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CITY OF NEW BEDFORD, MASSACHUSETTS

GRIT STUDY

August 31, 1987

SDMS DocID 62303

62303

CITY OF NEW BEDFORD, MASSACHUSETTS

GRIT STUDY

August 31, 1987

Camp Dresser & McKee, Inc.
One Center Plaza
Boston, Massachusetts

CDM

environmental engineers, scientists, planners, & management consultants

CAMP DRESSER & McKEE INC.

One Center Plaza
Boston, Massachusetts 02108
617 742-5151

August 31, 1987

Mrs. Kathleen Burns
Commissioner
Department of Public Works
133 William Street
New Bedford, MA 02740

Grit Study Report

Dear Mrs. Burns:

In accordancse with the terms of our contract with the City, please find enclosed CDM's Grit Study Report. The report meets the requirements of the draft consent decree between New Bedford and the regulatory agencies.

Included in the report is a summary of the existing conditions based on our recent field investigations; a discussion of alternative ways to remove the existing grit in the interceptor; and recommended methods to eliminate future grit deposition in the interceptor/collector system.

We are prepared to meet with you, at your convenience, to review our findings and recommendations.

Very truly yours,

CAMP DRESSER & McKEE INC.

Stephen J. Hickox
Vice President

SJH:paa

Enc.

#309-136-RT-GRIT/10

NEW BEDFORD, MASSACHUSETTS
GRIT STUDY

TABLE OF CONTENTS

Section		Page No.
I	INTRODUCTION	I-1
	Purpose	I-1
	Project Approach	I-1
	Report Organization	I-2
II	EXISTING CONDITIONS	II-1
	General	II-1
	Grit Deposition Problem	II-1
	Field Investigations	II-3
	Locations of Grit Accumulations	II-3
	Estimated Quantity of Grit	II-7
	PCB Levels in Existing Grit Deposits	II-9
	Impacts to System Operations	II-9
III	EVALUATIONS	III-1
	General	III-1
	Reasons for Grit Deposition in the Interceptor System	III-1
	Removal of Existing Grit Deposition from the Main Interceptor	III-5
	Mitigation of Future Grit Deposition in the Interceptor	III-6
	Improvements to the Grit Removal Facility at the Wastewater Treatment Plant	III-20
IV	RECOMMENDATIONS AND IMPLEMENTATION	IV-1
	General	IV-1
	Removal of Existing Grit	IV-2
	Improvements to the Grit Removal Facility at the Wastewater Treatment Plant	IV-4
	Best Management Practices	IV-5
	Structural Improvements to the Interceptor	IV-7
	Funding	IV-8

LIST OF FIGURES

		PAGE NO.
II-1	EXISTING COLLECTION SYSTEM - MAJOR COMPONENTS	II-2
II-2	PLAN OF EXISTING GRIT REMOVAL FACILITY AT THE WASTEWATER TREATMENT PLANT	II-4
II-3	MAIN INTERCEPTOR PROFILE - GRIT DEPTHS	II-6
II-4	MAIN INTERCEPTOR PROFILE - SAMPLING RESULTS	II-10
III-1	SCHEMATIC OF INTERCEPTOR SYSTEM	III-8
III-2	SCHEMATIC OF INTERCEPTOR SYSTEM - FLOW DIVERSION OPTION	III-11
III-3	SCHEMATIC OF INTERCEPTOR SYSTEM - PUMPING OPTION	III-12
III-4	SCHEMATIC OF INTERCEPTOR SYSTEM - RECOMMENDED OPTION	III-14
III-5	STREET SWEEPING PROGRAM - COMBINED SEWER AREAS	III-19
III-6	PLAN OF IMPROVEMENTS TO EXISTING GRIT REMOVAL FACILITY AT THE WASTEWATER TREATMENT PLANT	III-21
III-7	GRIT BASIN GRIT LEVELS - LOG SHEET	III-23

LIST OF TABLES

Page No.

II-1 SEWER REACHES FOUND NOT TO CONTAIN MEASURABLE GRIT ACCUMULATION..... II-5

II-2 GRIT PCB ANALYSIS..... II-11

IV-1 SUMMARY OF RECOMMENDATIONS..... IV-3

SECTION I

INTRODUCTION

Purpose

The purposes of this report are: (1) to define the reasons for grit accumulation in the major interceptors and collectors in the City's sewerage system; (2) to identify and evaluate alternatives addressing the grit problem; and (3) to recommend a grit management program, including the removal and disposal of the existing grit and methods to mitigate future accumulations.

Project Approach

The initial stages of the report were devoted to the collection of existing data and the generation of background information to be used throughout the study. This involved field investigations, and a review of existing maps and plans of the City of New Bedford's sewerage collection and pumping facilities. The field investigation included a physical inspection of the sewer collector/interceptor system.

The first phase of the report was the development of alternatives to remove the existing grit deposition in the interceptor. They were evaluated based on impacts to current system operation and the feasibility of the removal method.

In the second phase, the Extended Transport (EXTRAN) block of the EPA Stormwater Management Model (SWMM), developed in the Phase I Combined Sewer Overflow (CSO) Study by Camp Dresser & McKee Inc.(CDM), was used to: (1) identify the reasons for grit accumulations in the interceptors; (2) investigate the impacts of grit on system operations; and (3) determine and evaluate various alternatives to alleviate future grit deposition. It is important to note that the alternatives were developed concurrently with

other ongoing report tasks such that the final solutions to the grit problem would be compatible with the final recommendations submitted in the Facilities Plan.

Finally, a recommended grit management program was developed. It includes the recommended method for removal and disposal of the existing grit; a concept to help alleviate future grit deposition; and a plan to implement system management practices to mitigate grit loadings into the collection system.

Report Organization

The following report is divided into three basic sections:

- Existing Conditions (Section II)
- Evaluations
- Recommendations and Implementation (Section IV)

SECTION II
EXISTING CONDITIONS

General

New Bedford's wastewater collection system currently serves about 60 percent (7,400 acres) of the City's total land area, and 98 percent of the population. In addition, the system accepts flow from approximately 700 homes in the Town of Dartmouth and 60 homes in the Town of Acushnet. Originally constructed in the late 1800's, the existing system consists of approximately 128 miles of combined sewers in the south and central parts of the City, plus approximately 76 miles of separate storm and sanitary sewers, mostly in the north end. Wastewater is conveyed by an eleven mile main interceptor to the Fort Rodman Wastewater Treatment Plant.

Major components of the existing system include:

- 2 major interceptors
- 8 major collector sewers
- 22 wastewater pumping stations (10 major and 12 small package stations)
- 67 regulators, which regulate flow to interceptors, and
- 38 combined sewer overflow outlets, most of which activate during normal wet weather events.

The basic components of the existing municipal wastewater collection system are shown on Figure II-1.

Grit Deposition Problem

The grit deposition problem has been identified in several past reports on the City's collection system. A review of past grit profiles in the main interceptor show that grit deposition and accumulation is a persistent and growing problem.

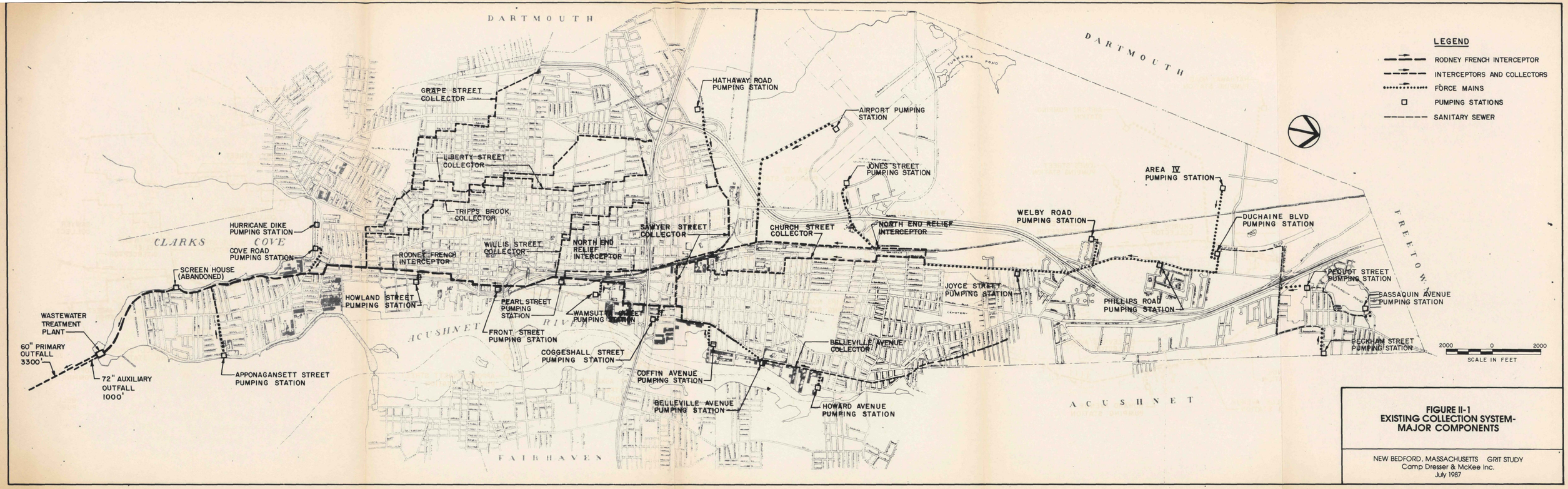


FIGURE II-1
EXISTING COLLECTION SYSTEM-MAJOR COMPONENTS

NEW BEDFORD, MASSACHUSETTS GRIT STUDY
Camp Dresser & McKee Inc.
July 1987

Currently, frequent interceptor surcharging has been reported by City Public Works personnel in the vicinity of the intersection of Wamsutta Street and Acushnet Avenue. Past field evaluations have determined that surcharging is a direct result of grit accumulations in the interceptor. Surcharging is further compounded by the operation of wastewater pump stations upstream of the surcharging location.

