

Technical Memorandum

Phase 1 Part 2 CSO Control Plan Wellington Avenue CSO Facility

Sewer Catchment Area 6 Flow Metering Investigation

Prepared for:

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INTRODUCTION

This Sewer Catchment Area 6 wastewater flow metering Technical Memorandum (TM) has been prepared to describe the investigation procedure used, results of the investigation, and recommendations for rehabilitation of observed defects. Figure 1 presents the meter locations along the Thames Street Interceptor, the primary sewer conduit in the catchment area.

METERING OF WASTEWATER FLOWS

The flow metering program was designed to provide a general understanding of the hydraulics of Sewer Catchment Area 6, which is tributary to the Thames Street Interceptor, to evaluate the dry weather and wet weather flow characteristics of the catchment area, and to determine infiltration and inflow sensitivity of the catchment.

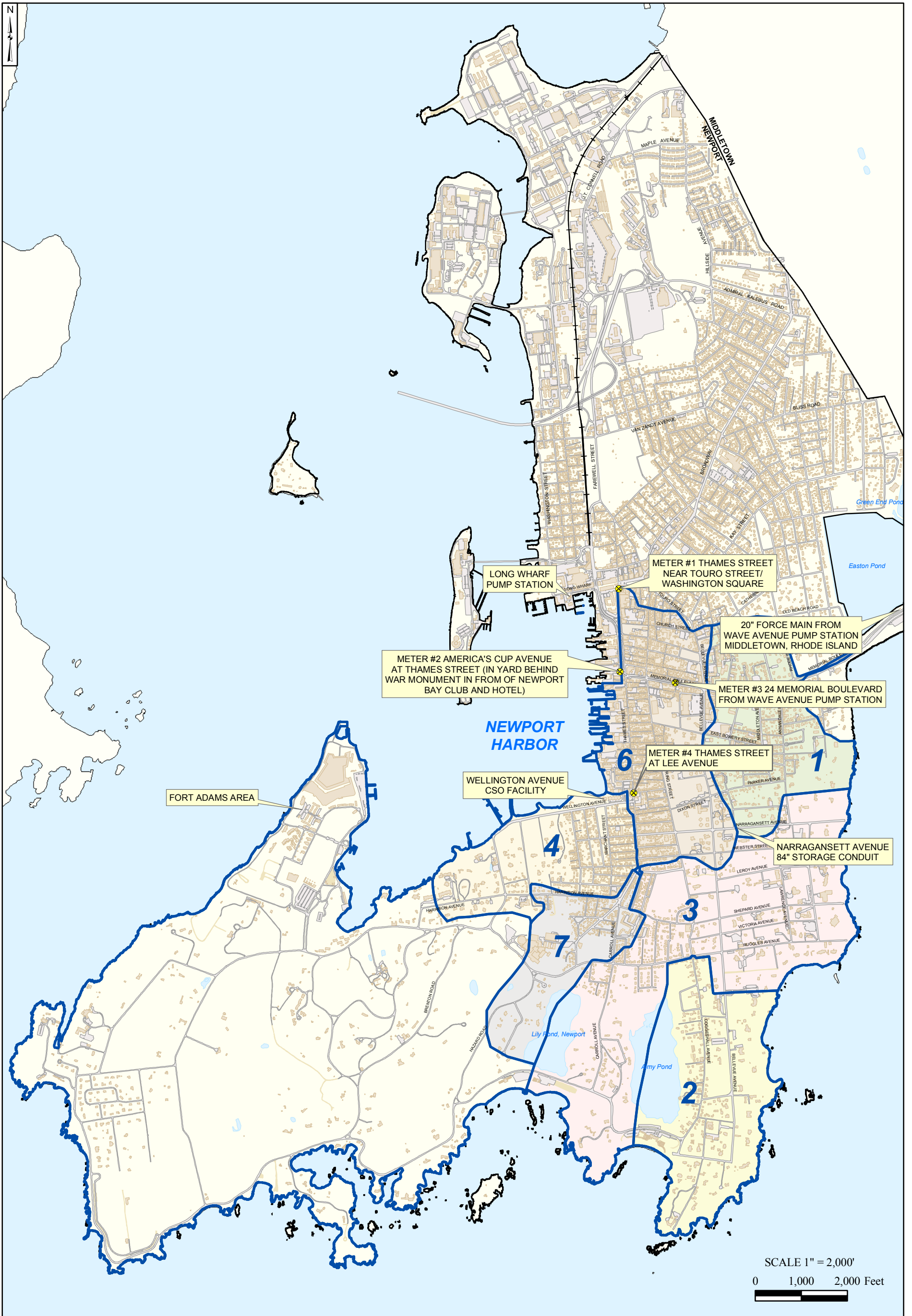
The program included measurement of flows from the southern tributary areas, the Wave Avenue Pump Station from Middletown, RI, the America's Cup Avenue relief sewer, and the terminus of the Thames Street interceptor at the twin 54" sewer conduit near Touro Street which directs wastewater flows to the Long Wharf Pump Station. The metering manholes were selected to provide a snapshot of the flows entering and exiting Catchment Area 6, enabling a more precise analysis of flows generated within the catchment area. Once the metering manholes were identified, ADS Environmental Services (formerly Severn Trent Pipeline Services, Inc. (STPS)) installed four flow meters. The locations of each flow meter are presented in Table 1.

