Wastewater Facilities Plan

Executive Summary

for the Town of Enfield, Connecticut

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EXECUTIVE SUMMARY

The Town of Enfield is a well-established community located in Hartford County, eighteen miles north of Hartford, Connecticut and eight miles south of Springfield, Massachusetts. The Town encompasses 34.2 square miles, and had a population of 44,654 during the 2010 Census.

The Town of Enfield owns and operates a sanitary collection system and water pollution control facility (WPCF) that serve the needs of the Town's sewered population. This Facilities Plan includes an evaluation of the wastewater needs of the Town to achieve water quality objectives over the next 20 years. Facilities planning must be performed to satisfy the Connecticut Department of Energy and Environmental Protection Agency (DEEP) whenever major changes are planned to a collection or treatment system.

KEY GOALS OF THE FACILITIES PLAN

This facilities plan was written to determine the wastewater collection and treatment needs of the Town of Enfield for a planning period of twenty years. Strategies to meet those needs are included, as well as a financial plan to pay for the required improvements. The key issues facing the Town of Enfield include: 1) collection system deficiencies; 2) aging and deteriorating infrastructure at the water pollution control facility; and 3) old and inefficient equipment at the pumping stations.

The primary objectives of the Facilities Plan include:

- Identify future needs of the treatment plant by estimating future flows and loads over the next 20 years;
- Identify and prioritize collection system areas with excessive amounts of infiltration and inflow (I/I) and determine if it is cost effective to make repairs or continue to transport and treat these flows;
- Evaluate and identify pump station and WPCF infrastructure deficiencies and limitations and develop a comprehensive sewerage plan to systematically and cost-effectively address these needs;
- Establish a funding strategy which examines the use of grants, low interest loans, and other contributions to finance capital improvements;
- Implement a public outreach program that assures future improvements are supported by the community; and
- Provide an implementation schedule for the recommended improvements.

COLLECTION SYSTEM EVALUATION

The sanitary collection system includes approximately 210 miles of gravity sewer pipe, 16 pump stations and associated force mains. Portions of the system were constructed in the 1930's and were designed to convey both wastewater and stormwater. Several studies and projects were performed from the 1970's through the early 2000's to identify and remove sources of infiltration and inflow (I/I). While these efforts were successful in removing a large portion of I/I entering the system, flows and loads analysis indicate that on an average day, approximately 0.75 million gallons per day (mgd) of inflow is entering the collection system due to rainfall events and 0.55 mgd of infiltration enters when the groundwater is high.

In an attempt to locate and quantify sources of clean water entering the system, an I/I study and a Sanitary Sewer Evaluation Survey (SSES) were completed as part of this plan. The I/I study goals include: (a) performing rainfall, groundwater and flow monitoring to examine I/I during various groundwater conditions and precipitation events; (b) initiating infiltration investigations using flow monitoring results and (c) identifying and prioritizing basins with I/I problems. The SSES study goals include: (a) locating specific I/I sources, (b) ranking and prioritizing observed I/I sources and (c) performing a cost effectiveness analysis of removing I/I sources.

Twelve (12) temporary flowmeters were installed throughout the collection system to measure flowrates over a period of 8 weeks, from March 17 to May 20, 2015. Infiltration and inflow unit rates were identified for each flow-metering basin to identify infiltration and inflow problem areas, respectively. The Connecticut Department of Energy and Environmental Protection Agency (DEEP) does not publish guidelines for excessive amounts of I/I, but the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection Agency (MassDEP) do and therefore these standards were utilized for comparison purposes. As shown in Table ES-1, no flow metering basins (FM) exhibited Base Infiltration (BI) rates above the EPA or MassDEP thresholds, indicating that infiltration is not a significant contributor to extraneous flow in the Enfield collection system.

Table ES-1: Unit BI for the Enfield Collection System

EPA Threshold	MassDEP Threshold	Maximum Infiltration (FM1)	Minimum Infiltration (FM3)
3,000 gpd/idm	4,000 gpd/idm	1,829 gpd/idm	398 gpd/dim

In terms of wet weather inflow, three flow metering basins showed excessive unit Rainfall Dependent I/I (RDII) rates as compared to the remaining collection system. The three areas (FM7, FM8, and FM9) together accounted for close to 75% of all RDII in gallons per foot of pipe for the 4/8/2015 storm. These basins are all located in the Thompsonville area of Town, which contains the oldest pipes.

The following conclusions are made from the I/I study:

- The lack of significant BI rates during high groundwater conditions suggests that infiltration is not a significant component of I/I in Enfield; and
- The majority of inflow originates in the Thompsonville part of the collection system.

