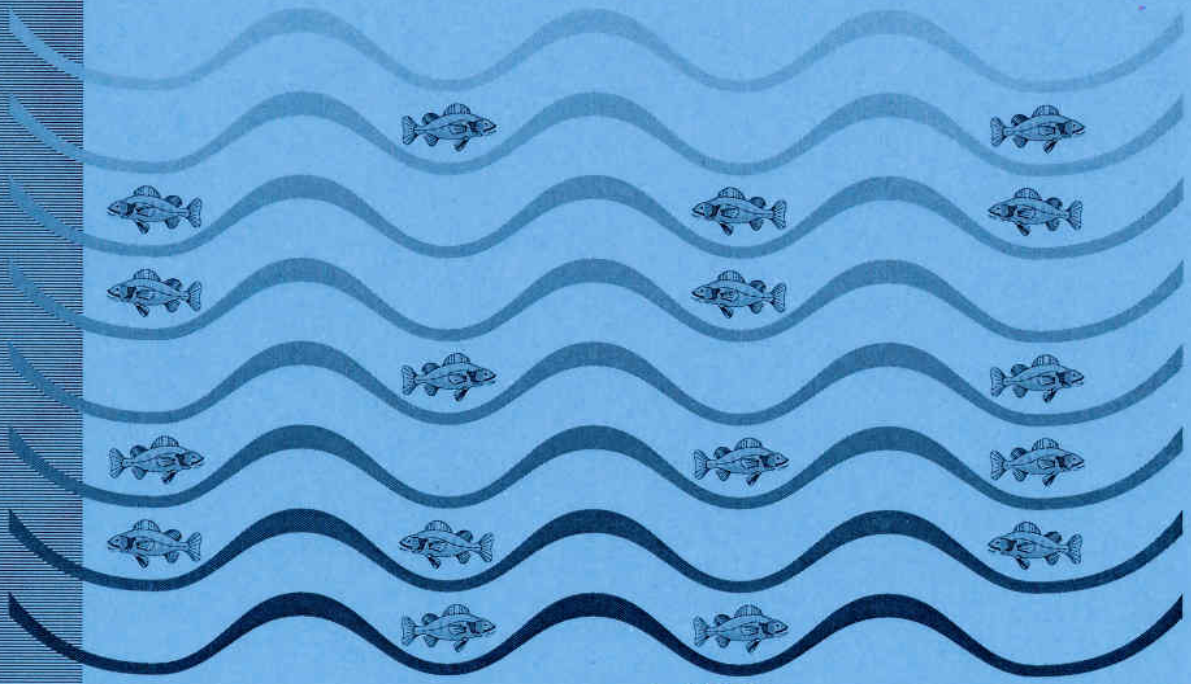
City of New Haven Long Term CSO Control Plan

The City of New Haven

New Haven Water Pollution Control Authority

Technical Memorandum #8
Nine Minimum Controls Report
(Part 2 of 2)



April 2000

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Subject: New Haven LTCP Project Task 5—Nine Minimum Controls

Dear Sirs:

Enclosed for your review and comment are two draft copies of Technical Memorandum (TM) #8, Part 2 of 2 of the Task 5 reports covering Nine Minimum Controls (NMCs). This memorandum documents a review of New Haven's baseline sewer system hydraulics and includes recommendations for a high flow management plan in accordance with NPDES permit requirements and specifically addressing NMC #2 and #4. NMC #1, #3, #5, #6, #7, and #8 were addressed previously in TM #7, submitted in June 1998. NMC #9 on compliance monitoring and any recommended solids and floatables controls will be included as part of the long-term control plan being developed under Tasks 7 and 8. Please do not hesitate to contact me should you have any questions.

Sincerely,

CH2M HILL

Rita Fordiani

Rita Fordiani
Task Manager

cc: Cliff Bowers, Peter von Zweck, Perrin Niemann/CH2M HILL
Bill Hogan/CT DEP

CITY OF NEW HAVEN LONG-TERM CSO CONTROL PLAN

TECHNICAL MEMORANDUM #8

Nine Minimum Controls Report (Part 2 of 2)

Prepared for

The City of New Haven
The New Haven Water Pollution Control Authority

Prepared by

CH2MHILL

25 New Chardon Street, Suite 500
Boston, MA 02114

April 2000

135807.BA.05

Contents

Acronyms

CSO	combined sewer overflow
CTDEP	Connecticut Department of Environmental Protection
DOT	Department of Transportation
DWO	dry-weather overflow
EPA	United States Environmental Protection Agency
HFMP	High Flow Management Plan
HGL	hydraulic grade line
LTCs	long-term controls
MG	million gallons
mgd	million gallons per day
NMCs	USEPA's Nine Minimum Controls
NPDES	National Pollutant Discharge Elimination System
OF	overflow
POTW	Publicly Owned Treatment Works
PS	pump station
STCs	short-term controls
TM	Technical Memorandum
USCGS	United States Coastal Geodetic Survey
WPAF	East Shore Water Pollution Abatement Facility
WPCA	Water Pollution Control Authority

SECTION 1

Introduction

Project Background

The City of New Haven (City) and the New Haven Water Pollution Control Authority (WPCA) operate a wastewater collection and treatment system that serves more than 100,000 residents of New Haven, and through interlocal agreements, the Towns of Woodbridge, Hamden, and East Haven (East Haven accepts some wastewater flow from North Branford.) The wastewater collection system includes both combined and separate sewers. A combined sewer is one that collects both sanitary sewage and stormwater runoff. In a separated sewer system, one sewer collects sewage and another sewer collects stormwater runoff.

During dry weather, New Haven's sewer system conveys a combination of sanitary flow and groundwater infiltration to the 40-mgd East Shore Water Pollution Abatement Facility (WPAF). All dry weather flows receive primary and secondary treatment and disinfection at the WPAF before discharge to New Haven Harbor.

During wet weather, large quantities of stormwater enter the combined sewer system. As a result, parts of the system become overloaded, and combined sewage then overflows to receiving waters. There are roughly 244 miles of sanitary/combined sewers and 24 combined sewer overflow (CSO) regulators that divert high flows from the interceptor sewers to 20 CSO outfalls (CH2M HILL June 1998).

A facility plan that evaluated alternative methods for controlling CSOs was completed in 1981 and updated in 1988 (Cardinal Engineering Associates 1981, 1988). The plan evaluated controls required to convey, treat, or store overflows associated with a 10-year storm. The plan concluded that sewer separation was the most cost-effective method of meeting the evaluation criteria. As of 1997, when the Long Term CSO Project began, approximately 35 percent of the planned sewer separation had been completed. Because of significant advances in regulatory requirements and control technologies, the City is reevaluating this approach.

Project Objectives

In 1997, the City of New Haven entered into an agreement with CH2M HILL to prepare a Long-Term CSO Control Plan. The objectives of the project as described in the agreement are to:

- Reduce the overall cost of constructing CSO controls
- Produce documents required for CSO-related issues described in the WPCA's National Pollutant Discharge Elimination System (NPDES) Permit, administered and enforced through the Water Management Bureau of the State of Connecticut Department of

Environmental Protection's (CTDEP) Permitting, Enforcement, and Remediation Division (CTDEP 1995)

- Produce a long-term CSO control plan that is generally consistent with guidance provided in the USEPA's CSO Control Policy of April 1994

These goals were reviewed, expanded, and prioritized through the Stakeholders' review process during Tasks 1 and 6. The top evaluation criteria identified by the Stakeholders, in order of priority, were (CH2M HILL January 1999):

- Meet State water quality standards
- Protect critical areas
- Eliminate dry and wet weather overflows
- Maximize aquatic habitat
- Maximize conveyance
- Maximize treatment plant capacity

For additional information on goals, see Technical Memorandum #1, *Project Goals and Approach* (CH2M HILL June 1997) or Technical Memorandum #12, *Preliminary Evaluation of CSO Control Alternatives* (CH2M HILL January 1999).

Task Objectives

The specific objective of Task 5 is to provide documentation as required by the WPCA's existing NPDES permit related to EPA's Nine Minimum Controls (NMCs) under the EPA CSO Control Policy of 1994. EPA's CSO Control Policy provided guidance to decision-makers for complying with the Clean Water Act. EPA determined the following list of NMCs would aid in reducing the impacts of CSOs on receiving waters (USEPA 1995):

1. Proper operation and regular maintenance programs for the sewer system and CSO outfalls
2. Maximum use of the collection system for storage
3. Review and modification of pretreatment requirements to ensure that CSO impacts are minimized
4. Maximization of flow to the POTW for treatment
5. Elimination of CSOs during dry weather
6. Control of solid and floatable materials in CSOs
7. Pollution prevention programs to reduce contaminants in CSOs
8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls

Purpose of this Memorandum

Several NPDES requirements and NMCs were addressed in a previous report, Technical Memorandum #7, *Nine Minimum Controls Report, Part 1 of 2* (CH2M HILL June 1998). However, developing a high flow management plan to maximize the collection system for storage (NMC #2) and maximize flow to the treatment plant (NMC #4) required completion of the sewer system model and hydraulic characterization. Figure 1-1 displays the NMCs that were discussed in TM#7 and those that are addressed in the current report. NMC #9 on compliance monitoring and any recommended solids and floatables controls will be included as part of the long-term control plan being developed under Tasks 7 and 8.

The purpose of this memorandum is to document the controls that constitute the high flow management plan and specifically refers to low cost modifications which can be quickly and easily implemented as compared to CSO controls being developed for the long-term control plan. As will be described, in some cases the controls can be implemented immediately, but in other cases the completion of on-going City sewer project is required before implementation.

Section 2 of this report presents an evaluation of the performance of the collection system during wet weather. It includes locations with severe surcharging and/or street flooding, bottlenecks, and existing storage; pump station capacities and operating procedures; and the collection system's ability to deliver wet-weather flows to the WPAF.

Section 3 describes the development of the high flow management plan recommendations. It indicates which sewer system modifications were reviewed, describes the results of the modeling simulations, presents cost estimates for the viable modifications, and presents the final recommendations and proposed implementation schedule.

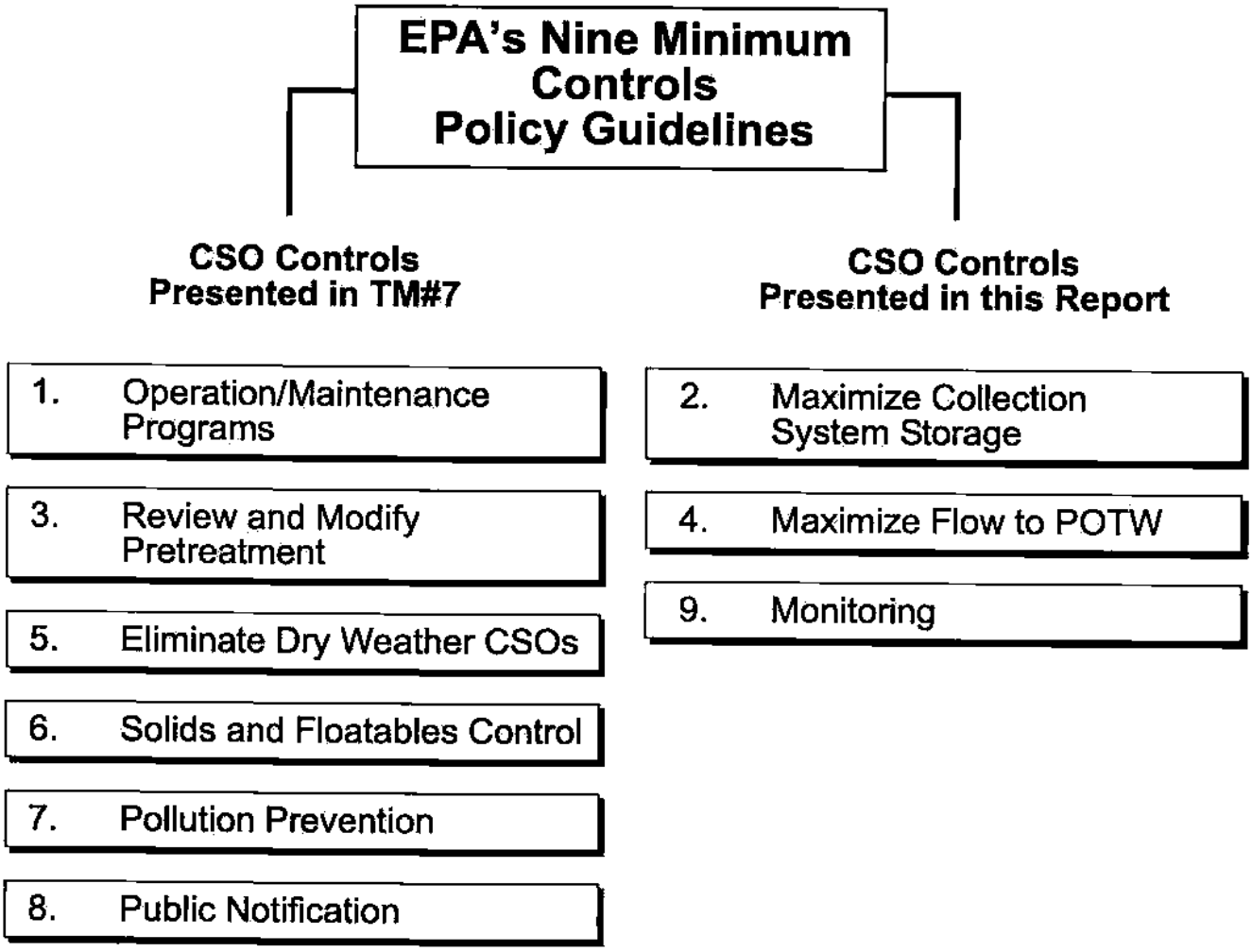

Figure 1-1
Nine Minimum Controls Presented in this Report

SECTION 2

Evaluation of the Baseline Collection System

This section provides a review of collection system performance during wet weather. Computer runs of the New Haven baseline model (described in TM#6, *Hydraulic Characterization Report*, CH2M HILL March 2000) using both the 2-year and 3-month design storms were performed for this analysis. Appendix A of this report provides a review of the baseline model and recent minor modifications. The following sewer system issues were reviewed to evaluate where sewer system capacity may be available or where maximizing conveyance to the treatment plant would be particularly beneficial:

- Potential storage
- Severe surcharging and street flooding
- Bottlenecks (i.e., hydraulic constrictions/losses)
- Pump station capacities and operating procedures
- Delivery capacity to the WPAF

Section 3 of this report presents the development of the high flow management plan as a result of an analysis of the following information.

Potential Storage

Figures 2-1 and 2-2 show locations in the sewer system where freeboard exists during the peak flows resulting from the 3-month and 2-year storms, respectively. The maximum water level during the storm is shown in the figures; red indicates a surcharged pipe while blue denotes a pipe that has freeboard. During the 3-month storm, some areas are already surcharged, but much of the sewer system has available storage capacity. During the 2-year storm, most of the sewer system is at capacity or surcharged.

The baseline New Haven sewer system model shows very limited capacity for storage. The most significant areas that still have some capacity during the 2-year storm are in the downtown area and in some local inflows to the Boulevard Interceptor. In the downtown area, sewer separation has been completed and many of the old (c. 1870) pipes are now carrying less wet-weather flow. According to WPCA staff, many of these old pipes would need to be lined/strengthened to prevent collapsing if desired for potential flow storage. There is some potential that raising CSO regulator weirs may be possible for relatively small volume, infrequent CSOs. This will be reviewed in Section 3.