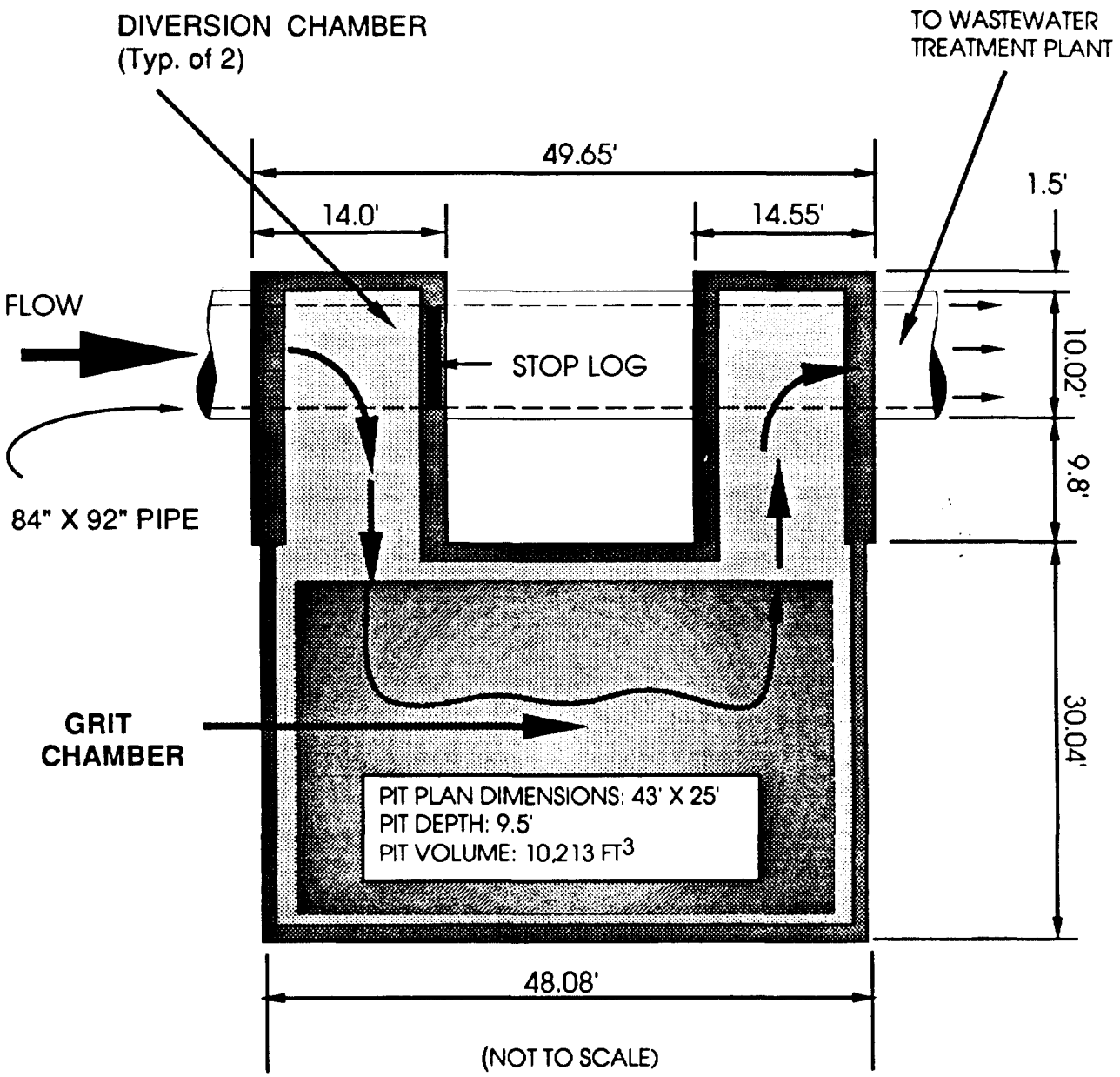
Grit that does not deposit in the interceptor is conveyed as part of normal wastewater flow to the City's Wastewater Treatment Plant located at Fort Rodman. A grit removal facility was constructed at the treatment plant approximately 12 years ago to remove grit from wastewater entering the plant from the main interceptor. The facility consists of a rectangular steel-sheeted chamber located at the end of the main interceptor, just upstream of the treatment plant. As shown on Figure II-2, all flow in the interceptor is diverted through the chamber. The intent is to reduce flow velocity and promote settling of heavier material. The accumulated grit is periodically removed by a clamshell and trucked away to a landfill.

Field Investigations

During the spring of 1987, field investigations were conducted by CDM. They included physical inspection of approximately 52,000 linear feet of interceptors and collectors for evidence of grit deposition. During this inspection, depth of grit measurements were taken in areas where grit accumulations were encountered. In addition, samples of grit were taken at several locations and analyzed for possible Polychlorinated Biphenyl (PCB) contamination.

Location of Grit Accumulations

Significant grit accumulations were found along the main interceptor from Holly Street and Belleville Avenue to Willis Street and Achusnet Avenue. No grit deposits were found in the other interceptors and collectors examined (see Table II-1). Figure II-3 indicates the depth (in profile) of the existing grit depositions in the main interceptor.



NEW BEDFORD, MASSACHUSETTS

Camp Dresser & McKee Inc.

FIGURE II -2
PLAN OF EXISTING
GRIT REMOVAL FACILITY AT THE
WASTEWATER TREATMENT PLANT

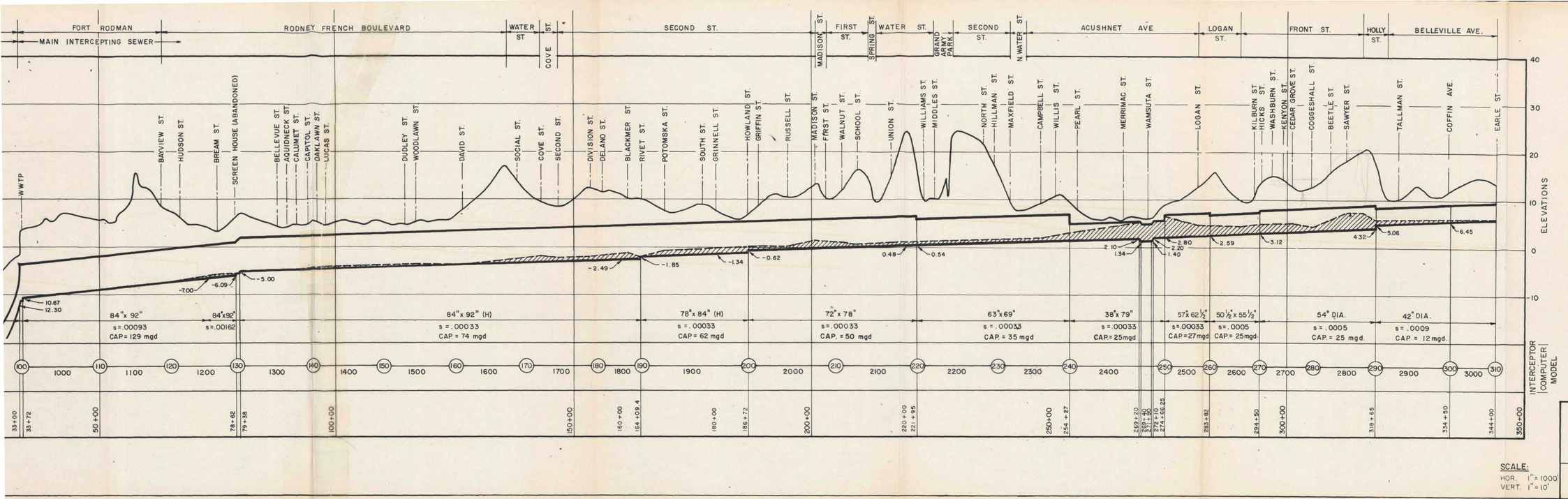
TABLE II-1

NEW BEDFORD, MASSACHUSETTS

SEWER REACHES FOUND NOT TO CONTAIN

MEASURABLE GRIT ACCUMULATION

Sewer Reach	Distance (Ft.)
1. Tripps Brook Collector	
o From Rivet Street and Second Street to Allan Street and Cottage Street	4,850
2. Bonney Street Collector	
o From Rivet Street and Bonney Street to Bonney Street and Briggs Street	2,100
3. Willis Street Collector	
o From Bullock Street and Roswell Street downstream to the Main Interceptor	9,500
4. North End Relief Interceptor	
o From Vanburen Street and downstream to the Main Interceptor	6,900
5. Sawyer Street Collector	
o From Purchase Street and Sawyer Street downstream to North Front Street and Sawyer Street	1,900
Total	25,250



NOTES:

1. CAPACITIES STATED ARE THEORETICAL RATES OF FLOW USING n = 0.015 WITHOUT REGARD TO FLOW RESTRICTIONS RESULTING FROM BOTTOM DEPOSITS
2. DATUM IS NEW BEDFORD CITY DATUM, 0.85 FT. ABOVE MEAN HIGH WATER.

LEGEND:

- (100) INTERCEPTOR COMPUTER MODEL – NODE NUMBER
- 1000 INTERCEPTOR COMPUTER MODEL – CONDUIT NUMBER
- SEDIMENT PROFILE – JUNE 1987

SCALE:
HOR. 1" = 1000'
VERT. 1" = 10'

FIGURE II-3
MAIN INTERCEPTOR PROFILE
GRIT DEPTHS

NEW BEDFORD, MASSACHUSETTS GRIT STUDY
Camp Dresser & McKee Inc.
July 1987

A layer of grit of at least 5 inches covers the invert along the main interceptor for a distance of about 21,000 feet from Coffin Avenue at Belleville Avenue downstream to David Street at Rodney French Boulevard. Grit accumulations also exist in two other areas along the main interceptor: 1) a 2,000-foot reach along Rodney French Boulevard from Woodlawn Street to Oaklawn Street; and 2) a 1,500-foot reach south of the abandoned screen house. No grit deposits were observed in about 2,000 feet of the interceptor.

Substantial accumulations of grit were found in the area of Wamsutta Street and Acushnet Avenue. A stagnant grit "slurry" was observed at the manhole at the intersection of Wamsutta Street and Acushnet Avenue at a depth just below street grade. This observed grit deposit substantially restricts flow through the interceptor. However, there appears to be a "free flowing" layer within the grit deposit, which allows some flow to pass. A second area of severe grit accumulation of up to approximately 3.5 feet in depth exists in the interceptor along Front Street and Holly Street, in the vicinity of the Sawyer Street Collector.

Estimated Quantity of Grit

Interceptor. The total amount of grit deposition in the main interceptor is estimated to range between 4,000-4,500 cubic yards, located over a distance of about 25,000 feet. In the area of Wamsutta Street and Acushnet Avenue, it was assumed that grit does not occupy the total volume of the pipe, as shown in Figure II-3. This assumption appears reasonable since some flow (although severely restricted) was observed passing through this section of pipe. For the purpose of the estimate, it was assume that grit occupies only about 75 percent of the available volume of the pipe.

Wastewater Treatment Plant. A review of current grit chamber operation indicates that under average dry weather flow conditions, settling velocities are adequate to allow settlement of 65-mesh(0.008 inch) particles. However, the chamber is not adequate to promote proper settling during peak dry-weather or wet-weather flow. For example, during average dry-weather flow, it was determined that the settling velocity in the

chamber is 4.2 feet per minute (FPM) compared to a recommended range of 3.3 to 4.3 FPM for 65-mesh particles, based on standard grit chamber design practices. Typically, horizontal flow grit chambers are designed with longer dimensional lengths to provide for even lower settling velocities (in the range of 2-3 FPM), to allow for settling of 100 mesh(0.006 inch) particles before flow exits the chamber. Currently, during peak flow conditions or during large wet weather events, high flow velocities have resulted in an observed short-circuiting of the chamber. This prevents proper settling times and results in lower removal rates and grit carryover into the treatment process train.

