Existing Facility Evaluation TM

CAAP – Methane Recovery Feasibility Study

Completed by HDR Engineering, Inc. on behalf of the City of Iowa City, to support the Climate Action and Adaptation Plan (CAAP) and the associated Action Items 3.7 and 3.8.

Iowa City, Iowa

March 20, 2020

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Attachments

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Technical Memorandum

Date:	Friday, March 20, 2020
Project:	City of Iowa City – Climate Action and Adaptation Plan Methane Feasibility Study
To:	Joe Welter, IA City; Tim Wilkey, IA City; Jennifer Jordan, IA City
From:	Morgan Mays, HDR; Eric Evans, HDR; Eric Sonsthagen, HDR
Subject:	Existing Facility Evaluation TM

This technical memorandum (TM) evaluates the existing facilities; specifically, the wastewater treatment plant (WWTP) and landfill; as part of the Climate Action and Adaptation Plan (CAAP) Methane Feasibility Study. The first part of the TM covers the assessment of the existing WWTP, including evaluation of existing and future conditions at the facility. The second part of this TM provides an evaluation of the existing and future conditions at the landfill facility.

Facility Evaluation - Wastewater Treatment Plant

Existing or Baseline Facility Conditions

The existing Iowa City WWTP treats wastewater to meet permitted discharge requirements shown in Table 1. Treatment requires removal of five-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), ammonia and E. Coli. to low concentrations. In addition, the WWTP removes nutrients; as measured by total nitrogen (TN) and total phosphorus (TP) concentrations. Treatment processes at the WWTP include preliminary treatment (screening and grit removal), primary treatment with sedimentation, secondary biological treatment using an activated sludge based biological nutrient removal (BNR) process, and finally, anaerobic digestion of solids residuals generated. Outputs from the WWTP include the treated effluent that is discharged to the Ralston Creek-Iowa River, and Class A (digested) biosolids that are land applied.

Table 1. Iowa City NPDES Permit

NPDES Permit	*IA 0070866*			*Effective Date:*	*05/01/2014*
Parameter	**Units**	**Month Max**	**Daily Max**	**Monitor Freq.**	**Note**
BOD_5	mg/L	25.0	40.0	Daily	Technology Based Limit
TSS	mg/L	30.0	45.0	Daily	Technology Based Limit
Ammonia (Jan)	mg-N/L	12.8	41.2	Daily	Water Quality Based Limit
Ammonia (Feb)	mg-N/L	15.1	43.1	Daily	Water Quality Based Limit
Ammonia (Mar)	mg-N/L	8.3	41.3	Daily	Water Quality Based Limit
Ammonia (Apr)	mg-N/L	5.2	41.1	Daily	Water Quality Based Limit
Ammonia (May)	mg-N/L	4.7	41.1	Daily	Water Quality Based Limit
Ammonia (Jun)	mg-N/L	3.7	39.3	Daily	Water Quality Based Limit
Ammonia (Jul)	mg-N/L	4.1	25.8	Daily	Water Quality Based Limit
Ammonia (Aug)	mg-N/L	4.2	26.6	Daily	Water Quality Based Limit
Ammonia (Sep)	mg-N/L	3.8	34.1	Daily	Water Quality Based Limit
Ammonia (Oct)	mg-N/L	5.7	49.4	Daily	Water Quality Based Limit
Ammonia (Nov)	mg-N/L	8.0	42.9	Daily	Water Quality Based Limit
Ammonia (Dec)	mg-N/L	9.0	44.6	Daily	Water Quality Based Limit
E. Coli.	#/100-mL	147		1/3 Months	March - November

Flows and Loads

The current flows and loads are evaluated in this section based on flow data exported from SCADA and routine monitoring data reported by the WWTP for BOD_5, TSS, TN, TKN, and TP. The monitored influent flow rate varies from about 1 million gallons per day (MGD) to nearly 40 MGD as shown in Figure 1 with higher seasonal flows in Spring and Summer. For the data period from Jan. 1, 2017 through Dec. 31, 2019, the average flow rate is 8.9 MGD, the median (50^{th} percentile) flow rate is 8.0 MGD, the 91.7^{th} percentile (statistical maximum month) flow rate is 11.9 MGD, and the 99.7^{th} percentile (statistical maximum day) flow rate is 27.3 MGD.

The $cBOD_5$ and TSS loads on the WWTP are presented in Figure 2. These loads are about 20,000 lb/d on average with a max day $cBOD_5$ load of roughly 38,000 lb/d and a max day TSS load over 47,000 lb/d. Figure 3 shows the TKN and TP loads, which average around 2,700 lb-N/d and 400 lb-P/d, respectively.

