2015 Wastewater Engineering Study

Digester Structural Evaluation • Energy Conservation Evaluation

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LaBella No 214393
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Table of Contents

Section 1 – Introduction

Section 2 – Digester Structural Evaluation

Section 3 – Energy Conservation Evaluation

This project was developed in accordance with all applicable state and federal requirements, including that the project is sufficiently complete in accordance with all project contracts and that the project can be utilized for its intended purposes.

List of Figures and Tables

List of Appendices

Section 1 – Introduction

1.1 Problem Definition

The Village of Webster operates a Wastewater Treatment Plant (WWTP) that includes two digesters as part of their solids handling process. One digester is approximately 50 years old and the second is 80 years old. Both concrete digesters exhibit cracking with some weeping of sludge through the walls. The digester heat exchanger is also approximately 50 years old.

The Village would like to investigate the condition of the digesters and associated heating equipment to develop recommendations for improvements that would correct perceived structural deficiencies and replace antiquated equipment that has exceeded its useful service life. In addition, the Village would like a review of the overall plant and equipment to seek opportunities for gains in energy efficiency that can provide cost savings.

1.2 Scope of Work

The Village of Webster has commissioned LaBella Associates, DPC to conduct an Engineering Study of their WWTP. The study objectives include the following:

- Investigate the structural condition of the digester tanks and recommend improvements to correct deficiencies prior to a significant failure.
- Investigate and recommend upgrades for the digester gas fired heating equipment.
- Examine plant buildings and equipment to seek opportunities for cost effective gains in energy efficiency. Review plant operations and practices to seek energy savings.

To achieve the above objectives, LaBella's scope of work consists of the following tasks:

- Perform field investigation of digesters and related solids handling equipment (including a structural and process review).
- Perform field investigation of digester heating equipment as well as the overall plant to seek opportunities in energy efficiency (including a mechanical, electrical, and process review).
- Identify needs and recommend improvements for:
  - ➢ Structural improvements for digesters
  - ➢ Mechanical improvements for digester heating equipment
  - ➢ Mechanical, electrical, and/or process improvements to improve energy efficiency
- Summarize field investigations and recommendations in a report with appropriate cost analyses.

1.3 Process Description

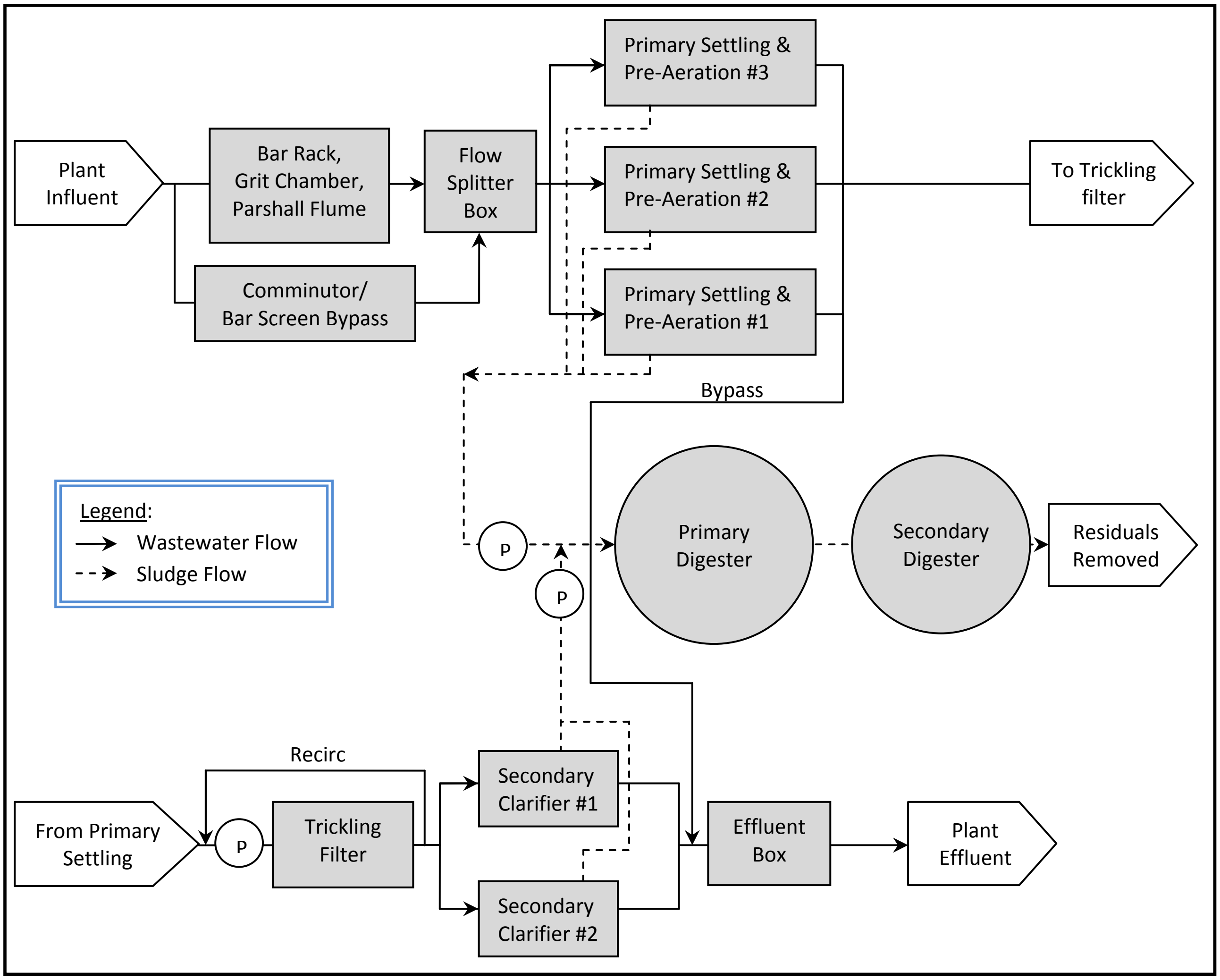
The Village of Webster operates a WWTP at 613 Webster Rd near the intersection with Wall Rd. The WWTP has a rated capacity of 2.5 mgd, with normal flows of 2.0 mgd and wet weather peak flows as high as 6-8 mgd. The WWTP is a secondary treatment facility consisting of the following unit treatment processes:

- Mechanical Bar Screen
- Pista Grit Chamber, Grit Concentrator, & Screw Conveyor
- Three (3) Primary Settling & Pre-Aeration Tanks
- Trickling Filter and Pump Station
- Two (2) Secondary Clarifiers
- Effluent Box
- Primary Digester
- Secondary Digester
- Centrifuge
- Covered Sludge Beds

These processes are shown in a process flow diagram and site overview diagram in **Figures 1.1** and **1.2**, respectively. The WWTP also includes the following support facilities:

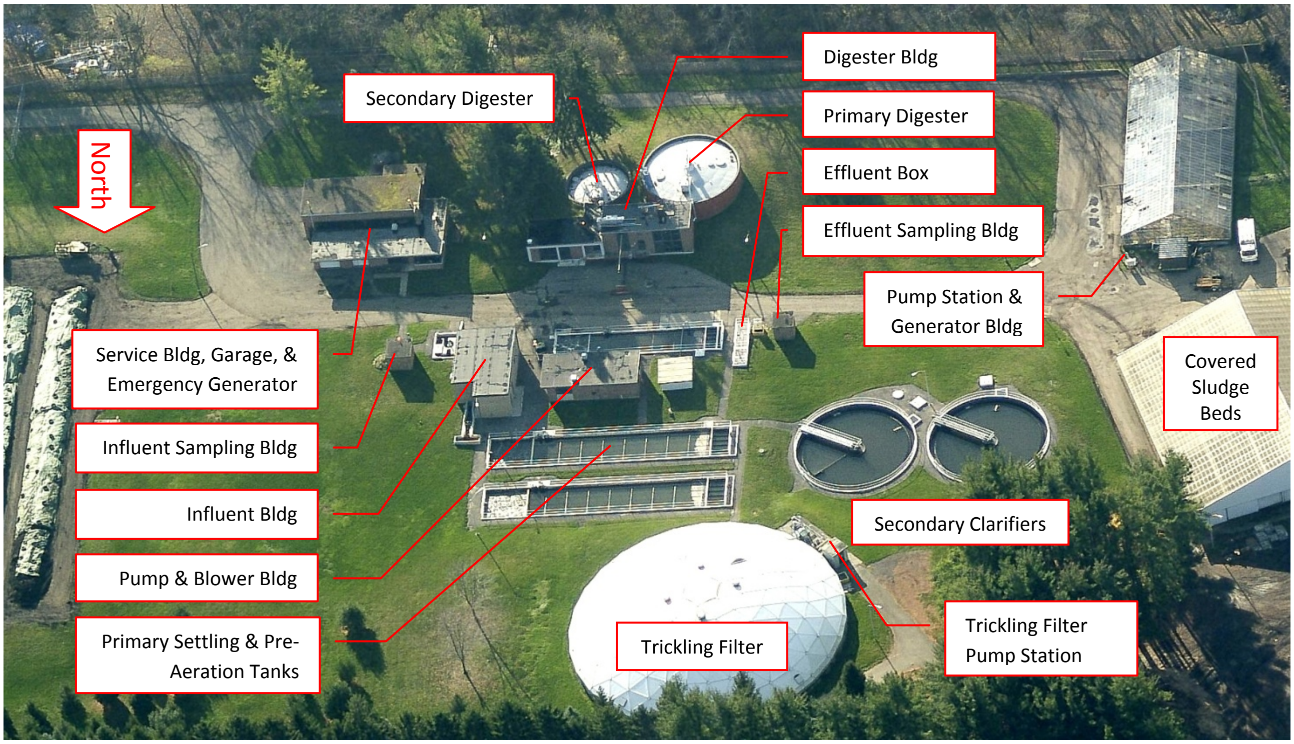
- Service Building: Supports laboratory and O&M activities
- Influent Building: houses bar screen and grit chamber equipment
- Digester Building: Houses boiler & heat exchanger for primary digester, process piping for digesters, and centrifuge
- Pump & Blower Building: Houses blowers for pre-aeration tanks and primary and secondary sludge pumps
- Influent Sampling Building: Houses influent 24-hr sampler, pH meter, and flow meter
- Effluent Sampling Building: Houses effluent 24-hr sampler and primary settling sampler
- Pump Station: Pumps site sewage, the clarifier drains, & digester supernatant back to the headworks of the plant

Figure 1.1: Process Flow Diagram



Raw wastewater flows by gravity from the village to the WWTP via a 24" sewer to the influent building. It passes through a mechanical bar screen and Pista grit chamber and continues by gravity through a Parshall Flume and into the flow splitter box. From there flow is distributed between three (3) primary settling and pre-aeration tanks. The primary tanks remove settleable solids and floatable material. Effluent flows by gravity from the primary tanks to a wet well for the trickling filter. Duplex pumps convey wastewater to the trickling filter. Trickling Filter effluent flows by gravity to two (2) secondary clarifiers. The effluent from the clarifiers flows to the effluent box and discharges to the effluent pipe. The effluent pipe passes through the Town of Webster's WWTP where flows from both plants are combined prior to disinfection and discharge to Lake Ontario.

Figure 1.2: WWTP Site Overview



The Village's WWTP uses the anaerobic digestion stabilization process. Waste sludge from the primary tanks and the secondary clarifiers is pumped to the primary digester where it is heated and mixed via recirculation pumping. The digested sludge is then transferred to the secondary digester for further thickening and storage. Sludge drawn from the secondary digester is then dewatered by means of a centrifuge prior to transfer to the sludge beds.

Both digesters utilize floating covers to collect the methane gas. The digester gas is used as fuel for the boiler and heat exchanger. Natural gas is used as a secondary fuel source when there is insufficient methane available.

The sludge pumps, piping, and centrifuge appears well maintained and in good condition. The concrete digester tanks show weathering, cracking, and some leaks; see **Section 2** for Digester Structural Evaluation. The boiler and heat exchanger for the primary digester is original equipment, approximately 50 years old; see **Section 3** for Energy Conservation Evaluation.

1.4 Discharge Permit and Effluent Data

The Village's WWTP shares an outfall with the Town of Webster's WWTP. The Town of Webster holds the SPDES Permit (#NY-0021610) to discharge to Lake Ontario, and is effective through April 30, 2016. The Village holds a 'Significant Other User Permit' with the Town and is re-issued annually. The significant Other User Permit includes the following discharge limits:

Table 1.1: Summary of Permit Effluent Requirements

Parameter	Effluent Limit	Type
BOD5	30 mg/l	Monthly Avg
TSS	30 mg/l	Monthly Avg
Settleable Solids	0.3 ml/l	Daily Max
pH (Range)	6.0 – 9.0 su	Range
Nitrogen, Ammonia (as NH3)	15.0 mg/l	Monthly Avg
Phosphorus, Total (as P)	1.0 mg/l	Monthly Avg

The historical wastewater characteristics for the WWTP are reported on the monthly Discharge Monitoring Reports (DMR's), submitted to the Town of Webster in accordance with the Significant Other User permit. The DMR reports the following wastewater data:

- Daily average flow, influent and effluent temperature, influent and effluent pH (minimum and maximum), and influent and effluent settleable solids
- Influent and effluent BOD5 and suspended solids (2/week)
- Influent and effluent Phosphorus (1/week)

In addition to the DMR's, laboratory analysis reports for the following parameters are provided to the Town of Webster:

- Effluent Ammonia (2/week)
- Effluent Copper, Nickel, Zinc, Selenium, and Chromium (4/year)
- Effluent Methylene Chloride; 1,1,1-Trichloroethane; and 1,2-Trans, dichloroethylene (2/year)
- Influent and effluent Mercury (1/year)

The information reported on the DMR's for the past three years (Mar 2012 through Feb 2015) is summarized in **Table 1.2**.

Table 1.2: Summary of WWTP Effluent Data

Parameter	Minimum	Average	Maximum	Type
Flow (gpd)	0.919	1.316	2.027	Monthly Avg
BOD5 (mg/l)	10.1	21.6	35.6	Monthly Avg
TSS (mg/l)	5.0	11.3	36.4	Monthly Avg
Settleable Solids (ml/l)	0.1	0.11	2.0	Daily Max
pH (su)	6.3	7.29	7.8	Range
P (mg/l)	0.26	0.49	0.78	Monthly Avg

Section 2 – Digester Structural Evaluation

Meagher Engineering, PLLC performed the structural evaluation of the digesters for this study. They documented the details of their work, including field observations, material testing, evaluation, and repair methods for consideration in a report, which is presented in **Appendix A**. Much of the following was developed during the course of their evaluation.

2.1 Evaluation Approach

The original approach for structural inspection of the digester tanks was to dewater and power wash the interior of each tank (by the Village), then perform a structural inspection of the interior and exposed portions of the exterior of the tanks. The Village received a quote from a contractor to perform the dewatering, cleaning, and confined space services, and it was clear that it was far too expensive of an endeavor for this study. Therefore, the structural evaluation was performed with the tanks full and without direct observation of the interior or below grade portions of the tanks. The accessible portions of the tanks represent only 15-25% of the tank surfaces. Assumptions had to be made during the development of recommendations.

The structural evaluation included field observations of tank conditions, hammer sounding, concrete core sampling and compressive strength testing within the accessible portions of the tanks. Field observations and testing data were used to develop an opinion of the structural soundness of the tanks and identify potential repair options.

2.2 Existing Conditions

The primary digester is a 45' diameter concrete tank with a floating steel cover. This digester was constructed in 1964. Record drawings indicate that the side walls are 33'-8" high and the tanks is 38'-8 ¾" deep at the center. The bottom is sloped towards the center with a 1'-9" thick bottom slab. The side walls are 1'-8" thick at the base and incrementally reduce to 1'-1" thick at the top of the tank. The bottom portion of this tank is covered by an earthen berm, and the upper 8-12' is exposed to the outdoors. A 12-14' wide section of the tank abuts the Digester Building and is observable from inside the building.

The secondary digester was originally a concrete Imhoff Tank constructed circa 1934. Record drawings indicate that it was converted to a digester in 1956 when all interior struts, beams, baffles, walks, and other protuberances of the Imhoff Tank were removed. The tank has a 30' inside diameter at the top and 28' diameter at the base. The side walls are 24'-4" high and the tank is 28'-6" deep at the center. The bottom is sloped towards the center with a 2' thick bottom slab. The side walls are 2' thick for the bottom 10'-4" of the tank, and are 1' thick for the top 14' of the tank. The majority of the exterior sidewalls of this tank are covered by an earthen berm with the exception of a small section at the top and an 8' wide section of the tank that abuts the Digester Building. This portion of the tank's exterior can be observed from inside the building. Record documents suggest that the floating steel cover was installed in 1958 and possibly upgraded or replaced in1967.

Table 2.1 summarizes when the digesters and related components were constructed. Relevant digester record drawings are provided in **Appendix D**.

Table 2.1: Summary of Digester Construction History

Year	Digester Construction
1934	30' diameter smaller digester was originally constructed as an Imhoff Tank. This structure is currently the secondary digester.
1956	Imhoff tank converted to a digester and east portion of digester building was constructed. Heat exchanger for digester was installed. All interior struts, beams, baffles, walks, and other protuberances of Imhoff tank were removed (leaving the tank clear & clean). Vendor information indicates floating steel cover was installed in 1958.
1964	45' diameter larger digester (primary) and west portion of digester building was constructed. Heat exchanger for larger digester was installed. Specifications indicate that steel floating cover was installed (presumably on the new larger digester).
1967	Record drawings suggest that a gas recirculation system and compressor housing was installed on both digester covers and that a new "deck" / roof may have been installed on smaller digester.
1979	Digester piping was reconfigured, sludge recirculation pumps for the primary digester were replaced, and the heat exchanger for the secondary digester was removed.

The structural inspection revealed the following:

Primary Digester

- Structural cracks at cold joints (above grade)
- Shrinkage cracks (above grade)
- Only about 20-25% of tank is visible for inspection
- Multiple layers of paint chipping on exterior
- Concrete below grade in better condition
- Moderate / severe seepage of sludge liquid through full penetration cracks
- Approximately 50 years old

Secondary Digester

- Structural cracks perpendicular to wall; full penetration
- Pitted and weathered surface
- Multiple layers of paint chipping on exterior
- Majority of tank is buried
- Concrete below grade in better condition
- Exposed area of tank inside digester building: moderate / severe structural cracks with seepage of sludge near pipe penetrations
- Approximately 80 years old

Although there are several issues with both tanks (i.e. moderate /severe structural cracks, weeping of content, shrinkage cracks, failed exterior paint etc), the structural evaluation indicated that the digesters can be repaired to restore their structural integrity, stop the leaks, and extend their service life. Additional details of the structural inspection and evaluation are presented in **Appendix A**.

2.3 Alternatives Considered

Alternatives for addressing the issues with the digesters fall into three categories:

A. Do nothing
B. Replace the digesters
C. Rehabilitate the digesters

The 'do nothing' alternative was withdrawn from consideration because it would portend failure of the digesters. The moderate / severe structural cracks that are weeping content are expected to continue to degrade at an accelerated rate, and will ultimately fail. If improvements are not made to the digesters, the Village may be faced with an emergency cleanup, trucking of sludge to another facility, and unplanned construction.

A conceptual opinion of probable project cost is $2.275 million to replace both digesters in kind. Although replacement of the digesters is a viable alternative from a technical perspective, it would cost on the order of 2 times that of rehabilitation.

Rehabilitation of the digesters was considered at length during the course of the structural evaluation. **Table 2.2** summarizes the structural repair options considered.

Table 2.2: Summary of Structural Repair Options

	Option 1	Option 2	Option 3
Interior Repairs	Disassemble gas collection piping and remove floating cover	Disassemble gas collection piping and remove floating cover	Disassemble gas collection piping and remove floating cover
	Dewater digester and clean	Dewater digester and clean	Dewater digester and clean
	Inject large cracks with epoxy adhesive	Inject large cracks with epoxy adhesive	Omit injecting cracks with epoxy adhesive
	Install carbon fiber reinforcing straps in portion of tank that is above grade	Install carbon fiber reinforcing straps in portion of tank that is above grade	Install carbon fiber reinforcing straps in portion of tank that is above grade
	Apply 2-3" shotcrete to entire interior of tank – add waterproofing compound to shotcrete mix	Apply flexible cementitious waterproof coating with heavy duty reinforcing fabric to the interior surface of the tanks.	Apply flexible cementitious waterproof coating with heavy duty reinforcing fabric to the interior surface of the tanks.
Exterior Above Grade Repairs	Remove all existing paint	Remove all existing paint	Remove all existing paint
	Remove all loose concrete	Remove all loose concrete	Remove all loose concrete
	Inject large cracks with epoxy adhesive	Inject large cracks with epoxy adhesive	In lieu of epoxy injection, reinforce large cracks with carbon fiber reinforcing straps
	Fill cracks and defects with a Sika concrete repair product	Fill cracks and defects with a Sika concrete repair product	Fill cracks and defects with a Sika concrete repair product
	Paint exterior to seal concrete with waterproof coating	Paint exterior to seal concrete with waterproof coating	Apply flexible cementitious waterproof coating with heavy duty reinforcing fabric to the exterior surface of the tanks (same coating as interior)

Shaded steps are identical to that of the previous option.

All three structural repair options involve some form of structural repair to the interior of the tank through a combination of epoxy injection of structural cracks, installing carbon fiber straps, and applying a cementitious shotcrete mortar or a cementitious water proof coating with heavy duty reinforcing fabric. All three options also include exterior repair through a combination of epoxy injection of structural cracks or reinforcement of large cracks with carbon fiber straps, filling defects with a repair mortar, and applying either an elastomeric or flexible cementitious water proof coating.

Although the structural repair options summarized above consider varying materials and products, they are similar in that structural cracks will be repaired and a waterproof coating will be applied. Additional sealing options to consider during final design of improvements include a flexible urethane liner (60-120 mils) with a resurfacing mortar, or a rigid cure epoxy liner.

A typical rehabilitation for the digesters would include the following general steps:

- Remove sludge
- Disassemble gas collection piping
- Remove floating cover
- Sandblast or use ultra high pressure water blasting to prepare concrete
- Detailed saw cutting of isolated areas of poor concrete
- Install carbon fiber reinforcing straps on interior for portion of tank that is above grade
- Crack injection: epoxy for structural cracks and urethane for leaks
- Spray applied and trowel finished repair mortar (water cure cement mortar)
- Interior liner: either a flexible urethane liner with a resurfacing mortar or a rigid cure epoxy liner
- Remove existing paint and loose concrete from exterior
- Apply repair mortar to exterior as required
- Apply waterproof sealant or flexible cementitious coating to exterior
- Recondition and reinstall floating cover and gas piping

The conceptual opinion of probable project cost for the rehabilitation of both digesters is $1,190,000 (see **Appendix B**). This is approximately 50% of the cost to replace the digesters. Therefore, rehabilitation is the selected alternative.

2.4 Engineering Criteria

The proposed alternative consists of rehabilitation of existing digesters to extend the life of the concrete tanks. Although it does not involve process selection or replacement of an existing process, the design criteria outlined in the *Recommended Standards for Wastewater Facilities, 2004 Edition* will be considered during the final design of improvements as well as the requirements and approval conditions of the NYS Department of Environmental Conservation. In addition, the relevant standards of the American Concrete Institute (ACI) will be observed.

2.5 Impact on Existing Wastewater Facilities

Rehabilitation of the digesters will require taking one digester at a time out of service to perform the rehabilitation. It is assumed that the primary digester would be rehabilitated first and that approximately 30% of the sludge can be reduced via on-site processing by the operator. After the primary digester is rehabilitated, a small portion of the contents of the secondary digester can be pumped to the primary for seeding. It is assumed that almost the full contents of the secondary digester will require dewatering and disposal.

Although only the primary digester is heated under normal operating conditions, both digesters are capable of being heated. It is expected that the secondary digester will be heated while the primary is out of service.

Once construction starts, it is envisioned that all in-process sludge generation (i.e. sludge in the primary tanks and secondary clarifiers) can be managed on-site by a combination of increased storage, recycling, and on-site processing.

2.6 Environmental Review

The digesters and related project area are within the confines of the Village's WWTP facility. Construction operations will be limited to the area immediately surrounding the digesters with incidental disturbance to soil or surrounding vegetation. The digesters are not in a flood plain or a state or federal designated wetland. There do not appear to be any significant environmental resources that will prohibit rehabilitation of the digesters.

The existing digesters have floating steel covers. Older floating covers may have been coated with a coal tar and/or lead based primer. In addition, some coal tars contained asbestos. Lead and/or asbestos abatement may be required if disturbance of the existing coatings is required.

Section 3 – Energy Conservation Evaluation

LaBella Associates, DPC performed the energy conservation evaluation for this study. The details of this work are documented in a report, which is presented in **Appendix C**. The following summarizes the evaluation.

3.1 Evaluation Approach

The Village of Webster engaged LaBella to evaluate the Village WWTP to investigate and recommend upgrades for the digester gas fired heating equipment and determine cost effective ways to maximize energy efficiency and improve building performance. A site survey was conducted by mechanical and electrical engineers to determine building conditions and collect inventory data on major energy consuming systems, such as HVAC and lighting. LaBella reviewed the energy bills for the buildings on the property and met with the Village maintenance staff to develop an understanding of the energy profile of the facility.

After analyzing these factors, a list of potential energy conservation measures (ECM's) was developed. Each measure that was considered feasible was then studied in depth to establish associated costs, energy savings, and simple payback periods. The measures that were studied included:

- Heating hot water system upgrades to high efficiency (condensing boiler) system,
- Controls upgrades,
- Retrofitting fixtures and lighting controls,
- Building envelope upgrades,
- Digester heater upgrades, and
- Power generation with photovoltaic solar panels.

Based upon payback and required capital expenditures, recommendations were made for each measure studied.

3.2 Alternatives Considered

A summary of energy conservation measures considered along with recommendations of which measures to implement are provided in **Table 3.1**. The details of the evaluation of each measure and energy calculations are provided in **Appendix C**.

Table 3.1: Summary of Energy Conservation Measures Considered

Measure Description		Fuel Saved	kW Saved	Annual Energy Savings		Annual Cost Savings	Cost Estimate	Simple Payback	Status
				kWh	Therms				
ECM-1	Upgrade to High Eff Boilers	NG	0	0	48,022	$ 10,649	$ 21,300	2.0	MR/R
ECM-2	Upgrade Indoor Lamps	Elec	3.01	4,031	0	$ 485	$ 10,200	21.0	NR
ECM-3	Install Occupancy Sensors	Elec	0	254	0	$ 31	$ 1,800	59.0	NR
ECM-4	Indoor Lamp and Occupancy Sensors	Elec	3.01	4,285	0	$ 514	$ 12,000	23.3	NR
ECM-5	Streetlights to LED	Elec	2.66	8,751	0	$ 1,050	$ 9,600	9.1	R
ECM-6	Outdoor Wallpacks to LED	Elec	0.53	1,725	0	$ 207	$ 2,600	12.6	R
ECM-7	Thermostat Management	Elec/NG	0	1,500	525	$ 255	$ 4,900	19.2	R
ECM-8	Bldg Envelope Improvements	NG	0	70	115	$ 32	$ 6,200	193.8	NR
ECM-9A	Replace Digester Methane Boiler	NG	0	0	32,175	$ 7,133	$ 477,000	66.9	MR
ECM-9B	Replace Heater w/ Microturbines	Elec/NG	133	561,040	48,022	$ 59,085	$ 1,306,500	22.1	NR
ECM-9C	Add High Efficiency Boiler	NG	0	0	4,109	$ 911	$ 223,500	245.3	NR
ECM-10	Generate Electricity with PV Panels	Elec	TBD	55,000	0	$ 8,800	$ 213,000	24.2	R
Grand Total - All Measures			142.01	636,656	132,968	$ 89,151	$ 2,288,600	25.7	
Grand Total - Recommended Measures			3.19	66,976	48,547	$ 20,961	$ 251,400	12.0	

Notes:
Measure Status: Implemented (I); Recommended (R); Recommended Study (RS); Not Recommended (NR); Maintenance Replacement (MR)
Fuel Saved: Elec, NG=Natural Gas, Oil2, Oil4, Oil6, Coal, LPG. MMBtu = 1,000,000 Btu

The total capital net cost of all recommended energy conservation measures is $251,400. These recommendations will save approximately $20,961 in energy costs per year, with an estimated combined payback of 12.0 years. The annual energy savings will be 66,976 kWh and 48,547 therms, with a reduction of demand of 3.19 kW. The above recommended ECM's are primarily based on payback period.

In addition, the digester heater and heat exchanger has reached the end of its useful life and requires replacement (ECM-9A). Replacement of the digester heater with microturbines (ECM-9B) is not considered viable for a 2.0 mgd WWTP. An alternative to replacement-in-kind would be to provide two separate boilers – one methane boiler (80-82% efficiency) and a high-efficiency natural gas condensing boiler (85-95% efficiency). An interim step could be to provide a high efficiency condensing boiler in the short term (ECM-9C). If ECM-9C were to be implemented, the eventual replacement of the existing heater could be a methane-only boiler.

3.3 Engineering Criteria

Energy savings were calculated using Trane Trace 700 Building Modeling Software, based on DOE-II algorithms and ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Standard 187-2007 “Cooling and Heating Load Calculations”.

Energy Savings Calculations were also based on the “New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs” published by the New York Department of Public Service in October 2010.

The recommended improvements include replacement of existing heating systems. The guidelines of ASHRAE as well as the Energy Conservation Construction Code of New York State will be observed during the final design of improvements.

3.4 Impact on Existing Wastewater Facilities

The recommended energy conservation improvements that involve lighting upgrades and building heating system upgrades will not impact the wastewater treatment process. The replacement of the digester heater will require a short duration shutdown of the heater during switchover of equipment and piping connections. This will require pre-processing of sludge to increase the amount of available storage in the digesters while the heater is offline.

3.5 Environmental Review

The existing digester boiler and related piping likely includes asbestos. Asbestos abatement will be required during equipment replacement.

Section 4 – Conclusions and Recommendations

The following conclusions and recommendations are based on the analyses reported herein:

Digester Rehabilitation

- The structural evaluation indicated that the digesters can be repaired to restore their structural integrity, stop the leaks, and extend their service life.
- A caveat to this opinion is the fact that only 15-25% of the tanks could be accessed for the inspection. Therefore, the extent of structural repair required for the inaccessible portions of the tanks is unknown until the digesters are dewatered. Assumptions were made during preparation of an opinion of probable project cost.
- Rehabilitation as outlined in Section 2.3 is the recommended alternative. The opinion of probable project cost is $1,190,000.
- Available record drawings of the floating steel covers do not show significant detail on their construction. These types of covers typically consist of a steel plate dome, a steel plate floor, and an interstitial space in between with a truss support system. If the covers leak (i.e. gas under the cover leaking into the interstitial space), then corrosion may exist. The interior of the floating steel covers should be inspected for potential corrosion issues during the design phase of the rehabilitation project.
- The existing floating steel covers may be coated with a coal tar that includes asbestos and/or a lead based primer. The design phase of the rehabilitation project should include testing for lead and asbestos during an inspection for potential corrosion on the interior of the covers. Existing coatings on the concrete tanks should also be tested. Lead and/or asbestos abatement may be required if disturbance of the existing coatings is required.
- There are many types of repair mortars (cementitious, polymer-modified cementitious, resin-based, and cementitious shotcrete) and liners (flexible polyurethane, polyurea, PVC, and non-flexible epoxy) on the market. Each type of repair mortar and liner has their use and there are trade-offs in ease of application, material costs, and substrate preparation costs. The Village may wish to include a coating and lining specialist during the design and construction phases of the rehabilitation to assist in selection and specification of the final repair products.

Energy Conservation

- After a review of the mechanical and electrical systems at the WWTP, the following energy conservation measures and their associated opinion of probable project cost are recommended to be implemented:

ECM-1	Upgrade Service Bldg to High Efficiency Boiler	$21,300
ECM-5	Change HPS Street Lighting to LED	$9,600
ECM-6	Change Exterior Wallpacks to LED	$2,600
ECM-7	Thermostat Management	$4,900
ECM-10	Generate Electricity with PV Panels	$213,000
	Total Recommended ECMs	**$251,400**

- In addition, the digester heater is at the end of its useful life. Alternative 9A – replacement-in-kind, or Alternative 9C – augment the existing heater by adding a high efficiency condensing boiler are viable alternatives. Alternative 9C includes a fully redundant system with heat exchangers and pumps, and could serve as a back-up to the existing digester heater if it fails. We recommend that the lower cost ECM-9C be implemented. The opinion of probable project cost for this ECM is $223,000.
- A smaller capital project for ECM-9C could be initiated by interfacing the boiler more closely with the existing digester heater – through the use of the existing heat exchangers and pumps. However, this would not provide the advantage of having a backup, fully redundant, digester heating system.
- If sufficient excess Methane is generated, interconnection of the digester heater and service building heating system should be considered. The additional cost of piping and equipment to interconnect the systems should be weighed against the potential gas savings cost during the design phase of the project.

Appendix A

Digester Structural Evaluation Report

Meagher Engineering, PLLC

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Feb 19, 2015

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RE: Repair Recommendations -Webster WWTP Digesters

I. PURPOSE AND SCOPE OF INVESTIGATION

The purpose of the investigation is to perform a condition survey of the two existing concrete digester tanks and provide recommendations for improvements to preserve the condition and extend the life of the digesters. It was requested that the inspection and evaluation be performed with the tanks full and be completed using non-destructive testing operations. Visually, only the top portion of the tanks could be inspected therefore the lower portions shall be inspected once the tanks are dewatered, power washed and ready for repair.

II. EXISTING CONSTRUCTION AND DOCUMENTATION

The primary digester was recorded to be constructed in 1964 and is 45 ft in diameter. There is a small section that abuts the WWTP digester building and can be viewed from the inside of the building. The majority of the tank is buried under an earthen berm and is unpainted concrete with no water proofing or damp proofing below grade. The upper exposed area of the tank ranges between 8-12 ft in height and has a few layers of paint which are in poor condition. The top wall section of the primary digester tank is approximately 13" thick. There is some existing documentation of the original tanks but it has limited detail and appears to be original construction documents, not "as-built" drawings. When using a metal scanner to detect reinforcing steel, the spacing seemed to be slightly off from what was shown on the original plans, however, the depth at which the reinforcing was placed may have given an erroneous reading.

Primary Digester integrated into the WWTP facility building.

Primary Digester exposed wall.

The secondary digester was constructed in 1934. It was originally an Imhoff tank and has since been converted to a digester with similar operation as the primary digester using a floating cover. The tank is 32 ft in diameter and sits adjacent to the primary digester. A portion of the tank wall is integrated into the WWTP digester building for piping connections and operations. The majority of the secondary digester is buried and has approximately 1-4 ft of exposed height around the perimeter. The wall thickness at the top of the tank is approximately 12".

Secondary Digester

III. FIELD OBSERVATIONS AND CONDITION SURVEY – PRIMARY & SECONDARY DIGESTER TANKS

A visual inspection was carried out to document the extent and severity of any distress or deterioration which could affect the load carrying capacity or service life of the digesters. The preliminary investigation showed a consistent trend of cracking mostly due to freeze/thaw cycles. Moderate to severe structural cracks have formed, causing the existing concrete tanks to be in poor condition. Field observations could only be conducted on exposed areas of the tanks. With the tank full of sludge and the majority of the tanks being buried, the area of study was limited to approximately 15-25% of the tanks' surfaces.

Several areas of the tanks were sounded using a sounding hammer to check the condition of the concrete by acoustical impact. The majority appeared to be solid concrete, however, cracked areas where there was seepage of sludge showed moderate to severe deterioration. These areas were spalling slightly and sounded "punky" causing sludge to seep more when disturbed. We directed the WWTP staff to remove the loose concrete from the exterior of the tanks to further evaluate the condition. The concrete appeared to be solid and did not chip off very easily. On the primary digester, the concrete has cracking along areas where there is a cold joint and/or where there is a joint between original concrete pours. It was determined to complete concrete core samples to determine a better idea of the concrete condition. Since we had to complete the inspection and core sampling with the tank filled with sludge and were unable to dewater it, it was necessary to select areas where the concrete was in good condition with no cracks. The concrete core samples could not go all the way through the wall so they were taken approximately 7" in depth on a 12-13" thick wall so that the sample could be removed without disturbing the integrity of the existing tanks. We selected three areas to core the primary tank and two areas on the secondary tank. We had very limited access on the secondary tank with most of it being buried. The photos below show the variety of cracking in the tanks. Most of the cracks are due to the freeze/thaw cycles of the tanks. A defect survey is attached in the appendix showing the severity of damage over the 50 & 80 years of service of the tanks.

Full penetration cracking in the Primary Digester

Radial cracking on the Primary Digester

Full penetration cracking on the Primary Digester

The lower buried portion of the Primary digester appears to be in better condition for two reasons. The first reason is because it is not exposed to the weather like the upper portion of the tank. Secondly, the lateral earth pressure on the outside supports the sides of the tank and reduces the radial stresses that the concrete sees during the freeze/thaw cycles.

Concrete condition of the Primary Digester below grade.