The problem of solids carryover from the grit chamber has been further aggravated by lack of proper maintenance. Reportedly, in the past, the grit chamber was not cleaned on a routine basis. Substantial grit accumulation resulted in additional grit carryover through the facility and into the treatment plant.

Recently, a treatment plant maintenance program has been initiated by plant personnel. Measurements in the grit chamber are taken daily to determine the amount of grit accumulation. When the grit reaches a certain depth, it is removed and disposed of. A review of recent records indicates that approximately 4 cubic yards of grit accumulates per day in the chamber. This represents an average accumulation rate of both dry- and wet-weather conditions.

Grit which is carried over to the primary sedimentation tanks is removed from the primary sludge using cyclone separators. The amount of grit removed from sludge is about 1 cubic yard per day. Accordingly, the total estimated volume of grit generated at the treatment plant is an average of 5 cubic yards per day of both dry- and wet-weather conditions. This rate of grit removal is within the average range for similar plants with tributary combined sewer systems.

PCB Levels in Existing Grit Deposits

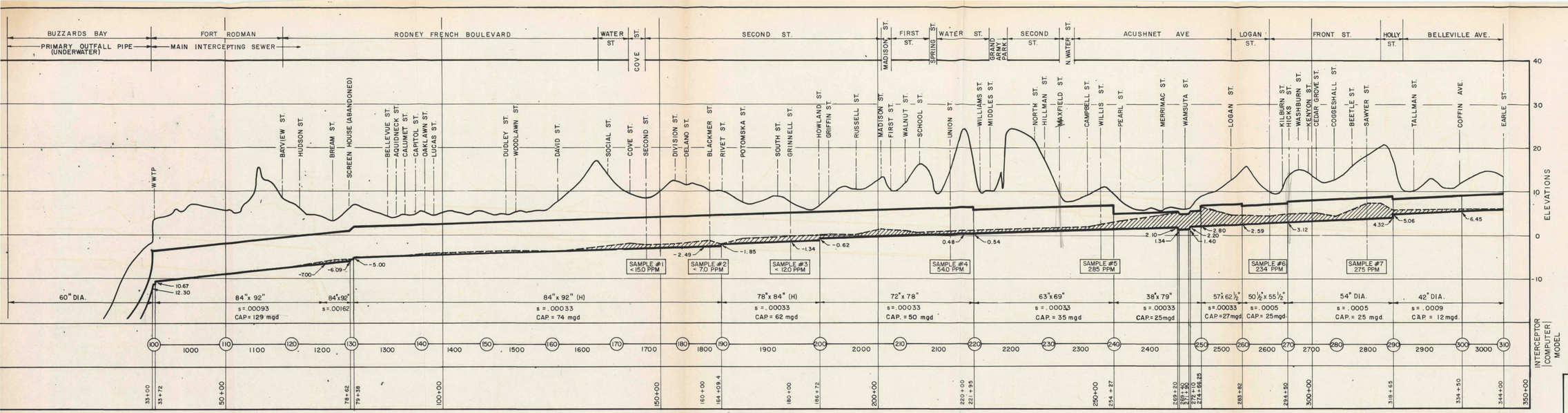
The existence of PCB's in the New Bedford area has been extensively documented. Former industrial PCB users in the City have been identified as having disposed of PCB wastes into the sewage collection system. Consequently, a large portion of grit deposition within the interceptor system is contaminated with PCB's.

Six samples of grit were taken in the main interceptor and analyzed for possible PCB contamination. The location of each sample and the level of PCB's detected at each location are shown on Figure II-4. A detailed breakdown of the types of PCB's detected is shown in Table II-2. A grit sample was also taken from the grit chamber at the treatment plant and analyzed for PCB's. (Results are reported in Table II-2).

Results of the analyses show that significant PCB levels exist in the interceptor, ranging from 12 parts per million (ppm) to 285 ppm, on a dry weight basis. High levels of PCB's were detected in areas where the most severe grit accumulations exist. The grit sample taken from the treatment plant grit chamber had 24 ppm PCB contamination. Currently, PCB levels that exceed 50 ppm are considered hazardous by the EPA and can only be buried in environmentally secured landfills.

Impacts to System Operations

Substantial grit deposition reduces the ability of the interceptor to properly convey wastewater to the treatment plant. As accumulations increase, the available carrying capacity of the sewer decreases. In a combined sewer system, reduction in capacity may result in surcharge conditions especially during periods of high flow. Extensive surcharging in the interceptor may back flow up to the regulators and result in dry weather overflows through existing CSO outlets. Grit accumulation may also impair the operation of regulators by blocking the dry weather connections and causing more frequent and severe sewage overflows. Currently, sewer surcharging problems along Acushnet Avenue and several dry-weather overflow discharges have been attributed to grit accumulation in the interceptor.



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2. DATUM IS NEW BEDFORD CITY DATUM, 0.85 FT. ABOVE MEAN HIGH WATER.

LEGEND:

- (100) INTERCEPTOR COMPUTER MODEL – NODE NUMBER
- 1000 INTERCEPTOR COMPUTER MODEL – CONDUIT NUMBER
- SEDIMENT PROFILE – JUNE 1987
- SAMPLE #6 234 PPM — TOTAL PCB LEVELS (PARTS PER MILLION)

FIGURE II-4
MAIN INTERCEPTOR PROFILE SAMPLING RESULTS

NEW BEDFORD, MASSACHUSETTS GRIT STUDY
Camp Dresser & McKee Inc.
July 1987

TABLE II-2
NEW BEDFORD, MASSACHUSETTS
GRIT PCB ANALYSIS
(in parts per million)

PCB Type	Sample #1 Cove St. and Second St.	Sample #2 Blackmer St. and Second St.	Sample #3 Grinnell St. and Second St.	Sample #4 Union St. and Water St.	Sample #5 Willis St. and Acushnet Ave.	Sample #6 Logan St. and Front St.	Sample #7 Sawyer St. and Front St.	Treatment Plant Grit Chamber
Arochlor 1016	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1221	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1232	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1242	<15	<7.0	<12	54	285	234	275	24
Arochlor 1248	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1254	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1260	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Arochlor 1262	<15	<7.0	<12	<1.0	<1.0	<1.0	<1.0	<1.0
Total PCB's	<15	<7.0	<12	54	285	234	275	24

At the wastewater treatment plant, excessive quantities of grit have frequently clogged grit/sludge piping. When this occurs, the removal of sludge from the primary clarifier must be curtailed until the grit/sludge lines are unclogged. This reduces the effectiveness of the primary clarifiers. In addition, grit causes excessive wear and treatment plant equipment, especially pumps, must be replaced more frequently.

SECTION III

EVALUATIONS

General

The analysis of the grit problem in New Bedford included: 1) determining the reasons for grit deposition in the interceptor; 2) identifying and evaluating alternatives to remove existing grit from the interceptor; and 3) identifying and evaluating alternatives to mitigate further grit deposition.

Reasons for Grit Deposition in the Interceptor System

The quantity and composition of grit entering a sewerage system varies with the type of the system. A combined sewerage system, such as New Bedford's, will receive a higher grit loading than a typical separated system. Sand and debris is washed from roads and other impervious surfaces into the collection system by way of storm drainage structures such as catch basins. The grit loading is somewhat dependent on the area served: industrial areas would contribute a higher grit loading because typically they contain more impervious surfaces (roads, parking lots, etc.); the type of street surfaces from which runoff is collected; and the climate of the region (or the frequency of street sanding).

In the New Bedford CSO Study (CDM - 1983), land use of the stormwater drainage basin area had been separated into three segments - residential (71%); commercial/industrial (13%) and open space/other (16%). Of this stormwater drainage basin, approximately 60 percent of the total area was determined to be impervious due to roads, parking lots, and house roofs. These structures all contribute to a higher stormwater runoff coefficient. City streets, for the most part, are paved - street runoff is collected by the drainage system and transported to the CSO regulators. New Bedford's climate is typically tempered by its coastal location. However, sand is

used frequently during the winter months on roads with ice and snow buildup.

Grit deposition in the interceptor occurs, for the most part, as a result of low flow velocities. These can result due to all, or some of the following:

- inadequate pipe slope
- obstructions in the pipe
- structural defects in the pipe
- influent flow into the pipe (directional changes)
- severe changes in pipe slope
- low flows

Standard sewer design practices dictate that sewer pipes be installed at a slope that would maintain a minimum flow velocity of at least 2.0 feet per second(FPS). However, since flow rate in a sewer varies throughout the day as well as seasonally, the depth of flow and velocity also varies. A velocity considered adequate at a future design flow rate may not be adequate at initial flow rates. To maintain adequate scour velocity, sewer pipe slopes in a separate sanitary collection system are typically based on estimated future average flow conditions and initial low flow conditions.

Sewers in combined systems are designed to accept and convey storm runoff in addition to peak dry-weather flow. Accordingly, piping within combined systems is oversized relative to peak dry-weather flow requirements because of the need to convey the large difference between dry weather wastewater flow rates and storm runoff (wet weather). As a result of this design practice, lower velocities and consequently, grit deposition occurs during periods of low dry weather flow. Combined systems, such as New Bedford's, rely on rainfall events to flush material from the sewer pipes.

The combined flow collectors in the system, and the North End Relief Interceptor are reasonably free of grit accumulation due to adequate pipe slopes and resulting high flow velocities. Sections of the main interceptor, however, cannot achieve adequate flushing velocity. According

to simulated system operation using the EXTRAN model, flowing full velocities through the entire 38" x 79" box conduit (2,000 feet)of the main interceptor along Acushnet Avenue are below 2.0 FPS based on clean pipe conditions (i.e., no grit). However, even a velocity of 2.0 FPS is not adequate to flush larger grit particles encountered in combined sewer systems. For example, using a grit sample obtained from a manhole at Blackmer Street and Second Street, it was determined that a flow velocity greater than 5 FPS would be necessary to transport some of the larger grit particles (0.5" or greater). No portion of the interceptor has flow velocities greater than 3 FPS under flowing full, clean pipe conditions. This clearly demonstrates that even during wet-weather events, the larger, heavier solids cannot be transported downstream through the interceptor. Thus they deposit in the pipe and over time can build up to substantial depths.

In some cases, grit deposition in any one section of pipeline should be somewhat self-limiting. As pipeline grit accumulations increase in depth, the cross-sectional pipe area decreases and the upstream water surface profile(head) increases as the same amount of flow tries to pass through a smaller area. Consequently, velocity in the area of the grit restriction increases. The increase in velocity should continue until it is adequate to transport the grit downstream, thus limiting further deposition.