Severe Surcharging and Street Flooding

Figures 2-3 and 2-4 present the maximum water level that occurred during the 3-month and 2-year design storm simulations, respectively. Nodes where street flooding occurred and nodes where the hydraulic grade line (HGL) is within two feet of the ground surface are

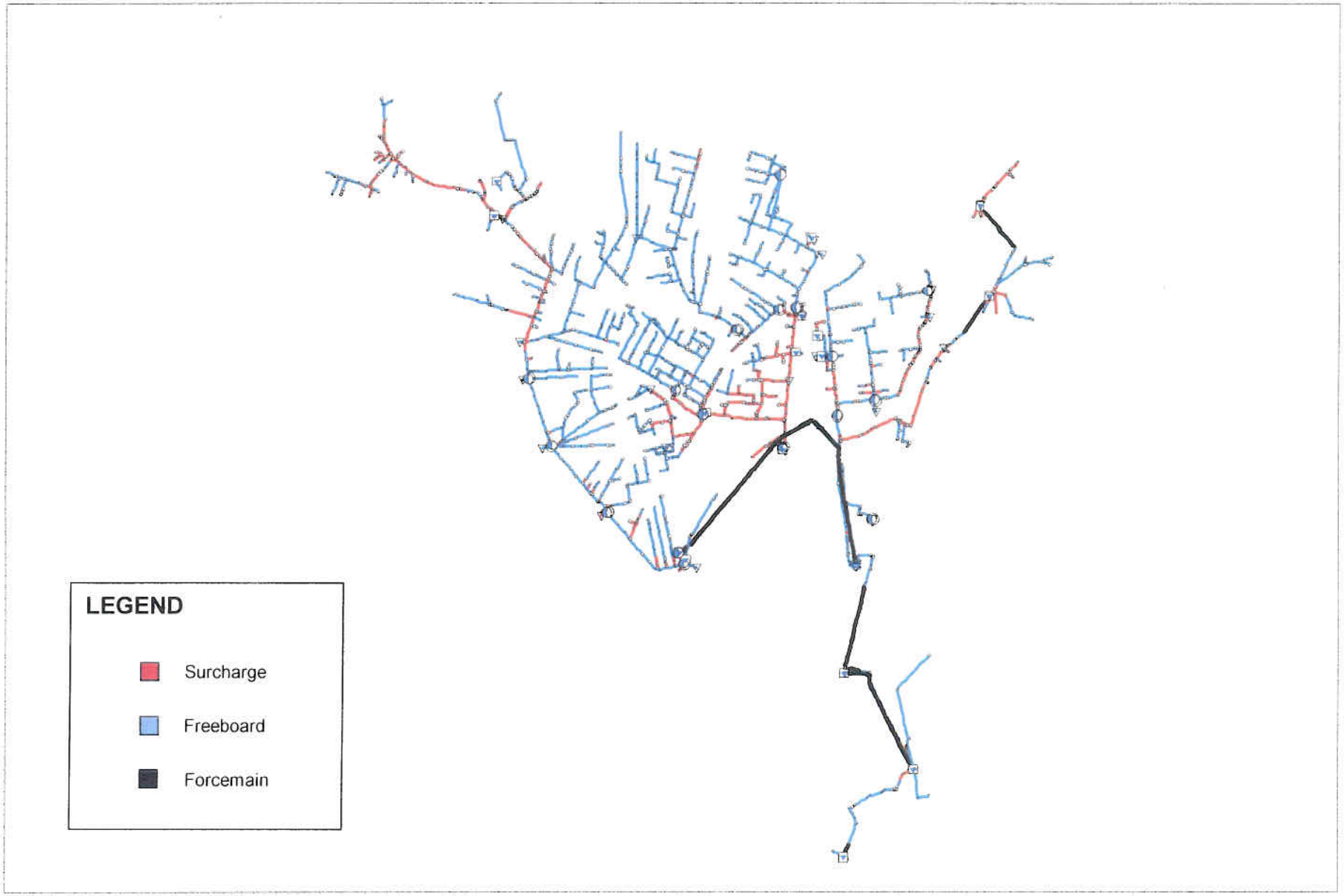

Figure 2-1. Existing Potential Storage and Severe Surcharging: 3-Month Storm Results

Figure 2-2. Existing Potential Storage and Severe Surcharging: 2-Year Storm Results

highlighted in red and blue, respectively. Significant areas that experience street flooding and severe surcharging, even during the 3-month storm, are the following:

- Whalley Ave near the West River, Blake Street
- Moreland Road and Goffe Street
- Boulevard Interceptor near Legion Avenue and CSO 004 overflow
- Water Street between Olive Street and the East Street Interceptor
- East Street Interceptor upstream of East Street Pump Station
- North Front Street, South Front Street
- James Street Interceptor downstream of inflow from River Street
- Upstream of Barnes Pump Station at Middletown Avenue/Ellis Street

All of these areas were highlighted as experiencing street flooding and severe surcharging in the Facility Plan (Cardinal Engineering Associates, 1981) for the 1-year storm with the exception of the following areas outside of the Facility Plan study area: Blake Street, Moreland Road, and areas near the Barnes Pump Station.

A comparison of Figures 2-1 through 2-4 shows the significant impact of the larger 2-year storm versus the 3-month storm on system hydraulics. Some areas, such as Whalley Avenue/Boulevard, Front Street, the Quinnipiac Avenue Interceptor, and the Wooster Square area, are severely surcharged for even the 3-month design storm.

Bottlenecks

The following locations have piping configurations that are bottlenecks (i.e., hydraulic constrictions) which impede conveyance and, due to high flows, also cause severe surcharging, flooding, or CSOs (see Appendix B for detailed information):

- Fairfield Street and Ramsdell Street
- Boulevard and Derby Avenue, CSO 005
- Boulevard and Orange Avenue, CSO 003
- Near Boulevard Pump Station and CSO 024
- George Street and Temple Street CSO
- Union Avenue and Columbus Avenue
- Lombard Street near North Front Street and CSO 018
- James Street between River Street and CSO regulator 015
- Quinnipiac Avenue gravity line downstream of twin force mains, near CSO 020
- Morris Causeway between Concord Street and Dean Street

Pump Station Capacities and Operating Procedures

The following information was reviewed for each pump station during the 2-year storm:

- Hydraulic grade lines upstream and downstream
- Whether the pump station was operated to pump at capacity
- Whether the pump station was bypassing (if an emergency bypass exists)

Table 2-1 summarizes the results of this review.

Figure 2-3. Street Flooding: 3-Month Storm Results

Figure 2-4. Street Flooding: 2-Year Storm Results

TABLE 2-1
Review of Pump Station Operations for the 2-Year Storm

Pump Station	Upstream HGL	Downstream HGL	Pump Station Pumping at Capacity?	Pump Station Bypass Overflowing?
Barnes	surcharged	not surcharged	yes	yes
Boulevard	surcharged	surcharged	no	yes
East Street	surcharged	surcharged	no	yes
Old Grand	not surcharged	surcharged/flooding	no	—
New Grand	surcharged	surcharged	yes	—
Humphrey	surcharged	surcharged	yes	yes
Long Wharf	surcharged	surcharged	yes	—
Mitchell	not surcharged	surcharged/flooding	yes	no
Morris Cove	surcharged	not surcharged	yes	—
Market/Murphy	surcharged	not surcharged	yes	—
Quinnipiac	surcharged	not surcharged	no	yes
Stone St	surcharged	surcharged	yes	—
Union	surcharged	surcharged	no	yes
West Rock	not surcharged	surcharged/flooding	no	—
Woodward	surcharged	not surcharged	yes	yes

HGL = hydraulic grade line
Surcharged/flooding = surcharged and possibly flooding through one or more manholes
— = not applicable (i.e., no bypass exists)

Pump station operations may be altered to either maximize in-system storage (i.e., detain or decrease flow) or to maximize conveyance (i.e., increase flow). For example, in cases with downstream surcharge and no upstream surcharge, pumping could be decreased to back-up flows and utilize available storage upstream, such as at Old Grand, Mitchell, and West Rock pump stations. Further review of these very small pump stations determined that decreasing the flow rates would have little impact, as the surcharge conditions downstream are primarily due to other factors such as sewer system backwater effects.

Several pump stations do not pump at their capacity and have active bypasses including Boulevard, East Street, Quinnipiac, and Union. Pump stations which experience surcharge upstream and not downstream where pumping could be increased include: Barnes, Morris Cove, Market/Murphy, Quinnipiac, and Woodward. Results of further analysis are presented in Section 3.

Delivery Capacity to the WPAF

Flow to the plant is controlled by the Boulevard, East Street, and East Shore pumping stations; each has a specific capacity and control strategy. Currently the East Shore WPAF operates at a peak capacity of 100 million gallons per day (mgd). Primary treatment has a capacity of 100 mgd. Secondary treatment has a capacity of 60 mgd. Peak flows above 60 mgd are diverted around secondary treatment, blended with secondary effluent, and discharged after disinfection. As noted in previous reports, this occurs approximately 40 times per year with relatively small volumes bypassing secondary treatment. In the past, WPCA staff have witnessed flow rates at the treatment plant up to 120 mgd. The following table shows the peak flow rates to the WPAF under baseline conditions during the 3-month and 2-year design storms and indicates the contributions from each part of the city.

TABLE 2-2
Collection System Peak Flow Rates under Baseline Conditions

Location	Peak Flow Rates (mgd)	
	3-Month Design Storm	2-Year Design Storm
James Street Siphon	9	10
Northeast Area (Quinnipiac Ave)	11	20
Southeast Area (Morris Cove)	14	21
East Shore Pump Station[1, 2]	33	50
Boulevard Pump Station	28	29
East Street Pump Station	28	28
WPAF (approximate totals)[2]	87	107

[1] The East Shore Pump Station receives 3 incoming flows: the James Street siphon; the northeast area; and the southeast area

[2] The numbers do not add exactly because the peak flow rates occur at different times

Previous New England CSO studies, for example for Bangor and Portland, Maine, have shown that conveyance and treatment of CSO using existing conveyance and treatment facilities is very cost-effective and provides reliable treatment. WPCA staff anecdotally report that there is a limiting hydraulic capacity at the WPAF of between 110 to 120 mgd; therefore, as shown in Table 2-2, the conveyance system is well-utilized during the 2-year design storm. Section 3 will provide results of an analysis to increase flows to the plant to approximately 120 mgd. Modifying the WPAF to accept flows above 120 mgd will be reviewed during the Long-Term Control Plan.

SECTION 3

Evaluation of Collection System Modifications

This section describes the review and recommendations of collection system modifications proposed as part of the high flow management plan that were evaluated using the New Haven baseline computer model. Table 3-1 summarizes the modifications evaluated and why.

TABLE 3-1
Short-Term Controls Considered for the High Flow Management Plan (HFMP)

NPDES #	Location	Candidate for HFMP	Reason
West River CSOs and Pump Stations			
n/a	Stone Street PS	no	At capacity, no bypass
n/a	West Rock PS	no	Downstream surcharge caused by backwater, no bypass
006	Whalley/Fitch	no	Large volume CSO
005	Boulevard/Derby	yes	Remove bottleneck to improve system conveyance and decrease CSO
004	Boulevard/Legion	no	Large volume CSO
003	Boulevard/Orange	yes	Remove bottleneck to improve system conveyance and decrease CSO
002	Boulevard/ Lamberton	yes	Small volume, infrequent CSO; potential to raise weir and reduce/eliminate CSO
Beaver Ponds CSO			
008	Munson/Orchard	yes	Basin already separated; small volume, infrequent CSO remains; potential to raise weir and reduce/eliminate CSO
Mill River CSOs and Pump Stations			
n/a	Old Grand PS	no	Downstream surcharge caused by backwater, no bypass
n/a	New Grand PS	no	At capacity; no bypass
n/a	Humphrey PS	no	At capacity, has active bypass
013	East Rock Rd	yes	Small volume, infrequent CSO; potential to raise weir and reduce/eliminate CSO
n/a	Cross-connection near 013	yes	Zero volume in 2-year storm; potential to prevent flow into storm sewer
012	Mitchell/Nicoll	yes	Moderate volume CSO; potential to raise weir and reduce/eliminate CSO; sewer separation completed

TABLE 3-1
Short-Term Controls Considered for the High Flow Management Plan (HFMP)

NPDES #	Location	Candidate for HFMP	Reason
n/a	Mitchell PS	no	Negligible impact on system; downstream surcharge caused by backwater, has non-active bypass
n/a	Market/Murphy PS	yes	Potential to increase conveyance
010 u/s	East/I-91	yes	Small volume, infrequent CSO; potential to raise weir and reduce CSO
010 d/s	East/I-91	yes	Small volume, infrequent CSO; potential to raise weir and reduce/eliminate CSO
011	Humphrey/I-91	no	Large volume CSO; outfall is shared with #010 (u/s) and #014
014	Trumbull/Orange	no	Outfall is shared with two other active CSOs, #010 (u/s) and #011 not suitable for short-term controls
009	James/Grand	no	High HGL in baseline
Quinnipiac CSOs and Pump Stations			
n/a	Barnes PS	yes	Potential to increase conveyance and reduce bypass
n/a	Quinnipiac PS	yes	Potential to increase conveyance and reduce bypass
018	N. Front/Lombard	no	Moderate volume CSO; high HGL in baseline; street flooding
019	N. Front/Pine	no	Moderate volume CSO; high HGL in baseline; street flooding
020	Quinnipiac/Clifton	yes	Small volume, infrequent CSO
016	Poplar/River	no	Large volume CSO
015	James Street Siphon	yes	Downstream capacity available; existing stop logs substantially reduce conveyance to WPAF and increases CSO
New Haven Harbor CSOs and Pump Stations			
n/a	Portsea/Liberty	yes	No CSO in 2-year storm; potential to raise weir and reduce/eliminate CSO
021	East Street PS	yes	Potential to increase conveyance and reduce CSO
025	Union PS	no	Large volume CSO, limited downstream capacity, small force main, high HGL
n/a	Long Wharf PS	no	At capacity; no bypass
n/a	George/Temple	yes	Moderate volume CSO; potential to raise weir and reduce CSO
024	Boulevard PS	yes	Potential to increase conveyance and reduce CSO
n/a	East/Ives	no	High HGL in baseline; sewer separation will be finished with completion of Wooster Square separation project
n/a	South Frontage/ Davenport	no	Moderate volume CSO, high HGL in baseline
n/a	Woodward PS	yes	Potential to increase conveyance and reduce bypass

TABLE 3-1
Short-Term Controls Considered for the High Flow Management Plan (HFMP)

NPDES #	Location	Candidate for HFMP	Reason
n/a	Morris Cove PS	yes	Potential to increase conveyance
022	Allen Place	no	CSO control pending DOT construction project

n/a = not applicable
PS = pump station
HGL = hydraulic grade line

Analyses and Recommendations

The following paragraphs describe site-specific issues, collection system modifications evaluated as short-term controls (STCs), model results, and recommendations. At many of the sites, negative impacts from implementing the modifications were shown by the model (e.g., an unacceptable increase in the elevation of the hydraulic grade line above an assumed elevation for basements). Where collection system modifications showed positive model results, a cost estimate was also developed. Appendices C and D provide sketches and detailed cost estimates, respectively, for the recommended modifications.

West River CSOs

The Boulevard Interceptor is greatly impacted by backwater during wet weather, and changes in hydraulics can easily produce negative impacts upstream and downstream. Because of the size of overflows to the West River and the interdependence between the regulators, the development of long-term controls (LTCs) will be necessary for addressing these CSOs.

