



Service Authority
Prince William County

**OCCOQUAN FOREST
WASTEWATER TREATMENT PLANT
UPGRADE EVALUATION**



April 2012

TABLE OF CONTENTS

TABLE OF CONTENTS	1
1. Project Objective	2
2. Summary of Existing Facilities	2
3. Coordination with DEQ	7
4. Effluent Storage Pond Volume Assessment & Recommendations	8
5. Plant Flow Capacity Evaluation	10
6. Recommended Treatment Process Upgrades	13
7. Replacement of Treatment Plant with Pump Station and Force Main Option	15
8. Planning Level Cost Information	17
9. Present Worth Cost Evaluation	19
10. Summary and Recommendations	20

APPENDIX A

Vendor Information for Proposed Treatment Equipment

1. PROJECT OBJECTIVE

The purpose of the project is to provide a review of the existing wastewater treatment plant and identify the recommended scope and associated cost for upgrading the facility. Although no increase in plant capacity is needed, the treatment components are reaching the end of their design life and are in need of replacement. As part of the evaluation, the following process components were reviewed:

- The scope and cost for replacement of the existing dual train steel packaged wastewater treatment units with new units of similar capacity was evaluated
- A bathymetric evaluation of the existing effluent storage pond was performed to determine its current volume and review plant flow and storage requirements to determine if providing additional storage volume would be necessary
- An evaluation of the cost for upgrading the effluent pond with a liner system was performed
- Evaluation of planning level costs for replacing the plant with a sewage pumping station and force main

As part of the scope of services for this project, an on-site condition evaluation of the existing wastewater treatment plant was conducted and a review of plant records was performed. The plant records included influent flows, irrigation flows and wastewater process parameters. WR&A also contacted the Virginia Department of Environmental Quality (DEQ) to discuss the project and identify issues and concerns that DEQ has regarding the upgrade of the existing facility.

2. SUMMARY OF EXISTING FACILITIES

The Occoquan Forest Wastewater Treatment Plant serves approximately 220 homes in the Occoquan Forest subdivision which is located along Davis Ford Road in central Prince William County. There are no industrial or commercial facilities within the service area. All flow to the plant is conveyed to the plant through a 6-inch diameter force main from the Occoquan Forest Pump Station No. 36. An overall facility photo is provided as **Figure 1**. The station is permitted for a design flow of 88,000 gallons per day.



Prepared by:
Whitman, Requardt & Associates, LLP
for
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
4 COUNTY COMPLEX COURT
WOODBRIIDGE, VIRGINIA 22192



OCCOQUAN FOREST WWTP EVALUATION
FIGURE 1

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

Headworks Facilities

Flow entering the treatment plant from the existing 6" force main is directed to a comminutor unit with a bypass. The by-pass channel is outfitted with a manual bar screen. At the time of the facility evaluation, the comminutor unit was out of service and the by-pass channel was in-use.



Photo 1 – Existing Comminutor with Bypass

The facility has a concrete vault with (4) telescoping mud valves which follow the comminutor unit. This vault was apparently previously used as a splitter manhole but the unit is currently out of service.

Aeration Basins

Two parallel in-ground steel extended aeration basins tanks are used for biological treatment. The tanks were part of a packaged steel facility manufactured by DAVCO. The facility was originally constructed as a step feed facility but was subsequently converted to a conventional extended aeration process. The design capacity for each train is 44,000 gallons per day (gpd).



Photo 2 – Existing DAVCO Treatment Unit 1 of 2

Each of the two aeration basins are followed by in ground steel circular clarifiers. The clarifiers are also steel tanks 11.3 feet in diameter with a sidewall depth of ten feet.



Photo 3 – Existing Aeration Basin

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

Residuals Handling

Each process train includes two aerobic sludge holding tanks. The volume of each tank is approximately 5,300 gallons. Flow from the aeration basins enters a central circular stilling well at the top of the clarifier. A rake arm at the bottom of the clarifier moves settled solids to a return activated sludge (RAS) pit. An airlift pump returns solids to the aeration basin or to one of the two aerated digesters. A baffle keeps floating material from overflowing the effluent weir. Another airlift pump pulls floating material from the clarifier surface and returns that material to the third chamber of the aeration basin. The skimming system is intended to be operated on an intermittent basis as needed. Floating material is manually removed from the clarifier with a pool cleaning screen.



Photo 4 – Existing Steel Clarifier

Aeration is supplied by two rotary positive displacement blowers mounted on a common base with a central electric control panel located between each motor-blower combination. The motor for each blower is a standard drip-proof induction type with standard NEMA frame. The blowers are equipped with manifold piping, valves, fittings, air intake filter-silencers, and flexible air coupling. The aeration basins and digesters both utilize coarse bubble diffusers and share the same air header system from the blower units.

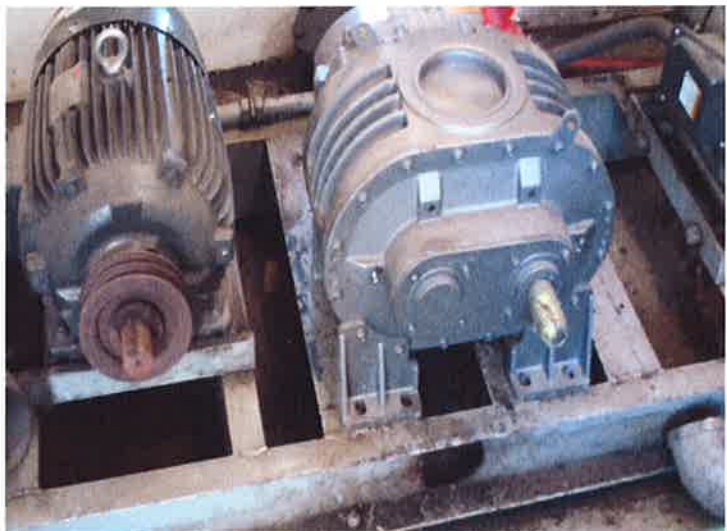


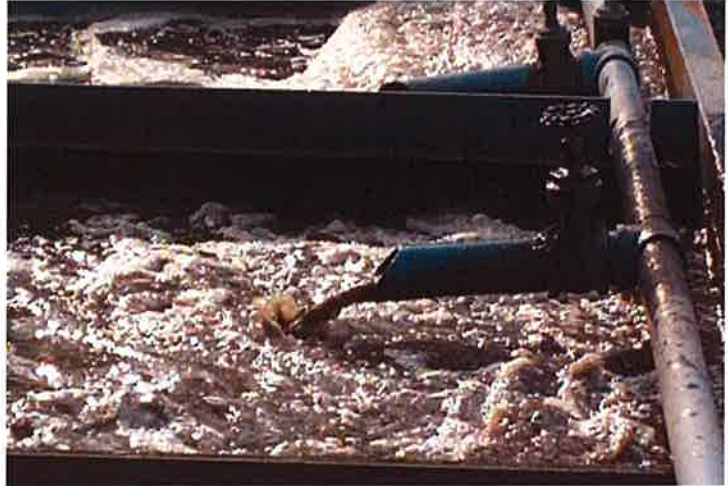
Photo 5 – Existing Blower Unit – This Unit Not Operational at Time of Inspection

Wasting is performed by opening the valve from the RAS header to the selected basin and closing the RAS valve to the aeration basin. Wasting volume is calculated from the change in elevation within the digester compartment (530 gallons per foot). Moderately digested sludge

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

is removed from the aerated digesters as needed to maintain sufficient operating volume for continued wasting.

Residuals generated at the facility are either hauled directly to the H.L. Mooney Water Reclamation Facility for further treatment or they are discharged to a sanitary sewer within the Mooney service area. No laboratory analysis is performed on the aerated digesters. Operators monitor the digesters for odor and visual appearance.



**Photo 6 – Existing Return Activated Sludge
Piping System**

RAS is removed from the clarifiers by an air lift pump. Air flow adjustments control the rate of RAS flow. The system is designed to maintain a RAS flow rate of approximately 100% of forward flow.

Effluent Disinfection

Clarifier effluent flows into the chlorine contact tanks. Liquid sodium hypochlorite is added in the first of three chambers as a disinfectant. All three chambers are mixed with air supplied by coarse bubble diffusers.

The first chamber is also mixed with a propeller mixer. Detention time is in excess of thirty minutes at design flow. A sufficient quantity hypochlorite is used to maintain a minimum chlorine residual of 2.0 mg/l. The chlorination system appeared to be functioning properly during the inspection.



**Photo 6 – Existing Return Activated Sludge
Piping System**

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

Clarified and chlorinated effluent from both treatment trains is combined before entering a modified Parshall flume (V-Notch installed). An ultrasonic level measuring device continuously measures the level prior to the flume throat. The level measurement is recorded on a circular chart in the facility office/lab. Totalizer readings are taken at the same time every morning to determine a daily flow total.

Effluent Storage

Effluent flow from the treatment facility flows by gravity into an effluent holding pond. The facility generally maintains a minimum of two feet of freeboard within the holding pond. The pond does not have a synthetic liner.

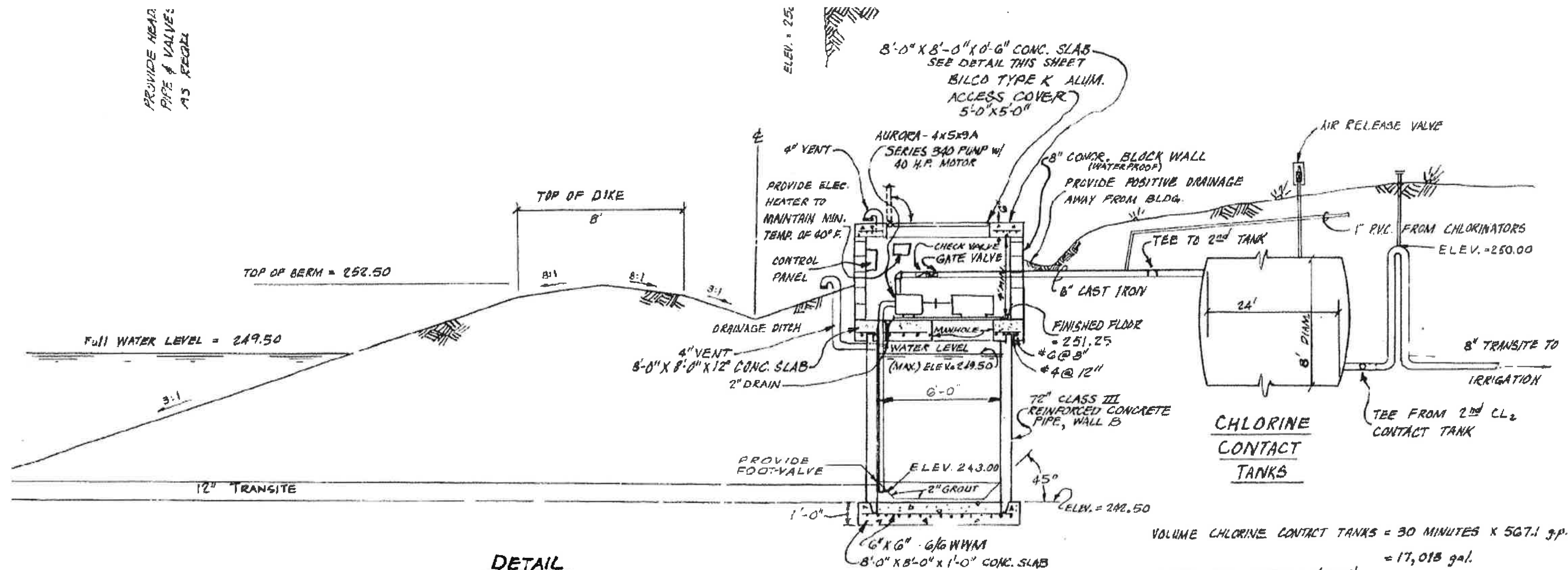
Water from the pond is chlorinated and sprayed on three forested irrigation areas. The total irrigation area is 14.3 acres. The spray irrigation area utilizes an irrigation pumping station with below grade piping and 28 pop-up type spray irrigation heads. 19 of the spray heads have a capacity rating of approximately 38gpm and 9 spray heads have a delivery rating of approximately 12gpm. The irrigation pump station is rated to deliver 567gpm at 170ft. of total dynamic head. Record plans for the pumping station are included as **Figure 2**. The record plans indicate that the irrigation header from the station is constructed of 8-inch transite pipe.



Photo 7 – Existing Effluent Storage Pond



Photo 7 – Existing Forested Spray Field Site



VOLUME CHLORINE CONTACT TANKS = 30 MINUTES X 567.1 g.p.m.
= 17,013 gal.
∴ USE TWO TANKS : 8' X 24'

DETAIL
EFFLUENT STRUCTURE & PUMPING FACILITY

SCALE: 1" = 4'

Prepared by:
Whitman, Requardt & Associates, LLP
for
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
4 COUNTY COMPLEX COURT
WOODBIDGE, VIRGINIA 22192



OCCOQUAN FOREST WWTP EVALUATION
FIGURE 2

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

Surface and groundwater sampling of certain parameters including nutrients and metals is required by the Virginia DEQ to ensure that no excessive pollutant load is delivered to surface or ground waters. DMR forms for groundwater and surface water are required for submission to DEQ as part of the facilities VPA permit.

Application to the irrigation areas is primarily conducted from March 1 to November 30. Spray activities do not occur when the ground is frozen or saturated, during periods of rainfall or within 24 hours of severe weather forecasts. Groundwater and surface water adjacent to the irrigation areas is monitored in accordance with permit requirements.

3. COORDINATION WITH DEQ

The Department of Environmental Quality (DEQ) was contacted to determine what requirements would need to be considered for the design of a replacement WWTP at Occoquan Forest. The DEQ representative was Ms. Anna Westernick who discussed the project by telephone on July 19, 2011. In this discussion, the DEQ representative made several significant comments and expressed some key concerns regarding the project which are summarized as follows:

- The 10 year permit for the facility expires in 2015 and will require renewal. DEQ does not currently anticipate approving the renewal unless the new spray field is upgraded.
- DEQ believes that the spray field lacks flexibility due to the piping configuration having the fields in series piping configuration and that the mature trees are viewed by DEQ as not having the uptake capacity that once existing when they were younger rapidly growing trees.
- DEQ was concerned about impacts to the groundwater in the area and wanted to evaluate chlorides from the groundwater monitoring wells.
- There is a major concern relating to the steep drop offs at the edges of the spray irrigation fields which lead to the potential risk of channelized surface water causing erosion.
- DEQ indicated that it was their preference that some other discharge means be considered such as a reuse for industrial user, golf course or similar facility. DEQ stated that they are aware of a previous engineering study performed by PWCSA to evaluate the elimination of the treatment plant and construction of a pumping station and force main into the service area of the H.L. Mooney WWTP facility. This concept to eliminate the plant is DEQ's preferred alternative.

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

- WR&A questioned what would be required if the existing spray fields were to continue in service. The representative indicated that DEQ would at a minimum require an analysis of the uptake rate and selective clearing of the mature trees with a replanting program with younger trees with a higher uptake rate.
- DEQ also expressed concern regarding the capacity of the irrigation holding pond. A bathymetric survey would be required to determine if the facility meets the current state requirements. The criteria which DEQ referenced is Article 9 of the Virginia SCAT regulations which states the following:

“A minimum holding period of 120 days shall be required when climatic data is not available. System backup storage shall be determined by the complexity of the entire treatment system. An increase or reduction of minimum storage may be considered on a case-by-case basis based on adequate documentation of agronomic crop production and nutrient utilization”.

In summary, based on our telephone conversation, DEQ has serious concerns regarding the continued use of the spray field. In order to utilize the existing spray field, DEQ will require further study of the soils, and trees to document the uptake capacity for the facility. In order to satisfy DEQ it may be necessary to remove many of the existing mature trees and re-forest. Some tree species such as the hybrid poplar tree have high uptake rates and have been used successfully in many areas throughout the United States. It should be noted though that during the re-forestation process as much as a 50% mortality rate can occur due to insect and animal destruction. Ongoing management and replanting inspections will be necessary.

4. EFFLUENT STORAGE POND VOLUME ASSESSMENT & RECOMMENDATIONS

A bathymetric survey was performed of the pond to determine if the required 120 days of minimum storage volume is available within the existing storage pond. A surveyor performed soundings of the pond and volumetric calculations were performed for various depths. The storage volume at varying surface elevations is provided in **Table 1**. The top of the pond berm is at approximately elevation 252.5. Based on a review of the record plans for the pond and irrigation pumping station, the design maximum water surface is 249.5. At the time of the inspection, the pond elevation was at 249.69, which represents the full pond volume. At this full water surface elevation, the pond has a volume of 4.10 million gallons. At the 88,000 gallon per day plant capacity, this volume is equivalent to approximately 46 days of storage at the plant design flow of 88,000 gallons per day. This is well short of the 120 day storage requirement identified previously. In order to provide 120 days storage, a total storage

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

volume of 10.56 million gallons of storage would be required. As a result, the minimum of an additional 6.46 million gallons of storage is required.

**Table 1
Summary of Pond Volume at Various Depths**

Water Surface Elevation (ft.)	Pond Area (sf.)	Pond Volume	
		(cuft.)	(Million Gal)
251.90	109,286	782,327	5.85
251.00	106,367	685,284	5.13
250.00	103,279	580,461	4.34
249.69	102,335	548,591	4.10
249.00	99,885	478,825	3.58
248.00	94,623	381,571	2.85
247.00	89,144	289,688	2.17
246.00	82,947	203,642	1.52
245.00	74,534	124,902	0.93
244.00	61,357	56,956	0.43
243.00	36,752	7,902	0.06
242.57	1	0	0

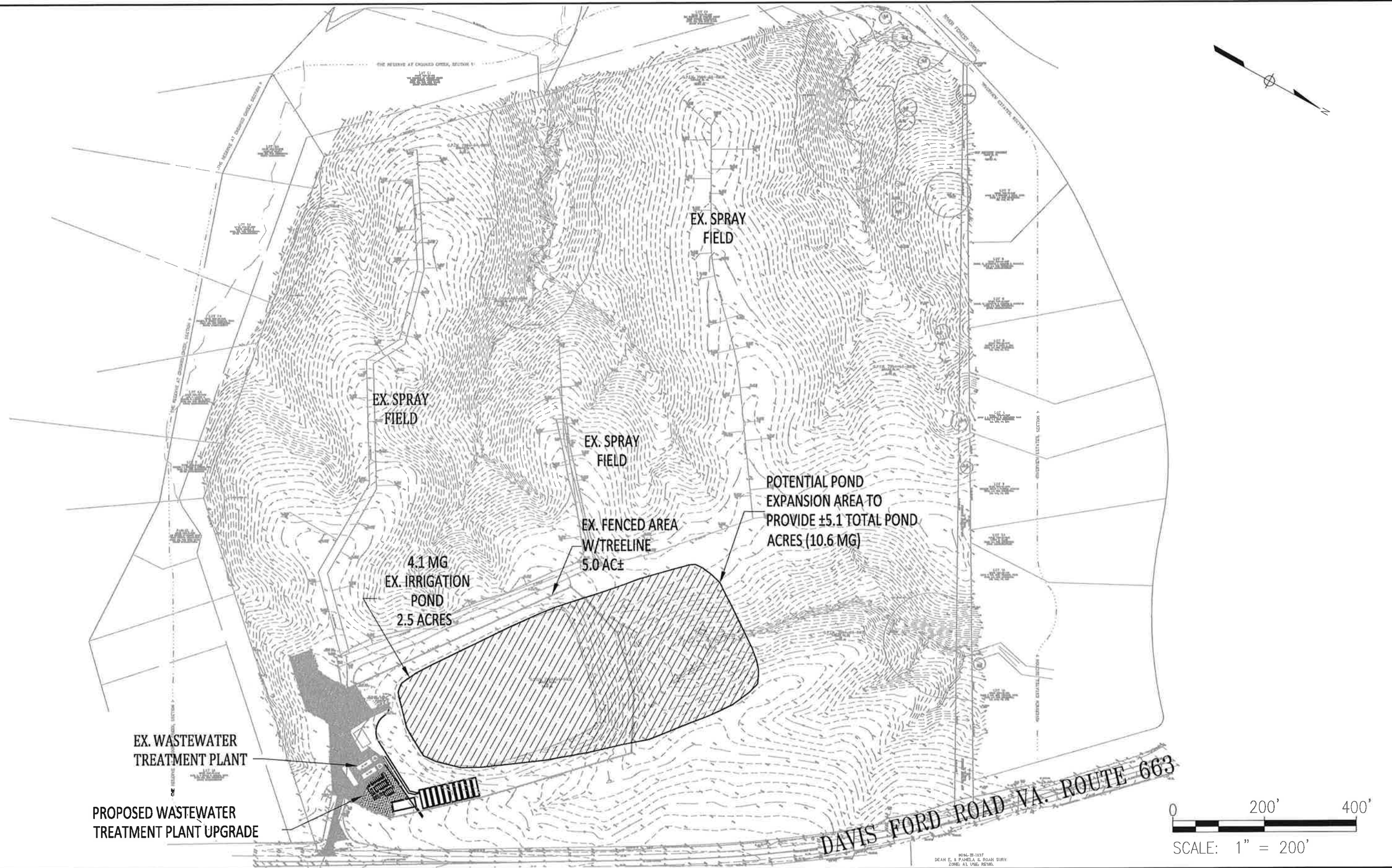
Approx. Volume with 3' freeboard = 4 MG

Providing the additional volume would require a significantly larger pond area. The current pond has a total area within the berm of 2.5 acres with a net capacity of 4.1 million gallons. If the pond was increased to 10.6 million gallons, it is anticipated that it would consume approximately 5.1 acres of land area within the site if the pond is constructed at a similar depth as the existing pond. It may not be feasible or practical to enlarge the pond to this scope considering the heavily wooded site which is already encumbered to a large extent with the spray irrigation system. **Figure 3** illustrates the potential size and location of an expanded pond at the site. **Table 2** summarizes planning level costs for enlarging the pond if it is desired by the Authority.