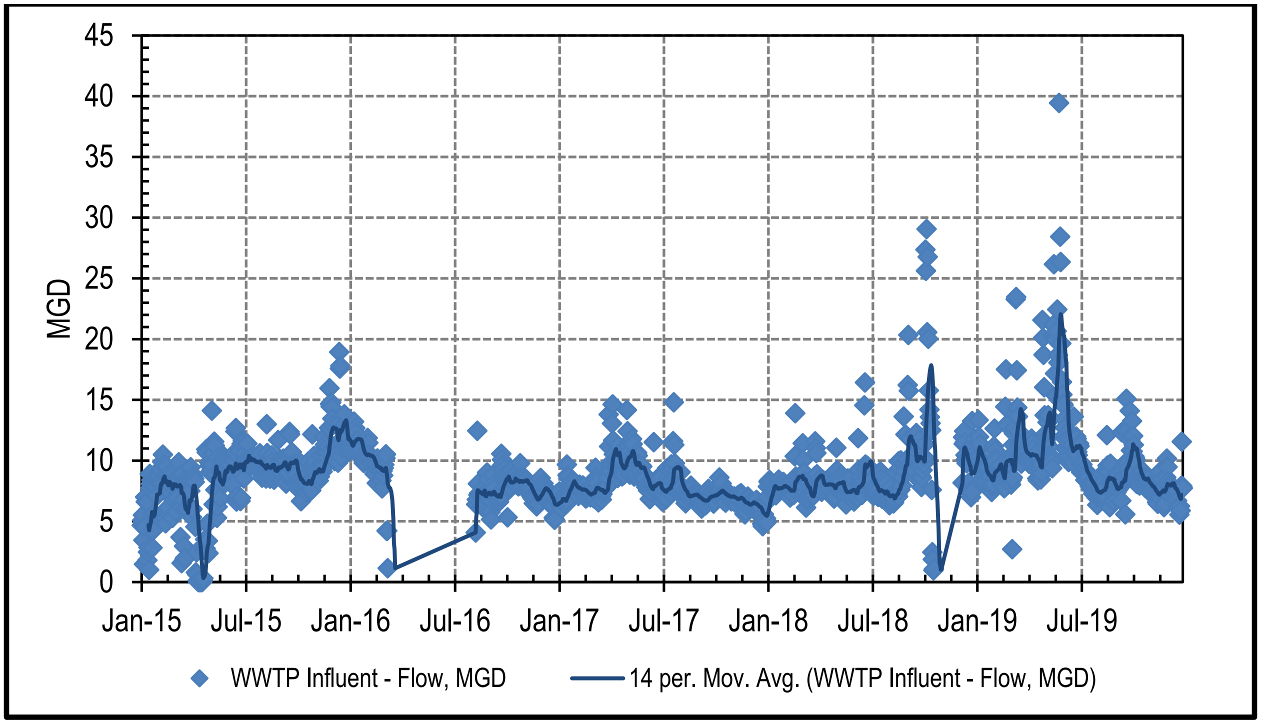

Figure 1. Influent Flow Rate

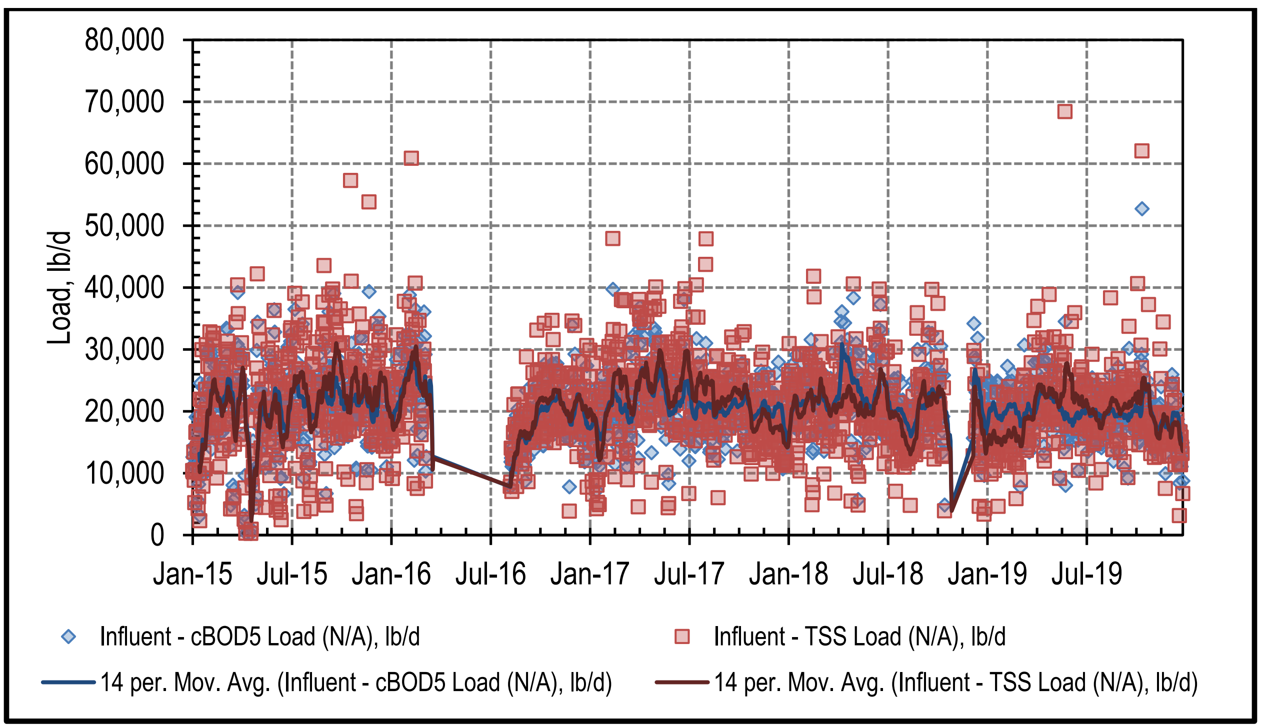

Figure 2. Influent $cBOD_5$ and TSS Loads

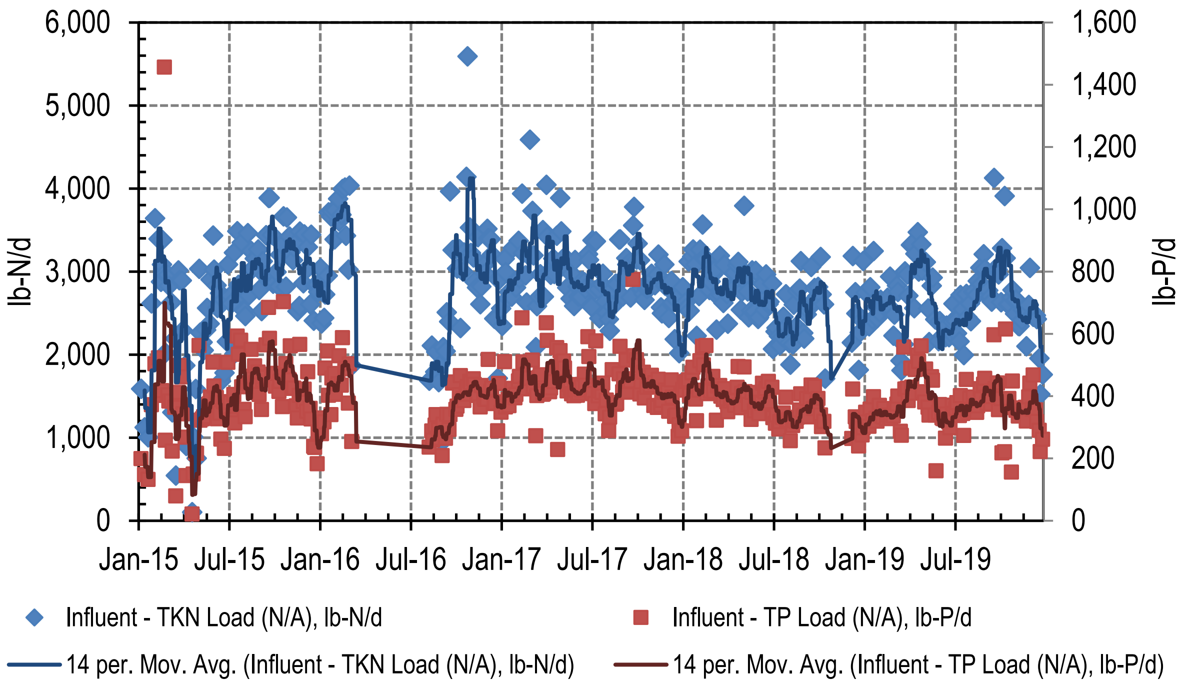

Figure 3. Influent TKN and TP Loads

Overall influent flows and loads are summarized in Table 2 based on the statistical analysis of the data. On a per capita basis, the average flow rate is about 105 gpd/capita and the average $cBOD_5$ load is 0.27 lb/d/capita; a relatively typical per capita flow rate but a per capita $cBOD_5$ load that is about 50% higher than typical. The peaking factors for flow based on the data are about 1.5 for max month and 3.4 for max day conditions, and the peaking factors for $cBOD_5$ based on the data are 1.3 for max month and 1.8 for max day conditions. The flows and loads translate to concentrations as shown in Table 3, which further support a classification of medium- to high-strength wastewater at the WWTP.

Table 2. Influent Flows and Loads

Parameter	Unit	Ave Annual	Max Month	Max Day
Flow	MGD	8.0	11.9	27.3
$cBOD_5$	lb/d	20,600	27,300	38,000
TSS	lb/d	20,200	30,000	47,300
TKN	lb-N/d	2,730	3,290	4,180
Ammonia	lb-N/d	1,500	1,870	2,270
TP	lb-P/d	394	510	664
***Based on data from**:		01/01/2017 - 12/31/2019		

Table 3. Influent Pollutant Concentrations

Parameter	Unit	Ave Annual	Max Month	Max Day
Flow	MGD	8.0	11.9	27.3
cBOD$_5$	mg/L	309	274	167
TSS	mg/L	303	302	208
TKN	mg-N/L	41	33	18
Ammonia	mg-N/L	22	19	10
TP	mg-P/L	5.9	5.1	2.9

Solids Production Rates

Solids are produced at the Iowa City WWTP by the primary sedimentation process and by the second-stage BNR process. The solids are combined and treated in the anaerobic digestion process.

PRIMARY SOLIDS

Primary solids are pumped to Sludge EQ Tank T8001 and measured through one of two flow meters. Figure 4. Primary Sludge Flow Rates provides the raw output primary sludge flow rate data for the last five years. For the data period from January 2017 through December 2019, the average primary solids flow was 29,000 gpd with a median value of 28,800 gpd, a 91.7th percentile value of 38,800 gpd and a 99.7th percentile value of 64,200 gpd. This corresponds to a primary solids load of about 12,000 lb/d on average with a max day load near 33,000 lb/d.

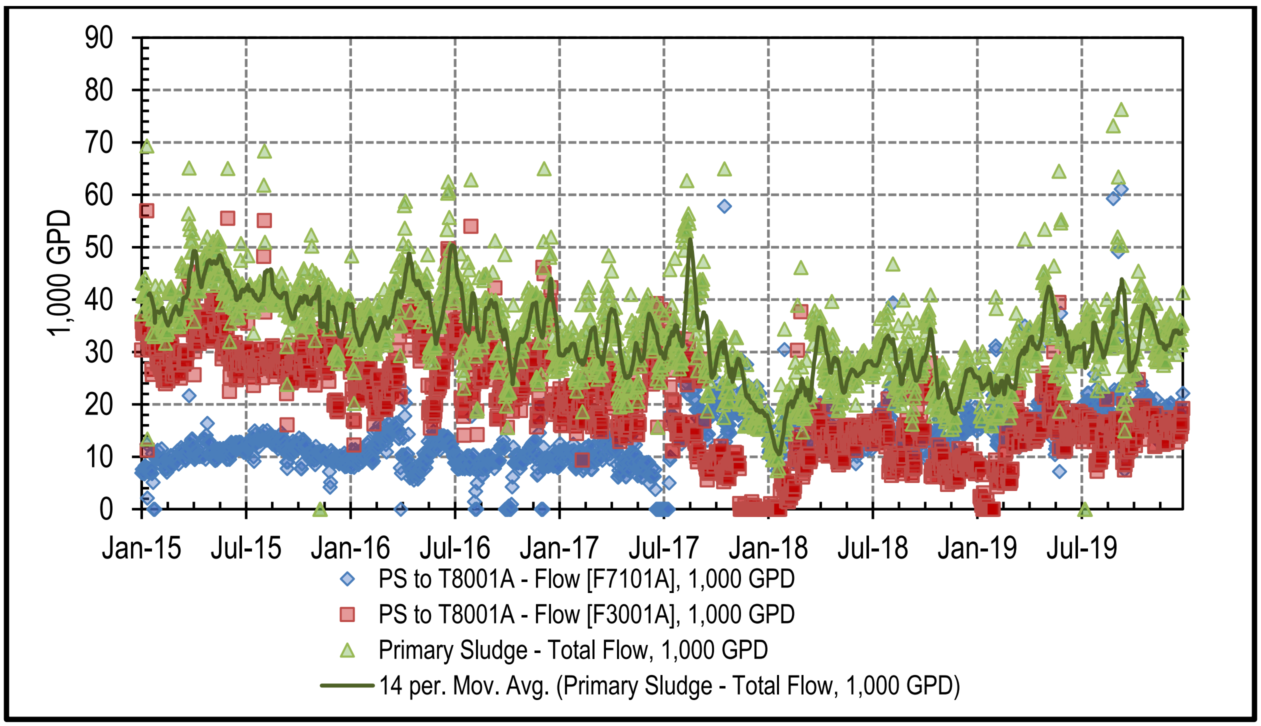

Figure 4. Primary Sludge Flow Rates

SECONDARY SOLIDS

Secondary solids (Waste Activated Sludge [WAS]), produced by the BNR process, are first pumped and thickened by rotary drum thickeners (RDTs) generating thickened WAS (TWAS). Thickened secondary solids are combined with primary solids and secondary scum in the sludge EQ tank T8001. Figure 5 presents the raw flow data from each process for the past five years. Secondary solids flow to the RDTs varies from an average of 264,000 gpd (median of 254,000 gpd) to a 91.7th percentile flow of 346,000 gpd. Thickened solids flow depends on thickening efficiency but ranges from an average of 28,400 gpd to a 91.7th percentile of 43,300 gpd, and a 99.7th percentile of 69,900 gpd.