IV. SAMPLING AND MATERIAL TESTING

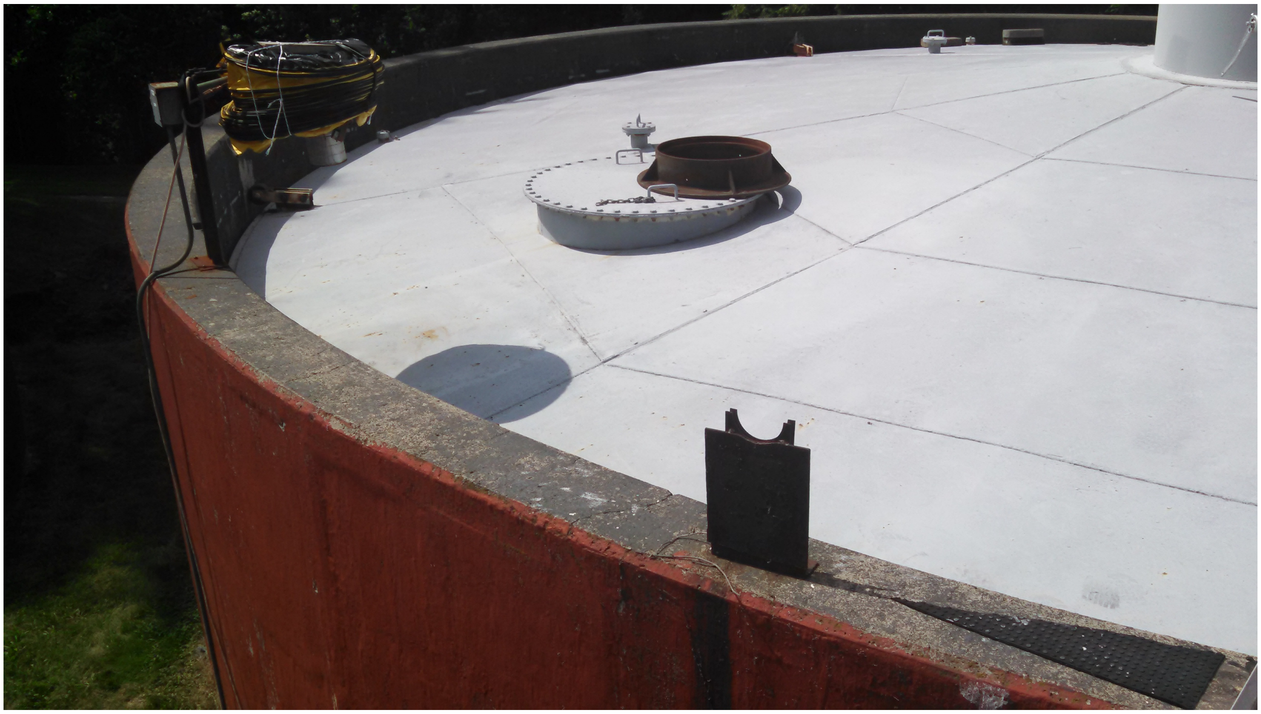
The concrete core samples taken were 3.7” in diameter (4” drill bit) by approximately 7.2” long and were found to have an average compressive strength of 8,763 psi on the primary tank and 4,050 psi for the secondary tank. The nominal maximum aggregate size of the course aggregate was noted as ¾“ for the primary tank and 1 ½ “ for the secondary tank. Both samples had good gradation of stone. The cores were moist conditioned in accordance with ASTM C 42 and the direction of load application on the cores tested were parallel to the horizontal plane of the concrete as placed. There were no defects noted in any of the caps or core samples. Concrete cores were taken by Atlantic Testing Laboratories, Inc. on Sep. 23, 2014 and the specific results are attached in the Appendix.

Concrete core samples taken from the Primary Digester

Concrete samples from Primary Digester

Concrete core samples showing good gradation of stone.

We chose not to core into any reinforcing steel so that we would not compromise the strength of the tank. We do not have any reason to believe that the concrete has a high chloride content which is the primary cause of corroding reinforcing steel.



Secondary Digester with full penetration cracks

V. EVALUATION

The evaluation was a process of determining the adequacy of the structure for its intended use. The structural components appeared to be fairly symmetrical, level, and generally built per original drawings. There was no evidence of large settlement of the tanks in relation to the WWTP digester building or deformation of the tanks as a whole. Connections between the tanks and building appeared to be in as originally constructed condition. Evaluation of existing concrete included determination of strength and quality and provide some understanding of the ability of the structure to sustain the loads and environmental conditions to which the structure is being subjected. Through concrete core testing we discovered that the concrete has high compressive strength. The condition of the reinforcing steel is unknown. Drilling into the existing reinforcing steel to evaluate its condition with the tank full was not considered prudent. The concrete condition is relatively good on areas below grade that were spot checked. The upper exposed areas of the tanks exhibit multiple cracks with some of the cracks having full penetration through the wall. These cracked areas have now compromised the function of the digester and have sludge seeping which contaminates the surrounding grounds as well as an area within the building where the digester tank is exposed on the interior of the building.

VI. RECOMMENDATIONS

The tanks are worth saving and repairs for the two existing digesters shall restore the structural integrity of the tanks to preserve and extend their life and shall seal the tanks to improve their function, and eliminate the safety and environmental concerns due to the leakage. Since the existing concrete tanks are partially buried and integrated into the digester building, it is prudent to reinforce the tanks and perform repairs to seal the tanks from the inside of the tanks. The structural integrity of the tanks is in question due to the full penetration cracks. Even though the concrete was proven to be strong in compression, the tanks withstand large tensile forces from the lateral pressures due to the sludge digestion operations and the weight of the floating covers. The condition of the reinforcing steel was not evaluated due to the function of the radial reinforcing, but there is concern with the seepage of sludge that some deficiencies may affect the integrity of the reinforcing steel. Recommendations to repair and extend the life of the digesters include the following:

Option 1 – Repair the digesters from the inside with Shotcrete to create minimal disturbance to the exterior buried surface and/or disturbance to the connection and integration of the tank with the facility building.

Interior repairs

- Remove the floating cover with a crane & disassemble the piping & any inner workings of the digester

- Dewater digester & clean (power wash). Note: Dewater costs are not included in the costs below.
- Epoxy inject large cracks from the interior where necessary, but prefer from the exterior where possible. Products such as BASF Master Inject 1500 low viscosity epoxy adhesive are installed in the cracks at 6-12" intervals and cure in approximately 7 days. Quality control should be checked by requiring the contractor to complete random coring samples of injection sites to spot check their work. There is a slight concern that the presence of contaminants may inhibit bonding in some areas. A pilot test program may need to be implemented prior to bidding a full repair contract to determine whether the repair objectives can be obtained.
- In addition to the epoxy injection, reinforce the large cracks & integrity of the existing reinforcing bars by installing Fortec 12" wide x continuous carbon fiber reinforcing straps around the upper region (interior circumference) of the tank where full penetration cracks are prevalent (Upper region of the tank exposed to freeze/thaw cycles, ie. above grade). These carbon fiber reinforcing straps will be epoxy glued in place on the interior surface of the tank supplementing the radial reinforcing steel and giving the existing tanks additional strength. The straps shall be installed at 2 ft on center vertical spacing for approximately the top 12 ft region of the tanks(ie. 5 rows).
- Apply 2"- 3" shotcrete to entire interior of tank walls to provide a waterproofing element. Prepare the interior surface with a grid of studs to gauge to the depth of shotcrete to be added, provide woven wire mesh to the interior surface to reduce the potential for shrinkage cracking of the shotcrete and promote bonding between the shotcrete and existing interior surface. Note: Due to the large surface area of the shotcrete being applied & only a thin layer application, there may be slight shrinkage cracks in the shotcrete. Due to the operation of the floating digester cover, there is only the potential for 2"-3" of shotcrete to build up & reinforce the interior surface of the existing concrete tank. Shotcrete would provide a sealant to encase the interior of the tank and improve its function. Below grade it is only anticipated that shotcrete repairs would be required, ie. no carbon fiber straps.

Exterior repairs (Above Grade)

- Remove/chip off all of the loose concrete above grade using only hand methods, not mechanical methods to prevent further damage to the tanks.
- Power wash to completely remove exterior paint, efflorescence, and seepage.
- Depending on the depth of repairs, fill cracks and defects with a Sika concrete repair product applied directly to the exterior of the tank.
- Epoxy inject large cracks where needed using BASF Master Inject 1500 low viscosity epoxy adhesive.

- Paint the exterior surface of the tank to seal the concrete and protect from the elements using BASF Master Protect EL 850 elastomeric waterproof coating.

Probable Construction Costs: Primary Digester is approximately $475,000
Secondary Digester is approximately $390,000

<u>Option 2 – Repair the digesters from the inside with Cem-Kote to create minimal disturbance to the exterior buried surface and/or disturbance to the connection and integration of the tank with the facility building.</u>

<u>Interior repairs</u>

- Remove the floating cover with a crane & disassemble the piping & any inner workings of the digester
- Dewater digester & clean (power wash). <u>Note:</u> Dewater costs are not included in the costs below.
- Epoxy inject large cracks from the exterior where possible. Products such as BASF Master Inject 1500 low viscosity epoxy adhesive are installed in the cracks at 6-12” intervals and cure in approximately 7 days. Quality control should be checked by requiring the contractor complete random coring samples of injection sites to spot check their work. There is a slight concern that the presence of contaminants may inhibit bonding in some areas. A pilot test program may need to be implemented prior to bidding a full repair contract to determine whether the repair objectives can be obtained.
- In addition to the epoxy injection, reinforce the large cracks & integrity of the existing reinforcing bars by installing Fortec 12” wide x continuous carbon fiber reinforcing straps around the upper region (interior circumference) of the tank where full penetration cracks are prevalent (Upper region of the tank exposed to freeze/thaw cycles, ie. above grade). These carbon fiber reinforcing straps will be epoxy glued in place on the interior surface of the tank supplementing the radial reinforcing steel and giving the existing tanks additional strength. The straps shall be installed at 2 ft on center vertical spacing for approximately the top 12 ft region of the tanks.
- Coat the entire interior surface of the tanks using a flexible cementitious waterproofing product called Cem-Kote Flex CR which is applied by troweling a thin (3 mm) coat to a clean damp surface, next apply the reinforcing fabric HD followed by another thin application of the Cem-Kote. The Cem-Kote will provide waterproofing and concrete restoration for smaller cracks. The coating along with the reinforcing fabric has very low shrinkage, is flexible, and has long term crack resistance.

Exterior repairs(Above Grade)

- Remove/chip off all of the loose concrete above grade using only hand methods, not mechanical methods to prevent further damage to the tanks.
- Power wash to completely remove exterior paint, efflorescence, and seepage.
- Depending on the depth of repairs, fill cracks and defects with a Sika concrete repair product applied directly to the exterior of the tank.
- Epoxy inject large cracks where needed using BASF Master Inject 1500 low viscosity epoxy adhesive.
- Paint the exterior surface of the tank to seal the concrete and protect from the elements using BASF Master Protect EL 850 elastomeric waterproof coating.

Probable Construction Costs: Primary Digester is approximately $190,000
Secondary Digester is approximately $145,000

Option 3 – Repair the digesters from the inside with Cem-Kote to create minimal disturbance to the exterior buried surface and/or disturbance to the connection and integration of the tank with the facility building. No epoxy injection for large cracks.

Interior repairs

- Remove the floating cover with a crane & disassemble the piping & any inner workings of the digester
- Dewater digester & clean (power wash). Note: Dewater costs are not included in the costs below.
- Reinforce the large cracks & integrity of the existing reinforcing bars by installing Fortec 12” wide x continuous carbon fiber reinforcing straps around the upper region (interior circumference) of the tank where full penetration cracks are prevalent (Upper region of the tank exposed to freeze/thaw cycles, ie. above grade). These carbon fiber reinforcing straps will be epoxy glued in place on the interior surface of the tank supplementing the radial reinforcing steel and giving the existing tanks additional strength. The straps shall be installed at 2 ft on center vertical spacing for approximately the top 12 ft region of the tanks.
- Coat the entire interior surface of the tanks using a flexible cementitious waterproofing product called Cem-Kote Flex CR which is applied by troweling a thin (3 mm) coat to a clean damp surface, next apply the reinforcing fabric HD followed by another thin application of the Cem-Kote. The Cem-Kote will provide waterproofing and concrete restoration for smaller cracks. The coating along with the reinforcing fabric has very low shrinkage, is flexible, and has long term crack resistance.

Exterior repairs (Above Grade)

- Remove/chip off all of the loose concrete above grade using only hand methods, not mechanical methods to prevent further damage to the tanks.
- Power wash to completely remove exterior paint, efflorescence, and seepage.
- In lieu of the epoxy injection, reinforce the large cracks using the Fortec 12" wide x continuous carbon fiber reinforcing straps around the upper region of the tanks where full penetration cracks are prevalent. It is anticipated that three rows of carbon fiber reinforcing straps will be epoxy glued in place on the exterior surface of the Primary digester tank and one or two rows of carbon fiber straps will be needed on the Secondary digester giving the existing tanks additional strength. The straps shall be installed at 2 ft on center vertical spacing similar to the interior repairs. Straps would only be applied to the exterior of the tanks up to where they meet the building, therefore would not be continuous radially as required for the interior straps.
- Coat the entire exterior surface of the tanks using a flexible cementitious waterproofing product called Cem-Kote Flex CR which is applied by troweling a thin (3 mm) coat to a clean damp surface, next apply the reinforcing fabric HD followed by another thin application of the Cem-Kote. The Cem-Kote application shall extend approximately 2 ft below existing grade.

Probable Construction Costs: Primary Digester is approximately $198,000
Secondary Digester is approximately $153,000

Other Options Considered and Conclusion

We reviewed several options to reinforce the upper regions of the tanks from the exterior with continuous metal or carbon fiber straps. This would require building penetrations to extend the cables/straps around the entire perimeter. It would also require excavation around the perimeter of the primary digester. The building penetrations required for this option could potentially compromise the connection between the tanks and the digester building. We, therefore, do not believe that this option should be considered.

Epoxy injection can be used for adhering large and full penetration structural cracks; however, a trial should be completed during the design phase to determine if the epoxy will adhere with the potential contaminants within the cracks.

Carbon fiber straps come in a variety of sizes, shapes, and lengths. They are very effective for spot repairs and reinforcing the upper portion of the tanks that appear to have the greatest stress and weathering. However, use of straps alone, without shotcrete or Cem-Kote as a proper sealant to protect them, is not recommended because the lasting bond/integrity of the product is unknown in a sludge environment.

In conclusion, there are several repair options for the digesters to restore their structural integrity, stop the leaks, and extend their service life. The final selection and specification of repair products should be made during the design phase of the rehabilitation project. Please note that the *Probable Construction Cost* listed in the options above are not complete rehabilitation costs for the overall project and only outline probable costs for the specific repair approaches.

Since only 15-25% of the tanks could be accessed for the inspection, the extent of required repairs is unknown and assumptions will need to be made when developing an opinion of probable costs. If the digesters cannot be dewatered before bidding the work, the interior of the tanks should be inspected by a structural engineer during the early stages of construction and the basis of payment should be unit pricing.

Lastly, we recommend meeting with the WWTP facility operators to determine a construction sequence that will minimize disturbance of their daily operations. Please contact our office is you have any further questions or concerns.

Best regards,
MEAGHER ENGINEERING, PLLC

Wendy L. Meagher, PE

Encl.

APPENDIX

ATLANTIC TESTING LABORATORIES

WBE certified company

DRILLED CONCRETE CORE REPORT NUMBER RT1194CC-01-09-14
ASTM C 42

CLIENT: Village of Webster
PROJECT: Webster Wastewater Treatment Plant
Webster, New York
CONTRACTOR: N/A
PLACEMENT LOCATION: Digester Wall

CONCRETE PLACEMENT DATE(S): c. 1965
DAILY CONCRETE REPORT NUMBER(S): N/A
CONCRETE CORING DRILLING DATE: September 23, 2014
CONCRETE CORES REQUESTED BY: Mahar Engineering
CONCRETE CORES OBTAINED BY: R. Knowlton/ S.Tompkins

LABORATORY DATA (ASTM C 39, C 42, and C 617)

Core I.D.	Date of Test	Age (yrs)	Drilled Core Length (in.)	Depth of Core Tested* (in.)	Uncapped Core Length (in.)	Capped Core Length (in.)	Average Core Diameter (in.)	Length to Diameter Ratio	Core Area (in.^{2})	Calculated Density (pcf)	Total Load (lbs.)	Strength Correction Factor	**Unit Load (psi)**	Core Location
C-1	9-30-14	49	7.3	0.1-7.2	7.1	7.6	3.70	2.06	10.75	150	92,200	N/A	**8580**	45' Tank E. Side
C-2	9-30-14	49	7.3	0.1-7.3	7.2	7.6	3.70	2.06	10.75	149	99,890	N/A	**9290**	45' Tank E. Side below grade
C-3	9-30-14	49	7.1	0.1-7.2	7.1	7.2	3.70	1.95	10.75	147	90,510	N/A	**8420**	45' Tank W. Side
C-4	9-30-14	49	7.0	0.1-7.1	7.0	7.2	3.70	1.95	10.75	148	46,850	N/A	**4360**	SW side Small Tank
C-5	9-30-14	49	7.2	0.1-7.2	7.1	7.2	3.70	1.95	10.75	147	40,160	N/A	**3740**	NW side Small Tank

REMARKS

* Referenced from outside face of wall.
No defects were noted in any of the caps or cores.
The nominal maximum aggregate size of the coarse aggregate noted was 0.75 in. for cores 1, 2, and 3, and 1.5 in. for cores 4 and 5.
The cores were moisture conditioned in accordance with ASTM C 42.
The direction of load application on the cores tested was parallel to the horizontal plane of the concrete as placed.

Reviewed by: ______________________ Date: 10/2/14

Appendix B

Opinion of Probable Project Cost

Digester Rehabilitation

Opinion of Probable Project Cost

Digester Rehabilitation - Concept Phase

2015 Wastewater Engineering Study
Village of Webster, NY
LaBella Number: 214393

Item No	Item Description	Quantity	Unit	Unit Cost	Item Cost	Subtotal by Category
PRIMARY DIGESTER						$ 505,608
Prep	Drawdown/process 50% of sludge content, by operator				$ -	
	Maintenance of Plant Operations	1	ls	$ 15,000.00	$ 15,000	
	Disassemble gas collection piping	1	ls	$ 5,000.00	$ 5,000	
	Remove & store floating cover	1	ls	$ 3,000.00	$ 3,000	
	Sludge dewatering & disposal (70% of tank)	277,950	gal	$ 0.25	$ 69,488	
Interior	Staging to access interior walls	1	ls	$ 12,500.00	$ 12,500	
	Sandblast & power wash interior, pump wastewater to plant	6,400	sf	$ 5.00	$ 32,000	
	Detailed saw cut of poor concrete areas Assume lf = 4 times the sf of repair mortar	4,000	lf	$ 5.25	$ 21,000	
	Repair mortar, concrete wall Assume 20% of inner wall or 7 vf	1,000	sf	$ 25.00	$ 25,000	
	Epoxy grout large cracks Assume 12 continuous cracks around perimeter	1,700	lf	$ 25.00	$ 42,500	
	Carbon fiber reinforcing straps Assume 35% of inner wall or 12 vf	1,700	sf	$ 20.00	$ 34,000	
	Liner / coating on entire interior, walls	4,760	sf	$ 20.00	$ 95,200	
	Coating on entire interior, floor	1,640	sf	$ 20.00	$ 32,800	
Exterior	Excavate & replace 2' soil around tank perimeter	40	cy	$ 35.00	$ 1,400	
	Remove exist paint & loose conc from exterior Assume excav 2' below grade & avg wall ht rehabbed is 12'	1,780	sf	$ 4.00	$ 7,120	
	Epoxy grout large cracks Assume 4 continuous cracks around perimeter	600	lf	$ 25.00	$ 15,000	
	Waterproof sealant or flex cementitious coating, ext walls	1,780	sf	$ 20.00	$ 35,600	
Cover	Recondition floating cover	1	ls	$ 45,000.00	$ 45,000	
	Reinstall floating cover	1	ls	$ 5,000.00	$ 5,000	
	Reassemble gas collection piping	1	ls	$ 5,000.00	$ 5,000	
	Site cleanup & restoration	1	ls	$ 4,000.00	$ 4,000	
SECONDARY DIGESTER						$ 265,250
Prep	Maintenance of Plant Operations	1	ls	$ 15,000.00	$ 15,000	
	Disassemble gas collection piping	1	ls	$ 5,000.00	$ 5,000	
	Remove & store floating cover	1	ls	$ 3,000.00	$ 3,000	
	Sludge dewatering & disposal (100% of tank)	121,800	gal	$ 0.25	$ 30,450	
Interior	Staging to access interior walls	1	ls	$ 12,500.00	$ 12,500	
	Sandblast & power wash interior, pump wastewater to plant	2,950	sf	$ 5.00	$ 14,750	
	Detailed saw cut of poor concrete areas Assume lf = 4 times the sf of repair mortar	1,900	lf	$ 5.25	$ 9,975	
	Repair mortar, concrete wall Assume 20% of inner wall or 5 vf	475	sf	$ 25.00	$ 11,875	
	Epoxy grout large cracks Assume 12 continuous cracks around perimeter	1,150	lf	$ 25.00	$ 28,750	
	Carbon fiber reinforcing straps Assume 50% of inner wall or 12 vf	1,150	sf	$ 20.00	$ 23,000	
	Liner / coating on entire interior, walls	2,300	sf	$ 20.00	$ 46,000	
	Coating on entire interior, floor	645	sf	$ 20.00	$ 12,900	
Exterior	Excavate & replace 2' soil around tank perimeter	30	cy	$ 35.00	$ 1,050	
	Remove exist paint & loose conc from exterior Assume excav 2' below grade & avg wall ht rehabbed is 5'	500	sf	$ 4.00	$ 2,000	
	Epoxy grout large cracks Assume 2 continuous cracks around perimeter	200	lf	$ 25.00	$ 5,000	
	Waterproof sealant or flex cementitious coating, ext walls	500	sf	$ 20.00	$ 10,000	
Cover	Recondition floating cover	1	ls	$ 20,000.00	$ 20,000	
	Reinstall floating cover	1	ls	$ 5,000.00	$ 5,000	
	Reassemble gas collection piping	1	ls	$ 5,000.00	$ 5,000	
	Site cleanup & restoration	1	ls	$ 4,000.00	$ 4,000	
	Subtotal, both digesters					$ 770,858
	Mobilization	1	ls	4%	$ 30,834	
	Testing	1	ls	2%	$ 15,417	
	Design Contingency	1	ls	24%	$ 187,110	
CONSTRUCTION COST						$ 1,004,219
	Survey	1	ls	1%	$ 10,042	
	Design Testing	1	ls	0.5%	$ 5,021	
	Engineering & RPR	1	ls	16%	$ 160,675	
	Funding Admin	1	ls	1%	$ 10,042	
TOTAL PROJECT COST						$ 1,190,000

Opinion of Probable Project Cost

Digester Rehabilitation - Concept Phase

2015 Wastewater Engineering Study
Village of Webster, NY
LaBella Number: 214393

Notes and Assumptions

1. The larger primary digester would be rehabilitated first.
2. 30% of the liquid contents can be reduced on-site by the operator.
3. Contractor will be responsible for removing & hauling off-site the remaining 70% of sludge from the primary digester.
4. Contractor will be responsible for removing & hauling off-site 100% of sludge from the secondary digester.
5. Quantity of repair mortar, saw cutting, grouting, & carbon fiber reinforcing straps is unknown.
6. Assume 20% of inner wall of both digesters require repair mortar.
7. Assume 12 continuous cracks around inner perimeter of both digesters for the purpose of estimating epoxy grout.
8. Assume 35% of inner wall of both digesters require carbon fiber straps.
9. Assume 4 continuous cracks around outer perimeter of primary digester for the purpose of estimating epoxy grout.
10. Assume 2 continuous cracks around outer perimeter of secondary digester for the purpose of estimating epoxy grout.
11. Final material recommendation for grout, liner, & coatings etc to be specified during final design .

Appendix C

Energy Conservation Evaluation Report

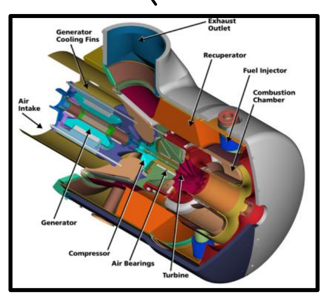
LaBella Associates, DPC

LABELLA Associates, D.P.C.

Engineering
Architecture
Environmental
Planning

ENERGY CONSERVATION REPORT

Village of Webster
Waste Water Treatment Plant



Prepared by:
LaBella Associates, DPC
300 State Street, Suite 201
Rochester, New York 14614

Date Prepared:
April 17, 2015

Relationships. Resources. Results.

Table of Contents

Appendices

Energy Conservation Evaluation

1.0 Project Description

The Village of Webster has engaged LaBella Associates to undertake an evaluation of the Village-owned Waste Water Treatment Plant (WWTP) to determine the most cost effective ways to maximize energy efficiency and improve building performance. In order to meet the objectives, LaBella Associates performed the following tasks:

Task 1 – Site Survey/Internal Inventory

1. Utility Analysis – Utility bills for electricity and natural gas consumption in this facility were analyzed and reviewed for consumption patterns and abnormalities.
2. Document Review – Available building documentation was collected and reviewed, and any pertinent energy related information was recorded.
3. Interviews with Key Personnel – Interviews were conducted with key management and operations personnel to gather anecdotal information about operational issues.
4. Internal Inventory of building systems – Inspections of the facilities were conducted to identify and evaluate operating systems and conditions. The main purpose of these walkthroughs was to identify and record the heating, cooling, lighting, and building controls systems. However, other equipment/systems were documented if energy savings appeared to be possible. Nameplate data was collected and photographs were taken of major energy consuming equipment.
5. Energy Conservation Measure of particular interest to the Village were as follows:
   a. The digester methane boiler is reaching the end of its useful life and needs replacement.
   b. Lighting and motors are large energy consumers.
   c. The facility is interested in pursuing a bank of photovoltaic panels to generate electricity.

Task 2 – Technical Assessment

A list of energy conservation measures was developed and evaluated for potential energy reduction and payback period. A detailed description of each measure and evaluation is presented in the Assessment section of this study. This list also includes additional measures identified during facility walkthroughs.

Task 3 – Economic Assessment

LaBella performed an energy savings analysis for each measure that was considered feasible. Energy savings were calculated based on the specific energy source for each operating system. A variety of evaluation and calculation strategies were employed, depending upon the type of measure.

Energy costs used in the analysis were obtained from utility bills and capital costs were estimated in order to provide a simple payback period. A detailed description of each measure and evaluation is presented in the Assessment section of this study.

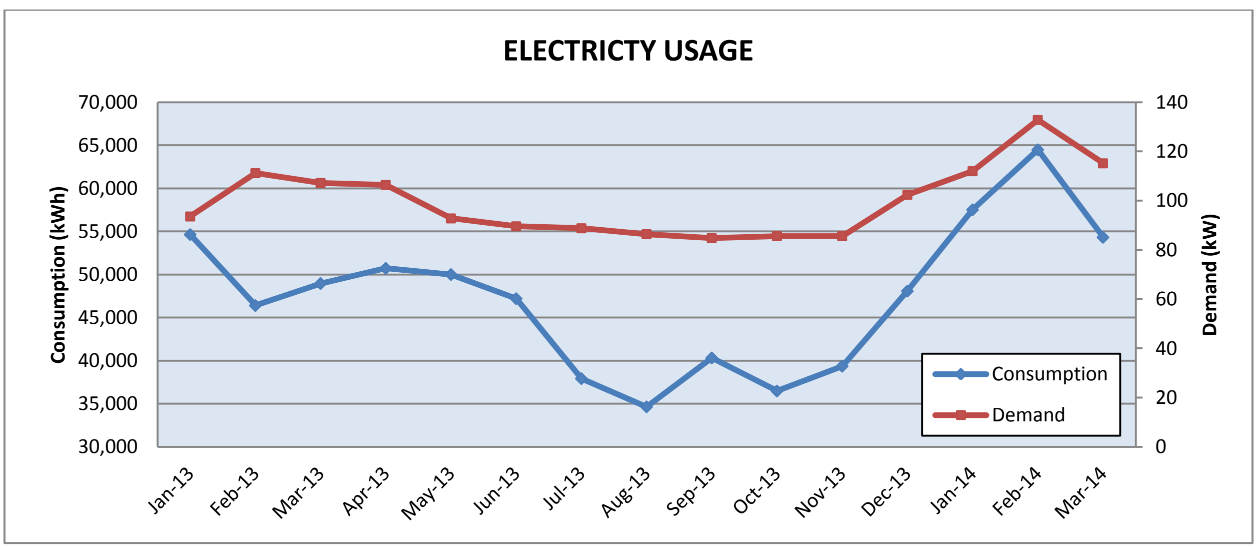
Note that the energy conservation measures in this report are presented as stand-alone measures. The interactions between them may affect the overall savings if they are implemented together and savings will be different depending on the order of implementation.

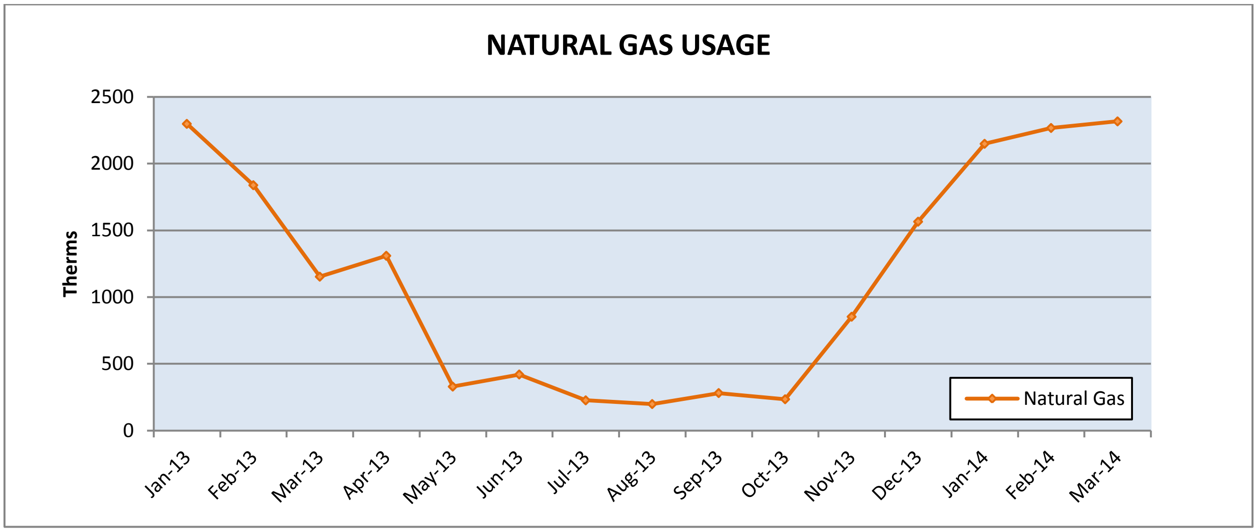
2.0 Utility Information

Monthly data on electrical and natural gas usage was collected for the two year period of February 2012 to March 2014. The monthly bills are provided in a table in **Appendix C3** and the most recent year was graphed to provide a visual record of consumption. Since the two year patterns are similar, only the recent year was graphed.

The Village purchases electricity and natural gas through RG&E (electric and gas delivery) and Energetix, Inc. (ESCO-electricity supplier), under the PSC-19 SC-3 Non-Residential service rate for electricity and the PSC-16 SC5 Non-Residential service rate for natural gas. The average annual electrical and gas costs are $0.093/kWh and $0.22/therm respectively. Annual energy costs for the Village are summarized in the following table:

Village of Webster			
	Annual Energy Costs*		
Facility	**Electricity**	**Natural Gas**	**Total**
WWTP – April 2012 through March 2013	$54,430.52	$2,700.38	**$57,130.90**
WWTP – April 2013 through March 2014	$51,945.75	$2,694.29	**$54,640.04**





The mean daily temperatures during winter 2013 and winter 2014 were 31 deg F and 21 deg F respectively. The smaller unoccupied buildings are heated by electric unit heaters and the main Service Building is heated by a hot water boiler using natural gas. Due to the colder winter in 2014, the increase in both electricity and natural gas is evident in the above graphs of energy consumption.

3.0 ECM Assessment

Based on the site visit, conditions survey, and the equipment inventory, the following Energy Conservation Measures (ECMs) were evaluated in detail for further consideration.

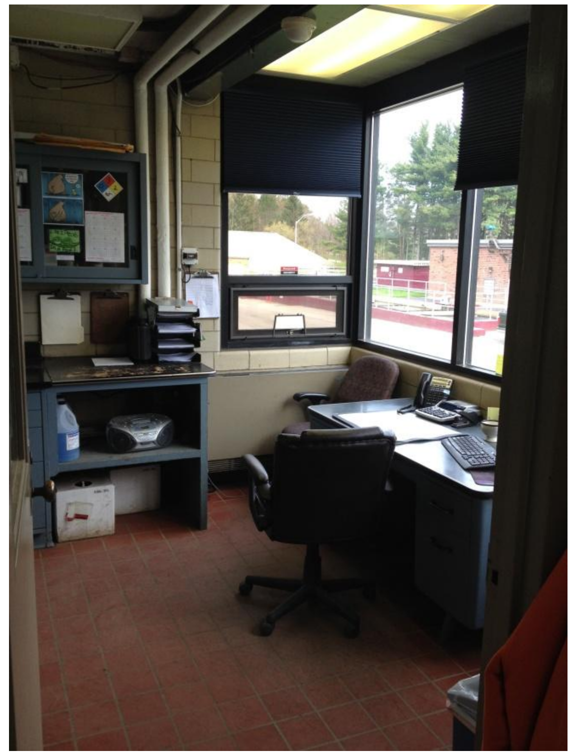
3.1 Upgrade to High Efficiency Boiler (ECM-1):

The main Service Building currently uses a natural-gas-fired 210,000 Btu/h Dunkirk hot water boiler to provide heating hot water to its terminal heating equipment. The boiler is a conventional, non-condensing type boiler with 81% rated thermal efficiency, and is at the end of its useful life. The system does not have a central computer with controls for boiler reset, occupied/unoccupied schedules, or setpoints. A potential for natural gas savings exists if the boiler was upgraded to a higher efficiency boiler, such as condensing type boiler. To estimate the potential savings associated with such an upgrade, an analysis was performed to compare the consumption of the existing heating system with a high efficiency boiler. Energy calculations are provided in **Appendix C3**. The resulting savings are presented in the following table.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-1	Boiler Upgrade	$21,300	-	-	48,022	$10,648.63	2.0 yrs

In addition, new condenser boiler technology provides substantial benefits with reductions in NOX and SOX (nitrous and sulfur oxide pollutants).

3.2 Indoor Lighting System Upgrades (ECM-2, ECM-3, and ECM-4):



Interior and site lighting form a major energy consumer in any facility. At this location, all buildings – the Influent Sample Building, Garage, Generator Room, Grit Building, Pump House, Centrifuge Area/Digester Plant, and Service Building – use lighting, generally in the form of ceiling mounted fluorescent fixtures. These fixtures are documented in the calculations in **Appendix C3**.

The facility has replaced a significant number of these fixtures with LED filled T8 tubes, a precursor to today's LED fixtures. We do not recommend these fixtures as a viable option as they are not known for longevity due to heat retention inside of the fixture and no real heat sink inside of the tube to dissipate the heat, leading to premature failure. The LED's are also not compatible with certain wall dimmers, resulting in the removal of the dimmers which is counterproductive to energy savings as it requires the lights to be manually shutoff instead of automatically. The existing fixtures seem to be performing adequately, but T8's and occupancy sensors should be utilized as lights need to be replaced. Bulb replacements will be cheaper and it will yield additional energy savings.

Interior Lighting currently uses either T-12 lamps or the LED filled T-8 lamps as described above. Substantial electricity savings can be realized by replacing either of these lamp with the more efficient T-8 fluorescent lamps and the associated electronic ballasts. This option is shown below as ECM-2.

Occupancy sensors can also have significant benefits if lights are commonly left on overnight and/or during unoccupied hours. NYSERDA accepts an assumption of a 30% reduction in operating hours for a typical occupied area when occupancy sensors are installed. Therefore, the savings analysis was based on this reduction. In general, the Service Building is the only area using manual lighting controls, i.e. switches. Also, the other buildings are only occupied infrequently and for short periods – leaving very little for energy savings. Therefore, the Service Building was the focus for the addition of lighting controls.

Savings associated with lamp upgrades and occupancy sensors are summarized in the table below. We have broken down this set of ECMs into 3 categories as follows, and as shown in the following Table:

a. Upgrade Lamps and Ballasts only (ECM-2).
b. Install Occupancy Sensors (without upgrading the Lamps and Ballasts) (ECM-3).
c. Install both the Occupancy Sensors and Upgrade the Lamps and Ballasts at the same time (ECM-4).

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-2	Upgrade Lamps + Ballasts	$10,200	3.01	4,031	-*	$483.72	21.0
ECM-3	Install Occupancy Sensors	$1,800	0	254	-*	$30.48	59.0
ECM-4	Lamps, Ballasts, and Occ-Sensors	$12,000	3.01	4,285	-*	$514.20	23.3

*Secondary cooling savings associated with reduced heat output assumed negligible

Note that these savings do not account for any reductions in maintenance cost.

3.3 Outdoor Lighting System Upgrades (ECM-5, ECM-6):

The outdoor lighting at this facility is composed of High Pressure Sodium (HPS) fixtures of the 400W and 70W variety. The 400W fixtures can be replaced with LED fixtures for significant energy and maintenance savings. The 70W wallpack fixtures can also be replaced with lower wattage LED fixtures for the same savings. Replacing inefficient older style light fixtures with LED's can have significant energy and maintenance savings, as these fixtures draw less power and have lifetime drivers. HPS fixtures require yearly re-lamping yielding high annual maintenance costs.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-5	Streetlights to LED	$9,600	2.66	8,751	-*	$1050.12	9.1
ECM-6	Wallpacks to LED	$2,600	0.53	1,725	-*	$207.00	12.6

3.4 Thermostat Management (ECM-7):

The WWTP Service Building does not currently employ a setback schedule for its heating system. Furthermore, the building is typically unoccupied, but it is heated during winter months. This presents a significant opportunity to reduce waste by implementing heating system controls with an appropriate setback schedule. The simplest way to accomplish the desired control capability is to replace the existing thermostats with programmable thermostats and incorporate a night setback within the programming.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-7	Thermostat Management	$4,900	-	1500	525	$255.00	19.2

3.5 Building Envelope Improvements (ECM-8):

The Service Building, like the others, has single pane windows around the entrance door, facing north, that were not replaced with the recent 2010 window upgrades. This measure proposes to replace the existing single pane windows with shorter, insulated aluminum frame windows and infill the masonry opening with materials matching surrounding brickwork. Estimated energy savings were quantified by comparing the total annual energy lost through the existing windows with the energy lost through upgraded windows (assumed to be storm windows), and then applying the appropriate energy cost to determine the savings associated with the measure. For the purposes of the study, LaBella assumed an average indoor temperature of 65, and U values of 1.13 and 0.45 for single pane and storm windows, respectively. In the model, heating is provided by the existing hot water boiler with an efficiency of 80%. Minimal cooling and heating energy savings were found.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-8	Building Envelope Improvements	$6,200	-	70	115	$32.00	194

The Digester Building has two large sections of windows (one section has been damaged and boarded over). Replacement of these windows will result in a more energy efficient building envelope, however the heat is primarily provided from the digester heat boiler. Therefore, the energy saved for this portion of the ECM's would be negligible, and therefore, this cost was not included in the above table.