**Table 2
Pond Expansion Planning Level Cost Estimate**

Description	Units	Quantity	Cost/Unit	Total
Excavation	CY	32,182	\$8.14	\$261,961
Clearing and Grubbing	AC	2.6	\$12,708	\$33,040
Fine Grading	SF	221,712	\$0.85	\$188,455
Seeding (includes fertilizing)	SF	19,440	\$4.42	\$85,925
Process Upgrades Subtotal =				\$569,381
Contingency (25%)				\$142,345
Total Project Cost =				\$ 711,726

Printed: 29 Sep 2011, 11:39am ATUEJA Path: N:\18457-000\CADD\C18457-FB-ATDWC File Tab: OVERALL PLAN



**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

In lieu of expanding the pond area to such a large extent, the following other alternatives could be considered:

- Expanding the pond area could be reduced by raising the berm and/ or excavating the pond bottom deeper to enhance the usable water depth within the pond. If this is performed, the irrigation pumping station will need to be replaced to lower the wet well and raise the top slab elevation to correlate to the new pond profile. Currently the top and bottom wet well elevations of the pumping station correspond top and bottom elevations of the lagoon. A possible disadvantage with this alternative will be lowered dissolved oxygen levels due to the longer retention time and increased depth. A mixer or aerator may be needed with this alternative
- A second alternative is to pursue a waiver of the 120 day storage requirement. Based on reviewing records from 2010, it is readily apparent that the PWCSA has an ongoing program for pumping and hauling the contents of the pond to the collection system served by the H.L. Mooney WWTP facility. In the months of January, February and March of 2010, the Occoquan Forest treatment plant recorded a total of 1.4 million gallons of water that was hauled from the pond to the H.L. Mooney system. Assuming an average truck volume of 3,500 gallons, this amounts to 400 truckloads of effluent water in the first three months of 2010. The disadvantage of not expanding the storage pond will be the continued reliance of the pump and haul operation and its associated cost, traffic and disruptions.

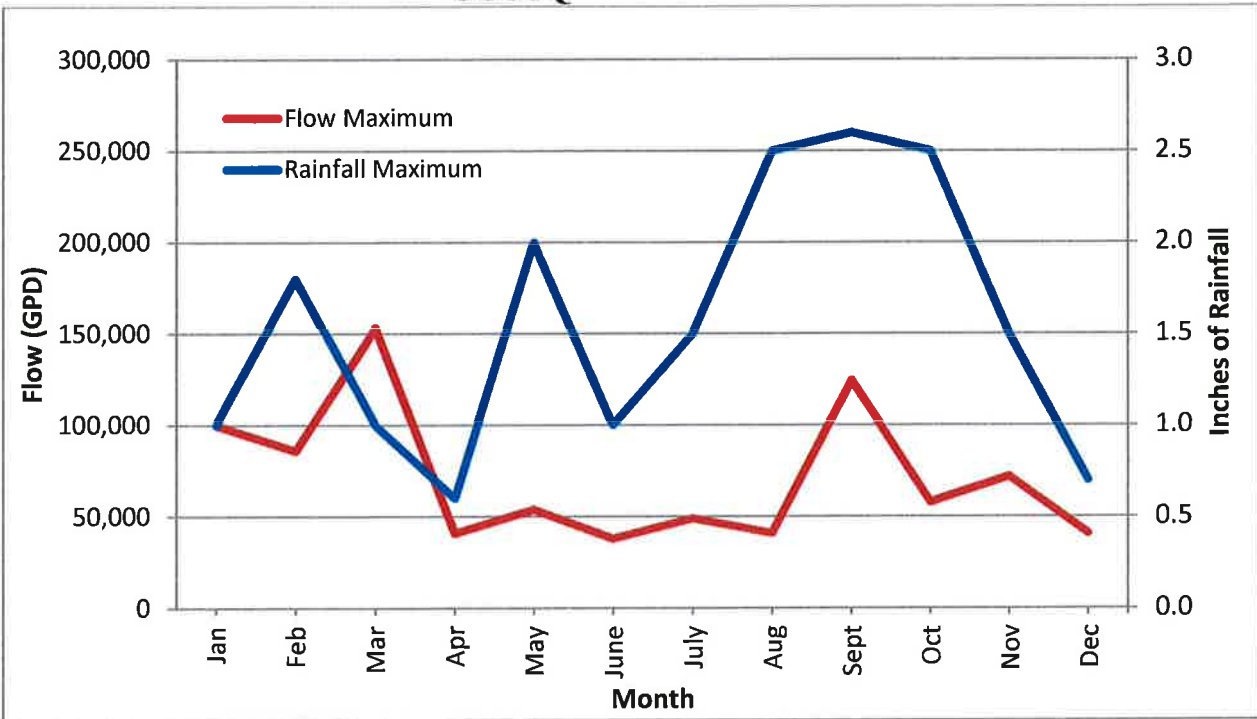
The pond is currently earth lined. It is also recommended that the facility upgrade include relining the pond with a geosynthetic liner system. The liner installation will require that the pond to be taken out of service and cleaned of organic sediment. The pond will be prepared with a suitable sub base material such as bentonite clay prior to lining in order to prevent damage to the liner material.

5. PLANT FLOW CAPACITY EVALUATION

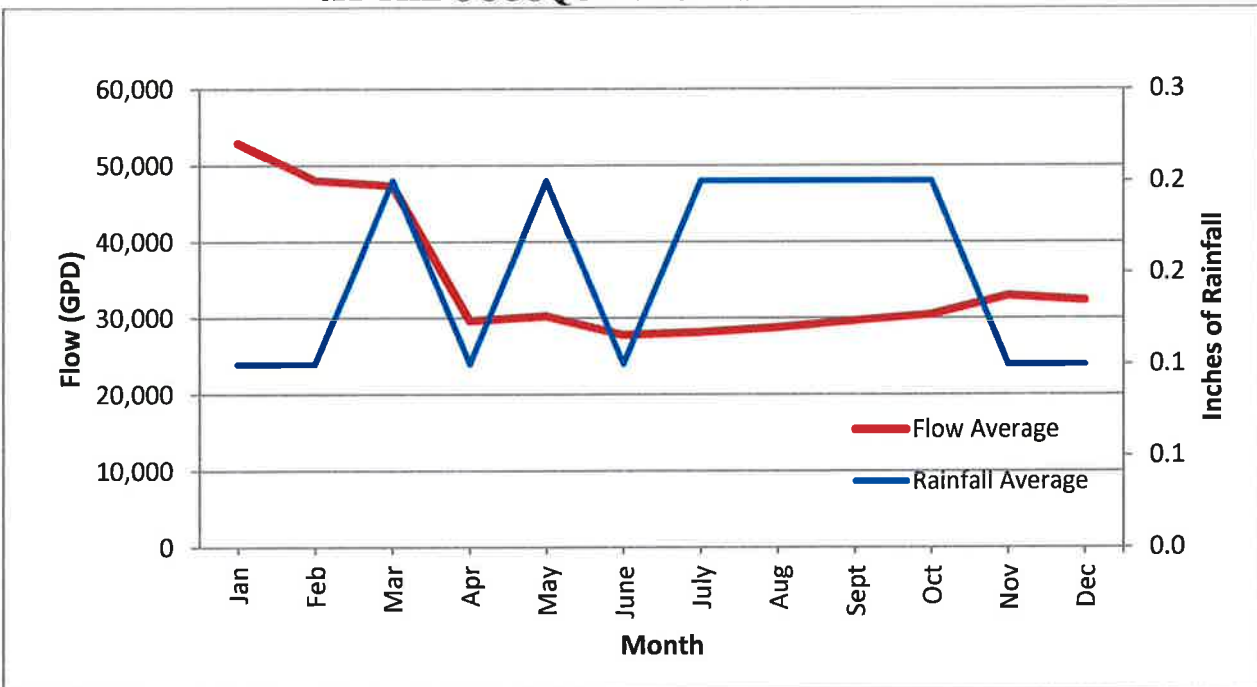
The wastewater treatment plant flows were evaluated for calendar year 2010 to determine the existing flow requirements. The plant serves the residential community of Occoquan Forest and essentially no increase in flow capacity would be anticipated. **Figure 4** illustrates the maximum day flows recorded by month at the plant and **Figure 5** summarizes the average daily flows recorded by month.

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

**FIGURE 4
MAXIMUM DAY FLOW AND RAINFALLS BY MONTH
AT THE OCCOQUAN FOREST WWTP**



**FIGURE 5
AVERAGE DAY FLOWS AND RAINFALL BY MONTH
AT THE OCCOQUAN FOREST WWTP**



**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

A summary of the 2010 wastewater treatment plant data is provided numerically in **Table 3**.

**TABLE 3
YEAR 2010 FLOWS AT THE OCCOQUAN FOREST WWTP**

2010	Rainfall in inches			Flow in gallons per day		
Month	Average	Maximum	Minimum	Average	Maximum	Minimum
Jan	0.1	1.0	0.0	52,963	101,799	38,618
Feb	1.0	1.8	0.0	48,078	85,507	27,711
Mar	0.2	1.0	0.0	47,378	153,986	26,102
Apr	0.1	0.6	0.0	29,650	40,868	19,999
May	0.2	2.0	0.0	30,258	54,418	22,335
June	0.1	1.0	0.0	27,778	38,246	23,215
July	0.2	1.5	0.0	28,131	49,267	17,421
Aug	0.2	2.5	0.0	28,775	40,875	21,283
Sept	0.2	2.6	0.0	29,675	124,884	15,237
Oct	0.2	2.5	0.0	30,474	57,540	21,142
Nov	0.1	1.5	0.0	32,939	72,123	23,178
Dec	0.1	0.7	0.0	32,300	41,224	25,783

2010 Annual Average WWTP Flow = 34,867 gpd

Plant Flow Summary of 2010 WWTP Flow Data

<u>Demand Condition</u>	<u>Flow Rate</u>	<u>Peak Factor (to Avg. Day)</u>
2010 Annual Average Day Demand =	34,867 gpd	1.00
2010 Max Month Demand =	52,963 gpd	1.52
2010 Maximum Day Demand =	153,986 gpd	4.41

The annual average flow at the facility is 34, 866 gallons per day. This is well below the 88,000 galloon per day capacity of the facility. January, February and March had the highest monthly average flows of 52,963, 48,078 and 47,378 gallons per day respectively. January, March and September each recorded maximum daily flows in excess of 100,000 gallons per day with the highest flow recorded in March of 153,968. As a result, although the 88,000 gallon per day capacity of the plant is well above the normal dry weather average day flows, the facility does experience relatively high wet weather flow events that exceed the plant capacity.

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

6. RECOMMENDED TREATMENT PROCESS UPGRADES

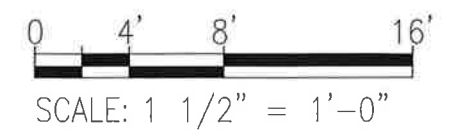
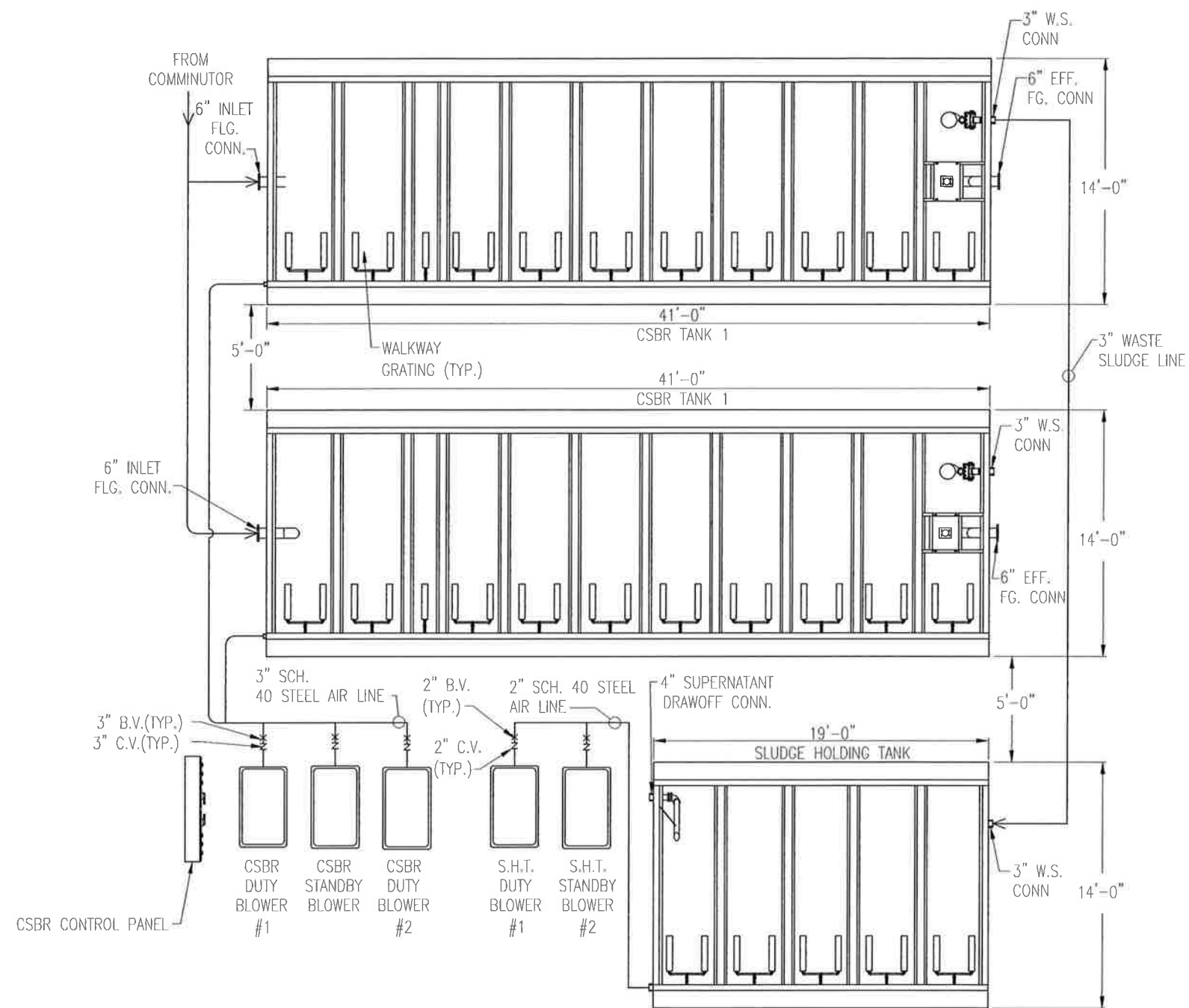
Due to the age and condition of the steel tanks and mechanical gear within the existing treatment facilities, it is recommended that the entire biological treatment system be replaced to include updated process equipment. WR&A contacted several equipment suppliers to provide quotations for a replacement steel packaged wastewater treatment system. The average strength values were provided to the process manufactures as anticipated wastewater strengths and design requirements to be used for the proposed treatment system upgrade.

Below is information WR&A has obtained from a manufacturers of wastewater treatment facilities similar to the treatment system needed for the Occoquan Forest WWTP upgrade. They also have plants in the area which can be visited to obtain a better understanding of the proposed system if needed.

The wastewater package plant anticipated for the replacement to be the most cost effective for this size is a pre-engineered, shop fabricated, and field erected sequencing batch reactor facility. The basic system consists of two (2) Secondary Treatment Tanks and one (1) Sludge Holding Tank. The design of the equipment is based on the Continuous Influent Sequential Reactor System (CSBR). A conceptual site plan for the treatment process equipment is illustrated in **Figure 6** and **Figure 7**. The treatment process scope was evaluated for the design parameters as identified as **Table 4**.

**TABLE 4
DESIGN PARAMETERS FOR THE TREATMENT PLANT PROCESS EQUIPMENT**

Average Daily Flow (ADF)	88,000 GPD	
Peak Dry Weather Flow (PDWF)	132,000 GPD	
Peak Wet Weather Flow (PWWF)	176,000 GPD	
BOD5 Average	250 mg/l influent	30 mg/l effluent
Total Suspended Solids (TSS)	250 mg/l influent	30 mg/l effluent
NH3N	35.0 mg/l influent	
Total Phosphorus (TP)	8.0 mg/l influent	
Total Nitrogen (TN)	40.0 mg/l influent	
pH	6-9 S.u.	
Alkalinity (Minimum)	273± mg/l	
Wastewater Temperature, Min.	50°F	
Wastewater Temperature, Max.	81°F	
Air Temperature, Winter	0-40°F	
Air Temperature, Summer	80-100°F	



OCCOQUAN FOREST WWTP UPGRADE

PROPOSED EQUIPMENT LAYOUT

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

The treatment plant components will include the following:

- Two sequencing batch reactor units each approximately 41' x 14' are anticipated. The batch reactors will avoid additional expense of constructing clarifier units.
- A 4" supernatant decanter airlift will be provided for decanting the sludge holding tank. The sludge holding tank is proposed for a minimum of 30 days holding time and a design volume of 20,500 gallons.
- The aeration system in the batch reactor and sludge holding tanks will be stainless steel coarse bubble diffusers.
- Three CSBR aeration blowers will be provided with two as the duty blowers and one stand-by blower.
- Two blowers will be furnished for the sludge holding tank. One will be the duty blower and one standby.
- The air blowers will be mounted inside of a precast blower / control building.
- A decanter mechanism will be provided into each of the two aeration basins
- If the alkalinity of the incoming sewage is less than 273 mg/l, then it will be necessary to use chemicals to increase the alkalinity. An alkalinity feed system is included in the proposed design.
- The treatment tanks will be mounted below ground level. Full aluminum walkway and grating will be provided for safety and access to equipment.
- The treatment system will incorporate a control panel with disconnect, branch circuit breakers, motor starters with overload protection, selector switches, indicating lights, lighting arrestor, three phase monitor control and an alarm system all controlled by Programmable Logic Controller (PLC). The capability for manual control of all equipment will also be provided. A transformer for the 120-volt, single-phase power will also be provided for control voltage and operation of the items and equipment.

In addition to the treatment plant process upgrades, it may be advisable to construct an influent equalization system at the plant site for wet weather flow conditions. If desired, the least expensive alternative may be to keep the old biological tanks and aeration system, clean and repaint them, in lieu of removing them from service. The tanks could be used as side stream storage during wet weather conditions. If the old tanks are desired to be reused in this capacity, the cost for repainting and installing pumps from the storage tanks would be somewhat offset by the costs of excavating and removing the tanks. A structural inspection would also need to be performed for the tanks to determine their condition.