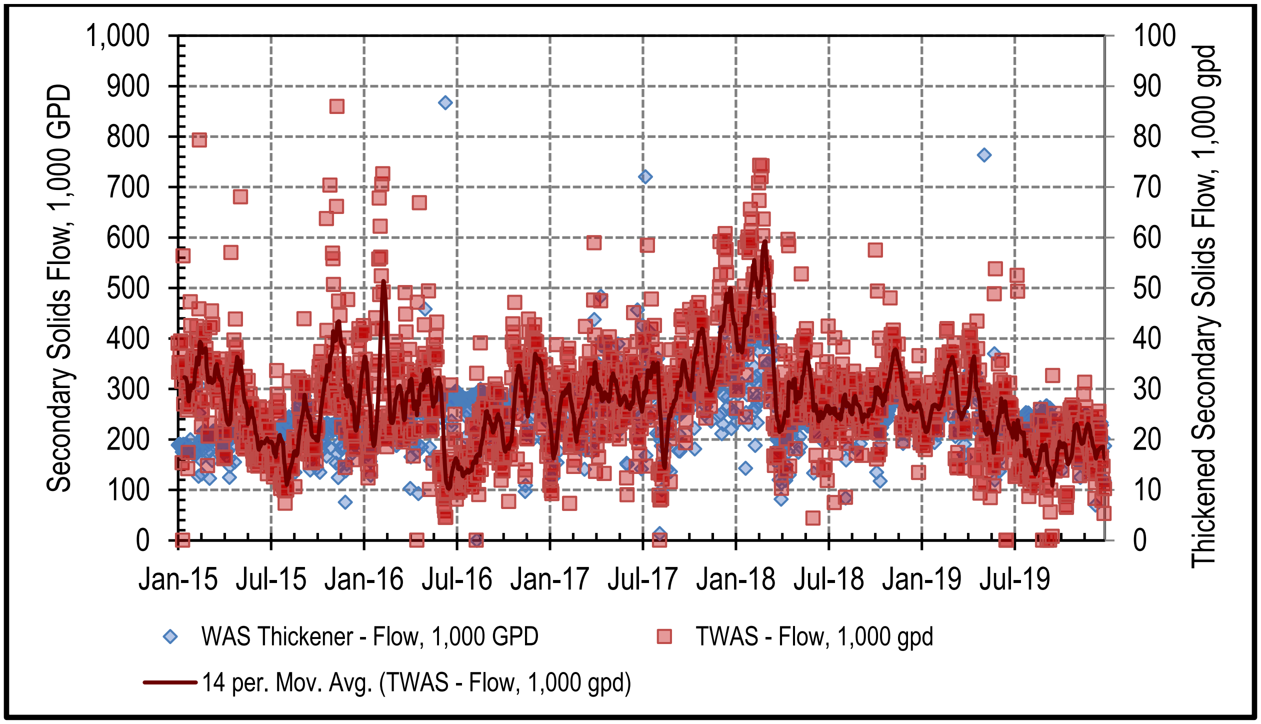

Figure 5. Secondary Solids (WAS and TWAS) Flow Rates

TOTAL DIGESTER FEED SOLIDS

The total digester feed solids reflect the sum of primary and thickened secondary solids. This total digester feed is transferred from the sludge EQ tank T8001 to the thermophilic digester (T8101, T8201, or T8101 and T8201). The total digester feed solids flow averages 57,300 gpd with a 91.7th percentile flow of 70,800 gpd and a 99.7th percentile of 98,500 gpd. Figure 6 shows the flow data from the last 5 years. A general decline from between 60,000 and 80,000 gpd to between 40,000 and 60,000 gpd is evident on the graph.

Total solids loads are shown in Figure 7 including the primary solids and secondary solids to Tank 8001 and the combined solids load from Tank 8001 to the digesters. Based on the data, the average loads are about 12,000 lb/d, 12,000 lb/d, and 19,000 lb/d for primary solids, secondary solids, and digester feed, respectively. The max month loads are about 17,000 lb/d, 17,000 lb/d, and 25,000 lb/d for primary solids, secondary solids, and digester feed, respectively. The data suggest that Tank 8001 provides some preliminary solids breakdown.

The key takeaway, however, is that the combined solids production results in an average solids yield from wastewater treatment of about 0.9 lb-TSS/lb-cBOD$_5$ treated, which is consistent with high end yields in references (Tchobonagolous, Stensel, Tsuchihashi, & Burton, 2014).

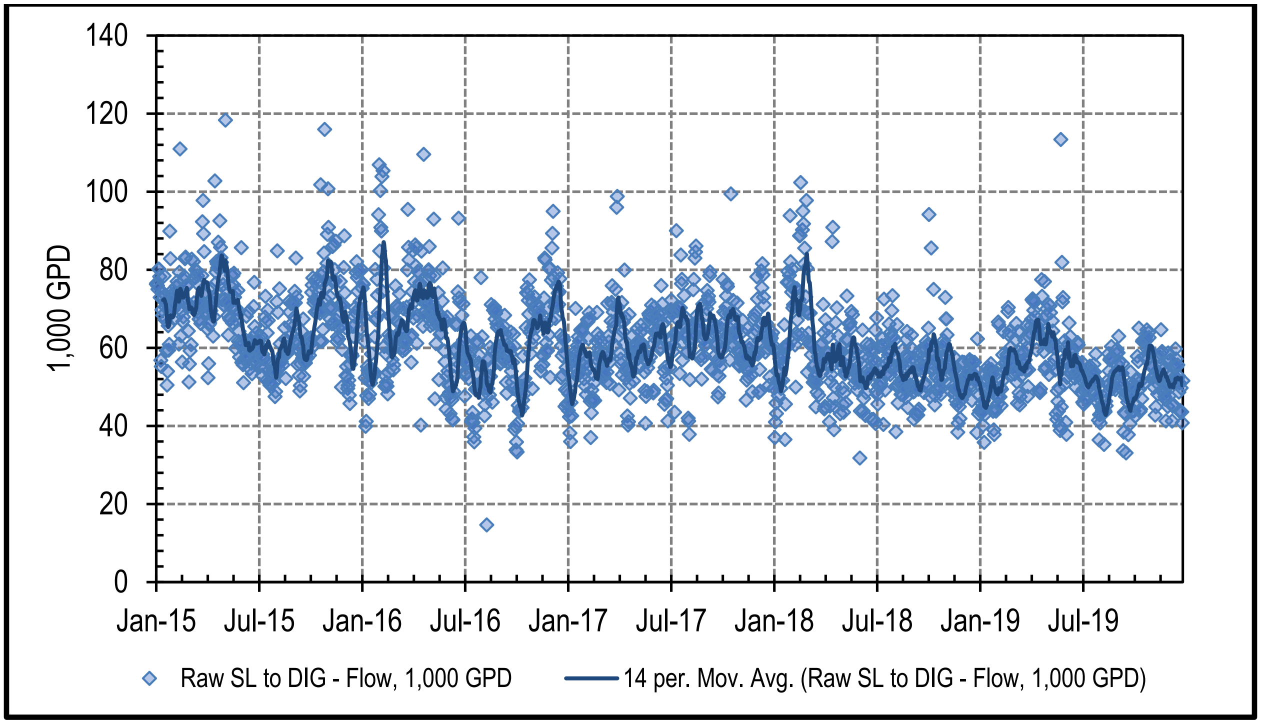

Figure 6. Combined Solids (Primary and Secondary - Raw solids) Flow to Digesters

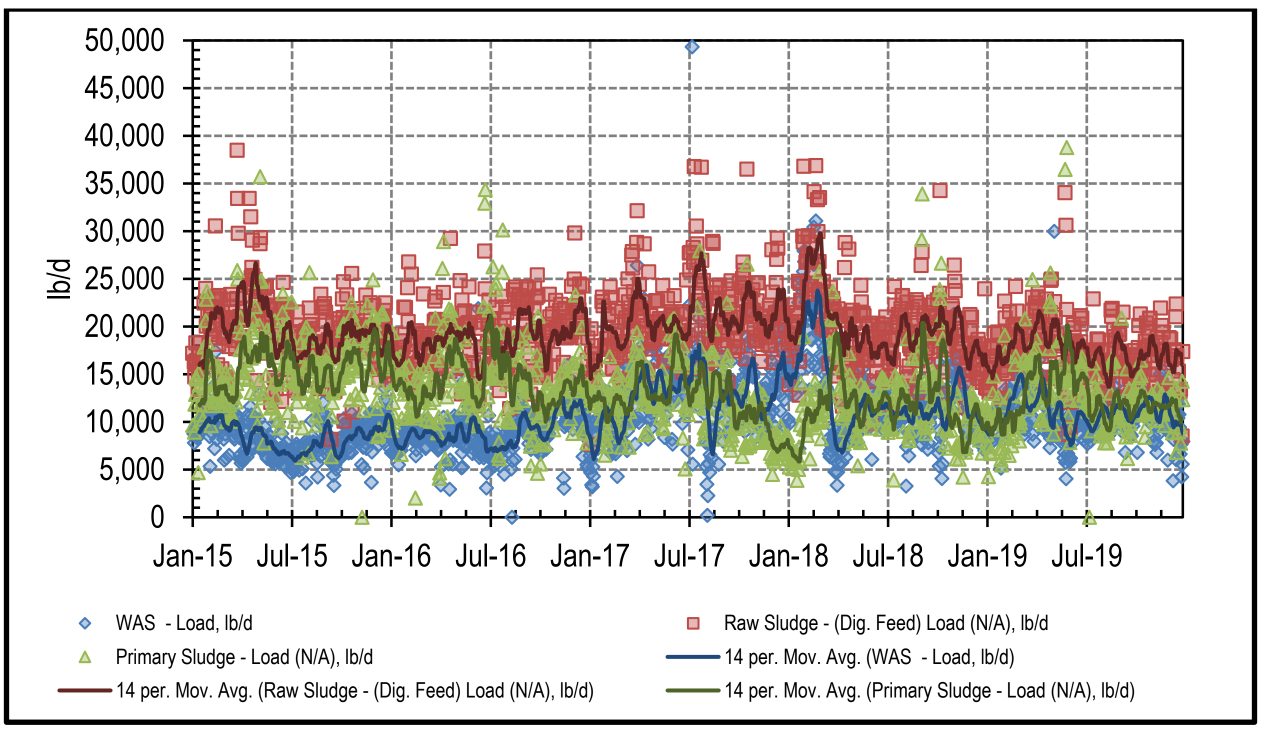

Figure 7. Solids Loads – Primary Solids, Secondary Solids, and Digester Feed

Digestion Process Configuration and Design

The digestion process at the WWTP is designed as a temperature-phased anaerobic digestion (TPAD) process; with thermophilic followed by mesophilic treatment phases/stages. During the study (Spring 2020), two digesters operate at thermophilic temperatures followed by mesophilic digestion with the remaining digesters. Figure 8 provides a schematic overview of the process flow scheme. The current operation uses two thermophilic digesters to support start-up of Tank T8101.

Normal operation uses one thermophilic digester a shown in Figure 9 with T8101 acting as the thermophilic digester phase, tanks T8201, T8301, and T8401 acting as the mesophilic digesters, and tanks T8601 and T8701 acting as the second stage mesophilic digesters and storage step.

