November 14, 2017

Mr. Steven J. Richtarik, PE
BETA
6 Blackstone Valley Place, Suite 101
Lincoln, RI 02865

Re: Taunton WWTP Energy Audit

Dear Steve,

BETA requested that TNZ perform energy audits of the City of Taunton's wastewater treatment plant (WWTP) and Department of Public Works (DPW) complex on Ingell Street to support grant proposal activity. This report focuses on the treatment plant and is intended to inform upgrades to non-process equipment; JK Muir is reviewing process systems. The identified upgrades can potentially be implemented in the near term or as part of the comprehensive plant upgrade that is currently in the middle stage of design. Lighting has been evaluated by SourceOne, a Veolia subsidiary, and will be upgraded soon through a DEP grant. The report does not provide detailed information on lighting systems but does recommend additional controls in the event that the Source One survey only focused on fixture replacements. Potential upgrades are enumerated in the sections that follow.

TNZ is grateful for the assistance of Jonathan Mongie, David Salvador, and Maribeth Barnes of Veolia and Sonja Britland of TLMP for their assistance with this review effort.

Plant Description

The Taunton wastewater collection system has been constructed over the past 100 years and currently has over 150 miles of pipe and 20 pump stations. The system serves 13,000 households in Taunton, 4,120 in Raynham, 560 in Dighton, and 40 in Norton as wells as the Myles Standish Industrial Park. Infiltration and inflow (I&I) can be quite high due to the age of the collection system and the intentional use of combined sanitary and storm sewers. The City has been working to reduce I&I over the years and also requires industrial pre-treatment. Metal finishing operations and semiconductor manufacturing has imparted elevated metal removal loads, particularly copper.[1]

The Taunton Wastewater Plant was originally constructed in the mid-1940s, and portions of the original plant buildings are still in use as part of the administration building. A significant upgrade and expansion was undertaken in the 1970s to bring the system into compliance with the Clean Water Act. The current plant architecture was established at that time: flow enters at the headworks, undergoes primary treatment, then is split 67%/33% between two secondary treatment trains, and is combined for disinfection and discharge. Each train includes two original covered aeration basins, an open aeration basin (added in 2004), and two clarifiers. The secondary treatment system had used pure oxygen prior to the most recent upgrade in 2004. This was replaced by a fine bubble system served by two centrifugal blowers housed in an aeration building. The layout of the plant structures is illustrated in Figure 1 below.

Veolia North America operates the plant for the City of Taunton, and is responsible for the cost of all utilities. Upgrades are paid for by the City. The site receives electricity from Taunton Municipal Lighting Plant (TMLP) at an average annual rate of $0.1034 per kWh. This cost is approximately 75% of the typical rate paid by commercial customers served by the investor-owned utilities in eastern Massachusetts and Rhode Island. Demand charges represent 28% of electricity costs and are assessed for an 11-month period based on the peak 15-minute average kVA demand during the months of June, July, and August.

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[1] EPDS Permit No. MA0100897 dated 2013, accessed online.

Most plant heating is provided by electric resistance heat and No. 2 heating oil. Natural gas service (Columbia Gas of Massachusetts) can potentially be extended to the plant as part of the upgrade. The nearest connection is several hundred feet from the plant main entrance at the animal control facility.

TMLP does not pay into the state-wide systems benefits charge and as a consequence its customers cannot receive electric efficiency incentives through Mass Save. TMLP does not have its own efficiency incentive program. If the plant converts from oil and electric heat to natural gas, some components of the plant upgrade can potentially receive incentives.

Figure 1
Plant Layout & Building Identification

General Recommendations

The following recommendations apply to all structures:

1. The use of automatic bi-level switching is recommended in all circulation and process spaces provided that this automatic control does not pose a safety hazard. The project's lighting designer will need to determine the appropriate illumination levels for occupied and unoccupied states. Control is likely to be most easily implemented via light fixtures with integral sensors. Ideally, fixture power would be reduced by ≥50%. Equipment noise, heat, and vibration could impact sensor accuracy and the presence of sulfur compounds in the general air could reduce fixture and sensor life if vapor-tight equipment is not specified.
2. Most process spaces are to be heated to prevent freezing risk and provide a comfortable work condition for operators. Heating energy use and cost can be minimized via the following strategies:
   a. Connecting the plant to natural gas service may allow the heating systems in moderate to highly ventilated process buildings to use direct-fired furnaces. This strategy would not be acceptable in spaces designed to be explosion proof such as the headworks. When weighing the first-cost impacts of connecting to natural gas, the avoided cost of new/refurbished oil-fired hydronic systems should be taken into consideration.
   b. Consider the use of gas-fired infrared heaters in spaces with adequate ceiling height and continuous ventilation. Makeup air can be heated to ≤40°F and the radiant systems can control to a space

temperature of 50°F. Occupants will experience the space as warmer than the sensible temperature due to radiant heat emanating from the floor and other surfaces within a direct line of the radiant source.

c. Space temperature setpoints in spaces with exposed process piping or subgrade spaces should not be set higher than the water or ground temperature. Temporary operator space temperature overrides can be monitored and more reliably returned to typical setback values if space temperature is controlled via the plant SCADA system. Zone controls can be limited to a temperature probe and an override button.

d. For process spaces where intermittent ventilation is acceptable, limit the ventilation system run time via occupancy sensors or cycling control.

3. Nearly all doors in the facility appear to require replacement. Durable weather stripping and insulated swing and overhead door units that meet or exceed current code requirements are recommended. Energy savings will be greatest in spaces that are not heavily ventilated or spaces where ventilation is intermittent.
4. It is assumed that many roofs will be replaced as part of the upgrade. Raising insulation thickness to meet current code requirements will save the most energy in zones with low ventilation rates and non-radiant heating sources.

Site Utilities

The primary energy-consuming site utilities are exterior lighting and plant water. Most of the plant is illuminated by high pole lighting that has recently been upgraded to LED. Numerous metal halide wall packs and driveway lighting at the west end of the plant have yet to be upgraded to LED. It is assumed that the remaining site lighting upgrades will be covered as part of the current DEP grant supported retrofit studied by SourceOne.

Plant water systems are likely to be reconfigured as part of the plant upgrade, and it is assumed that JK Muir will be commenting on this.

