AQUA-AEROBIC SYSTEMS, INC.
A Metawater Company

Process Design Report

WESTHAMPTON BEACH NY

Design# 148881
Option: Preliminary Design,
revised per 2017.08.02 comments

AquaSBR®

Sequencing Batch Reactor

August 08, 2017
Designed By: Tamera Knapp

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Pre-SBR

- Neutralization is recommended/required ahead of the SBR if the pH is expected to fall outside of 6.5-8.5 for significant durations.

- Coarse solids removal/reduction is recommended prior to the SBR.

- Elevated concentration of Hydrogen Sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, steps should be taken to eliminate Hydrogen Sulfide prior to the treatment system.

SBR

- The maximum flow, as shown on the design, has been assumed as a hydraulic maximum and does not represent an additional organic load.

- The decanter performance is based upon a free-air discharge following the valve and immediately adjacent to the basin. Actual decanter performance depends upon the complete installation including specific liquid and piping elevations and any associated field piping losses to the final point of discharge. Modification of the high water level, low water level, centerline of discharge, and / or cycle structure may be required to achieve discharge of full batch volume based on actual site installation specifics.

Aeration

- The aeration system has been designed to provide 1.25 lbs. O2/lb. BOD5 applied and 4.6 lbs. O2/lb. TKN applied at the design average loading conditions.

Process/Site

- The anticipated effluent total nitrogen requirement is predicated upon an influent waste temperature of 10° C or greater. While lower temperatures may be acceptable for a short-term duration, nitrification and denitrification below 10° C can be unpredictable, requiring special operator attention.

- Sufficient alkalinity is required for nitrification, as approximately 7.1 mg alkalinity (as CaCO3) is required for every mg of NH3-N nitrified. If the raw water alkalinity cannot support this consumption, while maintaining a residual concentration of 50 mg/l, supplemental alkalinity shall be provided (by others).

Anticipated

- The effluent Total Nitrogen (TN) limit of 10 mg/l is assumed to be comprised of 2 mg/l organic nitrogen, 7 mg/l Nox-N, and 1 mg/l NH3-N.

- The ability to meet the anticipated effluent organic nitrogen concentration is contingent upon the system's ability to hydrolyze the influent organic nitrogen to NH3-N. A certain fraction of the organic nitrogen may be refractory and, therefore, will not be biologically converted.

- In order to meet the required Total Nitrogen limit, strict operator attention will be necessary for process and operational control. It is also required that provisions be made for supplemental carbon source addition in order to facilitate denitrification (by others).

Equipment

- The basin dimensions reported on the design have been assumed based upon the required volumes and assumed basin geometry. Actual basin geometry may be circular, square, rectangular or sloped with construction materials including concrete, steel or earthen.

- Rectangular or sloped basin construction with length to width ratios greater than 1.5:1 may require alterations in the equipment recommendation.

- The basins are not included and shall be provided by others.

- Influent is assumed to enter the reactor above the waterline, located appropriately to avoid proximity to the decanter, splashing or direct discharge in the immediate vicinity of other equipment.

- If the influent is to be located submerged below the waterline, adequate hydraulic capacity shall be made in the headworks to prevent backflow from one reactor to the other during transition of influent.

- A minimum freeboard of 1.4 ft. is recommended for diffused aeration.

- Aqua-Aerobic Systems, Inc. is familiar with various “Buy American” Acts (i.e. AIS, ARRA, Federal FAR 52.225, EXIM Bank, USAid, PA Steel Products Act, etc.). As the project develops Aqua-Aerobic Systems can work with you to ensure full compliance of our goods with various Buy American provisions if they are applicable/required for the project. When applicable, please provide us with the specifics of the project’s “Buy American” provisions.

- Scope of supply includes freight, installation supervision and start-up services.