3.6 Replace Methane-Fired Digester Heater (ECM-9):

There are two levels of replacement to be considered for the existing Pacific Flush Tank, Co. Model 170 anaerobic digester heater / heat exchanger. This heater is a combined sludge heating system (maintaining sludge at approximately 100-135°F) and a hot water generator using methane gas as the fuel source (providing heating hot water for building heating). Natural gas provides the back up fuel source.

The existing digester heater / heat exchanger is now obsolete and at the end of its useful life. The considerations for energy efficient replacement are listed below:

- **Alternative A:** In kind replacement of existing digester heater. This would have the form of separate methane boilers and a digester sludge heat exchanger. Package systems mounted on a skid are available and includes the boiler, the heat exchangers, the pumps and controls. These package systems are also pre-piped and pre-wired with single points of connection. Literature is included on one system in **Appendix C1**. With recent advancements in energy saving equipment our investigation has also reviewed other options. We recommend that these alternatives be considered, and the economics be evaluated. This information has been included in this report.

- **Alternative B:** Installation of Microturbines: Wastewater plants represent a perfect opportunity for energy production when the time comes to upgrade their anaerobic digester heaters. New technologies, such as micro-turbines, can replace the digester heat exchanger in making hot water, heat the sludge to 95-97°F, and produce electricity. Two 65kW Capstone micro-turbines would produce 250MBH (capable of turning down to 50% capacity) of heating energy for the heating of the buildings and the sludge. The peak electrical demand happens to coincide with the largest heating demands. This correlation is directly linked to the seasonal variances of Webster, NY, and can work to the advantage of the Village cost to operate the facility. The micro-turbines utilize the existing methane gas and natural gas resources available on site.

  There are, however, some additional requirements for the micro-turbines to work properly. Micro-turbines require pre-conditioning of the gas. One critical consideration is the moisture in "the biogas has to be removed or it will build up sticky deposits inside the microturbine."[1] A skid-mount gas cleaning packaged system would dry out the methane gases and would remove solaxane (soaps, shampoos). In order to increase methane gas production to minimize the use of natural gas, it is necessary to increase the strength of the waste coming into the digester by adding septage, such as cooking oils from restaurants, or glycol from airports. The biochemical oxygen demand (BOD) source changes the incoming sewage at the digester and in turn creates more methane gas. This would need diligent balancing as to as to not upset the digester process.

- **Alternative C:** The final practical solution for the replacement of the digester heater may consist of two boilers – one methane boiler (efficiency 80 – 82%) and a hi-efficiency natural gas condensing boiler (85 – 95% efficiency). Therefore, an interim step is to provide the hi-efficiency natural gas condensing boiler only to gain the efficiency when burning natural gas. This also has the advantage of providing a back-up to the digester heater if it fails, or if it needs to be shutdown for maintenance (this backup would use natural gas only). This system would consist of the new boiler with its accessories, a digester sludge heat exchanger, a building heating heat exchanger, four pumps (two for backup), and the controls to operate the system and interface the system with the existing digester heater.

NOTE – This interim step would be configured to allow the plant to continue to operate, but through the use of natural gas. The digester gas would need to be combusted with the stack flare. Also, a smaller capital project could be initiated by interfacing this boiler more closely with the existing digester heater – through the use of the existing heat exchangers and pumps. However, this would not provide the advantage of having a backup, fully redundant, digester heating system.

It should be noted that additional energy savings are available, if there is sufficient excess methane gas available. This additional energy could be used to heat the Service Building (in lieu of the Boiler recommended in ECM-1). However, this does come with a significant capital investment of approximately $40,000.00.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-9A Alt. A	Replace Digester Heater w/Boilers & Sludge Heat Exchanger	$477,000	-	-	32,175	$7,133	66.9
ECM-9B Alt. B	Replace Digester Heater w/ 2x65kW Micro-turbines	$1,306,500	132.8	561,040	32,175	$59,085	22.1
ECM-9C Alt. C	Add Hi-Efficiency Condensing Boiler	$223,500	-	-	4,109	$911	245

We have discussed microturbine or cogeneration system installation with vendors and several peers. The general opinion is that this technology, although well developed, is not viable in a 2.0 mgd plant. It is generally installed in plants of 6.0 mgd and greater. Therefore, we do not recommend ECM-9B at this time.

Alternatives 9A and 9C do not have attractive paybacks (on an energy basis), but need to be implemented as the existing digester heater is well beyond the anticipated life expectancy, and it is critical for the plant operation. Therefore, it seems prudent to implement ECM- 9C as the lower cost and simpler of the two options.

3.7 Generate Electricity with PV Panels (ECM-10):

A 50kw solar panel field could be situated at the front of the facility adjacent to the sludge removal equipment and the mulch beds. This size solar installation takes advantage of the $0.70 per watt rebate available from NYSERDA for the first 50kw of solar generation. After this level, the incentives decrease to $0.45 per watt.

The size of the processing plant would necessitate a much larger solar field for full power production (and would be very expensive), but 50kw would have an impact on the overall energy bills as well as promote a greener image. A 50 kw solar panel field would require approximately one quarter acre footprint.

Measure	Measure Name	Measure Cost	Demand kW Savings	Annual Energy Savings		Annual Cost Savings	Simple Payback
				kWh	Therms		
ECM-10	50kw PV Array	$213,000*	N/A	55,000	-	$8,800	25.0

*estimated price after incentive assuming an average installation price of $4.40 per watt.

3.8 Other ECM's Considered:

Evaluate Power Generation from WWTP Hydraulic Drop

Hydropower turbines produce power, with the two main variables being available head and flow rate. The total drop across the Village's WWTP (from influent building to effluent box) is approximately 9 ft and the normal flow is approximately 1.5 to 2.0 mgd. In a WWTP, the treated effluent would be diverted from the outfall pipe or the last treatment process (all flow through the turbine must be treated), through a turbine-generator, and then back into the outfall pipe. Therefore, the total head available for hydropower generation is not the total head across the plant, but rather the available head between the secondary clarifiers and the effluent box. In Webster's WWTP, this amounts to approximately 2 ft of available head.

In accordance with the USEPA Renewable Energy Fact Sheet: *Low-Head Hydropower from Wastewater* provided in **Appendix C4**, the power produced can be estimated using the following equation:

Power [kW] = (H * F * Efficiency) / 11.8

Where, H = Available head [ft]

F = Flow [cfs]

Efficiency is the overall system efficiency as a fraction.

For Webster's case, less than 0.5 kW can be produced for a typical flow range of 1.5 to 2.0 mgd and 2 ft of available head, assuming an efficiency of 80%. It has also been noted that there is approximately 10 ft of available drop in the effluent sewer (just downstream of the effluent box) over a length of 165 lf. Without considering frictional losses or the complications of harnessing the available head over 165 lf, approximately 1.5 to 2.0 kW can be produced for the typical flow range. It appears that there is not enough available head to generate significant power.

Reduce Friction on Setting Tanks and Flights

At the top and bottom of each of the settling tank flights, there are wearing shoes, whose purpose is to reduce the friction of the entire flight scraping on the basin floor and the return rail. This also allows for the wearing friction surface to be easily replaced, instead of the whole flight.

There are improved wearing surfaces available which result in less friction – generally these are manufactured of some form of plastic materials. Fiberglass is a common material used for this application. The wear shoes are about $8 each (four to a flight), and the fiberglass flights are about $250 each (depends on size, quantity purchased, etc.). To further reduce rotational weight, plastic chains, sprockets and idler wheels are available. Although this would result in a slight decrease in energy consumption, we considered that it was not significant enough to include in this study.

4.0 Recommendations

After a review of the Village of Webster's mechanical and electrical systems at the WWTP that were analyzed, we recommend the following energy conservation measures, all of which will contribute to reducing the building's energy consumption as well as lower utility bills for gas and electricity.

ECM-1	Upgrade to High Efficiency Boiler	$21,300
ECM-5	Change HPS Street Lighting to LED	$9,600
ECM-6	Change Exterior Wallpacks to LED	$2,600
ECM-7	Thermostat Management	$4,900
ECM-10	Generate Electricity with PV Panels	$213,000
	Total Recommended ECMs	**$251,400**

These recommendations will save approximately $20,960 in energy costs per year, with an estimated combined payback of 12.0 years. The annual savings will be at least 66,976 kWh and 48,547 therms, with an electrical demand savings of at least 3.19 kw.

Note: As the digester heater and heat exchanger have reached (or gone beyond) the useful life, it is also recommended that ECM-9C be implemented to ensure continuous operation of the digester sludge heating system. ECM-9B, adding microturbines or cogeneration was found to be not viable for a plant of this size.

5.0 References

1. Biogas-fuel led micro-turbines, a positive outlook for growth in the US; Christine Hurley, Cogeneration and On-Site Power Production, November-December 2003, pg. 39.
2. "Renewable Energy Fact Sheet: Low-head hydropower from Wastewater," United State Environmental Protection Agency August 2013. (See **Appendix C4** for copy).

APPENDIX C1

EQUIPMENT

CUTSHEETS AND INFORMATION

HTP

Advanced Heating
and Hot Water Systems

Elite
Heating Boiler®

Best In Class Features

Elite

Heating Boiler®

Best Turndown Ratio: 5 to 1

The Elite boiler has an outstanding turndown ratio: 5 to 1. Greater turndown allows this appliance to modulate at lower firing rates which reduces short cycling, conserves energy and improves component reliability.

Best Range: 6 inputs, floor or wall mount

The Elite Heating Boiler® offers six input options ranging from 80,000 to 399,000 BTUs. This range will offer you the flexibility that you need to properly size your installation.

Up To 95.9% AFUE

Best Venting: 200 Feet

Maximize your venting options. The Elite Heating Boiler® offers an impressive combined 200 vent length feet allowing incredible installation flexibility. All Elite Heating Boilers are vented in easy to install PVC venting and utilize a built in ULC S636 compliant CPVC adaptor.

New Boiler Innovations

All New Appliance Finish

This new boiler boasts an exterior design that sets it apart from the competition. This unique looking boiler was designed to offer customers elegant controls and a sophisticated appearance.

Floor or Wall Mounted

Reduce the complexity of carrying multiple models by purchasing the Elite Heating Boiler®. This new boiler can be floor mounted, as standard or hung on the wall quickly and easily by installing simple optional brackets on the back of the boiler and securing them to a suitable wall surface by approved methods.

HTP Made In America • HTP Made In America •

TSC TOTAL SYSTEM CONTROL

HTP is proud to introduce Total System Control, which incorporates advanced monitoring and system controls to our lineup of products. The Elite Heating Boiler® gives homeowners and contractors alike the security of having an advanced system that monitors boiler performance, allows the unit to be cascaded (up to 8 boilers), offers outdoor reset and easily integrates system components. TSC® has programmable maintenance features that inform the homeowner when service should be performed and is displayed on a newly designed 40-character multi-line display.

Designed For Quality

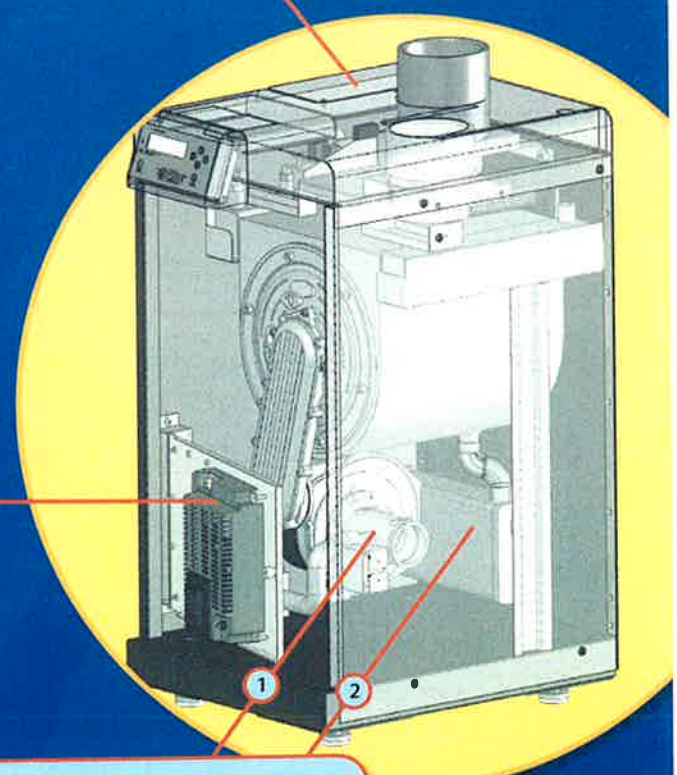
The Elite Heating Boiler® was designed utilizing the highest quality components and manufactured on sophisticated production lines that ensure that product quality is maintained throughout the assembly process. HTP is dedicated to ensuring that each boiler that leaves our facility has been meticulously assembled and tested using state of the art equipment to ensure the highest level of compliance to our standards.

Designed for Serviceability

Simply stated, the Elite Heating Boiler® is the most user friendly and serviceable boiler in the industry. The design of this boiler offers outstanding access to major components by incorporating unique features that allow contractors to service the unit without complex disassembly or dealing with confined spaces. Compare our product to the competition.

Electrical Connection Board with easy access on top of the boiler

Hinged arm provides easy access to control board and combustion system



(1) Gas valve assembly
(2) Condensate management system with float switch

HTP's Legacy of...

INNOVATION

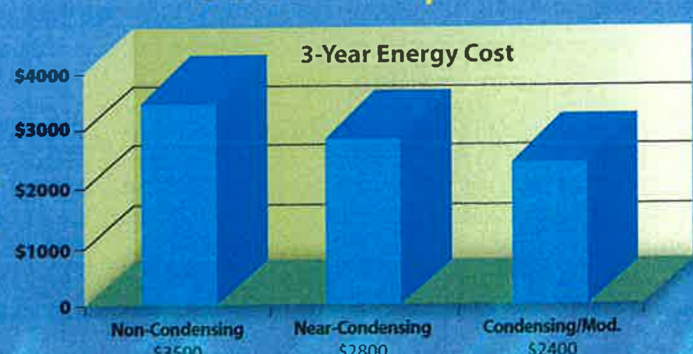
The Elite Heating Boiler® features a bold new appearance coupled with highly-engineered components, designed to offer our customers significant improvements in performance, quality and serviceability. In 1999, HTP was the first company to innovate and offer low mass high efficiency boilers to the North American market. Now, HTP continues that tradition of innovation by introducing the Elite Heating Boiler® to the North American Market. The Elite boiler lineup is uniquely designed to offer best in class features to the heating industry.

Elite Heating Boilers

Continuing a History of Advanced Space Heating

From the First North American Company to Introduce Modulating Condensing Boilers

Cost of Operation

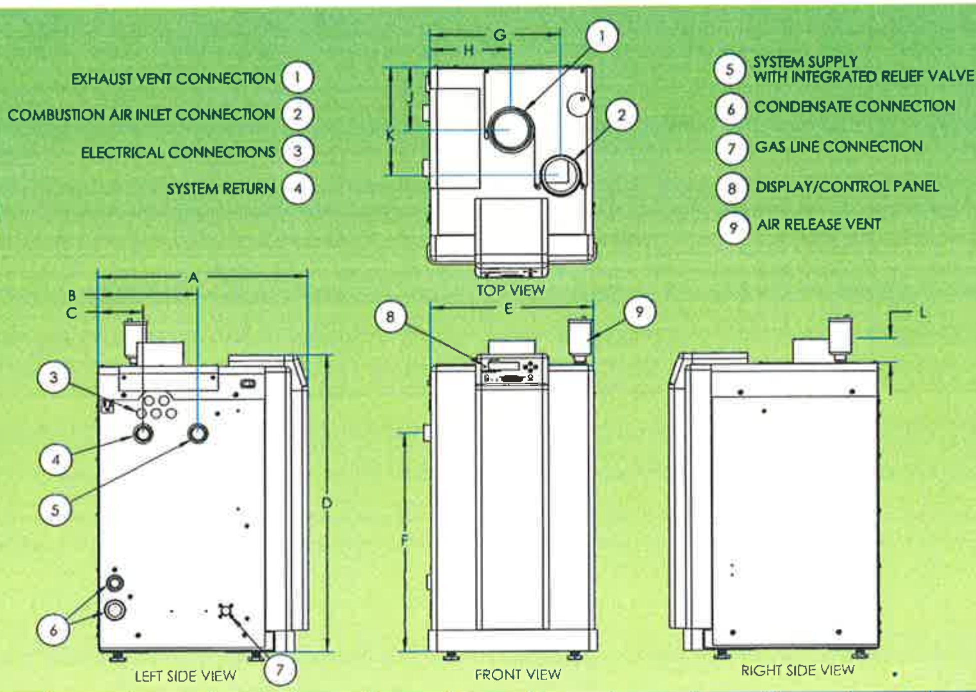


Condensing Technology

The cost of fuel in some areas of the country has increased almost 40% in just one year! HTP high efficiency modulating gas boilers provide a maximum payback on fuel savings. Savings can result in payback periods of less than 3 years. Depending on the age of your present equipment, our products could save you as much as 50% on your fuel bills.

The Elite Heating Boiler Dimensions & Specifications

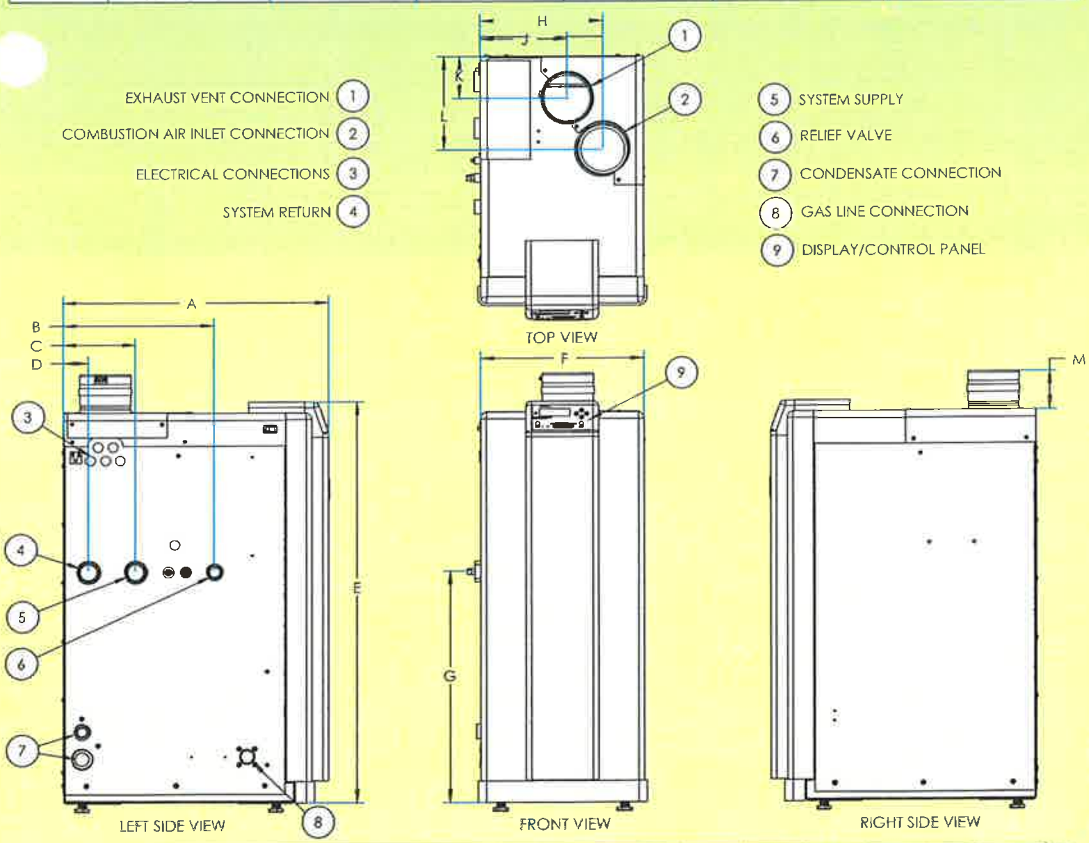
Elite Heating Boiler



MODEL*	A	B	C	D	E	F	G	H	J	K	L	SHIPPING WEIGHT
EL-80	18.50	9.00	2.50	27.25	14.50	20.00	11.75	7.38	5.75	10.00	2.18	108
EL-110	18.50	9.00	2.50	27.25	14.50	20.00	11.75	7.38	5.75	10.00	2.18	113
EL-150	19.50	10.50	2.50	27.25	14.50	20.00	11.75	7.38	4.25	8.50	2.18	126
EL-220	26.50	17.50	6.00	27.25	14.50	20.00	11.75	7.38	4.25	8.50	2.18	164

MODEL	BTU/INPUT LOW FIRE	DOE HEATING	IBR	SUPPLY/RETURN	EXHAUST/AIR INLET	GAS CONNECTION
EL-80	16,000-80,000	14,600-73,000	63,000	1"	3"	3/4"
EL-110	22,000-110,000	20,200-101,000	88,000	1"	3"	3/4"
EL-150	30,000-150,000	27,400-137,000	119,000	1"	3"	3/4"
EL-220	44,000-220,000	40,600-203,000	177,000	1"	3"	1"

HTP INC
120 Braley Road
East Freetown
MA 02717
508-763-8071



Elite Model	Btuh / Input Range	AFUE
EL-80	16,000-80,000	95.9
EL-110	22,000-110,000	95.7
EL-150	30,000-150,000	95.5
EL-220	44,000-220,000	95.2
EL-299	60,000-299,000	93.0
EL-301	60,000-301,000	96.1*
EL-399	80,000-399,000	96.0*

* Thermal Efficiency (Not AFUE)

www.htproducts.com

Checkout Our Elite Movies online

MODEL*	A	B	C	D	E	F	G	H	J	K	L	M	SHIPPING WEIGHT
EL-299	23.75	13.50	6.38	2.25	36.50	14.50	21.00	11.00	7.88	3.63	8.50	3.00	211
EL-301	23.75	13.50	6.38	2.25	36.50	14.50	21.00	11.00	7.88	3.63	8.50	3.00	211
EL-399	30.75	20.50	9.75	2.75	36.50	14.50	21.00	11.00	7.88	3.63	8.50	3.00	256

MODEL*	BTU/INPUT LOW FIRE	DOE HEATING	IBR	SUPPLY/RETURN	EXHAUST/AIR INLET	GAS CONNECTION
EL-299	60,000 - 299,000	55,000 - 275,000	239,000	1-1/4"	4"	1"
EL-301	60,000 - 301,000	55,000 - 275,000	239,000	1-1/4"	4"	1"
EL-399	80,000 - 399,000	76,200 - 381,000	331,000	1-1/2"	4"	1"

* "N" DENOTES NATURAL GAS "LP" DENOTES PROPANE

ALL DIMENSIONS ARE APPROXIMATE AND ARE SUBJECT TO CHANGE

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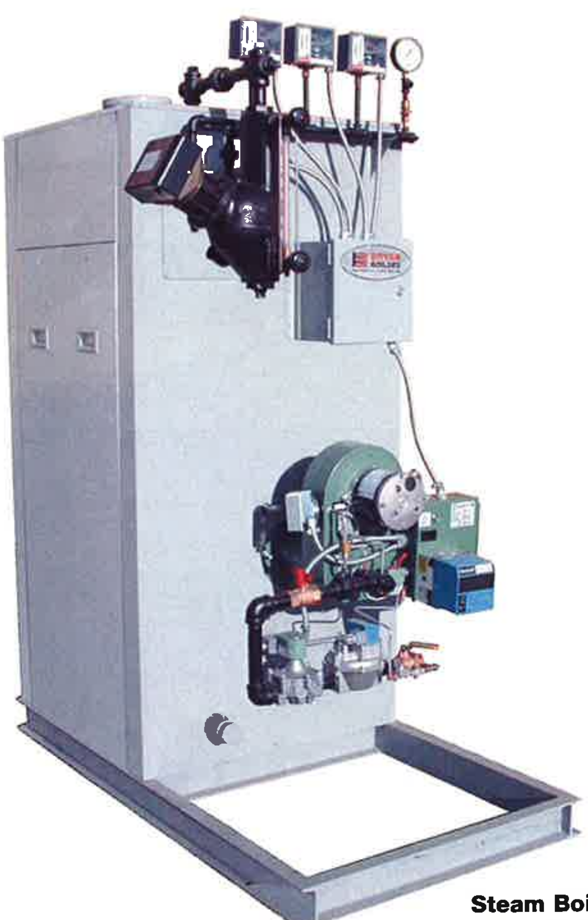
Form No. 3710
(Rev. 6/04)

Bryan "Flexible Water Tube"

DR Series
Steam & Water Boilers

250,000 to 850,000 BTUH
Forced Draft Gas, Oil or Dual Fuel Fired

Water Boiler
DR850-W-FDGO



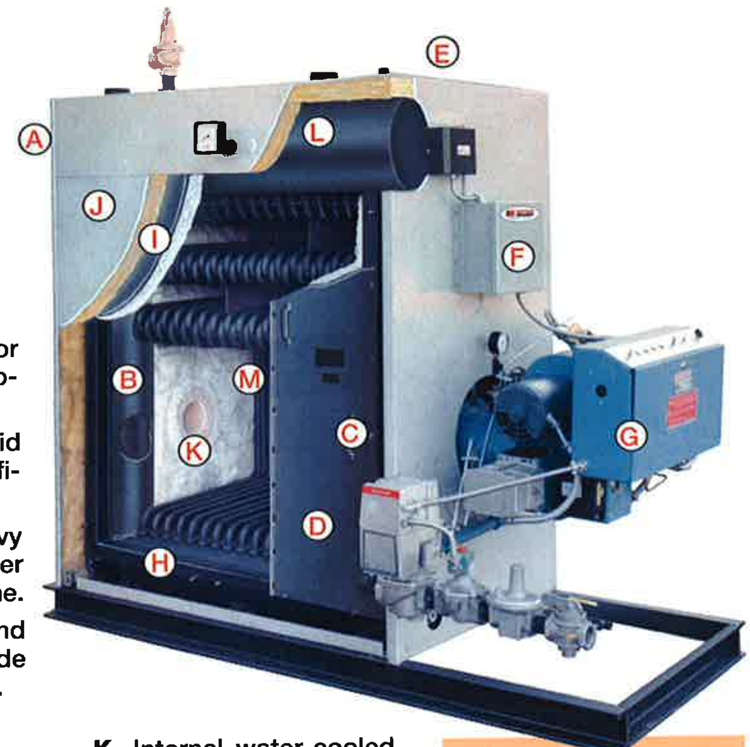
Steam Boiler
DR350-S150-FDG

BRYAN BOILERS

Originators of the "Flexible Water Tube" design

Low initial cost, high operating efficiency deliver substantial return on investment

- **True "flexible water tube" design**
- **High quality steam for heat or process**
- **Pressurized firing for high efficiency**



A. Water side or steam side interior accessible for cleanout and inspection, front and rear openings, upper and lower drums.

B. Large volume water leg downcomers promote rapid internal circulation, temperature equalization and efficient heat transfer.

C. Boiler tube and furnace area access panel: heavy gauge steel-lined with high temperature ceramic fiber and insulation, bolted and tightly sealed to boiler frame.

D. Single side access; combustion chamber, tubes and burner head are completely accessible from one side simplifying maintenance and minimizing floor space.

E. Minimum sized flue vent.

F. Control panel: all controls installed with connections to terminal strip.

G. Forced draft, flame retention head type burner. Efficient combustion of oil or gas, quiet operation.

H. Heavy steel boiler frame, built and stamped in accordance with the appropriate ASME Boiler Code.

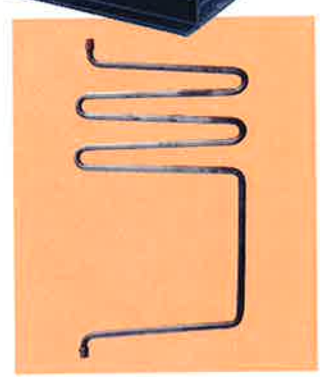
I. Heavy gauge steel boiler jacket with rust-resistant zinc coating and enamel finish, insulated with fiberglass to insure exceptionally cool outer surface.

J. Bryan bent water tubes are flexible, individually replaceable without welding or rolling. Never more than two tube configurations.

K. Internal water-cooled furnace with low heat release rate.

L. Steam boilers with extra large drum with high steam release area ensure stable water level and dry steam.

M. Pressurized design: inner fireside casing constructed of heavy gauge steel, completely sealed, lined with high temperature insulation and refractory.



Bryan DR Series Boiler Specifications

BOILER MODEL(1)	INPUT MBH (KW)	OUTPUT@ 80% EFFICIENCY(2)		OUTPUT@ 83.5% EFFICIENCY(3)		STEAM OUTPUT(4) LBS/HR (KG/HR)	HEATING SURFACE SQ. FT. (M²)	APPROX. SHIP LBS. (KG)
		MBH (KW)	HP (KW)	MBH (KW)	HP (KW)			
DR250-S	250 (73)	200 (59)	6 (59)	—	—	206 (93)	66 (6.1)	1,150 (522)
DR350-W	350 (103)	280 (82)	8 (82)	292 (86)	9 (86)	—	66 (6.1)	1,150 (522)
DR350-S	350 (103)	280 (82)	8 (82)	—	—	288 (131)	66 (6.1)	1,150 (522)
DR450-W	450 (132)	360 (106)	10 (98)	376 (110)	11 (110)	—	66 (6.1)	1,150 (522)
DR450-S	450 (132)	360 (106)	10 (98)	—	—	371 (168)	66 (6.1)	1,150 (522)
DR650-W	650 (190)	520 (152)	15 (147)	543 (159)	16 (159)	—	103 (9.6)	1,650 (748)
DR650-S	650 (190)	520 (152)	15 (147)	—	—	536 (243)	103 (9.6)	1,650 (748)
DR850-W	850 (249)	680 (199)	20 (196)	710 (208)	21 (208)	—	103 (9.6)	1,650 (748)
DR850-S	850 (249)	680 (199)	20 (196)	—	—	701 (318)	103 (9.6)	1,650 (748)

NOTES:
(1) W = Water / S = Steam
(2) Output and horsepower based on boiler industry standard of 80% of input.
(3) Output and horsepower based on an average natural gas combustion efficiency of 83.5% for hot water boiler. Actual combustion efficiencies for oil will be higher.
(4) Lbs. steam per hour from and at 212°F.

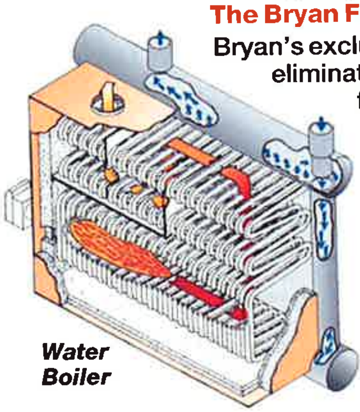
Guaranteed high efficiency performance and easy maintenance insure low cost operation

BRYAN BOILERS
The only boilers with full non-prorated
25 Year Warranty
Protection Against Thermal Shock

All Bryan DR Series boilers offer these operating and performance features

Guaranteed efficiency

The breakthrough in water tube boiler design that produced the DR Series provides operating efficiency so reliable, we guarantee it to be 83.5% for hot water boilers and 82.5% (15 psi) or 80% (150 psi) or better for steam boilers.



Water Boiler

The Bryan Flexible Tube

Bryan's exclusive "Flexible Tube" design eliminates the possibility of damage from so-called "thermal shock." Tubes are easily removable and replaceable, without welding or rolling, eliminating long, expensive downtime should repairs ever be required.

Water cooled furnace

The configuration of the water tubes provides a water cooled combustion chamber. A high percentage of the heating surface is exposed to direct radiant heat, increasing water velocities and heat transfer.

Large steam drum

The steam drum has generous water volume and steam release area. This design, along with effective drum internal functions, results in a stable water level and produces extremely dry steam at all load conditions.

Accessibility of furnace and tube area

Inner panel provides easy and complete access to furnace and boiler tube area, as well as to burner head. All panels are heavily insulated and sealed to boiler frame. All access is from only one side.

Compact design, minimum floor space

With our compact water tube design, the overall size of the unit is less than most other types of boilers. Needing only 24" for tube removal, and on only one side of the boiler, the DR Series boiler occupies very little space in the boiler room. This can result in considerable savings in building costs. Pressurized firing permits minimum sized breaching and vent.

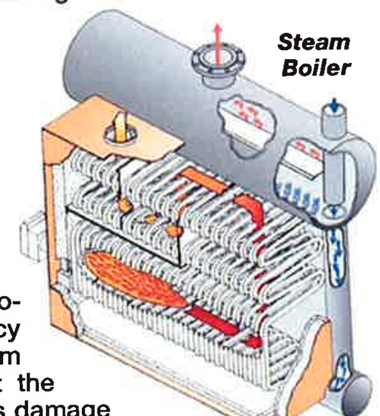
Multi-pass flue gas travel

High velocity four-pass flue gas travel is obtained by a unique baffling system. This contributes to maximum fire side heat transfer and overall high boiler efficiencies.

Thermal blend water return

Bryan's unique "thermal blend" return blends cold or cooler return water with warmer boiler water abridging it to design operating temperatures. An injector tube directs the "mixed" water flow through the downcomer to the lower header and heating surfaces at a temperature above possible condensing conditions. This reduces the possibility of "cold spots" and damage from corrosive condensation.

Positive internal circulation



Steam Boiler

Each pass of the Bryan water tube slopes upward. This configuration, along with the large volume down-comer water legs, provides the extremely rapid natural thermal internal circulation, promoting both high efficiency of heat transfer and uniform temperature throughout the boiler. Eliminating stress damage caused by unequal temperature distribution is especially important for heating systems, particularly where intermittent or continuous low temperature water returns may be encountered.

Bryan DR Series Boilers Standard and Optional Equipment

STANDARD EQUIPMENT FURNISHED

Water boiler

Combination thermometer and altitude gauge, ASME Code rated boiler relief valve, water temperature control (240°F max std.), high limit control, probe LWCO.

Steam boiler

Steam pressure gauge, steam pressure control, combination low water cutoff and pump control, auxiliary low water cutoff, high limit pressure control, ASME-rated safety valve, water glass set.

Straight gas fired unit

Electronic combustion safety control, automatic operating gas valve, safety gas valve, pilot solenoid valve, pilot ignition assembly, main manual gas shut-off valve, pilot cock, pilot and main gas pressure regulators, air safety switch, control panel, all controls installed and wired.

Straight oil fired unit

Electronic combustion safety control, dual oil valves oil ignition transformer, two-stage fuel unit, direct spark ignition of oil, oil nozzle assembly, control panel, all controls installed and wired.

Combination gas-oil unit

Electronic combustion safety control, automatic operating gas valve, safety gas valve, pilot solenoid valve, pilot ignition assembly, main manual gas shut-off valve, pilot cock, pilot and main gas pressure regulators, air safety switch, manual fuel selector switch, dual oil valves, gas pilot for both fuels, two-stage fuel unit, nozzle assembly, control panel, all controls installed and wired.

OPTIONAL EQUIPMENT, EXTRA COST

1. Manual reset high limit control
2. Manual reset low water cutoff
3. Auxiliary low water cutoff
4. Combination low water cutoff and feeder
5. Alarm bells or horns
6. CSD-1, FM, IRI or other insurance approved control systems
7. Indicating lights, as desired
8. Lead-lag systems for two or more boilers with or without outdoor reset control
9. Draft control system

OPTIONAL CONSTRUCTION:

Steam boiler

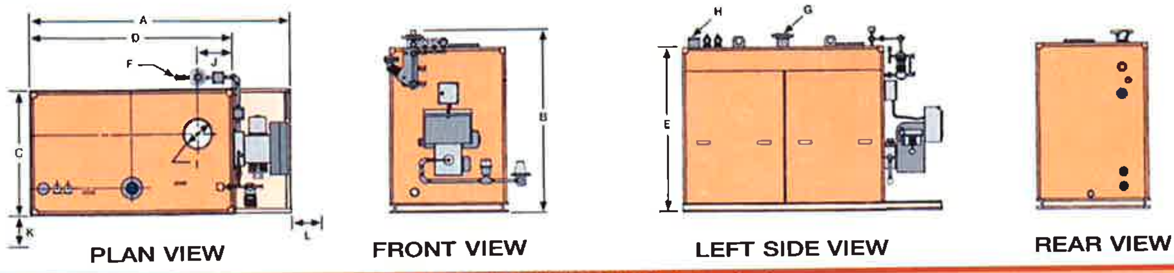
Optional construction to ASME Power Boiler Code requirements for pressure exceeding 150 psi to maximum of 300 psi design pressure.

Hot water boiler

Optional construction to ASME Power Boiler Code requirements for temperatures exceeding 240° F and/or pressure exceeding 160 psi to maximum of 285° F operating and 300° F design temperature and 250 psi.