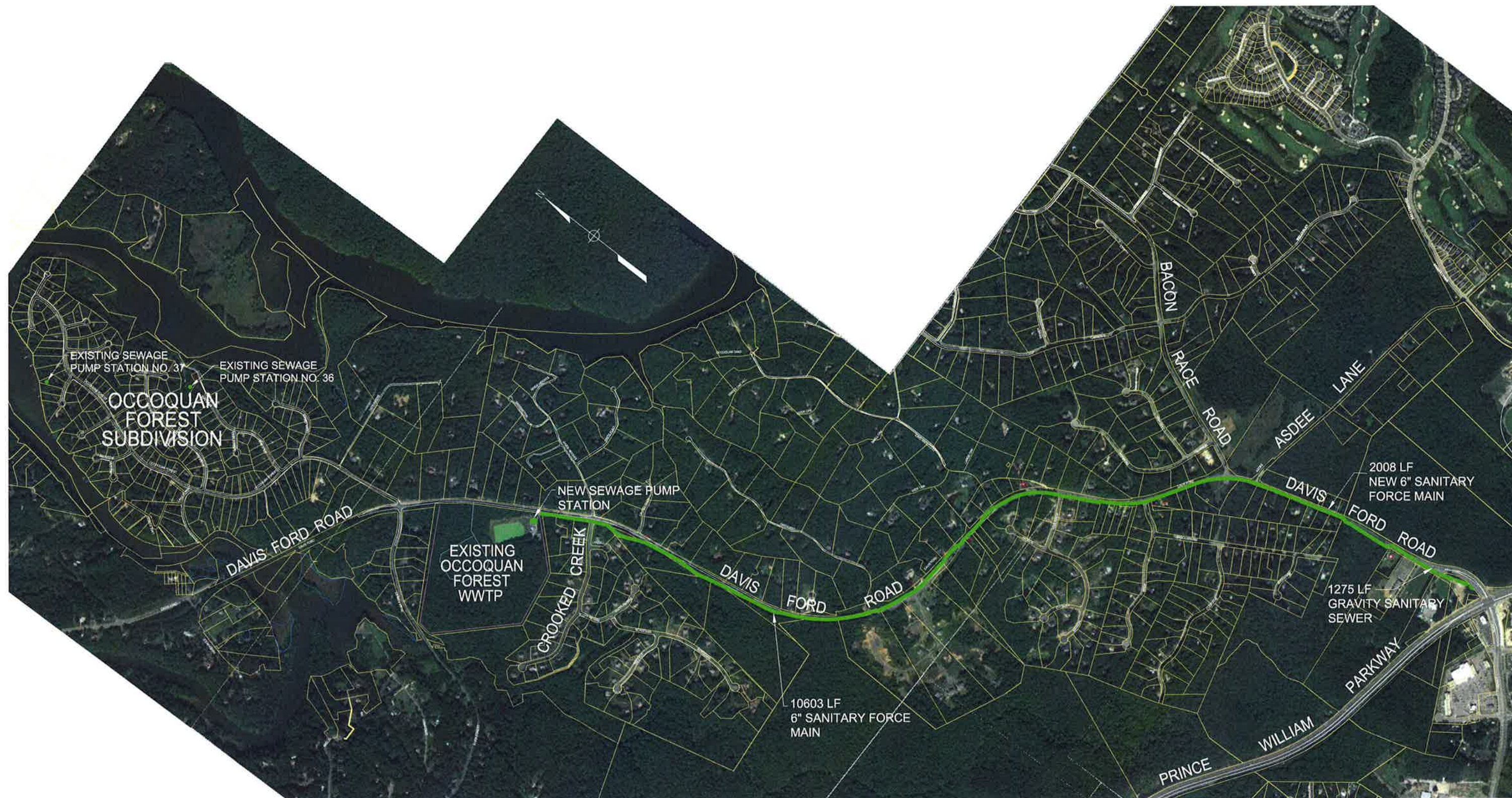
7. REPLACEMENT OF TREATMENT PLANT WITH PUMP STATION AND FORCE MAIN OPTION

Since the plant is in the Occoquan a point discharge is not possible. Therefore, the only feasible alternative to upgrading the WWTP is to completely replace the facility with a new sewage pumping station and force main to the existing sanitary sewer system served by the H.L. Mooney WWTP. The spray irrigation fields, pond and treatment facility can then be taken out service and demolished. Although this alternative would consume a small portion of the capacity at the Mooney plant, it would eliminate the expense associated with the operation of the Occoquan Forest treatment plant and would also provide the potential for the Authority selling or reusing the land for other purposes.

All of the flow entering the facility is currently pumped from Pumping Station #36 within the Occoquan Forest subdivision. A complete replacement of Pumping Station #36 is also being planned due to the age and condition of the existing station. WR&A recently prepared a Preliminary Engineering Report for the Occoquan Forest Pumping Station #36 and #37. In this report, a design criterion for flow capacity of the Upgraded Station #36 was identified as 220 gpm. This capacity was based on an assumed peak hour factor of 2 times the highest 2010 Max Day flow recorded which was 153,986 gallons per day. This results in a required pump capacity of 307,972 gallons per day, or 214 gpm.

WR&A considered the potential to pump all of the flow from Pumping Station #36 to the PWCSA's collection system into the H.L. Mooney treatment plant. This approach would allow the existing Occoquan Forest plant to be taken off line and the force main from Pumping Station #36 would be extended from its current terminus at the WWTP site to a discharge manhole at Asdee Lane. Although this alternative would eliminate the need to re-pump from the plant site, it is not feasible to add the additional head on Pumping Station #36. This pumping station already has a relatively high total design head of approximately 157 feet to deliver flow to the plant site. Of that total design head on the station, approximately 115 feet is static head. As a result, there is not feasible to add any significant additional head on the station.

WR&A reviewed the feasibility of constructing a new pumping station at the treatment plant site to receive flow from pumping station #36 and re-pumping to the collection system served by the H.L. Mooney WWTP. The overall scope and alignment of the potential force main from the plant site to the existing sanitary sewer manhole within the H.L. Mooney Service area is illustrated in **Figure 8**. The force main is anticipated to be installed along Davis Ford Road and consist of approximately 12,700LF of pipeline from the existing Occoquan Forest WWTP to a manhole located between Asdee Lane and the Prince William Parkway.



Prepared by:
Whitman, Requardt & Associates, LLP
for
PRINCE WILLIAM COUNTY SERVICE AUTHORITY
4 COUNTY COMPLEX COURT
WOODBIDGE, VIRGINIA 22192

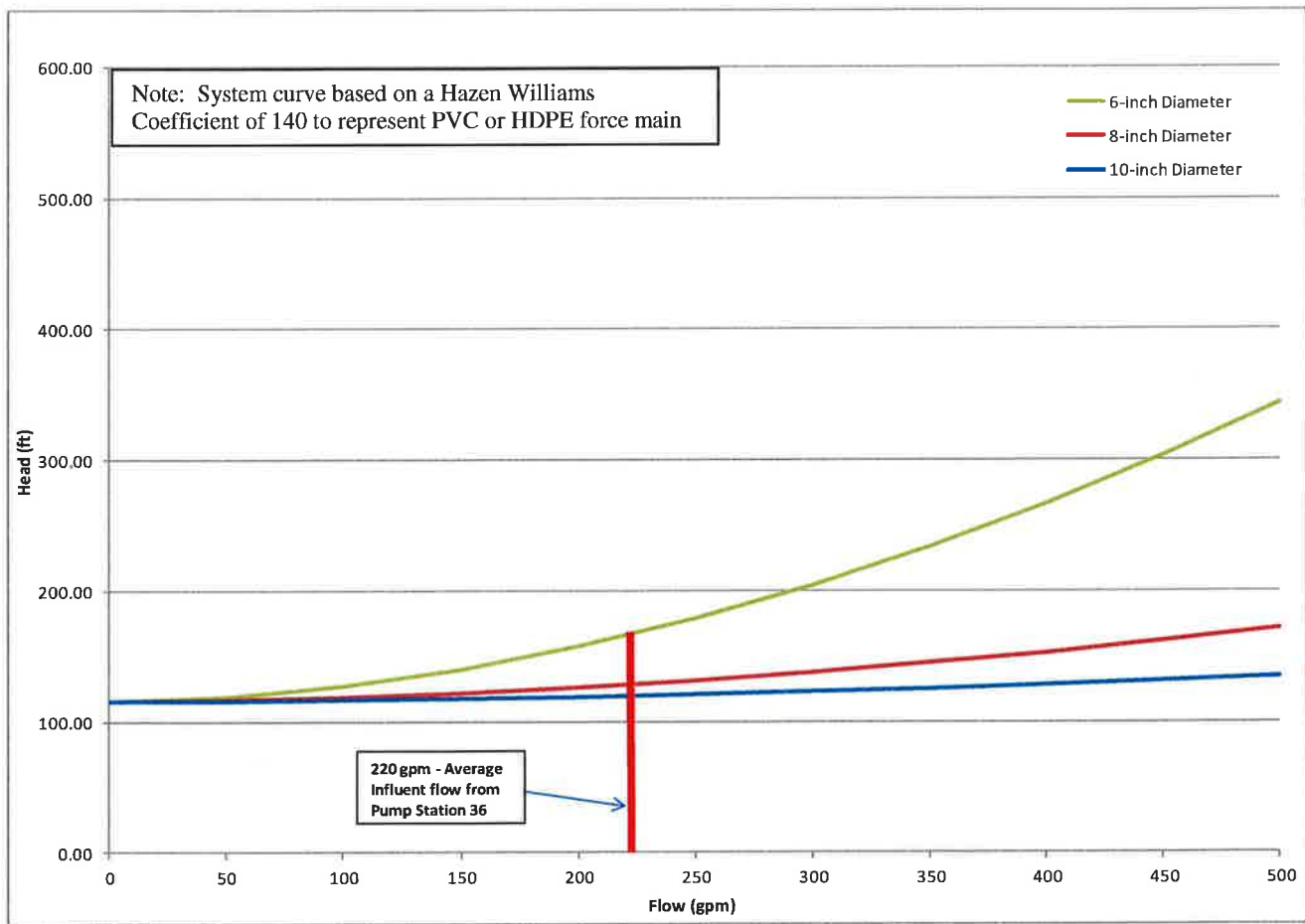


**OCCOQUAN FOREST WWTP PUMPING STATION AND
SEWER FORCE MAIN PROJECT
FIGURE. 8**

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

Based on the GIS topo, a preliminary system curve was developed for various force main sizes from the treatment plant site to Asdee Lane. The curves are provided as **Figure 9**. The force main should be designed to maintain a minimum flow velocity of approximately 2.5 feet per second. With a pump flow rate of 220 gpm, a 6-inch force main provides approximately 2.5 feet per second of velocity with approximately 167 feet of total design head. Although the 8-inch force main would potentially reduce the head on the pump, the minimum pump flow rate would be required to approach 400 gpm in order to maintain a 2.5 fps minimum velocity. Therefore, a 6-inch force main constructed of either PVC or HDPE would be recommended. A duplex pumping station with approximately 45 Hp pumps with a diesel generator for backup power is recommended for the project.

**FIGURE 9
SYSTEM CURVE FOR PROPOSED PUMP STATION AT THE TREATMENT PLANT SITE
FOR VARIOUS FORCE MAIN DIAMETERS**



**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

8. PLANNING LEVEL COST INFORMATION

The planning level costs anticipated for upgrade and replacement of the treatment facility is provided in **Table 5** and the cost for the pumping station and force main alternative to replace the treatment plant is provided in **Table 6**.

**TABLE 5
COST ESTIMATE FOR THE UPGRADE OF THE
OCCOQUAN FOREST WWTP**

SUMMARY OF COSTS FOR TREATMENT PLANT REPLACEMENT				
Description	Units	Quantity	Cost/Unit	Total
Temporary Bypass Pumping of Pond During Construction	LS	1	\$45,000	\$45,000
Expansion of Pond Volume with Liner and 25% contingency	LS	1	\$569,380	\$569,380
Installation of Pond Liner with Clay Base	SF	109,300	\$2.00	\$218,600
Dewater Existing Pond and Prep for New Liner	LS	1	\$50,000	\$50,000
Reforestation with Trees (200 Trees/Acre @ 14.3 Acre	EA	2,860	\$75.00	\$214,500
Clearing of Existing Forested Spray Field (14.3 Acre)	AC	14	\$10,000	\$143,000
New Wastewater Treatment Plant Process Equipment	LS	1	\$600,000	\$600,000
Process Equipment Installation and Startup	LS	1	\$250,000	\$250,000
Demolition of Existing Treatment Units	LS	1	\$75,000	\$75,000
Temporary Storage Tanks and Installation (pond bypass)	EA	10	\$3,500	\$35,000
Pre-Engineered Equipment Building (14-ft x 16-ft)	EA	1	\$40,000	\$40,000
Process Upgrades Subtotal =				\$2,240,480
Electrical, Controls and Wiring				\$325,000
Mobilization, Site Work and Restoration				\$225,000
Yard Piping				\$225,000
Contingency (25%)				\$560,120
Estimated Total Construction Cost =				\$3,575,600
Planning, Engineering and Administration				\$700,000
Spray Field Uptake Evaluation and Reforestation Plan				\$75,000
Total Project Cost =				\$ 4,350,600

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

**TABLE 6
COST ESTIMATE FOR THE
PUMPING STATION AT OCCOQUAN FOREST PLANT SITE
WITH FORCE MAIN TO H.L. MOONEY SERVICE AREA**

SUMMARY OF COSTS FOR PUMPING STATION AND FORCE MAIN TO REPLACE THE TREATMENT PLANT				
Item Proposed	Units	Quantity	Cost/Unit	Total
Construct New 6" Force Main	LF	12,611	\$80.00	\$1,008,880
Tie-ins to Existing Sanitary Sewer System	LS	1	\$6,000.00	\$6,000
New Pumping Station Control Building (10-ft x 12-ft)	EA	1	\$30,000.00	\$30,000
New 12" Gravity Sewer Main	LF	1,275	\$125.00	\$159,375
New Diesel Generator	EA	1	\$85,000.00	\$85,000
New Pumping Station Wet Well (8' Dia.)	EA	1	\$25,000.00	\$25,000
Proposed Sanitary Sewer Manholes (4-ft Diameter)	EA	5	\$10,000.00	\$50,000
Valve Vault w/6" Pipe and Valves	LS	1	\$25,000.00	\$25,000
Proposed Sewage Pumps	EA	2	\$30,000.00	\$60,000
Misc. Mechanical	LS	1	\$15,000.00	\$15,000
Misc. Electrical	LS	1	\$20,000.00	\$20,000
Misc. Instrumentation	LS	1	\$10,000.00	\$10,000
Demolition of Existing Treatment Units	LS	1	\$75,000.00	\$75,000
Roadway Restoration	LS	1	\$150,000.00	\$150,000
Clearing and Grubbing	LS	1	\$25,000.00	\$25,000
Maintenance of Traffic	LS	1	\$75,000.00	\$75,000
Base Construction Cost				\$1,819,255
Mobilization (5%)				\$90,963
Contingency (25%)				\$454,814
Estimated Total Construction Cost =				\$2,365,032
Planning, Engineering and Administration (25% of base cost)				\$454,814
Cost of Capacity				\$1,133,000
Total Project Cost =				\$3,952,846

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

9. PRESENT WORTH COST EVALUATION

A 20 year life cycle cost evaluation was performed to compare the capital costs for construction of the alternatives with consideration of anticipated annual operational costs. In this evaluation, an interest rate of 4% was used. PWCSA has provided WR&A input regarding the operational costs of the existing facility and the typical costs for the operations of wastewater pumping stations for the analysis. The life cycle costs are provided in **Table 7**.

**TABLE 7
20 YEAR LIFE CYCLE COST EVALUATION
FOR THE CONSTRUCTION ALTERNATIVES**

WWTP Upgrade Alternative	Value	Present Worth Factor	Present Worth Cost
Initial Costs			
Construction Cost =	\$ 4,350,600	1	\$ 4,350,600
Annual Costs			
Operations and Maintenance =	\$ 155,000	13.5903	\$ 2,106,497
Future Costs			
Permit Renewal/Uptake Evaluation - yr 10 =	\$ 75,000	0.6756	\$ 50,670
Permit Renewal/Uptake Evaluation - yr 20 =	\$ 75,000	0.4564	\$ 34,230
Major Pump & Equipment replacement -yr 20 =	\$ 200,000	0.4564	\$ 91,280
Present Value Cost of WWTP Upgrade Alternative =			\$ 6,633,277

Pumping Station Upgrade Alternative	Value	Present Worth Factor	Present Worth Cost
Initial Costs			
Construction Cost =	\$ 2,819,845	1	\$2,819,845
Cost of H.L Mooney Capacity Consumed = (Note: value assessed for 110 equivalent dwelling units @ \$10,300 per)	\$ 1,133,000	1	\$ 1,133,000
Annual Costs			
Operations and Maintenance =	\$ 5,200	13.5903	\$ 70,670
Future Costs			
Major Pump & Equipment replacement -yr 20 =	\$ 100,000	0.4564	\$ 45,640
Present Value Cost of Pumping Station Upgrade Alternative =			\$ 4,069,155

This analysis reveals a significant difference in overall cost of the alternatives when viewed on a life cycle cost basis.

10. SUMMARY AND RECOMMENDATIONS

Although both alternatives represent feasible options to be implemented by the Authority, the elimination and replacement of the treatment plant with a pumping station and force main is anticipated to be the lowest cost capital cost option by a significant margin. This option not only represents the lowest anticipated initial capital cost, but it also results in lower annual operations and maintenance costs in the future. The cost differential also does not account for the value of the land at the treatment plant site once the treatment facility is decommissioned. We also anticipate that the pumping station alternative will likely be the lowest risk alternative in the permitting process with DEQ. As part of preparing this report, WR&A conducted a telephone call with a representative of DEQ who made it clear that there will be significant concern and apprehension by this agency in regards to renewing the permit when it expires in 2015. The DEQ representative is also well aware that there is a potential alternative to replace the plant with a pumping station and force main and expressed a desire that the PWCSA pursue that alternative.

To mitigate DEQ's apprehension to approve the renewal of the plant's permit, DEQ will likely require extensive testing and study of the spray irrigation system to prove that it has the needed capacity and uptake to properly serve the treatment facility and eliminate any risk to the Occoquan Reservoir. The testing will involve soil characterization and uptake determinations of the treated wastewater for key wastewater parameters.

The primary disadvantage to the elimination of the treatment plant is that there will be additional flow to the H.L. Mooney WWTP facility. Based on the annual average flow from 2010, this would be an average of just under 35,000 gpd. Maximum daily flows during wet weather events were as high as 154,000 gallons per day in 2010. With either alternative, it is also recommended to evaluate I/I within the service area to determine if high wet weather flow rates can be mitigated. Constructing a force main from the plant will require over 10,600 feet of force main and approximately 1,275 lf of gravity sewer along Davis Ford Road. It is assumed that use of the VDOT Right-of-Way is available for use in this project so no easement acquisition is required to construct the project.

**PRINCE WILLIAM COUNTY SERVICE AUTHORITY
OCCOQUAN FOREST WWTP EVALUATION
PRELIMINARY ENGINEERING REPORT**

APPENDIX A

Vendor Information for Proposed Treatment Equipment



KA Wastewater Package Plants

Continuous Flow Sequencing Batch Reactor (CSBR)

AERATION SEQUENCE - SETTLING SEQUENCE - DECANT SEQUENCE

ALL UNIT PROCESSES CARRIED OUT IN A SINGLE TANK



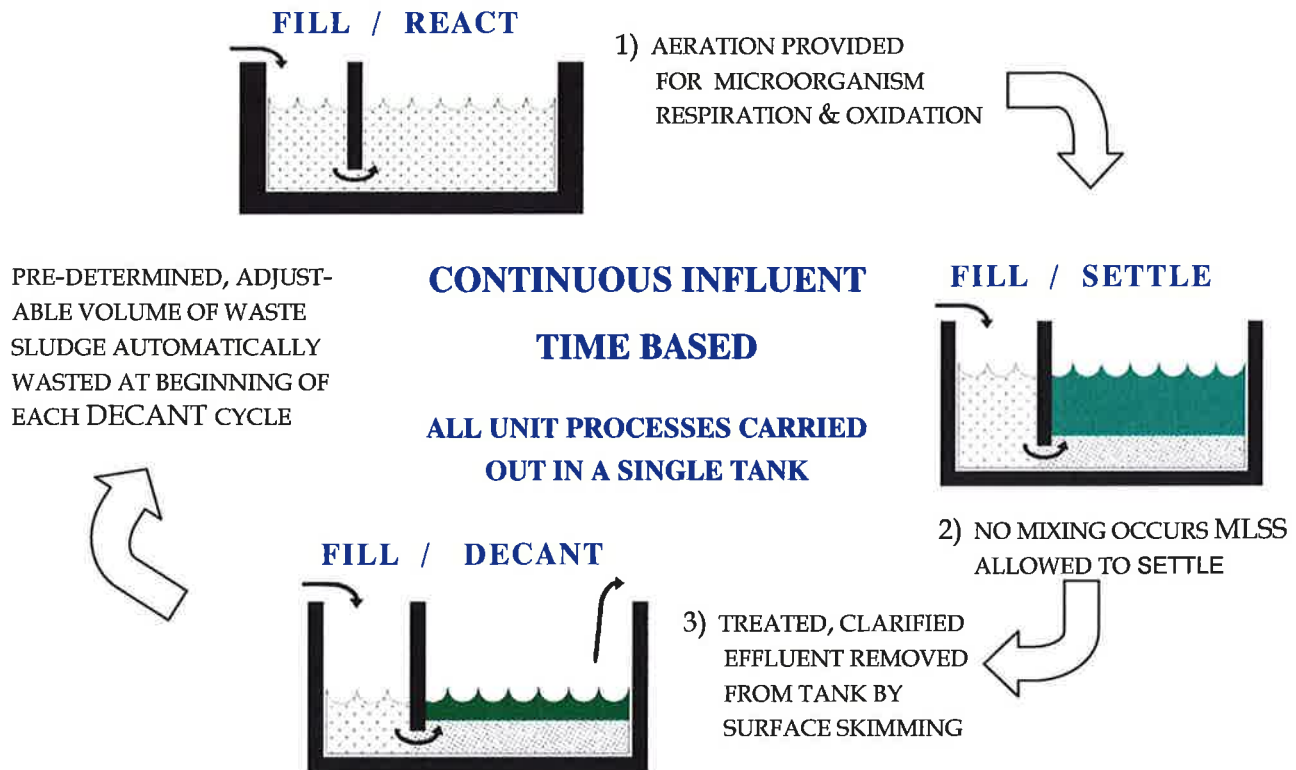
ADVANTAGES . . .