In New Bedford, as in most other combined sewer systems, this self-limiting concept is short-circuited. As a rule, CSO regulators normally regulate flow into the interceptor to prevent interceptor surcharging by allowing excessive wet-weather flow (combined storm plus sanitary wastewater) to discharge to receiving waters. However, along the main interceptor, the regulators have frequently backflowed, allowing excessive flow to discharge out of the surcharged interceptor, even during dry-weather flow. This occurs because as grit accumulates in the interceptor, it causes the water surface to rise above nearby regulator weir heights, producing a backflow condition. Consequently, due to this interceptor flow relief provided by backflow through the regulators, an adequate scouring flow rate cannot be achieved and grit accumulation will continue to increase.

This type of interceptor flow relief presently occurs at three regulators: Wamsutta Street and Rte. 18; Logan Street and North Front Street; and Sawyer Street and North Front Street. Accordingly, the most severe grit accumulations exist in the pipe reaches in the vicinity of these regulators.

Grit deposition also occurs as a result of localized flow conditions due to influent flow from a tributary sewer line. In general, as tributary flow enters the interceptor, a backwater condition is created due to the sudden increase in flow in the interceptor and the change of direction in the area of the intersection of the tributary sewer and the interceptor. As a result, velocities upstream of this connection decrease, enhancing grit deposition. This is most likely the cause of grit accumulations in the interceptor at the connections to sewers serving the following streets: Sawyer Street, Pearl Street, Madison Street, Russell Street, Rivet Street, and Cove Road (at the intersection of Water Street and Rodney French Boulevard).

Additionally, grit deposition is enhanced due to the various interceptor pipe sizes and shapes. The irregular pipe cross-sections along the interceptor result in slight restrictions to flow. These can cause localized flow eddying, backwater and decreased velocities. As a result, grit deposition can occur.

Finally, grit accumulation is also a function of system maintenance practices and the condition of the sewerage system. Catch basins, sumps and other drainage structures are designed to prevent large diameter solids (sand, stone and roadside debris) from entering the interceptor. If catch basins and sumps are not periodically cleaned, grit particles of larger diameters and higher densities may enter the system. Although these larger solids may be transported by the higher flows achieved in the smaller collector pipes, they cannot be transported by the low velocities in the interceptor. Smaller particles entering the interceptor should be adequately transported by interceptor velocities. However, as larger particles deposit, smaller particles can be trapped by flow restrictions imposed by the larger particle deposits. This results in increased solids

deposition. With time, a well graded deposition forms that is extremely difficult to flush down the interceptor.

In summary, grit accumulations in the interceptor can be attributed to several factors including: (1) the original interceptor design of large diameter pipes with flat slopes, and subsequent low flow velocities at flowing full condition; (2) tributary inflows that result in backwater conditions that lower local velocities; (3) the flow relief effect of the regulators limiting the availability of a scour velocity; and (4) the typical characteristics of combined systems -- an influx of larger grit particles due to a lack of proper maintenance.

Removal of Existing Grit Deposition from the Main Inteceptor

Two alternatives to remove and dispose of the existing grit in the interceptor were identified and evaluated. Alternative 1 consists of flushing the grit to the treatment plant for removal; and Alternative 2 consists of grit removal directly from the interceptor.

- Alternative 1. Under this alternative, the grit would be flushed to the treatment plant. It would be collected in the existing grit chamber and removed by current grit removal and handling methods. Interceptor flushing would be accomplished using high pressure pipe flushing equipment.

- Alternative 2. This option involves removal of existing grit using vacuum trucks. Short reaches of pipe would be cleaned at a time. High pressure flushing equipment would be used to consolidate the grit in the vicinity of certain accessible manholes where it would be removed by vacuum truck.

The evaluation of alternatives considered the likely impacts on current and projected system operations, and EPA regulations governing the handling of hazardous wastes. As a result of this evaluation, Alternative 2 was selected.

Alternative 1 was eliminated because of the burden it would place on the already overtaxed wastewater treatment plant, and the impracticality of the required flushing operation. Flushing the large amount of existing grit through the entire length of the interceptor would be difficult. Several flushing operations would have to be made through each reach of sewer to move the hard-packed grit. As the grit accumulates in downstream reaches, it will become nearly impossible to flush it further downstream. Localized flooding due to interceptor surcharging is also possible if it rains during the operation due to the significant restriction in the interceptor caused by the accumulated grit. Due to the current lack of effective grit handling at the wastewater treatment plant, the flushing operation may result in grit carryover into treatment processes, severely disrupting normal operations.

Alternative 2 is recommended since it addresses the concerns of both system operations and the handling of hazardous wastes. Vacuum trucks and other similar waste handling equipment would be employed to flush and clean short reaches of interceptor at a time. The section to be cleaned would be separated from the remainder of the interceptor line with flow bypassed around the section using temporary piping and pumping facilities. Therefore, the hazardous material can be contained and removed from the interceptor under closely controlled conditions. This alternative also facilitates a gradual reach-by-reach removal of grit, allowing for a phased operation to be implemented.

Mitigation of Future Grit Deposition in the Interceptor

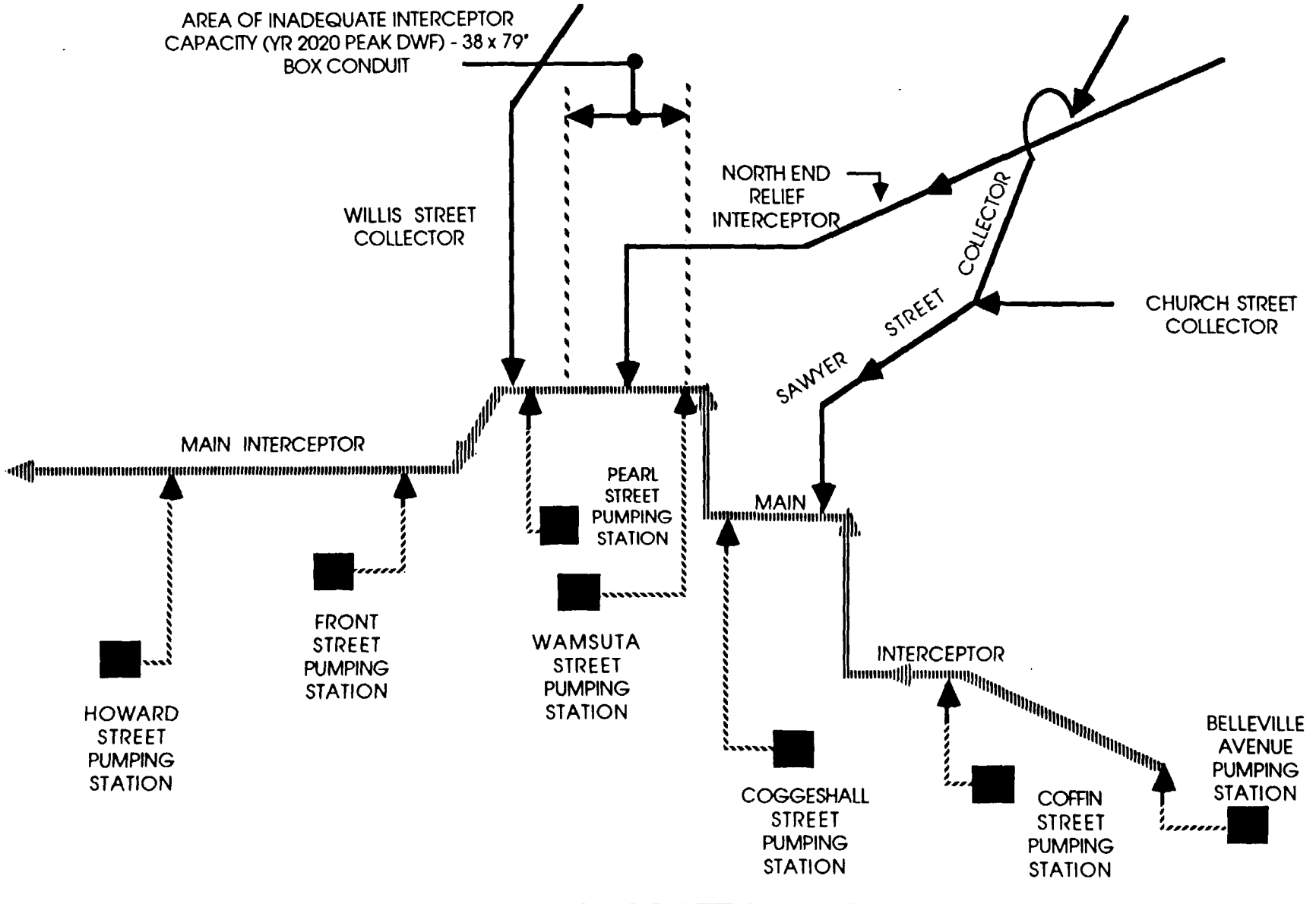
The investigation of alternatives to alleviate future grit deposition in the interceptor focused on options to eliminate the reasons for grit deposition discussed earlier. Since substanital amounts of grit were encountered only in the main interceptor, the alternatives address only that pipeline. Alternatives were examined for each distinctive reach of the interceptor found to have similar reasons of grit deposition. Two types of alternatives were evaluated: structural improvements and nonstructural/operational improvements. Because the final siting of the new secondary plant will dictate the hydraulics of the main interceptor

system, and final site selection will not occur until August 1988, the structural solutions presented below are considered conceptual in nature and are intended as only a preliminary presentation. Once the new plant is sited, the conceptual recommendations are to be verified and costs estimated.

Structural Improvements. The primary intent of structural improvements is to alleviate low velocity conditions in the main interceptor. Alternatives were developed using the EXTRAN model and were evaluated based on impacts to system operations, feasibility to implement, and compatability with goals of the ongoing Facilities Plan. Essential to the goals of the Facilities Plan is the capability of proposed improvements to the interceptor and the sewerage collection system to convey the expected year 2020 peak dry-weather flows. Accordingly, in conjunction with ongoing Facilities Plan investigations, this investigation concerning grit must also consider inadequacies of the interceptor to convey year 2020 flows. Preliminary improvement options must be developed if inadequacies are found, and improvements recommended to provide additional flow capacity as well as mitigate the grit deposition problem.

Using the EXTRAN model, it was determined that the entire 38" x 79" box conduit beneath Acushnet Avenue from the general vicinity of Wamsutta Street downstream to Pearl Street (2,000 ft.) is inadequate to convey the estimated year 2020 peak dry-weather sewage flow (Figure III-1). This is the only portion of the interceptor found to have inadequate(restrictive) carrying capacity. In addition, the restrictive capacity of this intereptor reach is a cause of grit deposition within the conduit and upstream reaches of the interceptor due to the resultant low flow velocities. Therefore, proposed grit mitigation options in this reach of interceptor must be compatible with proposed solutions to this conveyance problem. Three options were investigated: replacement piping, flow diversion, and pumping.