TABLE 1
METER LOCATIONS, PIPE AND CATCHMENT AREA DATA

Site No.	Meter Location
1	Thames Street near Washington Square
2	America's Cup Ave. at Thames Street
3	24 Memorial Blvd.
4	Lee Avenue

Notes:

1. Flow Metering Location 2 was installed to measure flows discharging from the high level connection of the Thames Street Interceptor to the relief sewer on Americas Cup Avenue.



SEPTEMBER 2006

- LEGEND:
- ✕ Metering Locations
 - Sewer District Boundaries
 - Buildings
 - Docks
 - Paved Roads and Parking
 - Unpaved Roads and Parking

FIGURE 1
SEWER CATCHMENT AREA 6
FLOW METER LOCATIONS
AND SEWER CATCHMENTS
PHASE I PART 2 CSO CONTROL PLAN

The flow meter installation was completed on April 18, 2006 and the meters recorded data between April 18 and May 30, 2006, at which time they were removed. The meters measured depth and velocity and recorded the data at 15-minute intervals in the meter's computer memory. The recorded data were uploaded from the meters periodically using a laptop computer. During the metering period, the meters were checked weekly for routine maintenance to ensure that they were operating properly. The routine maintenance inspections indicated that the meters were operating as intended and that any minor problems encountered were corrected. Data from the flow monitoring for Catchment Area 6 is located in Appendix A.

3.2 RAINFALL MONITORING

Rainfall data was obtained from a tipping bucket collector rain gauge with an electronic data logger installed by ADS on the roof of the Long Wharf Pump Station. Rainfall was recorded in 15-minute intervals during the entire flow metering period. During the metering period, eight rainfall events exceeding 0.25 inches of precipitation were measured and are summarized in Table 2.

**TABLE 2
RAINFALL SUMMARY**

Storm Events Exceeding 0.25 inches During the Metering Period						
Start		End		Peak	Total Rainfall	Duration (hr)
Date	Time	Date	Time	Hourly Intensity (in/hour)		
4/23/2006	16:30	4/23/2006	23:30	0.38	1.09	7
5/2/2006	2:45	5/2/2006	9:45	0.15	0.56	7
5/2/2006	20:45	5/3/2006	19:45	0.13	0.66	23
5/9/2006	10:00	5/9/2006	19:45	0.18	0.59	9.75
5/12/2006	12:00	5/13/2006	5:45	0.18	1	17.75
5/13/2006	13:15	5/15/2006	13:15	0.96	4.08	48
5/16/2006	2:30	5/16/2006	10:30	0.22	0.35	8
5/19/2006	9:30	5/19/2006	13:00	0.30	0.49	3.5

3.3 TIDAL MONITORING

The tide level in Newport Harbor was measured using a tide gauge behind the Long Wharf pumping station. The recorded data was then uploaded from the data logger to a laptop computer. The data loggers were checked weekly to retrieve the recorded data.