The west end of the plant is equipped with an odor control system that originally treated air from the solids building, headworks, and sludge gravity thickening tanks. This system is reported to have not functioned for many years. The plant upgrade may replace this system with a biofilter.

5. TNZ recommends that the future odor control fan be controlled by a VFD operating in response to a discharge static pressure sensor or airflow station. The airflow resistance of biofilters increases as the fill ages and breaks down, and fan speed will need to increase over time to maintain the same air capture at the pickup points.

Headworks Building

The headworks building is currently not actively ventilated and is maintained at 50°F using electric resistance heat. This space should be ventilated per NEWPCC TR-16 and this will be addressed as part of the plant upgrade. While the building is poorly sealed, electricity use will increase significantly if active ventilation is introduced.

6. TNZ recommends the use of an explosion-proof gas-fired heating source. Assuming the building footprint is 30 ft x 40 ft and 16 ft tall, the ventilation rate would be 3,840 cfm at 12 air changes per hour (12 ACH). There was an average of 2,486 heating degree days (base 50°F) over the past three years. Heating the building to 50°F with electric resistance heat would cost around $7,500 per year at $0.1034/kWh. An 80% efficient gas-fired heating system would cost $3,000 per year to operate ($0.997/therm). Natural gas would allow the cost to be reduced by 59% ($4,400).
7. A potential option for this building is to use a heat pipe to capture heat from the exhaust air stream. While a heat pipe can achieve up to around 65% recovery, the effectiveness is offset by flow imbalances required to

maintain the enclosure at a negative pressure relative to ambient. We only recommend that heat recovery be considered if electric resistance heat is planned to be used and only if a bypass around the heat exchangers is provided. The additional maintenance required for routine filter changes and heat exchanger cleaning as well as the fan energy penalties offset some of the operational benefits.

As a highly ventilated building with open water, there is not much of a reason to significantly improve the thermal performance of the headworks enclosure beyond what is required by code.

Pipe Gallery & Administration Building

The administration building and pipe gallery share a common heating system and are jointed together. Portions of the original 1940s building were retained during the 1970s plant expansion. The administration portion has two levels with ground level access of the upper level on the west side and ground level access of the lower level on the east side.

The heating plant consists of a single 3,500 kBtu/h oil-fired boiler serving two distribution loops.

- The larger loop has two 3-hp pumps and serves the pipe gallery and original portion of the administration building. Cast iron radiators and unit heaters are poorly controlled and plant staff turn the circulation pumps on/off depending on whether the regularly occupied spaces feel hot or cold. The pipe gallery heating is at the mercy of whether the circulation pumps are active but plant operators report that temperatures are generally stable and acceptable.
- The second hot water distribution loop serves the 1970s building expansion and has two ½-hp circulation pumps. The system has not operated in many years and space heating is provided by the heating section in an air handling unit (electric coil?) and electric space heaters.

Cooling in the administration building is provided by window air conditioners. The cooling section of the AHU has not worked for many years.

The building envelope is uninsulated masonry walls, extensive double-pane curtainwall, and nominally insulated ballasted flat roof. Sealant around the window units are failing and have been repaired with various types of mastic. The large window surfaces are likely to allow ample free solar heat during winter days with the associated summer cooling penalty. TNZ estimates that the administration building envelope has an above-grade average thermal resistance of around R-3 and is probably losing 3 to 4 times more heat than a new code-compliant building having the same fenestration area would lose.

TNZ recommends the following improvements to the administration building systems:

8. Glazing systems can be upgraded to current code standards to address occupant comfort and water intrusion issues as well as save energy. This upgrade is unlikely to be justified on the basis of energy savings alone. If window units are being replaced, TNZ suggests decreasing the window area to a size that better balances natural light, occupant comfort, and energy loss. For example, filling in the lower 3 feet of openings where floor-to-ceiling glass is not helpful and possibly reducing the header height by ~2 feet would result in a 4-foot high window in a 9-foot high space. This approach may be less expensive overall than a straight 1:1 replacement of the existing windows but would cost more than a repair to stabilize deterioration of the existing window units.
9. It is assumed that the existing air handling unit serving the administration building will be replaced with a high-performance unit containing inverter-driven compressors and controls capable of all code-required sequences of operation.
10. If the existing hydronic systems are retained, the central plant should be overhauled entirely and all terminal units should be equipped with 2-way modulating control valves.

a. Pump systems and piping in the boiler room should be replaced as needed to support a variable-primary hot water design. A single pair of VFD-controlled pumps should replace the existing two pairs of secondary pumps. The overhaul of the pumping system will save more than just electricity used to drive pumps since it will eliminate or significantly reduce the use of electric space heaters. This heating load will be placed on the main heating plant.

b. If the plant does not connect to natural gas, it is assumed that the existing boiler will be retained or that it will be replaced with a similar boiler having a high efficiency burner. No particular modifications to the zone systems would be required. We recommend that hot water reset be implemented to ensure stable 2-way valve control.

c. If the plant connects to natural gas, the existing boiler should be replaced by two gas-fired boilers capable of condensing operation.

    i. Zone convection elements, cast iron radiators, and unit heaters will need to be able to provide adequate heat at reduced supply temperatures. The efficiency improvements associated with condensing boilers are only achieved if the return hot water temperature is colder than 130°F.

    ii. TNZ suggests designing the system around a peak supply temperature of 140°F to 150°F and a temperature differential of 20°F.

    iii. Supply temperature would be reset in response to ambient drybulb temperature using the following reset schedule: 140°F supply at temperatures colder than 20°F, ramping down to 120°F at ambient temperatures warmer than 60°F. The hot water reset sequence helps to maintain stable 2-way valve control at low loads and enhances the performance of the condensing boiler.

    iv. The energy savings associated with condensing boilers could reduce fuel consumption on a Btu basis by 40% through improved thermal efficiency and reduced cycling losses. It is difficult to estimate the actual savings since it is unclear how much oil is used by the system per year and it is unclear how much electricity is used by the admin building.

11. It is possible to achieve fairly reliable operation through stand-alone controls and the AHU and boiler system. However, we recommend a digital energy management system since good energy performance is more likely to be maintained through centralized control.