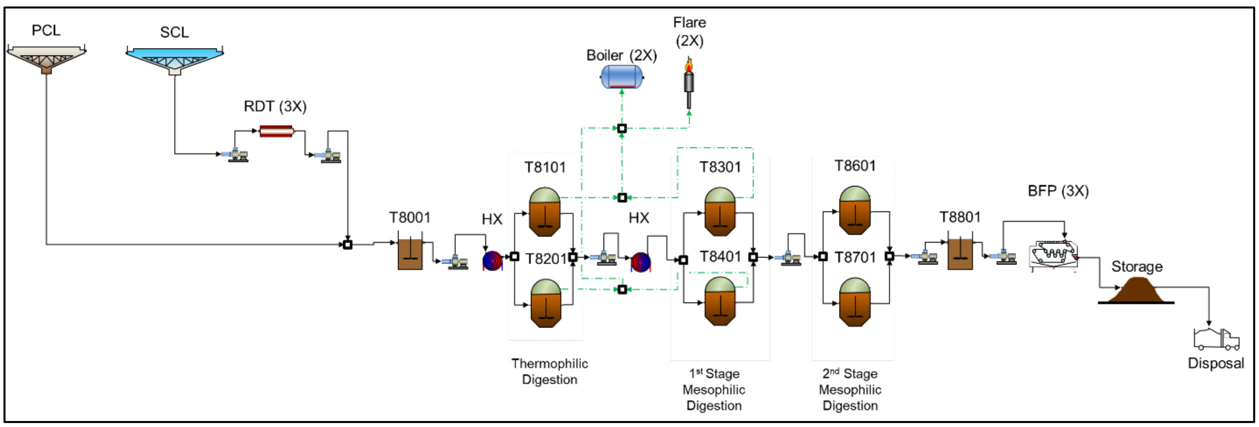

Figure 8. Digestion Process Flow Scheme – Spring 2020 Operation

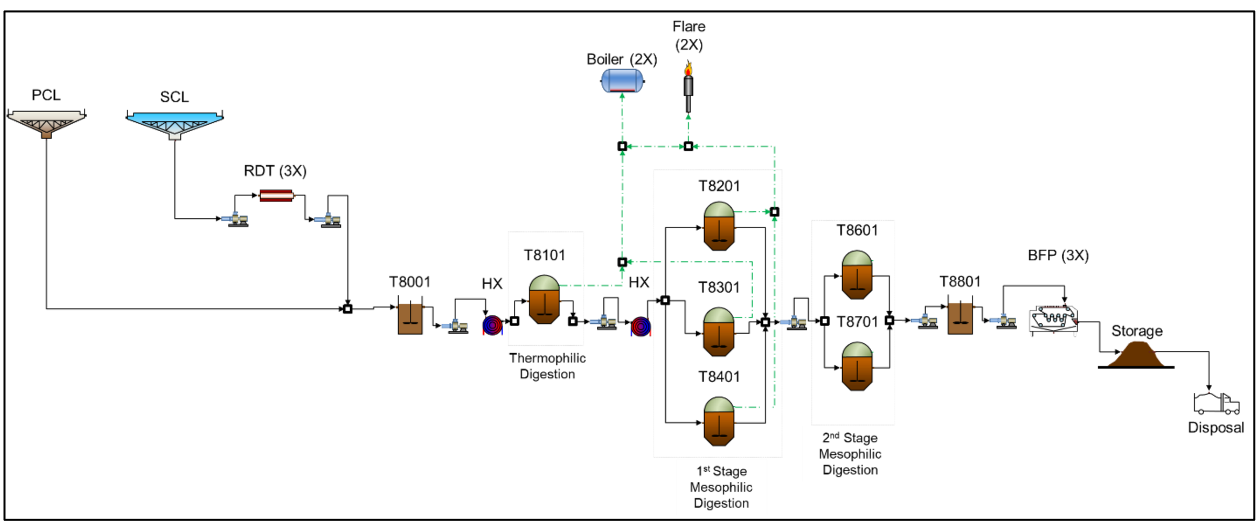

Figure 9. Digestion Process Flow Scheme – Normal Operation

The WWTP Operations and Maintenance (O&M) Manual identifies the required minimum digester tanks online as presented in Figure 10. The system can operate with one or two thermophilic digesters online and as many as four mesophilic digesters online. The six tanks that make up the digestion system at the WWTP are identified in Table 4. The digestion process is designed for a max month hydraulic retention time (HRT) of 20 days and an average annual HRT of 15 days with one tank out of service (Themophilic HRT = 5 days, Mesophilic HRT = 10 days). The design volatile solids (VS) loading rate is between 350 and 450 lb-VS/(1,000 ft^3•d) in the thermophilic digester(s). This translates to a design average flow of 96,600 gpd and a design max month flow of roughly 129,000 gpd.

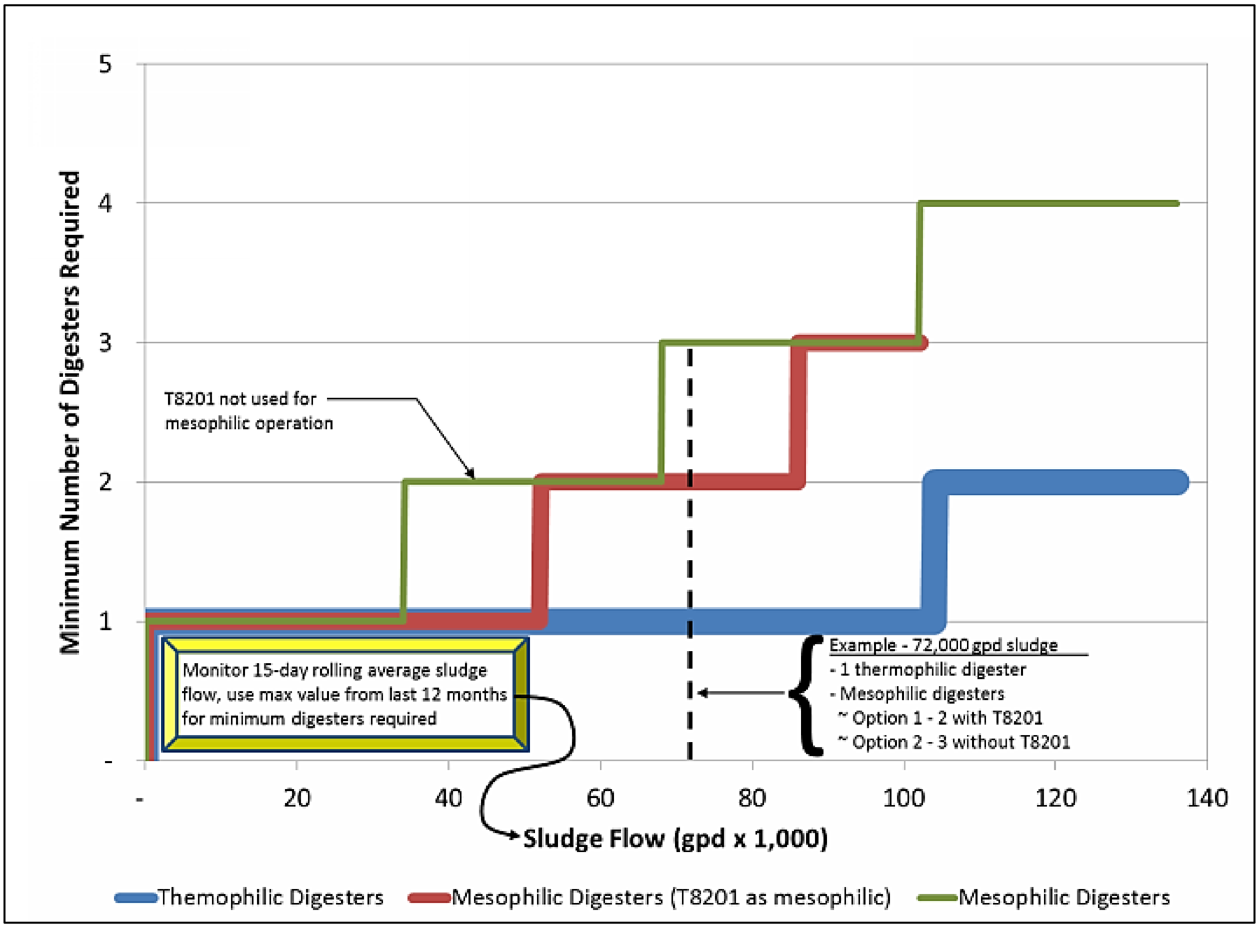

Figure 10. Minimum Number of Digesters Required per Sludge Flow (peak 15-day rolling average) – from Iowa City WWTP O&M Manual

Table 4. Digester Tank Sizes (Capacities)

Digester	Temperature	Diameter (ft)	Max. Depth (ft)	Volume (gal.)
T8101	Thermophilic	55	27	520,000
T8201	Thermophilic/ Mesophilic	55	27	520,000
T8301	Mesophilic	45	27	340,000
T8401	Mesophilic	45	27	340,000
T8601	Mesophilic	45	27	340,000
T8701	Mesophilic	45	27	340,000

Digestion Process Loading Rates

The data were used to evaluate baseline loading rates on the digestion process at the WWTP. As shown in Figure 11, the Thermophilic HRT varied between 5 and 20 days (partly a function of 1 versus 2 thermophilic digesters online) from January 2015 through December 2019. The Mesophilic HRT varied from 10 to 40 days (also due to the number of digesters online) during the same period. On average, the thermophilic HRT was between 8 and 10 days and the mesophilic HRT was between 16 and 20 days. As shown in Figure 12, the volatile solids loading rates average 230 and 50 for the thermophilic and mesophilic digesters, respectively.