NPDES #005 – Blvd/Derby

- ISSUES: large volume CSO; potential to improve system conveyance and decrease CSO
- STC: reconstruct connection with chamber and weir
- RESULTS: improves hydraulics and provides future flexibility to alter weir; increases conveyance (5%) and reduces overflow by 1 MG (20%) for 2-year storm
- COST: $75,000
- RECOMMENDATION: expensive for small gain, no STCs recommended at this time, develop LTCs which may incorporate STCs cost-effectively

NPDES #003 – Blvd/Orange

- ISSUES: large volume CSO; potential to improve system conveyance and decrease CSO
- STC: remove utility constrictions in interceptor
- RESULTS: improves hydraulics; benefits cannot be accurately modeled
- COST: $24,000
- RECOMMENDATION: consider if utilities pay for STCs, develop LTCs

NPDES #002 – Blvd/Lamberton

- ISSUES: small volume, infrequent CSO; potential to raise weir & reduce/eliminate CSO
- STC: raise weir (tried 100% and 50% closure and lowering weir)
- RESULTS: negative impacts upstream and downstream
- RECOMMENDATION: no STCs recommended, confirm operation of CSO discharge believed to be blocked, develop LTCs

Beaver Ponds CSO

NPDES #008 – Munson/Orchard

- ISSUES: separated basin with small volume, infrequent CSO; potential to raise weir & reduce/eliminate CSO
- STC: raise weir (tried 100% and 50% closure)
- RESULTS: 100% closure increases HGL above basement elevations; 50% closure does not increase HGL above basement elevations and reduces CSO by 50% for 2-year storm
- COST: $1,900
- RECOMMENDATION: create weir constricting overflow by 50%, develop LTCs

Mill River CSOs and Pump Stations

NPDES #013 – East Rock Road

- ISSUES: small volume, infrequent CSO; potential to raise weir & reduce/eliminate CSO
- STC: raise weir (tried 100% and 50% closure)
- RESULTS: 100% closure increases HGL above basement elevations; 50% closure does not flood basements but does not measurably decrease CSO for 2-year storm
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #N/A – Cross-Connection near 013

- ISSUES: cross-connection between CSO outfall and storm pipe; zero volume in 2-year storm
- STC: seal connection
- RESULTS: no negative impacts for 2-year storm
- COST: $1,900
- RECOMMENDATION: seal CSO

NPDES #N/A – Mitchell Pump Station

- ISSUES: limited downstream interceptor capacity
- STC: decrease pumping
- RESULTS: no significant effect on surcharge conditions in interceptor; caused overflow at the pump station in 2-year storm
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #012 – Mitchell/Nicoll

- ISSUES: moderate volume CSO; potential to raise weir & reduce/eliminate CSO; sewer separation completed
- STC: raise weir (tried 100% closure and new configuration)

- RESULTS: both 100% closure and new configuration increases HGL above basement elevations for 2-year storm
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #N/A – Market/Murphy Pump Station

- ISSUES: surcharge conditions upstream
- STC: increase pumping
- RESULT: calculations indicated that the existing pump rates were producing velocities in the forcemain of about 8 ft/sec, so that pump rates should not be increased
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #010 – East/I-91 (upstream)

- ISSUES: small volume, infrequent CSO; potential to raise weir & reduce CSO; CSO has shared outfall with #011 and #014
- STC: raise weir (tried 50% closure)
- RESULTS: 50% closure increases HGL above ground at #012 for 2-year storm
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #010 – East/I-91 (downstream)

- ISSUES: small volume, infrequent CSO; potential to raise weir & reduce/eliminate CSO
- STC: raise weir (tried 100% closure)
- RESULTS: 100% closure has no negative impacts for 2-year storm
- COST: $1,800
- RECOMMENDATION: seal CSO after completion of Humphrey Street sewer separation project

Quinnipiac River CSOs and Pump Stations

NPDES #N/A – Barnes Pump Station

- ISSUES: small volume OF; surcharge conditions upstream; limited downstream interceptor (Quinnipiac Interceptor) and pump station capacity
- STC: increase pumping
- RESULT: decreases Barnes OF but increases Quinnipiac pump station OF
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #N/A – Quinnipiac Pump Station

- ISSUES: small volume OF; limited downstream interceptor capacity
- STC: increase pumping
- RESULT: increases #020
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #020 – Quinnipiac/Clifton

- ISSUES: small volume, infrequent CSO; high HGL in baseline
- STC: interceptor relief project (tried 1800 feet of 18", 24", and 30" diameter)
- RESULT: minimal CSO reduction
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #015 – James Street Siphon

- ISSUE: large volume CSO; capacity downstream; stop logs substantially reduce conveyance to WPAF and increase CSO
- STC: Remove stop logs
- RESULTS: increases peak wet weather flow to WPAF from 10 to 22 mgd for 2-year storm and decreases CSO by 50% for 2-year storm
- COST: $1,550 to remove stop logs
- RECOMMENDATION: WPAF hydraulic capacity currently limited and unable to handle additional uncontrolled peak flows; therefore, need operational controls to monitor and control peak flow rates from siphon before removing stop logs; develop LTCs

New Haven Harbor CSOs and Pump Stations

NPDES #N/A – Portsea/Liberty

- ISSUES: zero volume in 2-year storm; potential to raise weir & reduce/eliminate CSO
- STC: raise weir (tried 100% closure)
- RESULTS: 100% closure has no negative impacts for 2-year storm
- COST: $1,750
- RECOMMENDATION: seal CSO

NPDES #021 – East Street Pump Station

- ISSUE: large volume CSO, capacity downstream, potential to maximize conveyance and reduce CSO
- STC: increase pumping (utilize 3rd pump and add further capacity)
- RESULT: reduces CSO 70% for 2-year storm
- RECOMMENDATION: consistently operate 3 pumps during wet weather through improved SCADA; WPAF hydraulic capacity currently limited, therefore, unable to increase capacity beyond 3 pumps; develop LTCs

NPDES #N/A – George/Temple

- ISSUE: moderate volume CSO, high HGL, potential to raise weir and reduce CSO
- STC: raise weir (tried 50% closure)
- RESULT: increased HGL above reasonable levels, given complaints
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #024 – Boulevard Pump Station

- ISSUE: large volume CSO, limited force main capacity, potential to increase conveyance and reduce CSO
- STC: increase pumping
- RESULT: minimal improvements
- RECOMMENDATION: no STCs recommended, develop LTCs

NPDES #N/A – Woodward Pump Station

- ISSUE: small volume OF, downstream capacity available, potential to increase conveyance and reduce OF
- STC: increase pumping
- RESULT: reduces OF by 20% in 2-year storm

- RECOMMENDATION: no STCs recommended, WPAF hydraulic capacity currently limited; develop LTCs

NPDES #N/A – Morris Cove Pump Station

- ISSUE: downstream capacity available, potential to increase conveyance
- STC: increase pumping
- RESULT: no negative impacts for 2-year storm
- RECOMMENDATION: no STCs recommended, WPAF hydraulic capacity currently limited; develop LTCs

High Flow Management Plan Model Results

Table 3-2 shows a comparison of modeled CSO volumes for the 3-month and 2-year design storms between baseline conditions and the high flow management plan.

TABLE 3-2
High Flow Management Plan Results
3-Month and 2-Year Design Storms

NPDES		3 Month Design Storm			2 Year Design Storm		
#	Location	Baseline	HFMP	% Diff.	Baseline	HFMP	% Diff.
			WEST RIVER				
006	Whalley/Fitch	1.1	1.1	0%	4.6	4.6	0%
005	Blvd/Derby	1.4	1.4	0%	5.0	5.0	0%
004	Blvd/Legion	2.6	2.6	0%	5.9	5.9	0%
003	Blvd/Orange	1.4	1.4	0%	4.2	4.3	0%
002	Blvd/Lamberton	0.0	0.0	0%	1.0	0.9	-2%
	WEST RIVER TOTAL	**6.5**	**6.5**	**0%**	**20.6**	**20.7**	**0%**
			BEAVER PONDS				
008	Munson/Orchard	-	-		0.2	0.1	-50%
	BEAVER PONDS TOTAL	-	-		**0.2**	**0.1**	**-50%**
			MILL RIVER				
013	East Rock Rd	-	-		0.1	0.1	0%
n/a	Cross-connection @ 013	-	-		-	-	
012	Mitchell/Nicoll	0.2	0.2	0%	1.5	1.5	0%
n/a	Mitchell Pump Station	-	-		-	-	
010	East/I-91 (upstream)	-	-		0.3	0.5	67%
010	East/I-91 (downstream)	0.0	-	-100%	0.5	-	-100%
011	Humphrey/I-91	2.5	2.4	-4%	7.9	8.0	1%
014	Trumbull/Orange	-	-		0.8	0.8	0%
n/a	Humphrey Pump Station	0.0	0.0	0%	0.1	0.1	0%
009	James/Grand	0.7	0.7	0%	2.4	2.4	0%
n/a	East/Ives	0.0	-	-100%	0.3	0.2	-33%
	MILL RIVER TOTAL	**3.4**	**3.3**	**-3%**	**13.9**	**13.6**	**-2%**

TABLE 3-2
High Flow Management Plan Results
3-Month and 2-Year Design Storms

NPDES		3 Month Design Storm			2 Year Design Storm		
#	Location	Baseline	HFMP	% Diff.	Baseline	HFMP	% Diff.
		QUINNIPIAC RIVER					
n/a	Barnes Pump Station	0.0	0.0	0%	0.3	0.3	0%
n/a	Quinnipiac Pump Station	0.0	0.0	0%	0.5	0.5	0%
018	N. Front/Lombard	0.0	0.0	0%	0.6	0.6	0%
019	N. Front/Pine	0.2	0.2	0%	0.9	0.9	0%
020	Quinnipiac/Clifton	0.1	0.1	0%	0.4	0.4	0%
016	Poplar/River	1.3	1.3	0%	3.7	3.7	0%
015	James Street Siphon	2.0	2.0	0%	3.6	3.6	0%
	QUINNIPIAC RIVER TOTAL	**3.6**	**3.6**	**0%**	**10.0**	**10.0**	**0%**
		NEW HAVEN HARBOR					
n/a	S. Frontage/Davenport	0.0	0.0	0%	0.7	0.7	0%
n/a	Portsea/Liberty	-	-		-	-	
021	East Street PS	2.6	0.8	-69%	4.2	1.9	-55%
025	Union PS	0.7	0.7	0%	2.7	2.7	0%
n/a	George/Temple	0.0	0.0	0%	0.9	0.9	0%
022	Allen Place	n/a	n/a	n/a	n/a	n/a	n/a
024	Blvd PS	1.4	1.4	0%	3.4	3.3	-3%
n/a	Woodward Pump Station	0.0	0.0	0%	0.1	0.1	0%
	NEW HAVEN HARBOR TOTAL	**4.8**	**3.0**	**-38%**	**11.9**	**9.6**	**-19%**
	GRAND TOTAL	**18.3**	**16.4**	**-10%**	**56.6**	**54.0**	**-5%**

Note: a dash indicates that no overflow occurred, while a zero indicates that a small overflow (less than 0.05 MG) occurred

The model simulations indicated that implementation of the recommended controls could reduce total CSO volume in a 2-year storm by 5 percent, and the CSO volume in a 3-month storm by 10 percent at a total cost of approximately $5100.

Schedule

Because the baseline conditions in the model include several sewer separation projects and planned modifications that have not yet been completed, it will be necessary to delay implementation of some of the short-term controls until after certain projects have finished. Figure 3-1 presents a proposed high flow management plan implementation schedule.

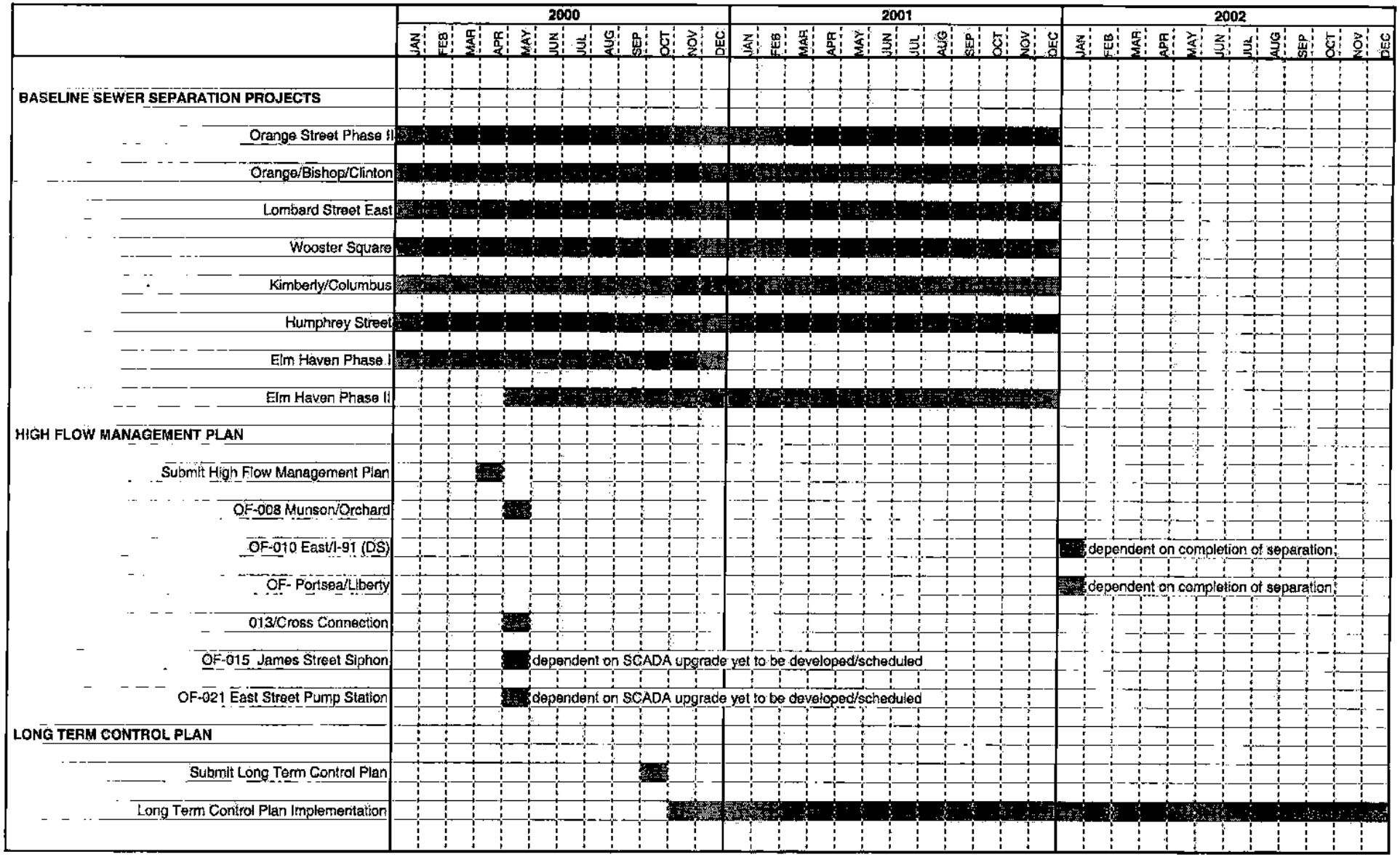

Figure 3-1. High Flow Management Plan Implementation Schedule

References

Cardinal Engineering Associates, Inc. 1981. *Facility Plan, Sewage Collection System*. Volume 1.

Cardinal Engineering Associates, Inc. 1988. *Update and Supplement to Facility Plan for Elimination of Combined Sewer Overflows*. March, 1988.

CH2M HILL. 2000. City of New Haven Long Term CSO Control Plan, Technical Memorandum #6, *Hydraulic Characterization Report*. February, 2000

CH2M HILL. 1999. City of New Haven Long Term CSO Control Plan, Technical Memorandum #12, *Preliminary Evaluation of CSO Control Alternatives*. January, 1999.

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CH2M HILL. 1997. City of New Haven Long Term CSO Control Plan, Technical Memorandum #1, *Project Goals and Approach*. June, 1997.

CTDEP. 1995. NPDES Permit Modification for City of New Haven WPAF. October 24, 1995.

United States Environmental Protection Agency (USEPA). 1995. *Combined Sewer Overflows, Guidance for Nine Minimum Controls*. EPA 832-B-95-003. May, 1995.

APPENDIX A

Revised Baseline Computer Model

The combined/sanitary sewer system model developed during Task 2 of the project is used to evaluate the sewer system's hydraulic characteristics under varying rainfall conditions. For detailed information about the model, see Technical Memorandum #3, *System Inventory and Model Results* (CH2M HILL December 1998).

Precipitation and tide data are input to the model in order to run the hydrologic model component. The results from the hydrologic model runs provide runoff hydrographs of wet-weather inflow to the sewers. Using these results, the hydraulic model routes flows through the sewer system. The resulting hydrographs are then evaluated to determine the volume, frequency, and duration of overflows (if any) at each regulator and the volumes and peak rates for the WPAF for each simulation.

The baseline model represents the conditions that will be achieved in a few years when the planned sewer separation projects have been completed. This appendix briefly reviews the conditions represented in the baseline model and discusses some minor revisions made to the baseline conditions model since the publication of Technical Memorandum #6, *Hydraulic Characterization Report* (CH2M HILL February 2000).

Sewer Separation

Under baseline conditions, the Quinnipiac River watershed has the greatest percentage of fully separated subcatchments. Hence, the river receives a greater percentage of its flow from stormwater than the other rivers. The Mill River watershed has the highest percentage of partially separated[1] subcatchments and no fully separated subcatchments. Therefore, less of the flow into the Mill River is from stormwater and possibly more is from CSOs than if it were fully separated (depending on the collection system's ability to accept wet-weather flow). In the West River watershed, the balance is about equal between combined, partially separated, and fully separated subcatchments. The New Haven Harbor watershed also has a substantial percentage of each subcatchment type, although it has more fully separated catchments than other types. The distribution of subcatchment types is shown in Table A-1.

Active sewer separation projects that were included in the baseline conditions model include:

- Livingston Street, Phases I and II
- Orange Street Phase II
- Orange, Bishop, and Clinton
- Lombard Street East
- Wooster Square

[1] Sewer separation refers to the construction of a new sewer so that sanitary flows can be conveyed to the WPAF without the significant addition of wet-weather runoff; storm sewers generally route wet-weather flows directly to receiving waters. Partial separation refers to a type of sewer separation in which some wet-weather connections to the sanitary sewer (for instance, roof leaders) still exist. In partial separation, the sanitary sewers convey dry-weather flow and some wet-weather flow, and the storm sewers convey the remaining wet-weather runoff.