AquaSBR - Sequencing Batch Reactor - Design Summary

Design#: 148881

Project: WESTHAMPTON BEACH NY

Option: Preliminary Design, revised per 2017.08.02 comments

Designed by Tamera Knapp on Tuesday, August 8, 2017

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 0.15 MGD	= 568 m3/day
Max Design Flow	= 0.15 MGD	= 568 m3/day

DESIGN PARAMETERS

			Effluent			
	Influent	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Bio/Chem Oxygen Demand:	BOD5	350	BOD5	30	BOD5	30
Total Suspended Solids:	TSS	320	TSS	10	TSS	10
Total Kjeldahl Nitrogen:	TKN	65	TKN	3	TKN	3
Ammonia Nitrogen:	--	--	NH3-N	1	NH3-N	1
Oxidized Nitrogen:	--	--	NOx-N	7	NOx-N	7
Total Nitrogen:	--	--	TN	10	TN	10
Total Inorganic Nitrogen:	--	--	TIN	8	TIN	8

SITE CONDITIONS

	Maximum		**Minimum**		**Design**		**Elevation (MSL)**
Ambient Air Temperatures:	85 F	29.4 C	30 F	-1.1 C	85 F	29.4 C	25 ft
Influent Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	50 F	10.0 C	7.6 m

SBR BASIN DESIGN VALUES

			Water Depth			Basin Vol./Basin		
No./Basin Geometry:	= 2 Rectangular Basin(s)		**Min**	= 12.5 ft	= (3.8 m)	**Min**	= 0.081 MG	= (305.3 m³)
Freeboard:	= 1.5 ft	= (0.5 m)	**Avg**	= 14.8 ft	= (4.5 m)	**Avg**	= 0.096 MG	= (362.1 m³)
Length of Basin:	= 36.0 ft	= (11.0 m)	**Max**	= 14.8 ft	= (4.5 m)	**Max**	= 0.096 MG	= (362.1 m³)
Width of Basin:	= 24.0 ft	= (7.3 m)						

Number of Cycles:	= 5 per Day/Basin (advances cycles beyond MDF)	
Cycle Duration:	= 4.8 Hours/Cycle	
Food/Mass (F/M) ratio:	= 0.072 lbs. BOD5/lb. MLSS-Day	
MLSS Concentration:	= 4500 mg/l @ Min. Water Depth	
Hydraulic Retention Time:	= 1.275 Days @ Avg. Water Depth (1.075 Days @ LWL)	
Solids Retention Time:	= 15.0 Days	
Est. Net Sludge Yield:	= 0.892 lbs. WAS/lb. BOD5	
Est. Dry Solids Produced:	= 390.5 lbs. WAS/Day	= (177.1 kg/Day)
Est. Solids Flow Rate:	= 87 GPM (4682 GAL/Day)	= (17.7 m³/Day)
Decant Flow Rate @ MDF:	= 750.0 GPM (as avg. from high to low water level)	= (47.3 l/sec)
LWL to CenterLine Discharge:	= 4.5 ft	= (1.4 m)
Lbs. O2/lb. BOD5	= 1.50	
Lbs. O2/lb. TKN	= 4.60	
Actual Oxygen Required:	= 1031 lbs./Day	= (467.6 kg/Day)
Air Flowrate/Basin:	= 402 SCFM	= (11.4 Sm3/min)
Max. Discharge Pressure:	= 8.0 PSIG	= (55 KPA)
Avg. Power Required:	= 222.4 KW-Hrs/Day	

DESIGN INFLUENT CONDITIONS

Avg. Design Flow	= 0.15 MGD	= 567.8 m^3/day
Max Design Flow	= 0.15 MGD	= 567.8 m^3/day

		Conc. mg/l	Mass lb/day	kg/day
Bio/Chemical Oxygen Demand:	BOD5	350	437.9	198.6
Total Suspended Solids:	TSS	320	400.3	181.6
Total Kjeldahl Nitrogen:	TKN	65	81.3	36.9

SITE CONDITIONS

	Maximum		Minimum		Design	
Ambient Air Temperatures:	85 F	29.4 C	30 F	-1.1 C	85 F	29.4 C
Influent Waste Temperatures:	68 F	20.0 C	50 F	10.0 C	50 F	10.0 C
Elevation (Mean Sea Level):	25 ft	8 m				

EFFLUENT OBJECTIVES

		Conc. mg/l	Mass lb/day	kg/day
Bio/Chemical Oxygen Demand:	BOD5	30	37.5	17.0
Total Suspended Solids:	TSS	10	12.5	5.7
Total Kjeldahl Nitrogen:	TKN	3	3.8	1.7
Ammonia Nitrogen:	NH3-N	1	1.3	0.6
Oxidized Nitrogen:	NOx-N	7	8.8	4.0
Total Nitrogen:	TN	10	12.5	5.7
Total Inorganic Nitrogen:	TIN	8	10.0	4.5

