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MEMORANDUM

TO: Ann A. Straut-Esden, CT-DEEP
FROM: Paul A. Dombrowski, PE BCEE, David R. Prickett, PE
DATE: August 31, 2012
RE: Executive Summary, Initial I/I Summary (Tasks 4 and 12)
Wastewater Facilities Plan, Woodridge Lake Sewer District – Goshen, CT

INTRODUCTION

Following is the Executive Summary for our Infiltration and Inflow (I/I) Investigations for the Wastewater Facilities Plan for the Woodridge Lake Sewer District (WLSD) in Goshen, Connecticut. This memorandum includes tasks completed to date, including flow monitoring, I/I field work, and our opinion of probable cost for initial I/I mitigation recommendations. The I/I recommendations will be updated following completion of the remaining I/I tasks, and will be integrated with the recommendations for the other Facilities Plan tasks as part of a single consolidated Report at the completion of the Project.

WASTEWATER FACILITIES PLANNING

The WLSD is actively engaged in the Wastewater Facilities Planning process with Woodard & Curran. The goals of the project include: (1) improving collection, treatment and disposal systems; (2) removing infiltration and inflow from the collection system to preserve wastewater treatment and disposal capacity; (3) evaluating infrastructure needs to provide sewer service to additional users in the existing WLSD service area; and (4) improving treatment and disposal performance to meet current and anticipated future permit requirements. At the completion of the Wastewater Facilities Plan, the WLSD will be equipped with an integrated recommended plan that provides strong environmental protection of the surrounding environment, as well as a cohesive, cost-effective and sustainable recommended plan to maintain and upgrade its wastewater systems for the next 20 years.

EXISTING COLLECTION SYSTEM

The WLSD, established in the 1970s, owns and maintains its collection system, water pollution control facility and groundwater disposal system. The WLSD collection system, shown in Figure EX-1, was privately installed more than 30 years ago and, until recently, has received limited preventative maintenance. The majority of the sewer pipes are plastic. The WLSD collection system consists of 16.2 miles (85,500 feet) of gravity sewer, 1.9 miles of force main piping, and 8 wastewater pump stations. Approximately 677 of the 835 current District parcels are developed and sewered, of which 115 low-lying homes around the Lake are served by individual grinder pumps that discharge to mainline gravity sewers. The system is spread out over a large area and encircles the lake. For the number of users, the system has an unusually large amount of pipe, which allows for greater I/I potential.

For the purpose of identifying and isolating I/I, the service area was divided into subareas, based on the locations of the pump stations. Table EX-1 summarizes the total length of pipe and inch-diameter-miles of pipe in each subarea. The unit of inch-diameter-mile of pipe is used to provide a level comparison of I/I flows in pipes of varying diameters. For example, a larger pipe size has more surface area to leak, so a larger pipe of lesser length (miles) may have the same potential as a smaller pipe with more length.

SUBAREA 1

SUBAREA 2

SUBAREA 3

SUBAREA 5

SUBAREA 6

SUBAREA 7

SUBAREA 8

WOODRIDGE LAKE

DOG POND

NATURE PRESERVE

CLUBHOUSE

BEACH

MILTON ROAD

ROUTE 4

THOMPSON ROAD

ELI BUNKER ROAD

CORNWALL DRIVE

WELDON COURT

REDWOOD CT.

ALLENBY CT.

W. HYERDALE CT.

SUTTON CT.

ROCKWALL COURT

WELDON DRIVE

HYERDALE DRIVE

WEST HYERDALE DRIVE

EAST HYERDALE DRIVE

BUEFORD COURT

BENTLEY CIRCLE

CANTERBURY COURT

BELSHYRE CT

SHELBOURNE DRIVE

ASHLEY DRIVE

WELLSFORD DRIVE

SHERBROOK DRIVE

BEACH STREET

SHELBOURNE CT.

VALCOVE COURT

WELLSFORD ROAD

SQUIRE CT.