- Humphrey Street
- Kimberly Avenue and Columbus
- Elm Haven

All catchments in these project areas, except those associated with the Elm Haven project, were classified as partially separated in the baseline model. Because the new storm sewers in Elm Haven will tie back to the combined sewer, these catchments continued to be classified as combined in the baseline model; however, the location where the stormwater enters the combined system was moved further downstream to represent the connection from the new storm sewer.

TABLE A-1
Distribution of Sewer Separation Within New Haven Under Baseline Conditions (acres and percent)

Watershed	Subcatchment Type				TOTAL
	Combined	Partially Separated	Separated	Non-sewered	
Quinnipiac River	334 (21%)	203 (13%)	971 (61%)	95 (6%)	1,603
Mill River	270 (30%)	636 (70%)	0 (0%)	8 (1%)	914
West River	1,026 (30%)	1,075 (32%)	1,145 (34%)	138 (4%)	3,384
Harbor	453 (21%)	558 (26%)	950 (45%)	148 (7%)	2,109
TOTAL	2,083	2,472	3,066	389	8,010

Other Changes

In the calibration and verification models, the tide gate at CSO 016 (Poplar/River) was modeled as stuck partially open, representing the existing field condition. Such a condition allows tidal flows to enter the overflow pipe as well as limiting the exit of overflows. In the baseline model, the tide gate was restored and allowed to function properly.

In response to field conditions, the WPCA modified three regulators in early 1998. The changes were included in the baseline model. The following list shows which regulators were impacted:

- CSO 004 (Boulevard/Legion Avenue) – weir crests of all three weirs were raised to the same elevation of 6.9 feet USCGS (34" above the invert of the interceptor)
- CSO 009 (James Street/Grand Avenue) – the weir crest was raised six inches to 5.7 feet USCGS
- CSO 013 (East Rock Road/Everit) – the weir crest was raised six inches to 22.2 feet USCGS

The baseline model (as well as the calibration and verification models) includes sediment in certain areas of the system, such as interceptors along Front Street in Fair Haven and along E. T. Grasso Boulevard. In many areas, velocities are sufficiently slow to cause the silt layer

to build up quickly if the sewer were cleaned, so modeling the sediment represents a realistic condition.

Recent Revisions

Since the publication of TM #6, a few additional revisions were made to the baseline conditions model to reflect new understandings through discussions with City and WPCA staff. These revisions include:

- As part of the Humphrey Street sewer separation project, the existing weir will be demolished and a new weir will be built a few hundred feet west on Humphrey Street. Based on a new understanding of the planned project, the weir crest elevation was raised from 11.7' to 12.4', which is the approximate elevation of the crown of the new 42" diameter pipe being constructed during the separation project. The effect of the change was that the overflow volume at 011 (Humphrey/I-91) was reduced and the CSO volumes at 012 (Mitchell/Nicoll), 010 (East/I-91), and East/Ives were increased.

- In association with the Kimberly/Columbus sewer separation project, tide gates will be installed just upstream of the Union Pump Station and just downstream of the weir on the overflow pipe at CSO 002 (Boulevard/Lamberton). These tide gates were added to the revised baseline conditions model.

- The Morris Cove Pump Station had previously been modeled with a bypass pipe. However, the bypass is understood to be closed by a sluice gate, so it was removed from the baseline model.

- Previous models did not allow bypassing at the Quinnipiac Pump Station and used only 1 pump during wet weather. However, a bypass pipe exists, and the pump station is operated with 2 pumps during wet weather. The model was revised, resulting in a small overflow at the Quinnipiac Pump Station and an increase in the CSO volume at 020 (Quinnipiac/Clifton).

- Cross-connections between combined and storm sewers that were recently determined to be open at S. Frontage/Davenport and Portsea/Liberty were added to the model.

APPENDIX B

Bottleneck Details

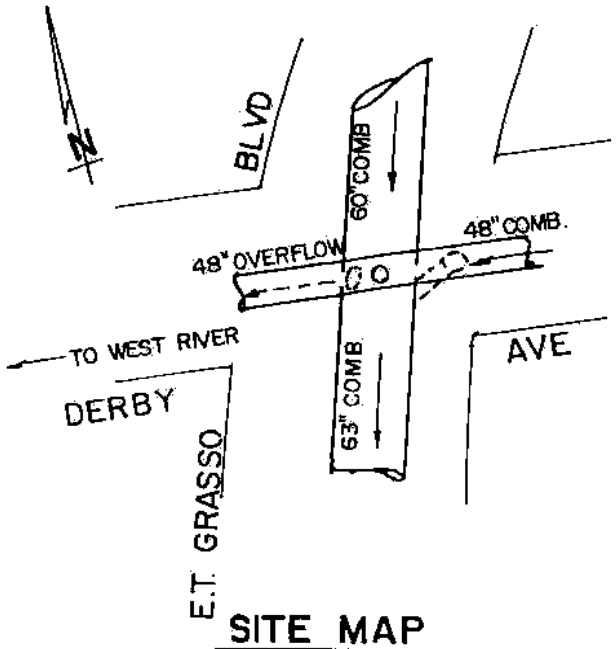
The following list provides further details about the bottleneck at each of the areas identified in Section 2. Maps and/or sketches for each site are provided following the list.

- Fairfield Street and Ramsdell Street (flow in steep 15-inch diameter pipe transitions to 250-feet of 10-inch diameter pipe, causing street flooding)
- Boulevard and Derby Avenue, CSO 005 (the local inflow from the Derby Avenue trunk line flows through 3-90° bends and drops 4 feet before entering the Boulevard Interceptor, causing significant head losses, contributing to CSOs, and resulting in the deposition of material at the connection)
- Boulevard and Orange Avenue, CSO 003 (several utilities are known to be crossing the Boulevard Interceptor at this location and are believed to contribute to siltation and CSO activity)
- Near Boulevard Pump Station and CSO 024 (7-foot wide x 5.75-foot high Boulevard Interceptor flowing full during wet weather plus 12-inch diameter sewer from Water Street and 6-inch diameter force main from Long Wharf Pump Station transitioning to 580 feet of 48-inch pipe to the Boulevard Pump Station near CSO 024, causing backwater and CSO activity)
- George Street and Temple Street CSO (a 42-inch egg-shaped sewer on George Street and a 24-inch egg-shaped sewer on Temple Street combine and transition to 20 feet of 48-inch sewer which then transitions at the CSO regulator to 260 feet of 24-inch sewer, causing flooding complaints at the nearby parking garage)
- Union Avenue and Columbus Avenue (a 54-inch sewer on Union Avenue transitions to 75 feet of two parallel sewers – an 8-inch and a 15-inch – and then combines with a 30-inch sewer on Columbus Avenue, transitioning to 23 feet of 30-inch and then to a 36-inch sewer)
- Lombard Street near North Front Street and CSO 018 (a steep 36-inch egg-shaped sewer on Lombard Street transitions to 105 feet of 18-inch sewer at CSO 018, where backwater exists from the Front Street Interceptor, causing CSO activity and limiting flow to the full interceptor)
- James Street between River Street and CSO 015 (the 2.9-feet wide x 4.3-feet high James Street Interceptor combines with a 60-inch sewer on River Street and transitions to 500 feet of 45-inch diameter sewer causing backwater upstream of the stop logs in the diversion chamber, another bottleneck)
- Quinnipiac Avenue gravity line downstream of twin force mains, near CSO 020 (24-inch gravity sewer has limited capacity to accept high flows delivered by twin 12-inch force mains, causing CSO activity)
- Morris Causeway between Concord Street and Dean Street (355 feet of 18-inch sewer has a lower invert than the pipes just upstream and downstream; at the downstream end, where there is a step up in the invert, street flooding occurs in the 2-year storm; physical inspections described in the Facility Plan (Cardinal Engineering Associates, 1981) indicated surcharge and sludge buildup due to the constriction)

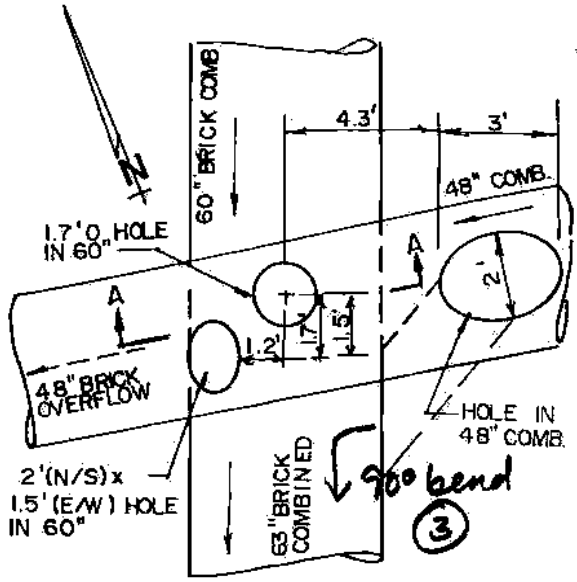
APPENDIX C

Site Sketches


Fairfield St
Ramsdell St
15" ϕ
G09N080
10" ϕ
F09N110
15" ϕ
N

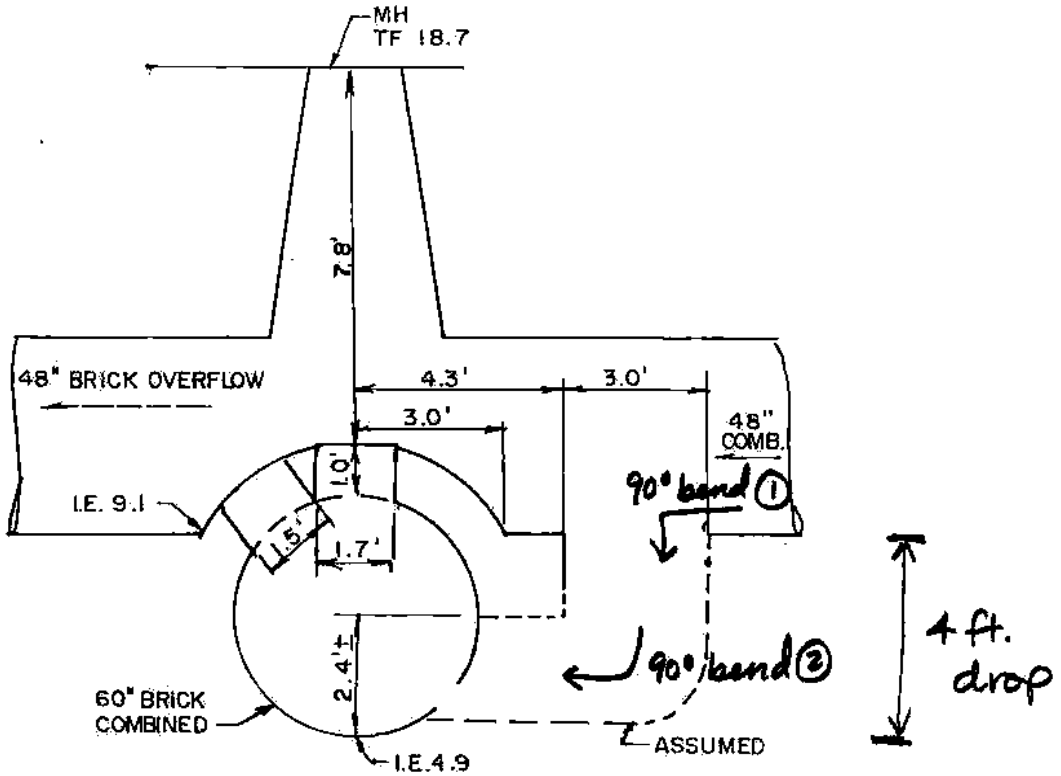


SITE MAP
N. T. S.



PLAN
N. T. S.

NOTE: 72°F/DRY @ 10:00 AM
FLOW DEPTH 1.6' FT IN 60"



SECTION "A-A"
N. T. S.

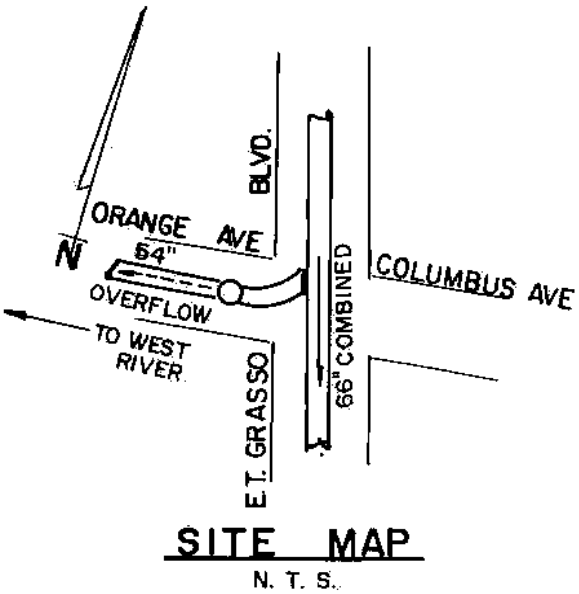
LEGEND

WET WEATHER FLOW

DRY WEATHER FLOW

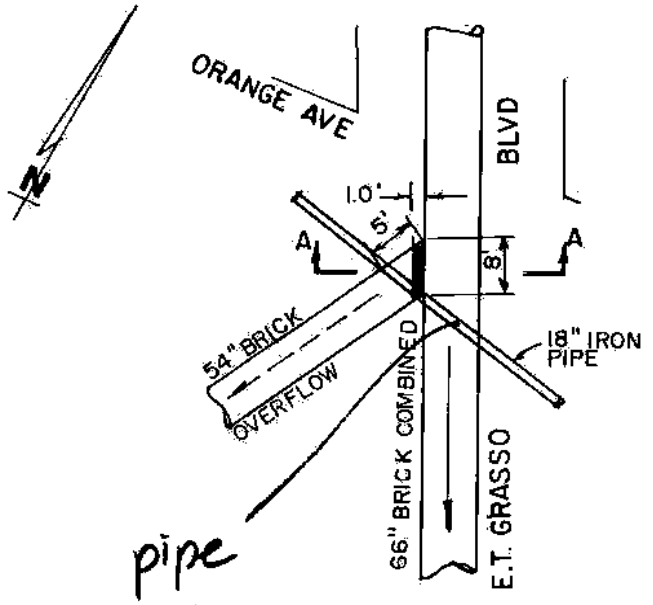
OVERFLOW NO. OB-1/005
E.T. GRASSO BLVD @ DERBY AVENUE
NEW HAVEN, CONNECTICUT

DATE: 8-20-97
JOB NO. 1146
SHT. NO. 23



SITE MAP
N. T. S.

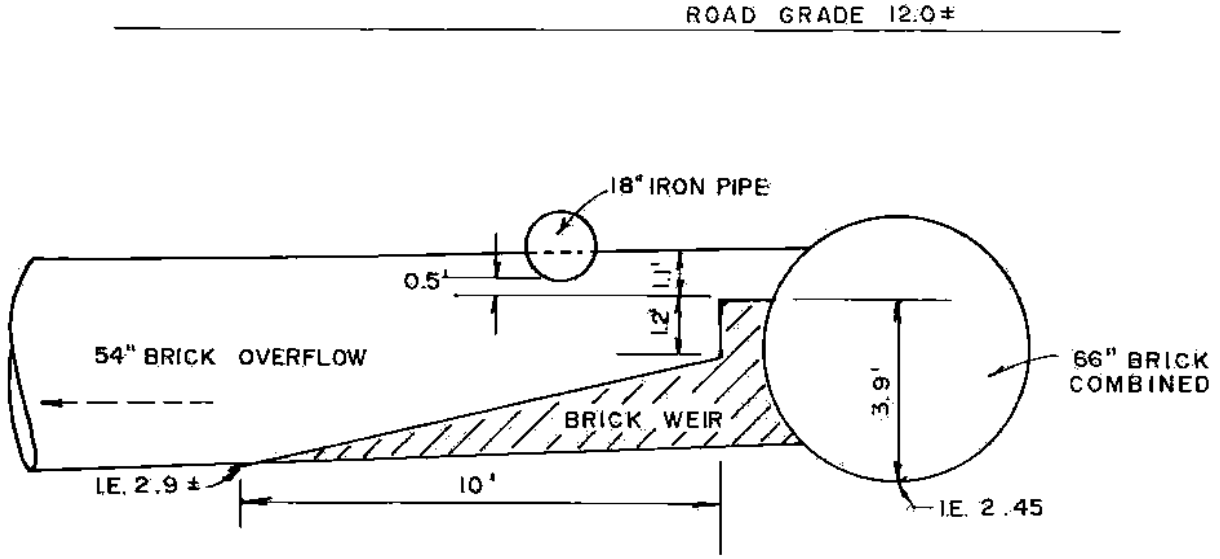
NOTE: 80° F / DRY @ 2:00 PM
FLOW DEPTH 3' FT IN 66"



pipe Crossing interceptor

PLAN
N. T. S.

