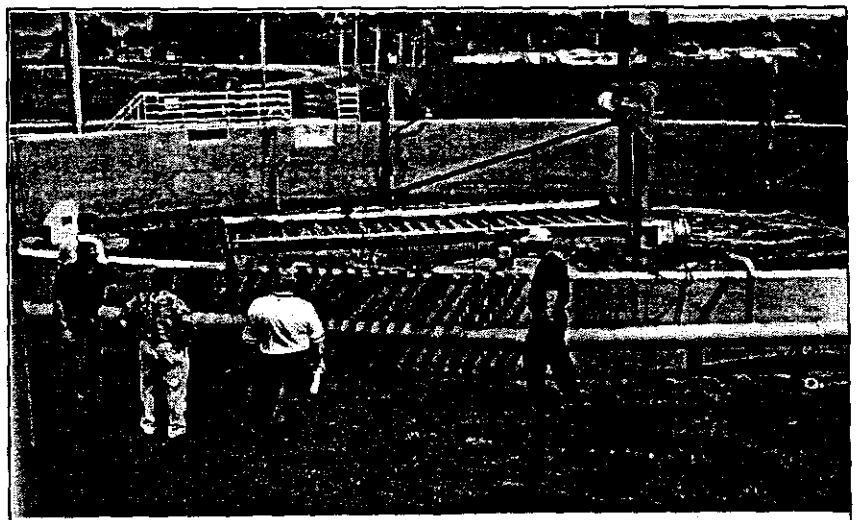

Figure 7.5.6 - SBR in Clear Lake, Iowa

Since there are no primary clarifiers in the treatment scheme, a more intensive preliminary treatment system is proposed to reduce the amount of grit, oil and grease, floatables, and larger debris from entering the reactor basins. The preliminary treatment system is identical to that described in Section 7.5.1.3.

The Aqua SBR system includes the following design criteria and component sizing:

- Four basin SBR
- Basin dimension – 94 feet x 94 feet x 22 feet deep
- F:M ratio – 0.08 pounds BOD/pounds MLSS – day
- MLSS concentration – 4,500 mg/l
- Hydraulic retention – 0.758 days
- Solids retention – 11.6 days
- Biological loading rate – 15 pounds BOD/1,000 cu. ft.
- Mixers – 4-40 Hp Model FSS DDM

- WAS transfer pumps – 4-3 Hp submersible
- Blowers – 5 Roots 824R, 250Hp each

The estimated construction cost for the SBR is detailed in Table 7.5.9. The SBR treatment system and other plant improvements evaluated in this alternative are shown in Figure 7.5.7 and include the following components.

- Two Schreiber Model DFR-100 Hydro-Grid fine screens, or equal, to be located in the existing modified influent channels that presently contain the bar screen and channel grinder, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD.
- Two Schreiber Model RWP-120 Clean Squeeze washer compactions, or equal;
- One Schreiber SFB-440 grit and grease removal system, or equal, at 53 feet in length, two-GM 4S 5.0 Hp grit blowers and appurtenances, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. Grit washer installed in 1999 will be reused.

Replacement of the primary treatment system, the secondary treatment activated sludge process and the secondary clarifiers with a four basin SBR as previously described in this section. The SBR system will provide adequate aeration tank volume for the projected 20-year BOD loading rate of 11,238 ppd. Oxygen requirements will be met to provide a dissolved oxygen concentration of 2.0 mg/l, satisfying the oxygen requirements for BOD and ammonia removal.