BASIN SIZING CALCULATIONS

1. **Mass of Bio-Solids necessary for treatment (lbs MLSS)**

   Based upon an F/M ratio of 0.072/day, the mass of mixed liquor suspended solids (MLSS) is:

   lb MLSS = (lb BOD5/day) / (F/M) = 6,053.5 lb MLSS = (2,745.8 kg)

2. **Total Reactor Volume at Low Level (Vlwl-T)**

   Based upon an MLSS concentration of 4,500 mg/l measured at the lowest water level, the total React Volume at low water level (Vlwl) is:

   Vlwl-T = lb MLSS/(MLSS mg/l x 8.34 lb/gal) = 0.161 MG-Total = 21,563.7 ft^3-Total = (610.6 m^3-Total)

3. **Reactor Volume for each Basin at Low Level (Vlwl/basin)**

   The AquaSBR shall utilize a 2 reactor system. The resultant unit volume for each reactor at the minimum water depth is:

   Vlwl/basin = (Vlwl-T)/(Number of Reactors) = 0.081 MG/basin = 10,781.9 ft^3/basin = (305.3 m^3/basin)

4. Average Decantable Volume for each basin (ADV)

Each AquaSBR basin shall perform treatment via 5 Cycle(s)/Day with each cycle comprising 288 Minutes (4.8 Hours). At the average daily flow (ADF) of 0.15 MGD, the batch volume at average conditions is:

ADV = ADF/(No. of Basins x No. Cycles/Day/Basin) = 15,000 gal = (56.8 m^3)

5. Reactor Volume per basin at Average Flow Conditions (Vawl/Basin)

Vawl/Basin = Vlwl/Basin + ADV = 0.096 MG/basin = 12,787.2 ft^3/basin = (362.1 m^3/basin)

6. Maximum Decantable Volume for each basin (MDV)

The AquaSBR has been specifically designed to maintain 5 Cycle(s)/Day/Basin up to the Maximum Daily Flow stated above. Based upon the Maximum Daily Flow (MDF) of 0.2 MGD, the batch volume at maximum conditions is:

MDV = MDF/(No. of Basins x No. Cycles/Day/Basin) = 15,000 gal = (56.8 m^3)

7. Reactor Volume per basin at Maximum Flow Conditions (Vhwl/Basin)

The maximum volume of each basin in the AquaSBR system is:

Vhwl/Basin = Vlwl/Basin + MDV = 0.096 MG/basin = 12,787 ft^3/Basin = (362.1 m^3/basin)

8. Minimum Sidewater Depth (Min. SWD)

The minimum sidewater depth (Min. SWD) must allow proper storage of sludge during the settle phase while providing a reasonable maximum water level. Based upon the design MLSS, the lowest operating water level is:

Min. SWD = 12.5 ft = (3.80 m)

9. Selection of reactor geometry and dimensional requirements

The AquaSBR can be configured for a variety of reactor geometries, quantities, and materials of construction. Typical construction may employ circular, square, or rectangular tanks in concrete, steel, or earthen-sloped basins. The following has been either assumed by Aqua or designated based upon supplied information:

Number of Basins (Nb):	= 2	
Selected Reactor Geometry:	= Rectangular	
Length of Reactor:	= 36 ft	= (11 m)
Width of Reactor:	= 24 ft	= (7.3 m)
Minimum Water Depth:	= 12.5 ft	= (3.8 m)
Average Water Depth:	= 14.8 ft	= (4.5 m)
Maximum Water Depth:	= 14.8 ft	= (4.5 m)
Minimum Reactor Volume/Basin:	= 0.081 MG	= (305.310 m^3)
Average Reactor Volume/Basin:	= 0.096 MG	= (362.096 m^3)
Maximum Reactor Volume/Basin:	= 0.096 MG	= (362.096 m^3)

PROCESS CALCULATIONS

Cycle Structure

1. Cycle Configuration

In order to perform the necessary physical and biological treatment for the specified conditions, the following treatment phases shall be used:

A.) Mixed-Fill	- True anoxic mixing, independent of aeration, with influent.
B.) React-Fill	- Aeration/Anoxic mixing with presence of influent.
C.) React	- Aeration/Anoxic mixing under true Batch conditions.
D.) Settle	- Quiescent solids/liquid separation.
E.) Decant/Idle	- Effluent withdrawal via solids excluding, dual control decanter.
F.) Sludge Waste	- Removal of excess biological sludge.