(not all constrictions shown)

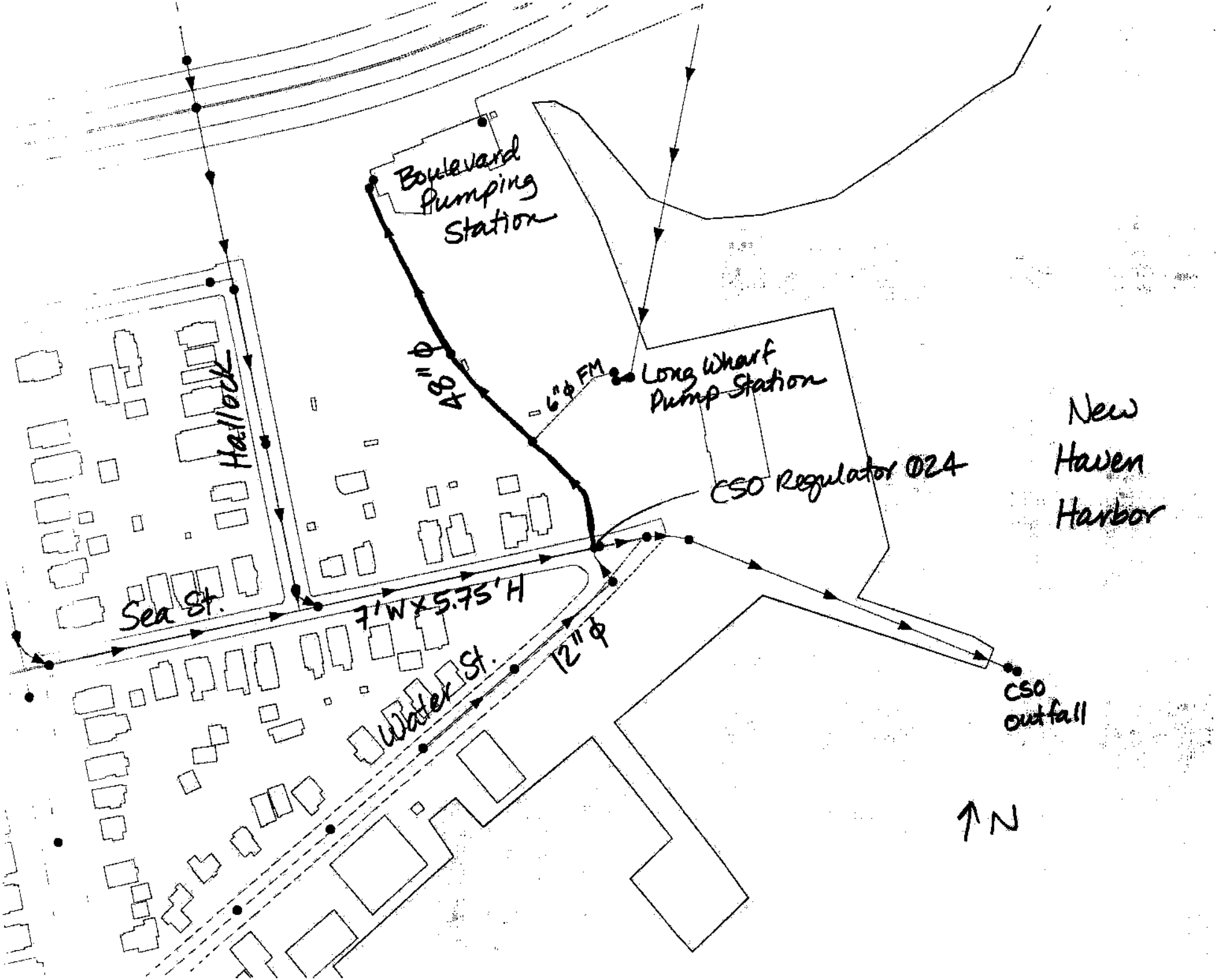


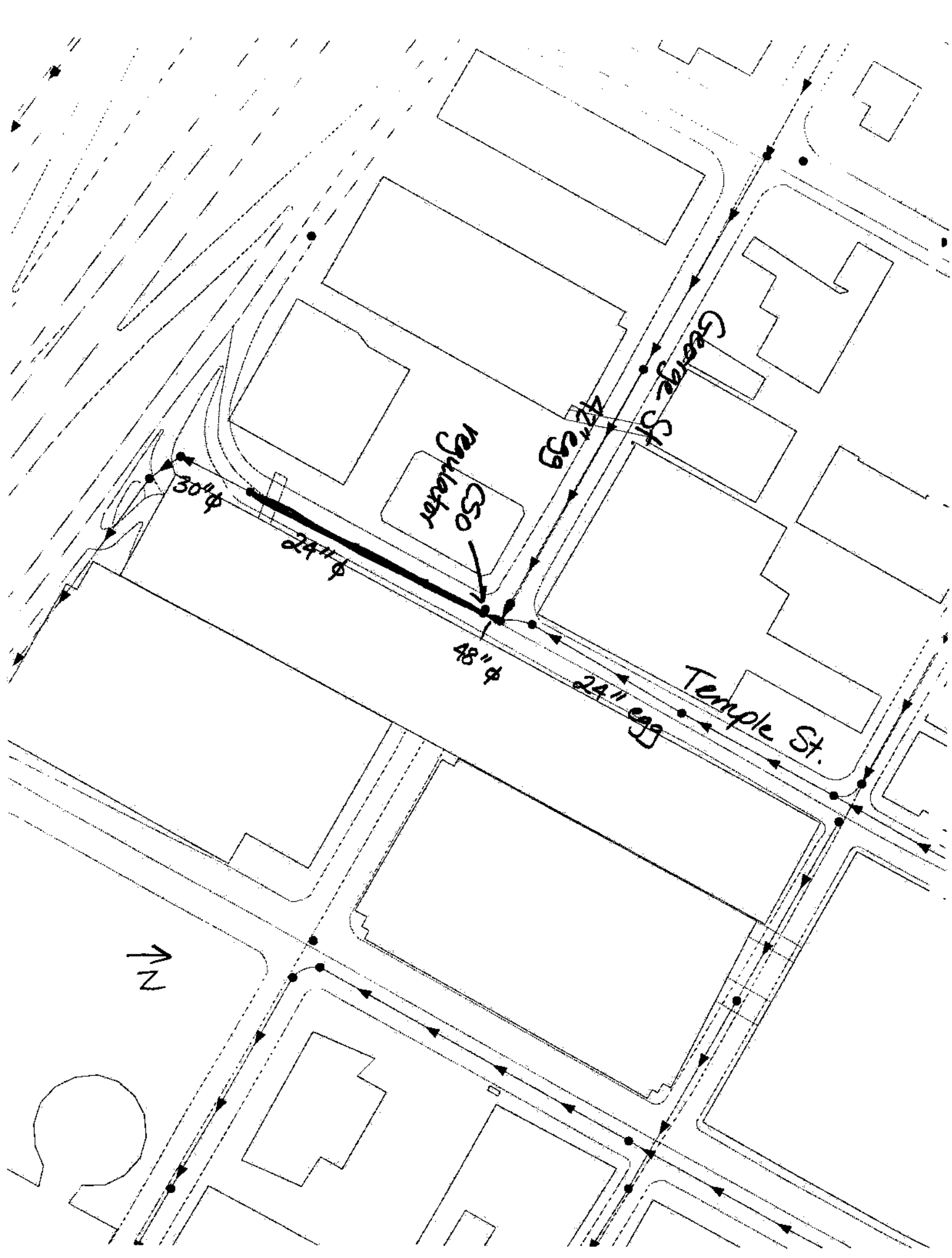
SECTION "A-A"
N. T. S.

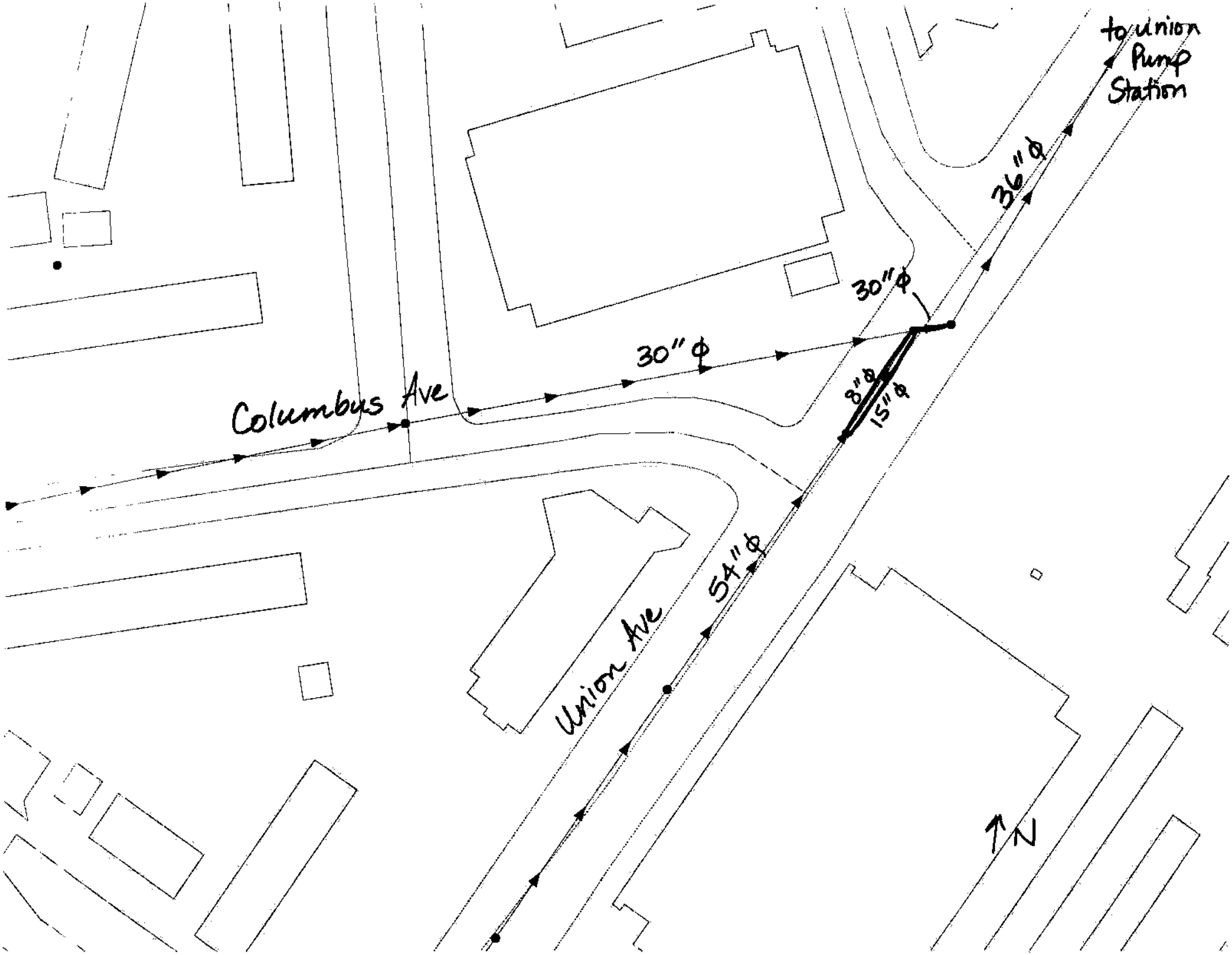
LEGEND
WET WEATHER FLOW
DRY WEATHER FLOW