Figures 2 through 5 present the sum of the flows recorded at the two inlet points (Meter 3 – Flows from the Wave Avenue Pump Station and Meter 4 - Lee Avenue) and at the two outlet points (Meter 1 – Terminus of the TMI and Meter 2 – America’s Cup Avenue relief sewer). For the purpose of this analysis, the sum of meters 1 and 2 shall be referred to as the downstream flow and the sum of meters 3 and 4 shall be referred to as upstream flow

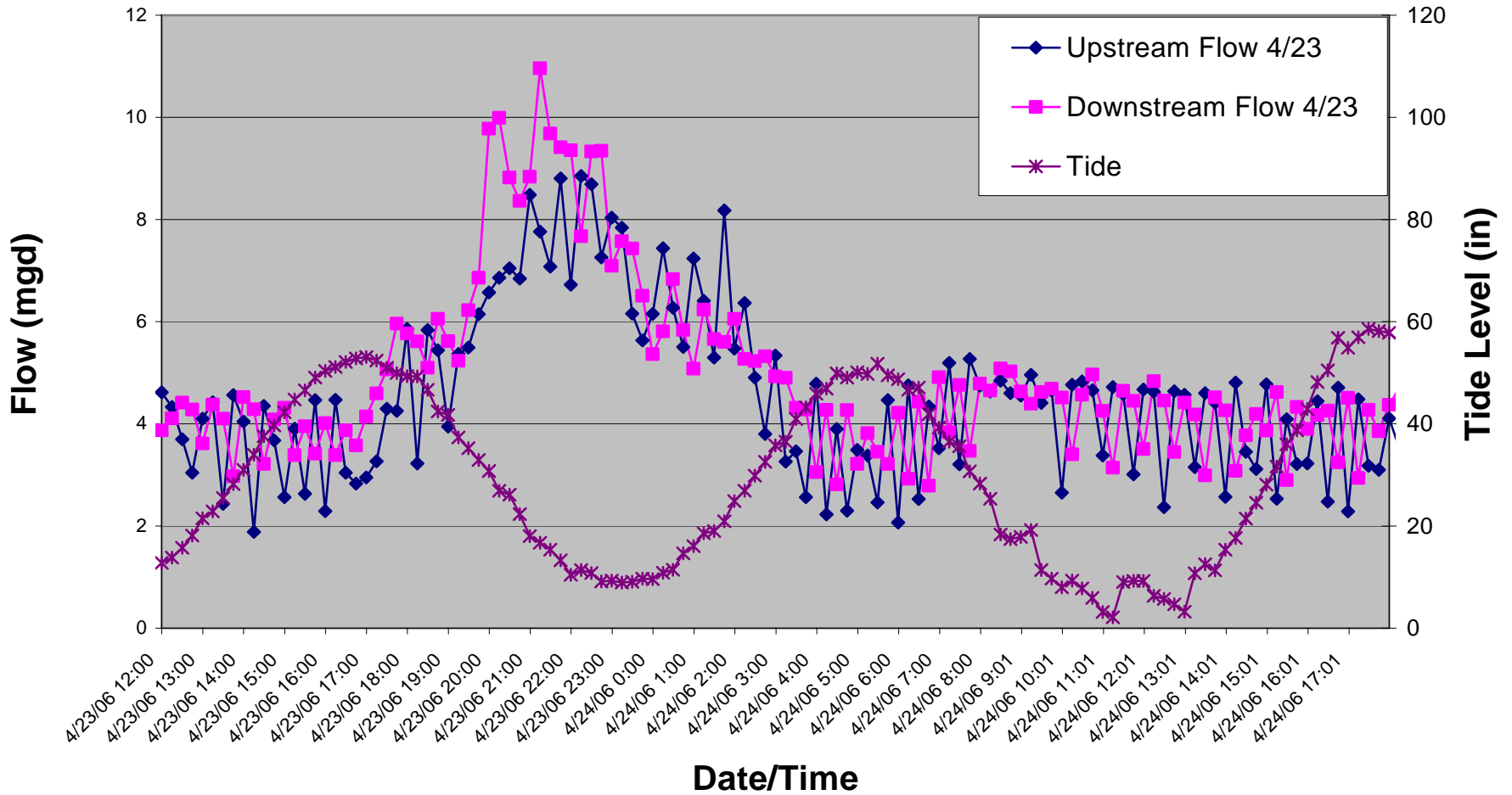
The tide does not appear to influence the sanitary sewage flow during the April 23, 2006 storm event used in the following analysis. The comparison of the wet weather flow and the tide is shown in Figure 2. The flow in the sanitary system does appear to reflect changes in the level of the tide during the dry weather period used in our analysis. The comparison of dry weather flows and the tide level is shown in Figure 3.

Earth Tech will continue to compare the tide and the metered flow data over the metering period to determine if the tide is affecting the volume of infiltration in the system.