2. Cycle Times

The following process segments have been determined specifically for this application based upon a combination of empirical data and established kinetic models adapted for the AquaSBR. The following summarizes the process conditions:

A.) No. Of Cycles (Ncdb)	= 5	E.) Mixing (Tmix)	= 3.47 Hours/Cycle
B.) Total Cycle Time (Tc)	= 4.8 Hours	F.) Settling (Tset)	= 1 Hours/Cycle
C.) Filling Time/Cycle (Tf)	= 2.4 Hours	G.) Decanting (Tdec)	= 0.33 Hours/Cycle
D.) Aeration (Tair)	= 1.8 Hours/Cycle	H.) Sludge Waste (Tsig)	= 5.4 Minutes/Cycle

Hydraulic Rentention Time (HRT)

1. Hydraulic Retention @Average Design Conditions (HRT-avg)

Based upon an average volume of 0.096 MG/Reactor and 2 reactor(s), the HRT at an average flow of 0.150 MGD is:

HRT-avg = (Vawl/Reactor x # Reactors)/ADF = 1.27 days (30.6 hours)

2. Hydraulic Retention @ Maximum Design Conditions (HRT-mdf)

Based upon a maximum volume of 0.096 MG/Reactor and 2 reactors, the HRT at a maximum flow of 0.150 MGD is:

HRT-mdf = (Vhwl/Reactor x # Reactors)/ADF = 1.27 days (30.6 hours)

Sludge Production

1. Net Sludge Yield (Yn)

Based upon the design MLSS concentration, influent loading, and volume requirements stated above, the AquaSBR shall produce a certain quantity of sludge, as is typical of Activated Sludge Processes. The sludge yield factor, Yn is:

Yn = 0.892 lb Waste Activated Sludge/lb BOD5/Day

Please note that the calculated sludge yield, Yn, was estimated via a kinetic model which accounts for the influent organic and inorganic TSS as well as the developed Active, Endogenous, Inert-Organic, and Inert-Inorganic fractions of the MLSS.

2. Net Sludge Production (lb WAS/Day)

The net sludge production (dry solids basis) is:

lb WAS/Day = lb BOD5/Day x Yn = 390.5 lb WAS/day = (177.1 kg/day)

3. Sludge Volume (Vs)

The volume of sludge produced, assuming a settled sludge concentration of 1.00% is:

Vs = lb WAS/Day/(Sludge Conc. x 8.34) = 4682 gpd = (17.7 m^3/day)

4. Mean Cell Retention Time (Ts)

The mean cell retention time (sludge age, Ts) of the proposed system necessary to attain the specified effluent objectives is:

Ts = lb MLSS/(lb WAS/Day + lb TSSe/Day) = 15.0 days

5. Oxygen Utilization Rates for Synthesis, Oxidation & Nitrification

Based upon a kinetic evaluation of the influent data with respect to the proposed design considerations, the estimated oxygen uptake rate (OUR) at average conditions is 46.6 mg/l/Hour. The process oxygen required is:

OUR lb/Hour = OUR mg/l/Hour x Vawl/Basin x 8.34 = 37.1 lb O2/hr/basin = (16.8 kg/hr/basin)

AERATION SYSTEM EQUIPMENT REQUIREMENTS

Actual Oxygen Requirement (AOR)

1. Oxygen Required For Organic Reduction (Rb)

The aeration system shall be designed to provide 1.50 lb O2 for each lb BOD5, as influent to the SBR system. This oxygen provision shall account for the oxygen utilization for synthesis, as well as endogenous respiration.