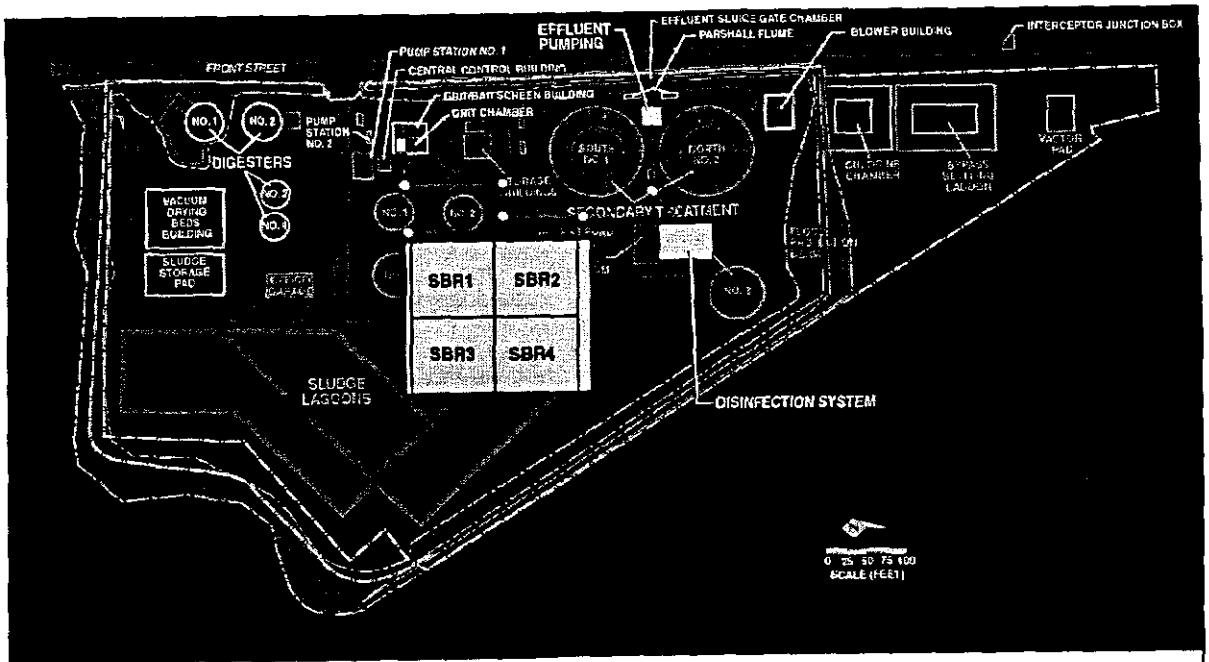

Figure 7.5.7 - Sequence Batch Reactor (SBR)

CA000084

- Replacement of the chlorination system used for final effluent disinfection with an INFILCO low pressure/high output ultraviolet light (UV) disinfection system, or equal. The UV system will include:

  - Two 24.5-inch-wide by 26-inch-long by 60-inch-deep concrete channels;
  - INFILCO Aquaray ® 40, with 320 lamps total assuming 65% UV transmission and a dosage at peak flow of 40,500 uwatt secs/cm^2 or equal;
  - In-channel air scrubbing system, including blower assembly;
  - Overhead lifting device;
  - Channel grating; and
  - Slide gates.

- Improvements to convert the anaerobic digester system to an aerobic system, including:

  - Addition of a gravity belt press, 2.2 meter Komline-Sanderson Model G-GRSL Series III combination belt filter press and gravity belt thickener, or equal, or a Model CA 405 Westfalia centrifuge or equal, for backup to the existing GBT and sludge lagoons;
  - Installation of a second 150 KW dual-gas engine-generator with transfer switch;
  - Replacement of the G-1 engine-generator transfer switch;
  - Digester gas room demolition;
  - Building improvements;
  - Digester No. 1, No. 2 and No. 3 conversion to aerobic digesters, including cover modifications, removal of gas mixing systems, addition of aeration systems and blowers (6-75 Hp units) and other required modifications.

- Effluent pump station installation for pumping of final effluent during periods of high Illinois River water levels. The pump station will include:

  - Two 11,000 gpm, 50 hp, vertical turbine solids handling pumps with variable speed drives;
  - Concrete pumping chamber;
  - Diversion chamber/valve vault; and
  - Connection to the existing piping.

The estimated total capital cost to construct the SBR treatment system is approximately $7,785,500. For purposes of comparison with other types of secondary treatment systems, the estimated total annual operation and maintenance (O&M) costs have been calculated for the SBR treatment system operating at a DAF of 6.84 MGD. The major components of the O&M costs were considered and included, smaller components that would be fairly consistent with all of the evaluated processes have not been included in the calculated O&M costs. The estimated annual O&M cost is $933,880 as listed in Table 7.5.10.

Table 7.5.9
STP #1 Upgrade -SBR System

Item	Estimated Cost
Preliminary Treatment	$ 453,000
Primary Settling	$ -0-
SBR System	$3,300,000
Secondary Clarifiers	$ -0-
Disinfection	$ 530,000
Sludge Digestion	$ 605,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 560,000
Subtotal	$6,154,500
Contingency	$ 615,450
Engineering & Admin.	$1,015,500
Estimated Total Construction Cost	$7,785,450

Table 7.5.10
STP #1 Upgrade – SBR System
Annual Operation and Maintenance Cost

Item	Estimated Cost
Labor (See Note 1)	$ 340,000
Electric (See Note 2)	$ 287,598
- Influent pumps - $22,721	
- WAS pumps - $2,491	
- Blowers for aeration system - $157,214	
- Aerobic digester system - $77,854 (See Note 3)	
- Effluent pumps - $1,038 (See Note 4)	
- Miscellaneous electric loads - $26,280	
Polymer (See Note 5)	$ 29,286
Sludge disposal (See Note 6)	$ 259,000
UV disinfection, including power costs	$ 17,995
Estimated Total Annual O&M Cost	$ 933,879

Notes:
1. Labor costs for five full-time positions (cost estimate provided by United Water)
2. Electric cost based on $0.06/KWH
3. Aerobic digester equipment includes two sludge re-circulation pumps, GBT, one brown water pump, and blowers for aerobic digestion.
4. Effluent pump power cost assumes operation of one pump five percent of the year.
5. Polymer cost = $1.05 per pound for the GBT and centrifuge or belt press. Digested sludge de-watering of 50 percent of the sludge with the centrifuge or belt press.
6. Sludge disposal costs include 50 percent land application and 50 percent de-watered and landfilled. Land application cost = $0.034 per gallon; landfill disposal cost = $0.023 per pound dry weight.

The estimated capital cost and annual O&M cost were used to calculate a present worth for the SBR system of $18,496,900. The present worth cost was calculated for 20 years at a six percent discount rate.