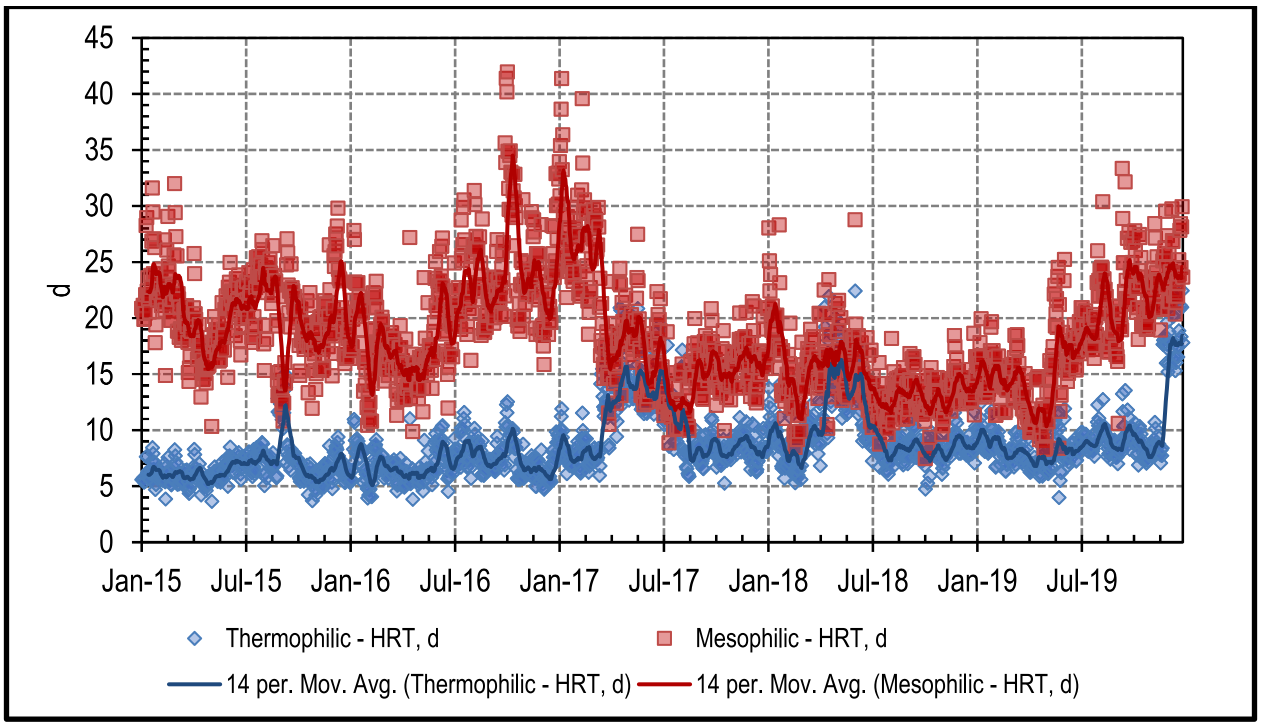

Figure 11. Digestion Process Hydraulic Retention Times (HRTs)

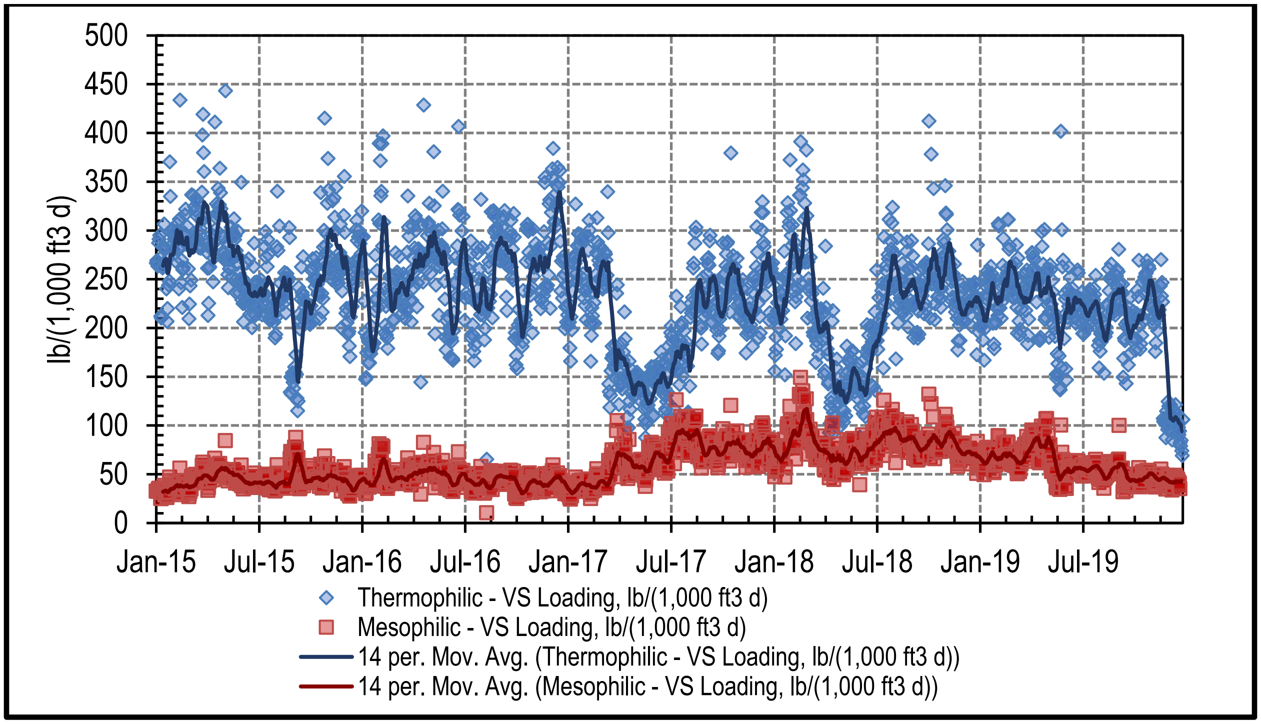

Figure 12. Digestion Process Volatile Solids (VS) Loading Rates

The basline digester process condition is compared to the design capacity in Table 5 showing available capacity that may be available for use in elevating biogas generation Based on the evaluation/comparison, the digesters operate below their design loading conditions. Available capacity within the digestion process is estimated between 30-60% depending on the loading condition and digester stage evaluated.

Table 5. Digestion Process Capacity Assessment

Digester Parameter	2017-2019 Digester Condition*	Digester Design Capacity
Ave. Annual Thermophilic HRT	8.4	5
Ave. Annual Mesophilic HRT	16	10
Max. Month Thermophilic HRT	5-10	7.5
Max. Month Mesophilic HRT	10-30	12.5
Ave. Annual Thermophilic VS Load	230	350-450
Ave. Annual Mesophilic VS Load	52	100-120
Max. Month Thermophilic VS Load	300-500	350-450
Max. Month Mesophilic VS Load	50-100	100-120

*Note: Average Annual Condition Assumes one digester offline

In order to support an assessment of nutrients and sulfur loading effects on the digestion process with outside organics (Future WWTP Section), the existing digestion process was also setup and evaluated using the wastewater simulator – BioWin™ as shown in Figure 13. The model validation is shown in this section to demonstrate alignment with the observed process. First, the configuration is setup based on the preferred operating strategy for the digestion process. Then, the model is setup to calculate the hydraulic retention time (HRT) and volatile suspended solids loading rate (VS Load) as shown in Figure 14. Finally, treatment performance by the digesters is shown in Figure 15 with both individual and overall volatile suspended solids removal rates[1] (VSRs).

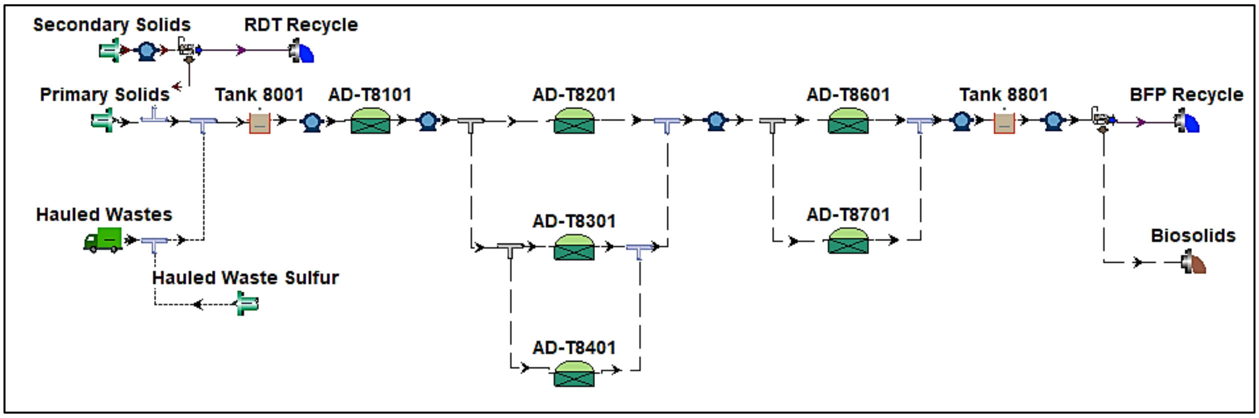

Figure 13. BioWin™ Iowa City Anaerobic Digestion – Process Flow Scheme

[1] Note, data typically presents total volatile solids and total volatile solids removal efficiencies; whereas, the model presents based on volatile suspended solids. This is typically a small difference in solids treatment (digesters).