As presently conceived, the most feasible solution to mitigate future grit deposition as well as provide adequate year 2020 conveyance capacity in the interceptor appears to be a combination of pumping and flow diversion to



NEW BEDFORD, MASSACHUSETTS

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July 1987

FIGURE III-1
GRIT STUDY
SCHEMATIC OF INTERCEPTOR SYSTEM

eliminate flow through the restrictive section of interceptor. As mentioned earlier, this will be verified during work associated with the Facilities Plan. This would include; (1) diverting flow from the northwestern quadrant of the City into the North End Relief Interceptor which flows into the main interceptor at a point slightly upstream of Willis Street; and (2) pumping flow collected from the northeastern quadrant into the interceptor at a point downstream of Willis Street using existing pumping stations. The implementation of this solution would allow the City to abandon interceptor reaches upstream of Pearl Street and Acushnet Avenue and consequently, eliminate the concerns of restricted conveyance and grit deposition in this area of the interceptor.
This conceptual recommendation is the result of an evaluation of several options, as discussed in the following sections.

- Replacement Piping. This option includes the construction of a new pipeline to replace the box conduit section of the interceptor that has inadequate capacity. However, this was found not to be possible due to limitations of pipe slope and ground elevations. The required pipe diameter to convey the anticipated peak flows was determined to be 60 inches. Due to existing ground elevations along the route of the pipe section to be replaced, the installation of a new pipe would result in the pipe crown rising above the ground surface at least 1.5 feet in some places. Accordingly, this option was not considered further.

- Interceptor Replacement. The complete replacement of the interceptor was also considered. Due to constraints imposed by construction within the City streets that are small and crowded with buried utilities, conventional pipe installation methods were not considered. An alternative method of installation would be tunneling. However, preliminary investigations indicated that construction cost using this method would be prohibitive. Tunneling would require a large capital expenditure to bore and line the tunnel itself and to construct the several required connecting shafts. In addition, this option would not allow a phased program of construction and monetary disbursement. The entire tunneling

operation must be completed before the tunnel could convey wastewater flow. Therefore, several years would elapse during construction before conveyance problems could be eliminated. A phased program would provide for gradual capital expenditure while allowing gradual elimination of problems. In addition, wastewater pumping and grit removal facilities at the terminus of the tunnel would be more expensive due to the tunnel depth. Accordingly, this option was eliminated.

- Diversion of Flow Upstream of the Interceptor. Under this option, wastewater from the Church Street Collector and the Sawyer Street Collector would be diverted to the North End Relief Interceptor (see Figure III-2). The intent would be to reduce the amount of flow conveyed through the restricted interceptor reach. However, due to the dynamics of interceptor hydraulics, this diversion produced an increased water surface profile(backwater condition) rising above the crown of the upstream pipe reaches of the main interceptor, resulting in system surcharging and dry-weather overflows. This was based on results from the EXTRAN model run under year 2020 peak flow conditions. Due to construction constraints, this backwater condition could not be alleviated by locating the diversion terminus to a point further downstream along the main interceptor. In addition, this option will not alleviate the grit deposition in this reach due to low velocities. Therefore, this option was not considered further.

- Pumping. This option would utilize existing wastewater pumping stations to transport flow past the interceptor restriction in an effort to reduce the affect of the restriction on upstream water surface profile. One arrangement considered involved pumping from Belleville Avenue Pumping Station to the North End Relief Interceptor (see Figue III-3). This arrangement is appropriate to consider since in the year 2020, Belleville Avenue Station is expected to contribute approximately 14 MGD to interceptor flow. However, this concept was eliminated due to the same dynamic hydraulic conditions encountered in the interceptor as discussed above (under the diversion option).

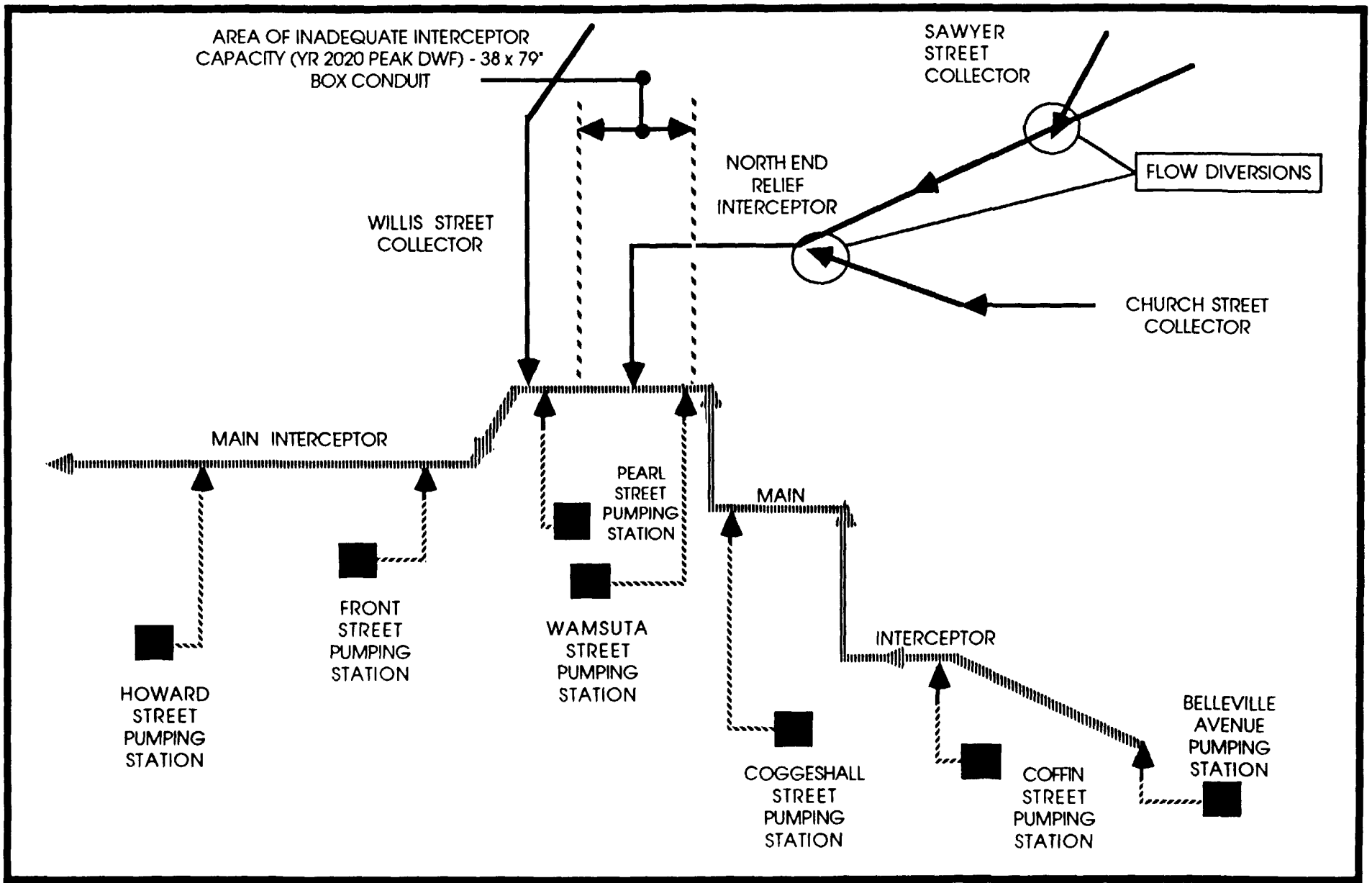

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FIGURE III-2
GRIT STUDY
SCHEMATIC OF INTERCEPTOR SYSTEM
FLOW DIVERSION OPTION

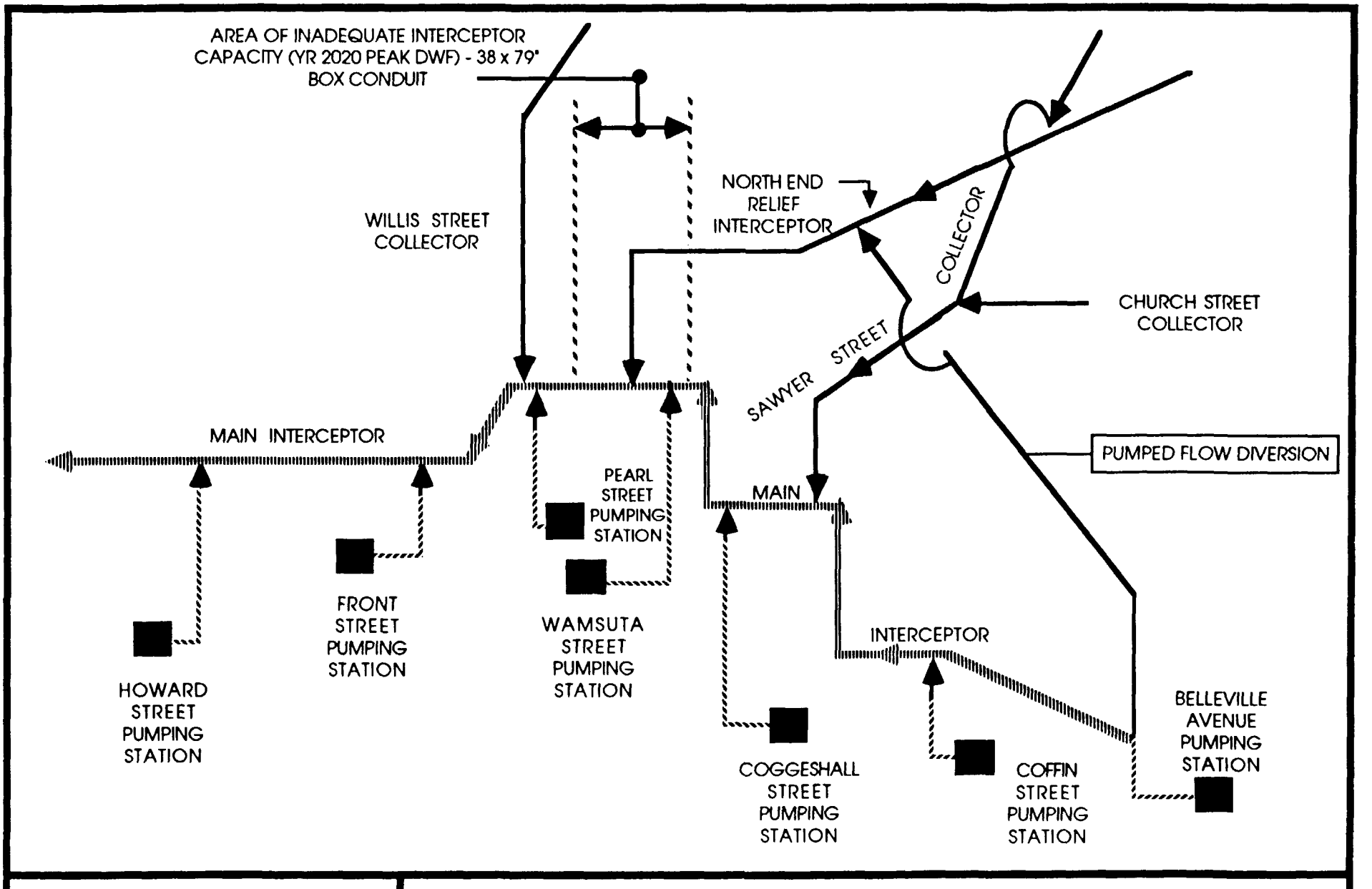

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FIGURE III-3
GRIT STUDY
SCHEMATIC OF INTERCEPTOR SYSTEM
PUMPING OPTION

As previously mentioned, due to construction constraints, it is not feasible to move the diversion terminus further downstream to avoid the backwater condition. Accordingly, this option in itself was not considered further.