7.5.6 Vertical Loop Reactor with Primary Treatment

Initially in this facility planning process, oxidation ditch technology was considered as another alternative to the conventional activated sludge process. But due to space constraints at the site and recommendations by Envirex, manufacturer of the Orbal Process, we evaluated Envirex's Vertical Loop Reactor (VLR) as a similar process to an oxidation ditch. (Additional VLR information is presented in Appendix I.)

The VLR has the process kinetics of the Orbal Process with a much smaller footprint. It is essentially an oxidation ditch on its side, as shown in Figure 7.5.8 and Figure 7.5.9., with each basin being divided into two compartments, upper and lower. Discs are located in the upper compartment for oxygen delivery and mixing; coarse bubble diffusers are located in the front part of the lower compartment for supplemental oxygen delivery. Air in the lower compartment is contained beneath the horizontal divider baffle for the full length of the tank, substantially increasing the retention time of the air in the liquid, doubling the oxygen transfer efficiency of the coarse bubble diffuser. The VLR system, using multiple tanks in series, has the same process benefits of the Orbal Process, including total nitrogen removal, biological phosphorous removal, stormflow treatment, and DO stratification across multiple reactors for energy savings.

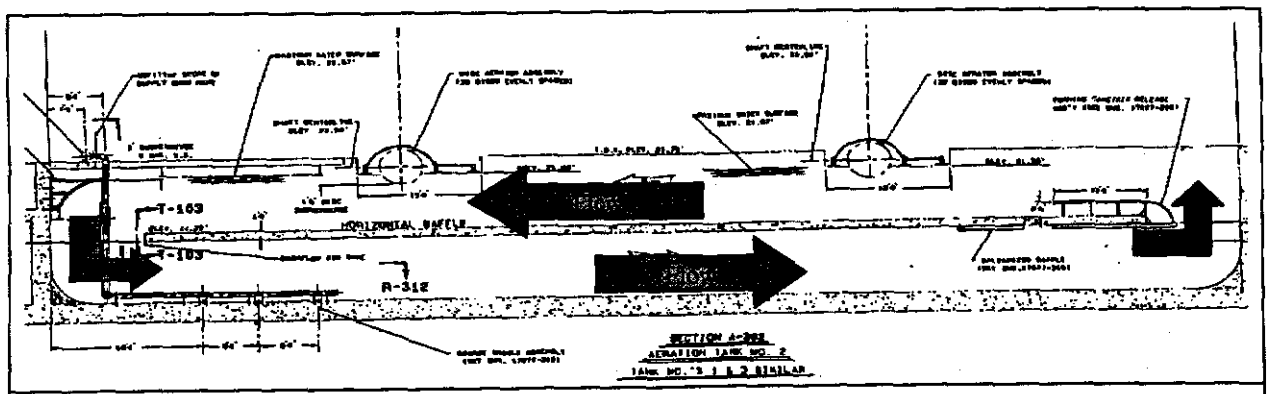

Figure 7.5.8 - Vertical Loop Reactor (VLR) - Section View

Staff from the City of Pekin, United Water and Harding ESE toured a VLR plant in Texas City, Texas, shown in Figure 7.5.9. The Texas City plant operates at nearly the same flow rate and loadings as the 20 year projected design flows for the City of Pekin.

The VLR system proposed by Envirex and used for costing and comparison purposes includes the following components.

- Four tank VLR system, plus a two compartment conventional activated sludge process tank
- VLR tank dimensions each – 126 feet long x 30 feet wide x 21 feet deep
- Conventional activated sludge process tank compartment dimensions each- 140 feet long x 50 feet wide x 15 feet deep to provide for IEPA required loading rate
- MLSS concentration – 25% @ 9,000 mg/l; 75% @ 4,500 mg/l
- Hydraulic detention – 14.5 hours
- Sludge yield – 1.0
- Sludge age – 9.8 days
- Number of discs – 72 per VLR tank
- Number of diffusers – 100 per VLR tank
- Biological loading rate – 14.9 pounds BOD/1,000 cu.ft.
- Blowers – five 75 Hp blowers – full duty
  one 75 Hp blower – standby
- RAS pumps – tube mounted screw pumps
- Number of RAS pumps – 2
- Capacity of RAS pumps each – 5,020 gpm @ 5 feet lift

The VLR system, including the VLR and conventional activated sludge tanks, with primary clarifiers will produce primary and waste activated sludge that will be digested in the existing, improved anaerobic digesters. The RAS and belt thickener/belt press filtrate will be pumped to the conventional aeration tanks prior to entering the VLR system. Primary effluent will be directed to the VLR system only.

The VLR system and other treatment plant improvements evaluated, are shown in Figure 7.5.10 and include the following components.

- Schreiber front load duplex screen system, or equal, to be located in the existing modified influent channels that presently contain the bar screen and channel grinder, providing a DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD.
- One Schreiber SFB-440 grit and grease removal system, or equal, at 53 feet in length, two-GM 4S 5.0 Hp grit blowers and appurtenances, providing a potential DAF of 6.84 MGD and a peak hourly flow of 15.39 MGD. The

grit washer installed in 1999 will be reused.