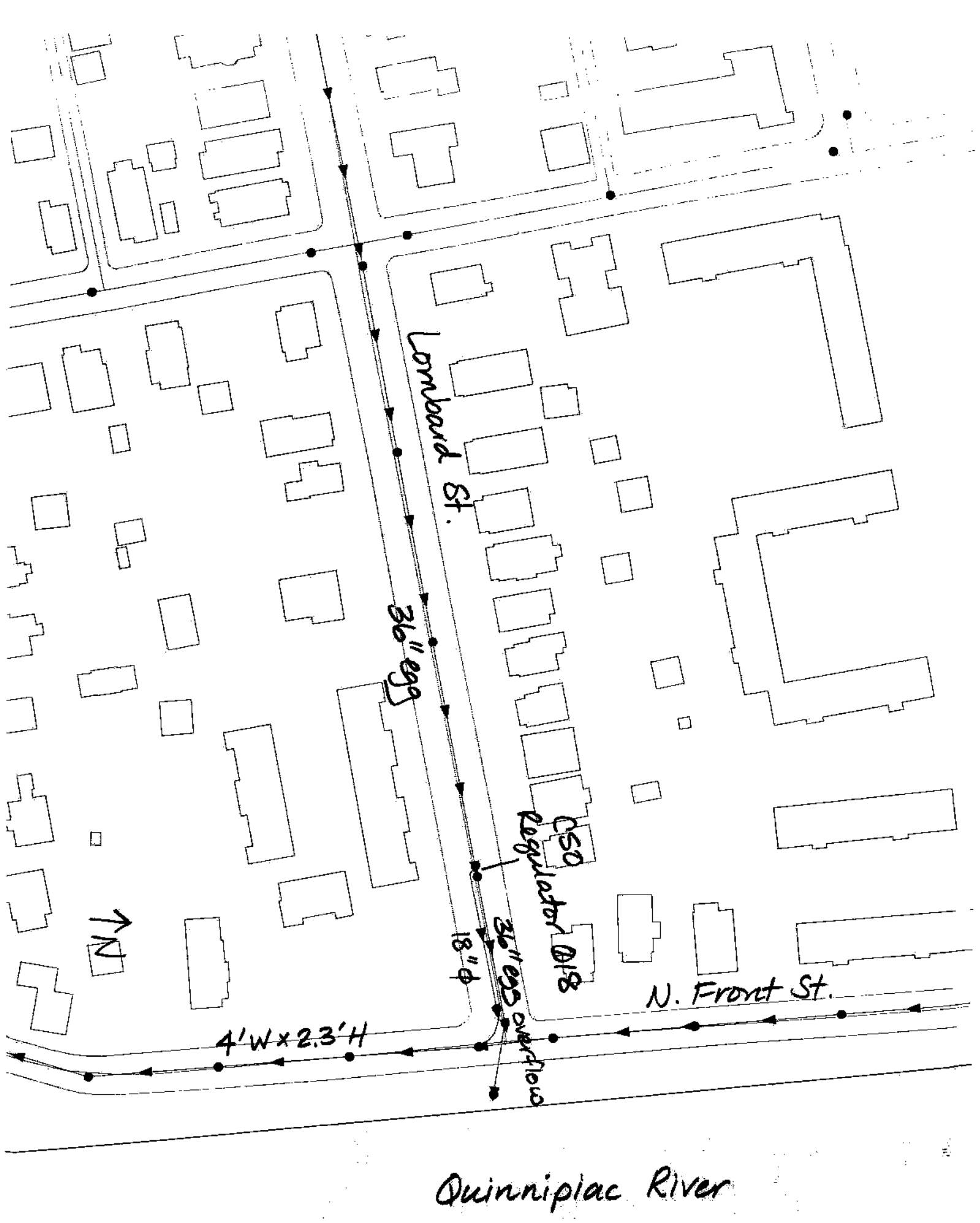
OVERFLOW NO. OB4/003
E.T. GRASSO BLVD @ ORANGE AVE
NEW HAVEN, CONNECTICUT

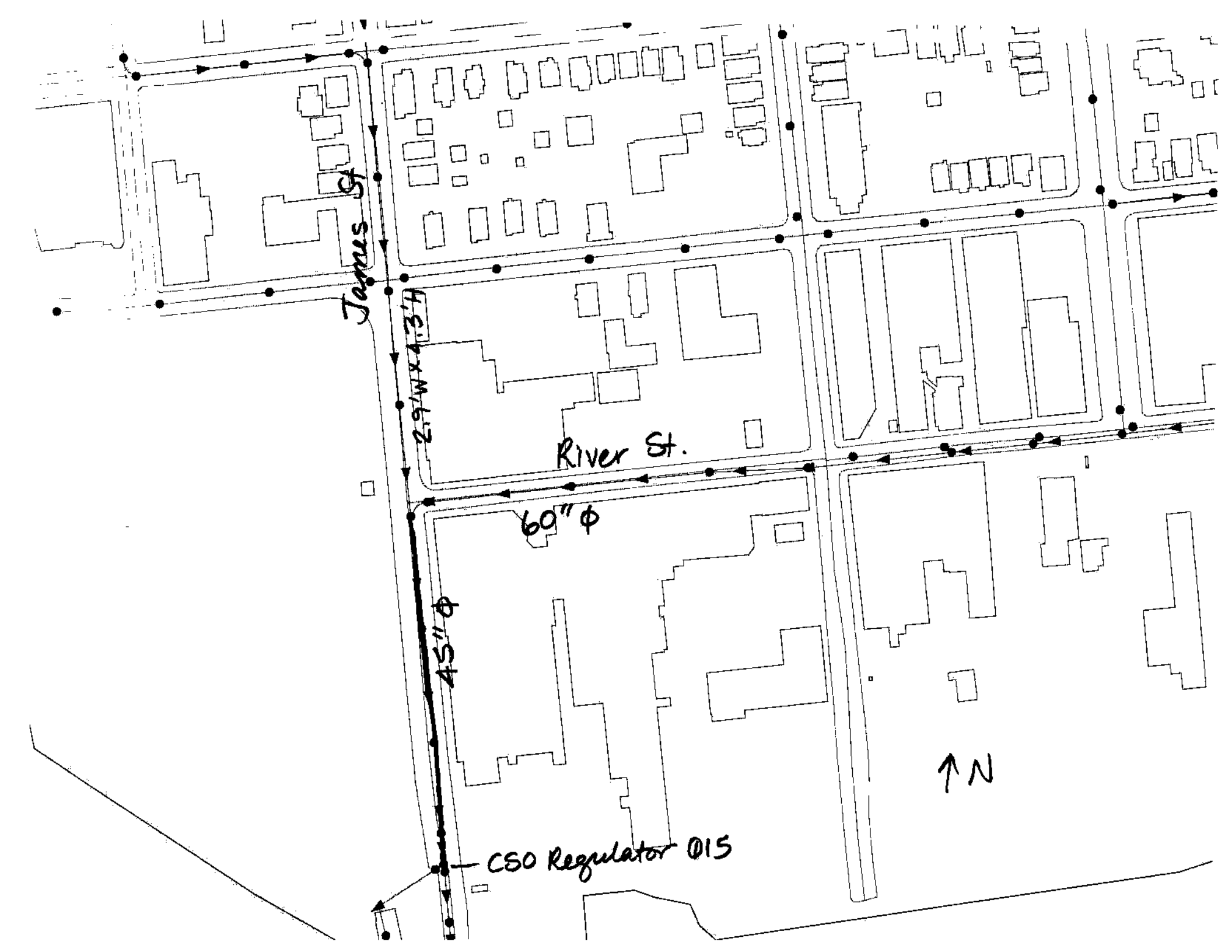
DATE: 7-30-97
JOB NO. 1146
SHT. NO. 21

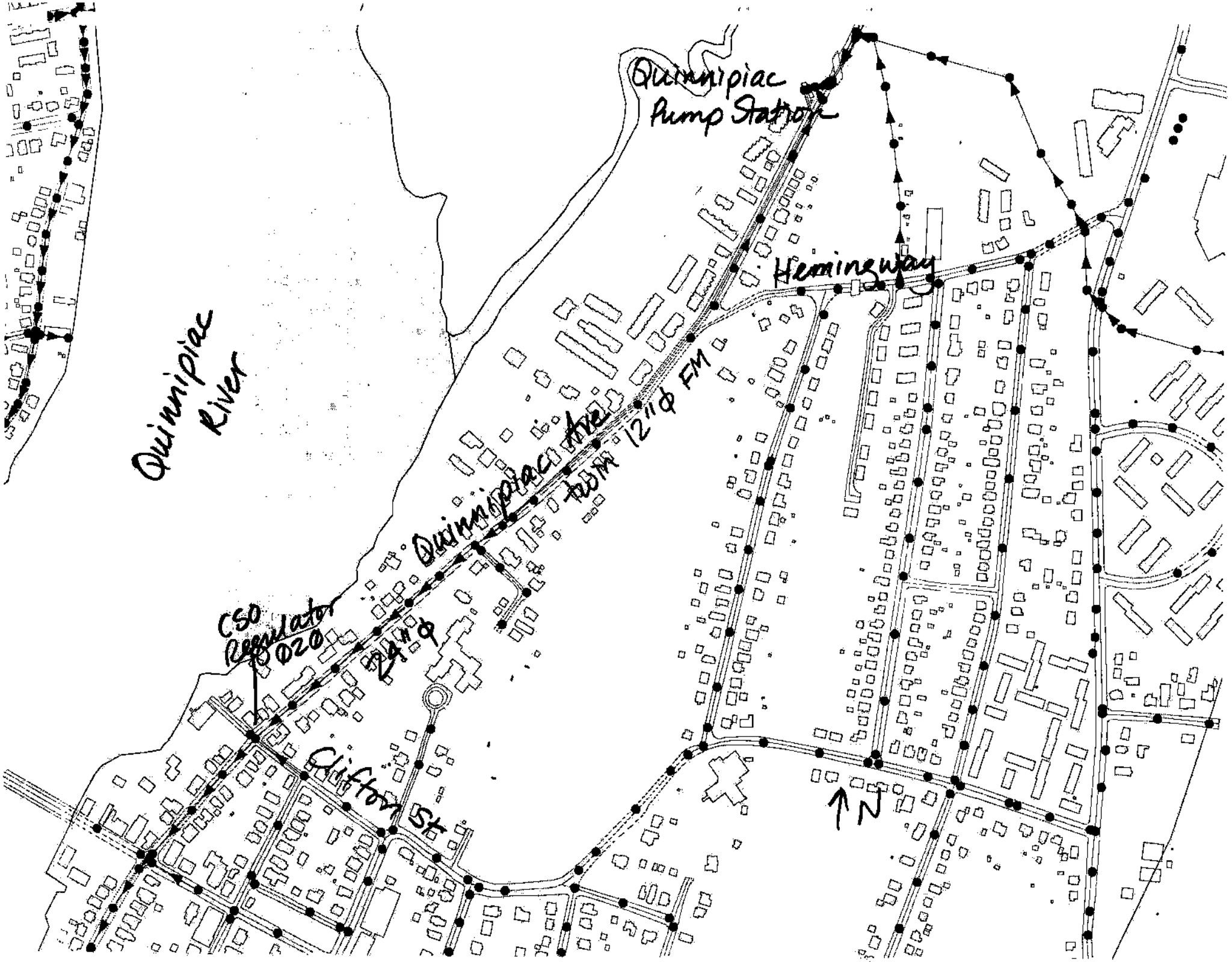

Boulevard Pumping Station
48" ϕ
6" ϕ FM
Long Wharf Pump Station
Hallock
CSO Regulator 024
New Haven Harbor
Sea St.
7'W x 5.75'H
Water St.
12" ϕ
CSO outfall
N

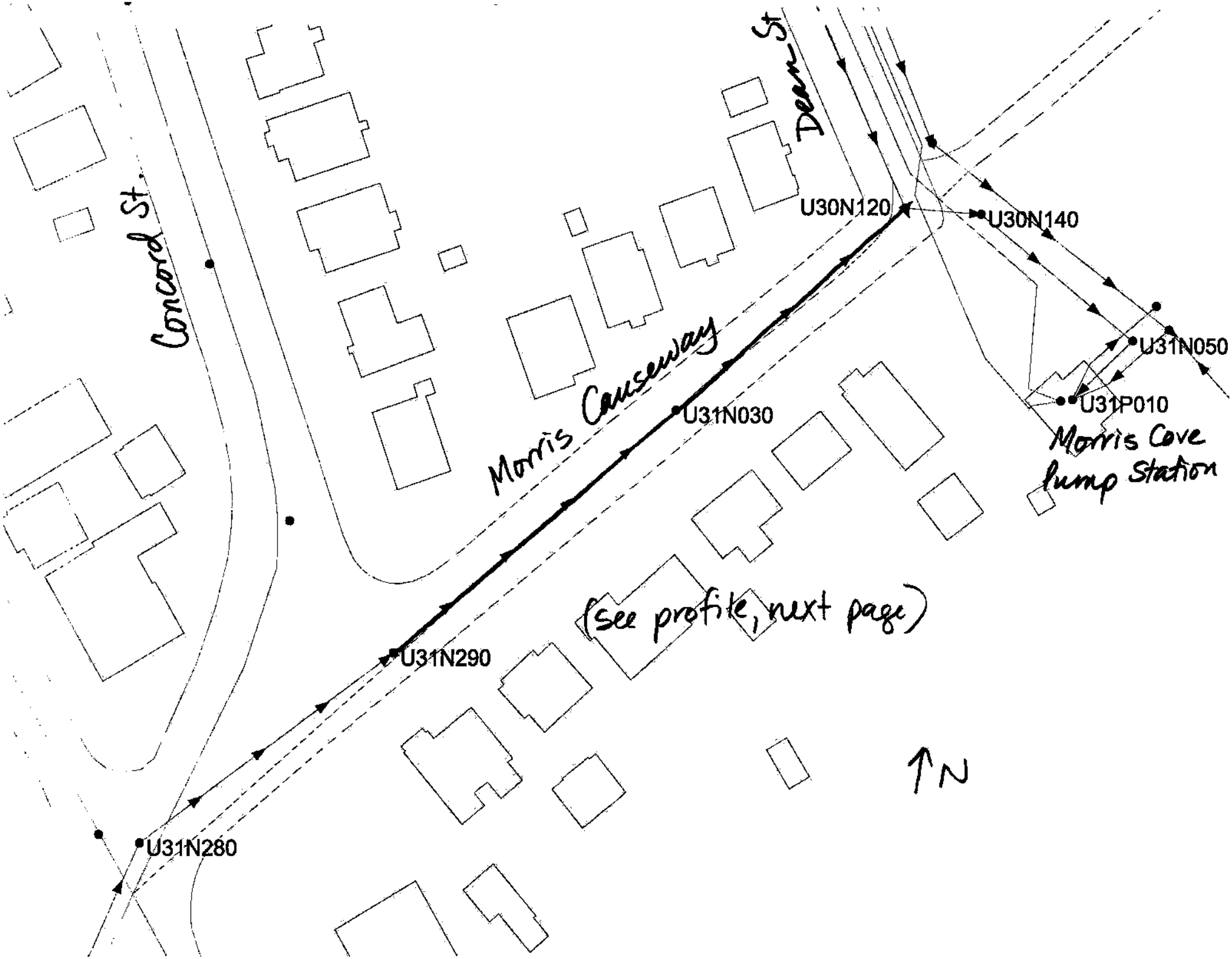

Temple St.
42"RCP
Temple St.
CSO
Regulator
30"ϕ
24"ϕ
48"ϕ
24" egg
Temple St.
N


to union Pump Station
36" ϕ
30" ϕ
30" ϕ
8" ϕ
15" ϕ
Columbus Ave
54" ϕ
Union Ave
N

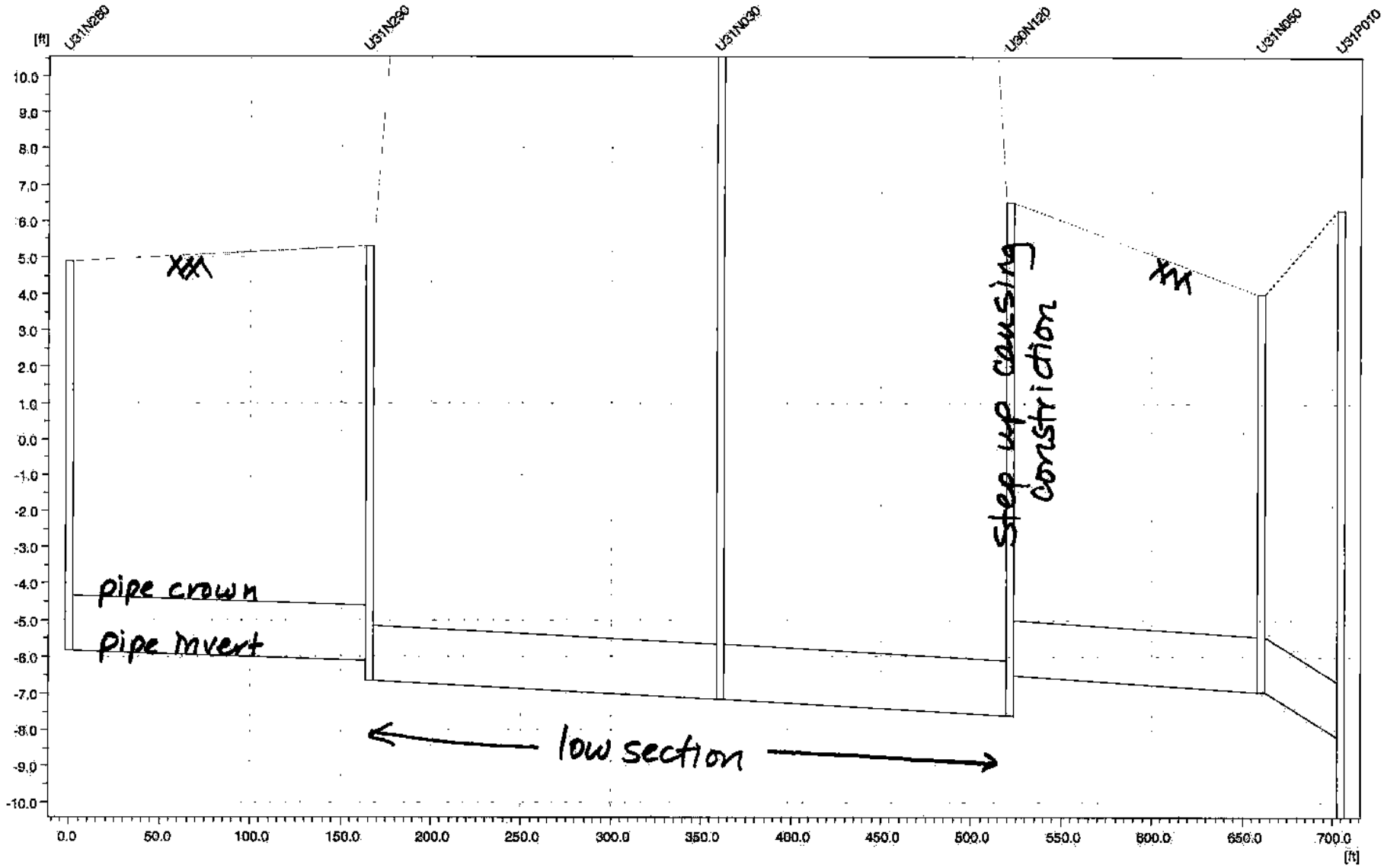

Lombard St.
36" egg
CSO Regulator 018
36" egg overflow
18" ϕ
N
N. Front St.
4'W x 2.3'H
Quinnipiac River


James St
2.9'W x 4.3'H
River St.
60" ϕ
45" ϕ
CSO Regulator 015
N


Quinnipiac Pump Station
Hemingway
Quinnipiac River
Quinnipiac Ave
from 12" ϕ FM
CSO Regulator #020
24" ϕ
Clifton St
N

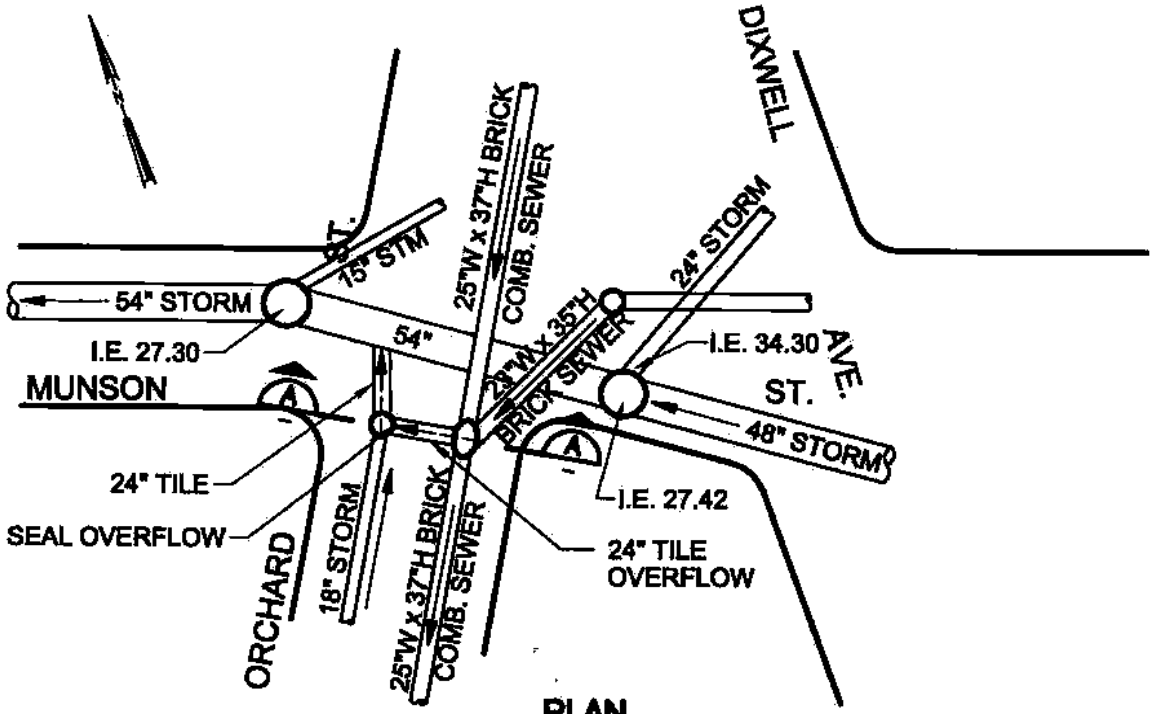

Concord St.
Dean St
Morris Causeway
U30N120
U30N140
U31N050
U31P010
Morris Cove
Pump Station
U31N030
(see profile, next page)
U31N290
U31N280
N