- HIGH TREATMENT EFFICIENCY
- SETTLING CONDITIONS ARE OPTIMIZED
- ELIMINATES NEED FOR EXTERNAL CLARIFIERS
- POSITIVE AND AUTOMATIC CONTROL OF SRT & MLSS
- REDUCES AMOUNT OF SPACE REQUIRED FOR TREATMENT PLANT
 - EXISTING FACILITIES ARE EASILY RETROFITTED TO USE CSBR PROCESS
 - CONTINUOUS FILLING GENERALLY INHIBITS FILAMENTOUS GROWTH
 - PROVIDES HYDRAULIC FLOW AND ORGANIC LOADING EQUALIZATION
 - CAPACITY CAN BE EASILY EXPANDED USING MODULAR TANK ADDITIONS
 - OPERATION IS AUTOMATIC REQUIRING MINIMAL OPERATOR ATTENTION



KA Wastewater Package Plants

Continuous Flow Sequencing Batch Reactor (CSBR)



TREATMENT FLEXIBILITY . . .

Depending on effluent requirements, the Continuous Flow Sequencing Batch Reactor can be designed to achieve four different levels of treatment. Each of these levels is achieved without the addition of chemicals or filters. The four levels are:

- ❖ BIOCHEMICAL OXYGEN DEMAND REMOVAL (BOD)
- ❖ NITRIFICATION (NIT)
- ❖ NITRIFICATION - DENITRIFICATION (NIT-DNIT)
- ❖ PHOSPHOROUS REMOVAL (P)



KA Wastewater Package Plants

CSBR: Beyond SBR

KA Wastewater Package Plants has taken the superior technology of SBR and improved it. The KA Wastewater Package Plants Continuous Flow Sequencing Batch Reactor (CSBR) allows continuous inflow of wastewater while utilizing a single basin. Flow to the CSBR basin is not interrupted at any time. Essentially, this design combines continuous inflow with intermittent decant which minimizes basin size and/or the need for multiple basins and contact absorption.

Like a typical SBR, CSBR is a process controlled through time. It carries out all the steps of flow equalization, biological oxidation, nitrification, denitrification and solids-liquid separation in the same basin. *All of the advantages of the SBR compared to the Conventional Activated Sludge system apply to CSBR as well.*

Unlike a typical SBR, CSBR does not require an influent control valve or another basin to hold diverted flow. Since CSBR fills continuously, it does not require a separate Fill or Idle phase, thereby simplifying the process.

The CSBR process is a repetition of a cycle which is comprised of three sequential phases: *Aeration, Settle, and Decant*. The length of the cycle is specific to each CSBR design.

A microprocessor controls the entire CSBR process. It automatically coordinates all the equipment and phases of the cycle. The system is pre-programmed to automatically switch to a storm cycle when the inflow reaches a certain level. CSBR can accommodate up to six times the average daily flow without effluent degradation. In addition, a CSBR operator can manually adjust the

controls to respond to varying load conditions. This operational flexibility is especially useful during start-up when there is usually a light influent load.

CONTINUOUS INFLUENT AND THE BAFFLE WALL

The CSBR system allows continuous flow into the basin without hydraulic short-circuiting during decant. In order to accomplish this, a baffle wall separates the CSBR basin into two sections - the Pre-React Zone and the Main Chamber. The pre-react zone occupies roughly twelve to fifteen percent of the total basin size.

Wastewater flows continuously into the pre-react zone and is directed down through the openings at the bottom of the baffle wall into the sludge blanket at the bottom of the main chamber. The sludge blanket absorbs BOD during clarification and decant. Also the hydraulic force will cause the incoming flow to move upward at a very slow rate thus prevent short-circuiting during decant.

In addition to providing for continuous influent, the pre-react zone also provides **pre-treatment** of the wastewater before it enters the main chamber. There is a high amount of BOD in a small volume in the pre-react zone. This situation creates a high "Food to Microorganism Ratio" (F:M). The high F:M encourages the maximum biosorption of food by the microorganisms. The pre-react zone therefore acts as an "organic selector" increasing the proliferation of the most desirable microorganisms. This organic selection process inhibits the filamentous growth that causes sludge bulking.



KA Wastewater Package Plants

THE CSBR CYCLE

Influent flows into the CSBR basin throughout each phase of the cycle.

The CSBR cycle is illustrated in Figure A.

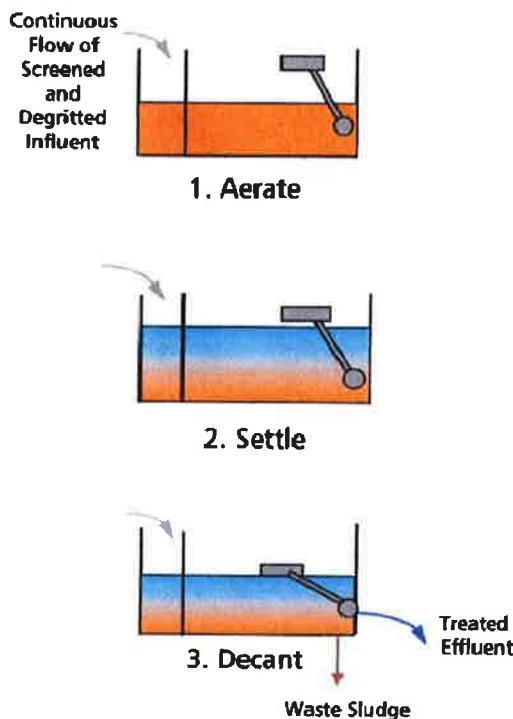


Figure A

During AERATE air is supplied to the basin and used by the microorganisms to consume the organics in the wastewater.

During SETTLE solids-liquid separation occurs. The solids settle to the bottom of the basin and the clear water rises to the top.

During DECANT the KA Wastewater Package Plants decanter lowers into the basin and skims off the uppermost liquid in the basin and discharges it. Sludge wasting typically occurs during the decant phase.

Influent is received continuously during all phases of the cycle, including settle and decant. This allows the CSBR process to be controlled on a time, rather than flow basis and ensures equal loading and flow to all basins. Use of a time-based control system in CSBR facilitates simple changes to the process control program. Changes to the process are made simply by changing the duration of individual segments.

Each phase of the CSBR cycle is associated with particular reactor conditions – turbulent, quiescent, oxic, anoxic – that promote changes in the chemical and physical nature of the wastewater. Depending on effluent requirements, CSBR can be designed to achieve four different levels of treatment. Each of these levels is achieved without the addition of chemicals or filters. The four levels are biochemical oxygen demand removal (BOD), nitrification (NIT), nitrification-denitrification (NDN), and phosphorous removal (DNP).



KA Wastewater Package Plants

DATE: August 15, 2011

TO: Kappe Associates, Inc.
1065 Longwood Ave.
Cumberland, MD 21502

ATTENTION: Daniel Thompson

SUBJECT: Occoquan Forest
Wastewater Treatment Plant
Manassas, Virginia

PROJECT NO.: KA 11-016
Please refer to this number when corresponding.

Dear Daniel:

We are pleased to present for your use and information the following scope of equipment for the Occoquan Forest wastewater treatment plant project located in Manassas, Virginia.

Please note the following design considerations:

1. The *KA Wastewater Package Plants* Pre-Engineered, Field Erected Wastewater Treatment System proposed is complete as herein specified and designed to treat domestic wastewater having the given and assumed average influent parameters and effluent requirements as specified below. The basic system consists of two (2) Secondary Treatment Tanks and one (1) Sludge Holding Tank. The design of the equipment is based on the Continuous Influent Sequential Reactor System (CSBR) Process for the following parameters:

<u>Parameter</u>	<u>Influent</u>	<u>Effluent</u>
Average Daily Flow (ADF)	88,000 GPD	--
Peak Dry Weather Flow (PDWF)	132,000 GPD	--
Peak Wet Weather Flow (PWWF)	176,000 GPD	--
BOD ₅ Average	250 mg/l	30 mg/l
Total Suspended Solids (TSS)	250 mg/l	30 mg/l
NH ₃ N	35.0 mg/l	--
Total Phosphorus (TP)	8.0 mg/l	--
Total Nitrogen (TN)	40.0 mg/l	--
Site Elevation	500 ft.	--
pH	6-9 S.u.	--
Alkalinity (Minimum)	273± mg/l	--
Wastewater Temperature, Minimum	10°C	--
Wastewater Temperature, Maximum	27°C	--



Air Temperature, Winter	0-40°F	--
Air Temperature, Summer	80-100°F	--

NOTE: Influent sewage contains no industrial and/or toxic wastes.

2. A 4-in. supernatant decanter airlift will be provided for decanting the sludge holding tank. The sludge holding tank is proposed for a minimum of 30 days holding time and has a minimum volume of 20,500 gallons.
3. The aeration system in the CSBR and sludge holding tanks will be stainless steel coarse bubble diffusers.
4. We are recommending three (3) CSBR aeration blowers, two (2) will be the duty blower and one (1) will be a complete stand-by blower. Two (2) separate blowers will be furnished for the sludge holding tank, one (1) duty and one (1) standby.

KA Wastewater Package Plants will provide blowers with a noise level as low as possible. However, noise is very subjective and what we consider a low noise level might not be considered low by a close neighbor to the treatment plant. Therefore, if noise is considered a problem, we strongly suggest that consideration be given to furnishing a blower building. *KA Wastewater Package Plants* will have to work closely with you in the design stage in order to assure a reasonable blower system as it applies to noise levels.

The air blowers can be mounted either on or off the treatment plant. We recommend that they be mounted off the plant on a separate concrete pad.

5. If the alkalinity of the incoming sewage is less than 273 mg/l, then it will be necessary to use chemicals to increase the alkalinity. We have included an alkalinity feed system in our proposal.
6. We are proposing tanks that will be mounted below ground level. We will provide full aluminum walkway grating for safety and access to equipment.
7. We are recommending that the blowers and control panel be mounted off plant as shown in the attached layout drawing. The electrical contractor is responsible to provide all wire, wiring, conduit, junction boxes etc. from the plant control panel to each motor off or on the plant. *KA Wastewater Package Plants* is not furnishing any wiring, conduit or junction boxes within the plant.

The following is the estimated proposal for the various items of equipment for the above subject project.

ITEM 1 – SINGLE TRAIN CSBR TREATMENT SYSTEM

- One (1) *KA Wastewater Package Plants* Pre-Engineered, Factory Built Wastewater Treatment System designed to treat 88,000 GPD of domestic wastewater having the



given and assumed average influent parameters and effluent limits listed above. The treatment system will include two (2) single train CSBR tanks and one (1) sludge holding tank. The system will be complete with the following:

a. CSBR Treatment Tanks

Two (2) *KA Wastewater Package Plants* Single Train Factory Built Wastewater Treatment Plants, Model CSBR 44. The CSBR Treatment Units of A-36 steel construction will be 41-ft. 0-in. long × 14-ft. 0-in. wide × 12-ft. 0-in. high and each complete with the following:

- Aeration Manifold
- Aeration Drop Pipe Assemblies
- Aeration Diffusers
- Decanter Assembly & Drive Unit
- Decanter Discharge Piping
- Waste Sludge Pumps with Slide Rails
- Waste Sludge Pump Piping
- Pump Lifting Hoist Assembly

b. Sludge Holding Tank (Separate Tank)

One (1) Sludge Holding Tank of A-36 steel construction will be 19-ft. 0-in. long × 14-ft. 0-in. wide × 12-ft. 0-in. high. Sludge Holding Tank will have a total working volume of 20,500 gallons based on 30-day retention time and complete with the following:

- Aeration Drop Pipe
- Aeration Manifold
- Aeration Diffusers
- Supernatant Decant 4-in. Airlift Unit

c. Air Blowers

1. CSBR Air Blowers

Three (3) *Sutorbilt/Roots* Air Blower Assemblies each rated to deliver 294 CFM at 4.5 PSIG. Each blower assembly complete with the following:

- One (1) 15.0 HP, 1750 RPM, 460 volt, 3 phase, 60 HZ TEFC motor.
- One (1) Fabricated steel baseplate.
- One (1) Motor slide base.
- One (1) V-belt drive assembly with belt guard.
- One (1) Inlet filter.
- One (1) Inlet silencer.
- One (1) Discharge silencer.



- One (1) Butterfly shut-off valve.
- One (1) Check valve.
- Two (2) Flexible connectors.
- One (1) Pressure relief valve.
- One (1) Pressure gauge.

Three (3) Soundproof Enclosures.

2. Sludge Holding Tank Air Blowers

Two (2) *Sutorbilt/Roots* Air Blower Assemblies each rated to deliver 83.0 CFM at 5.1 PSIG. Each blower assembly complete with the following:

- One (1) 7.5 HP, 1750 RPM, 460 volt, 3 phase, 60 HZ TEFC motor.
- One (1) Fabricated steel baseplate.
- One (1) Motor slide base.
- One (1) V-belt drive assembly with belt guard.
- One (1) Inlet filter.
- One (1) Inlet silencer.
- One (1) Discharge silencer.
- One (1) Butterfly shut-off valve.
- One (1) Check valve.
- Two (2) Flexible connectors.
- One (1) Pressure relief valve.
- One (1) Pressure gauge.

Two (2) Soundproof Enclosures.

d. Alkalinity Feed System

One (1) *KA Wastewater Package Plants* alkalinity feed system consisting of the following:

Chemical Feed Pumps (Two)
Pump Wall Support Shelf

e. Control System

One (1) Electrical Control Panel, NEMA 4X stainless steel enclosure with main disconnect, branch circuit breakers, motor starters with overload protection, selector switches, indicating lights, lighting arrestor, three phase monitor control and an alarm system all controlled by Programmable Logic Controller (PLC). Manual control of all equipment shall also be provided. A transformer for the 120-volt, single-phase power shall be provided for control voltage and operation of the items and equipment requiring the same. Control for:



CSBR Units (Two)
Sludge Holding Tank (One)
Chemical Feed Pumps (Two)

f. Miscellaneous

- One (1) Item of tank fabrication consisting of ASTM A-36 steel plate and shapes of 1/4-in. minimum thickness.
- One (1) Item of tank protective coating consisting of the following:
 - One (1) Item of tank preparation consisting of sand blasting to specification SPCC SP-10.
 - One (1) Interior and exterior tank surfaces painted as follows:
 - One (1) Coat of *Themec* Coal Tar Epoxy Paint.
- One (1) Item of all piping, valves, and fittings located in the tanks as specified.
- One (1) Item of aluminum walkway grating to cover all tank openings.
- One (1) Item anodes for cathodic protection.
- One (1) Start-up instruction service consisting of five (5) days with one (1) trip to the job site.
- Four (4) Operation and Maintenance Manuals.

BUDGET SELLING PRICE (FREIGHT INCLUDED)

ITEM 1: Wastewater Treatment System consisting of the following: **\$ TO FOLLOW**

- Two (2) CSBR Treatment Plants
- One (1) Sludge Holding Tank

Approximate shipping weight per CSBR Tank: 35,000 lbs.

Approximate shipping weight for Sludge Holding Tank: 18,000 lbs.

GENERAL NOTES

1. Each CSBR Tank will be shipped as a complete unit with no splice to be field welded.
2. The Sludge Holding Tank will be shipped as a complete unit with no splice to be field welded.

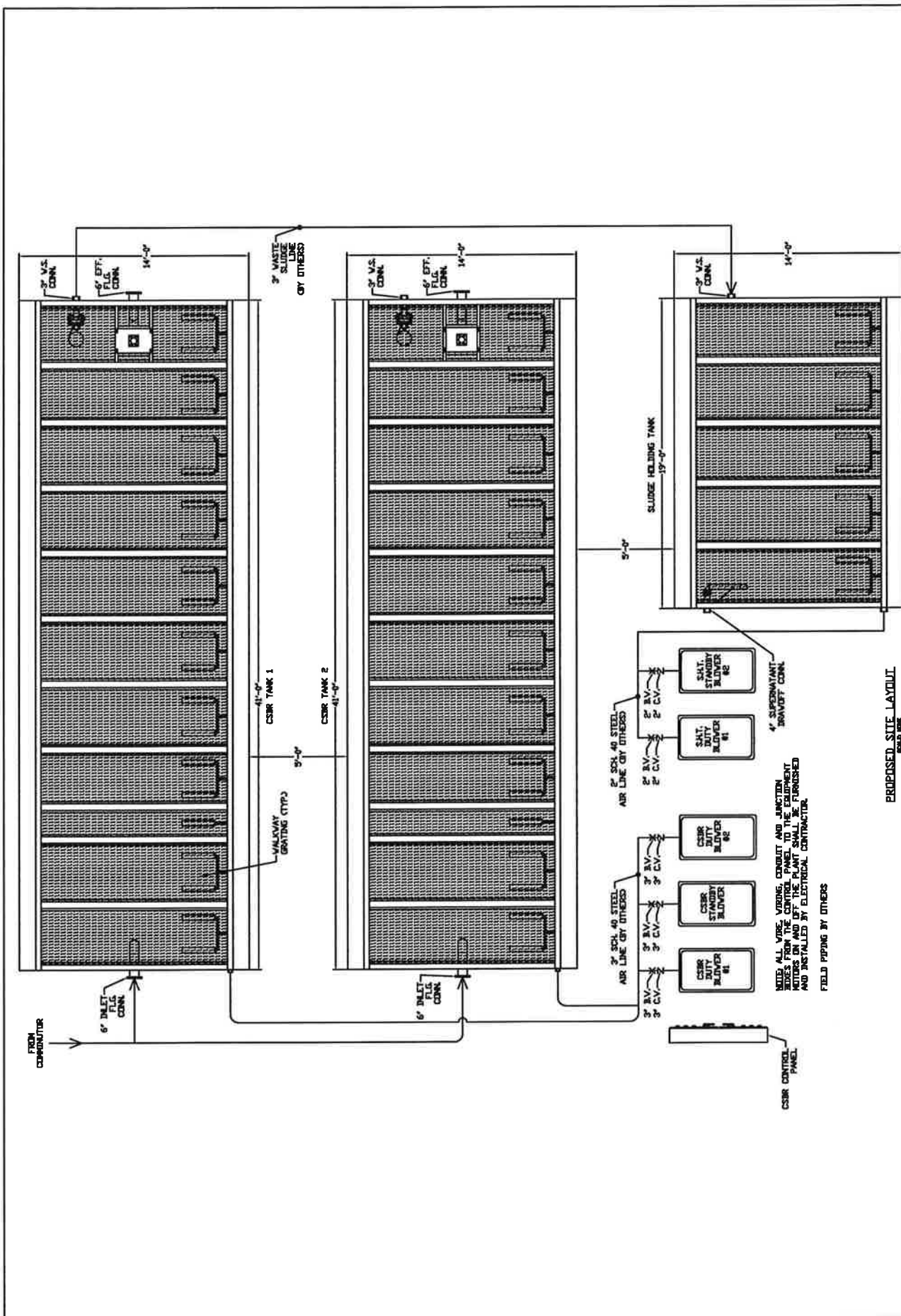


3. The equipment such as blowers, control panels, grating and any other loose items will be shipped separately with the tankage for field mounting by others.
4. Crane for unloading by Contractor.
5. The crane and any other tools required to properly install the equipment shall be furnished by others.