- Replacement of all four primary clarifiers with two 85-foot diameter WESTECH, or equal, primary clarifiers, providing a total surface area of 11,325 square feet. At a surface settling rate (SSR) of 1,200 gallon/day/square foot of tank area, 30 percent BOD removal is expected through the primary clarifier system at a peak hourly rate of 15.39 MGD. System replacement includes:

  - Concrete structures, including aluminum handrails;
  - Clarifier mechanisms;
  - Split flow chamber;
  - Wastewater and sludge piping, valves and fittings;
  - Flow meters;
  - Sludge and primary effluent pumping improvements;
  - Sidewalks;
  - Site improvements; and
  - Street replacement.

- Replacement of the secondary treatment activated sludge process with the Envirex VLR system described above. The system will provide adequate aeration tank for the projected 20-year BOD loading rate of 7,870 ppd (total influent BOD loading of 11,238 ppd x 70% = 7,870 ppd). Oxygen requirements will be met to provide a dissolved oxygen concentration of 2.0 mg/l, satisfying the oxygen requirements for BOD and ammonia removal.

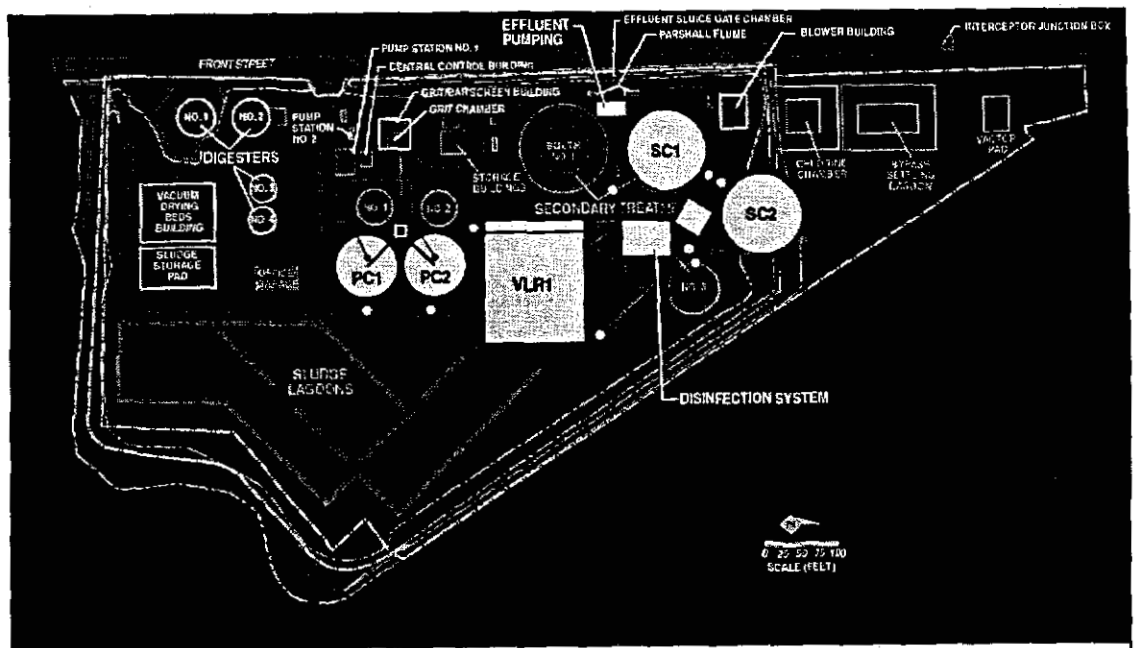

Figure 7.5.10 - Vertical Loop Reactor (VLR)

- Secondary treatment system-clarifier replacement to provide for a peak flow rate of 15.39 MGD with a SSR of 800 gallon/day/square foot, a solids loading rate of 50 pounds/day/square foot, and a weir loading rate of 30,000 gallon/day/lineal foot. The proposed system will include the following components:

  - Two 130-foot diameter concrete structures;
  - Two 130-foot diameter WESTECH, or equal, clarifier mechanisms, including bridge and aluminum peripheral hand rail system;
  - Scum pump station and forcemain;
  - WAS/RAS pumping system and piping;
  - Influent and effluent piping; and
  - Site and road improvements.

- Replacement of the chlorination system used for final effluent disinfection with an INFILCO low pressure/high output ultraviolet light (UV) disinfection system, or equal. The UV system will include:
  - Two 24.5-inch-wide by 26-inch-long by 60-inch-deep concrete channels;
  - INFILCO Aquaray ® 40, with 320 lamps total assuming 65% UV transmission and a dosage at peak flow of 40,500 uwatt secs/cm^2 or equal;
  - In-channel air scrubbing system, including blower assembly;
  - Overhead lifting device;
  - Channel grating; and
  - Slide gates.

- Improvements to the anaerobic digester system, including:

  - Addition of a gravity belt press, 2.2 meter Komline-Sanderson Model G-GRSL Series III combination belt filter press and gravity belt thickener, or equal, or a Model CA 405 Westfalia centrifuge or equal, for backup to the existing GBT and sludge lagoons;
  - Installation of a second 150 KW dual-gas engine-generator with transfer switch;
  - Replacement of the G-1 engine-generator transfer switch;
  - Digester gas room improvements, including pipe replacement; and
  - Building improvements.