ANALYSIS OF METERING PROGRAM

For the analysis of inflow, the April 23, 2006 storm was selected because it was a large, short duration wet weather event in the metering period which did not trigger a surcharge in any of the metered manholes; occurred during a period of generally dry weather; and was completely confined to the collection system (this event did not cause a CSO at any city facility). The storm occurred at about 4:30 PM on Sunday, April 23, with a duration of about 7 hours, a peak hourly intensity of 0.38 inches per hour, and total rainfall of 1.09 inches. Based on the storm’s characteristics, April 23 (Sunday) from 12:00 PM through April 24 (Monday) at 6 AM was considered an acceptable representative wet weather period. To provide a representative dry weather period to use with the analysis of inflow for the April 23 storm, the period from Sunday, April 30 through Monday, May 1, was selected as the representative dry weather period. This period covered both a weekend and weekday flow pattern; had a 7 day antecedent rain-free period; and was deemed acceptable. Base flows during the storm event were generally similar during the representative dry weather period. A comparison of wet weather and dry weather flows is shown in Figure 4.

**FIGURE 2 - Comparison of Wet Weather Wastewater Flows and the Newport Harbor Tide
April 23 to April 24, 2006**



**FIGURE 3 - Comparison of Dry Weather Wastewater Flows and the Newport Harbor Tide
April 30 to May 1, 2006**

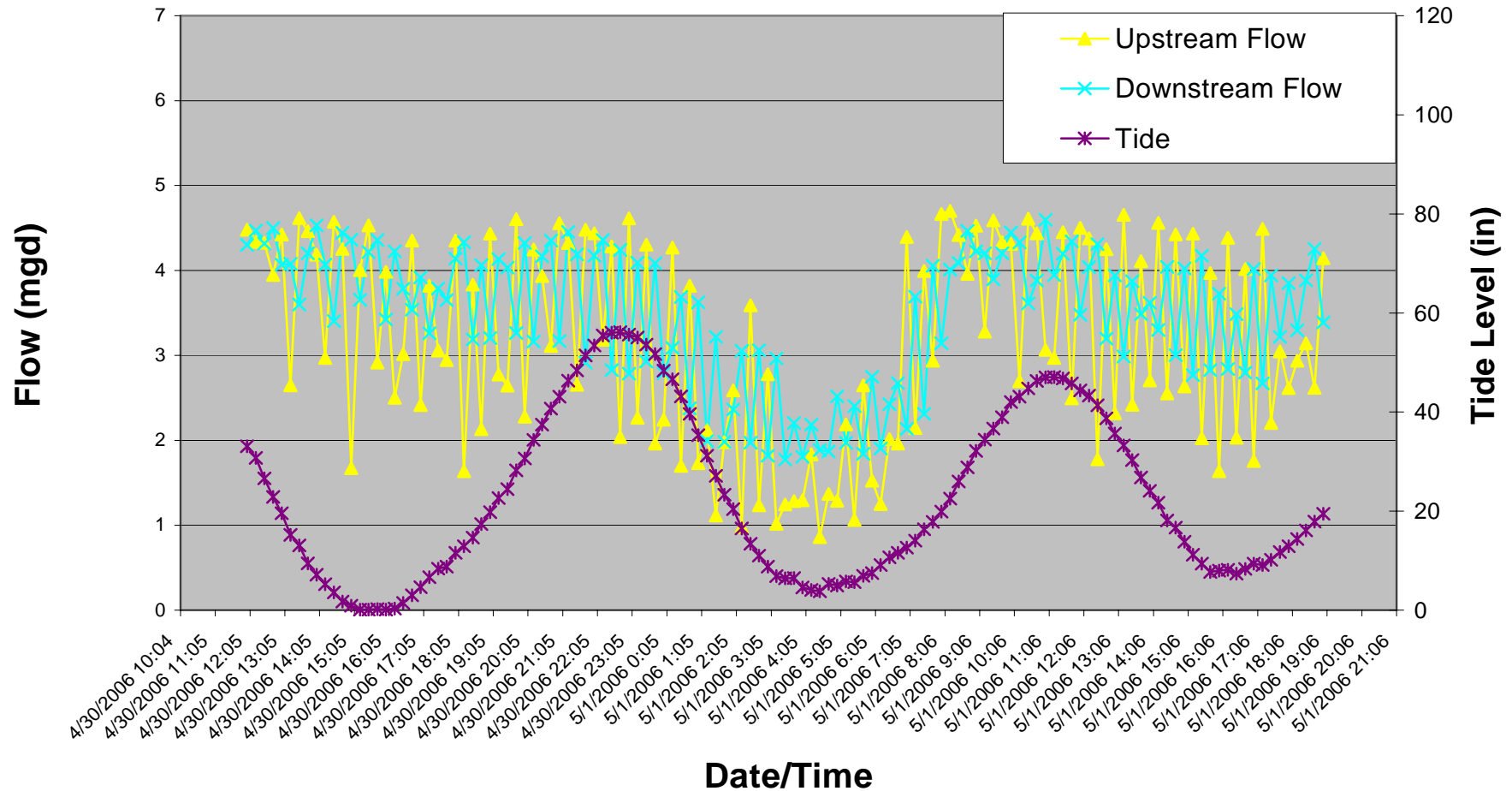
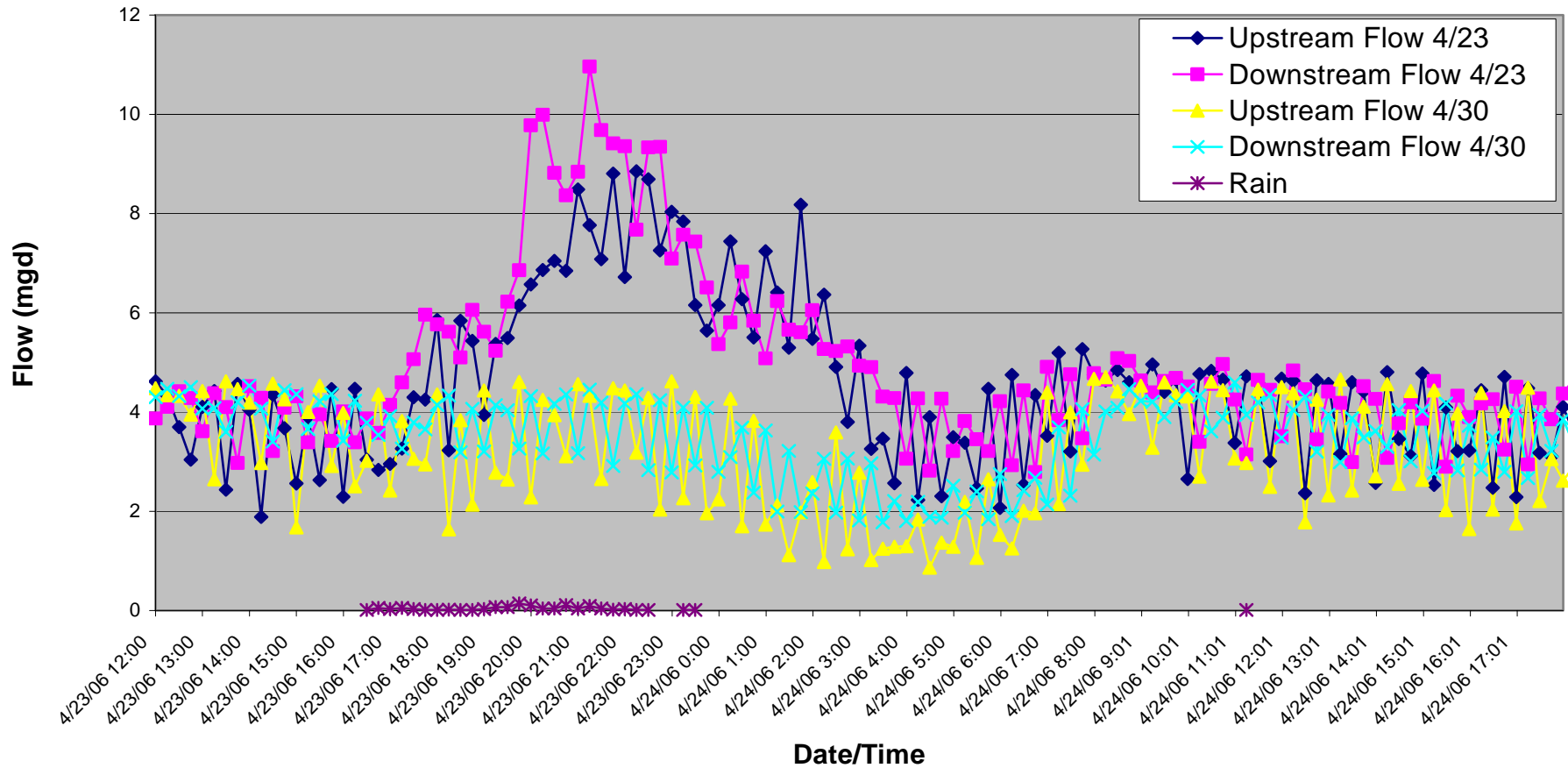