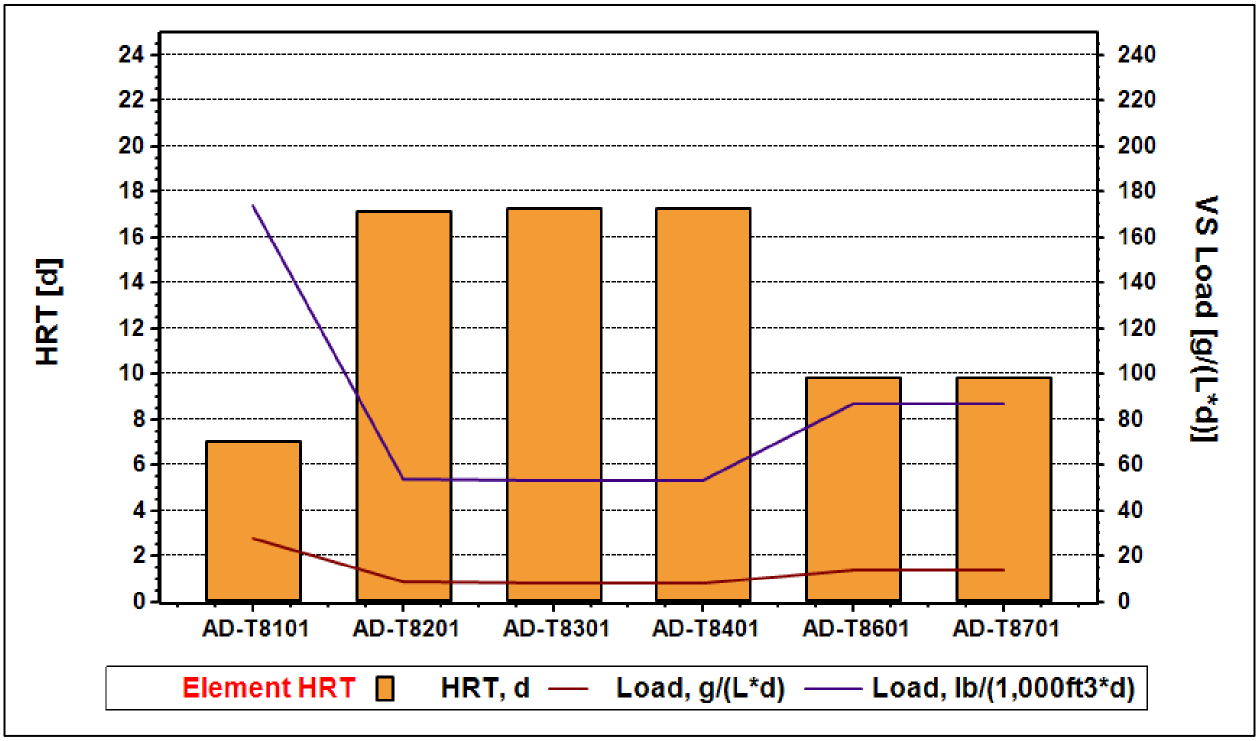

Figure 14. Digester Loading Rates (HRT and VSR)

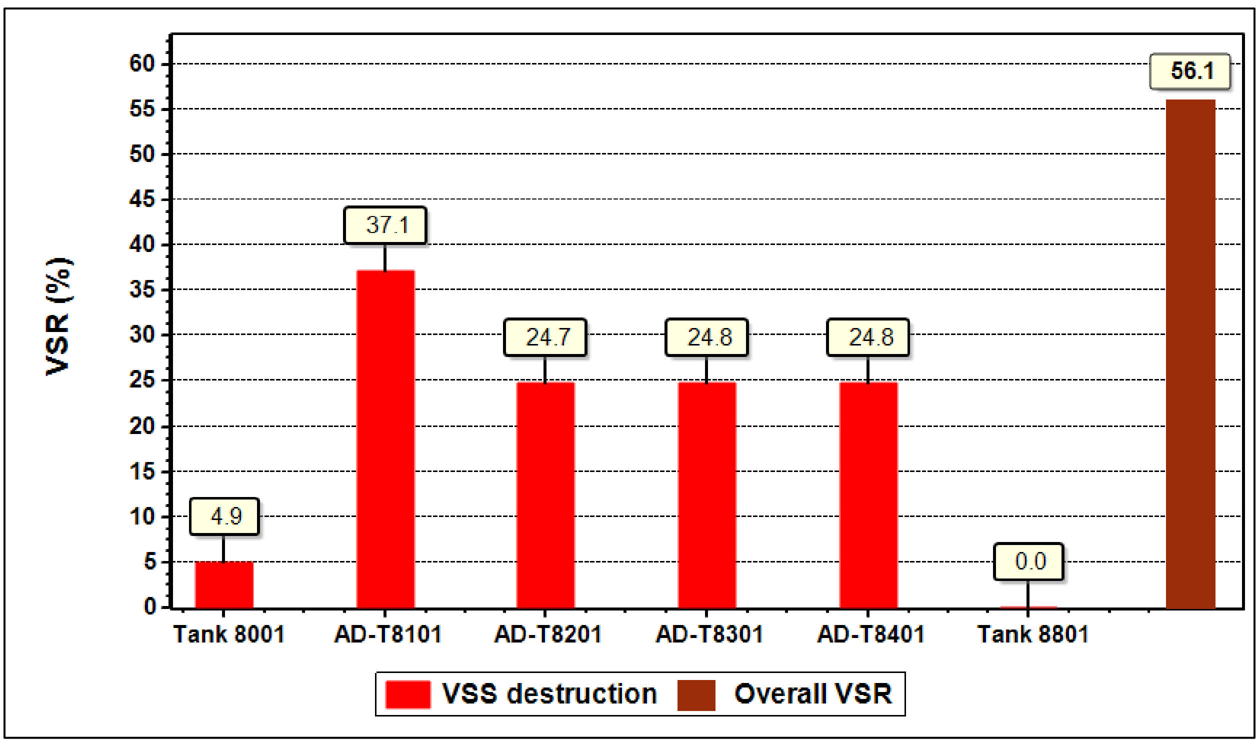

Figure 15. Volatile Suspended Solids Reduction Efficiencies (Red is VSR in individual tanks, dark red is overall VSR)

Electrical, Natural Gas, and Chemical Usage

Electricity, natural gas (NG), and chemical usage at the WWTP are evaluated in this section based on reported data from the last five years. Figure 16 shows total electricity usage at the WWTP, as well as showing specific usage for the aeration basins (the largest electricity consumer at the WWTP). On average, the WWTP uses 23,327 kWh per year (January 1, 2017 through December 31, 2019). Aeration demand reflects approximately 50% of the total electricity usage and the digestion process utilizes about 12% of the total electricity usage.

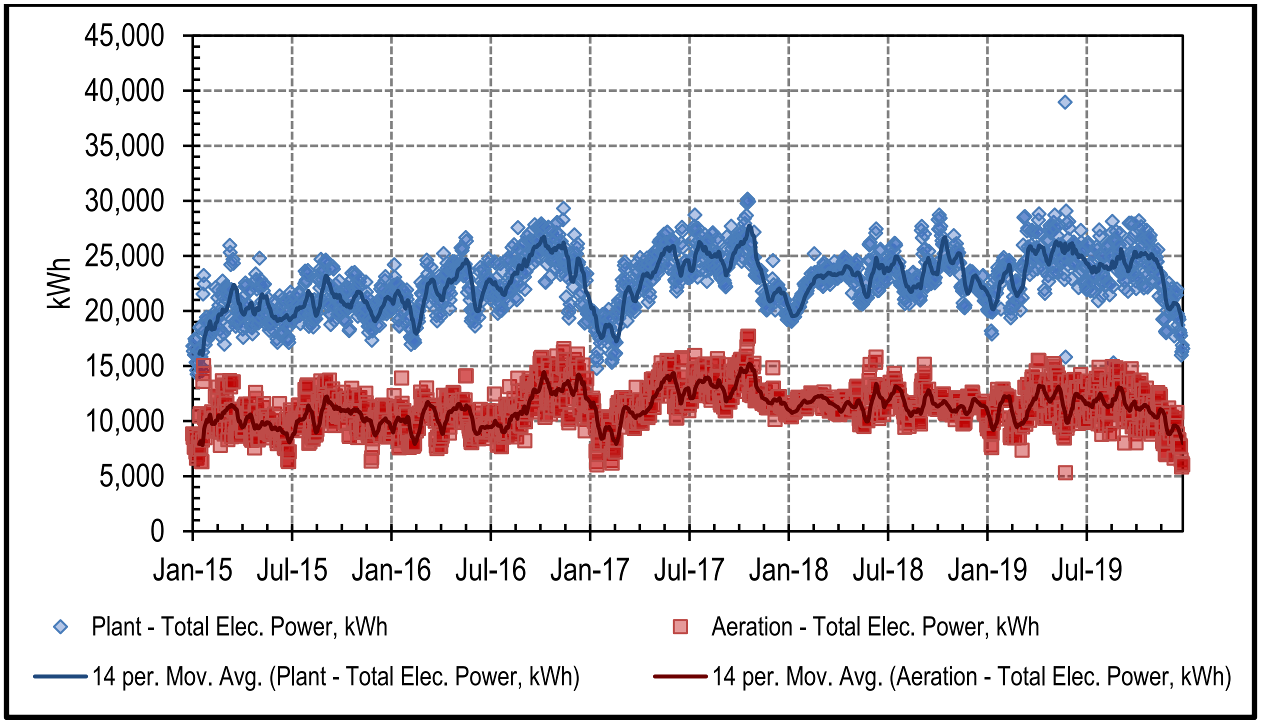

Figure 16. Iowa City WWTP – Electrical Power Usage (Total and Aeration)

Figure 17 shows the NG usage at the WWTP including both the total plant NG usage and the boiler NG usage. As is typical for the Midwest, NG usage reflects a seasonal pattern with winter peak NG usage and summer low NG usage. The average NG usage from 2017 to 2019 was 99,140 cubic feet per day.