- Effluent pump station installation for pumping of final effluent during periods of high Illinois River water levels. The pump station will include:

  - Two - 11,000 gpm, 50 hp, vertical turbine solids handling pumps with variable speed drives;
  - Concrete pumping chamber;
  - Diversion chamber/valve vault; and
  - Connection to the existing piping.

Table 7.5.11
STP #1 Upgrade
VLR System

Item	Estimated Cost
Preliminary Treatment	$ 452,000
Primary Settling	$ 990,000
Activated Sludge Process	$3,079,000
Secondary Clarifiers	$1,000,000
Disinfection	$ 500,000
Sludge Digestion	$ 372,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 300,000
Subtotal	$7,399,500
Contingency	$ 739,950
Engineering & Admin.	$1,109,925
Estimated Total Construction Cost	$9,249,375

Table 7.5.12
STP #1 Upgrade – VLR System
Annual Operation and Maintenance Cost

Item	Estimated Cost
Labor (See Note 1)	$ 340,000
Electric (See Note 2)	$ 200,562
- Primary effluent pumps - $22,721	
- WAS/RAS pumps - $4,760	
- Blowers for aeration system - $155,931	
- Anaerobic digester system - $9,737 (See Note 3)	
- Primary sludge pumps - $2,595	
- Effluent pumps - $1,038 (See Note 4)	
- Miscellaneous electric loads - $26,280	
- Savings from G-1 power generation - $22,500	
Polymer (See Note 5)	$ 29,286
Sludge disposal (See Note 6)	$ 259,000
UV disinfection, including power costs	$ 17,995
Estimated Total Annual O&M Cost	$ 846,843

Notes:
1. Labor costs for five full-time positions (cost estimate provided by United Water)
2. Electric cost based on $0.06/KWH
3. Anaerobic digester equipment includes two gas compressors, two sludge re-circulation pumps, GBT, and one brown water pump.
4. Effluent pump power cost assumes operation of one pump five percent of the year.
5. Polymer cost = $1.05 per pound for the GBT and centrifuge or belt press. Digested sludge de-watering of 50 percent of the sludge with the centrifuge or belt press.
6. Sludge disposal costs include 50 percent land application and 50 percent de-watered and landfilled. Land application cost = $0.034 per gallon; landfill disposal cost = $0.023 per pound dry weight.

The estimated total capital cost to construct the VLR treatment system is approximately $9,249,375 as detailed in Table 7.5.11. For purposes of comparison with other types of secondary treatment systems, the estimated total annual operation and maintenance (O&M) costs have been calculated for the VLR treatment system operating at a DAF of 6.84 MGD. The major components of the O&M costs were considered and included, smaller components that would be fairly consistent with all of the evaluated processes have not been included in the calculated O&M costs. The estimated annual O&M cost is $846,843, as listed in Table 7.5.12.

The estimated capital cost and annual O&M cost were used to calculate a present worth for the VLR system of $18,962,580. The present worth cost was calculated for 20 years at a six percent discount rate.

7.5.7 STP#1 and STP#2 Upgrades

A previous study, performed by Randolph & Associates, Inc., projected flow to STP#2 in the year 2000 to reach an average flow of nearly 2.0 MGD, a maximum flow of 4.0 MGD, and a peak flow of 4.8 MGD. Based on the existing development in the north and east sections of Pekin, these flows appear to be reasonable. Projecting the flows to 2015 and using the same criteria as was used for the city-wide wastewater projections, the 2015 flow to Pekin's STP#2 would be 3.0 MGD design average flow and 8.4 MGD peak hourly flow.

The estimated cost to construct a new STP #2 utilizing either a countercurrent aeration or oxidation ditch system would be approximately $2.5 million. To meet the total projected flow for the year 2015, STP#1 would be upgraded and STP #2 would be constructed for a total estimated cost of $9.4 million.

The estimated operations and maintenance costs for both STP #1 and STP #2 would be $877,500. The present worth of upgrading, operating and maintaining both STP #1 and STP #2 is $19,464,800.

8.0 Improvement Option Selection

8.1 Combined Sewer Overflow Structures

The combined sewer overflow structures are critical to proper operation of the City's combined sewer system and in preventing the Illinois River water from entering the system during periods of high river levels. As discussed in Section 7.1, a majority of the improvements recommended for the various structures are critical in nature but relatively minor in costs. A description of the improvements for each of the outfalls is given in Section 7.1.1 through Section 7.1.4 of this report. The improvement description is not repeated here, but Table 8.1 includes a list of the outfalls and the cost of the recommended improvements.

Table 8.1
Combined Sewer Overflow Structures
Cost of Proposed Improvements

Combined Sewer Overflow	Estimated Improvements Cost
Caroline Street – Outfall 004	$ 36,200
Court Street – Outfall 005	$ 43,560
Fayette Street – Outfall 006	$ 22,150
State Street – Outfall 003	$ -0-
Total Estimated Costs	$ 101,910

8.2 State Street First Flush Basin

Three options were evaluated to improve the cleaning system within the State Street Basin, the primary operational issue relative to the basin. The three options include the following improvements.