Rb = 1.50 lb O2/lb BOD5 x lb BOD5 Applied/Day = 656.9 lb O2/day = (297.9 kg/day)

2. Oxygen Required For Nitrification (Rn)

Additional oxygen may be necessary for Nitrification of TKN to NO3-N. While an effluent requirement may or may not exist, it may be difficult to prevent Nitrification from exerting an oxygen demand (when nitrogen is present in the influent). Nitrification requires 4.60 lb O2 to oxidize each lb of TKN to NO3-N.

Rn = lb O2/lb TKN x lb TKN Applied/Day = 374.0 lb O2/day = (169.6 kg/day)

3. Carbon Stabilized via Denitrification (Rd)

No credits for oxygen recovery via denitrification have been taken (Rd = 0)

4. Total Actual Oxygen Requirement (AORt)

The total oxygen demand under process (field) conditions is:

AORt = Rb + Rn – Rd = 1,030.8 lb O2/day (total) = (467.6 kg/day)

5. Hourly Actual Oxygen Requirement (AORh)

Based on 1.77 hours of aeration per cycle, 5 Cycles/Day/Basin, and 2 Basin(s), the hourly AORh is:

AORh = 58.4 lb O2/hr/basin = (26.5 kg/hr/basin)

6. Actual Aeration Time Required To Meet Average Demand (At)

The aeration system has been designed to meet the design maximum oxygen requirement in 1.77 Hours/Cycle/Basin. Since average conditions will not require as much oxygen, the actual aeration time shall be adjusted to generate a power draw reflective of average conditions. The aeration time required at average conditions is:

At = (OUR/AOR) x Design Aeration/Basin/Cycle = 1.1 hr/basin/Cycle

Process Wastewater Conditions (FINE BUBBLE DIFFUSERS)

1. Field Oxygen Transfer Factor (FTF)

While the AOR quantifies the necessary oxygen to satisfy the biochemical reactions, the process water possesses inherent characteristics that typically inhibit oxygen transfer as it compares to tap (clean) water. The FTF coefficient adjusts the oxygen transfer requirements in Field (dirty) conditions to Standard (clean) water conditions as follows:

FTF = Alpha x Theta^(T-20) x [(Beta x Csm) – Cr]/Cstm = 0.668

Where:

Alpha = Ratio of mass transfer rate of O2 in process water to clean water = 0.85

Beta = Ratio of saturation of O2 in process water to clean water = 0.95

Theta = Temperature correction factor for O2 transfer = 1.024

T = Design Reactor Temperature = 10.0 C

Cstm = Saturation DO at Mid-Depth and Standard Conditions = 10.94 mg/l

Csm = Cstm corrected for site Elevation and Temperature = 13.57 mg/l

Cr = Residual Dissolved Oxygen Concentration = 2.0 mg/l

Standard Conditions

1. Standard Oxygen Requirement (SORh)

The oxygen transferred at Standard conditions necessary to satisfy the required process oxygen demand at Field conditions is:

SORh = AORh / FTF = 87.4 lb O2/hr/basin = (39.6 kg/hr/basin)

2. Standard Cubic Feet of Air per Minute (SCFM)

The ability to transfer oxygen into the water under standardized conditions is:

SCFM = (SOR lb/Hour/Basin)/(60 x 0.0175 x SOTE/ft x Dsub) = 402 SCFM = (11.4 m^3/M)

Where:

0.0175 = lb O2 per cubic foot of air at standard conditions.

SOTE/FT = Standard Oxygen Transfer Efficiency per foot submergence = 1.50%/ft = (4.92%/M)

Dsub= Average Diffuser Submergence = 13.8 ft = (4.2 m)

Blower Inlet Conditions

1. Actual Inlet Pressure (Pa due to elevation and inlet filter/silencer/piping losses)

Note: An assumed inlet loss due to blower fittings/piping of 0.25 psig has been assumed.

Pa = 14.696 – (Elevation, ft/2116.3) – 0.25 = 14.43 P.S.I.A. = (99.60 KPA)

2. Blower Inlet Air Temperature in Degrees Rankine

Ta = Ambient Air Temp (Deg F) + 460 = 545.0 Degrees R = (302.4 K)

3. Inlet Cubic Feet of Air per Minute (ICFM)

From the perfect gas law, the universal gas constant (MR) can relate standard conditions to inlet conditions, as:

ICFM = SCFM x (14.696 x Ta)/(Pa x 528) = 422.5 ICFM/basin = (11.9 m^3/basin)

Blower Discharge Conditions

1. Discharge Pressure (Pd)

The discharge pressure includes the static pressure above the diffusers and dynamic losses from the blower discharge through the diffusers, as expressed by:

Pd = (0.4333 x Diffuser Submergence, ft) + System Losses, PSIG, Where the assumed system losses account for 0.20 PSIG blower discharge losses, 0.50 PSIG piping losses from blower to diffuser, and 1.30 PSIG diffuser losses.