We hope the above, along with the attached data, meets your current needs. Please do not hesitate to contact us if we can be of any additional assistance, or if you require any additional data.

Respectfully yours,

KA Wastewater Package Plants



PROPOSED SITE LAYOUT
SCALE: 1/8" = 1'-0"

KA WASTEWATER PACKAGE PLANTS			
PREFABRICATED STEEL		PACKAGE WASTEWATER TREATMENT SYSTEM	
SCALE AS LISTED	APPROVED BY	DESIGNED BY	H.J.P.
DATE: 08-15-11	E. J. SOROKA, P.E.	PROPOSED SITE LAYOUT	
CSIR PACKAGE WASTEWATER TREATMENT PLANT		CSIR PACKAGE WASTEWATER TREATMENT PLANT	
DOUGLASS TOWNSHIP WASTEWATER TREATMENT PLANT		DRAWING NUMBER	
MANASSAS, VIRGINIA		11-004-00	





KA Wastewater Package Plants

TECHNICAL DATA

**TITLE: DESIGN CRITERIA
 CSBR TREATMENT SYSTEM
 PREFABRICATED STEEL PACKAGE**

**PROJECT: KA 11-016
 OCCOQUAN W.W.T.P.
 MANASSAS, VIRGINIA**

ITEM 1: CSBR TANKS

KA WASTEWATER PACKAGE PLANTS MODEL NUMBER:	CSBR 44.0 Single
AVERAGE DESIGN FLOW (ADF)/TOTAL:	88,000 GPD
NUMBER OF TANKS:	Two (2)
NUMBER OF TRAINS/TANK:	One (1)
AVERAGE DESIGN FLOW (ADF)/TRAIN:	44,000 GPD
CSBR VOLUME/TOTAL:	90,000 gal.
CSBR VOLUME/TANK:	45,000 gal
DECANTER DISCHARGE RATE/TANK:	183.3 GPM
WASTE SLUDGE PUMP RATE/TANK:	44.0 GPM
CSBR AERATION BLOWERS:	294.0 CFM @ 4.5 PSI, 15.0 HP

DIMENSIONS

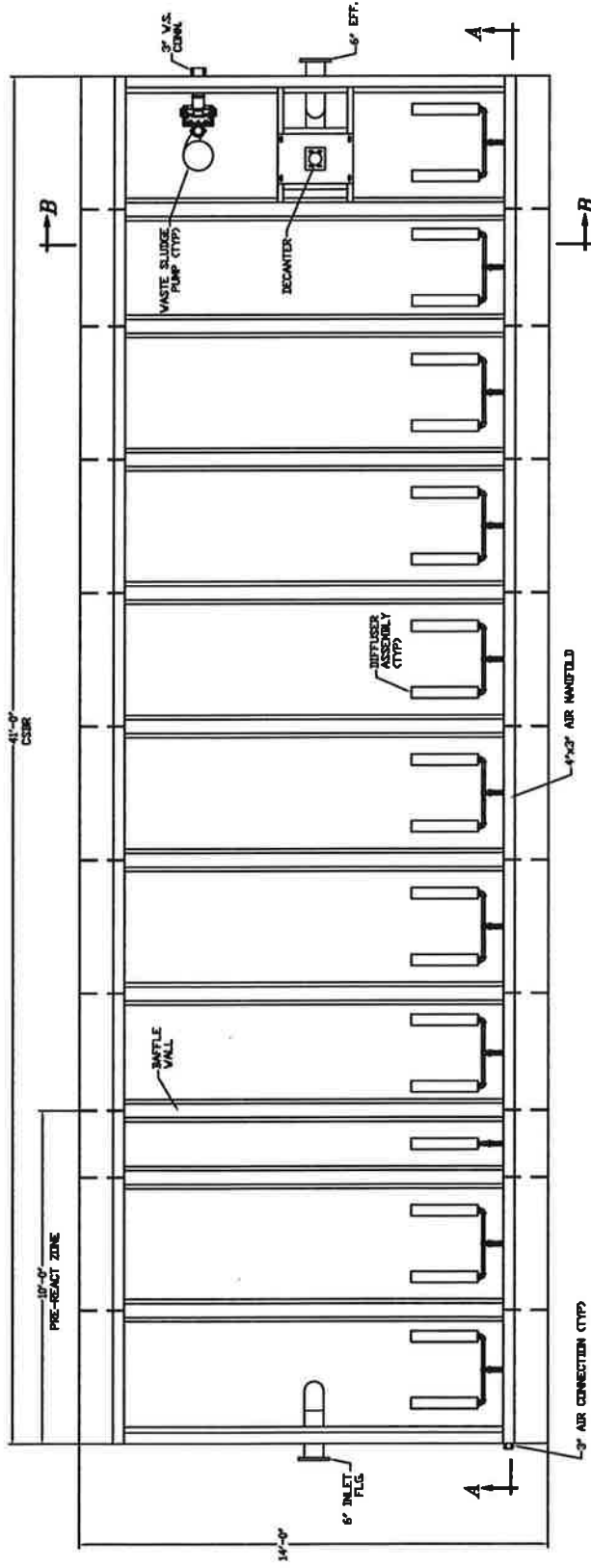
A. 41-ft. 0-in. (CSBR Length)	G. 14-ft. 0-in. (Width)
B. --	H. 12-ft. 0-in. (Height)
C. 10-ft. 6-in. (Maximum W/L)	I. 6-in. (Effluent Connection)
D. 10-ft. 6-in. (Top W/L)	J. 6-in. (Inlet Connection)
E. 8-ft. 6-in. (Minimum W/L)	K. 41-ft. 0-in. (Plant Overall Length)
F. 8-ft. 0-in. (Tank Effluent Height)	

ITEM 2: SLUDGE HOLDING TANK

KA WASTEWATER PACKAGE PLANTS MODEL NUMBER:	KA 88-C SHT
AVERAGE DESIGN FLOW (ADF)/TOTAL:	88,000 GPD
NUMBER OF TANKS:	One (1)
SLUDGE HOLDING TANK VOLUME:	20,500 gal
SLUDGE HOLDING TANK BLOWER:	83.0 CFM @ 5.1 PSI, 7.5 HP

DIMENSIONS

A. 19-ft. 0-in. (SHT Length)	E. 3-in. (Inlet Connection)
B. 10-ft. 6-in. (Maximum W/L)	F. 4-in. (Supernatant Decanter Connection)
C. 14-ft. 0-in. (Width)	G. 19-ft. 0-in. (Tank Overall Length)
D. 12-ft. 0-in. (Height)	



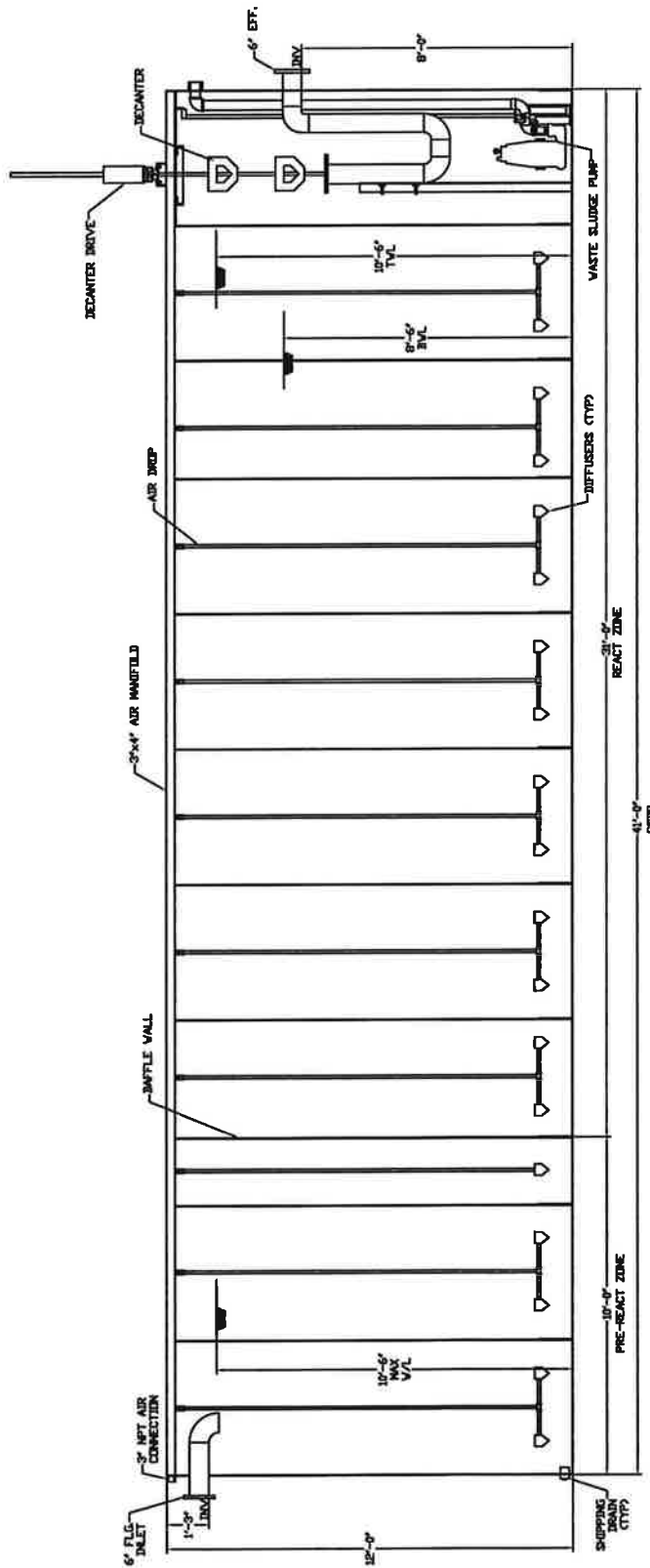
PLAN VIEW
TANKS 1 & 2
SCALE: NONE



© PROPRIETARY INFORMATION FOR
USE ON THIS PROJECT ONLY.

KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM		DESIGNED BY: K.J.P.
SCALE: AS LISTED	APPROVED BY: E. J. SERRANO, P.E.	DRAWN BY: K.J.P.
DATE: 08-15-11	PLAN VIEW	
CSBR 440 SINGLE V.V.T.P.		DECODUM FIREST WASTEWATER TREATMENT PLANT DRAWING NUMBER 11-06-01
MANASSAS, VIRGINIA		



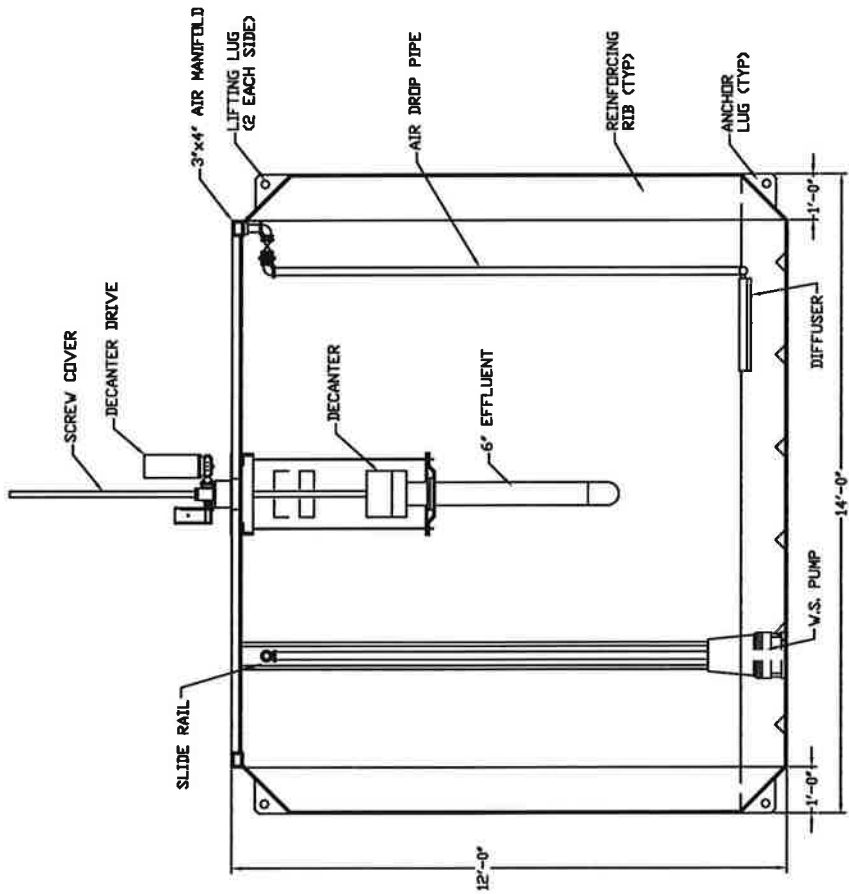
SECTION A-A
TANKS 1 & 2
SCALE NINE



© PROPRIETARY INFORMATION FOR
USE ON THIS PROJECT ONLY.

KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM	
SCALE AS LISTED	APPROVED BY
DATE 08-15-11	E. J. SEROVKA, P.E.
SECTION A-A	
CSBR 44.0 SINGLE V.M.T.P.	
DECIDUOUS FOREST WASTEWATER TREATMENT PLANT DRAWING NUMBER 11-016-02	
MANASSAS, VIRGINIA	



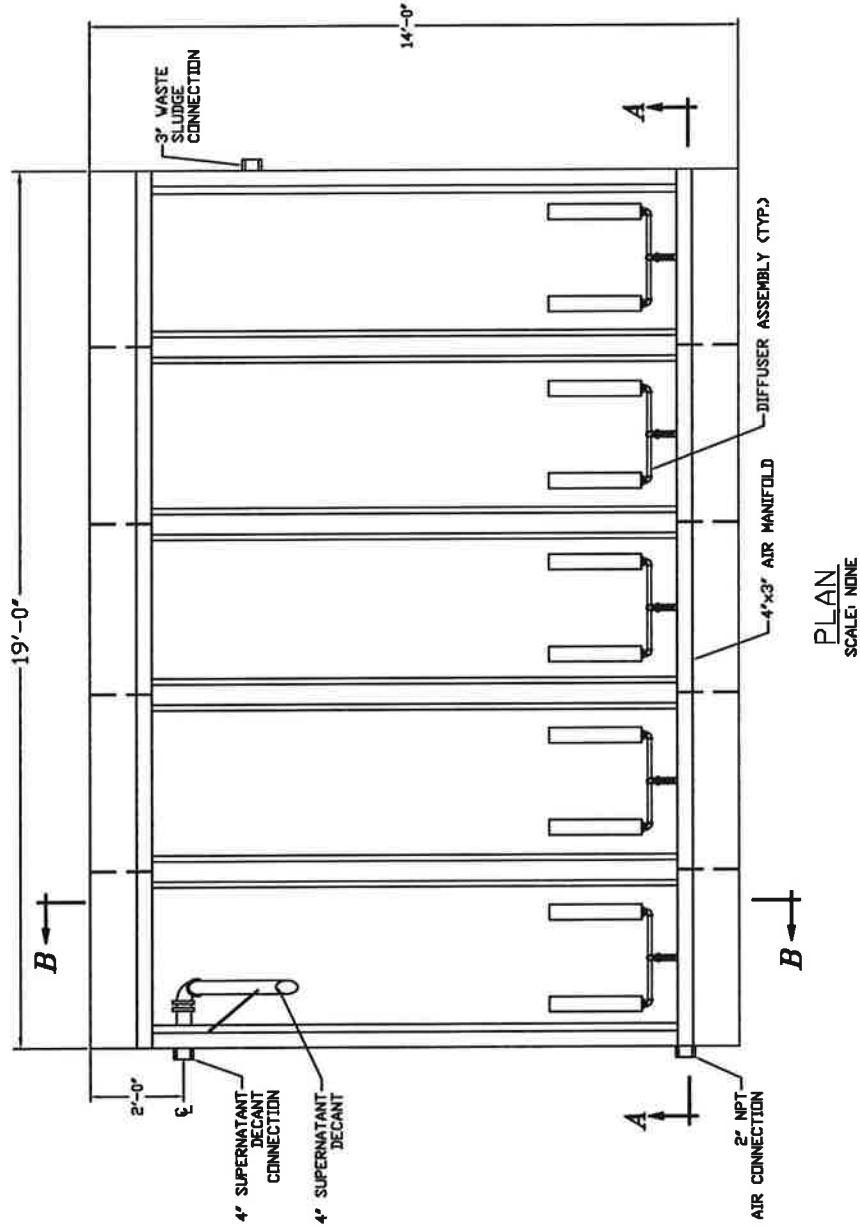
SECTION B-B
SCALE: NONE

KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM			
SCALE: AS LISTED	APPROVED BY:	DRAWN BY:	H.J.P.
DATE: 08-15-11	E. J. SEROVKA, P.E.		
SECTION B-B			
CSIR 44.0 SINGLE V.M.T.P.			
OCCOQUAN FOREST WASTEWATER TREATMENT PLANT DRAWING NUMBER MANASSAS, VIRGINIA 11-016-03			



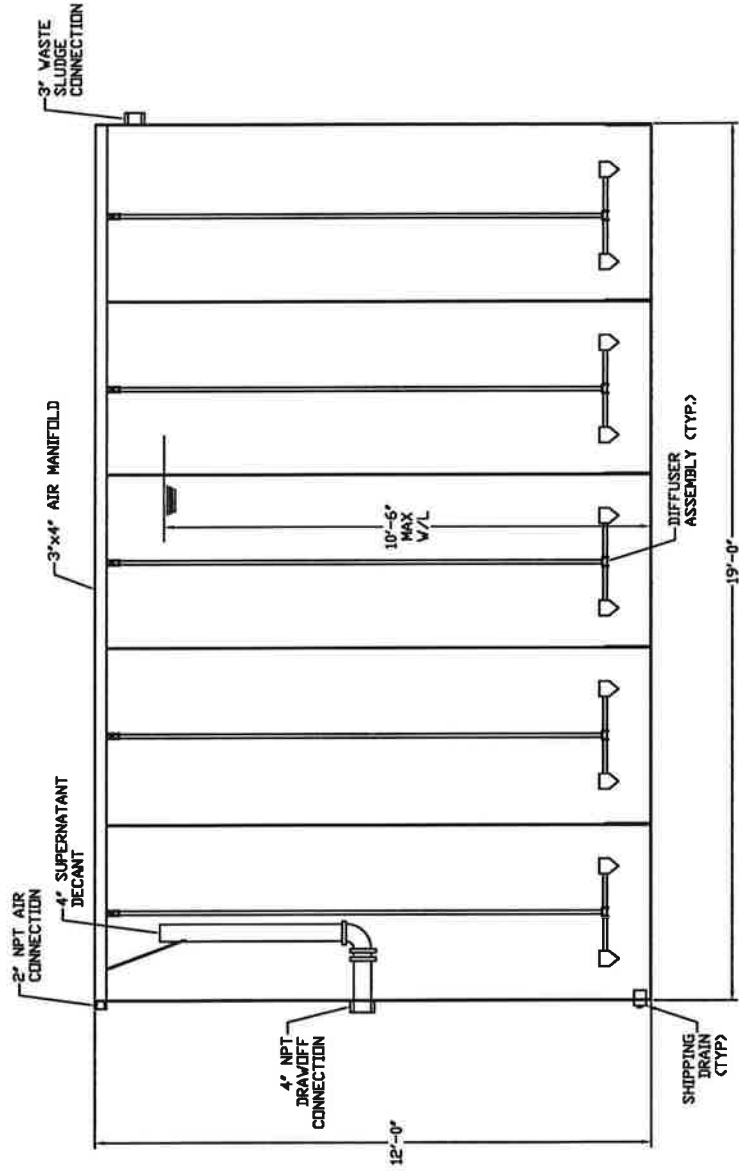
© PROPRIETARY INFORMATION FOR
USE IN THIS PROJECT ONLY.



KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM	
SCALE: AS LISTED	APPROVED BY: DRAWN BY: M.J.P.
DATE: 08-25-11	E. J. SEROVKA, P.E.
PLAN VIEW SLUDGE HOLDING TANK	
DECIDUUM FIRST WASTEWATER TREATMENT PLANT DRAWING NUMBER MANASSAS, VIRGINIA 11-016-04	



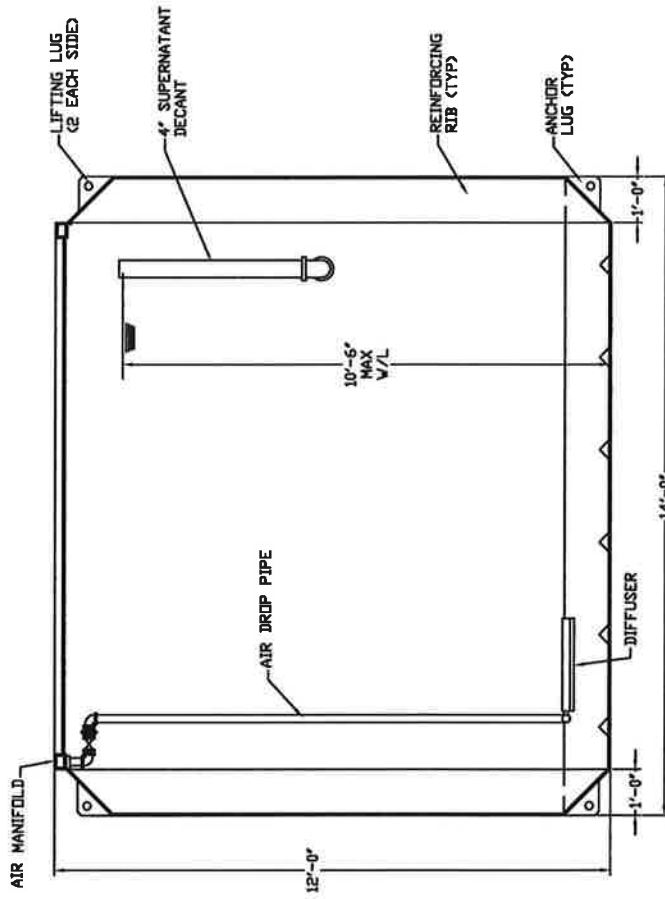


SECTION A-A
SCALE: NINE

KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM		DRAWN BY: H.J.P.
SCALE: AS LISTED	APPROVED BY: E. J. SERENKA, P.E.	DATE: 09-15-11
SECTION A-A SLUDGE HOLDING TANK		DRAWING NUMBER 11-016-05
OCCOQUAN FOREST WASTEWATER TREATMENT PLANT MANASSAS, VIRGINIA		





SECTION B-B
SCALE: NONE

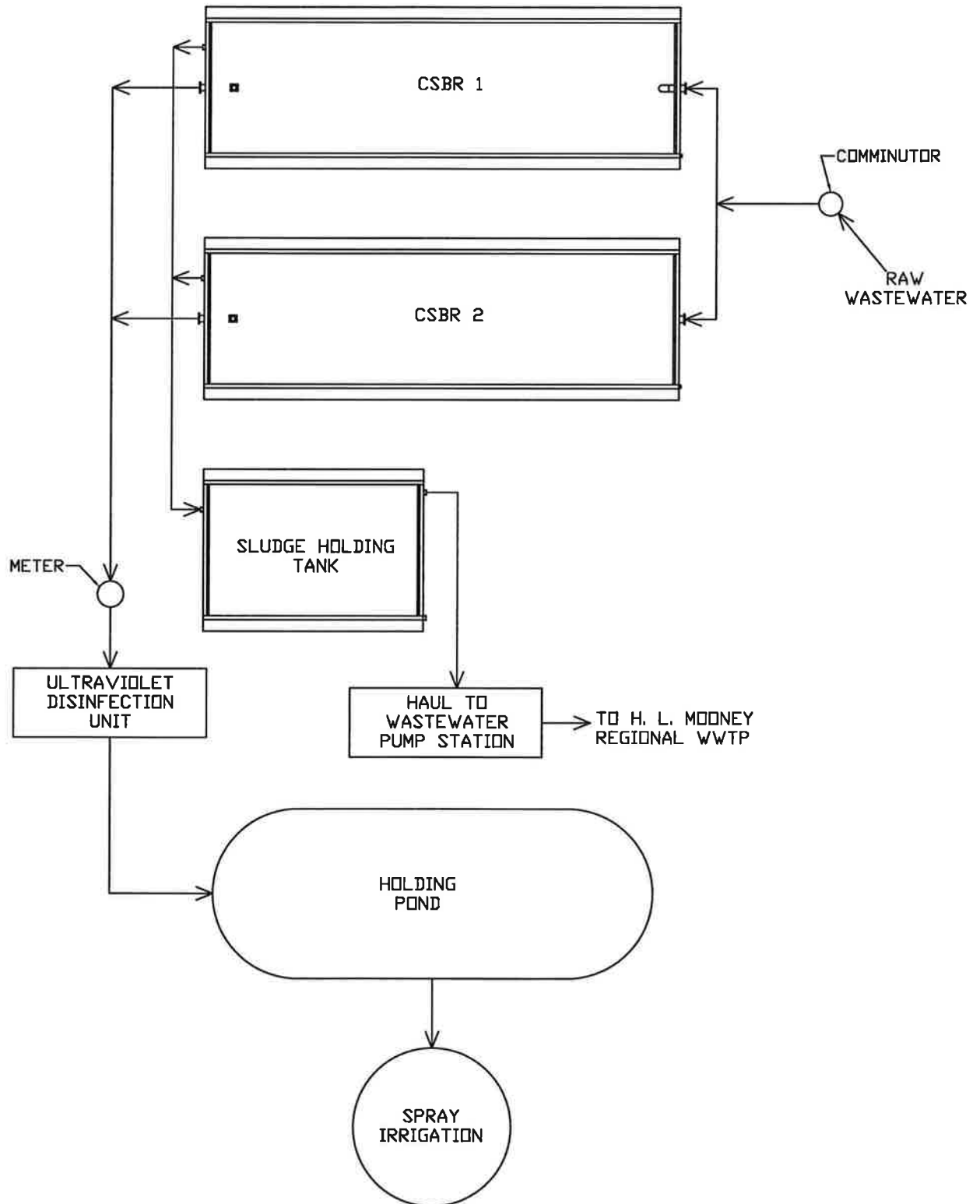


© PROPRIETARY INFORMATION FOR
USE ON THIS PROJECT ONLY.

KA WASTEWATER PACKAGE PLANTS

PREFABRICATED STEEL PACKAGE WASTEWATER TREATMENT SYSTEM		DRAWN BY: NLP	
SCALE: AS LISTED	APPROVED BY:	E. J. SCHOENK, P.E.	
DATE: 08-25-11			
SECTION B-B SLUDGE HOLDING TANK		DRAWING NUMBER	
OCCUBAH FOREST WASTEWATER TREATMENT PLANT MANASSAS, VIRGINIA		11-016-06	

PROPOSED
FLOW DIAGRAM
FOR
OCCOQUAN FOREST WASTEWATER TREATMENT FACILITY
MANASSASS, VIRGINIA



FLUIDYNE CORPORATION



5436 Nordic Drive, Suite D
Cedar Falls, Iowa 50613
Phone: (319) 266-9967
Fax: (319) 277-6034

Reply to: Fluidyne Florida
2202 Gold Oak Lane
Sarasota, FL 34232
Phone: (941) 342-8915
Fax: (941) 342-9765
E-mail: ptiflorida@aol.com

September 8, 2011

Mr. Richard Brannan
Whitman, Requardt and Associates
3701 Pender Drive, Suite 210
Fairfax, VA 22030

Re: Occaquan Forest WWTP
ISAM™ 45 Packaged WWTP

Gentlemen:

Per the request of Mr. Tim McComas of Kershner Environmental Technologies, Fluidyne Corporation is pleased to offer design calculations, layout drawing, and typical specifications, describing a complete ISAM™ Sequencing Batch Reactor process for the above referenced project.

Fluidyne's ISAM™ SBR is ideally suited to this type of small treatment facility. Each flow train of the ISAM™ process consists of a constant level anaerobic selector/trash trap/digester basin, followed by a SAM™ surge basin (influent equalization basin), and one SBR basin. In operation, all influent flow enters the anaerobic basin where influent solids and grit are allowed to settle much like a primary clarifier. The anaerobic chamber eliminates the need for fine screens or grit removal. Additionally, like a primary clarifier, the anaerobic chamber removes a minimum of 30% of the influent BOD, and 65% of the influent solids; this reduces the size of the SBR basins, and the power required for treatment by approximately one third. The influent flow then flows to the SAM™ surge basin. Mixed liquor is maintained in the SAM™ surge basin to immediately react with incoming raw sewage to suppress odors and initiate and accelerate carbon and nitrogen reactions. When the level in the surge basin reaches a predetermined level, the jet motive liquid/fill pump is started, and a batch is quickly fed to the reactor basin. When the SBR basin reaches top water level, mixed liquor overflows the proprietary flow and scum control system weir, and is returned to the SAM™ surge basin via the surge jet, and mixed with incoming wastewater in what is referred to as an "Interact" period. Aeration during the interact period is intermittent, and controlled by cycling the pump off and on to accomplish complete biodegradation of the wastewater in the SBR. In addition, during the interact phase, nitrates are recycled to the SAM™ tank for effective and rapid denitrification. Denitrification reactions are accelerated in the presence of the unreacted soluble carbon from the raw sewage entering the SAM™ surge basin. Aeration and energy requirements are reduced as nitrates are fully reduced to nitrogen gas in the SAM™ surge basin.

The positive assurance of anoxic followed by aerobic microbial environments in the Fluidyne ISAM™ system conditions the mixed liquor, encouraging highly flocculent microorganisms with optimal settling, compaction, and dewatering characteristics. Since denitrification takes place in the SAM™ tank the possibility of nitrogen gas bubbles attaching to and floating sludge during the settle cycle is eliminated.

A portion of the motive liquid is also recirculated to the anaerobic chamber where the mixed liquor is converted from an aerobic-dominant population to a facultative-dominant population. Aerobic bacteria are selectively destroyed in while enabling the low-yield, facultative bacteria to breakdown and utilize the remains of the aerobes and their byproducts. The recirculated aerobic mixed liquor also prevents the anaerobic chamber from entering the methane producing mode, and prevents the wide pH swings common to other anaerobic processes. The mixed liquor then flows to the SAM™ surge basin where the facultative bacteria, in turn, are out-competed by the aerobic bacteria and subsequently broken down in the alternating environments of the aerobic SBR treatment process and the anaerobic basin. A steady-state balance between selection and destruction is developed between the anaerobic basin and the SBR treatment process resulting in extremely low net biological solids produced. The ISAM™ process will reduce the volume of waste sludge by approximately 80%, compared to a conventional SBR/aerobic digester system, **and eliminate the need for separate digesters.** Waste solids are stabilized in the anaerobic chamber, and the waste sludge concentration is over 3.5%.

The interact period continues until the liquid level in the surge basin rises to the control water level where the pump is stopped and a settle period is begun in the SBR. After the settle period, approximately 25% of the SBR basin contents are decanted.

Operating control is simplified: No influent valves are required as flow continually enters the SAM™ tank. Cycle times are reduced as mixed liquor is rapidly pumped from the SAM™ to the SBR tank at the appropriate time greatly reducing fill time.

For seasonal or intermittent operation, the process is ideal; the interact period never ends until there is another full batch in the surge basin. That means that the system can go into an intermittently aerated holding mode for hours, days, or weeks at a time. Many of our installations are at schools, and ski resorts where huge weekly and seasonal flow variations have no effect on treatment efficiency.

Our design uses our aspirating aerators to eliminate the need for blowers.

This proposal includes a complete ISAM™ SBR system, as described in the design calculations, including:

ISAM™ SBR Process Equipment

One (1) Fluidyne Model ISAM™ 45 modular prepackaged sequencing batch reactor process systems. The flow train will consist of a three-chambered rectangular tank. The

tank will consist of separate compartments for pre-treatment/sludge storage (trash trap tank), flow equalization (anoxic tank), and biological treatment (SBR tank). Each tank will be fabricated out of carbon steel. The tank will be sandblasted and include 10 to 12 mil epoxy coating. The tank is 50' X 11.9' X 12.0' high. Each system will be shipped complete and ready for installation on a customer provided concrete pad.

A hoist socket integral to the tank will be provided at the location of each pump for retrieval of the pump

The control panel will ship loose to be mounted in the field on the tank.

Each tank weight is approximately 47,000 lbs dry and 440,000 lbs full of water.

Each ISAM™ 45 packaged plant will include:

Two (2) vertical submersible motive liquid/fill pumps (One is an on-line spare.). Each pump will provide motive liquid for a Model SAA15 aspirating aerator and be furnished complete with discharge connection, retrieval assembly, guide bars, all accessories, and a 15 Hp submersible motor.

One (1) Fluidyne Model FED300 fixed solids excluding effluent decanter. Decanter will be rated for a maximum flow rate of 300 GPM.

All in-basin air and liquid piping is included.

One (1) FJM-1 Jet Mixer with 1 HP submersible jet mixing pump, jet mixing nozzle, retrieval assembly and guide bars for anoxic mixing of SBR tank.

One (1) Preprogrammed and prewired process control panel. The microprocessor based process control panel will be capable of controlling all of the normal operating requirements of the SBR system based on liquid level and time.

One (1) Float type level monitoring systems.

One (1) Lot of valves, including:

- One (1) 6" electrically operated butterfly valve for the decant line.

- Two (2) 4" manual air control ball valves

- One (1) 3" manual plug valve for sludge disposal system.

- Two (2) 2" electrically operated WAS control ball valves

- Two (2) 2" manual WAS control ball valves

- Two (2) 2" manual WAS bypass ball valves

One (1) SBR overflow weir/scum skimmer. The overflow weir will allow flow from the SBR compartment to flow back to the influent equalization tank during the interact cycle. The weir will also provide scum skimming of the SBR tank. The weir will also provide flow diffusion during periods of extremely high flow.

Supports. All necessary supports for the aeration system, in-basin air and liquid piping, backflush system, and decanter are included.

Hardware. All gaskets, and flange hardware are included.

Six (6) days of startup and operator training. Provided in two (2) trips to the job site.

Budget price for complete ISAM™ 45 SBR system \$234,500.00

If effluent filtration or disinfection is required, an effluent equalization basin may be required:

One (1) Model EQ20 Effluent equalization basin. The effluent equalization tank will be built to the same specifications as the ISAM tank to store effluent from the SBR. The tank will be 20' long X 8.5' high X 11.9' wide. The tank will be equipped with two (2) 2 HP submersible effluent pumps with each to pump approximately 80 gpm at 20 to 25 feet TDH.

Budget price for Model EQ20 Effluent equalization basin. \$59,500.00

Price is firm for 30 days

Submittal drawings 6 - 8 weeks

Shipment 16 weeks after approval

FOB Shipping points, freight allowed

It is our intention that this proposal includes one complete SBR process system. This proposal does not include:

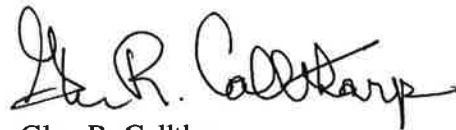
- Site and structural design
- Nutrient feed equipment and pH feed equipment and accessories if required
- Screening equipment if required
- Chemical feed equipment if required
- Freeze protection
- Any out of basin piping, valving or supports including influent and effluent piping, conduit, etc

- Remote panels, junction boxes or disconnects
- Field wiring
- Disinfection equipment if required
- Sludge handling and drying equipment
- Walkways, handrailing or platforms
- Hoist or lifting equipment
- Explosion proof motors
- SCADA system
- Anchor bolts
- Motor starters or related controls.
- Control of any equipment not related to items in the Fluidyne scope of supply
- Installation
- Sales or use taxes
- D.O. or ORP controls or monitoring equipment (optional)
- Any item or service not specified in our proposal

I trust that the enclosed information will be sufficient for your needs at this time. If you have any questions, or need additional information, please do not hesitate to contact us. Thank you for considering Fluidyne.

Very truly yours,

Fluidyne Corporation,

A handwritten signature in black ink, appearing to read "Glen R. Calltharp", with a stylized, cursive script.

Glen R. Calltharp

cc: Mr. Erick Mandt
Fluidyne Corporation

Mr. Tim McComas
Kershner Environmental Technologies

ISAM™ SBR with Aspirating Jet Aeration System
Design Calculations For
Occaquan Forest WWTP

Sep. 7, 2011

I. DESIGN CONDITIONS:

Design flow	=	44,000 GPD
Peak daily flow	=	88,000 GPD (Assumed)
Peak hourly flow	=	76 GPM (Assumed)
Influent BOD ₅	=	220 mg/L
Removal in anaerobic chamber	=	30%
BOD ₅ to SBR	=	154 mg/L
	=	57 lb/day
Effluent BOD ₅	=	10 mg/L
Influent TSS	=	220 mg/L
Removal in anaerobic chamber	=	65%
TSS to SBR	=	77 mg/L
Effluent TSS	=	10 mg/L
Influent TKN	=	40 mg/L
	=	15 lb/day
Effluent NH ₃ -N	=	2 mg/L (Assumed)
Effluent total N	=	10 mg/L (Assumed)
Design MLSS (Full reactor)	=	3,000 mg/L
Design F:M	=	0.06
SRT (SBR)	=	18 days
SRT (SBR plus SAM))	=	23 days
Elevation	=	350 ft. MSL (Assumed)
Average barometric pressure	=	14.50 psia

II. SYSTEM DESIGN:

	One (1)	Model ISAM™ 45
SBR basin	=	1
Length	=	25 ft. 0 in.
Width	=	11 ft. 10 in.
TWL	=	10 ft. 6 in.
BWL	=	8 ft. 0 in.
Volume	=	23,179 Gallons
Retention time	=	12.6 hrs.