CROSSMAN ROAD

DRESDEN COURT WEST

DRESDEN COURT EAST

TO PLANT FLOW STATION

LEGEND

- DISTRICT BOUNDARY
- PUMP REQUIRED FOR LOT
- GRAVITY SEWER LINE
- FORCE MAIN
- SEWAGE PUMP STATION
- SANITARY MANHOLE
- CONNECTED LOTS AS OF JANUARY 2007

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REV.	DESCRIPTION	DATE

DESIGNED BY: KD
DRAWN BY: JAR
CHECKED BY: VR
2736400 C-101 102.dwg

WOODRIDGE LAKE SEWER DISTRICT COLLECTION SYSTEM

WOODRIDGE LAKE SEWER DISTRICT
GOSHEN, CT.

FLOW ISOLATION LOCATIONS
CCTV INSPECTION AREAS

JOB NO.: 223604.00
DATE: APRIL 2011
SCALE: AS NOTED
SHEET: OF

C-103

\\Cheshire\Projects\223604 WLSD - Response to CTDEP\wip\DRAWINGS\Civil (new MH #)\223604 00 C-101_102.dwg, Jun 09, 2011 8:30am

Table EX-1: Sewer & Force Main Piping Lengths

Subarea[1]	Gravity Sewer Main			Force Main (miles)
	Diameter (inches)	Length (miles)	Unit Length (in-diam-mi)	
1	8	0.78	6.2	0.34
2	8	0.93	7.4	0.11
3	8	1.69	13.6	0.14
5	15	7.17	108	0.27
6	12/15	3.27	44	0.45
7	8	1.53	12	0.22
8	8	0.81	6.5	0.35
Total		**16.2**	**198**	**1.89**

1. Pump Stations are located at each subarea, with an additional Plant Pump Station located upstream of the treatment plant (a total of 8 pump stations).

WASTEWATER FLOW COMPOSITION

Wastewater is comprised of sanitary and I/I flow components. The average daily wastewater flow to the WLSD Water Pollution Control Facility (WPCF) was approximately 105,000 gallons per day (gpd) from January 2010 through December 2011. During this same period, total daily flows ranged from a minimum of 43,000 gpd to a maximum of 402,000 gpd. Accurate water consumption data is not available since WLSD properties are served by individual wells. Based on observations of flow values during low groundwater periods (Summer 2010), Woodard & Curran estimates that the average annual sanitary flow is 50,000 gpd, or 74 gpd for each of the 677 current sewer users. This estimate is based on the projection that the existing properties served in the District are near full occupancy for 4 months per year (June-August, plus December) and are at 75% occupancy for the remaining 8 months each year. The remaining 55,000 gpd is the average annual I/I and is more than 50% of the annual wastewater flow.