- Option No. 1 – Aeration system on the floor of the tank to keep the wastewater solids in suspension.
- Option No. 2 – Flushing system using domestic water, mounted on the basin floor to flush solids to the drain channel and the wet well to be pumped into the sewer system.
- Option No. 3 – Flushing system using wastewater, mounted on the basin floor, utilizing one existing sewage pump to flush the solids to the drain channel and the wet well to be pumped into the sewer system.

Option No. 3 has been selected based on lowest operational cost and the best anticipated performance. The estimated cost of this option is approximately $141,000, as detailed in Table 8.2.

Table 8.2
State Street Basin
Cost of Flushing Improvements

No.	Item	Quantity	Units	Unit Price	Total Price
1	8" buried force main	100	LF	$ 50.00	$ 5,000.00
2	8" electric plug valves in pump house	2	EA	$ 2,500.00	$ 5,000.00
3	6" electric plug valve	10	EA	$ 4,500.00	$ 45,000.00
4	Core drill walls for pipes	10	EA	$ 100.00	$ 1,000.00
5	Interior piping	840	LF	$ 30.00	$ 25,200.00
6	Building to house valves	250	SF	$ 40.00	$ 10,000.00
7	Conduit & wiring	1	LS	$ 3,500.00	$ 3,500.00
8	PLC programming	1	EA	$ 2,000.00	$ 2,000.00
9	Grinder for flushing water	1	EA	$14,000.00	$ 14,000.00
10	Seeding	1	LS	$ 500.00	$ 500.00
				Subtotal	$111,200.00
				Contingency	$ 11,120.00
				Engineering & Administration	$ 18,348.00
				Estimated Total	$140,668.00

8.3 FCI Bar Screen

Minor building improvements have been identified at the FCI bar screen facility. These improvements are described in Section 7.3 of this report and are estimated to cost $19,000, as detailed in Table 8.3.

Table 8.3
FCI Bar Screen
Cost of Improvements

Item	Estimated Cost
Electrical/Mechanical Improvements, including lighting, HVAC, and door opener	$ 7,500
Overhead door replacement	$ 3,000
Painting, sealing, and insulation	$ 4,500
Subtotal	$15,000
Contingency	$ 1,500
Engineering & Administration	$ 2,500
Estimated Total	$19,000

8.4 Wastewater Treatment

8.4.1 CSO Settling and Chlorination Basin – STP #1

Two options were evaluated in Section 7.4 for improving the ability to clean the sludge and debris that collects in both the settling and chlorination basins at STP #1. The two options each include the addition of a pumping station and forcemain for the proposed basin cleaning systems. Option No. 1 includes electrically operated valves sequenced by a PLC for the cleaning operation of both basins, in addition to

Table 8.4
Option 2
Wastewater Plant Basin
Cost of Flushing Improvements

No.	Item	Quantity	Units	Unit Price	Total Price
1	8" buried force main	50	LF	$ 50.00	$ 2,500.00
2	6" buried force main	250	LF	$ 40.00	$ 10,000.00
3	3" drop legs on slopes	75	LF	$ 30.00	$ 2,250.00
4	3" header pipes in cl basin	235	LF	$ 30.00	$ 7,050.00
5	3" plug valves	3	EA	$ 3,000.00	$ 9,000.00
6	Fire Hydrants	4	EA	$ 2,000.00	$ 8,000.00
7	Nozzles	30	EA	$ 50.00	$ 1,500.00
8	Concrete for slope in chlorination chamber	1	LS	$ 2,500.00	$ 2,500.00
9	Pump Station	1	EA	$ 63,000.00	$ 63,000.00
10	Concrete slab repair	25	SF	$ 5.00	$ 125.00
11	Holes in chlorine baffles	2	EA	$ 500.00	$ 1,000.00
12	Electrical feed for pump station	1	LS	$ 5,000.00	$ 5,000.00
13	Seeding	1	LS	$ 1,000.00	$ 1,000.00
14	Hose reel & cart	1	EA	$ 2,000.00	$ 2,000.00
15	Access ramp to chlorination chamber	1	LS	$17,500.00	$17,500.00
16	Baffle wall revisions	4	EA	$1,500.00	$1,500.00
				Subtotal	$138,425.00
				Contingency	$ 13,842.50
				Engineering & Administration	$ 22,850.00
				Estimated Total	$175,117.50

supplemental manual hose flushing and mechanical sludge removal. Option No. 2 includes the addition of a ramp to access the chlorination basin for mechanical cleaning with a small skid loader and manual hose flushing hydrants located in both basins.

Option No. 2 is the recommended improvement due to a lower capital cost, less complicated process, and the best anticipated performance. The estimated cost of Option No. 2 improvements is $175,118 as detailed in Table 8.4.

8.4.2 Treatment Systems

Five treatment system alternatives were considered for expansion of STP #1, in addition to an option that included improving STP #1 and replacing STP #2.

The following options were considered.

- STP #1 expansion conventional activated sludge
- STP #1 expansion Counter Current aeration (Schreiber) without primary treatment

- STP #1 expansion – Counter Current aeration (Schreiber) with primary treatment
- STP #1 expansion – Sequence Batch Reactor (SBR)
- STP #1 expansion – Vertical Loop Reactor (VLR)
- STP #1 improvement and STP #2 replacement

Each of these options was discussed in detail in Section 7.5 of this report, therefore they will not be repeated in this section.