When ordering, please specify:
1. Boiler size
2. Supply and return temperatures required
3. Boiler relief valve setting
4. Type of fuel: natural, LP, or other gas and/or No. 2 oil
5. If gas, type, BTU content, specific gravity and pressure available
6. Electric power voltage, phase and frequency
7. Optional extra equipment or construction
8. Special approvals required (UL, CSD-1, FM, or IRI)
9. Altitude

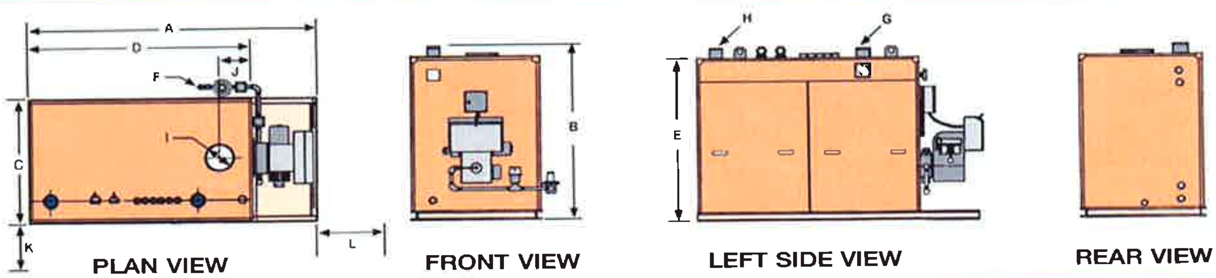
Bryan DR Series Steam & Hot Water Boilers



STEAM BOILER DIMENSIONS in inches (cm)

Boiler Model Number	A Overall Length	B Floor to Flow Nozzle	C Width Outside Jacket	D Length of Jacket	E Height Over Jacket	F Gas Train Connection (Approx.)	G Supply Nozzle 15 psi	G Supply Nozzle 150 psi	H Return Conn.	I Flue Size	J Flue Location	K Min. Tube Removal Clearance	L Clearance for Servicing Burner
DR250-S*	62 1/8 (157.80)	74 5/8 (189.54)	33 13/16 (85.88)	32 3/8 (82.23)	71 3/4 (182.25)	1 (2.54)	NA**	3 (7.62)	2 (5.08)	6 (15.24)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR350-S	62 1/8 (157.80)	74 5/8 (189.54)	33 13/16 (85.88)	32 3/8 (82.23)	71 3/4 (182.25)	1 (2.54)	3 (7.62)	3 (7.62)	2 (5.08)	6 (15.24)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR450-S	62 1/8 (157.80)	74 5/8 (189.54)	33 13/16 (85.88)	32 3/8 (82.23)	71 3/4 (182.25)	1 (2.54)	3 (7.62)	3 (7.62)	2 (5.08)	6 (15.24)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR650-S	73 1/2 (186.69)	74 5/8 (189.54)	33 13/16 (85.88)	43 3/4 (111.13)	71 3/4 (182.25)	1 (2.54)	4 (10.16)	4 (10.16)	2 (5.08)	8 (20.32)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR850-S	73 1/2 (186.69)	74 5/8 (189.54)	33 13/16 (85.88)	43 3/4 (111.13)	71 3/4 (182.25)	1 (2.54)	4 (10.16)	4 (10.16)	2 (5.08)	8 (20.32)	12 13/16 (32.54)	24 (60.96)	30 (76.20)

NOTE: Dimensions subject to change without notice. Consult factory for certified dimensions.
* Not intended for use as a principal heating source for the living space of an individual residence.
** Not available in 15 psi construction.



WATER BOILER DIMENSIONS in inches (cm)

Boiler Model Number	A Overall Length	B Floor to Flow Nozzle	C Width Outside Jacket	D Length of Jacket	E Height Over Jacket	F Gas Train Connection	G Supply Nozzle	H Return Nozzle	I Flue Size	J Flue Location	K Min. Tube Removal Clearance	L Clearance for Servicing Burner
DR350-W	62 1/8 (157.80)	67 7/8 (172.40)	32 1/8 (81.60)	32 3/8 (82.23)	66 3/8 (168.59)	1 (2.54)	2 (5.08)	2 (5.08)	6 (15.24)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR450-W	62 1/8 (157.80)	67 7/8 (172.40)	32 1/8 (81.60)	32 3/8 (82.23)	66 3/8 (168.59)	1 (2.54)	2 (5.08)	2 (5.08)	6 (15.24)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR650-W	73 1/2 (186.69)	67 7/8 (172.40)	32 1/8 (81.60)	43 3/4 (111.13)	66 3/8 (168.59)	1 (2.54)	2 (5.08)	2 (5.08)	8 (20.32)	12 13/16 (32.54)	24 (60.96)	30 (76.20)
DR850-W	73 1/2 (186.69)	67 7/8 (172.40)	32 1/8 (81.60)	43 3/4 (111.13)	66 3/8 (168.59)	1 (2.54)	2 (5.08)	2 (5.08)	8 (20.32)	12 13/16 (32.54)	24 (60.96)	30 (76.20)

Specifications subject to change without notice. Consult factory to consult on other boiler options.

BRYAN BOILERS

Bryan Steam LLC — Leaders Since 1916
783 N. Chili Ave., Peru, Indiana 46970 U.S.A.
Phone: 765-473-6651 • Internet: www.bryanboilers.com
Fax: 765-473-3074 • E-mail: bryanboilers@iquest.net

Form No. 3710

Printed in USA
64-6166

Sludge Spiral Heat Exchanger

Compact and efficient

For decades, spiral heat exchangers have been one of the most cost effective ways to keep a digester warm, to preheat sludge before dewatering, to pasteurize sludge and to perform a wide range of other sludge heating applications.

With more than 50 years of experience, Alfa Laval has 1500 sludge spiral heat exchanger installations in the US and more than 5,000 installations worldwide.

The fundamental advantage

Compared to conventional heat exchangers, the Alfa Laval Sludge Spiral Heat Exchangers only need one sixth of the space, yet give you higher heat transfer coefficients, less fouling and up to 75% lower pumping power consumption. With a completely clear passage and no sharp bends, the sludge flow channel keeps clear and you can count on efficient and continuous operation – time and time again.

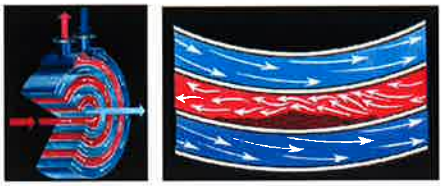
The sludge spiral heat exchanger requires only a very limited amount of space for service work, due to easy access with a hinged cover that exposes the entire sludge channel for CIP. And due to its size, it requires up to 50% less heating medium. This means major savings in operating costs – and also means lower costs for buildings, pumps, valves and piping.

The sludge spiral heat exchanger design provides improved heat exchange area, additional "easy clean" features that make it easier to inspect the inlet without opening the unit, faster opening/closing of the unit, and all pump and valve connections are at the same level and spacing, irrespective of heat exchanger size. The sludge spiral heat exchanger reduces maintenance downtime by up to 25%.

The smaller footprint of sludge spiral heat exchangers means that capital costs for both the heat exchanger unit and the ancillary equipment, as well as for buildings and structures where they are installed, are also significantly lower.

Working principle and design

The sludge spiral heat exchanger is constructed of a hot channel and a cold channel. The sludge channel (hot or cold) is manufactured with no obstructions and easily accessible for cleaning. In the case of heat recovery applications or sludge to sludge applications, both channels are accessible for cleaning and unobstructed.



The hot and cold channels are in a completely counter-current configuration to maximize the amount of heat transferred. The spiral geometry and channel design will induce a 'self cleaning' effect should any deposits collect on the walls. There is an increase in velocity locally, which scrubs any deposits away. Design velocity is maintained throughout the unit, maximizing the heat exchanged at all points between the sludge and utility fluid.

The sludge inlet is placed tangentially for even distribution of the sludge across the entire sludge channel. The cover(s) on the unit are hinged for ease of opening. Hook bolts and a gasket seal(s) are used to seal the unit shut after opening.

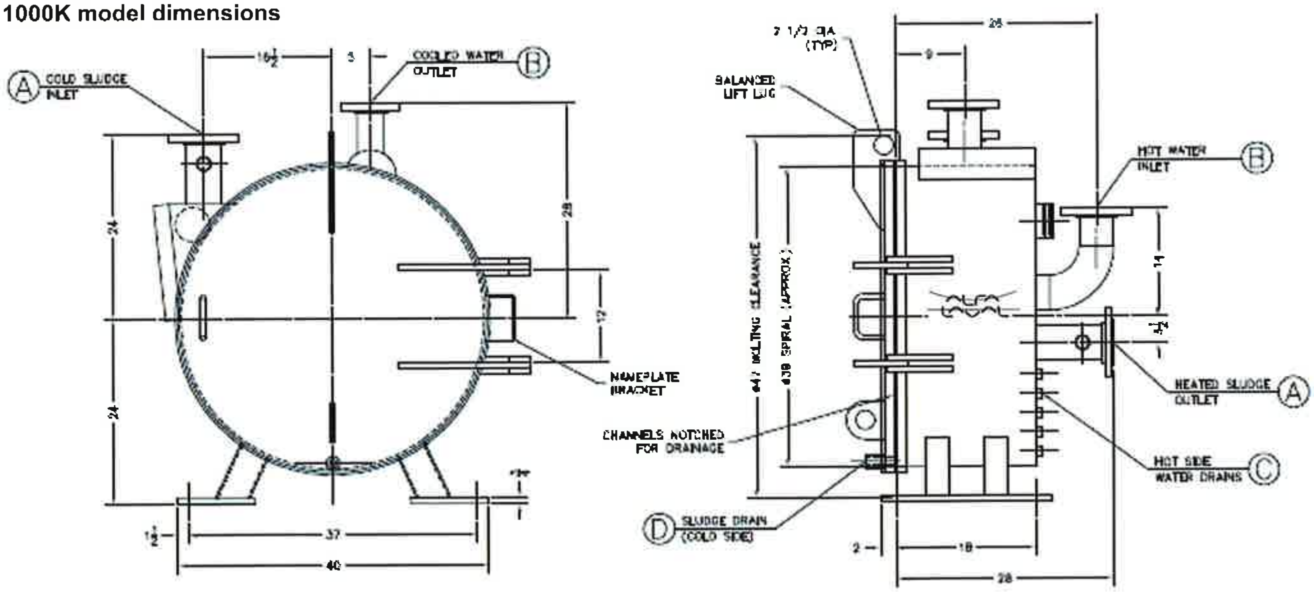
The sludge spiral heat exchanger is also equipped with a 2" back flush connections on both the sludge inlet and outlet in addition to a 4" hand hole cleanout. A series of 3/8" couplings are provided to drain each hot water channel, and a 1" coupling is provided for draining the sludge channels and is located at the lowest point on the cover.

Dimensions and technical data

Model and design may vary based on process. Please contact Alfa Laval for additional information.

Sludge spiral model	Sludge		A Height (inches)	B Width (inches)	C Depth (inches)	Weight (lbs)
	GPM	ΔP psi				
15L	120	2.1	35	29	18	700
25L	120	2.6	39	33	18	1080
35L	120	3.3	44	38	18	1370
500K	120	4.0	50	44	15	2380
750K	200	5.4	50	44	22	2670
1000K	300	4.7	50	44	28	3060
1500K	300	5.7	58	51	28	3840
2000K	430	5.2	54	48	34	3750
2500K	530	5.1	54	48	41	4170
3000K	660	5.8	55	49	47	4780

1000K model dimensions



How to contact Alfa Laval
Contact details for all countries are continually updated on our website. Please visit www.alfalaval.com to access the information directly.

Leaders in Biogas Technology

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Moisture Removal Systems

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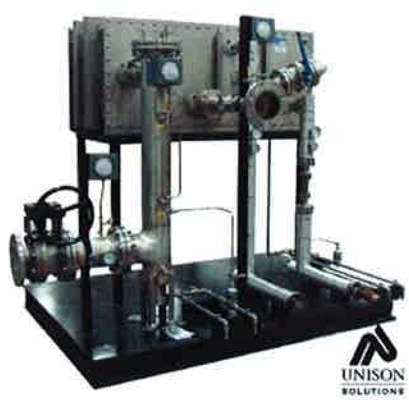
- Hydrogen Sulfide Removal Systems
- Gas Compression Systems
- Gas Blower Systems
- **Moisture Removal Systems**
- Moisture – Particulate Removal Vessel
- Siloxane Removal Systems
- BioCNG™ Vehicle Fuel Systems
- Capstone Turbine Distributor

Moisture Removal Systems

If compression is not required, we can provide the same level of gas conditioning for use with your blower or compressor. Whether you require filtration, condensate removal, or heat transfer, we can build a system for your application. We can also provide passive drying systems for process gases that are not related to biogas. Our experience with the heat transfer characteristics of gas mixtures allows us to design a system to meet your specifications.



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Home About Us Products BioCNG™ Services Projects Resources Contact Us Custom Manufacturing

Siloxane Removal Systems

You are here: Home » Products » Siloxane Removal Systems

- Hydrogen Sulfide Removal Systems
- Gas Compression Systems
- Gas Blower Systems
- Moisture Removal Systems
- Moisture – Particulate Removal Vessel
- **Siloxane Removal Systems**
- BioCNG™ Vehicle Fuel Systems
- Capstone Turbine Distributor

Siloxane Removal Systems

Siloxanes are chemicals used extensively in industrial products such as lubricants and in personal care products. Nearly all digester and landfill gas contains one or more species of siloxanes. When biogas containing siloxanes is combusted in gas turbines, boilers, fuel cells, or internal combustion engines, deposits of solid silica (SiO_2) collect within the equipment. Damage inflicted by siloxane deposits can be profound, causing more frequent maintenance and lower generation capacity. Due to increasing issues caused by siloxanes many of our systems include integrated siloxane removal systems.

SILOXANE BUILD UP ON A TURBINE RECUPERATOR

Because each source of biogas is unique, we have a variety of medias available to remove siloxane compounds. Our in house experts will evaluate your biogas chemistry and choose the optimum media for your specific location.

Unison Solutions offers vessel design and custom fabrication services. We are a certified ASME manufacturing shop in compliance with the ASME Section VIII, Division 1 Code using The Hartford Steam Boiler Company as our authorized inspector. We specialize in stainless steel fabrication and offer vessels up to 12' in diameter.

Would you like to test a siloxane removal system and various media types without a large investment? Our pilot study skid may be what you're looking for. Learn more about it

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Moisture – Particulate Removal Vessel

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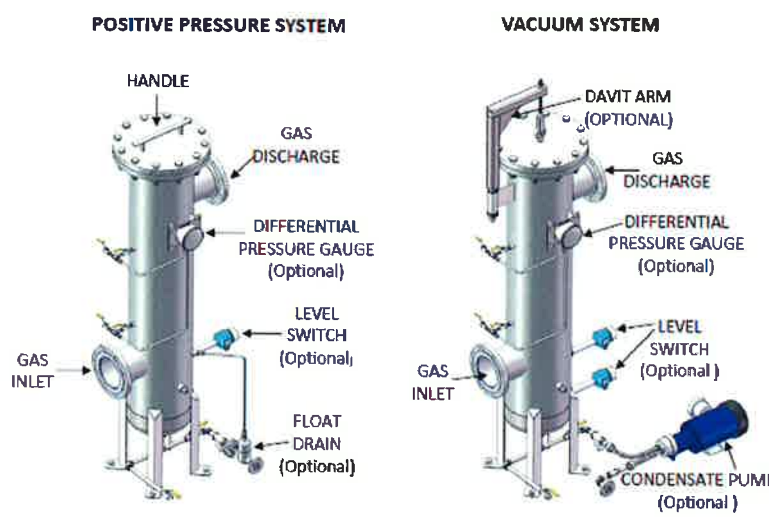
- Hydrogen Sulfide Removal Systems
- Gas Compression Systems
- Gas Blower Systems
- Moisture Removal Systems
- **Moisture – Particulate Removal Vessel**
- Siloxane Removal Systems
- BioCNG™ Vehicle Fuel Systems
- Capstone Turbine Distributor

Moisture – Particulate Removal Vessel

Unison's moisture/particulate removal vessels are built to last. The vessels are all 304L stainless steel and designed per ASME Section VII, DIV. 1. The 3 micron particulate system is our standard, but we have multiple sizes available to match your specifications. Please contact our sales group to discuss your requirements.sales@unisonsolutions.com



OPTIONS

- CAN BE CUSTOM BUILT TO FIT ANY APPLICATION
- 316L STAINLESS STEEL CONSTRUCTION
- 1 MICRON PARTICULATE REMOVAL
- ASME SECTION VIII, DIV. 1 STAMPED
- HIGH LIQUID LEVEL SWITCH
- LEVEL INDICATOR
- FLOAT OPERATED DRAIN
- DIFFERENTIAL PRESSURE GAUGE
- FLANGED CLEANOUT

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Gas Compression Systems

Gas Compression Systems

Using technology from the sour gas industry, we have developed a line of gas compression skids that resist the destruction caused by biogas. Our equipment has been used to fuel turbines, fuel cells and direct use biogas pipeline projects. Due to increasing maintenance issues caused by siloxanes many of our compressor skids are used in conjunction with integrated siloxane removal systems.

Our compression systems use two stage condensate removal to protect not only the end use equipment but also the compressor itself. We have developed a process to remove enough moisture prior to compression to prevent condensation within the compressor. The remaining moisture is removed post-compression where the efficiency is greater and a true pressure dew point can be achieved.

Packages can be designed for any gas flow at pressures up to 200 psig. The gas will be delivered particulate free with a relative humidity consistently lower than 25%. As a standard practice, we design all of our biogas systems for a Class I, Division 1 environment. Our in-house UL panel shop allows us to customize the automation of each system to meet the customers individual requirements. We work hard to make our systems easy to operate and maintain.

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Model # WWDS-HTS

c UL US LISTED

Wastewater Digester Sludge Heating System

for Anaerobic Digester

Dual Fuel—Bio-gas & LP or Natural Gas

Unfired Pressure

National Board

Pressure Piping

Process Piping & Power Piping

EnviroSep WWDS-HTS, Wastewater Digester Sludge Heating System is a UL-Listed, factory manufactured and tested system used in biological wastewater treatment plants for maintaining sludge temperature in the Anaerobic Digester. The Indirect Heating method is employed, with a sealed-in primary water circuit, combined with an internal heating coil eliminates corrosion, scaling, and sludge baking. The ***Model WWDS-HTS*** Secondary Water circuit is utilized to control the Digester Process Temperature within the mesophillic range at an optimum 100 deg F. A three-way Modulating Control Valve maintains a low Log Mean Temperature Difference in the Tube-in-Tube, Sludge Heat Exchanger which prevents baking of sludge on the tube walls and prevents Digester upsets. Additional safety devices are included to automatically prevent system operation unless specific process parameters are verified. The ***Model WWDS-HTS*** provides Air-free, Hot Water at a controlled flow rate, while automatically refilling under normal system losses and allows for system thermal expansion/compression based on the system volume. A UL-Listed, Industrial Control Panel with single-point power connection is pre-wired to all electrical field devices and power sources. The ***Model WWDS-HTS*** speeds installation and start-up by eliminating costly and time sensitive field construction and system integration.

Standard Features:

- **ASME, Tube-in-Tube, Wastewater Sludge Heat Exchanger,** ***with U-stamp***
- **Parker Indirect Fired, Hot Water Boiler,** ***w/ dual fuel gas train***
- **Centrifugal Hot Water End-suction Pumps**
- **Self-priming Sludge Transfer Pumps**
- **Vortex Air Separator,** ***with Auto Air Vent***
- **Bladder Expansion/Compression Tank**
- **Triple Duty Valves & Suction Diffusers**
- **UL Listed NEMA 4 Industrial Control Panel,** ***w/ stand alone controls***
- **Safety Relief Valve**
- **Make-up Water Assembly**
- **Pump Differential Pressure Gauges**
- **ASME Section IX Welding**

Options:

- **PLC System Controller w/ Touch Screen (customized controls and monitors—Upon Request)**
- **Internet Connectivity for Remote System Monitoring**
- **Flexible Pump Connectors**
- **Seismic or Vibration Isolators**
- **Specific Performance Criteria (Upon Request)**

TYPICAL SPECIFICATIONS	
Heating Loads	0.5 to 6.0 MMBTU/hr
Hot Water Temperature	120 to 140 deg F
Standard WW Flow Rate	125 to 1200 GPM
Standard Power	460 V (Other Voltages Available)
Dimensions	Based on Customer Requirements
Working Pressure	100 to 150 psig (6.8 to 10.2 barg)

EnviroSep

www.envirosep.com

P. O. Box 857 Georgetown, SC 29442 • Phone: 843-546-7400 Fax: 843-546-7407

BUDGETARY

Submitted To:	Rick McClung	**Proposal No.:**	1503013
	LaBella Associates	**Revision No.:**	0
	xxx	**Date:**	October 14, 2012
	xxx	**Terms:**	Progress Payments
	xxx	**RFQ No.:**	N/A
	Phone: (585) 295-6265		
	Fax: xxx	**Drawing Leadtime:**	2 to 3 weeks
	Email: RmcClung@LaBellaPC.com	**Manufacturing Leadtime:**	10 to 12 weeks

Job Name: Wastewater Sludge Heat Transfer System - 1 MMBTU/hr with BioGas and LP GasHW Boiler – Model WWDS-HTS

Item #	Description	Qty	Price Each
1	Wastewater Sludge Heat Transfer System - 1 MMBTU/hr with BioGas and LP GasHW Boiler – Model WWDS-HTS	1	$233,785.00

One (1) EnviroSep Fluid and Heat Recovery Systems, UL-Listed Hot Water Boiler / Hot Water Packaged Pumping System, and Sludge Heating System consisting of:

- One (1) Hot Water Boiler; Model T1210L Bent Tube, Water-tube design;
- One (1) BioGas/LP Gas Parallel Valve Trains Assembly, rated for 14" w.c. to 7 w.c. minimum gas supply
- pressure, Stainless Steel Material for BioGas Service, LP Gas - 1140 s.c.f, and Biogas - 1900 s.c.f.
- One (1) BET-037 Bladder Expansion Tan, 37 gal. with Isolation and Drain Valve
- Two (2) EnviroSep 4280 3x2x10, Close-coupled, End Suction Centrifugal pumps rated for 200 GPM at 90 ft. TDH, 7 1/2 Hp TEFC 1800 RPM motor for 480/3/60;
- Two (2) TDV-3SF, 3" Triple Duty valves;
- Two (2) SD-33 3"x 3" Pump Suction Diffusers with blowdown valves;
- Two (2) Mueller 88M 3" Butterfly Valves, Pump suction Isolation valves;
- Four (4) Pump Suction and Discharge Pressure Gauges with Isolation Valves
- Two (2) Sludge Pressure Gauges, Diagphram Seal type, for Heat Exchanger Inlet and Outlet;
- Two (2) Hot Water Pressure Gauges, For Heat Exchanger Inlet and Outlet
- Four (4) Heat Exchanger Inlet and Outlet Sytem Thermometers;
- One (1) ASL-003 3" Air Seperator with Auto Air Vent and Drain Valve;
- One (1) Endress & Hauser Flowphant DDT31, Thermal Dispersion Flow Switch;
- One (1) BFT-005-O 5 Gallon Chemical Bypass Feeder, with Isolation, Vent, and Drain Valves;
- One (1) Make-Up Water Assembly with pressure reducing valve set at 30 PSIG, Y-Strainer, Bypass Valve, and Isolation Valve;
- One Relief Valve Set at 75 PSIG;
- One (1) High Limit Control, Immersion Thermmostat, to Disable Hot Water Boiler upon High Temperature Condition;

- One (1) 3" Three Way Modulating Control Valve fo Sludge Return Temperature Control;
- One (1) UL-Listed NEMA 4, Industrial Control Panel, 480/3/60 with Hand-Off-Auto Selector Switche, Motor Starters, Remote Connections for Control System. PID Temperature Controller for Hot Water Supply to Heat Exchanger to Maintain Sludge Return Temperature. Alarm Horn and Alarm Light with Silence Button for system fault Condition.
- One (1) Heat Exchanger, EnviroSep Tube- In-Tube Design, Rated for 1 MMBTU/Hr to heat 325 GPM Sludge Flow with 200 Gpm Hot Water @ 140 F. Unit to be Single channel Counter-Current flow design; EnviroSep, Custom Non-ASME, Tube-in-Tube, Quantity of 4 Stacked units in Series, 3" SS Tube, 4" CS Shell, Heat Exchanger; Length 20Ft.;
- Two (2) Mueller 88M, 3" Lug mounted Butterfly Isolation Valves for Hot Water Inlet and Outlet to Heat Exchanger;
- One (1) Heat Exchanger Pressure Relief Valve, Set at 75 PSIG;
- One (1) Sludge Return RTD Temperature Transmitter; Endress & Hauser TH13-1A22A2AILAK;
- One (1) 4" ANSI 150 Red Valve 5200E, Actuated Pinch Valve; Sludge Inlet to Heat Exchanger;
- Two (2) 4" Mueller 71-AHI-6-H, Wafer Disc Check Valves, Sludge Pump Discharge;
- Two (2) 4" Dezurik Sartell W1-D1-EPDM-DI-S4-LT; Offset Disc Butterfly Valves; Sludge Pump Discharge;
- Frame Mounted on Common Structural Steel Frame coated with High Temperature, High Solids Epoxy;
- ASME Section IX Certified Welding;
- Simulated System Operational Testing and Hydrostatic Testing Prior To Shipment.

Estimated Weight: 15,000 lbs.
Estimated Dimensions: 200''L x 96''W x 84''H

Schedule:

1) Upon receipt of approval drawings, procurement and fabrication shall commence immediately.
2) Preparation of Approval Drawings and Submittal subject to change based on Date or Order.
3) Manufacturing Lead time subject to change based on Date or Order.
4) System Drawings for Approval shall be submitted following receipt of Purchase Order; any modifications requested subsequent to receipt of Certified Approval shall alter costs. Minimum Change Order Fee subsequent to Certified Approval is $500.

Commercial:

1) Freight not included. Freight shall be prepaid and added to Invoice or others may arrange Freight as Collect Shipment. FOB Georgetown, SC.
2) Sales tax, export fees, tariffs, taxes extra, if any. All prices and payments to be in US Dollars.
3) Start-up and Training is not included.. Start-up Service Fee may be added for $1,700 per day, plus $75/hr for travel time, plus travel expenses with 15% added. Rigging, Site Preparation, and Installation is not included. If Start-up is conducted within one-trip, start-up of system can be performed within XXX (x) days of site time; YYY (y) days of travel should be calculated.
5) The pricing of this proposal is for 30 days for the proposal date; Pricing beyond 30 days may be subject to change.
6) Witnessed Factory Acceptance Test, 3rd Party Inspections, or Client Inspections cost shall be $1,600.00 per day, if not identified within the proposal as inclusive. If requested by purchaser, Non-witnessed Factory Acceptance Test is conducted at no additional cost.
7) EnviroSep Standard Terms & Conditions shall apply, available upon request. Standard Terms & Conditions may be modified to accommodate special requirements, if required. All orders are subject to acceptance.

8) Payment Terms shall be 1/3 Down payment with Order, Balance Net 30 from Shipping Date. Due to custom nature of this project and extended timeframe from project initiation to completion, partial payment is required to maintain project working capital. Alternative Payment Terms may be negotiated.
9) All Purchase Orders shall be written directly to EnviroSep (Seller).

Technical Clarifications:

1) This proposal is based on an EnviroSep system design and interpretation of any specifications and/or drawings provided w/ RFQ; the purchaser or reviewer should compare any specific specifications to the offering of this proposal for compliance. Upon acceptance of this proposal, Seller recognizes the Accepted Proposal as the governing document, and changes in specific components or scope of work may result in cost modifications.
2) Any recognized exceptions to the specifications, drawings, terms and conditions and other requirements of this Request for Quotation shall be noted within the body of this proposal.
3) No other accessories or items are included, other than those specifically listed above.
4) EnviroSep standard paint color is industrial enamel gray. Alternate coating colors and type available upon request.
5) O&M Manuals shall be shipped with the equipment and will be provided on Compact Disc in lieu of Bound Copies.
6) Final Spare Parts List and cost, if required, shall be provided with O&M Manual, if required.
7) All connections possible will be welded or flanged construction. Although, several system components are only furnished with NPT connections. NPT connections shall be minimized.
8) Seismic anchorage calculations, if required, may be provided for additional cost of $1,400.00.

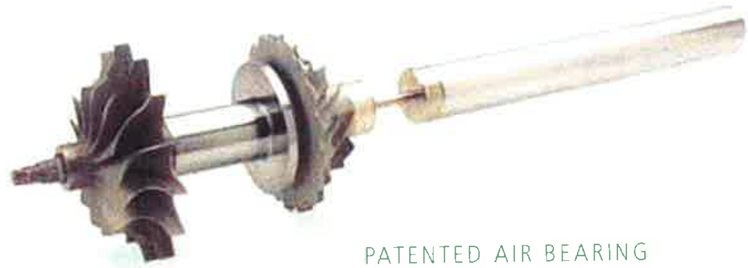
Product Catalog




Reliable power when and where you need it.
Clean and simple.

Capstone Microturbines

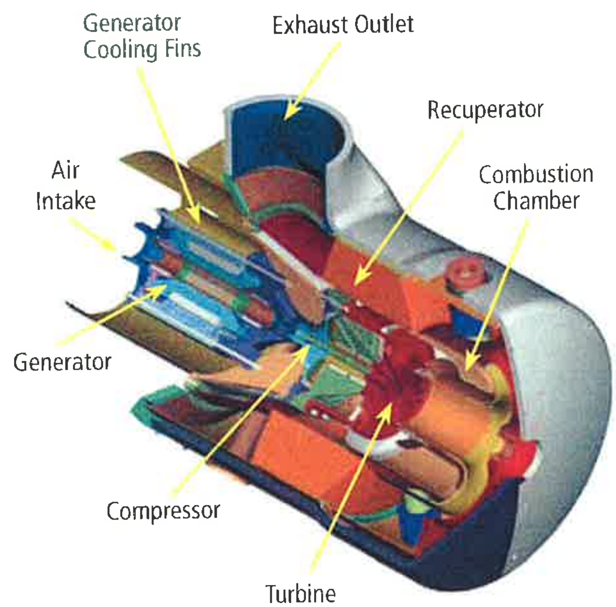
Capstone microturbines are used in distributed power generation applications including cogeneration, resource recovery, secure power, and hybrid electric vehicles (HEV).



PATENTED AIR BEARING

Low-emission, clean-and-green Capstone microturbines are scalable from 30kW to 10MW. The C1000 Power Package, the world's first megawatt microturbine power system, can be configured into smaller 800kW and 600kW solutions – all within a single ISO-type container. Models are available that operate on: Natural Gas, Propane, Landfill Gas, Digester Gas, Diesel, Aviation, and Kerosene fuels.

- Ultra-low emissions
- One moving part – minimal maintenance and downtime
- Patented air bearing – no lubricating oil or coolant required
- 5 and 9 year Factory Protection Plans available
- Remote monitoring and diagnostic capabilities
- Integrated synchronization and protection
- Reliable – tens of millions of run hours and counting



C30

C65

C65 ICHP

C65 CARB

HAZARDOUS LOCATIONS

Model	Fuels	Power Output[1]	Electrical Efficiency	Exhaust Gas Flow		Exhaust Temperature		Net Heat Rate		Dimensions[2] (W x D x H)	
		kW	%	kg/s	lbm/s	C°	F°	MJ/kWh	btu/kWh	m	in
GASEOUS FUELS[3]											
C30 LP	NG	28	25	0.31	0.68	275	530	13.8	13,100	0.76 x 1.5 x 1.8	30 x 60 x 70
C30 HP	NG, P, LG, DG	30	26	0.31	0.68	275	530	13.8	13,100	0.76 x 1.5 x 1.8	30 x 60 x 70
C30 HZLC[4]	NG	30	26	0.32	0.70	275	530	13.8	13,100	0.87 x 2.9 x 2.2	34 x 112 x 85
C65	NG, P	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 1.9 x 1.8	30 x 77 x 76
C65 ICHP	NG, P, LG, DG	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.4	30 x 87 x 93
C65 CARB	NG	65	28	0.51	1.13	311	592	12.9	12,200	0.76 x 2.2 x 2.6	30 x 87 x 103
C65 CARB	LG, DG	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.6	30 x 77 x 85
C65 HZLC[4]	NG	65	29	0.50	1.09	325	617	12.9	12,200	0.87 x 3.2 x 2.3	35 x 128 x 90
C200 LP	NG	190	31	1.3	2.9	280	535	11.6	11,000	1.7 x 3.8 x 2.5	67 x 150 x 98
C200 HP	NG, P, LG, DG	200	33	1.3	2.9	280	535	10.9	10,300	1.7 x 3.8 x 2.5	67 x 150 x 98
C200 HZLC[4]	NG	200	33	1.3	2.9	280	535	10.9	10,300	1.9 x 3.2 x 3.1	74 x 126 x 122
C600 LP	NG	570	31	4.0	8.8	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C600 HP	NG, P, LG, DG	600	33	4.0	8.8	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
C800 LP	NG	760	31	5.3	11.7	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C800 HP	NG, P, LG, DG	800	33	5.3	11.7	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
C1000 LP	NG	950	31	6.7	14.7	280	535	11.6	11,000	2.4 x 9.1 x 2.9	96 x 360 x 114
C1000 HP	NG, P, LG, DG	1000	33	6.7	14.7	280	535	10.9	10,300	2.4 x 9.1 x 2.9	96 x 360 x 114
LIQUID FUELS[5]											
[illegible]	D, A, K	29	25	0.31	0.69	275	530	14.4	13,700	0.76 x 1.5 x 1.9	30 x 60 x 70
C65	D, A, K	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 1.9 x 1.8	30 x 77 x 76
C65 ICHP	D, A, K	65	29	0.49	1.08	309	588	12.4	11,800	0.76 x 2.2 x 2.4	30 x 87 x 93
C200	D	190	30	1.3	2.9	280	535	10.9	10,300	1.7 x 3.8 x 2.5	67 x 150 x 98

[1] Nominal full power performance at ISO conditions: 59° F, 14.696 psia, 60% RH
[2] Height dimensions are to the roofline. Exhaust outlet can extend up to 7 inches above the roofline.
[3] Models available to operate on these different fuels: NG – Natural Gas; P – Propane; LG – Landfill Gas; DG – Digester Gas
[4] Hazardous Location units suitable for use in potentially explosive atmospheres (UL Class I, Division 2 or Atex Class I, Zone 2)
[5] Models available to operate on these different fuels: D – Diesel; A – Aviation; K – Kerosene

Specifications are not warrantied and are subject to change without notice.

C200

C1000

Capstone Turbine Corporation® is the world's leading producer of low-emission microturbine systems, and was first to market with commercially viable air bearing turbine technology. The company has shipped thousands of Capstone turbines to customers worldwide. These award-winning systems have logged millions of documented runtime operating hours.

Capstone is a member of the U.S. Environmental Protection Agency's Combined Heat and Power Partnership which is committed to improving the efficiency of the nation's energy infrastructure and reducing emissions of pollutants and greenhouse gases.

A UL-Certified ISO 9001:2008 and ISO 14001:2004 company, Capstone is headquartered in the Los Angeles area with sales and/or service centers in China, Mexico, Singapore, South America, the United Kingdom, and the United States.

For more information about Capstone Turbine Corporation and its clean-and-green microturbine technology solutions, please visit www.capstoneturbine.com or call 818.734.5300.

Capstone®

Capstone Turbine Corporation
21211 Nordhoff Street
Chatsworth • CA • 91311
818.734.5300 • Fax 818.734.5320
866.422.7786 • www.capstoneturbine.com

APPENDIX C2

ITEMIZED COST ESTIMATES

Village of Webster

FlexTech Study

Opinion of Probable Cost Summary

17-Jul-2014

ECM	Cost
ECM - 1: Waste Water Facility - Boiler Upgrade	$21,300
ECM - 2: Waste Water Facility - Lighting Upgrade	$10,200
ECM - 3: Waste Water Facility - Occupancy Sensors	$1,800
ECM - 4: Waste Water Facility - Lighting and Occupancy Sensors	$12,000
ECM - 5: Waste Water Facility - Streetlight upgrade to LED's	$9,600
ECM - 6: Waste Water Facility - Wallpack upgrade to LED	$2,600
ECM - 7: Waste Water Facility - Thermostat/Control Upgrade	$4,900
ECM - 8 : Waste Water Facility - Window Replacement	$6,200
ECM - 9A: Waste Water Facility - Replace Digester Methane Boiler	$477,000
ECM - 9B: Waste Water Facility - Microturbine Plant	$1,306,500
ECM - 9C: Waste Water Facility - Add Digester Hi-Eff NG Boiler	$223,500
ECM - 10: Waste Water Facility - Generate Electrictiy with PV Panels	$213,000
Total	$982,100

NOTE - Total does not include the microturbine plant.