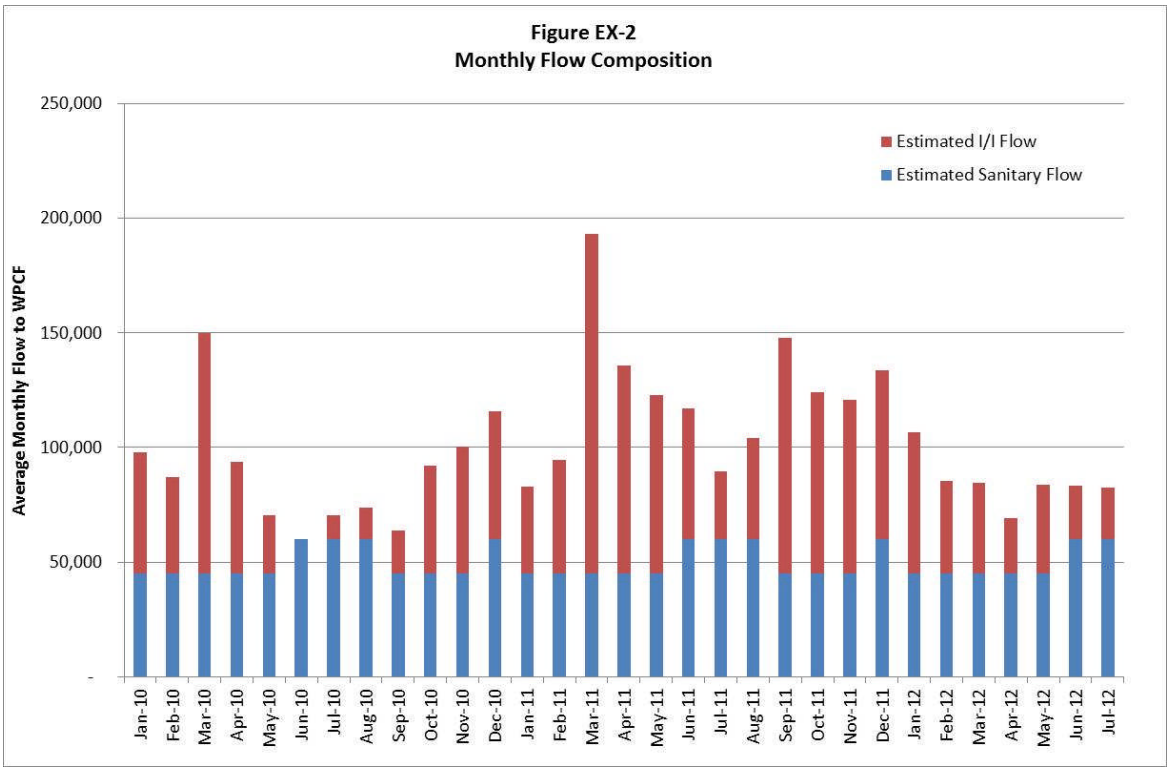
Figure EX-2 illustrates the variability of monthly sanitary and I/I flow components in the WLSD for 2010 and 2011. The red bars in the graph indicate I/I and show that the average I/I from month to month can range from near zero in the summer of 2010 to 148,000 gpd in March of 2011. We estimated base sanitary flows of 60,000 gpd over the summer and in December, and 45,000 gpd the remainder of the year (annual average of 50,000 gpd).

I/I REMOVAL GOALS

I/I consists of infiltration, inflow and rainfall-induced infiltration. In general, the goals for a typical I/I removal program generally include: (1) removal of direct inflow sources, including roof leaders and catch basins; (2) removal of infiltration sources with unit flows greater than 4,000 gallons per day per inch-diameter-mile (gpd/idm); and (3) elimination of other I/I sources that can be cost effectively removed, rather than continue to transport and treat these flows.

Based on the composition of wastewater in the WLSD, the ratio of average annual I/I to average annual sanitary flow is 1.1:1 (based on 2010 to 2011 flow data). This is moderate based solely on flows. However, WLSD has an expansive collection system as compared to the number of sewer users. Therefore, although the quantity of I/I is moderate, the density of I/I within the collection system is low.

The WLSD also includes potential future connections within the existing sewer service area. Since the WPCF utilizes groundwater disposal, it is important that I/I be removed to both improve treatment capabilities and meet groundwater discharge permit requirements.



Based on the above, the WLSD I/I removal program goals are more aggressive than most communities: (1) remove I/I to minimize the size of treatment plant and/or groundwater disposal system requirements; (2) implement an annual preventative maintenance and I/I removal program to minimize future I/I flow contributions; and (3) annually monitor and adjust I/I removal effectiveness and goals based on seasonal flow, groundwater and precipitation factors, and the rate at which new sewer users are connected to the system.

In order to combat excessive I/I, the Wastewater Facilities Plan includes two tasks related to I/I: Task 4 – Collection System Capacity Management (Infiltration and Inflow Evaluation); and Task 12 – Additional Inflow and Infiltration Investigations. The work associated with Tasks 4 and 12 includes: (1) preliminary flow monitoring; (2) infiltration field work; (3) inflow field work; (4) data evaluation; (5) capacity, management, operations and maintenance planning; and (6) integrated wastewater management recommendations.