Average Discharge Pressure (Pda) = 7.98 PSIG = (55.06 KPA)
Maximum Discharge Pressure (Pdm) = 7.98 PSIG = (55.06 KPA)

Average Blower Power Estimate

1. Estimated Average Power Draw (BHP)

The following is a general equation that estimates the power draw of the blower at the average oxygen demand and average pressure. While the actual blower selection shall be made from manufacturer supplied curves, programs, or recommendations at maximum conditions, this equation shall be used to estimate the annual average aeration power. Unless stated otherwise, a blower efficiency (e) of 0.70 shall be used (typical range 0.60 to 0.70).

BHP = 0.227 x ICFM x [((Pa + Pda)/Pa)^0.283 – 1]/e = 17.9 BHP = (13.4 kW)

2. Estimated Daily Power Required for Blowers (Pwa)

Pwa = (BHP x 0.7457 x At x Ncdb x Nb) = 150.7 kW-hr/day

Blower Selection

1. Blower Recommendation

The actual blower and motor sizing must consider inlet conditions under operating temperature and pressure extremes. Motor size, for example, must be selected to handle inlet air at maximum density, which occurs at lowest operating temperatures. Blower size must be selected to deliver the required air volume at minimum density (maximum operating temperature) throughout the range of pressures. The following has been recommended to meet the design extremes:

Number of Blowers Operating/Basin:	= 1	
Number of Total Blower Operating:	= 2	
Number of Standby Units:	= 1	
Total Number of Installed Units:	= 3	
Motor Size of Each Blower:	= 30 HP	
Airflow Capacity of Each Blower:	= 402 SCFM	= 11.4 m^3/min
Maximum Design Discharge Pressure:	= 8.0 PSIG	= 55.1 KPA

MIXING SYSTEM EQUIPMENT REQUIREMENTS

1. **Energy Requirements (Hp-mix)**

   To provide uniform mixing of biological solids to a level typically encountered in activated sludge, approximately 25.0 HP/MG is necessary with the AquaDDM mixer. The mixing level required is:

   Hp-mix = 25.0 HP/MG x Vawl/Basin = 2.4 HP = (1.8 kW)

   Based upon the above approximate energy requirements, recommend: (1) - 3.0 NPHP AquaDDM Mixer(s)

2. **Reactor Turnover Time (Tm)**

   To confirm the unit has been selected appropriately, the reactor contents must be completely mixed within 5 minutes. The selected mixer shall produce a recirculated flow (Qr) of 117,000 GPM, resulting in a turnover time:

   Tm = Vawl/Basin x 10^6/Qr = 0.8 Minutes

3. **Average Power Estimation (Pwm)**

   Pwm = NPHP x Lm x 0.7457 x Mixing hrs/cyc. x Nb x Ncdb = 71.3 kW-hr/day

   Where:

   Lm is the motor loading, typically 88-92% of full nameplate horsepower.

EFFLUENT DECANTING EQUIPMENT REQUIREMENTS

1. **Decant Flow Rate Required at Maximum Design Flow (Qdec)**

   The decanter shall remove effluent via gravity flow, reducing the water level from the maximum depth to the minimum depth in the design decant phase time (Tdec). The Decant flow required is:

   Qdec = MDV/(Ncdb x Nb x Tdec) = 750 GPM = (47.3 l/sec)

   The flow rate calculated above is the average rate (from high water level to low water level) at maximum design conditions. The actual decant flow rate will vary depending on the prevailing driving head, assuming the effluent valves are not throttled, flow is not pumped, or an orifice plate has not been employed. Refer to design notes for further decanter notes.