12. Domestic hot water is generated by an 85-gallon electric resistance storage type heater (12 kW input) located in the boiler room. Pipe insulation is missing or in poor repair in the vicinity of the heater.

    a. If gas service is extended to the plant, we recommend replacing the electric resistance unit with a condensing gas-fired water heater.

    b. DHW piping insulation should be repaired.

    c. Plant personnel report that it takes a long time for hot water to reach faucets, and it appears that the recirculation pump has been turned off or it has failed. Not using the pump saves energy but wastes water. We recommend that the pump be reactivated or replaced, and that its operation be placed under the control of the facility energy management system. The pump can then be scheduled off when nobody is likely to be in the buildings.

13. We have not seen the lighting study and it is unclear if lighting controls are to be included.

    a. Per the general recommendations, occupancy-based bi-level switching could potentially be installed in corridors, stair ways, and the pipe gallery.

b. Vacancy/occupancy sensors are recommended for the labs, office spaces, storage rooms, and other locations where automatic control is acceptable. This is a code requirement for new construction but it is unclear how the Taunton building inspector will classify the work at the plant.

c. There is a large degree of natural light in the eastern half of the pipe gallery, and we recommend the use of automatic daylight dimming controls to reduce lighting operating hours.

Pump Houses No. 1 & No. 2

These structures were constructed in the 1970s plant expansion and contain the return activated sludge (RAS) pumps for the two secondary aeration batteries/treatment trains. The pumps and motors are located on the subgrade level while electrical gear is located on the ground level. The plant's emergency generators are located on the ground level of Pump House No. 1. The buildings are heated by electric resistance unit heaters that maintain a space temperature of 60°F on the ground level. The original exhaust fans have not been operated for many years, and the upgrade is likely to reactivate ventilation per TR-16. We recommend considering the following:

14. Implement ventilation controls that cycle ventilation on/off or high/low based on feedback from occupancy sensors. The building is checked several times per day by the operators but is generally unoccupied.
15. Refer to the general recommendation regarding lighting controls.
16. We suggest heating the building with natural gas since it costs significantly less than electricity on a Btu basis. A heating and ventilating unit with gas-fired furnace could provide all heating needs or it could operate in conjunction with indirectly fired infrared heaters (provided adequate clearance is available). If intermittent ventilation is acceptable and only an H&V unit is installed, then recirculation capability may be warranted.
17. Refer to the general recommendations regarding SCADA control of HVAC equipment and door replacement.

Aeration Building

This building was constructed as part of the 2004 conversion from pure oxygen to fine bubble diffusion. The main room is reported to be heated by waste heat from the operating blowers. The plant electricians use a small room in the building as their storage space, and it is heated by electric resistance heaters to 60°F. We recommend considering the following:

18. Refer to the general recommendation regarding SCADA control of HVAC equipment, door replacement, and automatic lighting controls.
19. Consider circulating blower room hot air through the electrician closet as the first stage of heating. This would require a fan, two automatic dampers, and control logic.

Chemical Building

This building appears to have been built in the 1970s and originally housed material and equipment for chlorine gas disinfection, dechlorination chemicals, and lime for pH adjustment. The lime and dechlorination systems continue to be used but chlorine has been replaced by hypochlorite. The original oil-fired heating system failed during a flood and a limited number of rooms are heated (electric resistance unit heaters). We recommend the following:

20. In the near term, the thermostats controlling electric unit heaters should be checked and replaced as needed. This will be a low-cost, fast-payback correction given the amount of money that can be wasted through an electric resistance coil. We observed that the heater in the plant water room was operating despite reading a temperature that was higher than the setpoint.
21. The far eastern end of the plant where the chemical building is located is in a federal flood zone AE (13 ft elevation) with a 0.2% annual chance of flooding. With increased precipitation potential with climate change, the designers may not want to install a heating system that is prone to flood damage. A gas-fired

system would offer the lowest operating cost; space heaters and/or rooftop units with heat recovery are options. Continued use of electric resistance heat is not recommended due to operating cost implications.

22. Other plants have been retrofitting bisulfite room HVAC systems to use wheel-based heat recovery units. The required ventilation rate for this type of chemical storage room and need to maintain space temperatures above ~65°F make this a cost-effective design upgrade. Payback period is reduced by rising fuel costs, so the benefit of heat recovery is greater if the building continues to be electrically heated. Heat recovery is still cost effective even with gas heat.
23. Refer to the general recommendation regarding SCADA control of HVAC equipment, door replacement, and automatic lighting controls.

Solids Building

The solids building houses primary sludge pumping equipment, sludge dewatering centrifuges, and waste sludge pumping systems. The building is currently heated by an oil-fired hot water system with constant volume pumping and is only ventilated when air-side heating systems are active during winter months. We recommend the following:

24. It seems likely that the plant upgrade will replace the existing odor control system, and that makeup air will be provided by new heating and ventilation units.
    a. This arrangement can potentially be equipped with a glycol based heat recovery system but the benefits are likely to be limited relative to the installation cost and on-going maintenance requirements.
    b. Use of gas-fired furnaces may have the lowest installation cost and ongoing operating costs. Direct-fired furnaces may be an option if the ventilation rates are adequate to dissipate combustion gases during cold weather operation. At 100% efficiency, direct-fired systems are the most efficient gas-fired heating option.
    c. Additional heating capacity can be provided by radiant tube heaters. These systems are ideal for highly ventilated spaces where physical comfort can be achieved while maintaining lower than normal space temperatures. Clearances need to be maintained relative to equipment and vehicles, so this would be very good for the high-bay spaces but not for the solids garage.
    d. The corrosive nature of the return air suggests that air-side system should be 100% outside air and/or internal components should be resistant to long-term exposure.
25. See the general recommendations regarding lighting controls and doors.
26. The envelop of the solids building appears to be uninsulated and fairly leaky from the standpoint of air sealing. Regularly occupied spaces heated to warmer than 50°F should be isolated from semi-conditioned, ventilated process spaces by insulated doors with seals.

Sampling Sheds

The site has at least four small sampling sheds that house influent and effluent sampling equipment and defoaming dosing equipment. TNZ did not review these in detail but it is reported that they are electrically heated and uninsulated. We recommend the following:

27. Replace the sampling sheds with insulated enclosures.
28. Electric resistance heat seems likely to continue to be used but the cost of heating can be reduced through centralized temperature control via the SCADA.