SUMMARY OF I/I INVESTIGATIONS

In order to: (1) determine the composition of I/I; and (2) locate specific I/I sources within the collection system, Woodard & Curran and WLSD staff conducted the following I/I field work tasks, which are also summarized on Table EX-1:

- Preliminary Flow Analysis: The collection system was subdivided into eight subareas, and total daily flow data was collected from each pump station from May 2010 through March 2011. Pump station flows were calculated by utilizing pump run time data, together with estimated pumping rates. For March 2011, the estimated system-wide peak monthly I/I and peak daily I/I were 148,400 gpd and 357,000 gpd, respectively.

- Physical Site Inspection: A District-wide physical site inspection was conducted by Woodard & Curran staff during Spring 2011 to observe lot-by-lot surface features that may contribute to excessive I/I. The physical site inspection targeted low-lying areas, steep slopes, saturated areas, and other surface features that often result in the location of I/I sources. The qualitative results of the physical site inspection were used to narrow the focus of the follow-up building inspection program.

- Manhole Inspections: Approximately 364 manhole inspections were completed by WLSD staff in 2011 and 2012 to locate potential infiltration and inflow sources, inventory system attributes, physical defects, and identify operation and maintenance needs. Most of the manhole inspections were performed in summer months when visible infiltration sources were minimal and the potential rate of infiltration was projected based primarily on qualitative criteria. The results of the manhole inspection program recommended: (1) repairs and cleaning for 55 manholes, or 15% of those manholes inspected; and (2) monolithic lining and exterior grouting of 46 manholes, equal to 13% of inspected manholes. Based on the inspection reports and a projection of flow based on qualitative criteria, the proposed manhole work is estimated to remove between 13,000 and 53,000 gpd of peak month I/I (for a peak flow event similar to March 2011). Given that the manhole inspections were performed during low groundwater conditions when active infiltration was less likely, we compared the estimates of manhole I/I from these inspections to the manhole I/I observed during the flow isolation work completed in 2011 when groundwater levels were higher. This comparison of data shows a high variability between the source information and illustrates the limitations of using qualitative observations to project flow. Because most of the manholes identified as exhibiting I/I are in areas that are planned for flow isolation and CCTV work in 2013 (Subareas 1,2,3 and 5), substantial manhole rehabilitation work should be performed after the 2013 flow isolation work confirms priority of manholes to be rehabilitated.

- Flow Isolation: Woodard & Curran, through its sub-consultant Pereira Engineering/ADS, conducted a flow isolation program in Spring 2011 and Spring 2012. Flow isolation is performed in dry-weather nighttime hours during high groundwater periods to locate infiltration sources (on a manhole-to-manhole basis). Approximately 22,000 feet and 55,000 feet of gravity sewers were flow isolated in 2011 and 2012, respectively. A total of 21,000 gpd of pipeline infiltration and nearly 28,000 gpd of overall infiltration (pipeline, manhole and service lateral) was observed during the flow isolation work in May 2011, when groundwater levels were at very high levels following record snowfall and a series of significant spring precipitation events. A more modest 7,500 gpd of infiltration was observed in 2012, where abnormally low groundwater levels and few spring-time precipitation events occurred. The results of the 2011 flow isolation program were used to prioritize follow-up CCTV work. For perspective, we estimate that the average infiltration in the area of the Spring 2011 flow isolation work, that included 22,000 feet of pipe (26% of gravity pipe in the system), was approximately 30,700 gpd, and that 2011 flow isolation located approximately 90% of the infiltration present at that time. For comparison, average system wide I/I flow during the 2011 flow isolation work was 79,800 gpd or 53% of the peak month I/I (March 2011 basis).