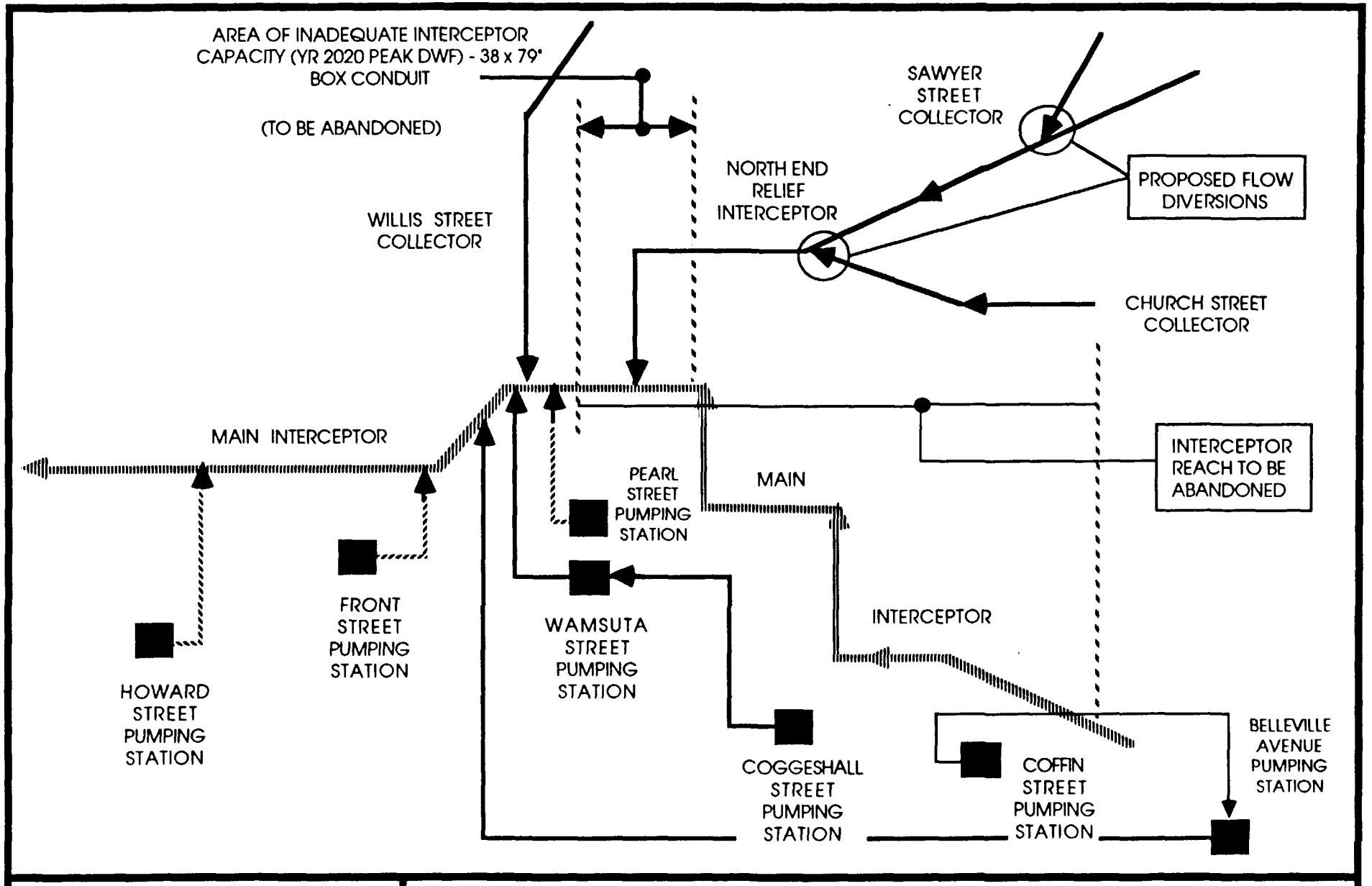
Upon preliminary evaluation of these options, the combination of pumping and flow diversion was considered the most efficient method to help mitigate grit deposition and eliminate the conveyance restriction in this reach of the interceptor. The result of combining both concepts is the elimination of flow through the restrictive section of interceptor and the remaining upstream reaches of the main interceptor. Consequently, the City could abandon these reaches and eliminate the problems of flow conveyance and grit deposition. The details of this recommended option is shown on Figure III-4 and summarized below. (All wastewater flows are year 2020 estimates).

- Wastewater flow of about 3.4 MGD would be diverted from the Sawyer Street Collector into the North End Relief Interceptor using an existing diversion structure (a brick bulkhead separating the sewers must be removed), located along Purchase Street near Van Buren Street.

- Wastewater flow of about 2.9 MGD would be diverted from the Church Street Collector into the North End Relief Interceptor using a proposed diversion structure, located in the vicinity of Sawyer Street and Purchase Street.

- Coffin Avenue Pump Station would pump about 3.4 MGD to Belleville Avenue Pump Station through a new force main of approximately 1,000 feet into an existing gravity sewer along Riverside Avenue.

- Belleville Avenue Pump Station would discharge about 14 MGD, including the additional flow from Coffin Avenue Pump Station into the main interceptor at a point downstream of Willis Street. The force main would run beneath Belleville Avenue and Herman Melville Boulevard (approximately 9,000 feet).



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July 1987

FIGURE III-4
GRIT STUDY
SCHEMATIC OF INTERCEPTOR SYSTEM
RECOMMENDED OPTION

- Coggeshall Street Pump Station will pump about 1.4 MGD to the Wamsutta Street Pump Station through a new force main of approximately 3,000 feet and/or gravity sewer along Herman Melville Boulevard.

- Wamsutta Street Pump Station would discharge about 2.5 MGD, including the additional flow from the Coggeshall Street Pump Station into the main interceptor at a point downstream of Willis Street. The new force main would run along Herman Melville Boulevard (approximately 2,200 feet).

- Renovations would possibly be required of all four existing pump stations: Belleville Avenue, Coffin Avenue, Coggeshall Street, and Wamsutta Street Pump Stations.

- Additional structural/mechanical improvements (piping) would be required to serve existing connections to the interceptor expected to be abandoned and other incidental piping would be required in redefined drainage and sewer collection basins.

Due to the ongoing Facilities Plan and the timing of this report, and considering that the specific recommendations of this report are dependent on the final siting of the secondary treatment plant, the final details (including costs) of this conceptual solution for mitigation of grit depositions and elimination of the conveyance problem has not been developed further. A definitive plan of specific recommended facilities, including preliminary design details and drawings and estimated construction costs, will be included in the Facilities Plan.

Structural improvements were also examined to mitigate grit deposition in the downstream reaches of the interceptor, from Pearl Street to the wastewater treatment plant. Grit accumulation in this section, can for the most part, be to attributed to directional changes in interceptor flow due to influent wastewater from collectors; and more importantly, low velocities due to existing flat interceptor slopes. As discussed above, the EXTRAN model indicates that the main interceptor can not achieve

adequate high flushing velocities even under clean, flowing full conditions. Conseqently, grit deposition will continue to occur due to low velocities. Accordingly, three alternatives were evaluated to help mitigate grit deposition in the downstream reaches of the main interceptor.

- interceptor replacement
- dry-weather connection sedimentation sumps located at the CSO regulators
- Non-structural/operational improvements - Best Management Practices(BMP)

Interceptor replacement was eliminated previously due to prohibitive costs and construction constraints. Settling sumps along dry-weather connections from CSO regulators would be used to promote settling of larger grit particles before entering the interceptor. However, preliminary investigations indicate that settling sumps may not be effective due to high velocities within the collectors leading to the regulators. Settling velocites would not be low enough to allow proper settling in the smaller basins. Therefore, the recommended option to mitigate grit deposition in the downstream reaches of the interceptor is nonstructural in nature, and would involve implementation of a defined program of Best Management Practices (BMP's).

Nonstructural/Operational Improvements. Best Management Practices (BMP's) are considered a nonstructural means of reducing the amount of grit entering the collection system. By mitigating the problem closer to its source, grit influx and subsequent deposition can sometimes be controlled more efficiently and cost effectively than at downstream treatment and collection facilities. Potential BMP's are listed below:

Planning

Land Use Planning

Use of Natural Storage and Drainage Features

Erosion Control

Porous Pavement

Operation and Maintenance Practices

- Neighborhood Areas
  - Litter Control
  - Street Sweeping
  - Management of Highway De-Icing
- System Maintenance
  - Catch Basin Cleaning and Maintenance
  - Sewer Cleaning
  - Sewer Flushing
  - Infiltration Reduction

Most of the above BMP's that do not effectively meet the grit control objectives of the study were discounted from further evaluation. Planning practices were discounted because much of the land area in the City of New Bedford is developed. Therefore, planning used to control future development and land use would not be effective in this situation. Infiltration reduction investigations are ongoing and recommended action will be forthcoming under a separate report. Litter can be controlled by street sweeping and catch basin cleaning. Accordingly, the four best management practices considered appropriate and realistic from implementation and cost standpoints were selected for evaluation as follows:

Street Sweeping. Street sweeping removes accumulated dust, dirt, and litter from street surfaces before it enters catch basins and other drainage structures. It also improves the aesthetics of neighborhoods. The efficiency of the street sweeping operation depends generally upon the type of cleaning equipment used, the type of street pavement, the number of passes made, and the extent of vehicles parked on the streets. The accumulation of deposits on the streets at the time of sweeping is dependent upon the interval of storm events between sweeping.