As part of the SSES, closed circuit television (CCTV) inspection of sewer pipes, manhole inspections, and smoke testing were performed to locate specific I/I sources. The SSES activities were targeted in high priority areas identified during the I/I study. A summary of the major findings for each program are listed below:

- CCTV Sewer Pipe Inspections – Sewer pipes were inspected in the Thompsonville area and Grape Brook pump station service area. Defects found indicating I/I include root infested pipe joints, mineral deposits, and active infiltration. Pipe fractures and deformations on Whitworth Street are prioritized for structural repair. Other lower priority structural defects on High Street and North Main Street are also recommended for repair. Overall, little evidence of direct infiltration was found.
- Manhole Inspections – Manholes were located and inspected throughout the Thompsonville area of the collection system, primarily due to a lack of existing mapping in that area. Evidence of I/I includes isolated active infiltration, mineral deposits, and root intrusions. High priority structural and maintenance issues were noted, including hydrogen sulfide deterioration, defective covers, debris and sediment buildup, and structural defects. Repair recommendations were made for five manholes, including rebuilding of bench and inverts, repair of cementitious lining, and resetting of a frame and cover.
- Smoke Testing – Smoke testing was performed throughout most of Thompsonville. The initial results indicate that several roof leaders from private homes and businesses are connected to the Town's sanitary collection system. A few catch basins and yard drains were also found to be connected. It is recommended that these sources be disconnected.

A detailed survey of the Connecticut River interceptor pipe and manholes was performed to confirm capacity and identify structural issues. Both the hydraulic model and the flow allocation spreadsheet indicate that is a capacity concern with a 24-inch diameter pipe on the interceptor, located between Meetinghouse Lane and Bridge Lane. The rest of the interceptor consists of primarily 30 to 36-inch diameter pipe. The installation of a relief sewer between Meetinghouse Land and Bridge Lane is recommended to prevent possible surcharging.

PUMP STATION EVALUATIONS

The Town owns and operates sixteen pumping stations including:

- 7 submersible stations;
- 3 pneumatic ejector stations;
- 5 conventional wet well/dry well stations; and
- 1 suction lift station.

The condition of the pumping stations varies from poor to satisfactory. Pneumatic ejection is an older technology that uses an air compressor to pressurize a metal vessel to convey wastewater. The metal vessels are located at the end of a deep underground shaft which puts the safety of workers at risk while they're being maintained. We recommend that the ejectors be replaced with submersible pumps, which will require new concrete wet wells to be installed. Upgrades required at other pump stations include replacing pumps with more energy efficient models, generators, automatic transfer switches, and other improvements. The South River pump station in particular requires complete replacement due to failing structural integrity of the building, and aging pumps and equipment.

Four pump stations, including Sharp Street, Windsor Court, Moody Road and Taylor Road, were investigated for feasibility of replacement with gravity sewer. In each case, replacement of the pump station with gravity sewer was found to not be feasible due to elevation or topography. Other alternatives for the Sharp Street pump station were investigated including replacing the existing station, which is nearly 40 feet deep, with two separate smaller stations or grinder pump systems for residents and one new pump station. We recommend replacing the station with two smaller stations.

WPCF EVALUATION

The WPCF was originally constructed in the late 1930's and updated in the early 1970's. It utilizes mostly aging and outdated equipment that has required an increasing amount of maintenance. The WPCF was originally designed to treat 10 million gallons per day (MGD), and currently treats an average daily flow (ADF) of approximately 5.3 MGD. The future ADF is estimated to increase to 5.5 MGD. In general, the effluent leaving the WPCF meets the current permitted requirements, and more stringent effluent permit requirements are not anticipated in the future.

The existing treatment processes at the WPCF comprise of preliminary treatment (screening / comminution and grit removal), primary sedimentation (two circular clarifiers), secondary treatment (four aeration basins and four secondary clarifiers), and disinfection using sodium hypochlorite. Waste activated sludge is co-settled in the primary clarifiers before it is dewatered using two belt filter presses.

An assessment of the physical condition and remaining useful life of the existing WPCF equipment was performed as part of this report. The results of the assessment were used to estimate the cost to modify or rehabilitate existing facilities. The general findings of the condition assessment are that much of the WPCF unit processes and equipment have surpassed their design lives and should be considered for replacement or major rehabilitation. Repairing or replacing the aging facilities will require a significant investment in the next 20 years. The major findings and replacement needs are summarized in Table 5-13.

PROJECTED FUTURE NEEDS

Future capacity needs of the WPCF were developed by projecting the influent flow and loads to the WPCF over the next twenty years. These projections were based on water usage records, population trends, and historical WPCF monthly operating report data. Anticipated growth was checked for consistency with both the State and Town Plans of Conservation and Development. We also met with Town Planners and officials from nearby communities to account for expected growth and future sewer users in the Town of Enfield. The existing and future flows are presented in Table ES-2.