- CCTV Inspection: CCTV inspection was conducted (by NEPPCO for our MBE Subcontractor) on approximately 13,000 feet of gravity sewers to locate specific infiltration sources. The CCTV work reviewed 57 pipe segments, with cracks, breaks, obstructions and leaks present in 25 pipe segments (44% of those segments inspected). CCTV work was not conducted in 2012, due to the limited results of the Spring 2012 flow isolation work and low groundwater conditions. The intent of the CCTV work is not to quantify infiltration sources already observed during the flow isolation program. Instead, the CCTV work determines the location and type(s) of infiltration sources to dictate the capital improvement needs. The CCTV work resulted in a recommendation to perform approximately 1,800 feet of pipe lining work in addition to 3,900 feet of clean, inspect, test and seal (CITS) of pipe joints. If we assume a typical range of I/I removal (10-50% of identified sources), the pipeline remediation work has the potential to remove from 10,000 to 20,000 gpd of peak month I/I.

- Building Inspections: Woodard & Curran staff targeted 193 homes for interior and exterior building inspections during Summer 2011. The intent of the building inspections was to locate potential sump pump, roof drain and drain connections to the WLSD collection system. Interior inspections were conducted in 104 of the homes (54% rate of entry). Although drainage systems were located, no interior connections were observed. Several potential exterior sources were recommended for follow-up smoke and dye testing.

- Smoke and Dye Testing: Based on the results of the physical site inspection and building inspections, smoke testing (22,500 feet) and dye testing (15 locations) were also conducted by ADS, Woodard & Curran's sub-consultant, in October 2011. No drainage connections illicitly connected to the sewer system were observed in those areas tested.

INITIAL REHABILITATION EFFORTS

During the May 2011 CCTV work, a significant I/I source, estimated at 7,200 gpd at that time, was located on Paxton Court. The WLSD subsequently installed a short liner to repair the damaged pipe section at a cost of approximately $21,000. A noticeable decrease in system flow was apparent at the WPCF following completion of this work, indicating that the initial rehabilitation efforts were effective.

PRELIMINARY I/I REMOVAL RECOMMENDATIONS

Based on the preliminary flow monitoring and 2011/2012 field work, Woodard & Curran developed a set of preliminary recommendations to: (1) reduce I/I through rehabilitation of the collection system; and (2) additional I/I evaluation tasks. In addition to the findings and recommendations presented above, following are additional I/I recommendations:

- Investigations: Repeat flow isolation in subareas 1, 2, 3 and 5 in Spring 2013 (or next high groundwater period), together with concurrent infiltration-based manhole inspections, followed by prioritized CCTV work; Complete remaining I/I planning work (Tasks 4 and 12), including cost effectiveness analysis and CMOM tasks.

- System Improvements: (1) Build on the District's initial pipe lining efforts by continuing I/I removal improvements, including pipe lining (1,800 feet), clean, test and seal pipe joints (3,900 feet) and repair of capped service connections; (2) complete manhole repair (55) and lining (46) after completion of 2013 flow isolation work; and (3) continue with parallel recommendations to implement permanent flow monitoring capabilities at the eight pump stations to continually monitor the progress of on-going I/I removal efforts.

In conjunction with CT-DEEP's review of these recommendations, we plan to submit our proposed scope of services and request funding under the CWF I/I set-aside loan program. The WLSD WPCA plans to appropriate funds for this work, pending receipt of the CT-DEEP pre-approval letter, in October 2012. The intent is to complete design phase work later this Fall 2012, with bidding in early 2013, and construction following in Summer 2013.

Table EX-2: Cost and Range of I/I Removal for Recommended Improvements

Recommended Improvement [1]	Capital Cost of Improvements [2]	Expected Range of Peak Month I/I Removed (gpd)[3]
Pipe Lining, CITS Pipe Joints	$272,000	10,000 – 20,000
Manhole Repair & Lining	$257,000	13,000 – 53,000
Total:	**$529,000**	**23,000 – 73,000**

Notes: (1) Preliminary based on results of 2011 investigation work
(2) Includes design and construction engineering and 15% contingency
(3) Peak Month I/I based on March 2011 WPCF data

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