Presently, the City has three street sweepers used on a rotating basis. One sweeper operates during the night from midnight to 7 am., 5 days a week. The streets included in this sweeper route are as follows:

- The downtown area
- Brock Avenue
- Cove Road
- Rockdale Avenue
- Acushnet Avenue
- Ashley Boulevard
- Nauset Street
- Hathaway Road
- Kempton Street(westerly near Buttonwood Road)

Generally this route schedule ensures that these streets are swept about once a week.

The other two sweepers operate during the day in the residential areas of the City and follow established snow removal routes. Streets under this category are cleaned an average of about twice a year. Street sweeping is continued during the winter months as long as daytime temperatures are above freezing and streets are dry.

The current sweeping program was not developed to address grit control. The nightly cleaning route is done basically for aesthetics; in fact, some of the streets that are swept are located in areas served by separated collection systems. A more frequent street sweeping program is required for all areas of the City to provide better grit control. A concentration of effort should be located in areas served by the combined portion of the collection system as shown by Figure III-5. Additionally, a concentrated effort to clean grit off the street is required during the spring, before street sand and debris can be washed off by heavy spring rains.

Catch Basin Cleaning and Maintenance. Historically, the role of catch basins was to minimize sewer clogging by trapping coarse debris and to reduce odor emanations from low-velocity sewers. Catch basins receive grit through the washoff from street surfaces and serve to settle larger grit particles before they enter the collection system. Therefore, regular cleaning and maintenance of catch basins is essential for control of grit in the system. Currently, the City owns four catch basin cleaning trucks,

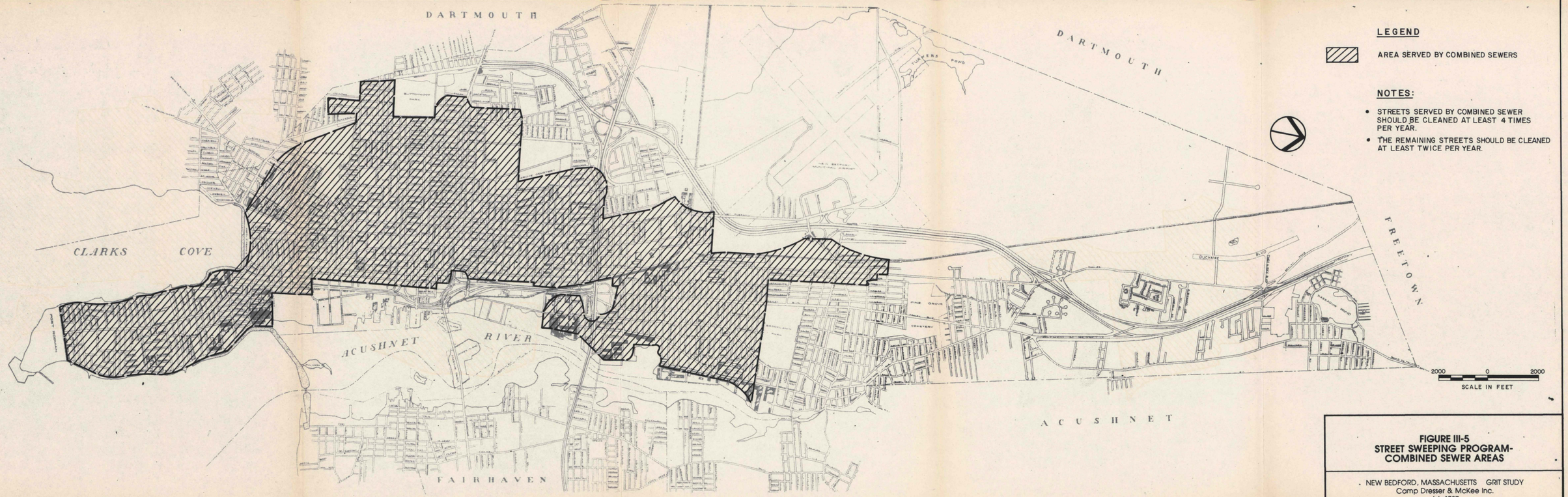

FIGURE III-5
STREET SWEEPING PROGRAM-
COMBINED SEWER AREAS

NEW BEDFORD, MASSACHUSETTS GRIT STUDY
Camp Dresser & McKee Inc.
July 1987

although only one truck is typically operable at any one time. This situation is not adequate to properly clean the City's catch basins on a regular basis and is addressed in the separate Wastewater Collection System Inspection Report.

Sewer Flushing. Much attention has been given to sewer flushing recently. Flushing of sewers on a regular basis can ensure the continuing capability of sewer laterals and interceptors to carry up to their design flow capacity. Sewer flushing is currently done on an as required basis only in the event of sewer blockages.

Sewer Cleaning. Sewer cleaning involves the routine inspection and cleaning of system pipes. The major causes of restrictions in large diameter sewers are siltation and accumulation of large debris. Sewer cleaning is a required maintenance item that is important to ensure the proper operation of the wastewater collection system.

Improvements to the Grit Removal Facility at the Wastewater Treatment Plant

As discussed earlier, the existing grit removal facility at the wastewater treatment plant is inadequately sized to promote settling of a large percentage of the smaller diameter grit particles. Consequently, these particles enter and disrupt the treatment process train.

The recommended option to improve the effectiveness of the existing grit removal facility is to install a baffle structure in the grit chamber as discussed above (see Figure III-6). This will promote additional grit settling and reduce grit carry-over into the treatment plant.

The baffle structure can be constructed at the inlet to the grit facility to help dissipate the occasional high flow velocities entering the facility. The baffle would consist of wood slats, with slot type openings between slats to help dissipate incoming velocity. This will reduce flow velocities in the grit chamber and help prevent scouring and enhance the settling of grit.

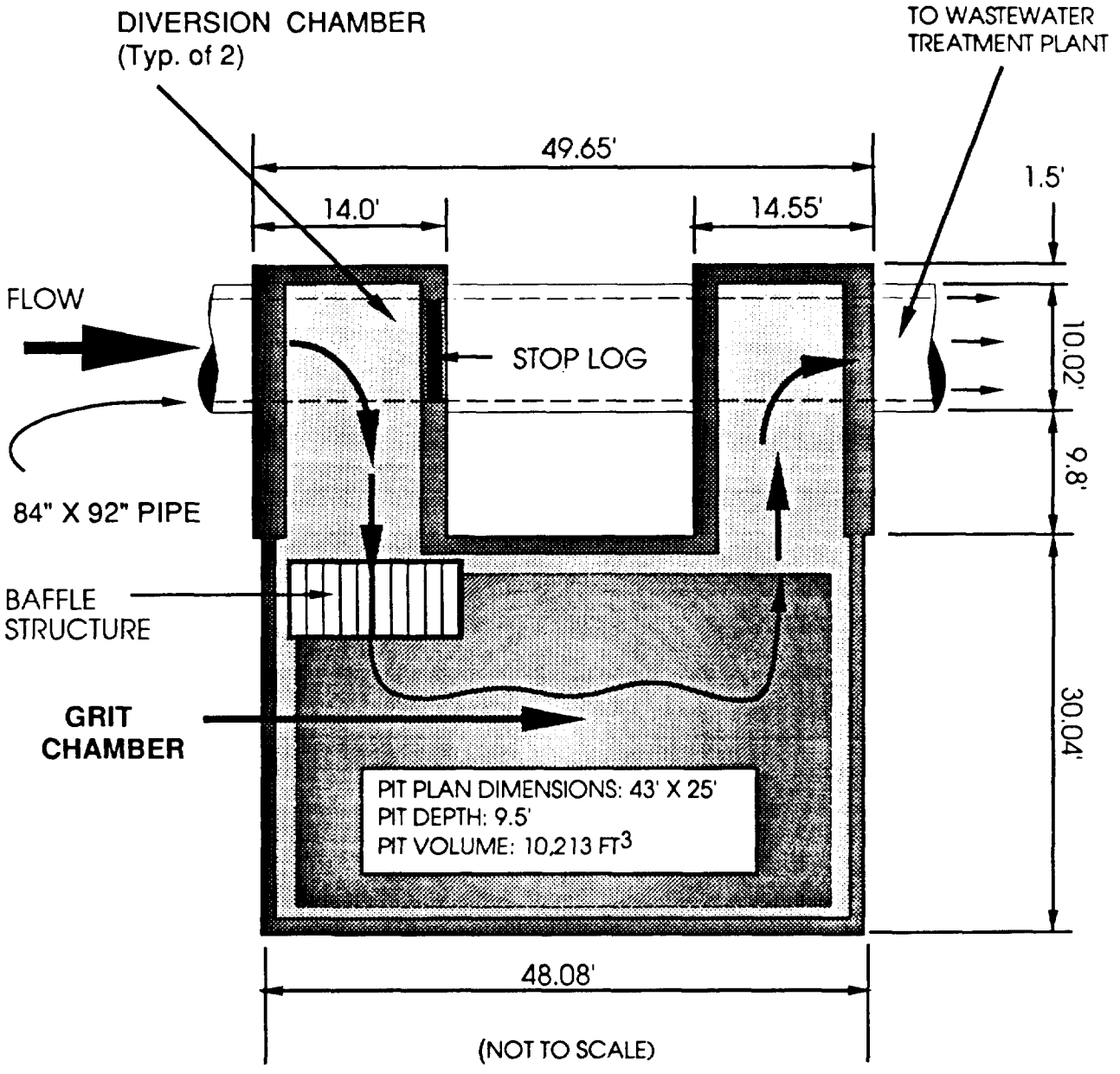

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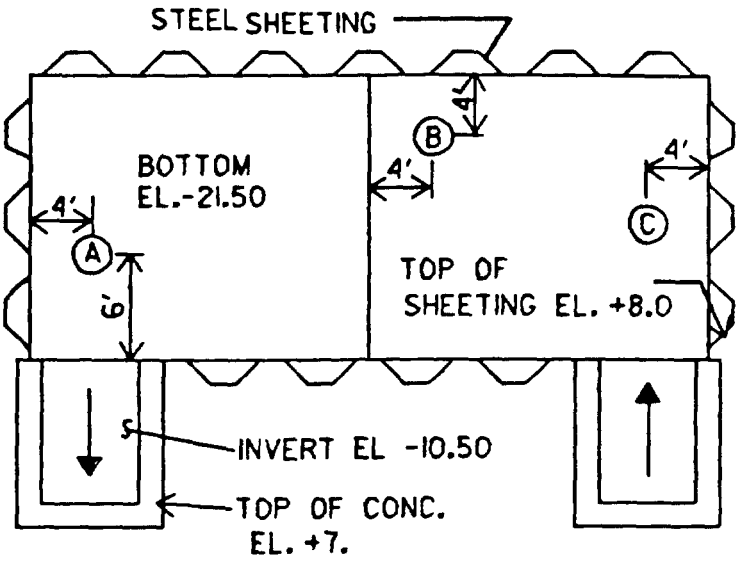
FIGURE III-6
PLAN OF IMPROVEMENTS TO EXISTING GRIT REMOVAL FACILITY AT THE WASTEWATER TREATMENT PLANT

In addition, a frequent cleaning program, previously recommended by CDM, to remove grit from the grit chamber should be continued. Presently, the grit chamber is cleaned whenever grit accumulates in the chamber to a recommended depth. The grit chamber log sheet (Figure III-7) is to be completed by the City in conjunction with the cleaning program.