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 1: Waste Water Facility - Boiler Upgrade

Date: 7/17/2014

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Removals of exg. Boiler, pumps, ET, AS, ctrls	1	Ea	$1,600.00	$1,600
2	Rinnai Q205S condensing boiler w/ controls	1	Ea	$5,000.00	$5,000
3	Circulation pump (incl. strainer, TDV, iso-valves)	1	Lot	$2,780.00	$2,780
4	Piping modifications (incl. Unions, iso-valves)	1	Lot	$1,240.00	$1,240
5	Piping specialties (AS, ET)	1	Lot	$1,238.00	$1,238
6	Flue modifications	1	Lot	$528.00	$528
7	Controls	1	Lot	$300.00	$300
8	Start-up and Warranty	1	Lot	$750.00	$750
9	System cleaning	1	Lot	$750.00	$750
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19	ITEMS NOT INCLUDED				$0
20	glycol fill station				$0
21	chemical pot feeder				$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$14,186
D&C Contingency	30%	$4,256
Soft Costs/Fees	20%	$2,837
Total (Rounded)		$21,300

LABELLA

Village of Webster - FlexTech Study | Date: 7/17/2014

Opinion of Probable Cost

ECM - 2: Waste Water Facility - Lighting Upgrade

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Replace T12 with T8 lamps and Ballasts	68	Ea	$100.00	$6,800
2					$0
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$6,800
D&C Contingency	30%	$2,040
Soft Costs/Fees	20%	$1,360
Total (Rounded)		$10,200

LABELLA

Village of Webster - FlexTech Study Date: 7/17/2014
Opinion of Probable Cost
ECM - 3: Waste Water Facility - Occupancy Sensors

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Add Occupancy Sensor	4	Ea	$295.00	$1,180
2					$0
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$1,180
D&C Contingency	30%	$354
Soft Costs/Fees	20%	$236
Total (Rounded)		$1,800

LABELLA

Village of Webster - FlexTech Study Date: 7/17/2014
Opinion of Probable Cost
ECM - 4: Waste Water Facility - Lamps & Occupancy Sensors

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Replace T12 with T8 lamps and Ballasts	68	Ea	$100.00	$6,800
2	Add Occupancy Sensor	4	Ea	$295.00	$1,180
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$7,980
D&C Contingency	30%	$2,394
Soft Costs/Fees	20%	$1,596
Total (Rounded)		$12,000

LABELLA

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 5: Waste Water Facility - Streetlight upgrade to LED's

Date: 7/17/2014

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	HID to LED for Streetlights	8	Ea	$800.00	$6,400
2					$0
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$6,400
D&C Contingency	30%	$1,920
Soft Costs/Fees	20%	$1,280
Total (Rounded)		$9,600

LABELLA

Village of Webster - FlexTech Study | Date: 7/17/2014

Opinion of Probable Cost

ECM - 6: Waste Water Facility - Wallpack upgrade to LED

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	HID Wallpack to LED	7	Ea	$250.00	$1,750
2					$0
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$1,750
D&C Contingency	30%	$525
Soft Costs/Fees	20%	$350
Total (Rounded)		$2,600

LABELLA

Village of Webster - FlexTech Study | Date: 7/17/2014
Opinion of Probable Cost
ECM - 7: Waste Water Facility - Thermostat/Control Upgrade

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Equipment controls	7	Ea	$400.00	$2,800
2	Boiler reset control	1	Ea	$480.00	$480
3					$0
4					$0
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$3,280
D&C Contingency	30%	$984
Soft Costs/Fees	20%	$656
Total (Rounded)		$4,900

LABELLA

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 8 : Waste Water Facility - Window Replacement

Date: 7/17/2014

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Service Building				$0
2	Aluminum Insulated window - Single Hung	2	Ea	$1,480.00	$2,960
3	Existing Window Removal	2	Ea	$100.00	$200
4	Masonry Infill	33	SF	$30.00	$990
5					$0
6	Digester Building	1	LS	$22,000.00	$0
7	(Not included due to energy cost)				$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
36					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$4,150
D&C Contingency	30%	$1,245
Soft Costs/Fees	20%	$830
Total (Rounded)		$6,200

LABELLA

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 9A: Waste Water Facility - Replace Digester Methane Boiler

Date: 4/15/2015

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Digester Sludge Heating System (EnviroSep)	1	LS	$240,000.00	$240,000
2	Gas Conditioning Skid w/ Compressor	1	EA	$20,000.00	$20,000
3	Piping Modifications	1	LS	$10,000.00	$10,000
4	Temperature Controls	1	LS	$10,000.00	$10,000
5					$0
6					$0
7					$0
8					$0
9					$0
10	Asbestos Abatement	1	LS	$30,000.00	$30,000
11	Removal of Heater and Accessories	1	LS	$8,000.00	$8,000
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$318,000
D&C Contingency	30%	$95,400
Soft Costs/Fees	20%	$63,600
Total (Rounded)		$477,000

LABELLA

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 9B: Waste Water Facility - Microturbine Plant

Date: 7/17/2014

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Microturbines (Two @ 65 kW each)	1	LS	$680,000.00	$680,000
2	Gas Conditioning Skid w/ Compressor	1	EA	$40,000.00	$40,000
3	Water to Sludge Heat Exchanger	1	EA	$25,000.00	$25,000
4	Pumps (Four) w/ pads	4	EA	$8,000.00	$32,000
5	Piping Modifications	1	LS	$15,000.00	$15,000
6	Temperature Controls	1	LS	$20,000.00	$20,000
7					$0
8					$0
9					$0
10	Asbestos Abatement	1	LS	$30,000.00	$30,000
11	Removal of Heater and Accessories	1	LS	$8,000.00	$8,000
12					$0
13	Storage Tank for Septage	1	LS	$8,000.00	$8,000
14	Metering Pump and Controls	1	LS	$5,000.00	$5,000
15	Piping to Digester	1	LS	$8,000.00	$8,000
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$871,000
D&C Contingency	30%	$261,300
Soft Costs/Fees	20%	$174,200
Total (Rounded)		$1,306,500

LABELLA

Village of Webster - FlexTech Study
Opinion of Probable Cost
ECM - 9C: Waste Water Facility - Add Digester Hi-Eff NG Boiler

Date: 4/15/2015

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	High Efficiency Natural Gas Boiler	1	LS	$25,000.00	$25,000
2	Boiler Accessories	1	EA	$15,000.00	$15,000
3	System Pumps	4	LS	$6,000.00	$24,000
4	Building Heat Exchanger	1	LS	$10,000.00	$10,000
5	Digester Sludge heat Exchanger	1	LS	$25,000.00	$25,000
6	Piping Modifications	1	LS	$15,000.00	$15,000
7	Temperature Controls	1	LS	$25,000.00	$25,000
8					$0
9					$0
10	Asbestos Abatement	1	LS	$10,000.00	$10,000
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$149,000
D&C Contingency	30%	$44,700
Soft Costs/Fees	20%	$29,800
Total (Rounded)		$223,500

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Village of Webster - FlexTech Study Date: 7/17/2014
Opinion of Probable Cost
ECM - 10: Waste Water Facility - Generate electricity with PV Panels

Item	Description	Quantity	Unit	Unit Cost	Total Cost
1	Photovoltaic Cells Installed (50 kW)	1	LS	$100,000.00	$100,000
2	Electrical Tie-Ins	1	EA	$20,000.00	$20,000
3	Connection to Electric Service	1	LS	$15,000.00	$15,000
4	Site Grading and Repair	1	LS	$7,000.00	$7,000
5					$0
6					$0
7					$0
8					$0
9					$0
10					$0
11					$0
12					$0
13					$0
14					$0
15					$0
16					$0
17					$0
18					$0
19					$0
20					$0
21					$0
22					$0
23					$0
24					$0
25					$0
26					$0
27					$0
28					$0
29					$0
30					$0
31					$0
32					$0
33					$0
34					$0
35					$0
37					$0
38					$0
39					$0
40					$0
41					$0

Subtotal		$142,000
D&C Contingency	30%	$42,600
Soft Costs/Fees	20%	$28,400
Total (Rounded)		$213,000

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APPENDIX C3

ENERGY CALCULATIONS

Village of Webster Waste Water Treatment Facility
Boiler Replacement Savings

Summary Table

	Baseline	Proposed	Savings
kWh	0	0	0
kW	0	0	0
Therms	601,026	553,004	48,022
Cost	**$133,275.28**	**$122,626.65**	**$10,648.63**

Cost Opinion	Simple Payback
$21,300	2.0 yrs

Existing Boiler Output =	170	MBH	81.0%
Proposed Boiler Output =	189	MBH	95.7%

Proposed

NEW CONDENSING SYSTEM

DB (F)	Bin Hrs	% Load	Heating Load Required (MBH)	Supply Water Temperature (°F)	Boiler 1 Output	B1 % Loading	B1 Efficiency[5]	Heating Energy Required (Therm)
60	664	14%	24	97	24	13%	95.7%	16848
55	566	21%	36	103	36	19%	94.6%	21804
50	619	29%	49	110	49	26%	92.2%	32614
45	692	36%	61	117	61	32%	89.6%	46904
40	974	43%	73	123	73	39%	88.1%	80545
35	842	50%	85	130	85	45%	87.3%	82054
30	675	57%	97	136	97	51%	87.1%	75316
25	374	64%	109	143	109	58%	86.8%	47078
20	463	71%	121	150	121	64%	86.3%	65173
15	259	79%	134	156	134	71%	86.1%	40256
10	123	86%	146	163	146	77%	85.9%	20825
5	89	93%	158	169	158	84%	85.9%	16408
0	36	100%	170	176	170	90%	85.9%	7178
	6377		1263					553004

Baseline

EXISTING SYSTEM

DB (F)	Bin Hrs	% Loaded	Heating Load Required (MBH)	Supply Water Temperature (°F)	Boiler 1 Output	B1 % Loading	B1 Efficiency	Heating Energy Required (Therm)
60	664	14%	24	180	24	13%	81%	19906
55	566	21%	36	180	36	19%	81%	25468
50	619	29%	49	180	49	26%	81%	37135
45	692	36%	61	180	61	32%	81%	51856
40	974	43%	73	180	73	39%	81%	87569
35	842	50%	85	180	85	45%	81%	88406
30	675	57%	97	180	97	51%	81%	80962
25	374	64%	109	180	109	58%	81%	50434
20	463	71%	121	180	121	64%	81%	69420
15	259	79%	134	180	134	71%	81%	42781
10	123	86%	146	180	146	77%	81%	22081
5	89	93%	158	180	158	84%	81%	17397
0	36	100%	170	180	170	90%	81%	7611
	6377		1263					601026

Assumptions

1. BIN Data reflects 24 hours per day operation, using utility bill information.
2. The inside design temperature is assumed to be 70°F. Therefore the percent of the boiler loading is taken as the difference in temperature between the outside air and inside air divided by the inside air temperature.
3. The reported cost for gas = $0.22 per therm
4. See attached Aerco Benchmark Fire Rate Boiler Thermal Efficiency graph.

Existing Facilities Program Lighting Form:

Performance Based

Applicant Village of Webster

Facility NWWTP

Date:

INSTRUCTIONS

Use one line for each fixture type in a room or area.

Line Item	Building	Floor	Area Description	Usage Group ID	PRE-INSTALLATION: Pre Fixt. No.	Pre Fixt Code	Pre Watts / Fixt	Pre kW / Space	Existing Control	POST-INSTALLATION: Post Fixt No.	Post Fixt Code	Post Watts/ Fixt	Post kW / Space	Proposed Control	kW Saved	Baseline Annual Hours	Proposed Annual Hours	Annual kWh Saved
Integer line number	Building Address	Floor fixture is on	Description of location that matches site map	Descriptive name for the usage group	# of existing fixtures	Code from Wattage Table	Watts/Fixt from Wattage Table	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-installation control device	Number of fixtures after retrofit	Code from Wattage Table	Watts/Fixt from Wattage Table	(Post Watts/Fixt) * (Post Fixt No.)	Post-installation control device	Pre kW/Space - Post kW/Space	Existing annual hours for the usage group	Proposed annual hours for the usage group	(PreFixt #*PreWatts/Fixt * Baseline Hrs) - (PostFixt#*PostWatts/Fixt * Proposed Hours)
Ex.	*485 7th Ave, Suite 1006*	*10*	*Men's Room*	*Restroom w/control*	*3*	*F44ILL*	*112*	*0.34*	*Light Switch*	*3*	*F42ILL*	*59*	*0.18*	*Motion Sensor*	*0.16*	*3,000*	*2,000*	*654*
	Upgrades only																	
1	WWTP		Outside		8	MH400/1	458	3.66	Photocell	8	Custom Fixture 1	125	1.00	Photocell	2.66	3,285	3,285	8,751
2	WWTP		Outside		7	HPS70/1	95	0.67	Photocell	7	Custom Fixture 2	20	0.14	Photocell	0.53	3,285	3,285	1,725
3	WWTP		Influent Sample Building		2	F42SS	94	0.19	Switch	2	F42SSILL	48	0.10	Switch	0.09	200	200	18
4	WWTP		Garage		11	F42SS	94	1.03	Occ Sensor	11	F42SSILL	48	0.53	Occ Sensor	0.51	1,164	1,164	589
5	WWTP		Garage		5	F42LE	71	0.36	Occ Sensor	5	F42SSILL	48	0.24	Occ Sensor	0.12	1,164	1,164	134
6	WWTP		Generator Room		4	F42SS	94	0.38	Switch	4	F42SSILL	48	0.19	Switch	0.18	100	100	18
7	WWTP		Grit Building		6	F42ILL	59	0.35	Switch	6	F42ILL	59	0.35	Switch	0.00	1,456	1,456	0
8	WWTP		Grit Building		2	F42ILL	59	0.12	Switch	2	F42ILL	59	0.12	Switch	0.00	1,456	1,456	0
9	WWTP		Pump House		8	F42SS	94	0.75	Occ Sensor	8	F42SSILL	48	0.38	Occ Sensor	0.37	1,164	1,164	428
10	WWTP		Centerfuge Room		8	F42SS	94	0.75	Switch	8	F42SSILL	48	0.38	Switch	0.37	1,456	1,456	536
11	WWTP		Digester Room		17	F42SS	94	1.60	Occ Sensor	17	F42SSILL	48	0.82	Occ Sensor	0.78	1,164	1,164	910
12			Inside Office		13	F42SS	94	1.22	Occ Sensor	13	F42SSILL	48	0.62	Occ Sensor	0.60	2,336	2,336	1,397
13	*Upgrades with Occupancy Sensors*																	
14	WWTP		Outside		8	MH400/1	458	3.66	Photocell	8	Custom Fixture 1	125	1.00	Photocell	2.66	3,285	3,285	8,751
15	WWTP		Outside		7	HPS70/1	95	0.67	Photocell	7	Custom Fixture 2	20	0.14	Photocell	0.53	3,285	3,285	1,725
16	WWTP		Influent Sample Building		2	F42SS	94	0.19	Switch	2	F42SSILL	48	0.10	Switch	0.09	200	200	18
17	WWTP		Garage		11	F42SS	94	1.03	Occ Sensor	11	F42SSILL	48	0.53	Occ Sensor	0.51	1,164	1,164	589
18	WWTP		Garage		5	F42LE	71	0.36	Occ Sensor	5	F42SSILL	48	0.24	Occ Sensor	0.12	1,164	1,164	134
19	WWTP		Generator Room		4	F42SS	94	0.38	Switch	4	F42SSILL	48	0.19	Occ Sensor	0.18	100	80	22
20	WWTP		Grit Building		6	F42ILL	59	0.35	Switch	6	F42ILL	59	0.35	Occ Sensor	0.00	1,456	1,164	103
21	WWTP		Grit Building		2	F42ILL	59	0.12	Switch	2	F42ILL	59	0.12	Occ Sensor	0.00	1,456	1,164	34
22	WWTP		Pump House		8	F42SS	94	0.75	Occ Sensor	8	F42SSILL	48	0.38	Occ Sensor	0.37	1,164	1,164	428
23	WWTP		Centerfuge Room		8	F42SS	94	0.75	Switch	8	F42SSILL	48	0.38	Occ Sensor	0.37	1,456	1,164	648
24	WWTP		Digester Room		17	F42SS	94	1.60	Occ Sensor	17	F42SSILL	48	0.82	Occ Sensor	0.78	1,164	1,164	910
25			Inside Office		13	F42SS	94	1.22	Occ Sensor	13	F42SSILL	48	0.62	Occ Sensor	0.60	2,336	2,336	1,397
26																		
27																		
28																		
29																		
30																		
31																		
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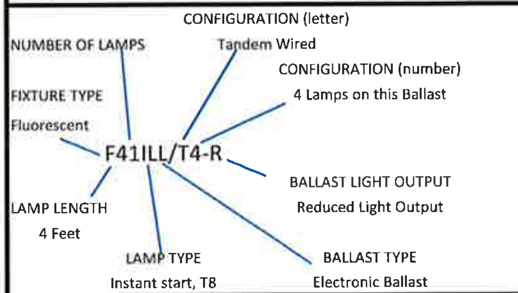
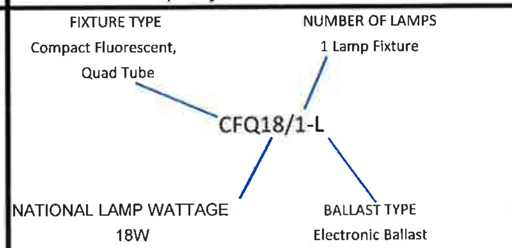
40																		
41																		
42																		
43																		
44																		
45																		
46																		
47																		
48																		
49																		
				Total Pre Fixt.	182		Total Pre kW	22	Total Post Fixt.	182		Total Pre kW	10	Total kW Saved	12.40	Total Annual kWh Saved		29,267

Fixture Code Legend and Notes

Sample Linear Fluorescent Fixture Code



Sample of Other Fixture Code:



Code Explanations

Fixture Type

CF	Compact Fluorescent
CFD	Compact Fluorescent, double-D shape
CFS	Compact Fluorescent, Spiral
CFT	Compact Fluorescent, Twin tube (including "Biaxial" fixtures)
CFQ	Compact Fluorescent, Quad tube
ECF	Exit sign, Compact Fluorescent
EI	Exit sign, Incandescent
ELED	Exit sign, LED
F	Fluorescent, linear
FC	Fluorescent, Circline
FU	Fluorescent, U-tube
H	Halogen
HLV	Halogen, Low Voltage
HPS	High Pressure Sodium
I	Incandescent
LED	Light Emitting Diode (LED) traffic signal
MH	Metal Halide
MHPS	Metal Halide, Pulse Start
MV	Mercury Vapor
QL	Induction

Lamp Type

for fluorescent fixtures

A	"F25T12" - 25 watt, 4ft, T12 lamp
IL	T8, Instant start
SIL	T8, Instant start, Super 30 watt
SSIL	T8, Instant start, Super 28 watt
L	T8, rapid start
G	T5, standard
GH	T5, standard, High output lamp
E	T12, Energy efficient
EH	T12, Energy efficient, High output lamp
EI	T12, Energy efficient, Instant start
EV	T12, Energy efficient, Very high output
S	T12, Standard
SIL	T12, Standard, Instant start
SH	T12, Standard, High output lamp
SV	T12, Standard, Very high output lamp
T	T10, Standard

for LED traffic signals

12GA	12" Green Arrow
12GB	12" Green Ball
12RA	12" Red Arrow
12RB	12" Red Ball
8GB	8" Green Ball
8RB	8" Red Ball
PH	Pedestrian Hand signal

Ballast Type

for fluorescent fixtures

L	Electronic
S	Standard magnetic
E	Emergy efficient magnetic

Configuration (letter)

T	Tandem wired fixture
D	Delamped fixture, i.e. some lamps permanently removed but ballasts remain

Configuration (number)

for delamped fixtures

Number signifies the total number of ballasts in the fixture: e.g. An "F42EEID2" is an "F44EE" with two lamps removed so that there is one extaneous ballast

for tandem wired ballasts

Number signifies the total number of lamps being run by the ballast: e.g. An "F42LLIT4" would indicate that a four-lamp ballast is wired to run two-lamp fixtures.

with no preceding letter

Number indicates the number of ballasts in an ambiguous multiple ballast fixture: e.g. An "F43ILU2" indicates a three-lamp fixture with two ballasts (as is often the case if there is A/B switching).

Ballast Light Output

R	Reduced light output
H	High light output
V	Very high light output

Notes:
1) The column labeled Watts/Fixtures in the data table includes ballast loads.
2) The fixture wattage values represent an average value, rounded to the nearest whole watt.

Village of Webster Waste Water Treatment Facility
Thermostat Replacement Savings

Description: Replace existing thermostats with programmable thermostats
Use M-F S/S scheduling and night setbacks

Summary Table

	Baseline	Proposed	Savings
kWh	19,220	17,722	1,500
kW	0.0	0.0	0.0
Therms	2,645	2,120	525
Cost	**$2,400**	**$2,100**	**$255**

Cost Opinion	Simple Payback
$4,900	19 yrs

Occupied Time Period

Temp-erature	Hours	Mean RH	Mean Enthalpy	Supply Fan kW	Return Fan kW	Total Fan kWh	Average RAT	Average MAT	Average DAT	Fan CFM	Fan kWh	Heating Therms
95	1	28.0	32.5	Trace 700	Trace 700	Trace 700	78.0	Trace 700	58.0	Trace 700	Trace 700	Trace 700
90	26	43.2	35.4	Trace 700	Trace 700	Trace 700	77.0	Trace 700	57.0	Trace 700	Trace 700	Trace 700
85	94	50.0	34.3	Trace 700	Trace 700	Trace 700	75.0	Trace 700	56.0	Trace 700	Trace 700	Trace 700
80	168	54.1	32.1	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
75	235	57.9	29.7	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
70	221	64.7	27.8	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
65	248	69.6	25.5	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
60	214	71.2	23.0	Trace 700	Trace 700	Trace 700	75.0	Trace 700	60.0	Trace 700	Trace 700	Trace 700
55	182	70.9	20.2	Trace 700	Trace 700	Trace 700	70.0	Trace 700	65.0	Trace 700	Trace 700	Trace 700
50	199	71.0	17.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	70.0	Trace 700	Trace 700	Trace 700
45	223	70.4	15.6	Trace 700	Trace 700	Trace 700	70.0	Trace 700	72.0	Trace 700	Trace 700	Trace 700
40	314	71.7	13.6	Trace 700	Trace 700	Trace 700	70.0	Trace 700	74.0	Trace 700	Trace 700	Trace 700
35	271	78.3	12.1	Trace 700	Trace 700	Trace 700	70.0	Trace 700	76.0	Trace 700	Trace 700	Trace 700
30	217	74.3	9.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	78.0	Trace 700	Trace 700	Trace 700
25	120	72.1	8.1	Trace 700	Trace 700	Trace 700	70.0	Trace 700	80.0	Trace 700	Trace 700	Trace 700
20	149	72.5	6.5	Trace 700	Trace 700	Trace 700	70.0	Trace 700	82.0	Trace 700	Trace 700	Trace 700
15	84	79.0	5.2	Trace 700	Trace 700	Trace 700	70.0	Trace 700	84.0	Trace 700	Trace 700	Trace 700
10	40	76.0	3.5	Trace 700	Trace 700	Trace 700	70.0	Trace 700	86.0	Trace 700	Trace 700	Trace 700
5	29	65.2	1.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	88.0	Trace 700	Trace 700	Trace 700
0	12	83.4	0.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	90.0	Trace 700	Trace 700	Trace 700
Total	**3,048**					0					0	0

Unoccupied Time Period

Temp-erature	Hours	Mean RH	Mean Enthalpy	Supply Fan kW	Return Fan kW	Total Fan kWh	Average RAT	Average MAT	Average DAT	Fan CFM	Fan kWh	Heating Therms
95	2	28.0	32.5	Trace 700	Trace 700	Trace 700	80.0	Trace 700	58.0	Trace 700	Trace 700	Trace 700
90	49	42.5	35.1	Trace 700	Trace 700	Trace 700	80.0	Trace 700	57.0	Trace 700	Trace 700	Trace 700
85	177	50.7	34.6	Trace 700	Trace 700	Trace 700	80.0	Trace 700	56.0	Trace 700	Trace 700	Trace 700
80	315	57.3	32.7	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
75	441	68.9	31.7	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
70	414	74.3	29.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
65	465	76.0	26.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
60	401	75.0	23.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	60.0	Trace 700	Trace 700	Trace 700
55	342	75.1	20.7	Trace 700	Trace 700	Trace 700	65.0	Trace 700	65.0	Trace 700	Trace 700	Trace 700
50	374	74.4	18.1	Trace 700	Trace 700	Trace 700	65.0	Trace 700	70.0	Trace 700	Trace 700	Trace 700
45	418	74.8	15.9	Trace 700	Trace 700	Trace 700	65.0	Trace 700	72.0	Trace 700	Trace 700	Trace 700
40	588	75.4	13.7	Trace 700	Trace 700	Trace 700	65.0	Trace 700	74.0	Trace 700	Trace 700	Trace 700
35	509	79.4	12.0	Trace 700	Trace 700	Trace 700	65.0	Trace 700	76.0	Trace 700	Trace 700	Trace 700
30	408	78.5	10.2	Trace 700	Trace 700	Trace 700	65.0	Trace 700	78.0	Trace 700	Trace 700	Trace 700
25	226	78.8	8.3	Trace 700	Trace 700	Trace 700	65.0	Trace 700	80.0	Trace 700	Trace 700	Trace 700
20	280	76.3	6.5	Trace 700	Trace 700	Trace 700	65.0	Trace 700	82.0	Trace 700	Trace 700	Trace 700
15	157	77.8	5.1	Trace 700	Trace 700	Trace 700	65.0	Trace 700	84.0	Trace 700	Trace 700	Trace 700
10	74	81.1	3.6	Trace 700	Trace 700	Trace 700	65.0	Trace 700	86.0	Trace 700	Trace 700	Trace 700
5	54	80.6	2.2	Trace 700	Trace 700	Trace 700	65.0	Trace 700	88.0	Trace 700	Trace 700	Trace 700
0	22	88.2	0.8	Trace 700	Trace 700	Trace 700	65.0	Trace 700	90.0	Trace 700	Trace 700	Trace 700
Total	**5,712**					0					0	0

Assumptions

BIN Data reflects an occupied schedule of 6am - 6pm Monday through Friday, using TMY2 data for Rochester.

Electricity Rate	$0.0926	per kWh
Natural Gas Rate	$0.2217	per therm
SHR	0.8	
Chilled Water System Efficiency	0.75	kW / ton
Boiler Plant Efficiency	75%	

Heating and cooling energy will not be taken into account in the savings calculation because the heat gain/loss will be accounted for in the morning warmup.

Supply fan efficiency of 75%, motor efficiency of 89.5%, drivebelt efficiency of 90%.

ECM-WWTP-7: Thermostat Management

BASELINE

ENERGY CONSUMPTION SUMMARY

By LABELLA ASSOCIATES

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1					
Primary heating					
Primary heating		264,482	80.1 %	264,482	278,403
Other Htg Accessories	3,674		3.8 %	12,540	37,624
Heating Subtotal	**3,674**	**264,482**	83.9 %	**277,023**	**316,027**
Primary cooling					
Cooling Compressor	248		0.3 %	846	2,538
Tower/Cond Fans	34		0.0 %	115	345
Condenser Pump			0.0 %	0	0
Other Clg Accessories	67		0.1 %	229	687
Cooling Subtotal....	**349**		0.4 %	**1,190**	**3,570**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps	475		0.5 %	1,621	4,863
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....	475		0.5 %	1,621	4,863
Lighting					
Lighting	14,722		15.2 %	50,247	150,756
Receptacle					
Receptacles			0.0 %	0	0
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	**19,220**	264,482	**100.0 %**	**330,080**	**475,216**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: Waste Water Treatment Facility
Dataset Name: Energy-Model.trc

ECM-WWTP-7: Thermostat Management
PROPOSED

ENERGY CONSUMPTION SUMMARY

By LABELLA ASSOCIATES

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3					
Primary heating					
Primary heating		211,987	77.8 %	211,987	223,144
Other Htg Accessories	2,371		3.0 %	8,094	24,283
Heating Subtotal	**2,371**	**211,987**	**80.8 %**	**220,080**	**247,427**
Primary cooling					
Cooling Compressor	237		0.3 %	810	2,431
Tower/Cond Fans	32		0.0 %	111	332
Condenser Pump			0.0 %	0	0
Other Clg Accessories	52		0.1 %	176	528
Cooling Subtotal....	**321**		**0.4 %**	**1,097**	**3,291**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps	307		0.4 %	1,046	3,139
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....	307		0.4 %	1,046	3,139
Lighting					
Lighting	14,722		18.4 %	50,247	150,756
Receptacle					
Receptacles			0.0 %	0	0
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	17,722	211,987	100.0 %	272,470	404,613

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: Waste Water Treatment Facility
Dataset Name: Energy-Model.trc

TRACE® 700 v6.3 calculated at 03:33 PM on 05/13/2014
Alternative - 3 Energy Consumption Summary report page 1

Village of Webster Waste Water Treatment Facility
Envelope Improvements to Service Building

Description: Replace existingsingle pain windows with dbl-pane insulated frame casement windows
Use M-F S/S scheduling and night setbacks

Summary Table

	Baseline	Proposed	Savings
kWh	19,724	19,155	70
kW	0.0	0.0	0.0
Therms	2,674	2,559	115
Cost	**$2,400**	**$2,300**	**$32**

Cost Opinion	Simple Payback
$6,200	194 yrs

Occupied Time Period

Temp-erature	Hours	Mean RH	Mean Enthalpy	Supply Fan kW	Return Fan kW	Total Fan kWh	Average RAT	Average MAT	Average DAT	Fan CFM	Fan kWh	Heating Therms
95	1	28.0	32.5	Trace 700	Trace 700	Trace 700	78.0	Trace 700	58.0	Trace 700	Trace 700	Trace 700
90	26	43.2	35.4	Trace 700	Trace 700	Trace 700	77.0	Trace 700	57.0	Trace 700	Trace 700	Trace 700
85	94	50.0	34.3	Trace 700	Trace 700	Trace 700	75.0	Trace 700	56.0	Trace 700	Trace 700	Trace 700
80	168	54.1	32.1	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
75	235	57.9	29.7	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
70	221	64.7	27.8	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
65	248	69.6	25.5	Trace 700	Trace 700	Trace 700	75.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
60	214	71.2	23.0	Trace 700	Trace 700	Trace 700	75.0	Trace 700	60.0	Trace 700	Trace 700	Trace 700
55	182	70.9	20.2	Trace 700	Trace 700	Trace 700	70.0	Trace 700	65.0	Trace 700	Trace 700	Trace 700
50	199	71.0	17.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	70.0	Trace 700	Trace 700	Trace 700
45	223	70.4	15.6	Trace 700	Trace 700	Trace 700	70.0	Trace 700	72.0	Trace 700	Trace 700	Trace 700
40	314	71.7	13.6	Trace 700	Trace 700	Trace 700	70.0	Trace 700	74.0	Trace 700	Trace 700	Trace 700
35	271	78.3	12.1	Trace 700	Trace 700	Trace 700	70.0	Trace 700	76.0	Trace 700	Trace 700	Trace 700
30	217	74.3	9.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	78.0	Trace 700	Trace 700	Trace 700
25	120	72.1	8.1	Trace 700	Trace 700	Trace 700	70.0	Trace 700	80.0	Trace 700	Trace 700	Trace 700
20	149	72.5	6.5	Trace 700	Trace 700	Trace 700	70.0	Trace 700	82.0	Trace 700	Trace 700	Trace 700
15	84	79.0	5.2	Trace 700	Trace 700	Trace 700	70.0	Trace 700	84.0	Trace 700	Trace 700	Trace 700
10	40	76.0	3.5	Trace 700	Trace 700	Trace 700	70.0	Trace 700	86.0	Trace 700	Trace 700	Trace 700
5	29	65.2	1.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	88.0	Trace 700	Trace 700	Trace 700
0	12	83.4	0.9	Trace 700	Trace 700	Trace 700	70.0	Trace 700	90.0	Trace 700	Trace 700	Trace 700
Total	**3,048**					**0**					**0**	**0**

Unoccupied Time Period

Temp-erature	Hours	Mean RH	Mean Enthalpy	Supply Fan kW	Return Fan kW	Total Fan kWh	Average RAT	Average MAT	Average DAT	Fan CFM	Fan kWh	Heating Therms
95	2	28.0	32.5	Trace 700	Trace 700	Trace 700	80.0	Trace 700	58.0	Trace 700	Trace 700	Trace 700
90	49	42.5	35.1	Trace 700	Trace 700	Trace 700	80.0	Trace 700	57.0	Trace 700	Trace 700	Trace 700
85	177	50.7	34.6	Trace 700	Trace 700	Trace 700	80.0	Trace 700	56.0	Trace 700	Trace 700	Trace 700
80	315	57.3	32.7	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
75	441	68.9	31.7	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
70	414	74.3	29.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
65	465	76.0	26.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	55.0	Trace 700	Trace 700	Trace 700
60	401	75.0	23.4	Trace 700	Trace 700	Trace 700	80.0	Trace 700	60.0	Trace 700	Trace 700	Trace 700
55	342	75.1	20.7	Trace 700	Trace 700	Trace 700	65.0	Trace 700	65.0	Trace 700	Trace 700	Trace 700
50	374	74.4	18.1	Trace 700	Trace 700	Trace 700	65.0	Trace 700	70.0	Trace 700	Trace 700	Trace 700
45	418	74.8	15.9	Trace 700	Trace 700	Trace 700	65.0	Trace 700	72.0	Trace 700	Trace 700	Trace 700
40	588	75.4	13.7	Trace 700	Trace 700	Trace 700	65.0	Trace 700	74.0	Trace 700	Trace 700	Trace 700
35	509	79.4	12.0	Trace 700	Trace 700	Trace 700	65.0	Trace 700	76.0	Trace 700	Trace 700	Trace 700
30	408	78.5	10.2	Trace 700	Trace 700	Trace 700	65.0	Trace 700	78.0	Trace 700	Trace 700	Trace 700
25	226	78.8	8.3	Trace 700	Trace 700	Trace 700	65.0	Trace 700	80.0	Trace 700	Trace 700	Trace 700
20	280	76.3	6.5	Trace 700	Trace 700	Trace 700	65.0	Trace 700	82.0	Trace 700	Trace 700	Trace 700
15	157	77.8	5.1	Trace 700	Trace 700	Trace 700	65.0	Trace 700	84.0	Trace 700	Trace 700	Trace 700
10	74	81.1	3.6	Trace 700	Trace 700	Trace 700	65.0	Trace 700	86.0	Trace 700	Trace 700	Trace 700
5	54	80.6	2.2	Trace 700	Trace 700	Trace 700	65.0	Trace 700	88.0	Trace 700	Trace 700	Trace 700
0	22	88.2	0.8	Trace 700	Trace 700	Trace 700	65.0	Trace 700	90.0	Trace 700	Trace 700	Trace 700
Total	**5,712**					**0**					**0**	**0**

Assumptions

BIN Data reflects an occupied schedule of 6am - 6pm Monday through Friday, using TMY2 data for Rochester.

Electricity Rate	$0.0926	per kWh
Natural Gas Rate	$0.2217	per therm
SHR	0.8	
Chilled Water System Efficiency	0.75	kW / ton
Boiler Plant Efficiency	75%	

Heating and cooling energy will not be taken into account in the savings calculation because the heat gain/loss will be accounted for in the morning warmup.
Supply fan efficiency of 75%, motor efficiency of 89.5%, drivebelt efficiency of 90%.

ECM-WWTP-8: Building Envelope Improvements

BASELINE

ENERGY CONSUMPTION SUMMARY

By LABELLA ASSOCIATES

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1					
Primary heating					
Primary heating		267,377	80.3 %	267,377	281,450
Other Htg Accessories	3,693		3.8 %	12,603	37,813
Heating Subtotal	3,693	267,377	84.1 %	279,981	319,263
Primary cooling					
Cooling Compressor	235		0.2 %	804	2,411
Tower/Cond Fans	32		0.0 %	109	327
Condenser Pump			0.0 %	0	0
Other Clg Accessories	65		0.1 %	221	663
Cooling Subtotal....	332		0.3 %	1,133	3,401
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps	477		0.5 %	1,629	4,888
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....	477		0.5 %	1,629	4,888
Lighting					
Lighting	14,722		15.1 %	50,247	150,756
Receptacle					
Receptacles			0.0 %	0	0
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	19,224	267,377	100.0 %	332,990	478,307

* Note: Resource Utilization factors are included in the Total Source Energy value.

** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

Project Name: Waste Water Treatment Facility
Dataset Name: Envelope-Energy-Model.trc

ECM-WWTP-8: Building Envelope Improvements
PROPOSED

ENERGY CONSUMPTION SUMMARY

By LABELLA ASSOCIATES

	Elect Cons. (kWh)	Gas Cons. (kBtu)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 3					
Primary heating					
Primary heating		255,907	79.7 %	255,907	269,376
Other Htg Accessories	3,671		3.9 %	12,531	37,595
Heating Subtotal	**3,671**	**255,907**	**83.6 %**	**268,437**	**306,971**
Primary cooling					
Cooling Compressor	194		0.2 %	661	1,984
Tower/Cond Fans	26		0.0 %	90	270
Condenser Pump			0.0 %	0	0
Other Clg Accessories	67		0.1 %	228	683
Cooling Subtotal....	**287**		**0.3 %**	**979**	**2,938**
Auxiliary					
Supply Fans			0.0 %	0	0
Pumps	475		0.5 %	1,620	4,859
Stand-alone Base Utilities			0.0 %	0	0
Aux Subtotal....	475		0.5 %	1,620	4,859
Lighting					
Lighting	14,722		15.6 %	50,247	150,756
Receptacle					
Receptacles			0.0 %	0	0
Cogeneration					
Cogeneration			0.0 %	0	0
Totals					
Totals**	**19,155**	**255,907**	**100.0 %**	**321,283**	**465,524**

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

UTILITY BILLS - ELECTRICITY SPREADSHEET										
Bill Date	Meter #	Reading (kWh Used)	Demand (kW)	Delivery Cost	Supply Cost	Total Cost	$/kWh	Date Start	Date Ending	Billing Period
Feb-12	05310658	56,720	121.6	$2,852.21	$2,428.00	$5,280.21	$0.090	1/17/2012	2/14/2012	28
Mar-12	05310658	53,040	112.0	$2,957.08	$1,992.07	$4,949.15	$0.091	2/15/2012	3/15/2012	29
Apr-12	05310658	47,280	97.6	$2,724.46	$1,579.16	$4,303.62	$0.088	3/16/2012	4/16/2012	31
May-12	05310658	44,000	98.4	$2,652.76	$1,635.11	$4,287.87	$0.095	4/17/2012	5/15/2012	28
Jun-12	05310658	41,920	91.2	$2,287.14	$1,842.50	$4,129.64	$0.096	5/16/2012	6/14/2012	29
Jul-12	05310658	41,440	84.0	$2,057.16	$2,263.16	$4,320.32	$0.101	6/15/2012	7/16/2012	31
Aug-12	05310658	37,040	85.6	$1,951.08	$2,088.15	$4,039.23	$0.106	7/17/2012	8/15/2012	29
Sep-12	05310658	35,360	84.8	$1,837.09	$1,787.34	$3,624.43	$0.099	8/16/2012	9/14/2012	29
Oct-12	05310658	35,280	86.4	$1,779.64	$2,203.13	$3,982.77	$0.110	9/15/2012	10/12/2012	27
Nov-12	05310658	45,920	96.8	$1,995.01	$2,937.07	$4,932.08	$0.104	10/13/2012	11/14/2012	32
Dec-12	05310658	44,320	96.8	$2,011.04	$2,780.70	$4,791.74	$0.105	11/15/2012	12/13/2012	28
Jan-13	05310658	54,640	93.6	$2,020.91	$3,290.82	$5,311.73	$0.094	12/14/2012	1/16/2013	33
Feb-13	05310658	46,400	111.2	$2,353.56	$3,963.05	$6,316.61	$0.132	1/17/2013	2/13/2013	27
Mar-13	05310658	48,960	107.2	$2,398.41	**$1,992.07**	**$4,390.48**	**$0.087**	2/14/2013	3/14/2013	28
Apr-13	05310658	50,720	106.4	$2,295.33	**$1,579.16**	**$3,874.49**	**$0.074**	3/15/2013	4/12/2013	28
May-13	05310658	50,000	92.8	$1,746.37	**$1,635.11**	**$3,381.48**	**$0.066**	4/13/2013	5/14/2013	31
Jun-13	05310658	47,200	89.6	$1,698.70	**$1,842.50**	**$3,541.20**	**$0.073**	5/15/2013	6/14/2013	30
Jul-13	05310658	37,920	88.8	$1,759.94	**$2,263.16**	**$4,023.10**	**$0.103**	6/15/2013	7/16/2013	31
Aug-13	05310658	34,640	86.4	$1,832.55	**$2,088.15**	**$3,920.70**	**$0.110**	7/17/2013	8/14/2013	28
Sep-13	05310658	40,320	84.8	$1,881.36	**$1,787.34**	**$3,668.70**	**$0.088**	8/15/2013	9/16/2013	32
Oct-13	05310658	36,480	85.6	$1,764.37	**$2,203.13**	**$3,967.50**	**$0.106**	9/17/2013	10/14/2013	27
Nov-13	05310658	39,360	85.6	$1,787.85	**$2,937.07**	**$4,724.92**	**$0.117**	10/15/2013	11/14/2013	30
Dec-13	05310658	48,080	102.4	$2,163.99	**$2,780.70**	**$4,944.69**	**$0.100**	11/15/2013	12/16/2013	31
Jan-14	05310658	57,520	112.0	$2,328.54	**$3,290.82**	**$5,619.36**	**$0.095**	12/17/2013	1/15/2014	29
Feb-14	05310658	64,480	132.8	$2,550.76	**$3,963.05**	**$6,513.81**	**$0.098**	1/16/2014	2/13/2014	28
Mar-14	05310658	54,320	115.2	$1,773.73	**$1,992.07**	**$3,765.80**	**$0.067**	2/14/2014	3/14/2014	28

April-12 to March-2013	522,560		$26,068.26	$28,362.26	$54,430.52	$0.104
April-13 to March-2014	561,040	132.8	$23,583.49	**$28,362.26**	**$51,945.75**	**$0.093**

UTILITY BILLS - NATURAL GAS SPREADSHEET

Bill Date	Meter #	Reading (CCF Used)	Therms	Cost	$/Therm	Date Start	Date Ending	Billing Period
Feb-12	00286359	1320	1360	$314.77	$0.23	1/17/2012	2/14/2012	28
Mar-12	00286359	1045	1077	$268.87	$0.25	2/15/2012	3/15/2012	29
Apr-12	00286359	861	887	$241.64	$0.27	3/16/2012	4/16/2012	31
May-12	00286359	474	488	$132.72	$0.27	4/17/2012	5/15/2012	28
Jun-12	00286359	508	523	$143.65	$0.27	5/16/2012	6/14/2012	29
Jul-12	00286359	212	218	$66.03	$0.30	6/15/2012	7/16/2012	31
Aug-12	00286359	281	290	$80.22	$0.28	7/17/2012	8/15/2012	29
Sep-12	00286359	418	431	$119.63	$0.28	8/16/2012	9/14/2012	29
Oct-12	00286359	415	428	$125.11	$0.29	9/15/2012	10/12/2012	27
Nov-12	00286359	880	907	$257.96	$0.28	10/13/2012	11/14/2012	32
Dec-12	00286359	1032	1063	$295.36	$0.28	11/15/2012	12/13/2012	28
Jan-13	00286359	2230	2298	$507.04	$0.22	12/14/2012	1/16/2013	33
Feb-13	00286359	1784	1838	$422.19	$0.23	1/17/2013	2/13/2013	27
Mar-13	00286359	1119	1153	$308.83	$0.27	2/14/2013	3/14/2013	28
Apr-13	00286359	1271	1310	$312.75	$0.24	3/15/2013	4/12/2013	28
May-13	00286359	320	330	$113.17	$0.34	4/13/2013	5/14/2013	31
Jun-13	00286359	408	420	$133.52	$0.32	5/15/2013	6/14/2013	30
Jul-13	00286359	220	227	$77.91	$0.34	6/15/2013	7/16/2013	31
Aug-13	00286359	193	199	$70.05	$0.35	7/17/2013	8/14/2013	28
Sep-13	00286359	273	281	$91.98	$0.33	8/15/2013	9/16/2013	32
Oct-13	00286359	228	235	$88.24	$0.38	9/17/2013	10/14/2013	27
Nov-13	00286359	828	853	$223.40	$0.26	10/15/2013	11/14/2013	30
Dec-13	00286359	1519	1565	$322.85	$0.21	11/15/2013	12/16/2013	31
Jan-14	00286359	2085	2148	$409.07	$0.19	12/17/2013	1/15/2014	29
Feb-14	00286359	2200	2267	$426.06	$0.19	1/16/2014	2/13/2014	28
Mar-14	00286359	2248	2316	$425.29	$0.18	2/14/2014	3/14/2014	28

April-12 to March-2013		10214	$2,700.38	$0.26
April-13 to March-2014		11793	$2,694.29	$0.22
Total Utility Costs	*Apr-12 to Mar-13*		**$57,130.90**	
Total Utility Costs	*Apr-13 to Mar-14*		**$54,640.04**	

APPENDIX C4

USEPA RENEWABLE ENERGY FACT SHEET

LOW-HEAD HYDROPOWER FROM WASTEWATER

United States Environmental Protection Agency

August 2013

Renewable Energy Fact Sheet: Low-Head Hydropower from Wastewater

DESCRIPTION

Hydropower turbines generally come in two types: impulse or reaction. The reaction type is generally used for low-head applications. Reaction type hydropower turbines include: propeller type, screw type, bulb type, waterwheels, and hydrokinetic energy "free" flow types. In the reaction type turbines, the water passing through the turbine loses its energy, or pressure, as it passes the turbine blades. In the impulse type turbine, the velocity of the water is regulated. Water is directed at the blades of the impulse turbine with a high-velocity nozzle, and the velocity of the water turns the blades[1].

There are two conditions that are used to choose the appropriate turbine for a particular site: head and flow rate. The head is measured as the vertical distance between the highest and lowest water surface, minus any losses that occur, such as friction. The flow rate is a measure of all of the water that will be passing through the turbine. Low-head turbines can generally operate through a range of flow rates, but the size of that range varies with turbine type. Also the efficiency of the turbine decrease as the flow rate varies from the best design flow rates. It is possible that the best turbine may not utilize all of the flow available at the highest flow, so that the range of the turbine can cover the lower flow periods. A detailed analysis of the flow over time will need to be performed to choose a turbine that is best suited for a particular site[2]. The power (kW) produced by a given site can be estimated using the following equation; where H is available head in feet; F is the flow in cubic feet per second (cfs); efficiency is overall system efficiency as a fraction; and 11.8 is a constant that converts the equation to kilowatts.

$$\text{Power (kW)} = \frac{H \times F \times \text{efficiency}}{11.8}$$

The equation can provide an estimate of the power available at a specific site, for either high or low head and high or low flow. However, you should contact the turbine manufacture regarding the efficiency of a particular turbine, and how that efficiency may vary with flow[3].

In the wastewater hydropower concept, treated effluent is diverted from the outfall pipeline and passes through one or more turbine-generator units before flowing into the receiving stream. Treated effluent can also flow through a shunted section of the outfall pipeline to bypass the turbine during times of hydropower system shutdown or high flows. Generated electricity is delivered to the wastewater plant via an independent transmission line that interconnects with the wastewater treatment plant's electrical distribution system. The hydropower site could also be connected to the electric utility grid[4].

There are a number of low-head and very low-head hydropower turbines on the market today. However, most of the operating experience is from Europe or Asia[5].

APPLICATION

Historically, turbines suited for low-head effluent hydropower applications were custom designed and manufactured by hydro-turbine construction specialists. The range of flows and heads at most wastewater treatment plants would suggest axial-flow tube turbines as the preferred equipment.

Several sewage pump manufacturers offer "pumps as turbines," using an off-the-shelf wastewater pump converted to operate as a turbine. However, this standardized design and manufacturing approach never achieved its anticipated impact in the wastewater hydropower market[6].

Interconnection requirements are essentially the same whether the electricity is used by the wastewater treatment plant or is sold to the local utility. Each utility has general guidelines for interconnection and specific requirements for each project. Equipment would normally include transformers, meters, and protective relays[7].

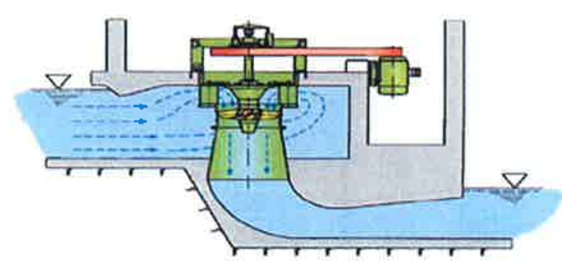
EQUIPMENT AND COSTS

There is a growing a number of manufacturers offering low-head and very low-head hydropower turbine equipment. Here is a description of several low-head turbines that may be suitable for wastewater treatment plant effluent discharge applications[8]. Estimated costs are for equipment only. Installation costs will vary greatly depending on the site conditions, size of the turbines, and complexity of the project[9].

- **Energy Systems and Design – Model LH 1000**: The LH 1000 is a small propeller type turbine suitable for sites with flows of about 2 cubic feet per second (cfs) and 10 feet of head. Under these conditions, one unit will produce about 1 kilowatt (kW) of direct current (DC) electricity. The LH 1000 uses a permanent magnet alternator. An inverter is utilized for alternating current (AC) systems. The Model LH 1000 can be purchased for around $3,000[10].

- **Power Pal – Model MHG 1000LH**: The MHG 1000LH is a small propeller type turbine suitable for sites with flows of about 5 cfs and 5 feet of head. Under these conditions, one unit will produce about 1kW of DC electricity. The turbine is set at the elevation of the incoming water and a draft tube extends below the turbine to create the head differential by suction. The turbine is generally used as a standalone application, either for direct load or battery charging. Grid connection of this type of turbine would require additional equipment. The Model MHG 1000LH can be purchased for around $4,000[11].

- **Canyon Hydro-Kaplan Turbine:** Canyon Hydro builds custom hydroelectric systems, including designing and manufacturing the turbine, and assembling the system in the field to provide a "water to wire" package[12]. A wide range of turbines are available for low-head application, including the Kaplan turbine based equipment package. The Kaplan turbine design adjusts to varying heads and varying flows using adjustable pitch runner blades and wicket gates. The efficiency of the turbine can be maintained down to 35% of design flow. The vertical turbine is recommended for heads between 30 and 50 feet and flow ranges between 100 and 400 cfs. The cost per turbine ranges between $30,000 to over $500,000 per unit[13].



Typical Vertical Turbine Installation

- **Toshiba International-Hydro-eKIDs**: Hydro-eKIDs are propeller type turbines best suited for installation in an existing pipe. The eKids have adjustable runner vanes to match site conditions. These horizontal turbines can be installed in series or parallel to accommodate a wide range of heads and flows.

Typical turbine outputs range from 5 kW to 200kW. The cost per turbine ranges between $7,000 to over $30,000 per unit[14].


Horizontal Hydro-eKIDS Type S Turbine

• **VLH Turbine**: The runner of the VLH Turbine is large (up to 16.4 feet) with a very slow rational speed (less than 40 revolutions per minute) that can operate at very low water velocity (less than 6 feet per second) through the runner. This slow operating speed and low flow velocity eliminates the need for a sophisticated control structure at the inlet and outlet of the channel. The turbine and generator are submerged, reducing the required infrastructure and the need to construct a building above the power plant. The units are mounted in the channel slanted away from the upstream flow. The units can be removed from the channel passage way by a lifting system, so the unit can be raised for maintenance or to allow full flow in the channel during high flow periods. When running, the system produces no noise or vibration and has no impact on downstream migration. The runner blades are adjustable and self closing, allowing automatic upstream water level regulation and eliminating the need for a separate closing gate to shut off the unit. The units can also operate in a discharge mode (when not generating electricity) and are capable of operating isolated from the distribution system.

The VLH Turbine concept is not a site-specific design. The units are available in five standard sizes with blades ranging from 10.3 feet to 16.4 feet. These units are very efficient and can operate at almost 80% efficiency. The VLH turbine generating set is double regulated with both adjustable blades and variable speed. This allows operation on sites where the head drops with variations in flow.

The variable speed capability of the generating set assures a stable and efficient operation under variable head. The VLH Turbine is able to work under 1/3 of the normal head while maintaining normal efficiency[2].

These units have a net head range from 4.2 feet to 10.5 feet and a flow range from 0.16 million gallons/day to 0.48 million gallons/day. The units can produce 100 to 500 kW (at the converter terminal box). For example: a Model DN 3150 (10.3 feet diameter), operating at 5.9 of head, and a flow of 0.14 million gallons per day (MGD) can produce 118 kW; while, a Model DN 5000 (16.4 feet diameter), operating at 8.5 feet of head, and a flow of 0.41 million gallons per day can produce 500 kW. Although installation costs vary greatly depending on actual site conditions and the size of the turbines, the equipment costs for a Model DN 3150 is approximately $575,000, while the equipment cost for a Model DN 5000 is approximately $1,100,000[15].


VLH Turbine Installed In Effluent

• **HydroCoil:** The HydroCoil turbines use a ribbon drive helical technology to capture and convert kinetic energy of flowing water to usable clean electricity. The compact design allows for easy installation for generating renewable energy in a variety of applications, including water distribution systems, wastewater treatment plant effluent pipes, and irrigation channels.

The turbine is fabricated from lightweight polymer or composite materials using low-cost injection molding. The units are corrosion-resistant to salt and chlorine. Metal components (such as bearings and permanent magnet alternators) are enclosed in watertight housings. HydroCoil units are carbon neutral during operation and do not produce pollutants. When installed in an effluent pipe where inflow to the turbine is clean and debris free, maintenance is minimal. However, when installed in water that is not debris free, periodic inspection and cleaning of the turbine vanes is required.

The 6-inch diameter unit is 34 inches long and weighs 40 pounds, while the 12-inch diameter unit is 50 inches long and about 70 pounds (including the generator). Power output depends on water flow, head or velocity, and revolutions per minute (rpm) of the turbine runner and generator. Site- specific effective head or pounds/square inch can be modified by design of the intake manifold at the turbine entry.

The 6-inch diameter turbine has an operating head range of 10 to 60 feet with a flow range up to 1,200 gallons/minute (1.8 million gallons/ day), and has an estimated peak capacity of 2.4 kW. With a head of 12 feet and a flow velocity of 9.2 feet/sec., the alternator produces 65 volts DC at 646 rpm of the helix vanes, which corresponds to 1,292 rpm for the permanent magnet alternator. At higher rpm, the 6-inch unit can produce up to 100 volts. The alternator is rated at 24 amperes for 50 volts and above. With 2 kW generating capability, the system can provide up to 17,500 kilowatt hours (kWh) per year.

The 12-inch helical turbine has an operating range of 10 to 100 feet with a predicted flow range up to 4,800 gallons/minute (7.2 million gallons/day). It has an estimated peak output of between 8 kW to 10 kW. Actual electrical output is dependent on the specific location and use. The 12-inch system can produce 50 amperes and 200 volts DC at 1,700 to 2,500 rpm of the generator. At an 8 kW output, the system produces approximately 70,000 kWh per year. Although installation costs will vary depending on actual site conditions, putting the Hydrofoil unit into an existing facility is relatively quick and easy. Since the units are light, no heavy cranes are needed. The equipment cost for the 6-inch turbine is approximately $6,500 and for the 12-inch unit is approximately $13,000. In some scenarios, several units can be bundled together in modules, for a compact package that can produce more energy[16].


6-inch HydroCoil Unit

CASE STUDIES

Point Loma, San Diego, California
The City of San Diego's Point Loma Wastewater Treatment Plant and Pump Energy Recovery Project (PERP) are now selling power to the San Diego grid through a contract with San Diego Gas and Electric (SDG&E). The $1.2 million project, completed by Henwood Energy Services, Inc., included a $360,000 grant from the California Energy Commission, in addition to $420,000 in renewable energy incentives from the State of California, to get the wastewater treatment facility back up and running. The hydropower station supplies approximately 1.35 megawatts of "green" renewable energy to the San Diego power grid. The Point Loma hydroelectric turbines were originally installed in the mid-1980s, but were shut down in 1989 and partially disassembled due to the inability to properly regulate the effluent flow. However, changes to the plant piping system in conjunction with improvements in the ocean outfall's hydraulic characteristics, plus the rising cost of energy, created a renewed interest in brining the project back on-line.

The new design (Figure 1) is powered with treated wastewater that drops some 90 feet from the cliff-side plant into a 4.5 mile ocean outfall, resulting in the generation of enough incremental power to supply more than 13,000 homes with 'green" renewable electricity.

Henwood, a leading energy technology and consulting company, was chosen for the major maintenance overhaul, including the installation of the new turbine and generator, new control system, and interconnection wiring. After two months of testing, the renovated hydropower plant was brought back on-line in June of 2001.

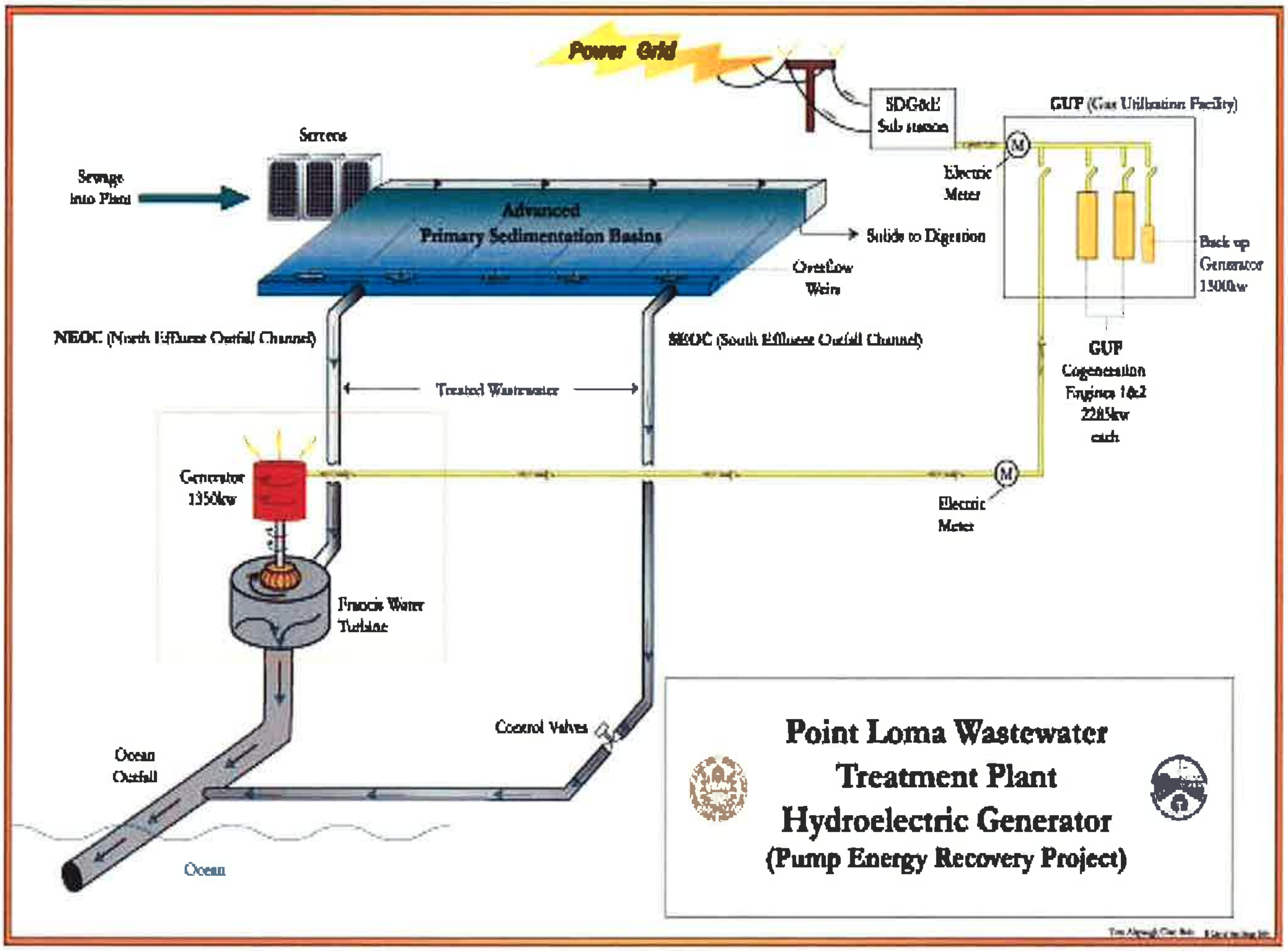


Figure 1: Point Loma Hydropower Plant Flow Diagram

Kankakee, Illinois

The City of Kankakee receives a substantial benefit from its current operating strategy, since the metro utility pays the city for the hydropower it uses at a rate matching the electric utility's charges. The net annual income, for the years between 1992 and 1994, ranges from about $102,000 to $275,000 per year. By reconstructing and upgrading the hydroelectric plant to modern technology standards, Kankakee has transformed the plant into an environmentally safe, revenue producing facility.

The Kankakee Illinois Hydro Project was initially started up in 1912 with five manually controlled turbines with supporting equipment. These units were seriously limited in that they were unable to respond to variations in flow and available head. As a result, developing maximum power was not always easy, and the only operational decision to be made was determining how many units should be run.

The new three-turbine hydro installation incorporates a number of design features that provide considerable operating flexibility and result in significantly higher efficiency. Although the power output still is governed by the head as well as the flow, a computer-based control system monitors variations in flow and head in order to maximize efficiency. The data gathered is used to select automatically the number of turbines that should run under the existing conditions. In addition, variable pitch turbine blades can be adjusted for optimum operation. These features mean that the hydro plant can react to natural changes in flow and head and still produce power efficiently.

The three 400 kW turbines installed at Kankakee are somewhat unconventional in that they operate on the siphon principle, in contrast with the more common pit design. They are the first units of this type to be installed in the United States, and were supplied by C. E. Neyrpic of France. This company sees the Kankakee project as a demonstration of its innovative siphon design and its appropriateness for low-head hydro sites such as this one.

The city received a state grant of over $1.0M from the Illinois Department of Energy and Natural Resources (ENR) to assist in financing the project. The grant was made to encourage the utilization of an alternative energy source and to allow the ENR to use this project to demonstrate the application of low-head hydroelectric technology.

In addition to the hydroelectric equipment cost of $1.6M, powerhouse and site work required $2.5M, an electrical transmission line cost $344,000, and connection to the electric utility was $70,000. The engineering design fee to Stanley Consultants of Muscatine, Iowa, was $350,000. The project's total cost was $4.8M, which netted out to a cost to Kankakee of $3.8M after the ENR grant from the state was received.

Since the hydroelectric plant went back online in mid-1991, much data has been collected and analyzed about its performance, and the power consumption relationships between it, the wastewater plant's cogeneration system, the use of natural gas as a backup fuel, and what the electric utility has provided. The scenario is complicated, and a review of the rate structure reveals that producing hydro or cogenerated power solely for sale to the electric utility is not cost-effective. There is not enough revenue to offset the costs of operation and maintenance, or to support the capital costs. However, when these readily available power sources supply the entire or a significant portion of the base load needed to operate the treatment plant, real savings are achieved[20].

Deer Island, Boston, Massachusetts

Massachusetts Water Resource Authority (MWRA) generates hydropower at its Deer Island Wastewater Treatment Facility. Once treated wastewater is disinfected, it is discharged into effluent channel #1. Flow is then split through two horizontal intake openings at the base of effluent channel #1 and transmitted through separate rectangular concrete conduits below the disinfection basins and through two corresponding hydro-turbines. The two intake openings in the effluent channel are each approximately 11 feet by 11 feet at the two motorized roller intake gates located immediately upstream of the turbines. The average head available is approximately 29 feet. The hydropower facility includes two normal 1,000 kW Kaplan units each with a flow capacity of approximately 500 cfs (320 mgd). The maximum flow (640 mgd) is approximately equivalent to the maximum flow through the secondary treatment portion of the plant. Turbine runner blades and wicket gates are adjusted to meet changing power demands and changes in flow and head. After the turbines, the effluent conduit joins the outfall chute, which discharges into the outfall shaft, which drops the effluent into the 9.5-mile outfall tunnel to Massachusetts Bay.

The hydropower facility's instrumentation and control systems are designed to interface with the wastewater treatment facility's control system. The system allows fully automatic, unattended operation. The treatment plant must operate continuously to prevent backups of the sewage collection system. Wastewater flow in excess of the hydro facility bypasses effluent channel 1 and is discharged through effluent channel 2 directly to the outfall tunnel. The building that houses the turbines, generators and all associated electrical switchgear equipment is situated directly over effluent channel #1. The hydropower facility has been operating continuously since 2001.

The total construction cost for the contract that included the hydropower plant was $36.2M, but included the new disinfection facilities (basins, chemical storage and pumping, etc), the North Main Pumping Station electrical modifications, including a 13.8 kilovolt (kV) electrical transmission cable and installation. The estimated construction cost for the hydro-generating facilities was approximately $7.4M, but the estimate did not include the enormous excavation and construction of the outfall chute between the disinfection basin and tunnel shaft, since this work needed to be done whether the hydro plant was constructed or not.

Annual maintenance costs have varied in the past several years. The actual reported maintenance costs for 2009, 2010, and 2011 were $134,000, $140,000, and $256,000,[21] respectively. The higher operation and maintenance costs for 2011, were primarily due to unscheduled maintenance events (i.e., intake gate overhaul, shaft seal replacement, and runner operating shaft disassembly and reassembly).

The treatment facility is a conduit facility and received a conduit exemption from the Federal Energy Regulatory Commission. The hydroelectric facility was also part of a thorough environmental review by state and federal agencies as part of the Deer Island Water Treatment Plant renovation project. The Deer Island Treatment Plant discharges, including all discharges through the hydropower plant, received both an EPA National Pollution Discharge Elimination System permit and Massachusetts Division of Water Pollution Control Water Quality Certification. The facility is located some 200 feet from the shoreline and does not impact fisheries, wildlife, flood control, or navigation[22].

CONCLUSIONS

Although the concept of using low-head hydropower generated from effluent has been around for many years, only a few wastewater treatment plants in the U.S. are in operation. While historically the use of wastewater effluent to generate hydropower was considered impractical due to its high cost and low payback, the need for more municipalities to become energy self-sufficient has opened the door. With the emergence of new technologies, many wastewater plants in Europe and Asia are harnessing low-head hydropower. Some of the new technologies can operate at very low-head and flows. With this new generation of turbines, generating hydropower from effluent is becoming a cost-effective alternative for generating on-site renewable energy.

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Victoria, BC, Canada
http://powerpal.com

12. **Canyon Hydro, Inc.**
5500 Blue Heron lane
Deming, WA 98244 USA
http://canyonhydro.com

13. **Netel Energy, Inc.**
2175 Monarch Street,
Alameda, CA 9450, USA
http://netelenergy.com

14. **Toshiba International Corporation**
2 Morton Street Parramatta, NSW,
Australia 2150
http://www.tic.toshiba.com/au/hydro-ekid_8484

15. **MJ2 Technologies**
7049 Gaslamp Walk
Mississauga, Ontario, Canada 5W 1A4
http://vlh-turbine.com

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1359 Arbordale Road
Third Floor
Waynewood, PA 19096 USA
http://hydrocoilpower.com

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Some of the information presented in this fact sheet was provided by the manufacturer or vendor and could not be verified by the EPA.

The mention of trade names, specific vendors, or products does not represent an actual or presumed endorsement, preference, or acceptance by the EPA or federal government. Stated results, conclusions, usage, or practices do not necessarily represent the views or policies of the EPA.

Environmental Protection Agency
Office of Wastewater Management
EPA 832-F-13-018
August 2013

Appendix D

Digester Record Drawings

VILLAGE OF WEBSTER
SEWAGE TREATMENT PLANT
IMHOFF TANK~SECTION AND DETAILS
MONROE COUNTY, N.Y.

SCALE : 1" = 2'

MAY, 1934

GEORGE R. NEWELL, ENG'R.

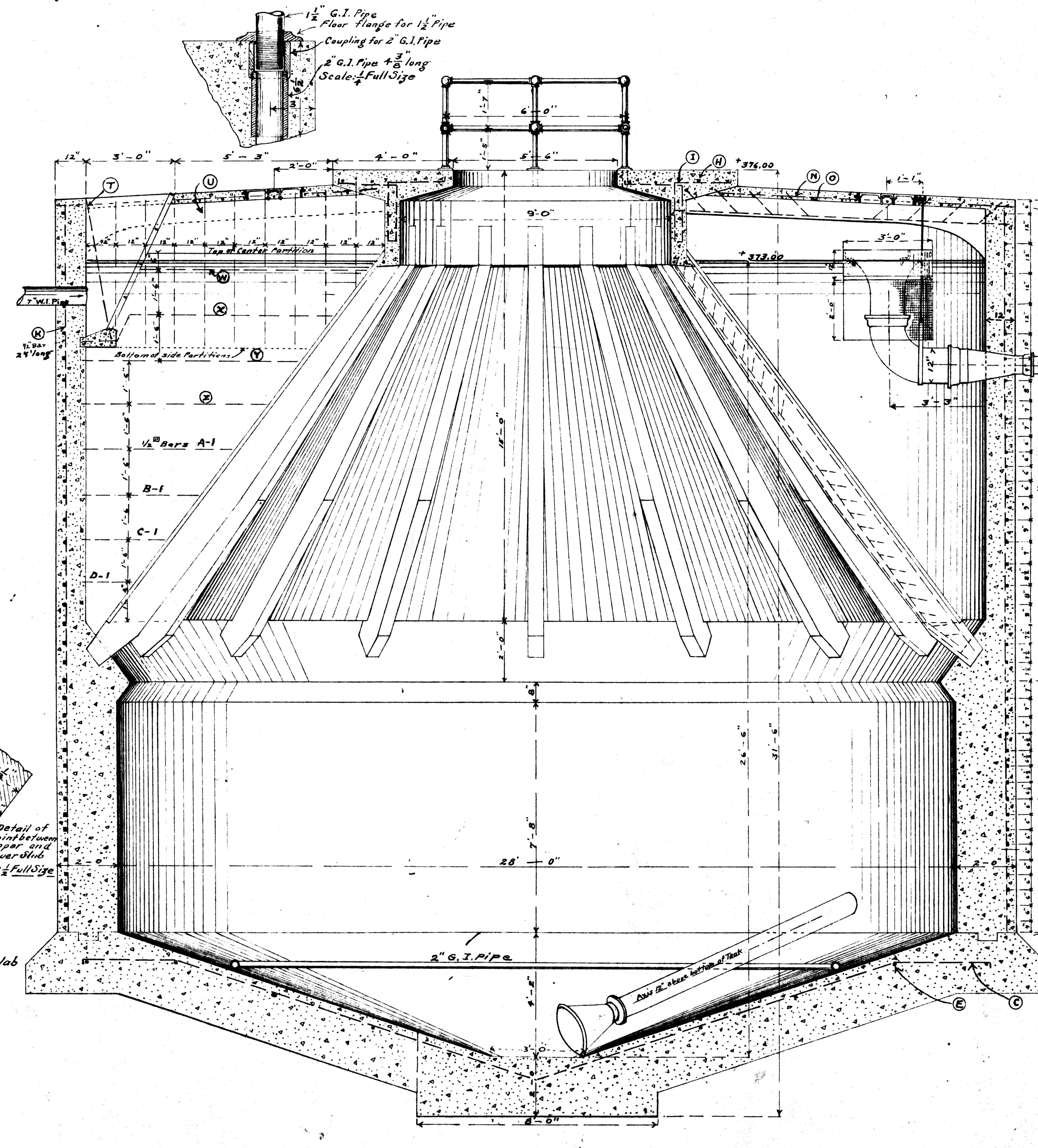
NOTES
FOR CONVERSION TO DIGESTER

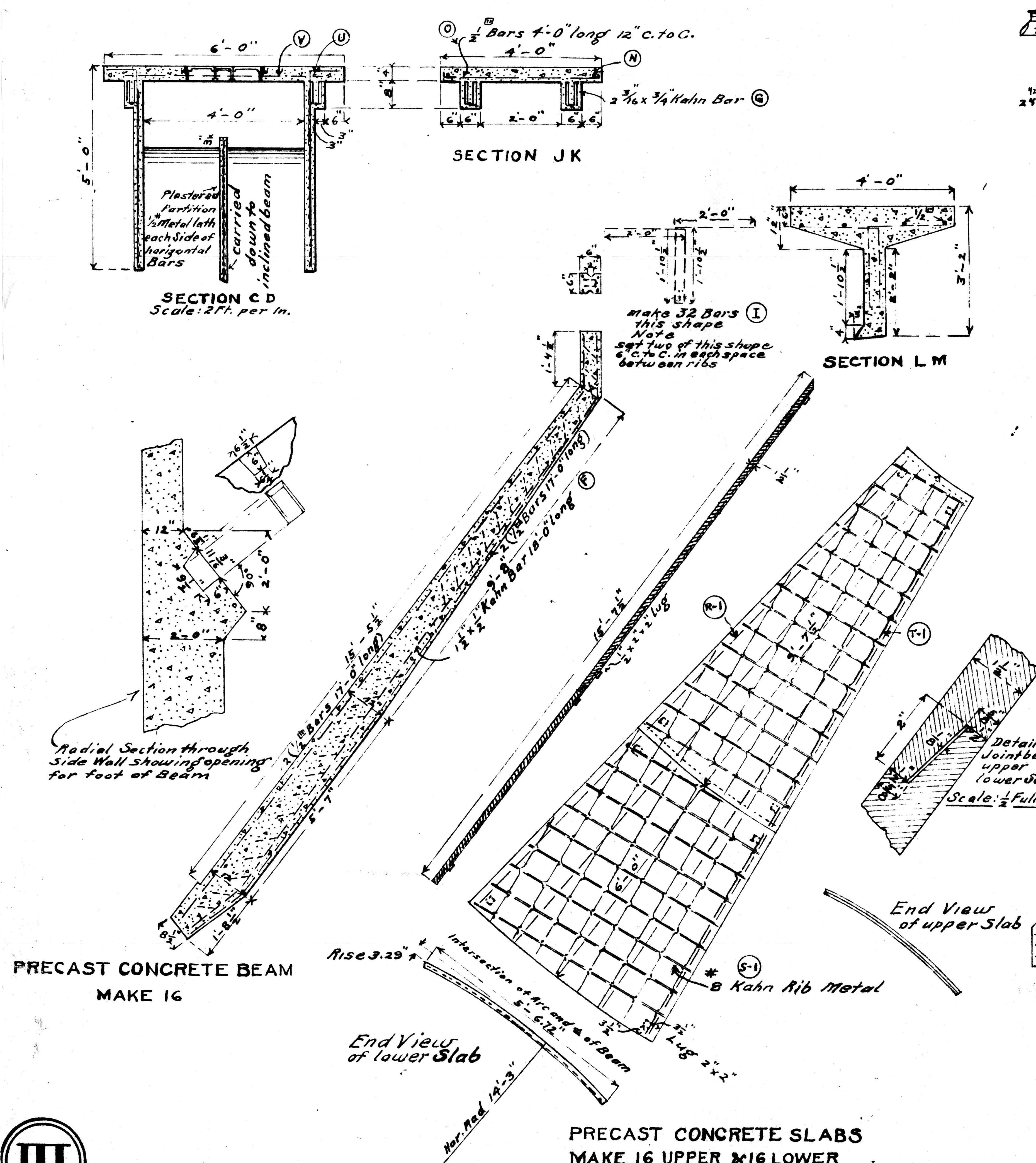
1. Walkway, concrete beams, slabs, leaf walls partitions and all other concrete work extraneous to the tank walls shall be removed.
2. All piping except sludge drawoff pipe shall be removed and the openings plugged.
3. All holes shall be filled with concrete and the tank patched where required.
4. Tank shall be painted (tank shall be emptied and cleaned before any work is done on the tank).