FIGURE 4 - Comparison of Wet Weather (April 23 to 24, 2006) and Dry Weather (April 30 to May 1, 2006) Wastewater Flows



The total inflow for the Thames Street Interceptor and upstream tributary area can be observed as the area between the wet weather flow meter data and the dry weather metering data. Based on the correlation between the wet and dry weather flows shown, infiltration does not appear to be a major concern at the time of the flow metering in Catchment Area 6. This corresponds with the low volumes of infiltration observed in the CCTV inspection of the Thames Street Interceptor (TMI) performed prior to this metering period. The CCTV inspection of the TMI was summarized and submitted under the technical memorandum titled “Thames Street Interceptor Television Inspection” dated August 30, 2006.

Based on the close correlation between wet and dry weather flows, our analysis of the meter data centered on inflow sources within Catchment Area 6. Our analysis was based on comparing upstream flow and downstream flow and observing the difference in flows. In Figure 5, a reaction in both the upstream and downstream flows is evident at or immediately following the first recorded rainfall measurement. Measured downstream flows generally appear to fluctuate with the rainfall intensity. The upstream and downstream flows quickly diverge with increases in rainfall intensity and converge with decreases in rainfall intensity. This trend is observed at approximately 5:45 to 6 PM, 8:15 PM, and finally at 9:15 to 9:30 PM as the storm event ends. The drain down period extends approximately 7 to 8 hours after the storm event. This extended drain down period is likely caused by indirect sources of inflow, such as sump pumps.

The volume of inflow estimated to have entered the system during this storm is approximately 500,000 gallons. This amount is considered significant for a storm event of short duration (about 7 hours) with a relatively low peak hourly intensity of 0.38 inches per hour.

Based on conditions observed in other areas of the city; lack of infiltration flow at the time, as observed in both the CCTV inspection of the TMI and in the metering data; and the frequency of inflow sources encountered in other areas of the city (i.e. rain leaders, roof drains, catch basin, yard drains), Catchment Area 6 appears to generate significant volumes of inflow.

PRELIMINARY RECOMMENDATIONS

Based on a preliminary analysis of flow information obtained during the metering period, the conditions encountered in the TMI CCTV inspection, the building inspections, and the results of the smoke testing in other priority inflow areas in the city, the city should consider performing a full sewer system evaluation study (SSES) of Sewer Catchment Area 6. Additional recommendations may be included in the

Wellington Avenue CSO Control Plan, Phase I Part 2 report after all field work is completed and the information is evaluated by Earth Tech.