GRIT BASIN GRIT LEVELS

MONTH _____



NOTES:

1 MEASURE DISTANCE TO GRIT FROM TOP OF SHEETING

2 DEPTH OF GRIT: 29.5 MINUS DISTANCE TO GRIT

3 USE 4' LONG EXTENSION POLE TO MEASURE OUT 4' FROM SHEETING

4 USE SLUDGE BLANKET LEVEL DETECTOR TO DETECT LEVEL OF GRIT

5 BASIN IS FULL WHEN DEPTH OF GRIT AT (B) IS 8'

				DISTANCE TO GRIT (Ft)		DEPTH OF GRIT (Ft)	
DAY	TIME	FLOW	INITL.	A	B	A	B

SECTION IV

RECOMMENDATIONS AND IMPLEMENTATION

General

As discussed in Section I, the purpose of this report is to; (1) define the reasons for grit accumulation in the major interceptors and collectors in the City; (2) identify and evaluate alternatives to correct the grit problem; and (3) recommend a grit management program, including removal of existing grit and methods to mitigate future grit accumulations.

The investigations of this report have indicated that the major reasons for grit accumulation in the interceptor are: (1) the original interceptor design consisting of large diameter pipes with flat slopes, and subsequently low flow velocities at flowing full condition; (2) tributary inflows that result in backwater conditions that lower local velocities; (3) the flow relief effect of the regulators limiting the availability of a scour velocity; and (4) the typical characteristics and configuration of combined systems which result in an influx of grit due to lack of proper maintenance.

The major restrictions to conveyance of future dry-weather flows within the existing interceptor system is the section beneath Acushnet Avenue identified in Section III. This reach has also been identified as one major location of the existing grit deposition in the upstream reaches of the interceptor due to low flow velocities. Consequently, this study evaluated options to eliminate this restrictive conduit. However, since the ongoing Facilities Plan work will include a more detailed evaluation of this problem, and result in definitive recommendations and estimated costs, only conceptual arrangements were developed for this evaluation.

Evaluation of the grit deposition problem indicated that structural improvements to the sewerage system are limited in their effectiveness to mitigate grit deposition. Best management practices, which include proper

and regular system maintenance, is the most effective means to control grit. Required personnel and equipment of several applicable best management practices (catch basin cleaning, sewer flushing and cleaning) as recommended in Section III, have been discussed in detail in previously submitted reports (Staffing Plan, August 1987, and Wastewater Collection System Report, August 1987). Accordingly, only the recommended best management practice of street sweeping is detailed in this section, although a summary of the other BMP requirements and estimated costs are provided.

The recommendations are discussed below and summarized in Table IV-1. They include: (1) removal of existing grit from the interceptor; (2) improvements to the existing grit removal facility at the wastewater treatment plant; (3) best management practices; and (4) the conceptual arrangement of structural improvements to the interceptor.

Removal of Existing Grit

The recommended method for removal of existing grit from the interceptor is utilization of vacuum trucks in conjunction with flushing, to clean the interceptor on a section-by-section basis. Advantages of this method over others evaluated in Section III include simplicity of operation, more controlled handling of grit contaminated by hazardous wastes and relatively minimal impact to system operations. It is estimated that interceptor grit quantities range from 4,000 to 4,500 cubic yards.

Preliminary discussions with qualified hazardous waste removal contractors have focused on the method of removal and disposal of the grit. Based on these discussions, it is anticipated that grit will be removed as follows:

- Grit will be removed from the interceptor by vacuum trucks;
- Grit will be transported to a staging area where it will be solidified by chemical treatment; and
- Grit will be transported and disposed of in environmentally secure landfill.

TABLE IV-1

NEW BEDFORD, MASSACHUSETTS

SUMMARY OF RECOMMENDATIONS

Item	Implementation Date
1. Initiate a street sweeping program concentrating in areas served by combined sewers	October, 1987
2. Remove and dispose of existing grit from the main interceptor (commencement)	February, 1988
3. Changes in equipment and personnel to implement programs established in the Wastewater Collection System Inspection Report (August, 1987)	
o Purchase vacuum/flush-type truck	February, 1988
4. Purchase 1 street sweeper	August, 1988
5. Hire 1 additional equipment operator for street sweeper	August, 1988
6. Finalize conceptual structural solution to mitigate future grit deposits in main interceptor (see Figure III-4)	August, 1988
7. Install baffles in existing grit chamber at WWTP	December, 1988
8. Purchase hydraulic-type jet rodder and a vacuum/flush-type truck	July, 1989
9. Purchase vacuum/flush-type truck(optional)	July, 1990

In addition to costs associated with grit removal and transport, other cost items include legal and land acquistion requirements for the staging area, state and federal permitting costs and ultimate disposal. At this time, removal and transport costs were not available from a contractor.

Improvements to the Grit Removal Facility at the Wastewater Treatment Plant

Recommended improvements to increase the effectiveness of the grit chamber consist of installation of a baffle structure at the inlet. The baffle structure should eliminate, for the most part, grit carry-over into the treatment plant, as discussed in Section III. The estimated cost (July, 1987 - ENR = 4404) of this improvement is as follows:

Engineering	$3,500
Materials	3,350
Total	$6,850
Labor Hours	120

This cost is based on the assumption that DPW personnel will install the baffle structure. In lieu of utilizing DPW personnel, the City may consider engaging an outside contractor. The estimated costs (July, 1987 - ENR = 4404) for the project are as follows:

Engineering	$ 5,200
Materials	3,350
Labor	2,850
Total	$11,400

The engineering cost has been increased to include the extra cost associated with preparing contract documents.

Best Management Practices

As discussed in Section III, the following best management practices are considered warranted for mitigation of grit deposition and to assure proper long-term system operation:

- Catch Basin Cleaning and Maintenance
- Sewer Flushing
- Sewer Cleaning
- Street Sweeping

The first three practices above, have been examined in detail in previous reports recently completed by CDM. In summary, based on these previous investigations, it is recommended that equipment and personnel be provided to have two crews continually maintain and clean the City's catch basins. This would enable the cleaning of every catch basin at least once a year. Catch basins in areas found to highly susceptible to grit should be cleaned as often as 4 times per year. In addition, a separate, properly equipped crew, is recommended to perform regular inspections and maintenance of the interceptor/collection system. Sewer flushing and cleaning would be performed by a fourth crew, as required, based on recommendations of the inspection crew. A full description of the recommended equipment, procedures, and scheduling are presented in the Wastewater Collection System Inspection Report (August 1, 1987) and the Staffing Plan (August 1, 1987), both submitted under separate cover.

The fourth "best management practice" is street sweeping. It is recommended that grit and debris deposited on City streets be cleaned by sweepers to prevent it from entering drainage structures, and subsequently, the collection system. Presently, the City has an ongoing street sweeping program using three sweepers. The intent of the program is mainly for aesthetics, and currently focuses on heavily traveled and highly visible main streets and the downtown area.

It is recommended that the street sweeping program be expanded. Sweeping efforts should be concentrated in areas served by combined collection

systems, and be intensified in the spring, after winter street sanding. All City streets be cleaned at least once in the late winter, before heavy spring rains (February, March, April). Streets served by separated sewers(1,845 acres, or approximately 25% of the City's total land area) should be cleaned twice per year. Streets served by combined sewers(3,446 acres, or approximately 47% of the City's land area) should be cleaned at least four times a year (see Figure III-5). The intent of this high frequency street sweeping is to prevent grit from entering the collection system, where the removal of grit accumulations becomes more expensive.

An additional street sweeper should be purchased to help perform this program. With a new sweeper added, a total of three sweepers should operate during the day to effectively sweep the streets when they are relatively free of vehicles. The nighttime sweeper shift cannot be expanded because of the large amount of parked cars. Additionally, the street sweeping program should be adapted to a computerized maintenance program, as recommended previously by CDM for catch basin cleaning, and sewer flushing, cleaning, and inspection (Wastewater Collection System Inspection Report, August 1987).

The estimated cost of implementing the above recommendations, in addition to the current expenditures for system maintenance, is presented below(August 1987, ENR = 4404):

Capital Costs

Street Sweeper (1)	$90,000
Hydraulic Jet-Rodder(1)	$53,000
Vacuum/Flush Type Truck (3)	$420,000
(includes one optional future truck)	
Total Capital Costs	$563,000

Additional Annual Costs

Street Sweeper Operator (1)	$20,000
Vehicle Maintenance(Street Sweeper)	$7,500
Total Additional Annual Costs	$27,500

The third Vacuum/Flush Type Truck is optional should the City be unable to adequately clean the catch basins at the recommended frequency. Personnel is assumed to be available to conduct the catch basin cleaning, sewer flushing/cleaning and sewer inspection programs if the recommendations of the previously submitted Staffing Plan Report(August 1987) are adopted. In addition, the annual cost of the vehicle maintenance does not reflect an increase due to the addition of the Hydraulic Jet-Rodder and the Vacuum/Flush Type Trucks because they are intended to replace existing vehicles. Accordingly, annual vehicle maintenance costs should not increase except for one new street sweeper.

Structural Improvements to the Interceptor

The proposed structural option to help mitigate grit deposition and eliminate the flow conveyance problem in the interceptor consists of a pumping and flow diversion arrangement. Wastewater from the northwestern areas of the City tributary to the Church Street and the Sawyer Street Collectors, would be diverted to the North End Relief Inteceptor. Flow from the northeastern areas of the City will be pumped to a point in the interceptor downstream of the restriction section. In concept, this will permit the interceptor from Pearl Street to the upstream reaches, including the restrictive conduit, to be abandoned.

The structural improvements are presented herein in concept only because this solution must be coordinated with the Facilities Plan. The final structural recommendation relating to the grit and conveyance problems will be developed, evaluated, cost-estimated and presented at a later date, in the New Bedford Facilties Plan report.

Funding

Funding for these recommendations must be borne wholely by the City. There are currently no grant programs available for these capital improvements or annual maintenance programs. The structural improvements to the treatment plant grit facility are ineligible for funding under the current Wastewater Treatment Plant Improvements contract. Funding options for the structural improvements to the interceptor will be presented in the Facilities Plan.