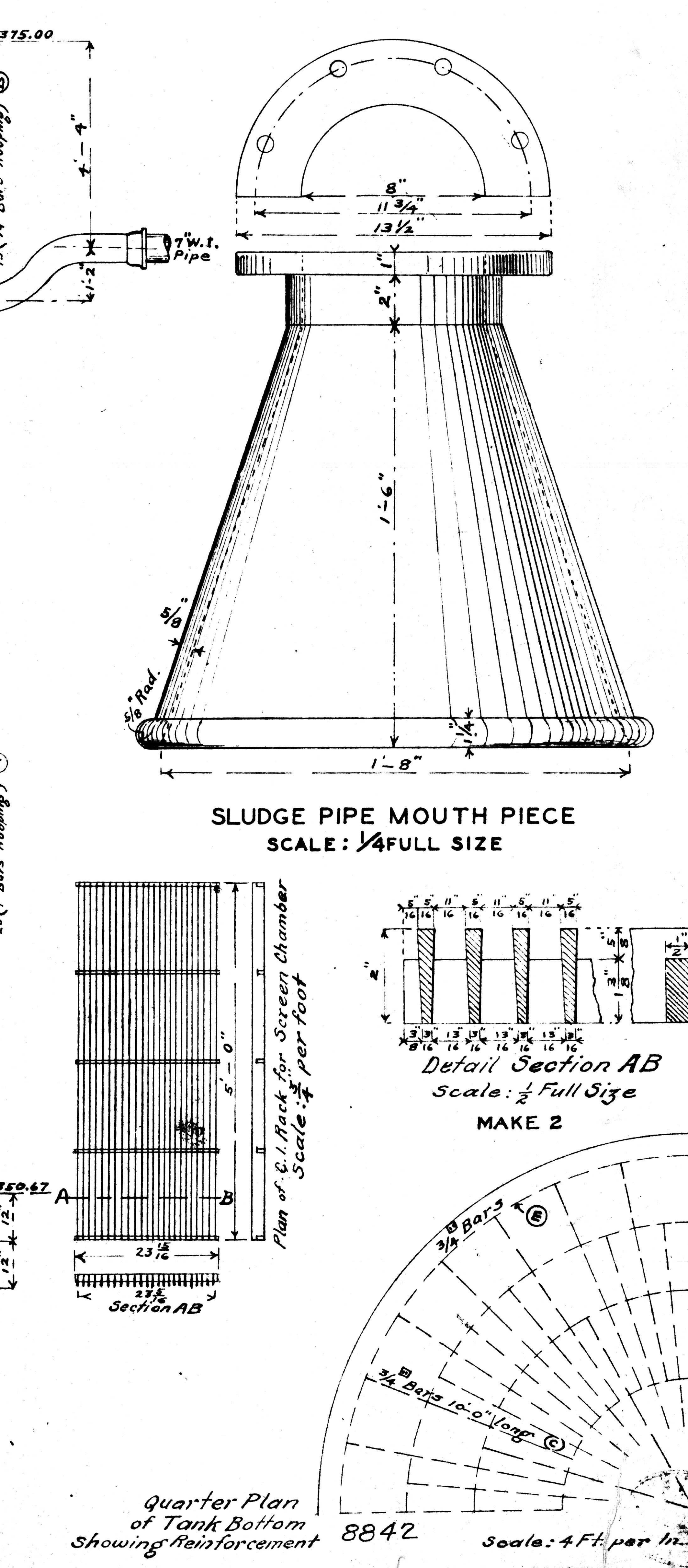
STEEL REINFORCEMENT

R.E.F.	P.C.S.	MATERIAL	LENGTH	WEIGHT
A	100	1" Bars Hooping	26'	8840.
B	52	3/4" " "	26'	2582.3
C	64	3/4" Radial	10'	1222.4
E		" Hooping	275'	525.2
F	16	1 1/2" x 1/2" Kahn Bars	288'	483.2
G	4	2 3/16" x 3/4" " "	44'	119.
H		1/2" Bars Deck Hooping	131'	111.3
I	32	" Bends	8'	217.6
K	25	" Vertical	24	510.
N	2	" Bridge	11'	18.7
O	8	" "	4'	27.2
P	64	" Beams	17'	924.8
T	1	" Partition	15'	13.
U	18	" "	6'	108.8
V	8	" "	5'	34.
W	1	" "	8'	6.8
X	1	" "	9'	7.6
Y	1	" "	7'-6	6.4
Z	1	" "	6'-6"	5.5
A-1	1	" "	5'-6"	4.7
B-1	1	" "	4'	3.4
C-1	1	" "	3'	2.5
D-1	1	" "	2'	1.7
R-1	—	1/4" Bar Con. Slabs	1240'	264.1
S-1	5	Kahn Rib Metal #8	18'	152.
T-1	7	" " " #7	18'	318.8
U-1	3	1/2" Metal Lath	6 1/2' x 20'	195.
			Total	16,706.0#

1934: Secondary Digester







8842

III

1956: Secondary Digester

DESIGNED C.P.	ADDITIONS TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER, N.Y.	SCALE As Shown
DRAWN		JOB NO. 1036
CHECKED	THE LOZIER COMPANY CIVIL & SANITARY ENGINEERS 10 GIBBS ST. ROCHESTER 4, N.Y.	FIELD BOOK 653
REVISED	BY P.E. NO DATE	FILE NO. 8831
	GENERAL PLAN	SHEET NO. 1

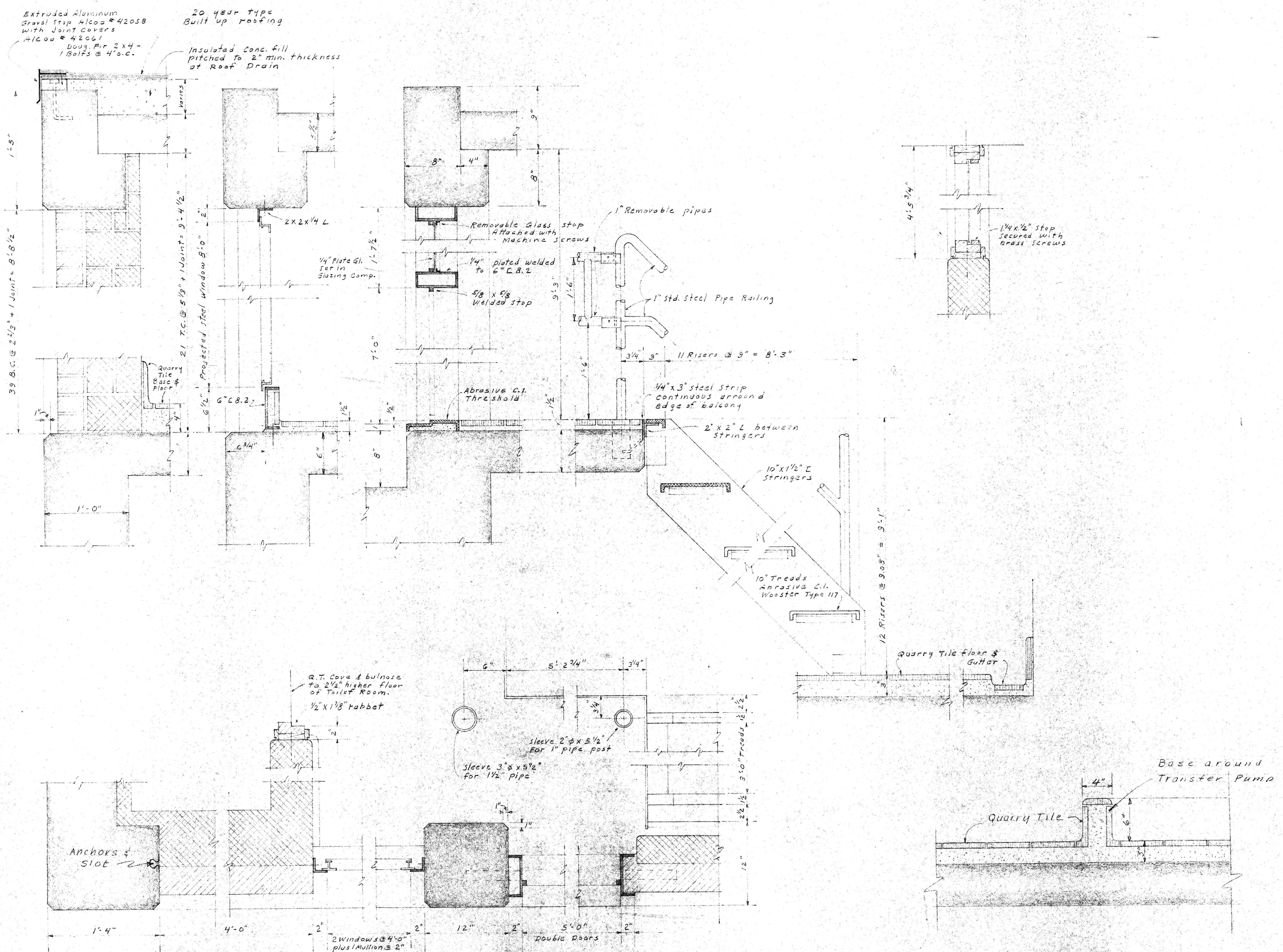
1956: Secondary Digester

DESIGNED C P	ADDITIONS TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER, N.Y.	SCALE As shown
DRAWN		JOB NO. 1036
CHECKED	THE LOZIER COMPANY CIVIL & SANITARY ENGINEERS 10 GIBBS ST. ROCHESTER 4, N.Y.	FIELD BOOK
REVISED	BY P.E. NO. DATE	FILE NO. BB32
	SECTIONS & DETAILS	SHEET NO. 2

1956: Secondary Digester

DESIGNED / DRAWN / CHECKED / REVISED	ADDITIONS TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER, N.Y.
	THE LOZIER COMPANY — CIVIL & SANITARY ENGINEERS, 10 GIBBS ST., ROCHESTER 4, N.Y.
	DIGESTER BUILDING PLANS & ELEVATIONS
SCALE	1/4" = 1'-0"
JOB NO.	1036
FILE NO.	883
SHEET NO.	6

1956: Secondary Digester



DESIGNED J.R.G.	ADDITIONS TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER, N.Y.	SCALE 1 1/2"=1'-0
DRAWN J.R.G.		JOB NO 1036
CHECKED E.K.	THE LOZIER COMPANY CIVIL & SANITARY ENGINEERS 10 GIBBS ST. ROCHESTER 4, N.Y.	FIELD BOOK
REVISED	BY P.E. NO DATE	FILE NO. 8837
	DIGESTER BUILDING DETAILS	SHEET NO. 7


1956: Secondary Digester
DIGESTER
PLAN PUMP RM. FLOOR SLAB
Scale 1/4"=1'-0"
PLAN MAIN FLOOR SLAB
Scale 1/4"=1'-0"
PLAN ROOF SLAB
Scale 1/4"=1'-0"
SECTION THRU BEAM B
Scale 1/2"=1'-0"
SECTION THRU BEAM A
Scale 1/2"=1'-0"
SECTION OF COLUMN
Scale 1/2"=1'-0"
SECTION B3-B3
SECTION B2-B2
Scale: 1/2"=1'-0"
SECTION B1-B1
Scale 1/2"=1'-0"
For General notes See Sheet No
ADDITIONS TO
SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER, N.Y.
THE LOZIER COMPANY
CIVIL & SANITARY ENGINEERS 10 GIBBS ST. ROCHESTER 4, N.Y.
DIGESTER BUILDING REINFORCING
DESIGNED
C.P.
DRAWN
CHECKED
REVISED
JOB NO
1036
FILE NO
8838
SHEET NO
9

1956: Secondary Digester

DESIGNED C.P. PEN	ADDITIONS TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER, N.Y.		SCALE AS SHOWN
DRAWN PEN			JOB NO. 1036
CHECKED	THE LOZIER COMPANY CIVIL & SANITARY ENGINEERS 10 GIBBS ST., ROCHESTER 4, N.Y.		FIELD BOOK
REVISED	BY	P.E. NO. / DATE	FILE NO. 8339
	DIGESTER BUILDING PIPING		SHEET NO. 9

23-671

NOTES: 1. Abandoned pipe lines shall be disconnected and plugged watertight at the point of abandonment.
2. Valves are indicated thus: ⋈

1964: Primary Digester

DESIGNED J.R. Gray	FIELD BOOKS	REVISIONS Revise sludge line flushing arrangem'ts and relocate hydrants. 12-21-64
DRAWN M.V.	SCALE 1" = 20'	
CHECKED J.R. Maanera		

SECOND ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
SITE PLAN - OUTSIDE PIPING

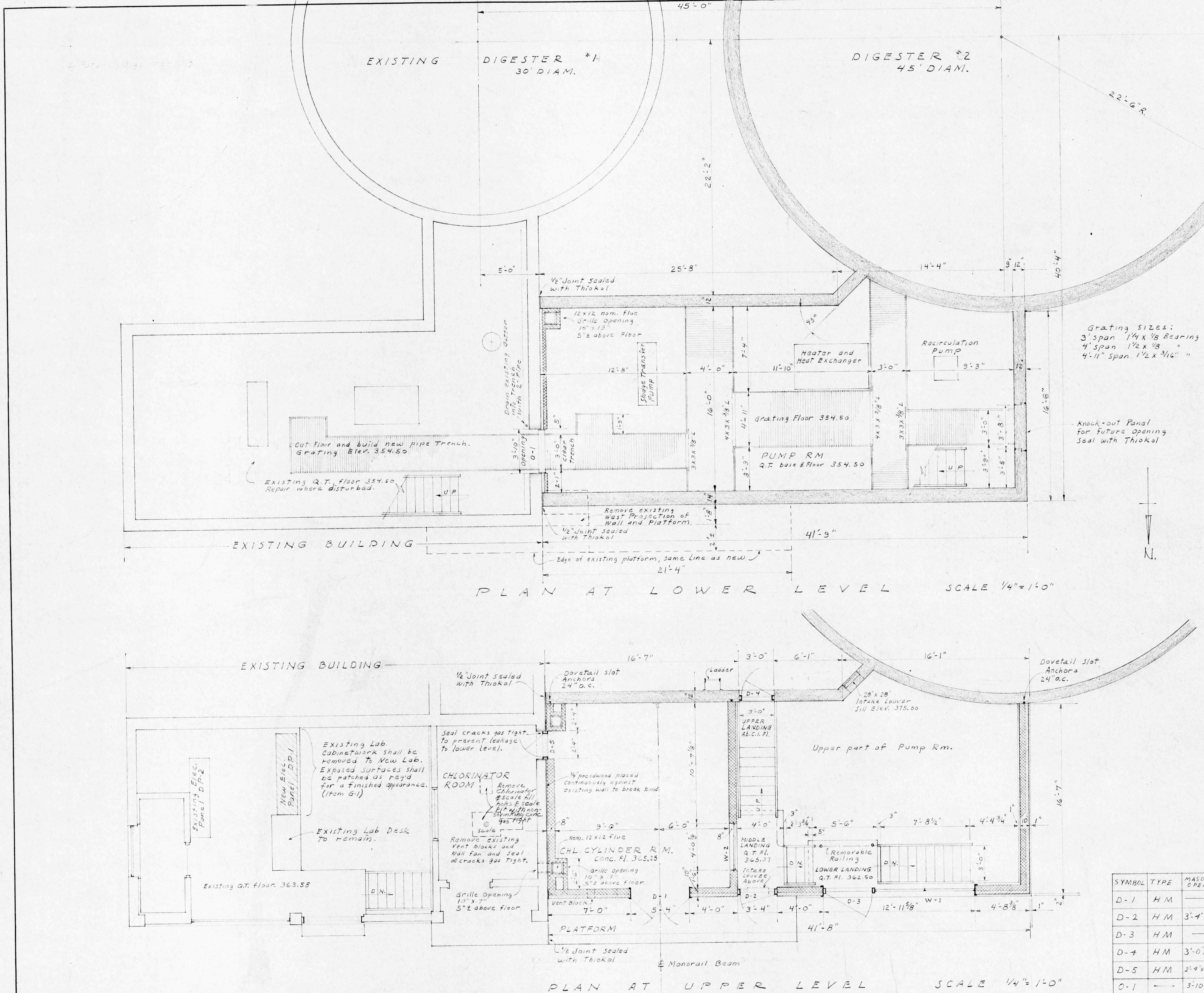
LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY John R. Gray R.A. NO. 4721 DATE May 1964

JOB NO. 1316-8B
SHEET NO. 2
FILE NO. 12452

1964: Primary Digester

DESIGNED E. KUMMER DRAWN E. KUMMER CHECKED J.R.G.	FIELD BOOKS SCALE As noted	REVISIONS	SECOND ADDITION TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER MONROE COUNTY NEW YORK HYDRAULIC PROFILES - SEWAGE PUMP STA. - VALVE VAULT	LOZIER ENGINEERS, INC. 10 GIBBS STREET CIVIL AND SANITARY ENGINEERS ROCHESTER 4, NEW YORK P. E. NO. 21241 DATE 5/12/64	JOB NO. 1316-8B SHEET NO. 3 FILE NO. 12453

1964: Primary Digester



STRUCTURAL STEEL SCHEDULE

LOCATION	SECTION	BEARING
Monorail Beam	18" I 54.7	(2) 4x4x3/8" Seat & Clip Ls
"A" Frame	5" [6.7 & Misc.	
Lintel at D-1	8" WF 31	12" Bearing
Channel Jambs at D-1	12" x 1 1/2 [10.6	Strap Anchors
Lintel at D-2	{ 3 1/2 x 4 x 1/4 L 5 x 3 x 1/4 L	6" Bearing
Air Intake Louver above D-2	Same	" "
Lintel at W-1	8" WF 31	12" Bearing
Channel Jambs at W-1	12" x 1 1/2 [10.6	Strap Anchors
Lintel at W-2	(2) 3 1/2 x 4 x 1/4 Ls	6" Bearing
Lintel at D-4	8" WF 17	6" Bearing
Lintel at D-5	5 x 3 1/2 x 1/4 L	6" Bearing
Lintel at O-1	4 x 4 x 3/8 L	6" Bearing
Pipe Trench grating	(2) 3 x 3 x 3/8" L (2) 4 x 3 x 3/8" L	4" leg with 2-5/8" bolts to Trench wall

DOOR SCHEDULE

SYMBOL	TYPE	MASONRY OPENING	DOOR OPENING	DOOR PANELS	DOOR FRAME	THRESHOLD	COMMENTS
D-1	HM	—	5'-4" x 12'-2"	—	str. [	—	Double door with weatherstripped cut-out for monorail.
D-2	HM	3'-4" x 6'-10 3/4	3'-0" x 6'x 9"*	23" x 23" glass	str. [	Abr. C.I.	* use 6'-8" door
D-3	HM	—	4'-0" x 7'-5"‡	—	str. []	Abr. C.I	‡ Use 7'-4" door
D-4	HM	3'-0" x 6'-10 1/2	3'-0" x 6'-8 1/2*	17" x 17" glass	str. [	Abr. C.I	* use 6'-8" door
D-5	HM	2'-4" x 6'-10 1/2"	2'-0" x 6'-8 1/2*	12" x 12" glass	str. [	1/4" steel Plate	* use 6'-8" door
O-1	—	3'-10" x 7-3	—	—	—	1/4" steel plate	

DESIGNED J.R.G. DRAWN J.R.G. CHECKED J.R.M.	FIELD BOOKS SCALE As Noted	REVISIONS	SECOND ADDITION TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER MONROE COUNTY NEW YORK DIGESTER BUILDING — FLOOR PLANS

LOZIER ENGINEERS, INC. — 10 GIBBS STREET — CIVIL AND SANITARY ENGINEERS — ROCHESTER 4, NEW YORK

BY John R. Gray — RA NO. 4721 — DATE May 1964

JOB NO. 1316-83
SHEET NO. 14
FILE NO. 12464

1964: Primary Digester

DESIGNED J.R.G.	FIELD BOOKS	REVISIONS
DRAWN J.R.G.	SCALE 1/4"=1'-0"	
CHECKED J.R.M.		

SECOND ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
DIGESTER BUILDING - ELEVATIONS AND SECTIONS

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY John R. Gray R.A. NO. 4721 DATE May 1964

JOB NO. 1316-8B
SHEET NO. 15
FILE NO. 12465

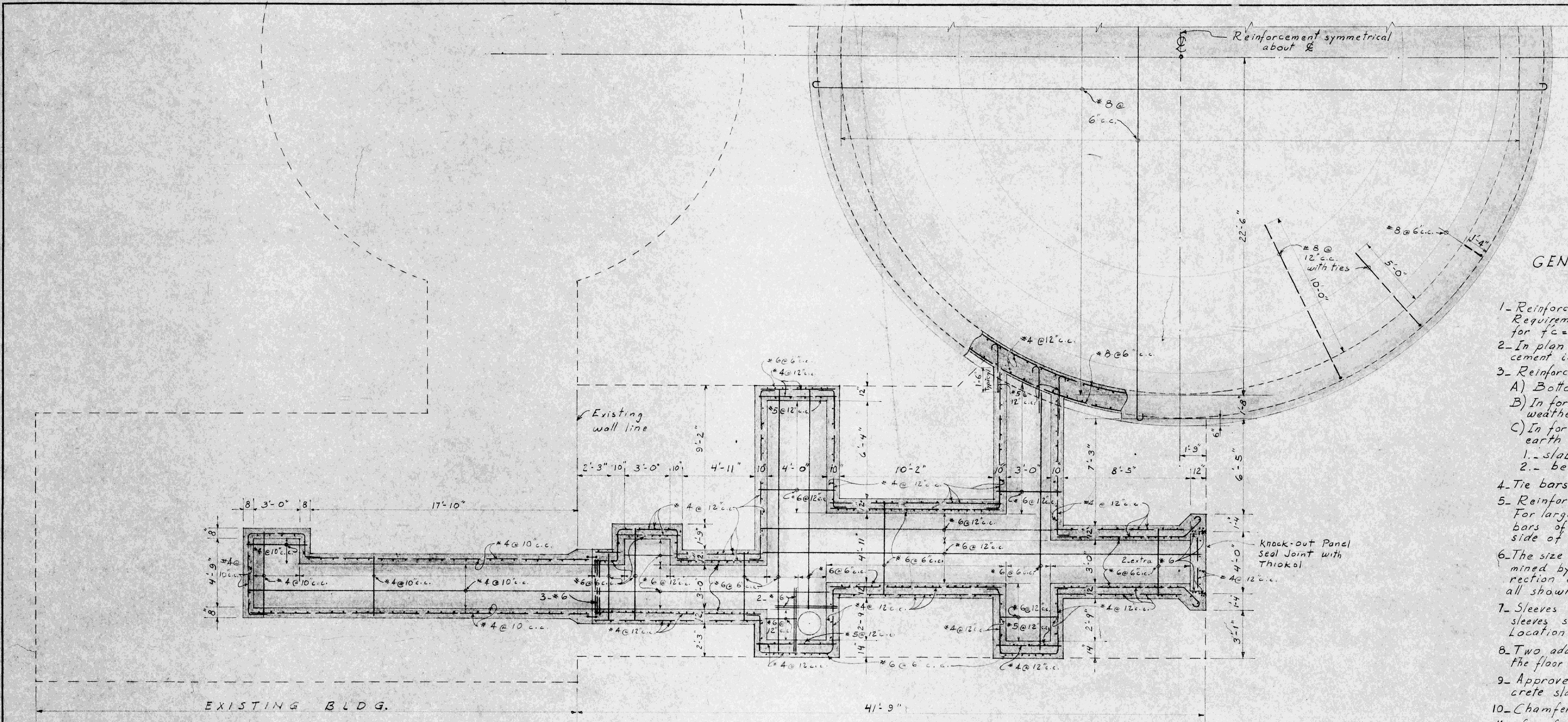
NOTE.- For general and reinforced concrete notes see sheet file No 12467

1964: Primary Digester

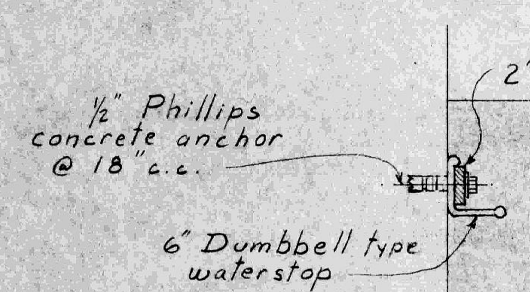
DESIGNED J.R.G. DRAWN J.R.G. CHECKED E.K.	FIELD BOOKS / SCALE 1/2"=1'-0"	REVISIONS	SECOND ADDITION TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER MONROE COUNTY NEW YORK DIGESTER BUILDING - ARCHITECTURAL DETAILS

LOZIER ENGINEERS, INC. — CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET, ROCHESTER 4, NEW YORK
BY John R. Gray R.A. NO. 4721 DATE May 1964

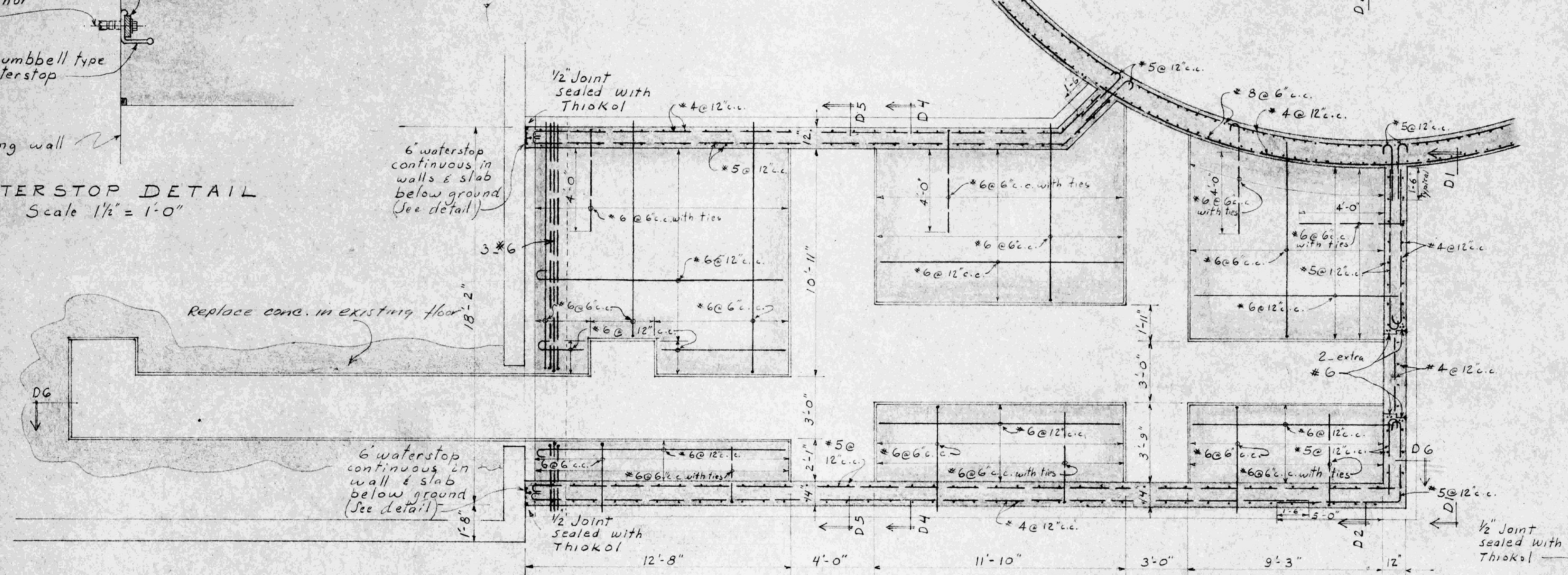
JOB NO. 1316-8B
SHEET NO. 16
FILE NO. 12466



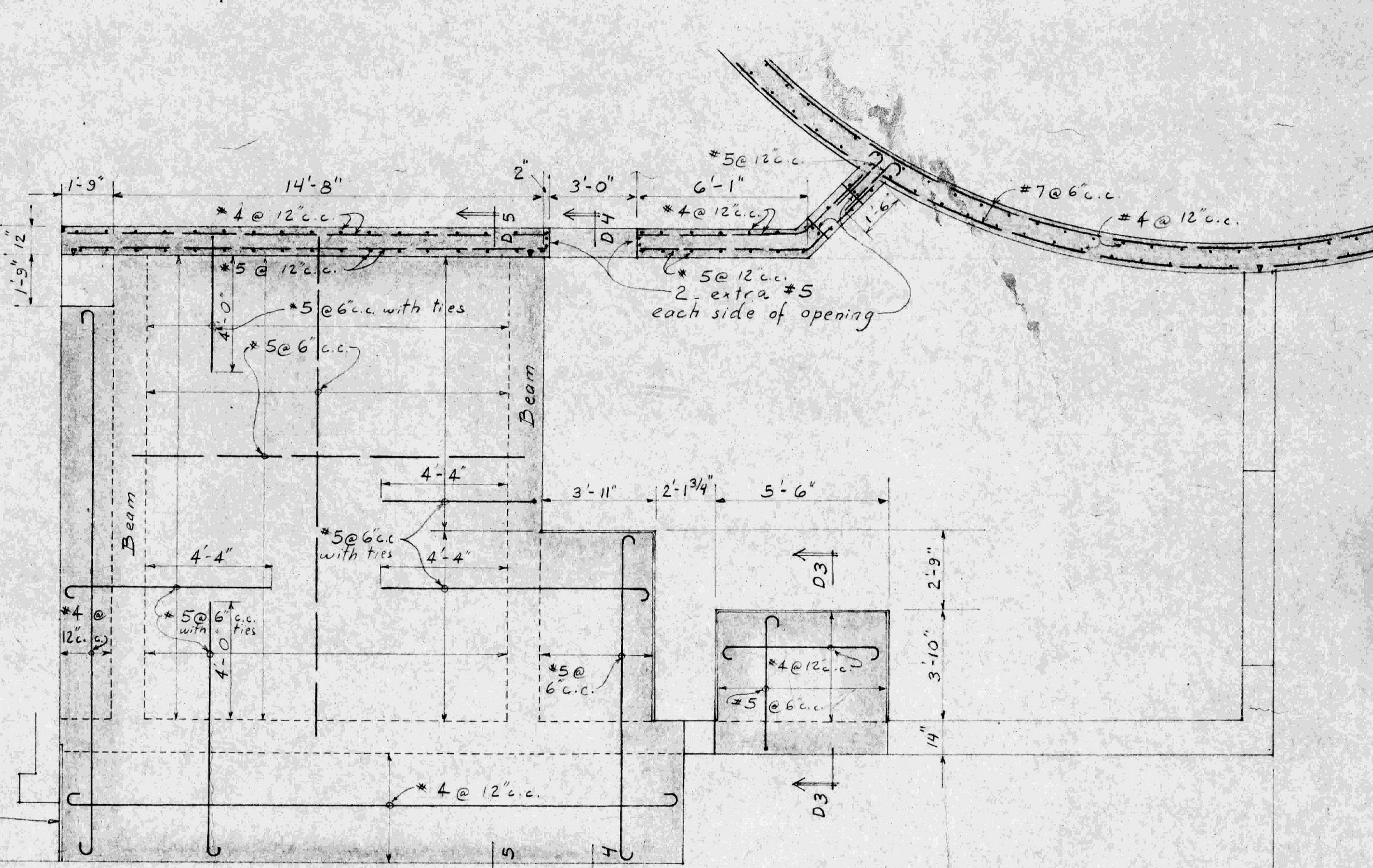
PLAN AT PIPE TRENCH LEVEL SCALE 1/4" = 1'-0"



WATERSTOP DETAIL
Scale 1 1/2" = 1'-0"



PLAN AT PUMP ROOM FLOOR SCALE 1/4" = 1'-0"



PLAN AT CYLINDER ROOM FLOOR

GENERAL NOTES.- REINFORCED CONCRETE
(Use where applicable)

1- Reinforced concrete was designed in accordance with the "Building Code Requirements for Reinforced Concrete" of the American Concrete Institute for f'c = 3000 pounds per square inch.
2- In plan top reinforcement is indicated by a solid line and bottom reinforcement is indicated by a dashed line.
3- Reinforcement shall have a minimum clear cover of concrete as follows:
   A) Bottom bars of slabs and walls placed in contact with the ground - 3"
   B) In formed members bars adjacent to surfaces to be exposed to the weather or in contact with earth or water - 2"
   C) In formed members not to be exposed to the weather or in contact with earth or water:
      1.- slabs and walls - 3/4"
      2.- beams - 1 1/2"
4- Tie bars shall be #4 @ approx. 18" c.c.
5- Reinforcement shall be bent around openings less than one foot in diameter. For larger openings reinforcement may be discontinuous with two extra bars of at least the size of the main reinforcement placed at each side of opening.
6- The size and location of openings and equipment foundations shall be determined by approved manufacturers drawings and shall be placed at the direction of the field engineer. Openings and equipment foundations are not all shown on these drawings.
7- Sleeves shall be placed for all pipes thru the walls and floors. Type 3 sleeves shall be used where pipes pass thru walls unless otherwise noted. Location and type of sleeves shall be approved before concrete is poured.
8- Two additional bars extending from support to support shall be placed in the floor slab under each interior wall not supported by a beam or wall.
9- Approved pipe hanger inserts, anchors and bolts shall be placed in concrete slabs or walls as required.
10- Chamfer all exposed concrete corners.
11- See Section 51 of specifications for concrete joints.
12- All concrete shall be structural grade.

1964: Primary Digester

DESIGNED A. M.	FIELD BOOKS	REVISIONS
DRAWN J. R. G. & A. M.		
CHECKED E. K.	SCALE	

SECOND ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
DIGESTER BLDG REINFORCEMENT PLANS

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY Roger M. Rice P. E. NO. 23756 DATE 5/12/64

JOB NO. 1316-8B
SHEET NO. 17
FILE NO. 12467

DESIGNED A.M.	FIELD BOOKS	REVISIONS
DRAWN J.R.G.	SCALE	
CHECKED A.M.		

SECOND ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
DIGESTER BLDG.—REINFORCEMENT SECTIONS

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY Roger A. Rice P.E. NO. 23756 DATE 5/12/64

JOB NO. 1316-88
SHEET NO. 18
FILE NO. 12468

1964: Primary Digester

SECOND ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
DIGESTER BLDG. — PIPING PLANS & SECTIONS

DESIGNED	E. K.
DRAWN	E. K.
CHECKED	J. R. G.

FIELD BOOKS

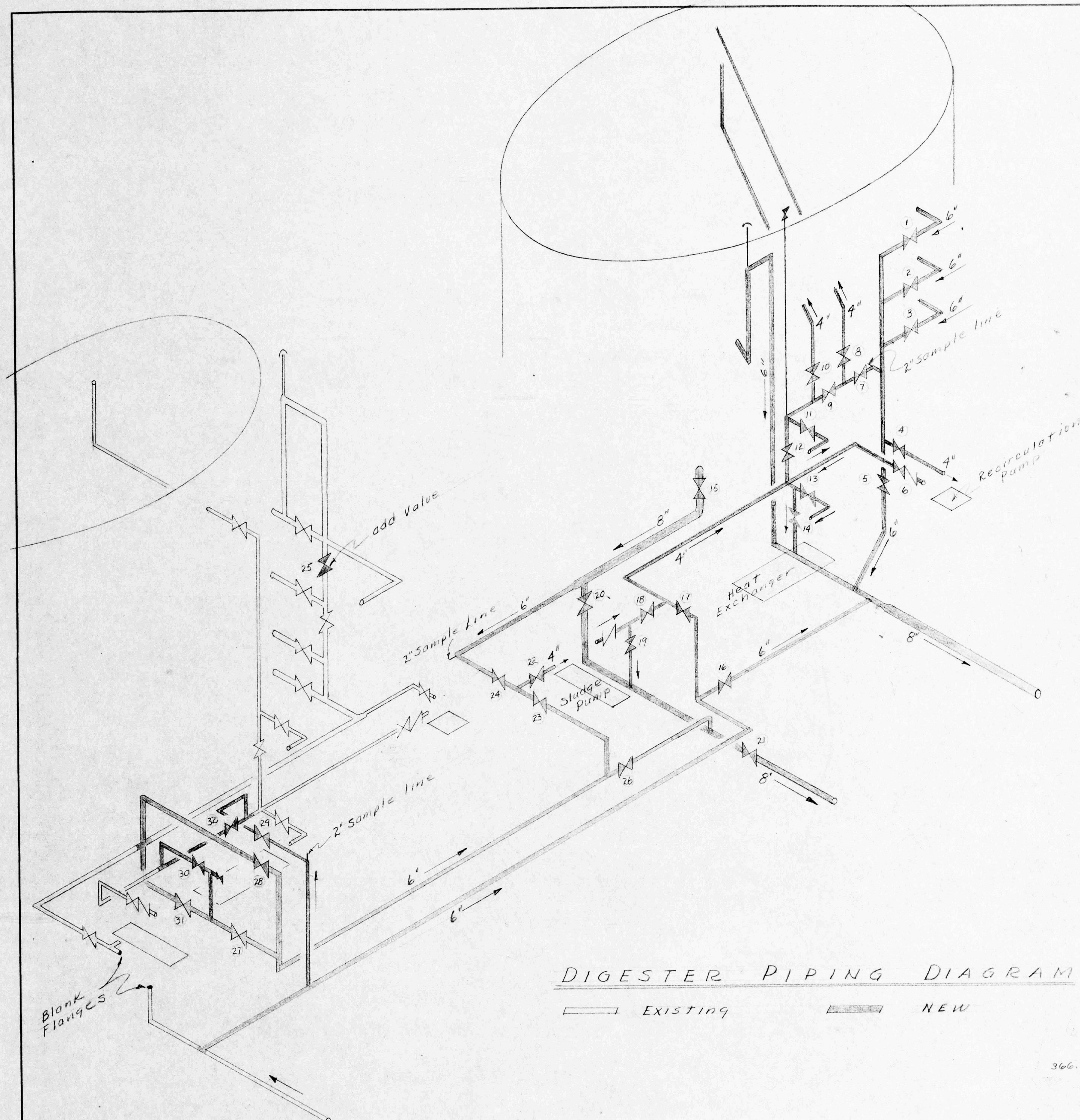
SCALE 3/8"=1'-0" unless otherwise noted.