Morris Causeway

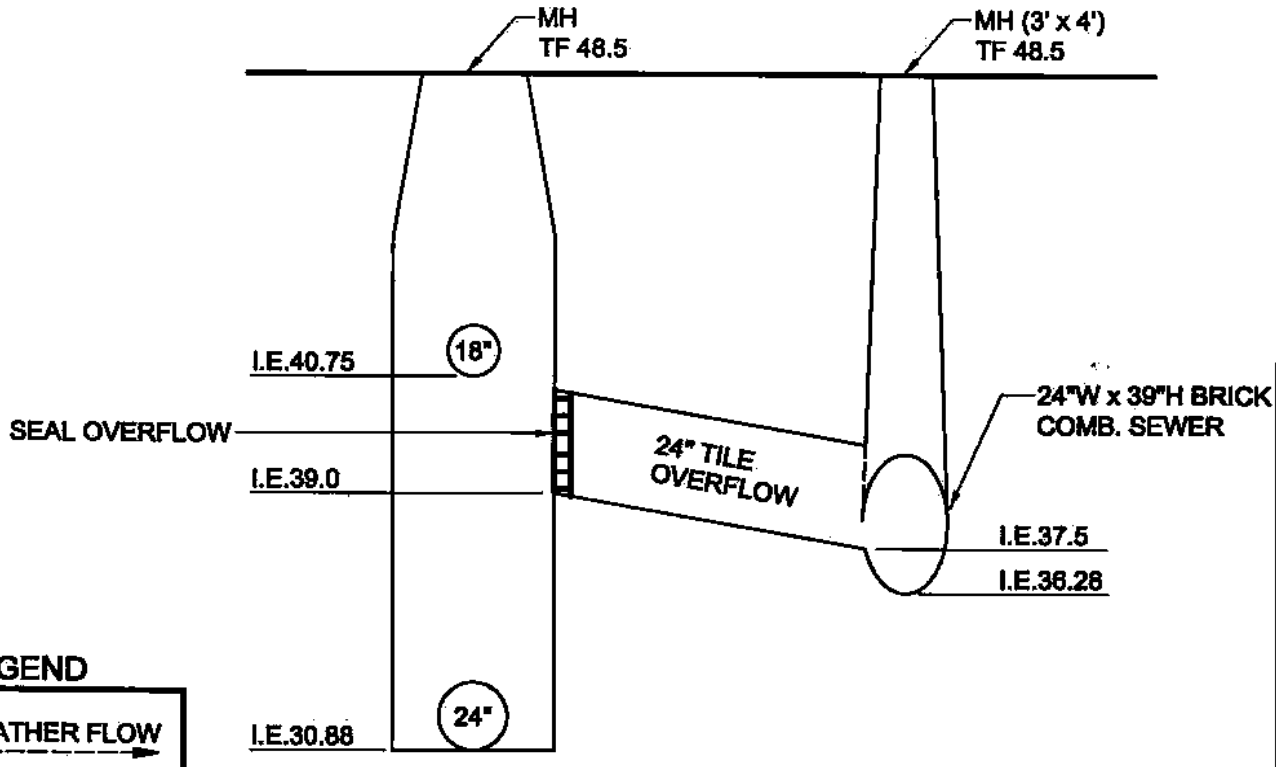


APPENDIX C

Site Sketches



PLAN
NTS



SECTION A
NTS

LEGEND

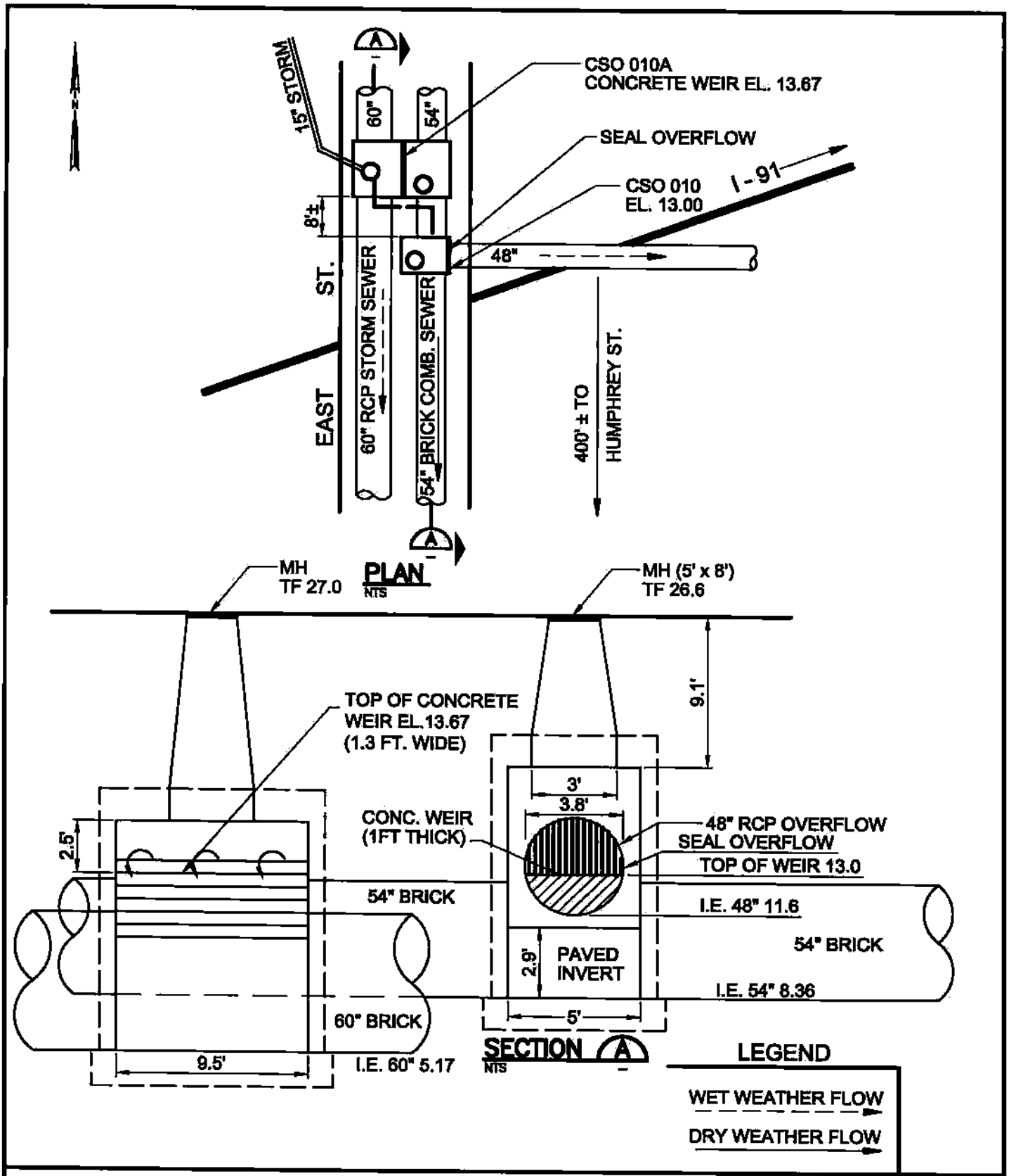
WET WEATHER FLOW

DRY WEATHER FLOW

CITY OF NEW HAVEN
LONG–TERM CSO CONTROL PLAN
CSO 008
MUNSON STREET AT ORCHARD STREET

CH2MHILL

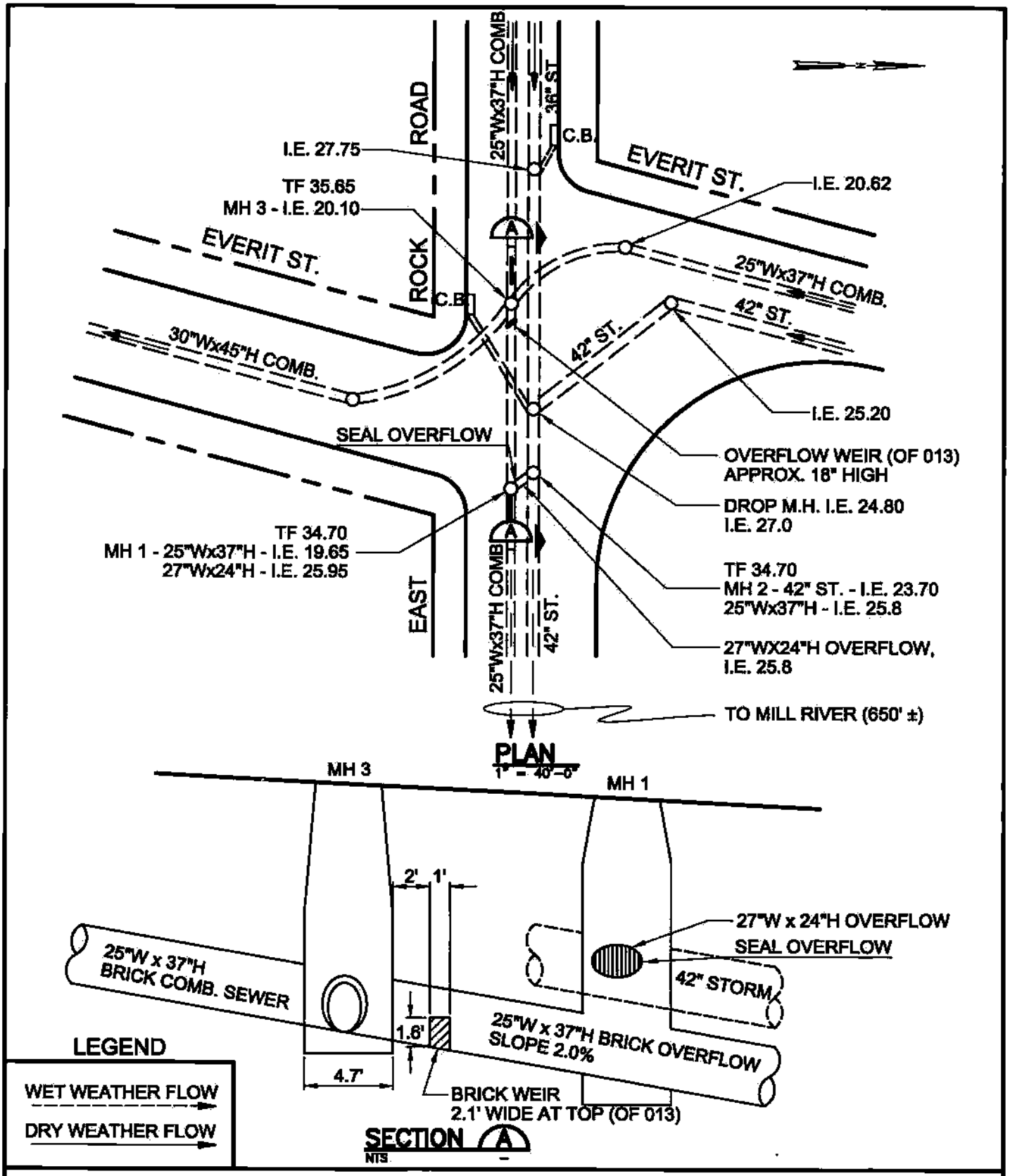
MARCH 22, 2000 OFB.dwg



CITY OF NEW HAVEN
LONG–TERM CSO CONTROL PLAN
CSO 010/010A
EAST STREET AT I–91

CH2MHILL

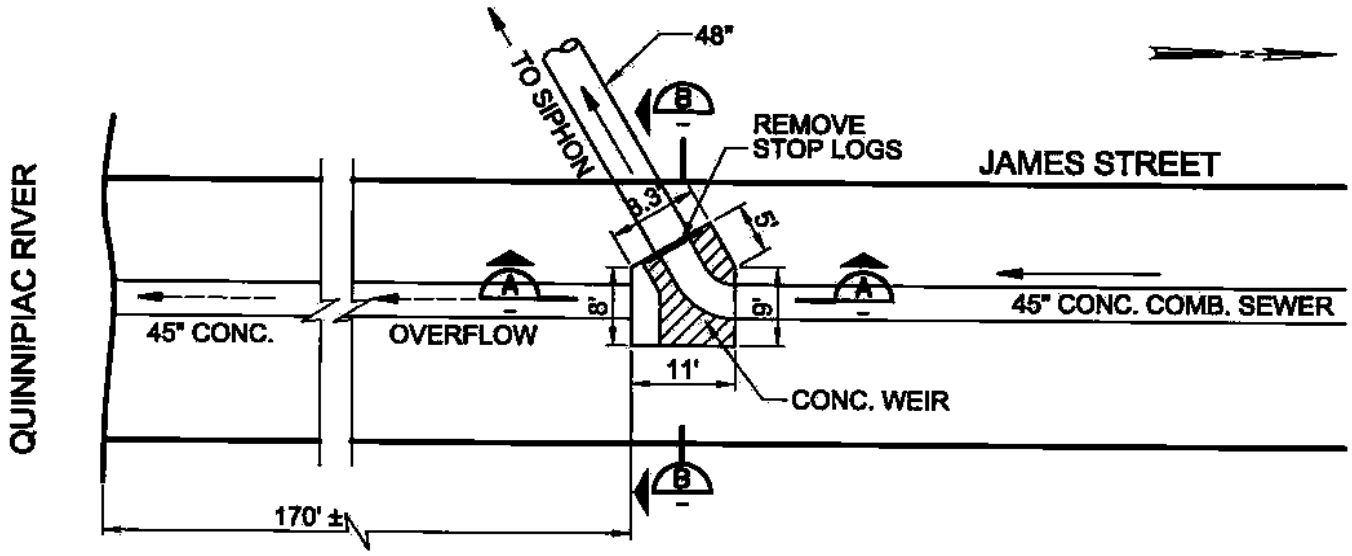
MARCH 22, 2000 OF10A.dwg



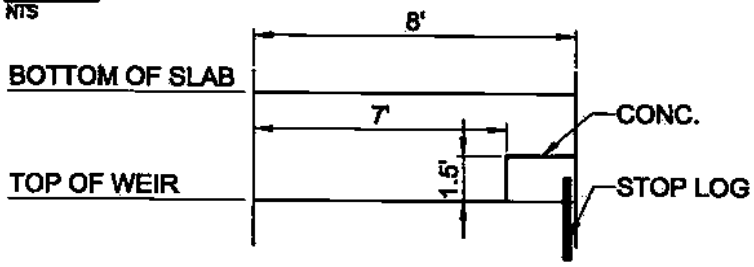
CITY OF NEW HAVEN
LONG–TERM CSO CONTROL PLAN
CSO 013/CROSS CONNECTION
EAST ROCK ROAD AT EVERIT STREET