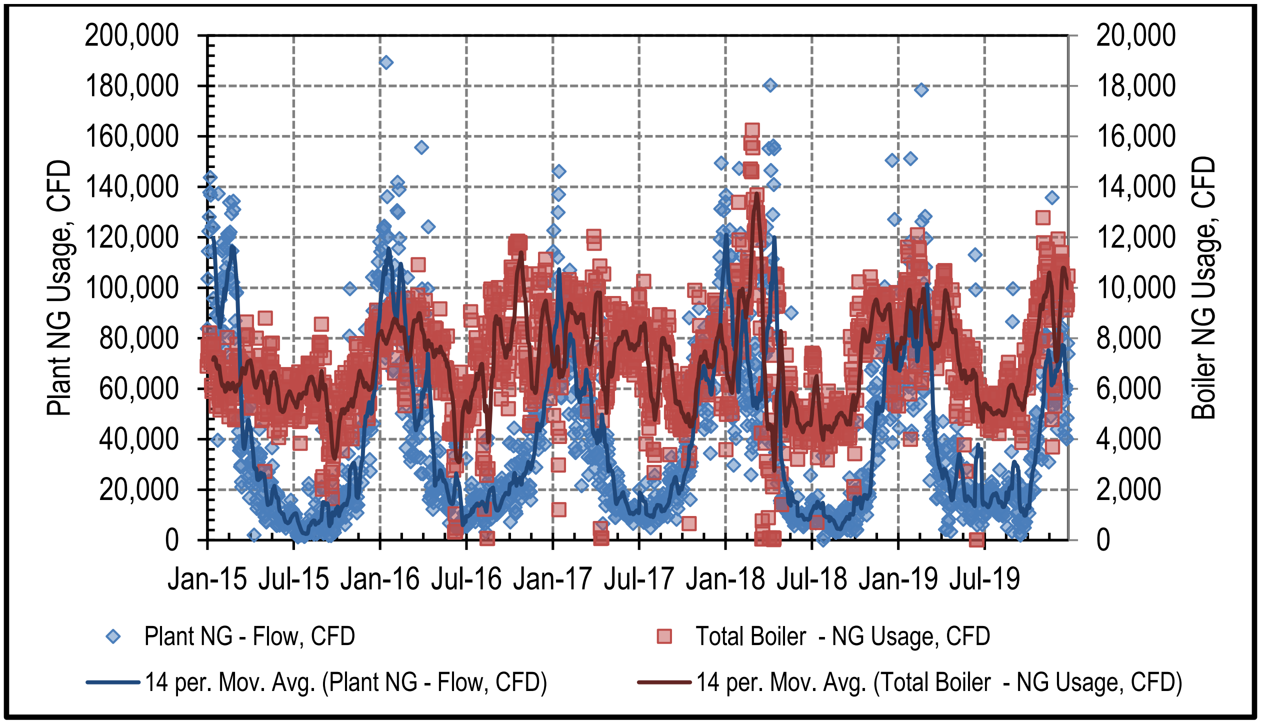

Figure 17. Iowa City WWTP – Natural Gas Usage (Total and Boiler)

Future WWTP - Facility Conditions

DESIGN FLOWS AND LOADS

The current WWTP liquid treatment processes are designed with capacity to support growth through 2025 (Phase I). The design flows and loads are compared to the 2017-2019 flows and loads in Table 6 and Table 7. Table 6 shows that flow rates (average, maximum, and peak) are significantly below design capacities. Design loads are compared to observed statistical maximum month loads, which also shows additional $cBOD_5$ capacity (10-20%), TSS capacity (10-20%), and TKN capacity (50%) remains within the WWTP. A Phase II expansion is reflected in planning documents and provides capacity through 2040.

Table 6. Design Flows compared to 2017-2019 Flows (Table reproduced from O&M Manual)

Condition	Design Flow [MGD]	2017-2019 Flow [MGD]
Ave Annual	---	8.0
AWW (Max Month)	24.20	11.9
MWW (Max Day)	43.30	27.3

Note: [1]EQ flow is 30 MGD, Hourly flow data not evaluated

Table 7. Design Maximum Month Loads compared to 2017-2019 Loading

Parameter	Design Loading [lb/d]	2017-2019 Loading [lb/d]
BOD_5	32,658	27,300
TSS	34,386	30,000
TKN-N	6,311	3,290

DESIGN SOLIDS PRODUCTION RATES

The anaerobic digestion system was originally designed for the projected solids values (through 2040) for average annual and maximum month conditions shown in Table 8. The average annual capacity of nearly 97,000 gpd is approximately 40% higher than the current average feed flow, and the maximum month capacity of almost 129,000 gpd is roughly 80% higher than the current 91.7th percentile (statistical maximum month) flow. Additionally, the current solids mass fed to the digester (19,000-25,000 lb/d) is below the design capacity for the digestion process. Based on the current solids load and the recent growth trend, the 2040 projected solids production rate will average 23,000 lb/d with a maximum month mass of 28,000 lb/d indicating that residual capacity may be available for the entire design period.

The comparison between digester feed flows and digestion capacity shows available capacity for hauled wastes can be used to increase biogas production potential. Overall, the available capacity varies from between 40 to 50% currently to 30 to 40% in the future. Typically, municipal digesters fed with outside wastes limit the external carbon feed to between 25% and 50% of the total feed. The available capacity is consistent with these operational goals. Therefore, the available capacity[2] for outside wastes is between 4,000 (minimum) and 12,000 (peak) lb-solids/d currently (2020) and between 6,000 (minimum) and 14,000 (peak) lb-solids/d in 2040. This equates to a potential average external carbon feed of roughly 7,000-8,000 lb-solids/d in 2020 and 8,000-9,000 lb-solids/d in 2040.

Table 8. Digester Design Solids Feed Flow Rates

Parameter	Design Capacity	2017-2019 Condition
Ave Annual Flow, gpd	96,577	57,300
Ave Annual Mass, lb/d	32,218	19,000
Max Month Flow, gpd	129,148	70,800
Max Month Mass, lb/d	43,084	25,000

*Mass loadings assume 4% total solids content of digester feed.

[2] In order to realize estimated capacities, operation of the digesters may require a shift to two thermophilic digesters, or feed of outside wastes directly to mesophilic digesters with lower loading rates.

ANAEROBIC DIGESTER – MODEL HAULED WASTE IMPACTS

The anaerobic digestion model of the existing process, developed during this evaluation of existing conditions, can be used to test the impacts of hauled waste on the treatment process. This analysis is used to evaluate the increased biogas potential, changes to volatile solids reduction efficiency, impacts on biogas hydrogen sulfide (H2S) content, and the potential struvite generation due to the addition of external organics.

The focus of the preliminary modeling exercise is evaluating general relationships and/or trends using the average annual operating condition. A base solids flow of roughly 61,000 gpd and a base TSS load of about 22,000 lb/d (corresponding to 25,000 lb/d COD load) is applied conservatively. This allows for a hauled waste addition between 0 and 10,000 lb/d of TSS corresponding to about 17,000 lb/d COD in about 20,000 gpd of feed flow (three to five hauled waste tanker trucks). The results of all the model scenarios tested (Base and hauled waste [HW] scenarios 1 through 10) are shown in Table 9.

The goal of adding external organics or hauled waste is to increase the biogas production potential from the digesters. The baseline model shows a biogas production rate between 80 and 100 scfm. With the addition of hauled wastes, the biogas production rate increases to between 100 and 150 scfm. The biogas increase corresponds to a biogas yield between 8 and 15 ft^3 per pound TSS added. In general, higher sulfur and phosphate content of the waste reduced the biogas yield due to competition for organics and reaction volume.

The sulfur load for the model conditions varied from 0 to 134 lb-S/d compared to the base sulfur load of 2 lb-S/d (base sulfur load derived from current H_2S concentration near 100 ppmv in digester). A high TSS to sulfur ratio in the hauled waste can dilute the hydrogen sulfide content of the biogas from the baseline of about 100 ppmv to 26 ppmv. A lower ratio between TSS and sulfur increased the sulfur concentration to 316 ppmv for the conditions modeled, but experience at other facilities shows higher ratios can result in over 2,000 ppmv of hydrogen sulfide in the biogas.

Impacts to struvite generation on digestion are also tested. Hauled wastes can contain both phosphorus and magnesium, both of which are key to struvite formation in the digesters. When testing a range of phosphorus load increases to the digester from 0 to 667 lb-P/d, the struvite generation potential increased by less than 5%. However, when magnesium loading increased, which is generally the limiting factor, the struvite production can increase over 100%. A significant magnesium content would be required, however, to create the strong impact to struvite production.

Table 9. Model Anaerobic Digestion Scenarios with External Organics (Hauled Waste) Additions

	Primary + Secondary Solids			Hauled Waste						Digester Impact			
Scenario	Flow, gpd	COD, lb/d	TSS lb/d	Flow, gpd	COD, lb/d	TSS, lb/d	Sulfur, lb-S/d	Magnesium, lb/d	Phosphorus, lb-P/d	VSR, %	Biogas, scfm	Biogas H_2S ppmv	Struvite, lb/d
Base	60,750	25,210	21,590	0	0	0	0	0.0	0	56.1	88.6	104.0	1,137
HW-1	60,750	25,210	21,590	5,000	4,172	2,608	4.2	0.0	41.7	59.8	113.2	26.0	1,124
HW-2	60,750	25,210	21,590	5,000	4,172	2,608	8.3	0.0	83.5	59.8	109.6	44.0	1,128
HW-3	60,750	25,210	21,590	5,000	4,172	2,608	16.7	0.0	167	59.9	102.3	75.5	1,131
HW-4	60,750	25,210	21,590	5,000	4,172	2,608	16.7	1.7	167	59.9	102.3	81.1	1,148
HW-5	60,750	25,210	21,590	5,000	4,172	2,608	16.7	3.3	167	59.9	102.3	81.1	1,164
HW-6	60,750	25,210	21,590	10,000	8,345	5,216	33.4	6.7	334	64.0	117.1	129.0	1,182
HW-7	60,750	25,210	21,590	15,000	12,516	7,823	50.1	10.0	500	67.2	132.2	158.0	1,199
HW-8	60,750	25,210	21,590	20,000	16,690	10,432	66.8	53.4	667	69.7	146.8	170.9	1,606
HW-9	60,750	25,210	21,590	20,000	16,690	10,432	66.8	106.8	667	69.7	146.3	168.6	2,129
HW-10	60,750	25,210	21,590	20,000	16,690	10,432	133.6	213.6	667	69.5	144.9	316.0	3,137

Facility Evaluation – Iowa City Landfill

The following sections provide a brief summary of the Iowa City Landfill facility and provides an overview of the existing landfill, an overview of the composting operations that take place on-site, a description of the landfill gas (LFG) collection and control system, known deficiencies of the existing LFG system, historical landfill gas recovery, and expansion and operational considerations.

Existing Landfill Overview

The Iowa City Landfill and Recycling Center is located at 3900 Hebl Ave. SW in Johnson County, Iowa. The landfill is owned and operated by the City of Iowa City, and began receiving waste in 1971. The facility serves Johnson County, Kalona and Riverside and accepts both residential and commercial waste haulers. In total, the landfill is approximately 400 acres in size and about half of the total footprint contains buried waste. The remaining land is primarily used for wetlands and as a buffer for surrounding properties. The facility is considered an Environmental Management System by the Iowa Department of Natural Resources (DNR), and offers community composting and educational opportunities.