Table ES-2: Future Flows

	Peaking Factor	Existing	Future	Unit
Flow				
Average Annual		5.25	5.50	mgd
Peak Hour	3.1	16.2	17.0	mgd
Maximum Month	1.4	7.2	7.6	mgd
Minimum Month	0.7	3.9	4.0	mgd
Maximum Week	1.9	9.9	10.3	mgd
Maximum Day	2.7	14.1	14.8	mgd

As shown, the future flows are not expected to be much higher than the existing flows.

TREATMENT ALTERNATIVES EXPLORED

To achieve compliance with the requirements of the NPDES permit, enhance nitrogen removal capabilities, and improve wet weather flow management, a range of potential treatment alternatives are available. The following were considered the most viable alternatives worthy of consideration:

1. Biomag Process
2. Four-Stage Biological Nutrient Removal (BNR) Process
3. Variable Operating Mode (VOM) / BNR Process
4. Integrated Fixed-film Activated Sludge (IFAS)

The viable alternatives were evaluated with respect to capital, O&M, site layout, and process control flexibility to treat the estimated 20-year projection of flows and loads. Each alternative is capable of meeting the anticipated effluent permit requirements.

The “do nothing” alternative was investigated. In this alternative, the estimated costs associated with leaving the WPCF in its existing configuration are evaluated, without making any upgrades. The do nothing alternative is not feasible at the Enfield WPCF because the equipment has surpassed the useful design life and will not last another 20 years. Without the replacement of existing equipment and a reconfiguration of the existing process, the plant will not be able to consistently treat the estimated future flows and loads and meet the permit requirements.

A cost comparison of each alternative is presented in Table ES-3. Operating costs include operational, electricity, sludge processing, chemicals, and maintenance. All of the alternatives have a significant capital cost, but each will result in improved performance and reliability. As shown in Table ES-3, the Four Stage BNR and VOM / BNR Processes have similar low capital and O&M costs compared to the other two alternatives. We recommend the

Table ES-3: Treatment Alternatives Cost Comparison

Alternative	Total Capital Cost	O&M Annual Cost	Total PWC
1 – Biomag	$10,284,000	$391,000	$16,677,000
2 – Four Stage BNR	$5,146,000	$162,000	$7,795,000
3 – VOM / BNR	$5,219,000	$146,000	$7,606,000
4 - IFAS	$9,722,000	$221,000	$13,336,000
Notes: Costs presented in 2015 dollars. PWC: Present Worth Cost			

VOM / BNR alternative be selected based on lower equivalent present worth cost and improved operational flexibility over the Four Stage BNR process.

RECOMMENDED PLAN

COLLECTION SYSTEM RECOMMENDATIONS

Overall, little evidence of I/I was found during the SSES. This is not surprising since the flow to the WPCF never exceeded four times the average daily flow during the past four years, which is a relatively low ratio. The only deficiencies that were found included structural defects that must be repaired and illicit connections from private properties. Recommended repairs for manholes and pipes are intended to address structural issues noted during inspection. Our opinion of probable cost for the recommended collection system repairs is $354,000, including contingency and overhead. We recommend that the Town develop a program to televise and clean their collection system on a regular basis.

PUMP STATION RECOMMENDATIONS

The following major recommendations were made as a result of the pump station evaluation. These recommendations are critical to reduce preventative O&M, increase reliability, and improve emergency readiness:

- Replace pneumatic ejector stations with submersible pump stations to improve reliability and increase worker safety;
- Replace the Sharp Street pneumatic ejector station with two separate pump stations to reduce the required wetwell depth from 40 feet to 20 feet or less;
- Replace the South River Street pump station with a new wet well and dry well configuration on a new site;
- Replace two of the existing pumps and related electrical, and replace the roof at the Grape Brook pump station; and
- Replace the existing pumps and related electrical, and replace the roof at the South River pump station

Our opinion of probable project cost to upgrade the pump stations is $8,710,000.

WPCF RECOMMENDATIONS

To meet the Town's NPDES Permit requirements, improve nitrogen removal capabilities, and accommodate for future flows and loads that are projected over the next twenty years, the following improvements are recommended:

- Headworks: Replace the existing mechanical bar screen with a new unit, and upgrade the existing comminutor to a new mechanical screen. Replace the existing screenings washer and compactor with a new unit that is capable of handling screenings from both new screens. Enclose this new equipment inside a new Headworks structure to be located on top of the existing headworks structure. Treat odorous air from inside this building using new odor control equipment to be located inside the Operations Building.
- Grit Chamber: Replace diffusers and install a new clamshell or other type of grit removal equipment to remove grit from the existing chambers. Provide new aeration blowers that will be dedicated to the grit chambers to improve performance. Treat the odorous air from the headspace in the grit chamber to reduce odors at the plant.
- Primary Clarifiers: Replace the primary clarifier equipment, motors, gear reducers, walkways, handrails, weirs, and baffles. This equipment has been in service for over 40 years and has surpassed its useful design life. The slide gates in the distribution box upstream of the primary clarifiers leak excessively and also need to be replaced. Some of the valves and piping inside the primary sludge pump gallery might also need to be replaced.
- Liquid Treatment: Replace the 43-year-old centrifugal aeration blowers with newer, energy efficient blowers. Upgrade all of the ceramic style diffusers with membrane diffusers that will be more efficient and easier to maintain. Replace the mixing system in the anoxic zones of the biological reactors with a compressed gas mixing system. The recommended VOM / BNR process will allow for operational flexibility depending on seasonal temperature variations and is designed to protect from washout during extreme wet weather flow events. As part of this upgrade, new sludge recirculation and wasting pumps will also be installed.
- Solids Processing: Replace the two belt filter presses with two rotary screw presses. The dewatered sludge will be conveyed to the roll-off container using new shaftless screw conveyors. The new presses and conveyors will reduce odors, water use, and the labor required to process sludge. We also recommend constructing two new gravity thickeners. This equipment will improve the liquid treatment process and increase sludge processing performance. The estimated cost to construct these is approximately $4.3 million, so we suggest that they be included as a design alternate.
- Effluent Plant Water System: Replace the existing effluent plant water system with a new packaged plant water pumping system in the lower level of the proposed blower/ sludge building. The system will be designed to maintain a constant system discharge pressure at variable flow demands and will supply water throughout the WPCF.
- Support Facilities: Provide additional improvements at the Operations Building. These improvements include providing bathrooms that meet the Americans with Disabilities Act (ADA) requirements, demolishing the incinerator to make room for the new sludge processing and aeration equipment, providing a larger space for the laboratory, structural improvements including removing and replacing a portion of the exterior walls to allow the old sludge processing equipment to be removed, replacing the roof, updating of the heating and ventilation equipment, and other architectural improvements including new windows and doors.
- Chemical Systems: The chemical feed systems proposed include: (1) a low-cost sodium hydroxide storage and feed equipment to provide pH adjustment if needed; (2) polymer addition requirements for the proposed sludge processing equipment; and (3) storage and feed pumps for a carbon source which may be needed to enhance nitrogen removal.

A proposed site plan and process flow diagram indicating the recommended improvements to the WPCF are presented in Figures 7-1 and 7-2, respectively. Our opinion of probable costs for the recommended WPCF upgrade, pump station improvements, and collection system repairs is $36 million. This opinion of probable cost does not include the $4.3 million for the gravity thickeners. A breakdown of the opinion of probable cost is presented in Table ES-4.

Table ES-4: Opinion of Probable Project Cost Summary

Item #	Item	Cost
1	Facilities Plan & I/I Study	$1,111,559
2	WPCF Upgrades	$25,801,000
3	Collection System Repairs	$354,000
4	Pump Station Upgrades	$8,710,000
Total Project Cost		**$35,977,000**

FUNDING / FINANCING

Because the Town decided to switch from an *ad valorem* to a user-based system, this project is eligible for funding through the State's Clean Water Fund (CWF) program. The CWF program provides grants and low-interest loans for wastewater abatement projects. Furthermore, the Town recently implemented a sewer fee program that was designed to pay for the improvements recommended as part of this plan. This fee is expected to generate $5,681,000 per year over the next 5 years and will fund annual debt service associated with a CWF loan. After a period of 5 years, it is recommended that the Town reassess its sewer fees for possible changes in funding requirements. The flat 5-year sewer fee was designed to meet projected FY2016 revenue requirements.

In addition to the standard loans and grants of the CWF as detailed above, the Town of Enfield will qualify for grant money from Eversource for upgrading to premium efficient motors, replacing outdated lighting and HVAC equipment, and for other energy efficiency improvements at the WPCF and the pumping stations.

The proposed WPCF upgrade will result in a cost effective and reduction in the discharge of pollutants from the WPCF. In addition, the long term reliability of the plant will be enhanced through the replacement and upgrade of various aging systems at the plant in order to improve wet weather operations and handle future flows and loads.

IMPLEMENTATION PLAN

An implementation schedule for the project is presented in Figure 7-6. This schedule is based upon this report being approved by DEEP in September of 2016. In preparing the schedule of implementation, the following prioritization has been assigned to the recommendations:

- Proceed with the design of the WPCF, pump station, and collection system improvements;
- Construction of high priority collection system and pump station improvements;
- Construction of the WPCF improvements; and
- Construction of the remaining collection system and pump station improvements.