The evaluation of the various treatment processes was performed as a joint effort of the City of Pekin, United Water and Harding ESE. The primary elements of this evaluation include the following items.

- Preliminary design and information gathered from manufacturers on the various processes.
- Process components sized to adequately treat the City of Pekin's projected wastewater loading.
- Site visits to similar treatment plants as being considered for Pekin.
- Conceptual treatment plant design for each treatment scheme, including conceptual drawing, preliminary construction cost estimate, and preliminary operation and maintenance costs.
- Present worth calculation for a 20-year period for each option considered.
- Consideration of operational and maintenance issues, exclusive of costs.

The treatment plant options and their respective costs are listed in Table 8.5.

Table 8.5
Summary of Costs Analysis – Treatment

Alternatives	Capital Costs	O & M Costs	Present Worth
Conv. Activated Sludge	$8,963,125	$768,310	$17,775,560
Counter Current w/o Pr.	$8,253,450	$893,950	$18,507,000
Counter Current	$8,465,625	$807,480	$17,727,340
Sequence Batch Reactor	$7,785,450	$933,880	$18,496,900
Vertical Loop Reactor	$9,249,375	$846,843	$18,962,580
STP #1 Improvement and STP #2 Replacement	$9,400,000	$877,500	$19,464,800

The treatment plant option selected is expansion of STP #1 with a conventional activated sludge system as described in Section 7.5.2. As listed in Table 8.5, the conventional activated sludge option has a construction cost of $8,963,125, an estimated annual operation and maintenance cost of $768,310 and a 20-year present worth of $17,775,560, based on a six percent discount rate.

The conventional activated sludge system is the recommended option based on the following criteria.

- Least cost annual operation and maintenance of all evaluated systems
- Plant personnel familiar with system operation due to similarity to existing plant.
- Capable of tolerating variable hydraulic and organic loads based on previous experience.

- IEPA recommendation to use conventional activated sludge system over alternate treatment systems.

The conventional activated sludge system is described in Section 7.5.2, including conceptual drawing, construction cost estimate and operation and maintenance cost projection while operating at DAF. The estimated construction cost is repeated in Table 8.6 for reference.

Table 8.6
STP #1 Upgrade
Conventional Activated Sludge

Item	Estimated Cost
Preliminary Treatment	$ 452,000
Primary Settling	$ 990,000
Activated Sludge Process	$2,850,000
Secondary Clarifiers	$1,000,000
Disinfection	$ 500,000
Sludge Digestion	$ 372,000
Sludge Dewatering/Disposal	$ 356,500
Effluent Pump Station	$ 250,000
Demolition of Structures	$ 100,000
Electrical Power & Controls	$ 300,000
Subtotal	$7,170,500
Contingency	$ 717,050
Engineering & Admin.	$1,075,575
Estimated Total Construction Cost	$8,963,125

City of Pekin
Public Works

CC: RN
CAS
ORIG: PEORI

Memo

RECEIVED
PEORIA OFFICE
DEC 19 2001
ENVIRONMENTAL PROTECTION AGENCY
STATE OF ILLINOIS

To: Mr. Jim Kammueller, IEPA - Peoria

From: Dennis Kief, Public Works Director
400 Margaret Street
Pekin, Illinois 61554 – 3260
309 – 477 –2328 (Phone) 309 – 347 – 1064 (Fax)
dkief@ci.pekin.il.us

CC: Larry Sevier, David Pagliaro, and Don Gasper

Date: December 18, 2001

Re: Possible Southeast Interceptor Cross Connection

Recently City personnel televised the City's Southeast Interceptor just south of the entrance to Wastewater treatment Plant No. 1 on Front Street. This work was done as a continuation of the field evaluations conducted by Ken Newman, then of your office. Ken had worked extensively with Don Gasper first in 1996 and then again in 1998 in an effort to locate the cause for the loss of flow in Pekin's Southeast Interceptor.

When the original evaluations were conducted in 1996, we were unable to locate several manholes. Those manholes were located and made accessible for the 1998 evaluations that your agency was involved with.

On December 13, 14, and 17, 2001, we televised all of the sewers between Manhole #5 and #79 (Map attached). This involved televising the following lines:

350' of 27 " sewer between Manholes #7 and #6

80' of 27" sewer between Manholes #6 and #5B

95' of 27" sewer between Manholes #5B and #5A

60' of 3 – 12" sewers between Manholes #5A and #5

450' of 27 " sewer between Manholes #5 and #4

There was no evidence whatsoever of any cross-connection from the City's sewers in the most "suspect" areas between manholes between manholes #5B and #5, those manholes where the Williams Company lines cross above and below the City's Interceptor. In fact, the televising yielded only one service each between Manholes #7 & #6 and #5 & #4. Both of those services showed only small amounts of flow entering the City's interceptor.

The City's televising crew did notice an apparent backing up of flow as they got closer to the Treatment plant. There was even an evidence of some solids in those lines. We plan on pursuing the possibility of flows backing up in the Southeast interceptor because of the flows coming in from the north. The crew also noticed some swirling/turbulence at Manhole #5A, but attributed that to the drop manhole that exists at that location, not the result of any discharging from the manhole.