SAM™ reactor basin	=	1
Length	=	12 ft. 6 in.
Width	=	11 ft. 10 in.
Maximum SWD	=	10 ft. 6 in.
Minimum SWD	=	2 ft. 0 in.
Working volume	=	9,364 Gallons
Anaerobic chamber	=	1
Length	=	12 ft. 6 in.
Width	=	11 ft. 10 in.
SWD	=	10 ft. 6 in.
Volume	=	11,589 Gallons
Effluent equalization/filter feed basin	=	1
Length	=	20 ft. 0 in.
Width	=	11 ft. 10 in.
Maximum SWD	=	6 ft. 0 in.
Minimum SWD	=	1 ft. 6 in.
Working volume	=	7,861 Gallons

III. OXYGEN REQUIREMENT:

lbs. O ₂ / lb. BOD ₅ removed	=	1.25
lbs. O ₂ / lb. TKN applied	=	4.6
lbs. O ₂ recovered/ lb. NO ₃ denitrified	=	2.86
Actual Oxygen Required	=	106 lbs./day

Actual to Standard Oxygen Conversion Formula:

$$SOR = \frac{AOR}{\alpha \theta^{(T-20)} \left\{ \frac{\beta C_{SMID} - C_L}{C_s \left[1 + \frac{0.5(S)}{34} \right]} \right\}}$$

Where:

α	=	0.85	β	=	0.95
T	=	20 ° C	θ	=	1.024
C _s	=	9.09	C _L	=	1.0 mg/L
C _{SMID}	=	Oxygen saturation concentration at 50 % submergence at site elevation and temperature.			
C _{SMID}	=	9.11 mg/L			



Therefore:

Standard Oxygen Required	=	151 lbs./day
Peaking Factor	=	1.50
Peak SOR (Design)	=	226 lbs./day

IV. PROCESS DESIGN

Cycle time at design flow	=	2.91 hrs.
Fill time	=	0.12 hrs.
Aerated interact time at average load	=	0.98 hrs.
Anoxic time at average load	=	0.76 hrs.
Aerated interact time at peak load	=	1.54 hrs.
Anoxic time at peak load	=	0.20 hrs.
Settle time	=	0.75 hrs.
Decant time	=	0.30 hrs.
Total cycle time	=	2.91 hrs.
Total aeration time (Peak Design)	=	1.66 hrs./cycle
	=	14 hrs./day
SOR for aeration design	=	16.5 lbs./hr.
Aspirating jets per basin	=	1
BHp required per aspirator	=	10.31
Aspirator model	=	SAA 15 /1

VI. PUMP CALCULATIONS:

Jet motive/fill pump:

Pumps per basin	=	1
Flow per pump	=	715 GPM
Total pump head	=	40 ft.
Assumed pump efficiency	=	70 %
BHp per pump	=	10.32
Pump motor Hp	=	15

VII. DECANter SIZING:

Cycles per day	=	8.24
Batch size	=	5,341 Gallons
Decant flow	=	300 GPM

VIII. SUMMARY:

Design Standard Oxygen Required	=	226 lbs./day
Avg. BHp for 24 hrs. @ Peak SOR	=	5.9

Power usage (Peak SOR)	=	105 kWh/day
Power usage (Average SOR)	=	77 kWh/day

IX. SLUDGE PRODUCTION CALCULATIONS:

Inert accumulation	=	0.21 lbs./lb. BOD ₅ removed
VSS production	=	0.44 lbs./lb. BOD ₅ removed
Total sludge yield	=	0.65 lbs./lb. BOD ₅ removed
Dry solids from SBR	=	34 lb/day
Anaerobic volatile sludge reduction	=	60%
Waste sludge concentration	>	3.5%
Sludge production	=	20 lbs. day
	=	70 GPD
Sludge storage	=	74 days

X. NITRIFICATION/DENITRIFICATION

Minimum mixed liquor temperature	=	10 ° C
Mixed liquor dissolved oxygen	=	1.0 mg/L
Alkalinity required for nitrification	=	254 mg/L
Alkalinity recovered, denitrification	=	57 mg/L
Net influent alkalinity required	=	197 mg/L
Max. nitrifier growth rate	=	0.125 days ⁻¹
Minimum SRT required for nitrification	=	8 days
Actual SRT at minimum temp. (SBR)	=	16 days
Kn, half velocity constant	=	0.22 mg/L
Des. growth rate for heterotrophs/nitrifiers	=	0.061
Projected effluent soluble NH ₃ -N	=	0.22 mg/L
Specific utilization rate	=	0.20 lbs BOD ₅ /lb MLVSS
MLVSS required for BOD & NH ₃ removal	=	279 lbs.
MLVSS percentage in MLSS	=	80%
MLVSS	=	2,400 mg/L
Tank volume req. for BOD & NH ₃ removal	=	0.014 MG
SBR specific denitrification rate at T _{MIN}	=	0.019 g/g/day
NO ₃ removed at T _{MIN} in SBR	=	2.3 lb/day
NO ₃ removal required in SAM	=	4.7 lb/day
SAM specific denitrification rate at T _{MIN}	=	0.025 g/g/day
SAM MLVSS required for denitrification	=	188 lbs.
SAM tank volume for NO ₃ removal	=	0.009 MG
Total tank volume required	=	0.0233 MG
Total tank volume provided	=	0.0348 MG

FLUIDYNE CORPORATION



THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY



ISAMTM

SEQUENCING BATCH REACTOR PROCESS



THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY

TRUST FLUIDYNE'S EXPERIENCE

The Fluidyne ISAM™ Sequencing Batch Reactor (SBR) system incorporates the latest and most innovative technology and over thirty years of experience in providing the most reliable SBR systems producing the highest effluent quality. Fluidyne SBR systems are in operation around the world and have won numerous awards. Fluidyne SBRs consistently provide better than 10/10/5/1 (BOD₅/TSS/TN/TP) effluent quality. Fluidyne engineers have designed over 500 SBRs, and been granted over twenty patents.

A TOTALLY NEW CONCEPT IN SBR DESIGN

The Fluidyne ISAM™ Sequencing Batch Reactor system is a single train SBR process which incorporates a constant level anaerobic selector-digester chamber, followed by a surge/anoxic/mix (SAM™) tank, and one or more SBR basins.

In operation, all influent flow enters the anaerobic selector chamber where influent solids are allowed to settle much like a primary clarifier. Elimination of primary solids in the anaerobic chamber allows for much smaller SBR basins than conventional SBRs at equivalent SRTs. The anaerobic selector also creates soluble carbon as a food source for biological nutrient removal through anaerobic conversion of settleable BOD to soluble BOD. Settled solids are digested anaerobically in the anaerobic selector chamber.

The influent then flows to the SAM™ surge basin (influent equalization basin). The surge basin provides flow and nutrient equalization to optimize treatment at the full range of flows and loadings. When the level in the surge basin reaches a predetermined level, the jet motive liquid/fill pump is started, and a batch is quickly fed to the SBR reactor basin.

Several unique features of the Fluidyne ISAM™ SBR include odor control and scum skimming. Mixed liquor is maintained in the SAM™ tank to immediately react with incoming flow from the anaerobic chamber to suppress odors and initiate and accelerate carbon and nitrogen reactions. Mixed liquor from the SBR tank overflows the proprietary flow and scum control system weir, and is returned to the SAM™ surge basin, and mixed with incoming wastewater in what is referred to as an "Interact" period. In addition, nitrates are recycled to the SAM™ tank for effective and rapid denitrification. Denitrification reactions are accelerated in the presence of the unreacted soluble carbon from the raw sewage entering the SAM™ tank. Aeration and energy requirements are reduced as nitrates are fully reduced to nitrogen gas in the SAM™ tank.

FLUIDYNE PREPACKAGED ISAM™ SBRs

The Fluidyne prepackaged ISAM™ SBR is available in standard sizes for average influent flows from 5,000 GPD to 110,000 GPD. Each unit is shipped complete; prewired and prepiped. Packaged systems can be buried or installed above grade on customer provided concrete pad.

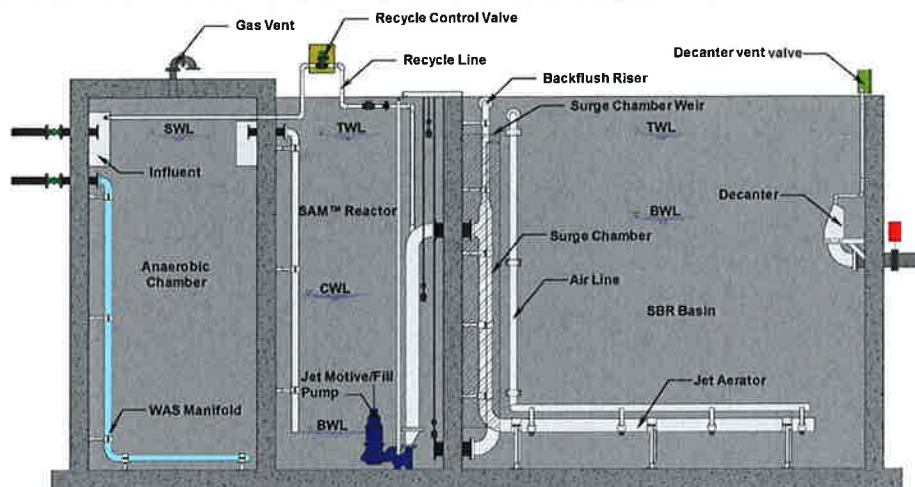
100% ON-LINE STANDBY EQUIPMENT

Fluidyne's prepackaged ISAM™ SBRs are furnished with spare mixing/fill pump and aerator assembly installed for 100% redundancy.

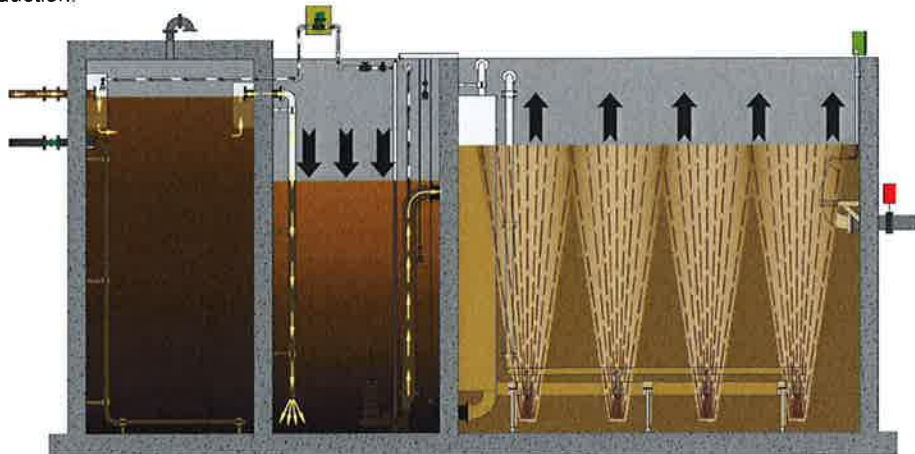


REDUCES WASTE SLUDGE BY 80%

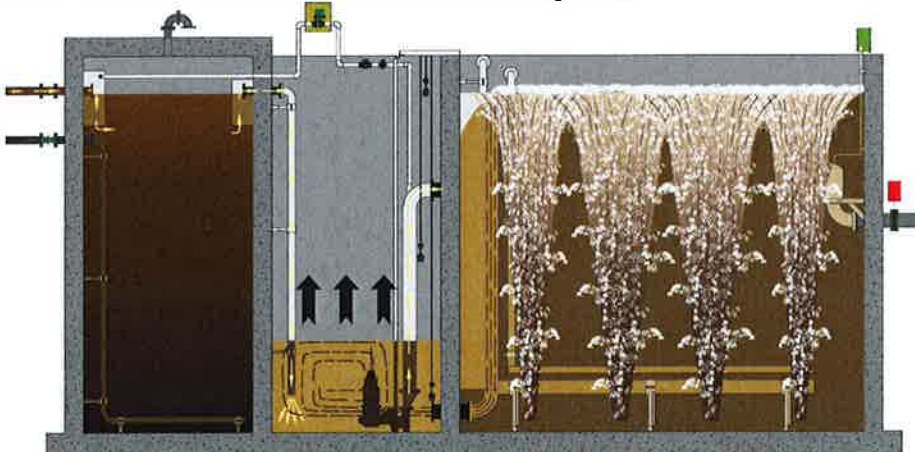
The Fluidyne ISAM™ Sequencing Batch Reactor incorporates an anaerobic selector chamber with the SAM™ SBR. All influent flow enters the anaerobic chamber where influent solids settle. The anaerobic selector chamber also creates soluble carbon as a food source for denitrification through anaerobic conversion of settleable BOD to soluble BOD. During the "Interact" phase, a portion of the motive liquid is also recirculated to the anaerobic selector chamber where the mixed liquor solids are converted from an aerobic-dominant population to a facultative-dominant population. Aerobic bacteria are selectively destroyed while enabling the low-yield, facultative bacteria to breakdown and utilize the remains of the aerobes and their byproducts. The mixed liquor then flows to the SAM™ surge basin where the facultative bacteria, in turn, are out-competed by the aerobic bacteria and subsequently broken down in the alternating environments of the aerobic SBR treatment process and the anaerobic chamber. A balance between selection and destruction is developed between the anaerobic selector chamber and the SBR treatment process resulting in extremely low net biological solids produced. The ISAM™ process will reduce the volume of waste sludge by approximately 80%, compared to a conventional SBR/aerobic digester system, and eliminate the need for separate digesters.



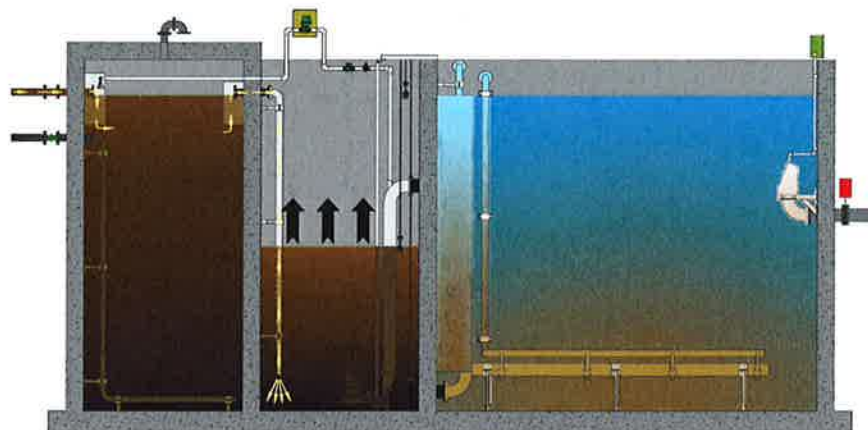
System Components: Influent continuously enters the anaerobic chamber where solids settle. Settleable BOD is converted to soluble BOD. BOD is reduced by 30%, and solids are reduced by 60%. The influent then flows to the SAM™ reactor. Mixed liquor is maintained in the SAM™ reactor to suppress odors, and initiate and accelerate carbon and nitrogen reduction.



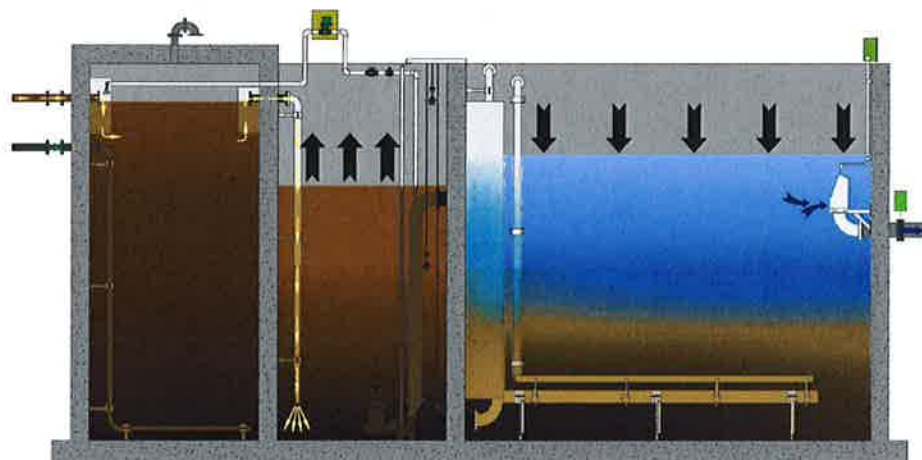
Fill Phase: When the level in the SAM™ reactor reaches a predetermined "control level" the motive liquid pump is started. The SBR basin is filled and mixed. A percentage of the pumped flow is returned to the anaerobic chamber where biological solids settle. Settled solids in the anaerobic chamber are digested.



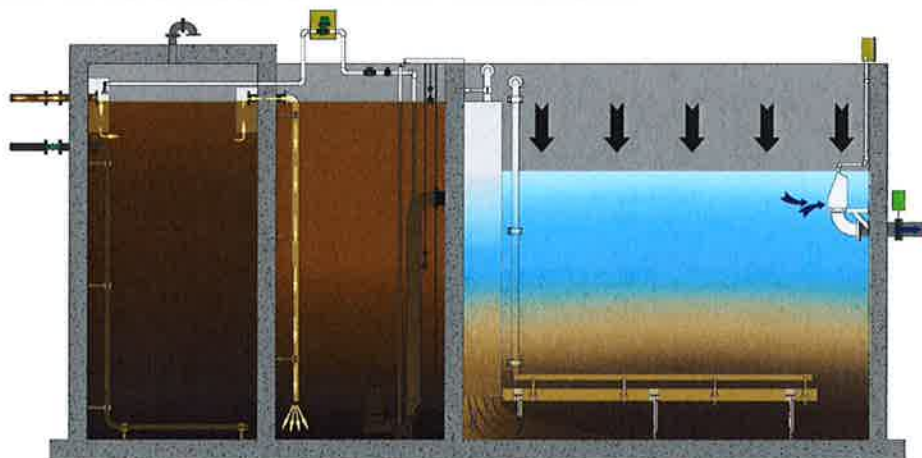
Interact Phase: When the level in the SBR reaches TWL, nitrified mixed liquor overflows the surge chamber weir and is returned to the SAM™ chamber to mix and react with the raw influent. Aeration is cycled on and off to provide the required oxygen. Denitrification is reliable and complete. Scum is also removed from the SBR basin.



Settle Phase: When the level in the SAM™ reactor again reaches “control level,” aeration is discontinued, and the SBR basin settles under perfect quiescent conditions.



Decant Phase: When the settle timer expires, the decant valve is opened, and treated effluent is withdrawn from the upper portion of the SBR basin by means of a fixed solids excluding decanter.



Filled Decant Phase: If, during peak flow events, the SAM™ reactor reaches TWL before the decant phase ends, influent flows in a reverse direction through the surge return line and overflows the surge chamber secondary weir, and is diffused into the settled sludge at very low velocity as the decant phase continues.



CORPORATION

THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY

CUSTOM ENGINEERED ISAM™ SYSTEMS

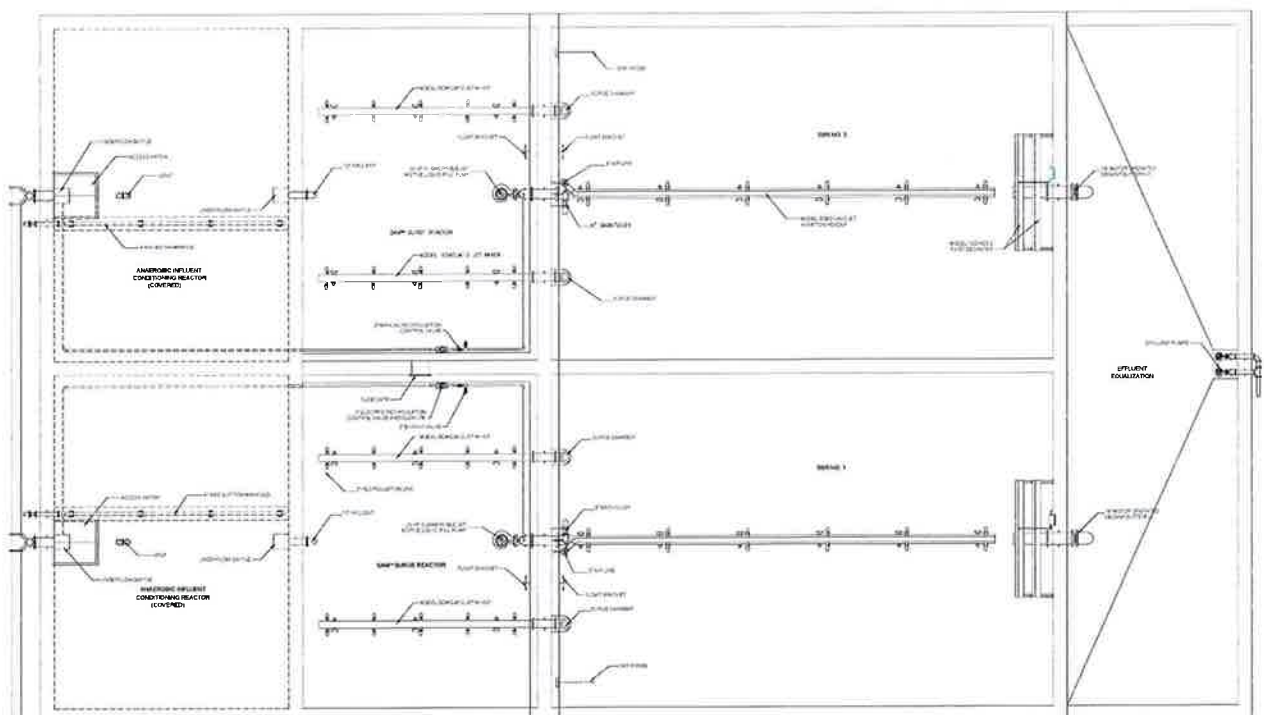
The majority of ISAM™ systems currently operating are packaged systems for daily flows of less than 100,000 GPD. However, the process offers the same advantages for larger facilities. The first advantage is that the ISAM™ requires smaller SBR basins than a conventional SBR, at identical loadings. This is due to the fact that 65% of the influent solids are removed in the anaerobic chamber, and are therefore not considered in calculation of the SRT. An ISAM™ designed for an average daily flow of 1.0 MGD, and an SRT of 20 days will have an SBR basin capacity of 0.67 MG, and an HRT of 16 hours. A conventional SBR designed for a 20 day SRT would have a capacity of 1.24 MG, and an HRT of 30 hours. The 1.0 MGD ISAM™ SBR design also includes the SAM™ reactor having a capacity of 0.14 MG. Since the SAM™ reactor contains mixed liquor, the actual working SRT for the ISAM™ process is 25 days, and the total volume is only 66% of that of the conventional SBR.

The ISAM™ design also includes two anaerobic influent conditioning chambers having a total capacity of 0.50 MG. Therefore, the total volume of the entire ISAM™ SBR process is 1.31 MG, and no additional digesters are required. Aerobic digesters for a conventional 1.0 MGD SBR would have a capacity of 0.30 MG if designed for a 30 day sludge age. This

means that the total volume for a 1.0 MGD conventional SBR plus aerobic digesters would be 1.54 MG. The total volume for the ISAM™ process is 1.31 MG.



The total power consumption for a 1.0 MGD conventional SBR plus aerobic digestion would be approximately 1,680 KWH/day. The total power consumption for a 1.0 MGD ISAM™ SBR is approximately 845 KWH/day; 50% less than a conventional SBR.