SLUDGE REMOVAL SYSTEM REQUIREMENTS

1. **Sludge Flow Rate required at Average Design Flow (ADF)**

   Sludge Flow Rate (Qs):

   Sludge will be removed at the end of each cycle at the following rate:

   Qs = Vs/(Ncdb x Nb x Tslg) = 87 GPM = (5.5 l/sec)

2. **Sludge Energy Required (Hp-sludge)**

   Based upon an estimated average driving head of 15.0 ft and an assumed pump efficiency of 60%, the sludge removal energy required is:

   Hp-sludge = (Flowrate x head)/(3,960 x efficiency) = 0.549 BHP = (0.41 kW)

3. **Average Power Estimation (Pws)**

   Pws = BHP x Tslg x Ncdb x Nb x 0.7457 = 0.367 kW-hr/day

   Note: Power estimation assumes sludge is pumped. Refer to design notes for discussion if gravity sludge wasting is employed.

Sludge Holding Basin - Design Summary

Design#: 148881

WESTHAMPTON BEACH NY / ProjectID: 105385B

Option: Preliminary Design, revised per 2017.08.02 comments

Designed By Tamera Knapp on Tuesday, August 8, 2017

SLUDGE HOLDING BASIN DESIGN PARAMETERS

Sludge Flowrate to the Digester	= 4,683.5 gal/day	= (17.7 m³/day)
Inlet Sludge Concentration	= 1.00%	
Solids Loading to the Digester	= 390.6 lb/day	= (177.2 kg/day)
Inlet Volatile Solids Fraction	= 75.7%	

SLUDGE HOLDING BASIN DESIGN VALUES

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 12 ft	= (3.6 m)			
Width of Basin:	= 18 ft	= (5.5 m)			
Min. Water Depth:	= 10.3 ft	= (3.1 m)	**Min. Basin Vol. Basin:**	= 16,641.5 gal	= (61.4 m³)
Max. Water Depth:	= 14.8 ft	= (4.5 m)	**Max. Basin Vol. Basin:**	= 23,831.3 gal	= (89.1 m³)

No./Basin Geometry:	= 1 Rectangular Basin(s)				
Length of Basin:	= 22.75 ft	= (6.9 m)			
Width of Basin:	= 18 ft	= (5.5 m)			
Min. Water Depth:	= 10.3 ft	= (3.1 m)	**Min. Basin Vol. Basin:**	= 31,549.5 gal	= (117.6 m³)
Max. Water Depth:	= 14.8 ft	= (4.5 m)	**Max. Basin Vol. Basin:**	= 45,180.4 gal	= (170.8 m³)

SLUDGE HOLDING PROCESS DESIGN PARAMETERS

Solids Retention Time:	= 29.6 days	
Digester Design Temperature:	= 10 C	
Volatile Solids Destruction:	= 41.3%	
Digester Solids Concentration:	= 2%	
Oxygen Supplied for Digestion:	= 2.00 lbs O2 per lb VSS Destroyed	
Oxygen Distribution Per Basin:	= 100.0%	
Actual Oxygen Required:	= 244.2 lb/day	= (110.8 kg/day)
Volatile Percentage After Digestion:	= 64.6%	
Estimated Dry Solids to be Removed:	= 268.5 lb/day	= (121.8 kg/day)
Volume of Solids to be Removed:	= 1,609.6 gal/day	= (6.09 m³/day)
Estimated Supernatant Volume:	= 20,586.5 gal/basin	= (77.93 m³/basin)
Assumed Supernatant Duration:	= 180 minutes	
Calculated Supernatant Flow:	= 114.4 gpm	= (7.2 l/sec)

1. The Volatile Solids Destruction listed above shall be used for determination of the oxygen demand during summer conditions. It should be noted that the actual VSS destruction will be dependant upon digester inlet condition, temperature, and operating conditions.
2. The Digester Solids Concentration is reflected as an average concentration, assuming the operations include frequent settling and supernating practices.

AquaSBR

Influent Valves

2 Existing Influent Valve(s) will be used as follows:

- 6 inch electrically operated valve(s).

Mixers

2 AquaDDM Direct Drive Mixer(s) will be provided as follows:

- 3 HP Aqua-Aerobic Systems Endura Series Model FSS DDM Mixer(s).
- Unit will be factory wet tested and checked for vibration not to exceed: 5.0 mils for 900 RPM units, 4.0 mils for 1200 RPM units, or 3.0 mils for 1800 RPM units.