We did tape all of the sewer televising and would gladly make that available to you to review. In addition, we are looking at the possibility of installing some portable flowmeters to see if in fact there is a loss of flow in that sewer.

MEMORANDUM

RECEIVED
MAR 27 2002
IEPA

SUBJECT: PEKIN #1 (Tazewell County) -Wastewater Treatment Facilities NPDES Permit No. IL0034495 SSO - South Interceptor Meeting/WWTF Reconnaissance Inspection

JB
-RECORDS
-PERMITS

TO: DWPC/FOS and RU

FROM: James E. Kammueller, DWPC-FOS, Peoria Region

DATE: March 12, 2002

INTERVIEWED: Dennis Kief, Public Works Director
Dominick Gasper, Project Manager, United Water
Gary Davis, ESE

I met with city officials/representatives and sewer maintenance people to discuss ways to inspect the south interceptor to determine if one or more SSO points might exist (refer to Ken Newman memorandum (one) dated May 14, 15, and 26, 1998). To date, the City has only been able to TV inspect the interceptor upstream of the WWTF near Williams Energy (formerly Pekin Energy). It was agreed that the interceptor needed to be inspected in its entirety from Williams to the WWTF and that detailed inspection was essential in the WWTF headworks area where the old 24-inch original plant outfall and the 1964 "pumping" outfall crossed the south interceptor. It was also recommended that this work be done contractually as the City does not have the equipment for cleaning and inspecting larger sewers. I provided Mr. Kief with contacts in Washington and Rock Island regarding references for contractors who could clean/inspect larger sewers.

The WWTF flow was around 3 MGD with no bypassing. The effluent appeared less gray/turbid than noted during my February 13, 2002 inspection. Mr. Gasper indicated a new field D.O. meter had been obtained and F/M monitoring was being implemented.

James E. Kammueller

JEK/lc

Attachment: Sketch

cc: DWPC/CAS
DWPC/Permit Section
Peoria File

Monthly Meeting Minutes
By: Dennis Kief

CP - Geauls

United Water Services
Pekin WWTF
606 South Front Street
P.O. Box 883
Pekin, Illinois 61555-0883
telephone 309-477-2333
facsimile 309-347-3298
e-mail dhughes@unitedwater.com

CLIENT MEETING MARCH 12, 2003

ATTENDANCE:

Mr. Dennis Kief, Pekin Public Works Director
Mr. Don Hughes, Project Manager United Water Pekin, IL

TOPICS OF DISCUSSION:

STATE STREET LIFT STATION:

Jim, Gary, Doug

- A problem developed over the last month that was caused by inadequate heating in the screen room under very cold conditions. We received a copy of a letter stating the contractors would be responsible for correcting the problem.
- What is the current status of the punch list for this project? ?

LICK CREEK LIFT STATION:

- Status of electrical hook up. Next week

WASTEWATER TREATMENT PLANT #1:

- Anything from Williams Company concerning drawings, etc. We did get some more grease during the last couple of weeks.
- Anything more on the IEPA revolving loan or the plan to determine whether or not an SSO exists in the South interceptor? Tom
- There was a representative coming down on January 14th to look at the Roots blowers. Did this visit occur? If so, what was the outcome of the visit? Jan 6
- There is a representative of Turblex blowers that will be here on January 16 to look at the blower system. Did this visit occur? If so, what was the outcome of the visit? Gary

Calibrate of flowmeter

Client Meeting

- Have you sent a letter to Mobile Pressure Washing pertaining to the $25 fee for each load of recovery water?
- We have a quote for adding a shut off switch for the traveling bridges to stop them before climbing onto the bridge. The estimate is for about $1800 to do both bridges. We are planning to add pull out ladders to each bridge that will automatically shut off the bridge when extended for use. This part of the project will be done in house. Are funds available at this time to address this safety issue?
- Does the City have a dump truck we could use to remove material from the storm holding tank to ~~speed up the~~ cleaning process?
- We are trying to determine if a Bobcat can be used to remove material from the contract chamber of the storm holding tank as well. Does the City have one we could use as a test?
- We have identified a better way to waste solids from the FBOP plant and would like to install a valve operator and controller for that purpose. We will be getting a quote for this to discuss with you in the near future.
- We are studying the possibility of adding VFDs for operation of the primary pumps to better control the "spikes" that occur in the secondary influent flow. We will be looking into compatibility and interference issues to make sure the units will work as planned.
- Did you get a report yet from Jim Kammueller related to his last month's inspection of the facility? I have not gotten anything back yet.
- Has there been any resolution on how to proceed with the leak on the 64 digester yet?
- We are looking for ideas of how to measure flow from the air lift pumps.
- A different method of activating the bar screen here at the plant is being researched.

PERSONEL RELATED ITEMS:

- Gary Haller and I will both be taking the Illinois Class 1 certification test on April 1st.
- Safety and job related training are being conducted on an ongoing basis and will continue. The safety tailgate meeting topic for this month was Using Ladders Safely.

Oakwood Lift Station Grade