The current total permitted waste disposal capacity is approximately 7.71 million tons of municipal solid waste (MSW) for all cells. Based on historical waste disposal quantities, it is estimated that approximately 4.46 million tons of MSW are currently disposed of within the landfill as of June 30, 2019. **Recent records show that approximately 135,000 tons of waste is disposed of annually.**

The waste cell layout and other features of the landfill can be found in Attachment A, which was provided by the City. The overall development of the landfill has been constructed in phases that have generally progressed in a clockwise direction, with the first cell (FY72) being constructed in the northern portion of the site in 1971 and the FY06 cell constructed south of the FY74 cell. Cells FY09 and FY18 have deviated from the clockwise orientation and were constructed west of the FY95 through FY02 cells. Cells FY72 through FY91 were constructed prior to promulgation of Subtitle D and are currently closed while cells FY95 through FY18 were constructed after issuance of Subtitle D and are currently open for future waste disposal.

Currently waste filling operations are in Cells FY09 and FY18, with construction of future North Cells, the first of which is scheduled for development within the next seven (7) years. Future expansion into the areas denoted “Future North” and “Future Northwest” in Appendix A, will be comprised of approximately 16 to 17 years of site life that should achieve the full 7.71 million ton capacity of the site. **Current life of site estimates show the landfill continuing to accept waste through approximately January 2043**.

Composting Overview

The City owns and operates a wind-row type composting operation at the landfill where yard waste and food waste are composted into a soil amendment. **The composting operation manages approximately 9,000 tons of incoming waste material annually**. The incoming material is composted at the landfill within an approximate 4-acre area located on the north side of the landfill on top of the FY73 and FY74 cells, with a portion of the operations located just west of these cells. **The site produces approximately 1,900 tons of compost product and**

2,200 tons of wood chips on an annual basis. The compost and wood chips are available at the landfill to businesses and the general public. There is a minimal cost for the compost and the wood chips are made available at no cost.

Discussions with the City indicates that the composting operation is operating at capacity based on the current available footprint area designated for composting at the landfill. If additional organic material was either collected or diverted from the landfill towards composting, a new larger area for composting would need to be identified. Ideally, the composting operation would stay at the landfill to maintain synergies with staffing, equipment operations, and material drop-off. **These planning considerations serve to limit the design composting capacity into the future to the currently through-put rate of approximately 9,000 tons of incoming waste material annually.**

Landfill Gas Collection and Control System

The City utilizes an active LFG collection and control system at the landfill, which consists of a series of vertical gas extraction wells and horizontal collectors installed within the landfill footprint. Once LFG is collected within the extraction points, it is conveyed to a blower/flare station by a network of lateral and header pipes.

The initial LFG collection system components were installed in 2000, and went online the following year. Components of the initial LFG collection system installation consisted of 37 gas extraction points (vertical wells and horizontal collectors) which were installed primarily within the pre-Subtitle D area of the site. In 2009, the system was expanded, with 9 horizontal trench collectors installed and connected to the LFG system. LFG connections to the leachate system risers were also constructed at this time. The LFG is routed to the blower/flare station located on the north side of the landfill on top of the FY73 cell (see Appendix A). The original LFG flare and blowers were replaced in 2016 and the existing system consists of a 46.5 million British Thermal Units per hour (MMBTU/h) enclosed ground flare manufactured by Perennial Energy, LLC. (PEI). The new blowers are rated for 85 inches of water column pressure differential and total flow rates between 155 and 1,550 standard cubic feet per minute (scfm) and are manufactured by National Turbine. Components of the LFG system are also presented in Appendix A.

Although not shown in the Appendix A, there are several operations layer horizontal collectors that were installed at the bottom of the FY09 cell that extend west to east across the cell. The wells are connected to the LFG system near wells GW-09G and GW-09F on the west perimeter of cell FY09.

The landfill is currently subject to the New Source Performance Standards (NSPS) promulgated under 40 Code of Federal Regulations (CFR) Part 60, Subpart XXX as it has commenced construction, reconstruction, or modification after July 17, 2014. It is also subject to the National Emission Standards for Hazardous Air Pollutants (NESHAP) Subpart AAAA, promulgated under 40 CFR 63. The landfill gas system has been installed to comply with the 40 CFR Part 60, Subpart XXX requirements. The facility is also subject to the Mandatory Reporting Rule (MRR) for greenhouse gases (GHG) promulgated under 40 CFR 98.

Landfill Gas System Operations and Maintenance

The existing LFG system at the landfill is operated and maintained by City personnel. Monitoring of the LFG system wells and piping is necessary to collect operational data and is typically performed on a monthly basis to tune the wellfield and maintain compliance with regulatory requirements. Maintenance is performed on an as-needed basis to correct deficiencies within the LFG system and supporting infrastructure. Typical operation and maintenance activities include the following:

- Monthly monitoring and tuning of each LFG wellhead for temperature, pressure and gas concentrations.
- Re-checking LFG wellheads that have exhibited regulatory exceedances.
- Inspection and routine repair of wellheads, flexible hosing, and exposed piping.
- Inspection and routine repair of condensate management infrastructure such as sumps and pumps.
- Monitoring of flow rates and LFG concentrations at the blower flare station.
- Inspection and routine repair of leachate extraction and pumping equipment installed within LFG wells.

Non-routine actions may include replacing or raising wellheads, troubleshooting of pipe blockages, excavation and replacement of piping sections, repair of sumps or pumps, and other minor construction related items.

Existing Landfill Gas System Deficiencies

From discussion with City staff there are a number of known deficiencies within the existing LFG collection and control system. A summary of these reported deficiencies are described in detail below:

- There is a remote sump located near the intersection of the FY83 and FY98 cells near the eastern central portion of the landfill that connects to the north/south traversing center main header. This sump has historically had issues with drainage that has impacted flow to several LFG extraction wells in the area. Although this problem is located near the middle of the center main header, it has not caused significant blockage issues for the LFG system.

- Just south of the remote sump near the overlapping area of FY86 and FY98 cells is an area that has historically experienced elevated concentrations of fugitive emissions during routine surface emission monitoring scans. This area is located between wells GW-126, GW-131, GW-315, GW-316, and GW-318. This area is approximately 0.75 acres in size.

- Based on historical readings, there is limited vacuum available at the southern end of the east main header within the FY91 cell. This has inhibited gas recovery in the FY91 cell but is expected to be addressed in the near future.

- Existing gas wells GW-209 through GW-216 are off-line and not actively collecting LFG. These wells are located on the southwestern portion of the landfill within the FY95, FY96, and FY98 cells. These 8 wells were required to be abandoned as waste filling operations in the area progressed above the well heights such that they could not be extended and utilized in the future. It is anticipated that new wells within this area would need to be installed in the future after waste filling has moved from the area.

- Existing gas wells GW-201 through GW-208 are currently actively collecting LFG. However, these wells will need to be abandoned in the future similar to wells GW-209 through GW-216 as filling progresses northward from FY09 to FY18 and into the future north cells that have not yet been constructed. Similarly, it is anticipated that new wells within this area would need to be installed in the future after waste filling has moved from the area.

Historical Landfill Gas System Recovery

Historical LFG recovery from initial system operation in 2001 through 2014 not provided for this evaluation and were estimated based on an assumed LFG recovery efficiency of 60 percent based on the approximate coverage area of the gas system. The average LFG recovery flow rate during 2001 through 2014 was estimated to be approximately 480 scfm.

Actual LFG recovery flow data was provided by the City from December 2015 through December 2019. During 2015 and 2016 the system was operating at an average of approximately 630 scfm. From 2017 to 2019, the average flow rate increased to approximately 850 scfm during the past three years. The 2017 through 2019 enhanced gas recovered rates are believed to be attributed to the new flare and blowers that were installed in 2016.

Additional information regarding historical and future LFG system recovery data will be presented in the forthcoming LFG Recovery Technical Memorandum.

Landfill Gas System Expansion Planning

The following section provides a brief description of known LFG system expansion based on discussion with City staff and future planned activities. Each of the planned activities as described by the City are provided in detail below:

- In an attempt to address low vacuum being observed in the header line adjacent to well GW-136 at the southern end of the landfill in cell FY91, a new header line is planned for installation to connect the center main header and the east main header lines near GW-135 to the west header line near GW-09B. Installation of this piping will create a looped header system that will allow more routes for the LFG collected on the southern end of the landfill to reach the blower/flare station and should increase the available vacuum to wells in the area, thereby increasing the LFG recovery from this area.
- After construction of the future north cell(s), a new west header line will be installed from the blower/flare station to the west around the future north cell(s) and traverse the perimeter of the FY18, and FY09 cells. The west header line will connect to the existing gas infrastructure in place at the FY09 cell and promote gas capture in the FY18 and future north cell(s). Although this expansion is not anticipated for some time, it will continue to enhance gas recovery at that time and into the future.
- New vertical LFG wells are typically installed periodically as cell expansion and waste filling progresses across the landfill. In general, LFG wells are installed approximately every 5 years to maintain adequate system coverage and regulatory compliance.

Conclusion

Based on the planning efforts outlined above the collection efficiency of the existing and future LFG collection system should generally improve and that future landfill expansions will incorporate LFG collection efforts in a timely manner and in accordance with regulatory requirements. The existing LFG system has capacity to collect more LFG as the landfill grows and additional waste is disposed of. The existing capacity of the blower and flare is anticipated to be sufficient for the fully permitted future buildout of the landfill, but this will be fully evaluated in the forthcoming LFG Recovery Technical Memorandum. Additional details regarding the LFG generation and recovery estimate will be included in the upcoming memorandum, which will provide quantitative values for determining the feasibility and evaluation of beneficial use projects.

Conclusion paragraph here – can you take the above planning and make the case that collection efficiency will generally improve and that future landfill expansions will be installed with LFG collection in a timely manner? And will they still generally be within the capacity of the existing blower/flare? You may need to stop short of saying these things, but need to end similar to the WWTP section, with a statement that there is room to collect more LFG commensurate with the growth of the landfill, and that details of generation/collection will be provided and estimated into the future in the following TM to provide quantitative values for fueling a beneficial use project.