Historical Energy Use Patterns

This section provides an overview of historical energy use patterns for the facility for the 12-month period September, 2016 through August, 2017. Electricity consumption is taken from monthly billing data, electricity demand is taken from TMLP 15-minute pulse data, and oil consumption is based on the site's reported single delivery for the year and the starting and ending stored volume. Figure 2 below provides a summary of energy use, assumed rates, and the breakdown of energy costs by source.

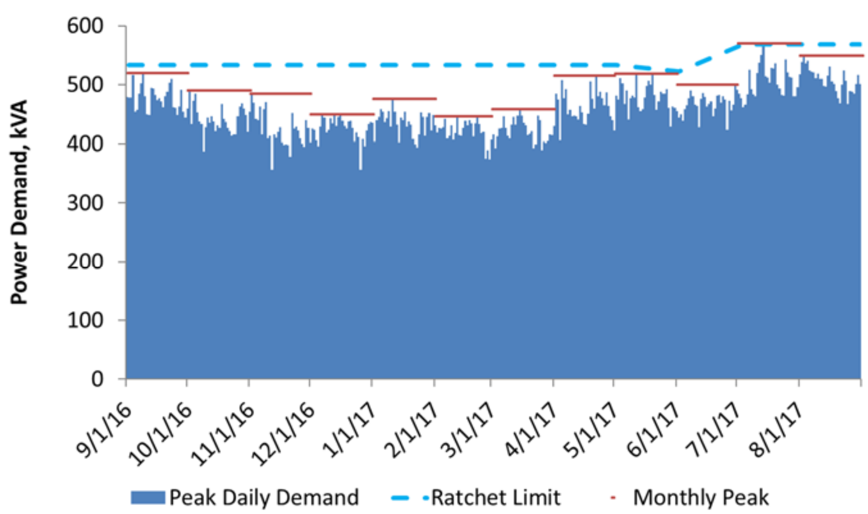
Figure 2
Energy Use Summary

Energy Type	Consumption			Avg	Annual	% of
	Type	Use	Units	$/Unit	Cost	Total Cost
Electricity	Energy	3,306,600	kWh	$0.0710	$234,789	62%
	Demand	537.9	kVA	$14.79	$95,466	25%
	Customer	12	months	$959.90	$11,519	3%
	Total				$341,774	91%
No. 2 Oil	Volume	13,652	gallons	$2.55	$34,811	9%
Annual Cost					$376,585	100%

Electricity rates are based on current TMLP Rate 31, oil rate is estimated by TNZ

TMLP assigns demand charges using a ratchet based on the greater of 1) the highest monthly 15-minute average kVA reading or 2) the peak kVA logged during June, July, and August of the previous summer (the ratchet summer reference resets at June of the current year). Figure 3 below illustrates the peak daily power demand for each month in the analysis period, the peak monthly kVA, and the billing basis for the demand charge. This information is being presented since upgrades to the plant that reduce base load energy consumption will likely reduce the demand charge basis. Lighting and aeration system upgrades are likely to have the greatest impacts.

Figure 3
Daily Peak Demand, Monthly Peak Demand, and Demand Charge Basis



As shown in Figure 4 below, the peak demand of 570 kVA is the highest reading relative to a typical maximum of around 500 kVA. There are only 17 hours per year that power demand exceeds 520 kVA and 88 hours with a demand greater than 500 kVA. If this peak can be avoided, demand charges can be reduced for the entire year. Figure 5 presents the power demand profile for the day the peak occurred during the analysis period. July 14 was a cool, dry day with an ambient temperature of 65°F at 2 PM according to the National Weather Service site in Taunton. It is likely that the combination of routine plant operation, elevated aeration requirements to warm process temperatures, possibly suboptimal aeration control, and operation of sludge dewatering equipment led to the peak. Given that dewatering can be shifted to other times of the day, this may be one of the most significant demand control strategies that Veolia could pursue. If the peak summer demand can be reduced by 70 kVA, the annual savings would be worth 70 kVA * $14.79/kVA * 12 months = $12,424, or roughly 3.6% of historical annual electricity costs.

Figure 4
Demand Duration Curve

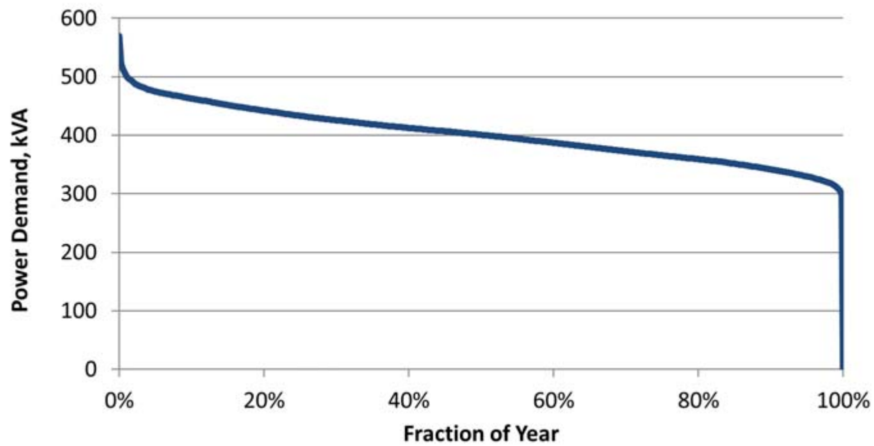
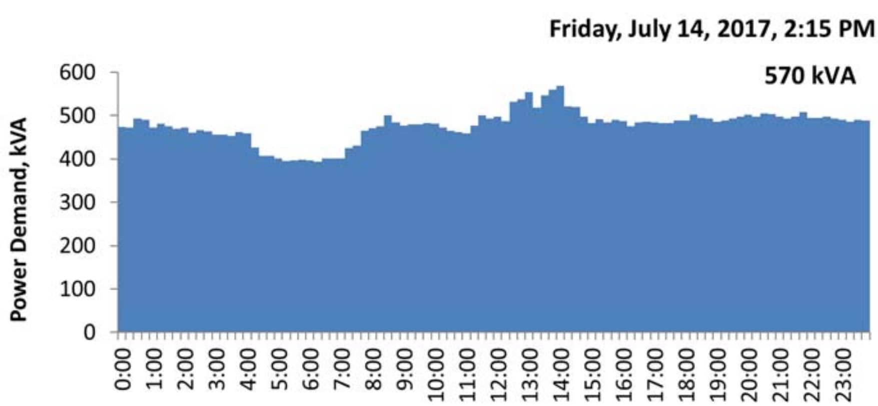