REVISIONS

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK

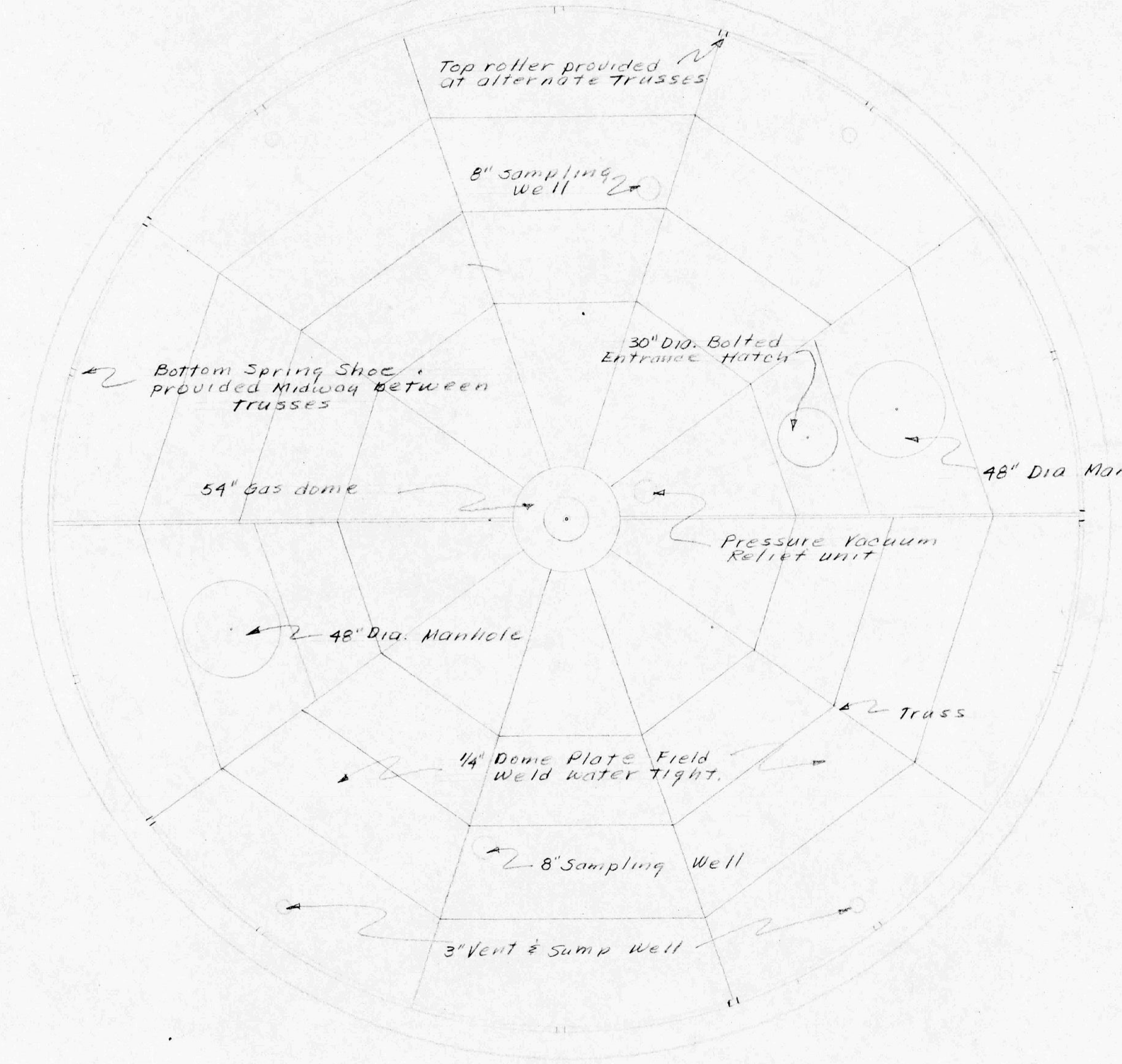
BY C.H. Playford P. E. NO. 21241 DATE 5/12/64

JOB NO. 1316-88
SHEET NO. 19
FILE NO.



DIGESTER PIPING DIAGRAM

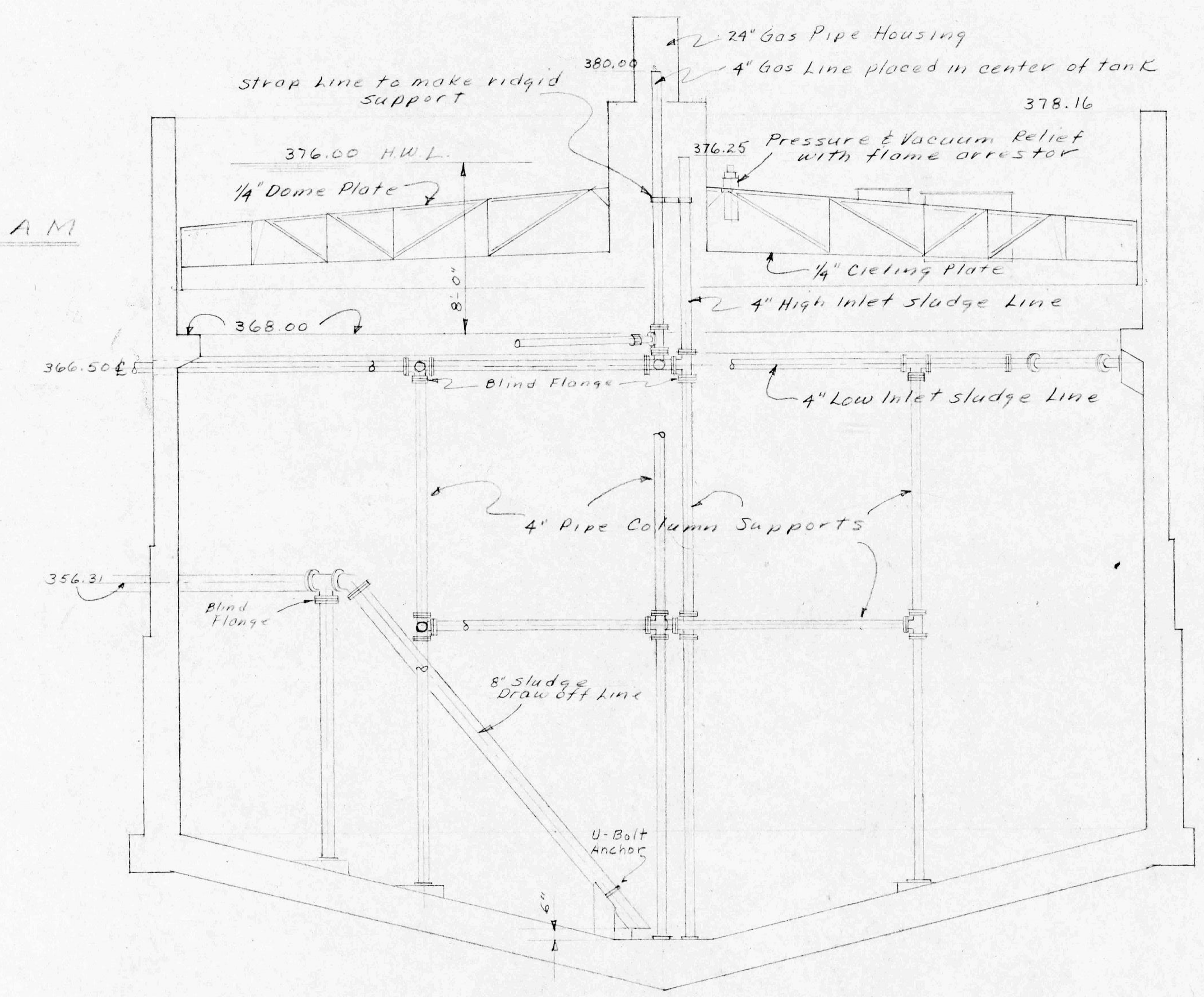
EXISTING — NEW



45'-0" DIA.

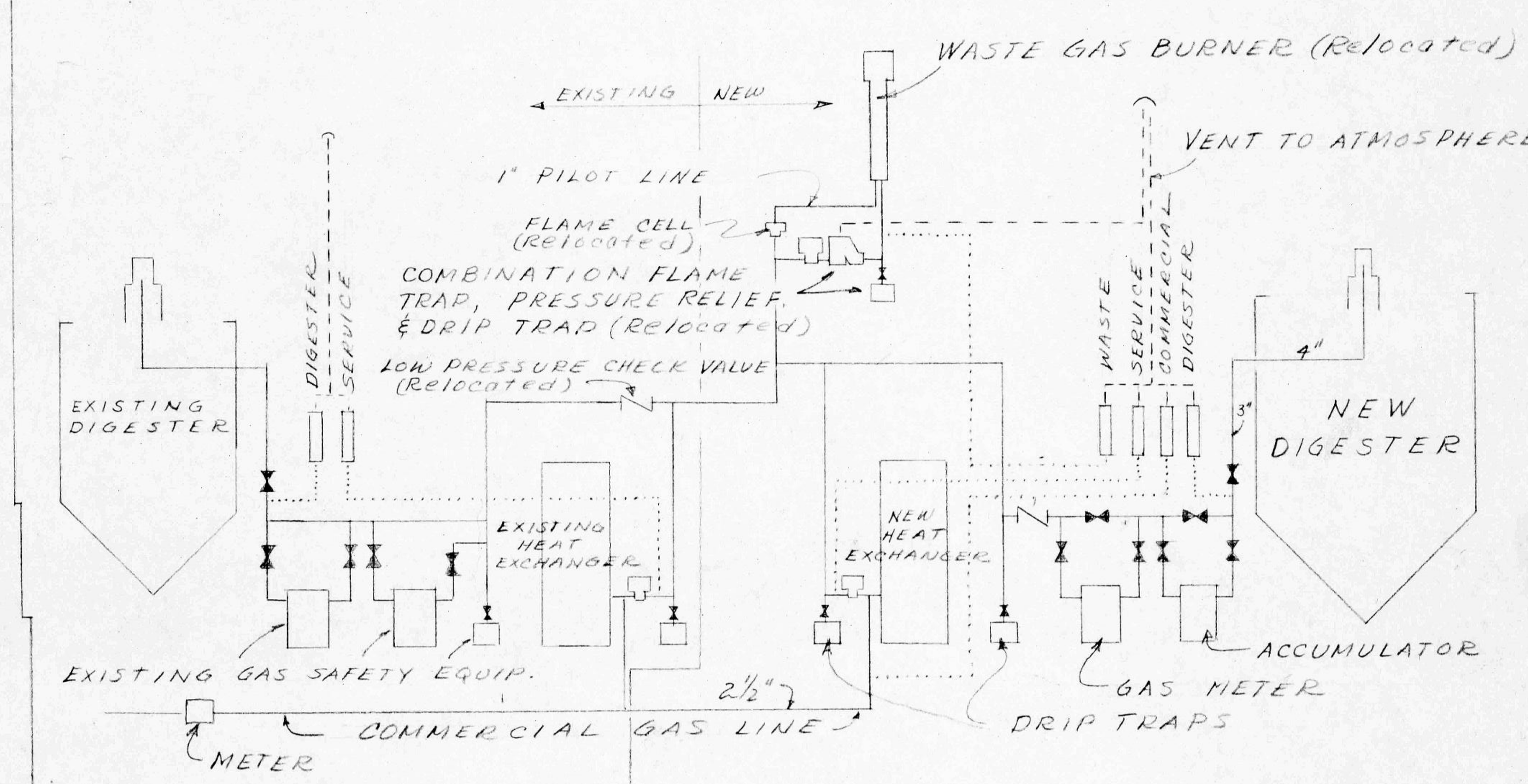
DIGESTER FLOATING COVER

NO Scale



SECTION SHOWING TANK PIPING & COVER

NO Scale



NEW & EXISTING GAS PIPING DIAGRAM

NO scale

NOTE : All valves on gas lines shall be of an approved plug Variety

- (1) 2 (3) 6" Plug Valves on Recirculation Lines (chain operated)
- 4 4" Plug Valve on Recirculation Pump Suction Line
- 5 6" Plug Valve on Drain Line for Recirculation System
- (6) 4" Plug & Check Valves on Recirculation Pump Discharge Line
- 7 9 4" Plug valves on Inlet header Line
- 8 10 4" Plug Valves on Low & High Inlet Lines
- 11 (13) 4" Plug Valves on Inlet & outlet Lines of Heat Exchanger
- 12 4" Plug Valve on Heat Exchanger bypass Line
- 14 4" Plug Valve on Drain Line for Sludge Inlet System.
- 15 8" Plug Valve on Sludge Drawoff Line.
- 16 6" Plug Valve on Drain Line for Raw Sludge Line System
- (17) 4" Plug Valve on Raw Sludge Line
- 18 4" Plug & check Valves on sludge pump discharge to heat exchanger
- 19 4" Plug Valve on Sludge pump discharge to sludge drawoff Line
- 20 21 8" Plug Valve on Sludge Drawoff Line to Sludge Beds
- 22 4" Plug Valve on Sludge Pump Suction Line
- 23 24 6" Plug Valve on Sludge Pump suction Lines
- (25) 6" Plug Valve on existing header pipe below over flow line
- 26 6" Plug Valve on Sludge Drawoff Line from existing Digester
- (27) (31) 6" Plug Valve on sludge Drawoff Line each side of pump discharge
- 28 6" Plug Valve on Sludge Pump bypass
- (29) 4" Plug Valve on Raw Sludge Inlet Line to existing Building
- (30) 4" Plug Valve on existing sludge pump discharge
- 32 4" Plug Valve on sludge inlet Line (existing)

1964: Primary Digester

DESIGNED E.K.	FIELD BOOKS	REVISIONS	SECOND ADDITION TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER MONROE COUNTY NEW YORK DIGESTER BLDG.—PIPING DIAGRAM
DRAWN E.K.	SCALE		
CHECKED J.R.G.			

LOZIER ENGINEERS, INC. 10 GIBBS STREET

CIVIL AND SANITARY ENGINEERS ROCHESTER 4, NEW YORK

BY C.H. Playford P.E. NO. 21241 DATE 5/12/64

JOB NO. 1316-88
SHEET NO. 20
FILE NO. 12470

1965: Primary Digester

DESIGNED	FIELD BOOKS	REVISIONS	SECOND ADDITION TO SEWAGE TREATMENT PLANT VILLAGE OF WEBSTER MONROE COUNTY NEW YORK CONTRACT CHANGE ORDER NO. 1	LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS 10 GIBBS STREET ROCHESTER 4, NEW YORK BY John R. Gray R.A. NO. 4721 DATE Oct. 4 '65	JOB NO. 1316-88
DRAWN E. KUMMER	SCALE AS SHOWN				SHEET NO.
CHECKED					FILE NO. 12476

1967: Primary & Secondary Digesters

NOTES

- Contour Lines indicate existing surface elevations. "X" marks, indicate finished surface to be accomplished under this contract.
- All trees shall be removed south of N-1300 & east of E-780. Other trees may be removed by the contractor if necessary and if approved by the engineer.
- All area disturbed by operations of the contractor shall be finish graded and seeded. Finish graded areas shall be shaped to provide surface drainage and filled or cut as necessary to tolerances of 0.10± ft. from the elevation given. Transition to undisturbed surfaces shall be made with gentle grades. No slopes shall be steeper than 4 horiz. to 1 vert.
- Top soil of all areas in either fill or cut shall be stripped, stockpiled, and evenly re-distributed for finish grading.
- Excess or unsuitable material shall be disposed of off the site at Contrs. own arrangement.
- All elevations are based on U.S.G.S. datum.

DESIGNED C.H.P.	FIELD BOOKS 1445	REVISIONS Revise Size and add #2 Clarifier Aug. 26, 1968 J.R.G.
DRAWN J.R.G.	SCALE 1"=20'	
CHECKED JRG		

THIRD ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
SITE PLAN

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY John R. Gray R.A. NO. 4721 DATE June 13, 1967

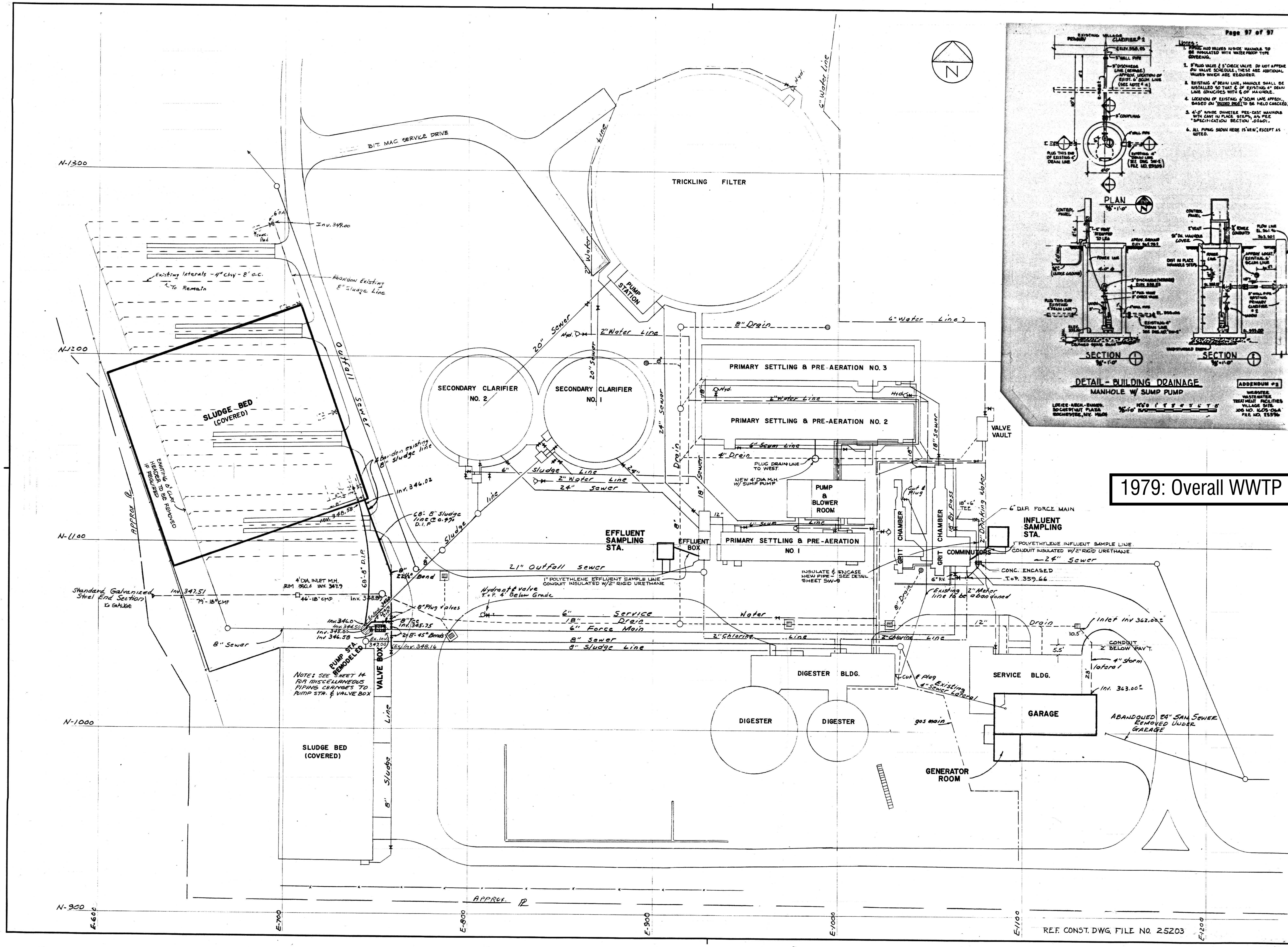
JOB NO. 1316-12
SHEET NO. 1
FILE NO. 14451

DESIGNED J.R.G.	FIELD BOOKS	REVISIONS	
DRAWN B.D.C.			
CHECKED JRG	SCALE AS SHOWN		

THIRD ADDITION TO SEWAGE TREATMENT PLANT
VILLAGE OF WEBSTER
MONROE COUNTY NEW YORK
GEN. BLDG. & DIGESTER COVERS

LOZIER ENGINEERS, INC. CIVIL AND SANITARY ENGINEERS
10 GIBBS STREET ROCHESTER 4, NEW YORK
BY [signature] P. E. NO. 22471 DATE 6/13/67

JOB NO. 1316-12
SHEET NO. 5
FILE NO. 14455



PROJECT TITLE

WASTEWATER TREATMENT FACILITIES

IMPROVEMENTS & ADDITIONS

TOWN & VILLAGE WEBSTER, NEW YORK

SHEET TITLE

RECORD DRAWING REDUCED

SITE PIPING

VILLAGE SITE

LOZIER ENGINEERS INC.

50 CHESTNUT PLAZA
ROCHESTER, NEW YORK

Engineers • Architects • Planners

DRAWING ALTERATION

The following is an excerpt from the New York Education Law, Article 145, Section 7209, and applies to this drawing: "It is a violation of this law for any person, unless he is acting under the direction of a licensed professional engineer or land surveyor, to alter an item in any way. If an item bearing the seal of an engineer or land surveyor is altered, the altering engineer or land surveyor shall affix to the item his seal and the notation "altered by" followed by his signature and the date of such alteration, and a specific description of the alteration."

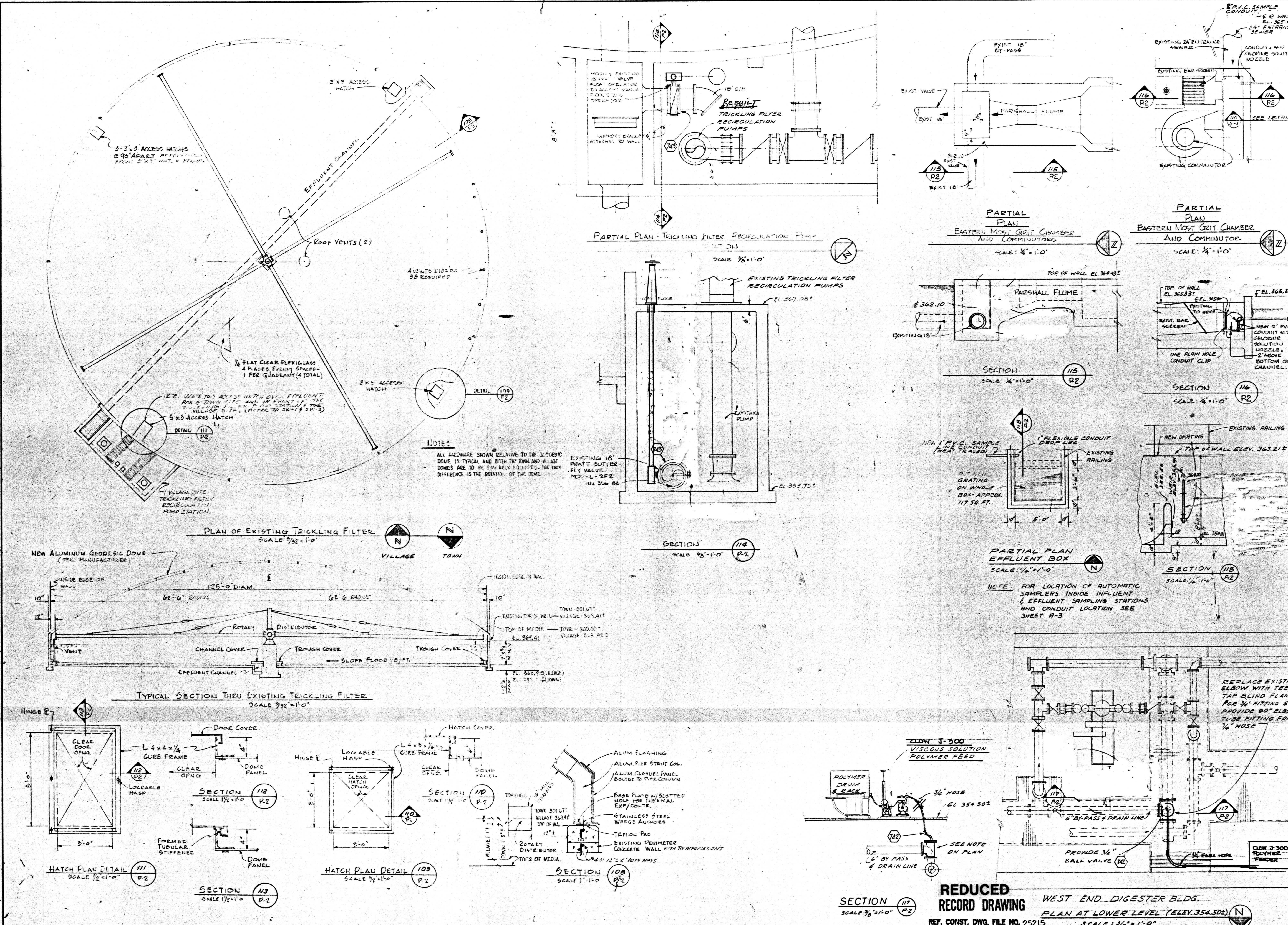
A CORPORATION REGISTERED FOR THE PRACTICE OF PROFESSIONAL ENGINEERING AND LAND SURVEYING IN THE STATE OF NEW YORK IN ACCORDANCE WITH SECTION 7209 OF THE EDUCATION LAW

BY Glenn C. Hall

DATE 3/30/79

DESIGNED	FIELD BOOKS	PROJECT NO.
G. HALL J. MANNARA		1605-07A
DRAWN J. MANNARA	SW-2	SHEET NO. 3
CHECKED	SCALE 1"=20'	FILE NO. 27804

NO.	REVISION	BY	DATE



REDUCED RECORD DRAWING

REF. CONST. DWG. FILE NO. 25215

NO.	REVISION	BY	DATE
1.	MISC. CORRECTIONS		

1979: Primary Digester

PROJECT TITLE

WASTEWATER TREATMENT FACILITIES

IMPROVEMENTS & ADDITIONS

TOWN & VILLAGE WEBSTER, NEW YORK

SHEET TITLE

MISCELLANEOUS MODIFICATIONS & ADDITIONS

AS BUILT

VILLAGE SITE

LOZIER ENGINEERS INC.

50 CHESTNUT PLAZA
ROCHESTER, NEW YORK

Engineers • Architects • Planners

DRAWING ALTERATION

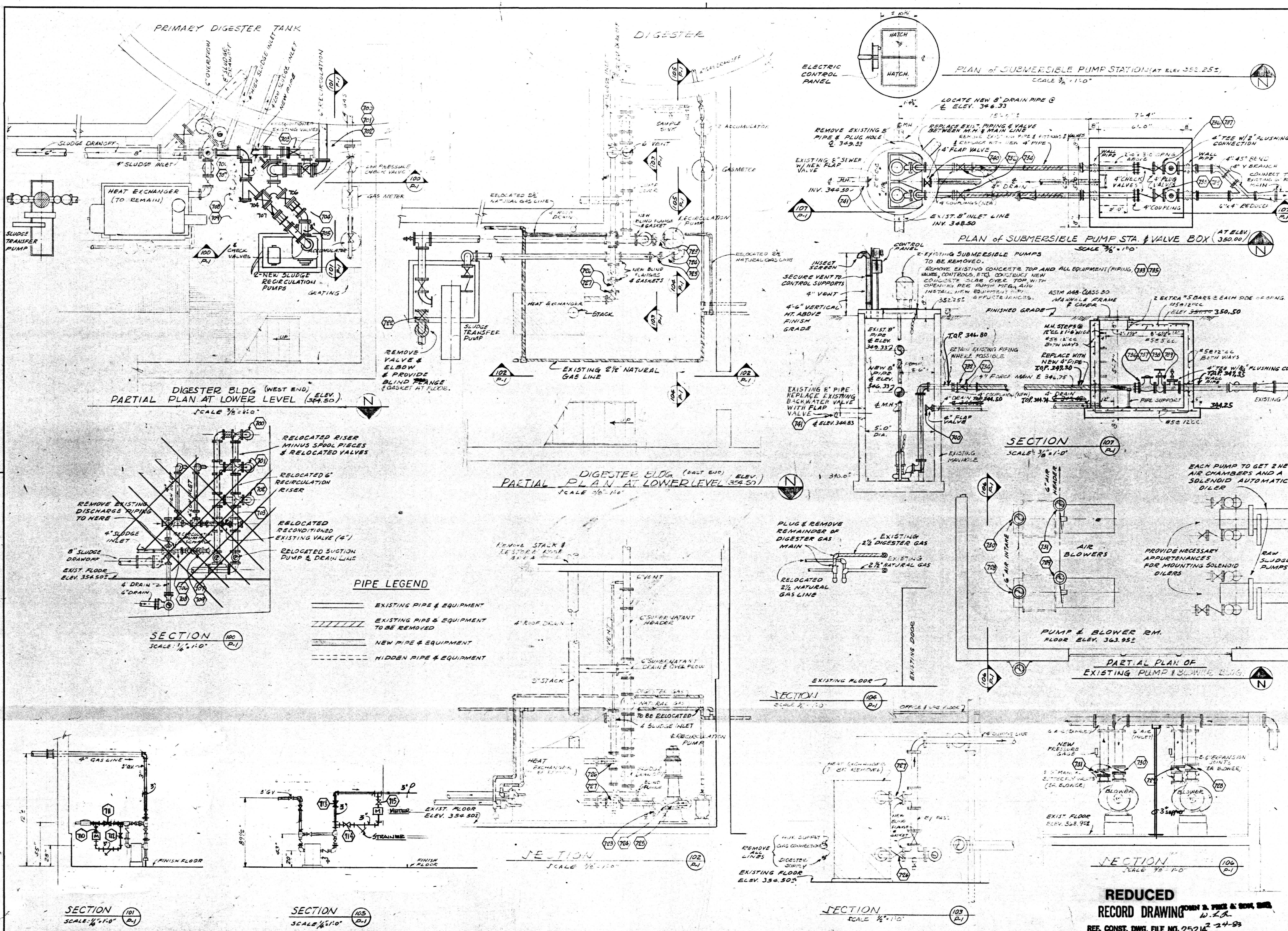
JOHN B. PIKE & SON, [redacted]
D.J.R.
2-24-85

LOZIER INC. INCORPORATED 1925

A CORPORATION REGISTERED FOR THE PRACTICE OF PROFESSIONAL ENGINEERING AND LAND SURVEYING IN THE STATE OF NEW YORK IN ACCORDANCE WITH SECTION 7209 OF THE EDUCATION LAW

DATE 3/31/79

DESIGNED	FIELD BOOKS	PROJECT NO.
L. LAWSON		1605-07A
DRAWN		SHEET NO.
DWA. SGT.	P-2	15
CHECKED	SCALE	FILE NO.
T. LAWSON	AS SHOWN	27816



NO.	REVISION	BY	DATE
1	EFFL. BOX DETAILS ADDED	T.L.	6/6/79
2	MISC. NOTES	SGT	8/2/79

1979: Primary & Secondary Digesters

PROJECT TITLE

WASTEWATER TREATMENT FACILITIES

IMPROVEMENTS & ADDITIONS

TOWN & VILLAGE WEBSTER, NEW YORK

SHEET TITLE

MISCELLANEOUS MODIFICATIONS & ADDITIONS

AS BUILT

VILLAGE SITE

LOZIER ENGINEERS INC.

50 CHESTNUT PLAZA
ROCHESTER, NEW YORK

Engineers • Architects • Planners

A CORPORATION REGISTERED FOR THE PRACTICE OF PROFESSIONAL ENGINEERING AND LAND SURVEYING IN THE STATE OF NEW YORK IN ACCORDANCE WITH SECTION 7209 OF THE EDUCATION LAW

DATE 3/31/79

DESIGNED	FIELD BOOKS	PROJECT NO.
T.L. JEM		1605-07A
DRAWN JEM, SGT	P-1	SHEET NO. 14
CHECKED	SCALE AS SHOWN	FILE NO. 27815

REDUCED
RECORD DRAWING JOHN B. PIKE & SON, INC. W.L.B.
REF. CONST. DWG. FILE NO. 25214 2-24-83

Appendix E

Smart Growth Assessment Form

New York State Environmental Facilities Corporation
625 Broadway Albany, New York 12207-2997
(518) 402-6924 Fax (518) 402-7456

Smart Growth Assessment
New York State Clean Water State Revolving Fund (CWSRF)

This form should be completed by the applicant's project engineer or other design professional. [1] Please refer to EFC's "Smart Growth Guidance." [2]

CWSRF Applicant:	Village of Webster	CWSRF Project #:	30559

Is project construction complete? Yes ☐ No ☒

Project Description:	Evaluation of Digesters at the Village of Webster's WWTP

Project Summary: Please provide a short project summary of the project in plain language including the location of the area the project serves.

Digesters at the Village of Webster's WWTP are 50 and 80 years old with cracks and weeping of sludge through the walls. Heat exchanger is also 50 years old. The digesters and related heating equipment was studied to develop an approach for rehabilitation. In addition, the overall WWTP was reviewed to seek opportunities for gains in energy efficiency.

SECTION 1 - SCREENING QUESTIONS

1. Prior Approvals
   a. Has the project been previously approved for CWSRF financing?

      Yes ☐ No ☒

      If so, what was the CWSRF project number(s) for the prior approval(s)?

   b. If so, is the scope of the project substantially the same as that which was approved?

      Yes ☐ No ☐

If the project was previously approved by EFC's Board and the scope of the project has not materially changed, the project is not subject to smart growth review. Skip to signature block.

[1] If project construction is complete and the project was not previously financed through the CWSRF, an authorized municipal representative may complete and sign this assessment.
[2] Available at http://www.efc.ny.gov/Default.aspx?TabID=76&fid=436

2. New or Expanded Infrastructure

   a. Does the project add a new wastewater collection or treatment system? (Note: New infrastructure project adds wastewater collection or treatment where none existed previously.)

      Yes ☐ No ☒

   b. Will the project result in an increase of the State Pollution Discharge Elimination System (SPDES) permitted flow capacity for an existing treatment system? (Note: An expanded infrastructure project results in an increase of the SPDES permitted flow capacity for the treatment system.)

      Yes ☐ No ☒

If the answer is "No" to both "a" and "b," the project is not subject to further smart growth review. Skip to signature block.

3. Court or Administrative Consent Orders

   a. Is the project expressly required by a court or administrative consent order?

      Yes ☐ No ☐

   b. Have you previously submitted the order to NYS EFC?

      Yes ☐ No ☐ If not, please attach the order to this submittal.

SECTION 2 – ADDITIONAL INFORMATION NEEDED FOR RELEVANT SMART GROWTH CRITERIA FOR CWSRF PROJECTS

EFC has determined that the following smart growth criteria are relevant for CWSRF projects and that projects must meet each of these criteria to the extent practicable:

1. Uses or Improves Existing Infrastructure.

   a. Does the project use or improve existing infrastructure? Please indicate and describe below.

      Yes ☐ No ☐

2. Serves a Municipal Center. Projects must serve an area in either a, b or c to the extent practicable.

   a. Does the project serve an area **limited** to one or more of the following municipal centers? Please select and describe all that apply:

      i) A City or Incorporated Village.

         Yes ☐ No ☐

ii) A central business district.

Yes ☐ No ☐

iii) A main street.

Yes ☐ No ☐

iv) A downtown area.

Yes ☐ No ☐

v) A Brownfield Opportunity Area. For more information, go to http://www.dos.ny.gov and search for "brownfield".

Yes ☐ No ☐

vi) A downtown area of a Local Waterfront Revitalization Program Area. For more information, go to **Error! Hyperlink reference not valid.** and search for "waterfront revitalization".

Yes ☐ No ☐

vii) An area of transit-oriented development.

Yes ☐ No ☐

viii) An Environmental Justice Area. See http://www.dec.ny.gov/public/899.html for more information.

Yes ☐ No ☐

ix) A Hardship/Poverty Area. Note: Projects that primarily serve census tracts and block numbering areas with a poverty rate of at least twenty percent according to the 2000 Census.

Yes ☐ No ☐

b. If the project serves an area located outside of a municipal center, does it serve an area located adjacent to a municipal center which has clearly defined borders, designated for concentrated development in a municipal or regional comprehensive plan and exhibit strong land use, transportation, infrastructure and economic connections to an existing municipal center? If yes, please describe and reference applicable plans.

Yes ☐ No ☐

c. If the project is not located in a municipal center as defined above, is the area designated by a comprehensive plan and identified in zoning ordinance as a future municipal center? If yes, please describe and reference applicable plans.

Yes ☐ No ☐

3. Community- Based Planning

a. Provide a description of the plan to solicit community input regarding the project.

b. Does the project affect an Environmental Justice Area? See http://www.dec.ny.gov/public/899.html for more information.

Yes ☐ No ☐

If yes, how does the applicant propose to engage the community in planning for the project?

4. Sustainable Development.

a. Were green infrastructure techniques considered in the project design? (Note: Green infrastructure includes green wet weather practices which mimic natural hydrology and use, infiltrate, evaporate or evapotranspire rain near or where it falls. These practices include permeable pavement; bioretention/ bioinfiltration systems including rain gardens; green roofs and walls; stormwater street trees/urban forestry; riparian buffers, floodplains and/or wetlands; stream daylighting; downspout disconnection and rainwater harvesting and reuse.

Yes ☐ No ☐

b. Were green infrastructure techniques adopted where appropriate? Please provide a description of measures that were adopted and references to supporting material (for example, page 6 of "title of report") or explain why these measures were not adopted.

Yes ☐ No ☐

c. Were decentralized infrastructure techniques considered in the project design?

Yes ☐ No ☐

d. Were decentralized infrastructure techniques adopted where appropriate? Please provide a description of measures that were adopted and references to supporting material (for example, page 6 of “title of report”) or explain why these measures were not adopted.

Yes ☐ No ☐

e. Were energy efficiency measures considered in the project design?

Yes ☐ No ☐

f. Were energy efficiency measures adopted where appropriate? Please provide a description of measures that were adopted and references to supporting material (for example, page 6 of “title of report”) or explain why these measures were not adopted.

Yes ☐ No ☐

SECTION 3 – ADDITIONAL INFORMATION

1. Does the project include measures that exceed required natural resource protection? Please explain below.

   Yes ☐ No ☐

2. Does the project support smart growth planning and design principles? Please explain below.

   Yes ☐ No ☐

3. Other State Infrastructure Agencies must also complete a smart growth review prior to approving a project. Please check all agencies from which the applicant is seeking support and/or funding and the type of support or funding, as applicable.

☐ The Department of Environmental Conservation

☐ The Department of Transportation

☐ The Department of Education

☐ The Department of Health

☐ The Department of State

☐ The New York State Housing Finance Agency

☐ The Housing Trust Fund Corporation

☐ The Dormitory Authority

☐ The Thruway Authority

☐ The Port Authority of New York and New Jersey

☐ The Empire State Development Corporation

☐ The Urban Development Corporation

☐ All other New York State Authorities

By entering your name in the box below, you agree that you are authorized to act on behalf of the applicant and that the information contained in this Smart Growth Assessment is true, correct and complete to the best of your knowledge and belief.

[signature]	4/17/2015
(Signature of Project Engineer or Design Professional or Authorized Municipal Representative if construction is complete prior to CWSRF Application)	(Date)
James W. Matzat, PE - Engineer	(585) 295-6242
(Name and Title)	(Phone Number)
James 'Jake' Swingly, Village of Webster	
(Applicant)	