CORPORATION

THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY



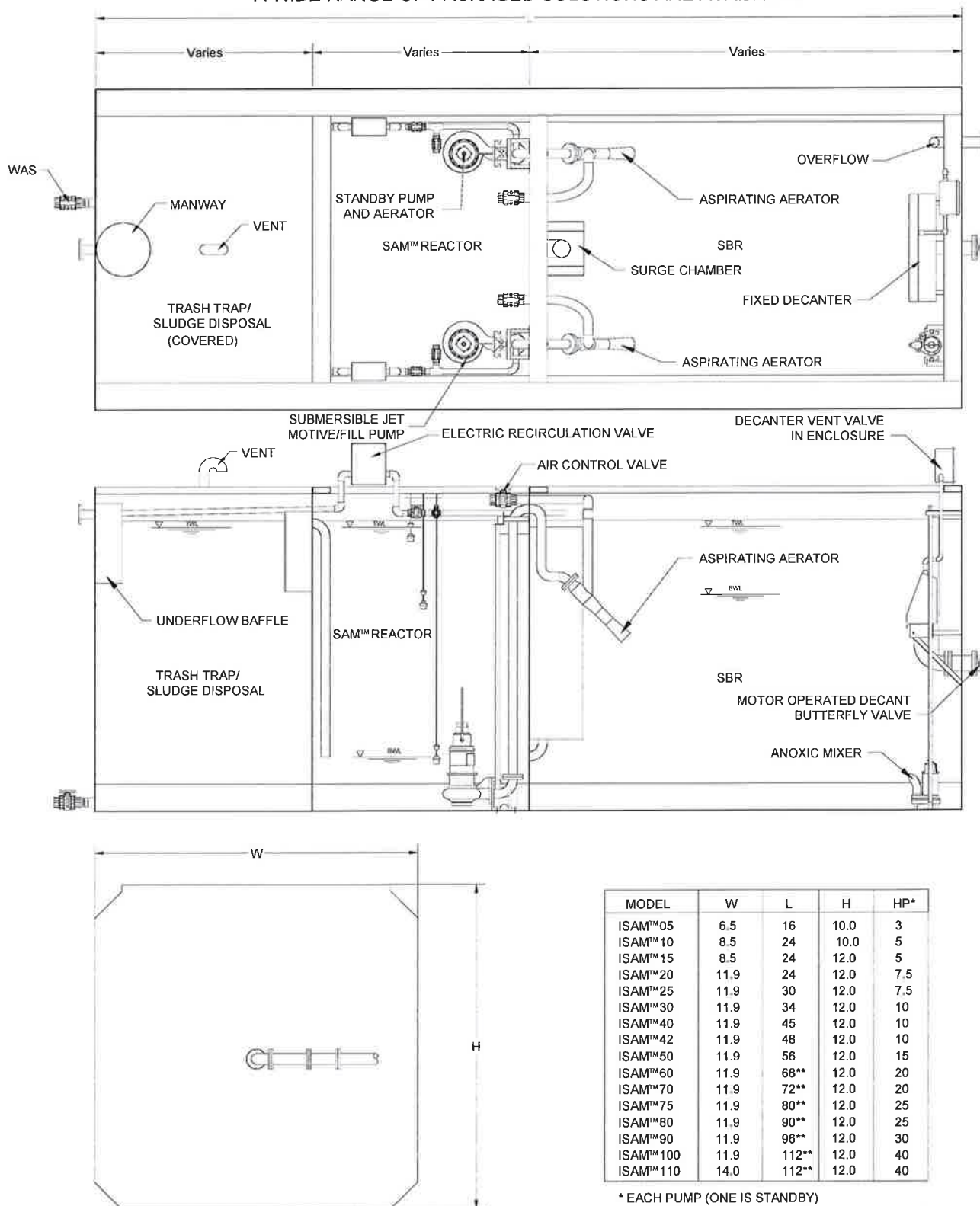
FLUIDYNE SAM™ SBR - BARONA, CA - WEEKLY REPORTS

DATE	INFLUENT					EFFLUENT						
	BOD ₅	TSS	NH ₃ -N	TKN	FOG	BOD ₅	TSS	NH ₃ -N	NO ₃	NO ₂	TKN	FOG
02/16/05	632	327	20.2	36.0	64.8	2.0	ND	ND	0.1	0.02	0.50	<1.0
02/23/05	338	226	6.7	7.8	45.5	ND	ND	ND	ND	0.02	0.60	ND
03/02/05	813	390	23.5	35.0	75.8	4.6	ND	2.0	0.1	0.01	0.80	ND
03/09/05	653	328	15.1	22.7	88.8	4.9	ND	0.2	0.3	ND	1.10	ND
03/16/05	640	237	23.7	35.9	79.4	2.7	ND	0.2	0.3	0.02	1.10	ND
03/23/05	385	445	24.1	38.2	80.7	2.2	ND	2.0	0.2	0.13	0.70	ND
03/30/05	736	358	15.2	19.3	217.0	10.0	ND	0.1	0.1	0.03	0.50	ND
04/06/05	627	338	28.3	34.5	97.0	9.0	ND	0.4	ND	ND	0.40	ND
04/13/05	784	356	23.0	27.2	31.0	12.0	ND	0.5	ND	ND	0.70	ND
04/20/05	336	223	14.0	16.6	8.4	3.5	1.9	0.4	ND	ND	3.30	<1
04/27/05	579	485	6.7	8.9	27.5	<2	ND	0.3	ND	ND	3.10	<1
05/04/05	940	334	1.0	33.1	48.9	2.9	2.5	1.0	0.1	0.08	2.60	<1
05/11/05	622	330	22.2	74.2	66.7	<2	ND	ND	ND	ND	1.80	ND
05/18/05	718	329	20.8	28.0	492.0	2.2	ND	ND	ND	ND	0.49	ND
05/25/05	575	322	13.1	13.3	450.0	4.6	ND	0.5	ND	ND	0.50	ND
06/01/05	711	688	24.0	25.8	327.0	12.3	ND	0.5	0.2	ND	0.50	ND
06/08/05	508	277	22.4	27.9	52.6	2.4	NO	0.1	0.4	ND	0.70	<1
06/15/05	343	155	14.9	22.5	90.8	<2	ND	0.5	0.4	ND	1.00	ND
06/22/05	661	477	27.6	33.5	87.2	<2	ND	0.2	0.4	ND	0.70	1.1
06/29/05	444	345	32.6	50.5	61.5	2.0	ND	0.1	0.3	0.03	0.50	ND
07/06/05	925	379	27.6	48.1	87.5	1.7	ND	0.2	0.3	0.03	0.80	ND
07/13/05	673	346	33.1	52.5	99.5	<2	ND	0.5	0.5	ND	0.90	<1.0
07/20/05	650	109	29.1	43.0	84.9	<2	ND	0.1	ND	0.04	0.70	<1.0
07/27/05	694	305	33.0	43.0	83.1	<2	ND	0.2	0.3	0.08	0.40	ND
08/03/05	580	324	26.3	28.0	65.9	3.6	ND	0.6	0.3	0.02	0.80	ND
AVG. YTD	623	337	20.9	32.2	116.5	4.6	ND	0.4	0.2	0.03	1.01	ND

FLUIDYNE CORPORATION

THE EXPERIENCED LEADER IN SEQUENCING BATCH REACTOR TECHNOLOGY

A WIDE RANGE OF PACKAGED SOLUTIONS ARE AVAILABLE



MODEL	W	L	H	HP*
ISAM™05	6.5	16	10.0	3
ISAM™10	8.5	24	10.0	5
ISAM™15	8.5	24	12.0	5
ISAM™20	11.9	24	12.0	7.5
ISAM™25	11.9	30	12.0	7.5
ISAM™30	11.9	34	12.0	10
ISAM™40	11.9	45	12.0	10
ISAM™42	11.9	48	12.0	10
ISAM™50	11.9	56	12.0	15
ISAM™60	11.9	68**	12.0	20
ISAM™70	11.9	72**	12.0	20
ISAM™75	11.9	80**	12.0	25
ISAM™80	11.9	90**	12.0	25
ISAM™90	11.9	96**	12.0	30
ISAM™100	11.9	112**	12.0	40
ISAM™110	14.0	112**	12.0	40

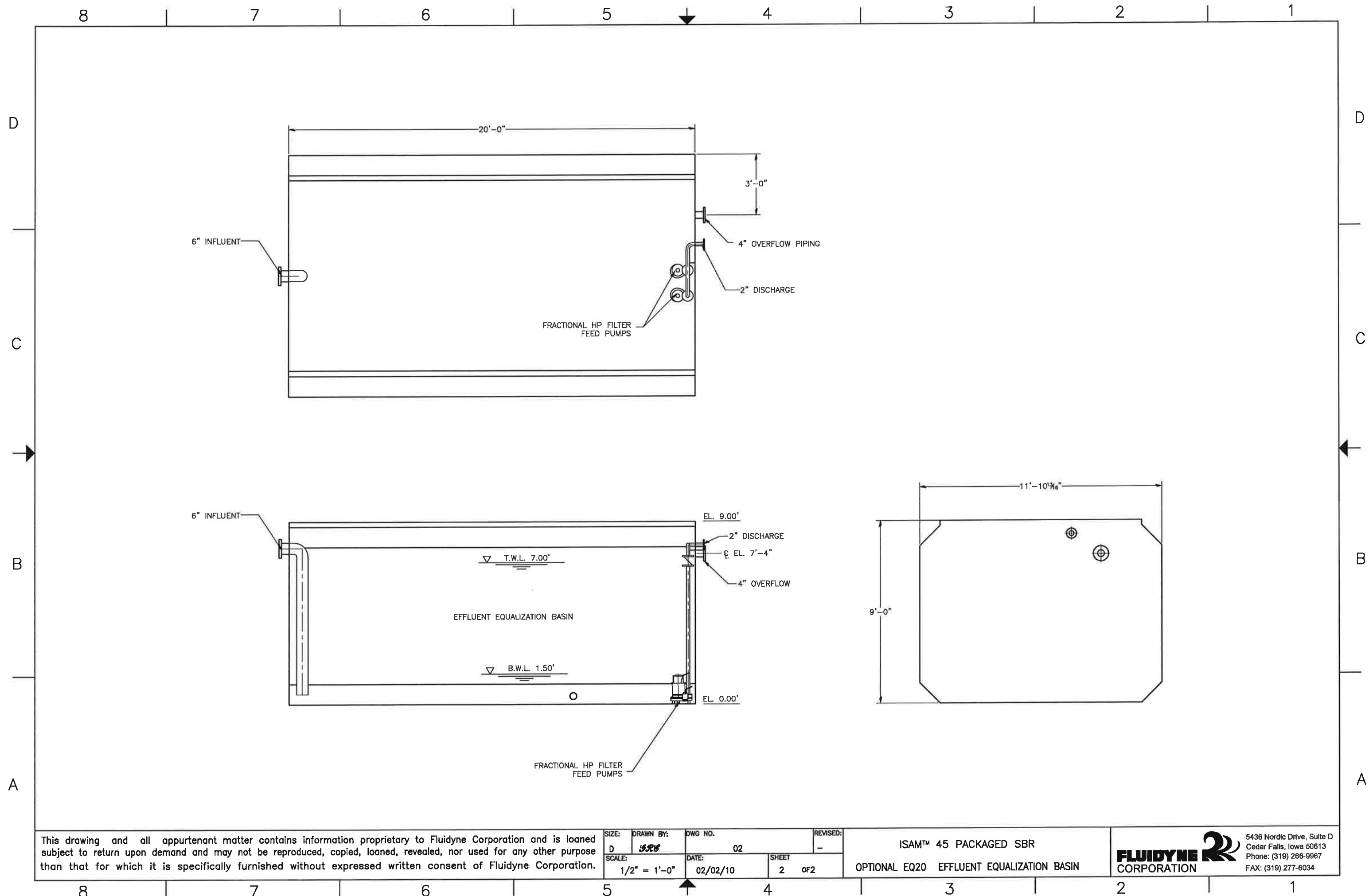
* EACH PUMP (ONE IS STANDBY)

** TWO TANKS (EACH TANK IS HALF OF TOTAL LENGTH)

The Fluidyne ISAM™ SBR system provides the following benefits:

1. Ability to handle highly variable flows and loading associated with small, to medium size plants. The ISAM™ is more flexible than continuous flow plants. Regardless of flows or loading, aeration and mixing can automatically be adjusted to optimize power and prohibit filamentous growth.
2. At high flows, solids cannot wash out as with extended aeration plants as the ISAM™ SBR process utilizes quiescent settle and decant periods.
3. ISAM™ facilities are easily expandable by adding additional flow trains. The additional flow trains do not require major changes in controls; only new tankage and associated equipment.
4. ISAM™ provides a small footprint with no digesters, secondary clarifiers, RAS piping and pumping.
5. ISAM™ produces the highest quality effluent. Typical Fluidyne ISAM™ facilities are achieving less than 10 mg/L BOD₅ and TSS, less than 1 mg/L NH₃-N, less than 7 mg/L total N, and less than 2 mg/L phosphorous.
6. Easy to operate and maintain as mechanical equipment is minimized with no chasing of sludge associated with extended aeration plants.
7. Built in sludge reduction system using the anaerobic selector chamber and facultative/aerobic enhanced cell lysis significantly reduces sludge handling and hauling costs.
8. Built in flow equalization is provided in the SAM™ reactor to handle peak hourly flows.
9. Automatic scum skimming prior to effluent discharge provides highest quality effluent.
10. Exceptional after sales service by Fluidyne technicians. Fluidyne employees have been granted over 20 patents in wastewater and water treatment technology and equipment.
11. Reduced operation and maintenance costs as power usage is controlled through the Fluidyne control panel.
12. Installed cost is lower as the system comes with the in-basin equipment pre-installed
13. The anaerobic selector chamber is covered and raw wastewater reacts immediately with mixed liquor in an aerated environment, there are no odor concerns.

Checked by: GRC
Revision Date: - - -



This drawing and all appurtenant matter contains information proprietary to Fluidyne Corporation and is loaned subject to return upon demand and may not be reproduced, copied, loaned, revealed, nor used for any other purpose than that for which it is specifically furnished without expressed written consent of Fluidyne Corporation.

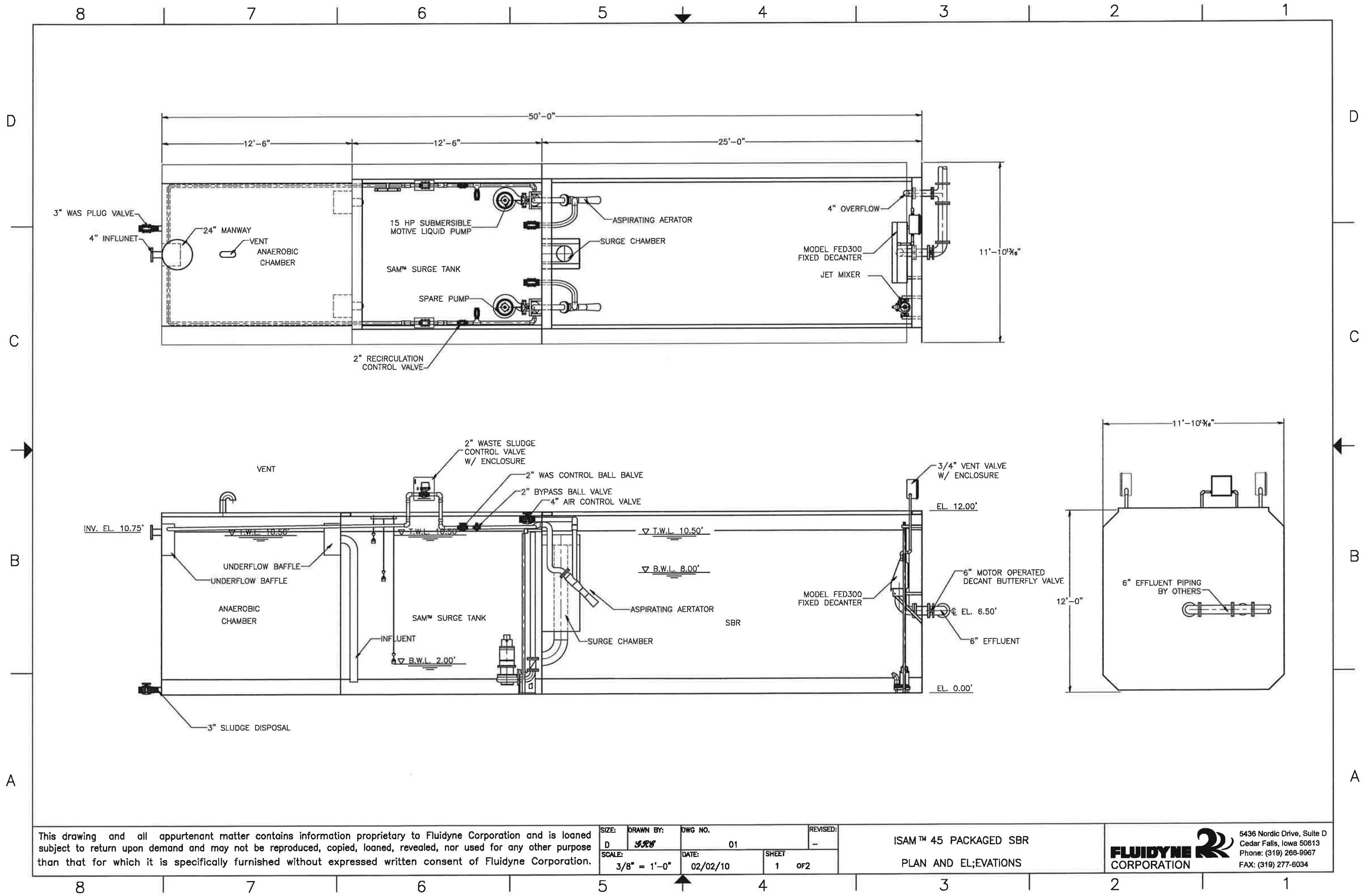
SIZE:	DRAWN BY:	DWG NO.	REVISED:
D	JRB	02	-
SCALE:	DATE:	SHEET	
1/2" = 1'-0"	02/02/10	2 of 2	

ISAM™ 45 PACKAGED SBR
OPTIONAL EQ20 EFFLUENT EQUALIZATION BASIN

FLUIDYNE
CORPORATION

5436 Nordic Drive, Suite D
Cedar Falls, Iowa 50613
Phone: (319) 266-9967
FAX: (319) 277-6034

Revision Date: - - -
Checked by: GRC



This drawing and all appurtenant matter contains information proprietary to Fluidyne Corporation and is loaned subject to return upon demand and may not be reproduced, copied, loaned, revealed, nor used for any other purpose than that for which it is specifically furnished without expressed written consent of Fluidyne Corporation.

SIZE:	D	DRAWN BY:	JRB	DWG NO.	01	REVISED:	-
SCALE:	3/8" = 1'-0"	DATE:	02/02/10	SHEET	1	OF	2

ISAM™ 45 PACKAGED SBR
PLAN AND EL;EVATIONS

FLUIDYNE CORPORATION



5436 Nordic Drive, Suite D
Cedar Falls, Iowa 50613
Phone: (319) 268-9967
FAX: (319) 277-6034



Service Authority

Prince William County

Fairfax

3701 Pender Drive, Suite 450
Fairfax, VA 22030
Phone: 703.293.9717
Fax: 703.273.6773

Baltimore

801 South Caroline Street
Baltimore, MD 21231
Phone: 410.235.3450
Fax: 410.234.5716

Richmond

9030 Stony Point Parkway, Suite 220
Richmond, VA 23235
Phone: 804.272.8700
Fax: 804.787.7200

Newport News

11870 Merchants Walk, Suite 100
Newport News, VA 23606
Phone: 757.599.5101
Fax: 757.599.5320

Pittsburgh

300 Seven Fields Boulevard, Suite 130
Seven Fields, PA 16046
Phone: 724.779.7940
Fax: 724.779.7943

York

224 St. Charles Way, Suite 140
York, PA 17402
Phone: 717.741.5057
Fax: 717.741.5124

Wilmington

Three Mill Road, Suite 309
Wilmington, DE 19803
Phone: 302.571.9001
Fax: 302.571.9011

Blacksburg

1700 Kraft Drive, Suite 1200
Blacksburg, VA 24060
Office: 540.951.3727
Fax: 540.951.3741

Houston

19530 FM362 Road
Waller, TX 75380
936.372.1800