Figure 5
Peak Demand Day



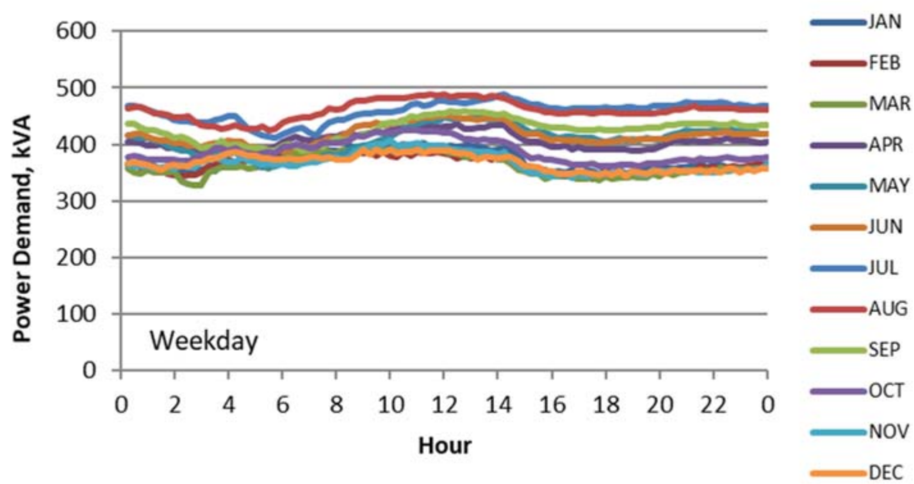
The attached Time of Day analysis provides a heat map illustrating the distribution of average 15-minute kVA data for the analysis period year. Our observations are as follows:

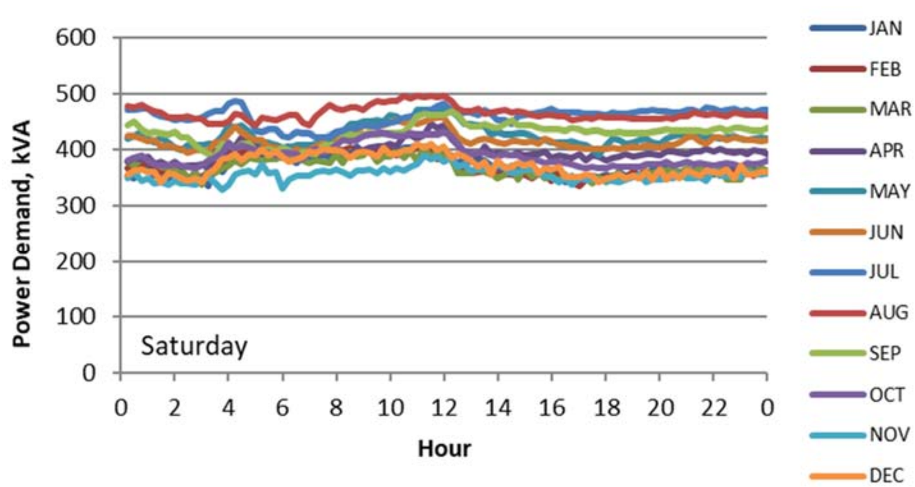
- The impact of permit seasons and the associated blower operation is readily apparent. The summer BOD season extends is May through October while Ammonia-Nitrogen removal has a summer season extending from June through September.
- Plant demand increases significantly in July and August and this appears to be due to treatment system dynamics rather than changes to treatment targets. TNZ suspects that the constant speed base load blower is active during these two months. Operation of a variable speed centrifugal blower in concert with a full speed blower is likely to lead to poor blower control given the need to balance discharge pressures.

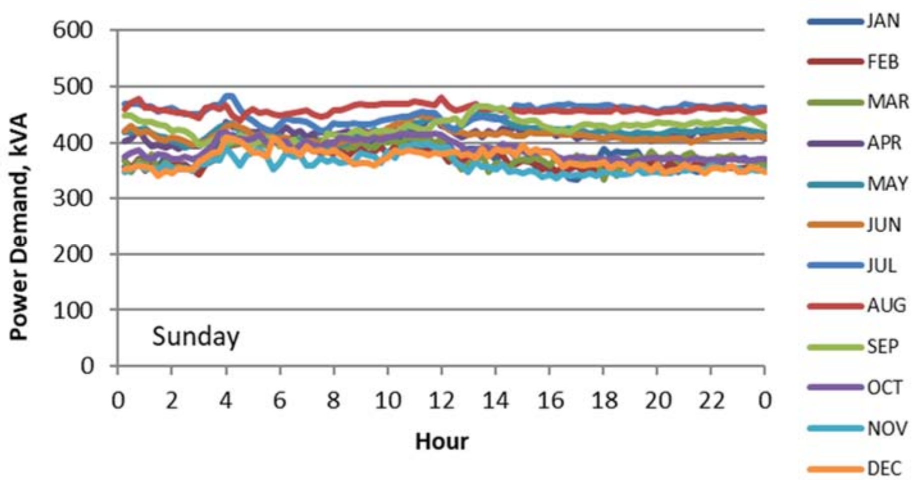
- While electric resistance heaters are used in many plant spaces, these systems do not lead to significantly elevated power demand during the winter months. Improvements in blower efficiency with colder, more dense air may offset the impact of increased heater power demand.
- There is a distinct diurnal variation in load with most high demand occurring on weekdays between mid-morning and the end of 1st shift at approximately 3 PM. Loads are lowest during the early morning hours, which is typical of municipal plants. The power demand between 2 AM and 5 AM is generally only 7% lower than the daytime average between 10 AM and 2 PM. It is unclear if this is due to unresponsive plant equipment, fairly regular discharges into the system, and/or time delays bringing water to the plant in an extensive system.