CH2MHILL

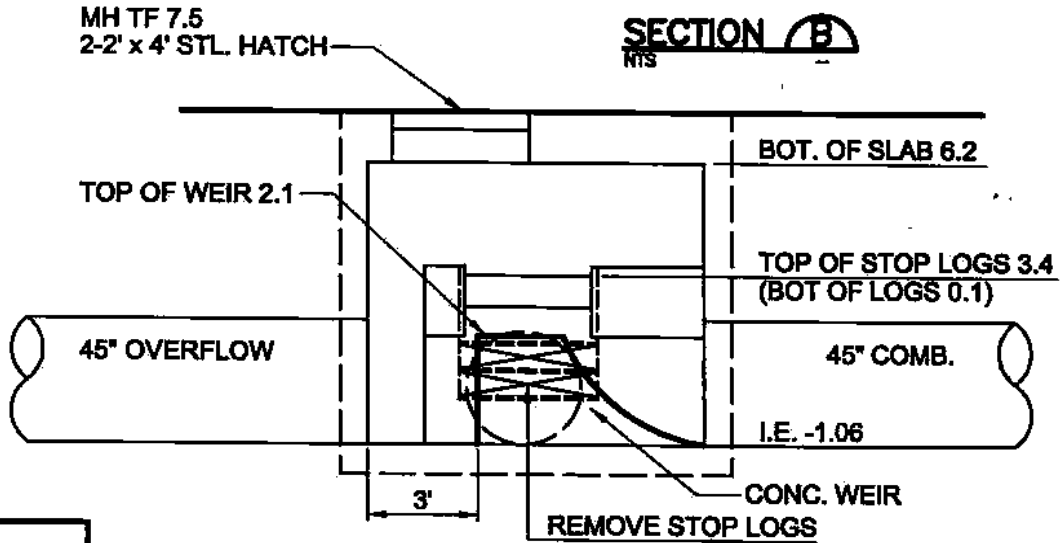
24–FEB–2000 OF13.dwg



PLAN
NTS



SECTION B
NTS



SECTION A
NTS

LEGEND

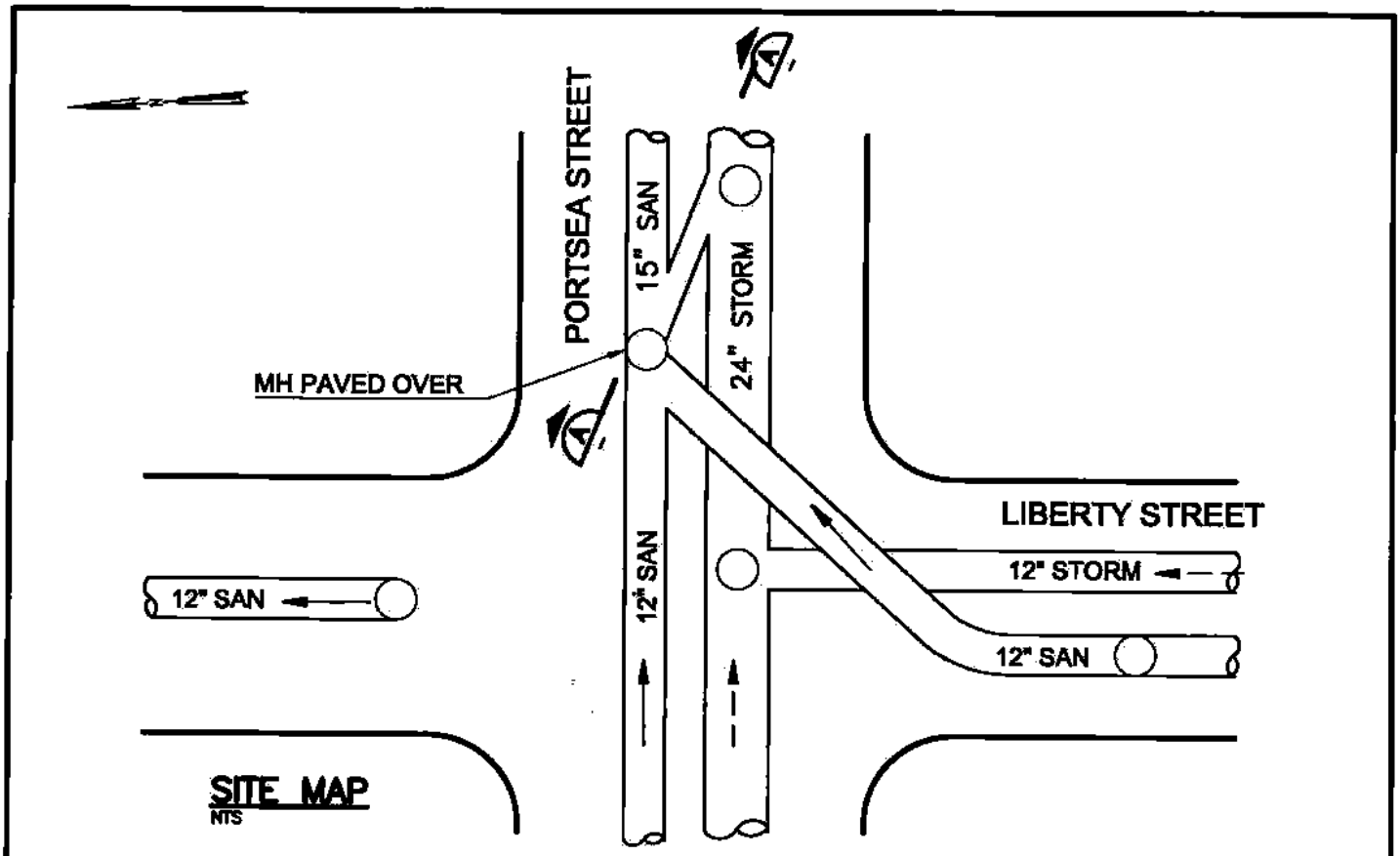
WET WEATHER FLOW

DRY WEATHER FLOW

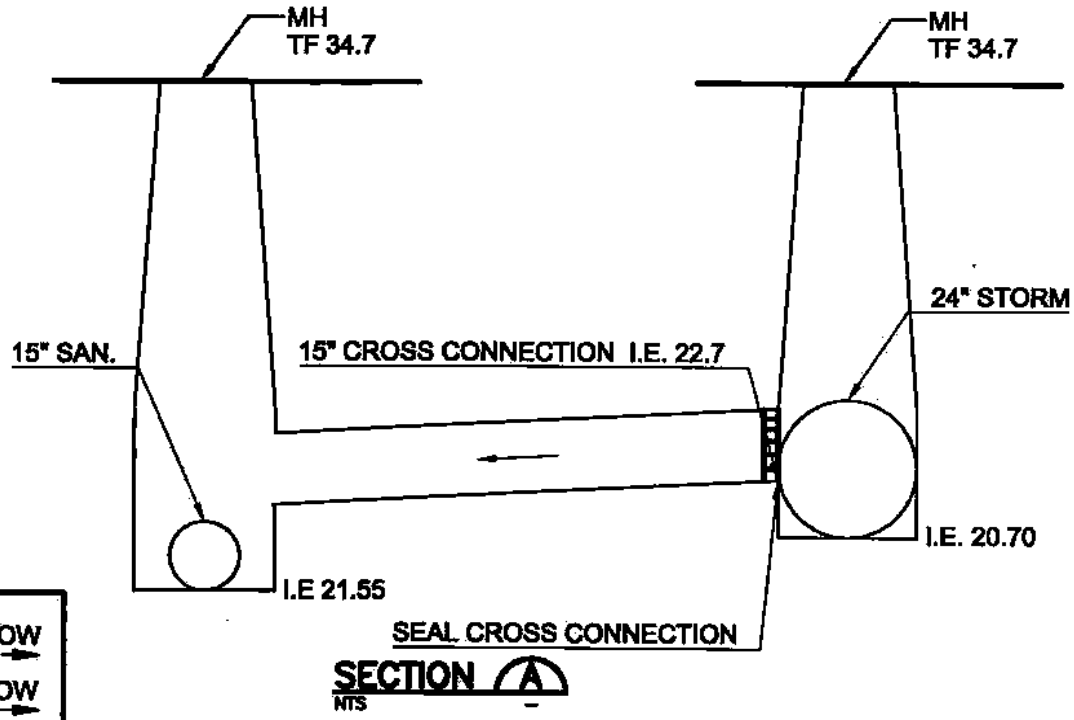
CITY OF NEW HAVEN
LONG–TERM CSO CONTROL PLAN
CSO 015
JAMES STREET

CH2MHILL

MARCH 22, 2000 OF15.dwg



SITE MAP
NTS



SECTION A
NTS

LEGEND

WET WEATHER FLOW

DRY WEATHER FLOW

CITY OF NEW HAVEN
LONG-TERM CSO CONTROL PLAN

PORTSEA AND LIBERTY

CH2MHILL

MARCH 22, 2000 PORT-LIB.DWG

APPENDIX D

Cost Estimates

Estimate Summary

Project:	CITY OF NEW HAVEN		BY: BRG
Facility:	SHORT TERM SOLIDS & FLOATABLES		26-Apr-2000
File Name: NH ST COSTS.XLS	CSO # 005		PN: 135807.BA.05

	DESCRIPTION	QTY	UNIT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR FURNISHING AND INSTALLING SEWER PIPE							
Item 1a	For Furnishing and Installing 48" RCP Sewer Pipe	LF.	8	$80	$640	$96	$110	$846
Item 1b	For Furnishing and Installing 66" RCP Sewer Pipe	LF.	8	$150	$1,200	$180	$207	$1,587
ITEM 2	FOR EXCAVATION (Including Disposal)							
Item 2a	For Excavations up to 15 feet Deep	CY.	60	$120	$7,200	$1,080	$1,242	$9,522
ITEM 3	FOR FURNISHING AND PLACING SELECT MATERIAL							
Item 3a	For Dense Graded Aggregate (DGA)	CY.	25	$35	$875	$131	$151	$1,157
Item 3b	For ¾" Broken Stone	CY.	10	$45	$450	$68	$78	$595
ITEM 4	FOR PAVEMENT RESTORATION INCLUDING SUBGRADE PREPARATION							
Item 4a	For Saw Cutting	LF.	45	$15	$675	$101	$116	$893
Item 4b	For Bituminous Concrete Stabilized Base Course Mix I-2	CY.	4	$240	$960	$144	$166	$1,270
Item 4c	For Bituminous Concrete Surface Course Mix I-5	CY.	1	$260	$260	$39	$45	$344
ITEM 5	FOR FURNISHING, INSTALLING AND REMOVING SHEETING							
Item 5a	For Sheeting up to 15 feet Deep	SY.	70	$60	$4,200	$630	$725	$5,555
ITEM 6	FOR FURNISHING AND PLACING CONCRETE AND REINFORCEMENT							
Item 6a	For Concrete (Including forms)	CY.	25	$385	$9,625	$1,444	$1,660	$12,729
Item 6b	For Reinforcement	LBS.	500	$5	$2,500	$375	$431	$3,306
ITEM 7	FOR FLOW BYPASS AND DEWATERING							
Item 7a	For 4" Pump	Hours	120	$80	$9,600	$1,440	$1,656	$12,696
ITEM 8	FOR STEEL PLATING							
Item 8a	For Furnishing, Installing and Removing Steel Plates	Ton	3	$2,200	$6,600	$990	$1,139	$8,729
ITEM 9	FOR TRAFFIC CONTROL	Hours	120	$40	$4,800	$720	$828	$6,348
ITEM 10	FOR UTILITY RELOCATION	LS.	0	$5,000	$0	$0	$0	$0
ITEM 11	FOR CONFINED SPACE ENTRY	DAY	2	$250	$500	$75	$86	$661
ITEM 12	MOBILIZATION	LS.	1	$6,500.00	$6,500	$975	$1,121	$8,596
							TOTAL:	$74,834

Estimate Summary

Project:	CITY OF NEW HAVEN	BY: BRG
Facility:	SHORT TERM SOLIDS & FLOATABLES	26-Apr-2000
File Name: NH ST COSTS.XLS	CSO # 003	PN: 135807.BA.05

	DESCRIPTION	QTY	UNT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a	Raising or Removing Stop Log Weir	LF.	1	$25	$25	$4	$4	$33
ITEM 2	FOR FLOW BYPASS AND DEWATERING							
Item 2a	For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3	FOR TRAFFIC CONTROL	Hours	4	$40	$160	$24	$28	$212
ITEM 4	FOR UTILITY RELOCATION	LS.	1	$15,000	$15,000	$2,250	$2,588	$19,838
ITEM 5	FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 6	MOBILIZATION	LS.	1	$2,500	$2,500	$375	$431	$3,306
							TOTAL:	$24,142

Estimate Summary

Project:	CITY OF NEW HAVEN	BY: BRG
Facility:	SHORT TERM SOLIDS & FLOATABLES	26-Apr-2000
File Name: NH ST COSTS.XLS	CSO # 008	PN: 135807.BA.05

DESCRIPTION	QTY	UNIT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1 FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a Construction or Reconstruction with Brick Masonry	SF.	3	$40	$120	$18	$21	$159
Item 1b Plastering Walls of Manholes and Weirs	SF.	7	$12	$84	$13	$14	$111
ITEM 2 FOR FLOW BYPASS AND DEWATERING							
Item 2a For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3 FOR TRAFFIC CONTROL	Hours	4	$40	$160	$24	$28	$212
ITEM 4 FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 5 MOBILIZATION	LS.	1	$500	$500	$75	$86	$661
						TOTAL:	$1,896

Estimate Summary

Project:	CITY OF NEW HAVEN	BY: BRG
Facility:	SHORT TERM SOLIDS & FLOATABLES	26-Apr-2000
File Name: NH ST COSTS.XLS	CSO # 013 CROSS CONNECTION	PN: 135807.BA.05

	DESCRIPTION	QTY	UNT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a	Construction or Reconstruction with Brick Masonry	SF.	3	$40	$120	$18	$21	$159
Item 1b	Plastering Walls of Manholes and Weirs	SF.	7	$12	$84	$13	$14	$111
ITEM 2	FOR FLOW BYPASS AND DEWATERING							
Item 2a	For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3	FOR TRAFFIC CONTROL	Hours	4	$40	$160	$24	$28	$212
ITEM 4	FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 5	MOBILIZATION	LS.	1	$500	$500	$75	$86	$661
							TOTAL:	$1,896

Estimate Summary

Project: CITY OF NEW HAVEN
Facility: SHORT TERM SOLIDS & FLOATABLES
File Name: NH ST COSTS.XLS — CSO # 010 (DOWNSTREAM)

BY: BRG
22-Mar-00
PN: 135807.BA.05

	DESCRIPTION	QTY	UNT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a	Construction or Reconstruction with Brick Masonry	SF.	2	$40	$80	$12	$14	$106
Item 1b	Plastering Walls of Manholes and Weirs	SF.	4	$12	$48	$7	$8	$63
ITEM 2	FOR FLOW BYPASS AND DEWATERING							
Item 2a	For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3	FOR TRAFFIC CONTROL	Hours	4	$40	$160	$24	$28	$212
ITEM 4	FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 5	MOBILIZATION	LS.	1	$500	$500	$75	$86	$661
							TOTAL:	$1,796

Estimate Summary

Project: CITY OF NEW HAVEN
Facility: SHORT TERM SOLIDS & FLOATABLES
File Name: NH ST COSTS.XLS — CSO # 015

BY: BRG
26-Apr-2000
PN: 135807.BA.05

	DESCRIPTION	QTY	UNT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a	Construction or Reconstruction with Brick Masonry	SF.	0	$40	$0	$0	$0	$0
Item 1b	Plastering Walls of Manholes and Weirs	SF.	0	$12	$0	$0	$0	$0
Item 1c	Raising or Removing Stop Log Weir	LF.	4	$25	$100	$15	$17	$132
ITEM 2	FOR FLOW BYPASS AND DEWATERING							
Item 2a	For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3	FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 4	MOBILIZATION	LS.	1	$500	$500	$75	$86	$661
							TOTAL:	$1,547

Estimate Summary

Project: CITY OF NEW HAVEN
Facility: SHORT TERM SOLIDS & FLOATABLES
File Name: NH ST COSTS.XLS CSO # Portsea - Liberty

BY: BRG
26-Apr-2000
PN: 135807.BA.05

	DESCRIPTION	QTY	UNT	INSTALLED COST UNIT$	INSTALLED COST AMOUNT	OH & P 15%	CONTINGENCY 15%	TOTAL
ITEM 1	FOR REHABILITATION OF MANHOLES AND WEIRS							
Item 1a	Construction or Reconstruction with Brick Masonry	SF.	1.25	$40	$50	$8	$9	$66
Item 1b	Pargetting Walls of Manholes and Weirs	SF.	4	$12	$48	$7	$8	$63
Item 1c	Raising or Removing Stop Log Weir	LF.	0	$25	$0	$0	$0	$0
ITEM 2	FOR FLOW BYPASS AND DEWATERING							
Item 2a	For 4" Pump	Hours	4	$80	$320	$48	$55	$423
ITEM 3	FOR TRAFFIC CONTROL	Hours	4	$40	$160	$24	$28	$212
ITEM 4	FOR CONFINED SPACE ENTRY	DAY	1	$250	$250	$38	$43	$331
ITEM 5	MOBILIZATION	LS.	1	$500	$500	$75	$86	$661
							TOTAL:	$1,756