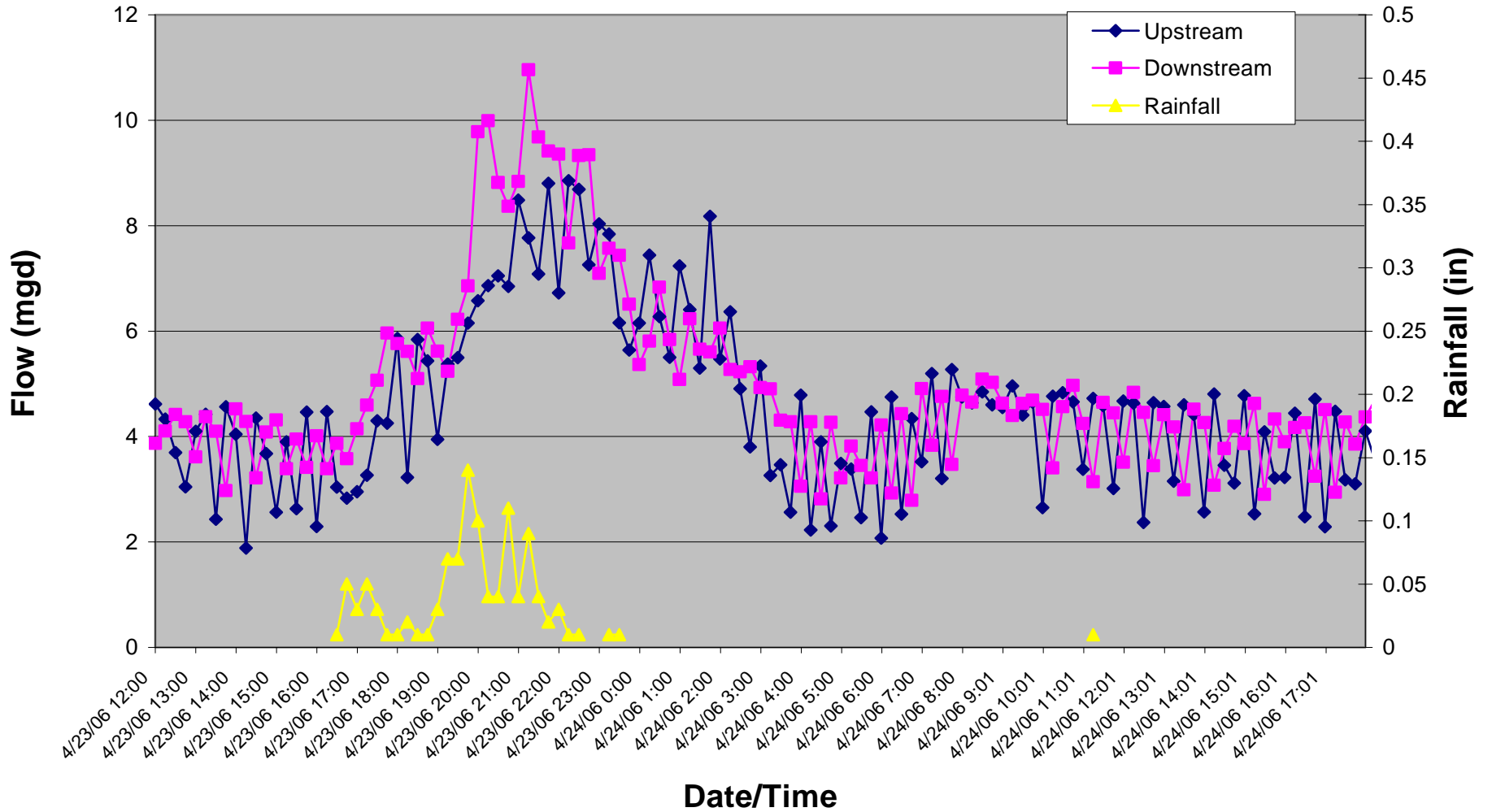
COST ESTIMATE FOR SSES FIELD WORK FOR SEWER CATCHMENT AREA 6

A preliminary cost estimate to complete a SSES of Sewer Catchment Area 6 is shown in Table 3 below. The SSES would consist of performing smoke testing of the entire sanitary sewer system and performing a house to house survey of all buildings in the catchment area. Sewer Catchment Area 6 consists of approximately 1,354 buildings and 57,610 linear feet (LF) of sanitary sewer pipe. Based on the conditions encountered in the other priority catchment areas in the city, Earth Tech would recommend a minimum of 100 dye tests to confirm suspect connections to the sanitary sewer as observed in the smoke testing and the house to house surveys.

**TABLE 3
ESTIMATED COST FOR SSES FOR SEWER CATCHMENT AREA 6**

Item	Assumption	Source	Unit Cost	Quantity	Estimated Cost
Smoke Testing	100% of Area 6 Sanitary Sewer	Inflow	\$0.50	57,610	\$28,805
House to House Survey	100% Buildings in Area 6	Inflow	\$45.00	1,354	\$60,930
Dye Testing	100 Tests	Inflow	\$95.00	100	\$9,500
	Subtotal				\$99,235
Contingency	25%	Inflow	\$24,809	1	\$24,809
Engineering	20%	Inflow	\$19,847	1	\$19,847
	Total				\$143,891
	Estimated Cost For SSES in Area 6				\$144,000

FIGURE 5 - Comparison of Upstream and Downstream Flows for April 23-24, 2006 Storm Event



CONCLUSION

Based on the results of the wastewater flow metering of Sewer Catchment Area 6, it is recommended that the City of Newport perform a SSES program to identify inflow sources to reduce total inflow entering the sanitary sewer system during storm events in an effort to provide additional system capacity for sanitary flow and reduce combined sewer overflows.