The three charts included as part of Figure 6 illustrate the daily average diurnal power demand by month for weekdays, Saturdays, and Sundays, respectively. Higher power demand corresponds to the summer treatment season. It is interesting that power demand does not exhibit diurnal variations on Sundays relative to other weekdays and that the demand remains high. The impact of electric heat can be seen during the early morning hours during winter months.

Figure 6
Weekday, Saturday, and Sunday Average Daily Power Demand







The plant's electricity performance in terms of wire-to-water efficiency and wire-to-BOD efficiency is presented in Figures 6 and 7 below. The other data points in the plot are the 19 municipal wastewater treatment plants in Rhode Island. Taunton is permitted to discharge 8.4 MGD and has an average daily flow of 7.36 MGD, which places it as a fairly large regional plant.

The wire-to-water performance (2,689 kWh/MG) is typical of plants discharging to rivers (as opposed to the sea, where nitrogen removal has not been as stringently regulated). The lack of headworks lift pumps or internal pumping helps to reduce electricity relative to other plants that do not benefit from 100% gravity fall.

The wire-to-BOD performance (1,640 kWh/ton) is good relative to other plants in the comparison, which suggests fairly efficient blower control, moderate to low wastewater temperatures, and possibly moderate to low nitrogen loading relative to BOD. BOD concentration, expressed as annual tons per annual million gallons, suggests the plant has slightly lower than average BOD loading but is on par with other large regional plants with extensive, older collection systems.

Figure 7
Wire-to-Water Performance

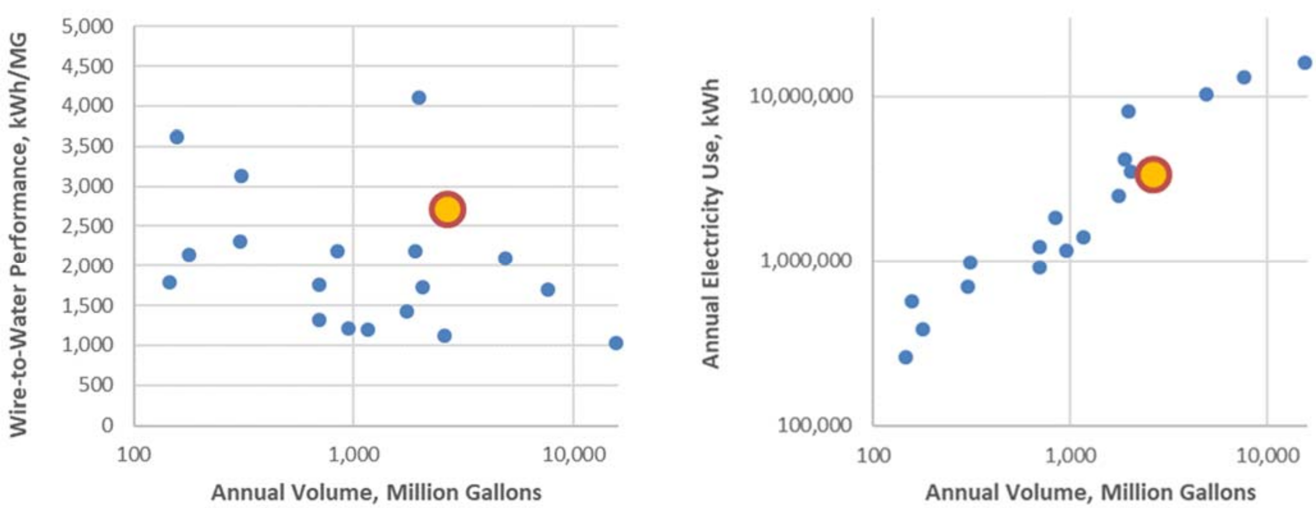
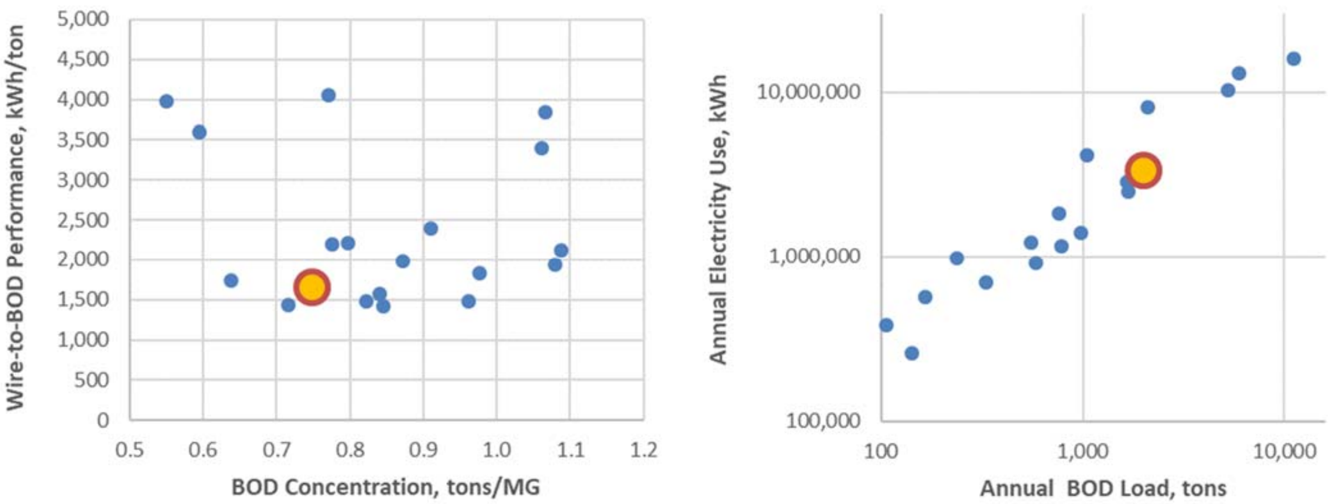


Figure 8
Wire-to-BOD Performance



In summary, there are relatively few improvements other than lighting upgrades that we recommend be undertaken for non-process systems prior to the larger plant upgrade. Coordinating the operation of the two centrifugal aeration blowers will provide significant savings that may be greater than the lighting upgrade may offer. The plant redesign has the potential to significantly increase heating fuel consumption due the increased use of ventilation systems. However, the associated penalty can be minimized through the use of natural gas heat and systems capable of maximizing thermal performance, minimizing standby losses and space temperature setpoints, and possibly capturing heat that would otherwise be exhausted.