Mixer Mooring

2 Mixer cable mooring system(s) consisting of:

- #12 AWG-four conductor electrical service cable(s).
- Aerial support tie(s).
- Electrical cable strain relief grip(s), 2 eye, wire mesh.
- 304 stainless steel mooring cable(s).
- Maintenance mooring cable loop(s).
- Stainless steel mooring spring(s).

Decanters

2 Decanter Assembly(ies) consisting of:

- 6x4 Aqua-Aerobics decanter(s) with fiberglass float, 304 stainless steel weir, 304 stainless steel restrained mooring frame, and painted steel power section with #14-10 conductor power cable.
- 8 inch diameter decant hose assembly.
- 4" schedule 40 304 stainless steel restrained mooring post(s) with base plate.
- 8 inch DeZurik electrically operated butterfly valve(s) with Limitorque actuator.

2 Valve Extension(s) will be provided as follows:

- Valve extension(s) stainless steel.

Transfer Pumps/Valves

2 Existing pump assembly(ies) will be reused:

- Existing Pump(s) and accessories.

Retrievable Fine Bubble Diffusers

4 Retrievable Fine Bubble Diffuser Assembly(ies) consisting of:

- 20 diffuser tubes consisting of two flexible EPDM porous membrane sheaths mounted on a rigid support pipe with 304 stainless steel band clamps.
- 304 stainless steel manifold weldment.
- 304 stainless steel leveling angles.
- 304 stainless steel leveling studs.
- 304 stainless steel vertical support beam.
- 304 stainless steel vertical air column assembly.
- Galvanized upper vertical beam and pulley assembly.

- Galvanized top support bracket.
- 3" EPDM flexible air line with ny-glass quick disconnect end fittings.
- Galvanized threaded flange.
- 3" manual isolation butterfly valve with cast iron body, EPDM seat, aluminum bronze disk and one-piece steel shaft.
- Ny-glass quick disconnect cam lock adapter.
- 304 stainless steel adhesive anchors.
- Brace angles.

1 Diffuser Electric Winch(es) will be provided as follows:

- Portable electric winch.

<u>Positive Displacement Blowers</u>

3 Positive Displacement Blower Package(s), with each package consisting of:

- Aerzen 30HP Rotary Positive Displacement Blower(s).
- 6" manual butterfly valve(s).

<u>Misc/Spare Parts</u>

1 Set(s), Spare Parts will be provided as follows:

- (1) Decanter linear actuator.
- (1) Decanter linear actuator capacitor.
- Limit switch(es).
- (1) Limit switch arm.
- Input card(s)
- Output card(s).
- Analog input card(s).
- Analog output card(s).
- (40) Diffuser sleeve(s).
- Hose clamp(s).
- (1) Diffuser clamp installation tool.
- 6 inch Inlet Filter(s)
- Set(s), 30 HP Blower V-Belts.
- Spare fuses
- Lens spares consisting of (3) amber, (3) red, (3) yellow, (3) green, (3) blue, and (3) white.
- Level sensing pressure transducer(s).
- Selector switch(es).
- Tube(s) grease.
- Blower synthetic lubricant supply(ies) for one year
- Pump seal leak relay(s).
- Operator interface.
- Power supply(s).
- Allen Bradley Compactlogix programmable controller.
- Control relay(s).
- One (1) gallon Series N69 Hi-Build Epoxoline paint.
- DO probe(s).

1 Set of Equipment Tags consisting of the following:

- Equipment tags.

<u>Controls</u>

Controls wo/Starters

1 Controls Package(s) will be provided as follows:

- NEMA 12 panel enclosure suitable for indoor installation and constructed of painted steel.
- Fuse(s) and fuse block(s).
- Transient eliminator TE/110.
- Uninterupted power supply.
- Allen Bradley Compactlogix programmable controller.
- Operator interface.
- Selector switch(es).
- Push-To-Test pilot light(s).
- Alarm horn and silence button.
- Internal control panel light.
- Chart recorder(s).
- Remote Access Ethernet Modem.
- Panel will be UL listed and labeled.