We invite BETA, Veolia, and the City of Taunton to reach out any time with questions or comments regarding this report.

Sincerely,

Eric Studer, PE
President

TIME OF DAY DATA ANALYSIS

POWER DEMAND

Taunton WWTP

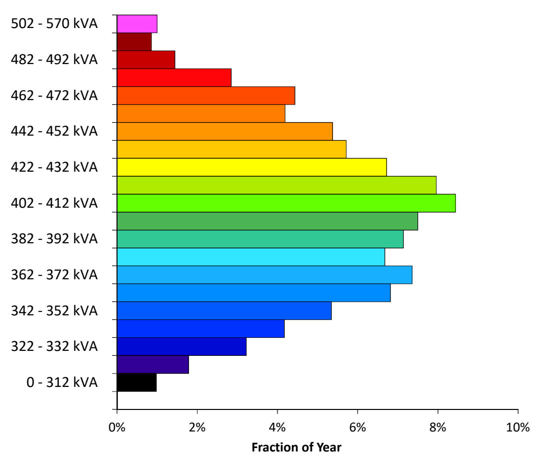
Sep 1, 2016 to Aug 31, 2017

Acct No: 20000 028

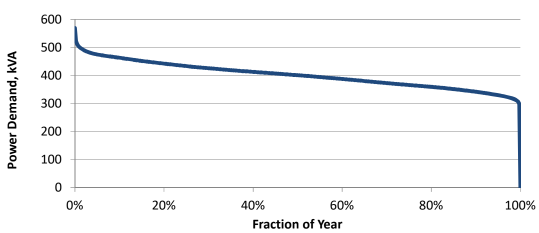
3,512,083 kVAH per Year

LEGEND & GENERAL DISTRIBUTION

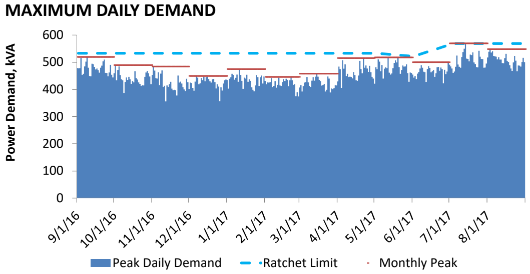
Data Interval: 10.0 kVA per color gradation, 20 gradations



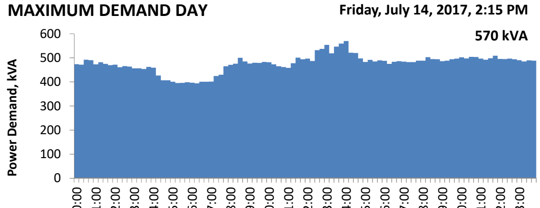
DEMAND DURATION

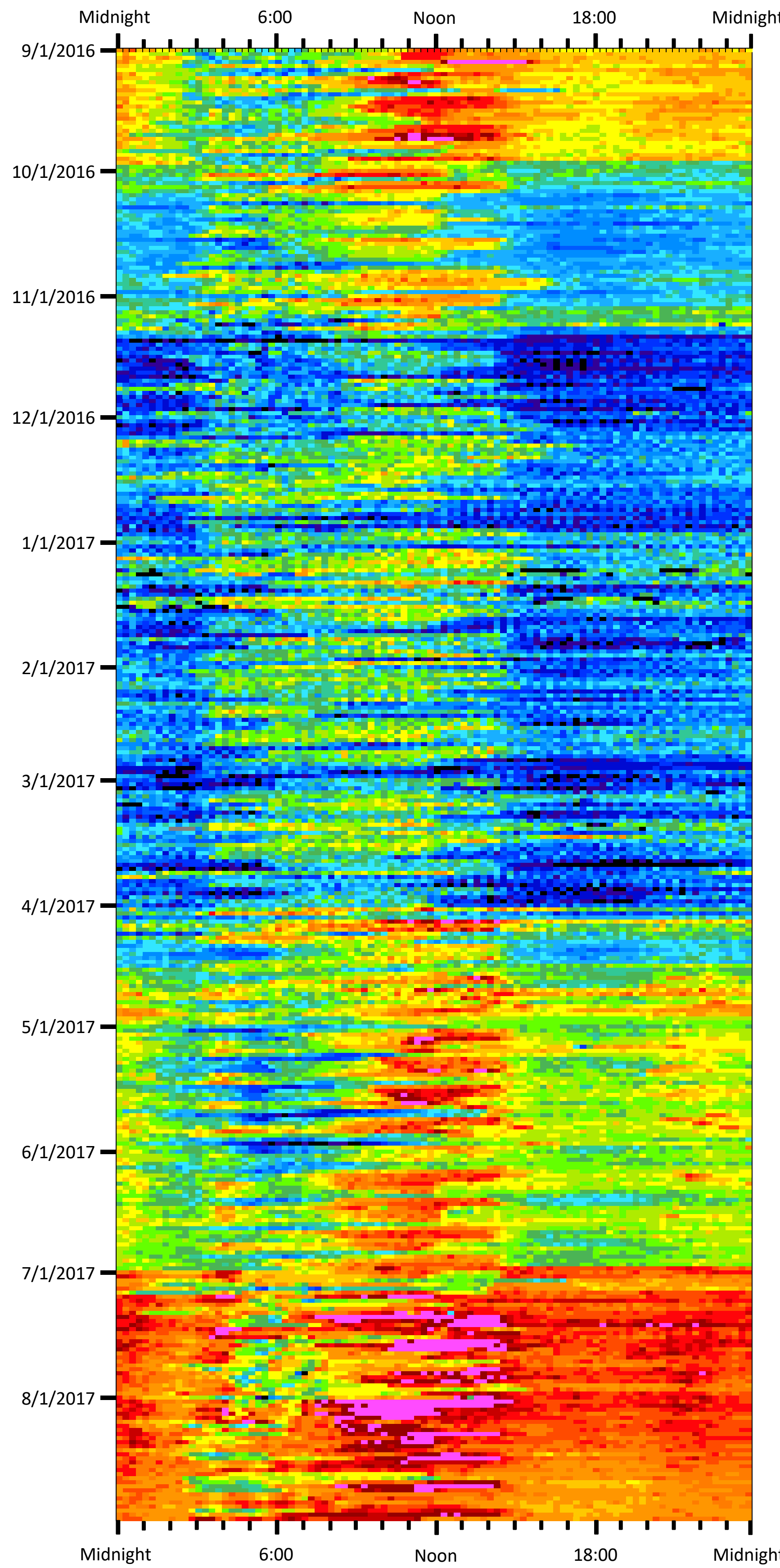


MAXIMUM DAILY DEMAND



MAXIMUM DEMAND DAY Friday, July 14, 2017, 2:15 PM



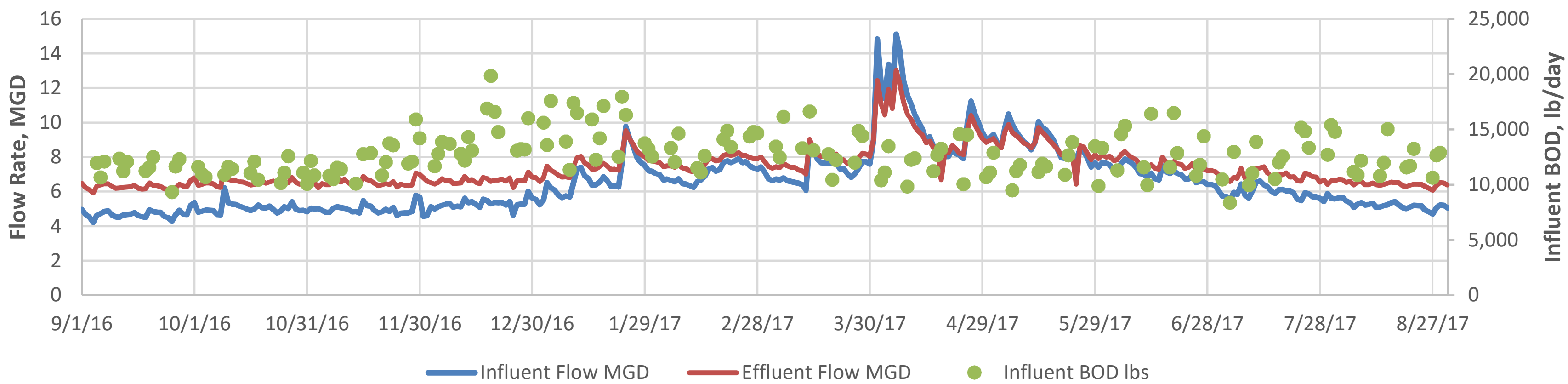


Electricity Use and Plant Load Data

Billing Period		Days	Use	Demand, kVA		Avg	Effluent	Load lb/day	
Start	End		kWh	Actual	Billed	kW	MGD	BOD	TKN
8/2/16	9/1/16	31	300,600	520.2	532.8	404.0			
9/2/16	10/3/16	32	307,800	518.4	532.8	400.8	6.30	10,227	1,390
10/4/16	11/1/16	29	250,200	484.2	532.8	359.5	6.54	9,545	1,359
11/2/16	12/1/16	30	248,400	486.0	532.8	345.0	6.53	10,565	1,361
12/2/16	1/3/17	33	277,200	448.2	532.8	350.0	6.67	12,623	1,279
1/4/17	2/1/17	29	248,400	475.2	532.8	356.9	7.68	12,919	1,217
2/2/17	3/1/17	28	234,000	444.6	532.8	348.2	7.74	11,522	1,210
3/2/17	4/3/17	33	279,000	482.4	532.8	352.3	8.14	11,058	1,159
4/4/17	5/1/17	28	253,800	514.8	532.8	377.7	9.50	9,800	989
5/2/17	6/1/17	31	284,400	516.6	532.8	382.3	8.63	10,064	1,098
6/2/17	7/3/17	32	300,600	498.6	522.0	391.4	7.54	11,635	1,234
7/4/17	8/1/17	29	300,600	568.8	568.8	431.9	6.87	11,537	1,382
8/2/17	9/1/17	31	322,200	547.2	568.8	433.1	6.44	10,988	1,372
9/2/17	10/2/17	31	309,600	541.8	568.8	416.1			
Total & Average		365	3,306,600	498.8		377.5	2,689	4,033,656	458,187

Plant Avg Power Factor

Total kVA	3,512,083
Avg PF	0.941



Month Ending	Days	Influent MGD	Effluent MGD	Influent BOD lb/day+	Influent BOD mg/l	Influent TKN lb/day+	Influent TKN mg/l	Effluent, mg/l* BOD	Effluent, mg/l* TKN	Load, lb/day BOD	Load, lb/day TKN
10/3/16	32	4.71	6.30	11,540	219.6	2,178	41.4	25	15	10,227	1,390
11/1/16	29	5.06	6.54	11,183	204.9	2,178	39.9	30	15	9,545	1,359
12/1/16	30	4.97	6.53	12,199	224.0	2,178	40.0	30	15	10,565	1,361
1/3/17	33	5.32	6.67	14,291	256.9	2,114	38.0	30	15	12,623	1,279
2/1/17	29	6.94	7.68	14,840	231.7	2,178	34.0	30	15	12,919	1,217
3/1/17	28	7.10	7.74	13,458	208.6	2,178	33.8	30	15	11,522	1,210
4/3/17	33	7.77	8.14	13,095	192.8	2,178	32.1	30	15	11,058	1,159
5/1/17	28	10.04	9.50	12,177	153.7	2,178	27.5	30	15	9,800	989
6/1/17	31	8.67	8.63	11,864	164.9	2,178	30.3	25	15	10,064	1,098
7/3/17	32	6.92	7.54	12,893	205.0	2,178	34.6	20	15	11,635	1,234
8/1/17	29	5.91	6.87	12,684	221.2	2,242	39.1	20	15	11,537	1,382
9/1/17	31	5.20	6.44	12,062	224.7	2,178	40.6	20	15	10,988	1,372

+Influent nutrient loads may be understated if they are calculated using the metered influent flow rates; there appears to be accuracy issues with the meter.

**Effluent concentration data was not provided by the site, estimates are taken from a Rhode Island plant discharging to the Pawtuxet River.*