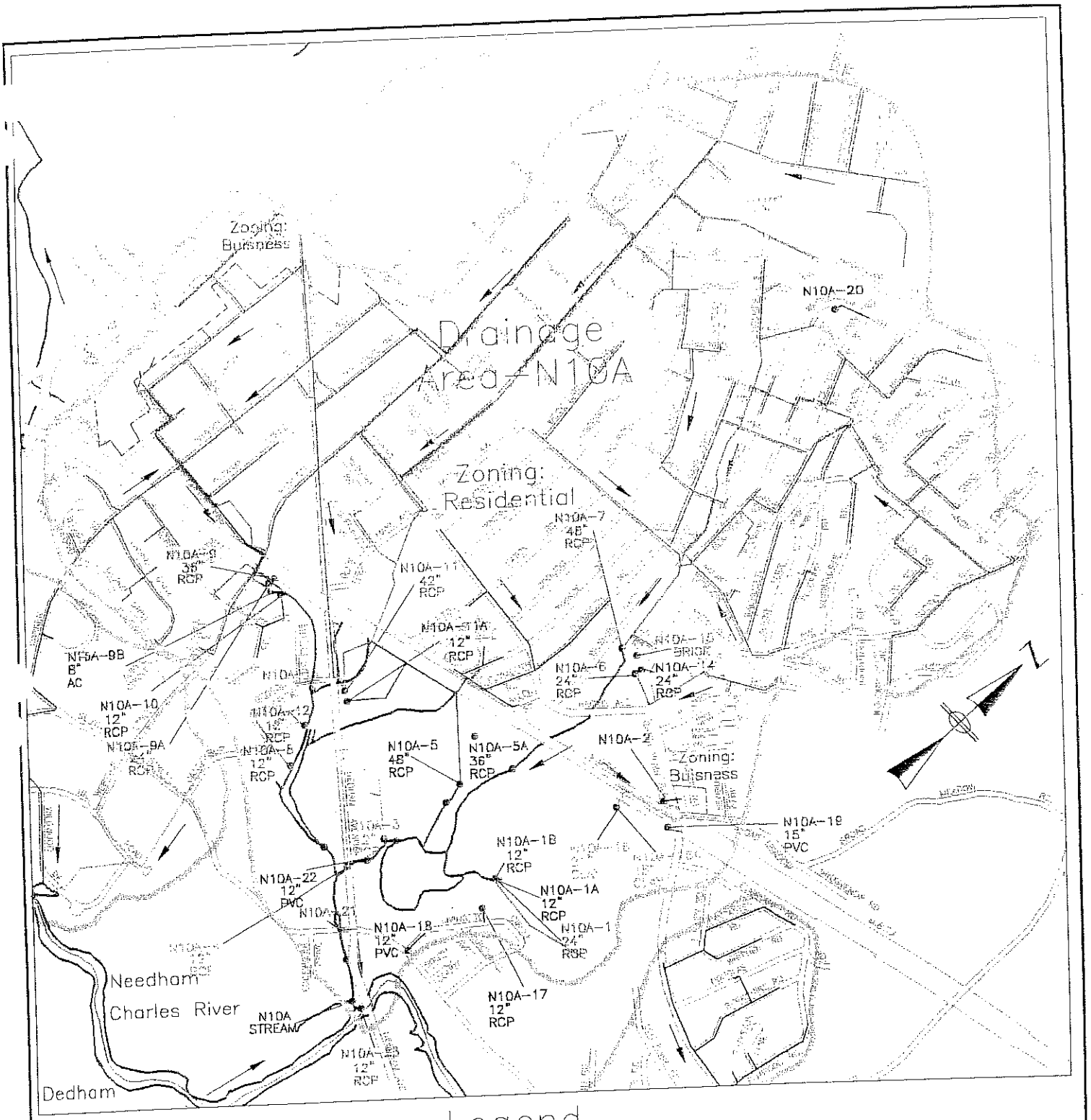
N10A-12	East of Canterbury Lane	12-RCP	0.5	10/8/96	14:50	74	ND	23
N10A-13	George Abbot Lane	NS	Dry	10/8/96	14:15	NA	NA	NA
N10A-14	West of Great Plain Avenue	24-RCP	Dry	10/8/96	14:55	NA	NA	NA
N10A-15	West of Great Plain Avenue	Brick	0.5	10/8/96	14:10	120	ND	300
N10A-16	Needham Golf Course	21	15	11/5/96	11:30	94	ND	500
N10A-16A	Needham Golf Course	15	Dry	11/5/96	11:30	NA	NA	NA
N10A-17	Northwest of Livingston Circle	12-RCP	Dry	11/5/96	13:10	NA	NA	NA
N10A-18	Southwest of South Street	12-PVC	Dry	11/5/96	13:20	NA	NA	NA
N10A-19	Southwest of Great Plain Avenue	15-PVC	Dry	11/5/96	13:25	NA	NA	NA
N10A-20	South of Washington Avenue	12-RCP	Dry	11/5/96	13:45	NA	NA	NA
N10A-21	South St. and Dedham Avenue	NS	Dry	11/5/96	13:23	NA	NA	NA
N10A-22	DPW Parking Lot	12-PVC	0.5	11/5/96	10:00	410	0.23	ND
N10A-23	South of Dedham Avenue	12-RCP	NS	11/6/96	14:00	NS	NS	130
N10A-Stream #1	Southwest of Dedham Avenue	STREAM	NS	11/5/96	13:50	NS	NS	20
N10A-Stream #2	Southwest of Dedham Avenue	STREAM	NS	11/5/96	14:10	NS	NS	130
N10A-Stream #3	West of Needham Reservoir	STREAM	NS	11/5/96	14:10	NS	NS	80
N10A-Stream #4	Southwest of Dedham Avenue	STREAM	NS	11/5/96	14:15	NS	NS	500
N10A-Stream #5	Northwest of Needham Reservoir	STREAM	NS	11/5/96	14:30	NS	NS	220
N10A-Stream #6	North of Needham Reservoir	STREAM	NS	11/5/96	14:35	NS	NS	1,300

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay

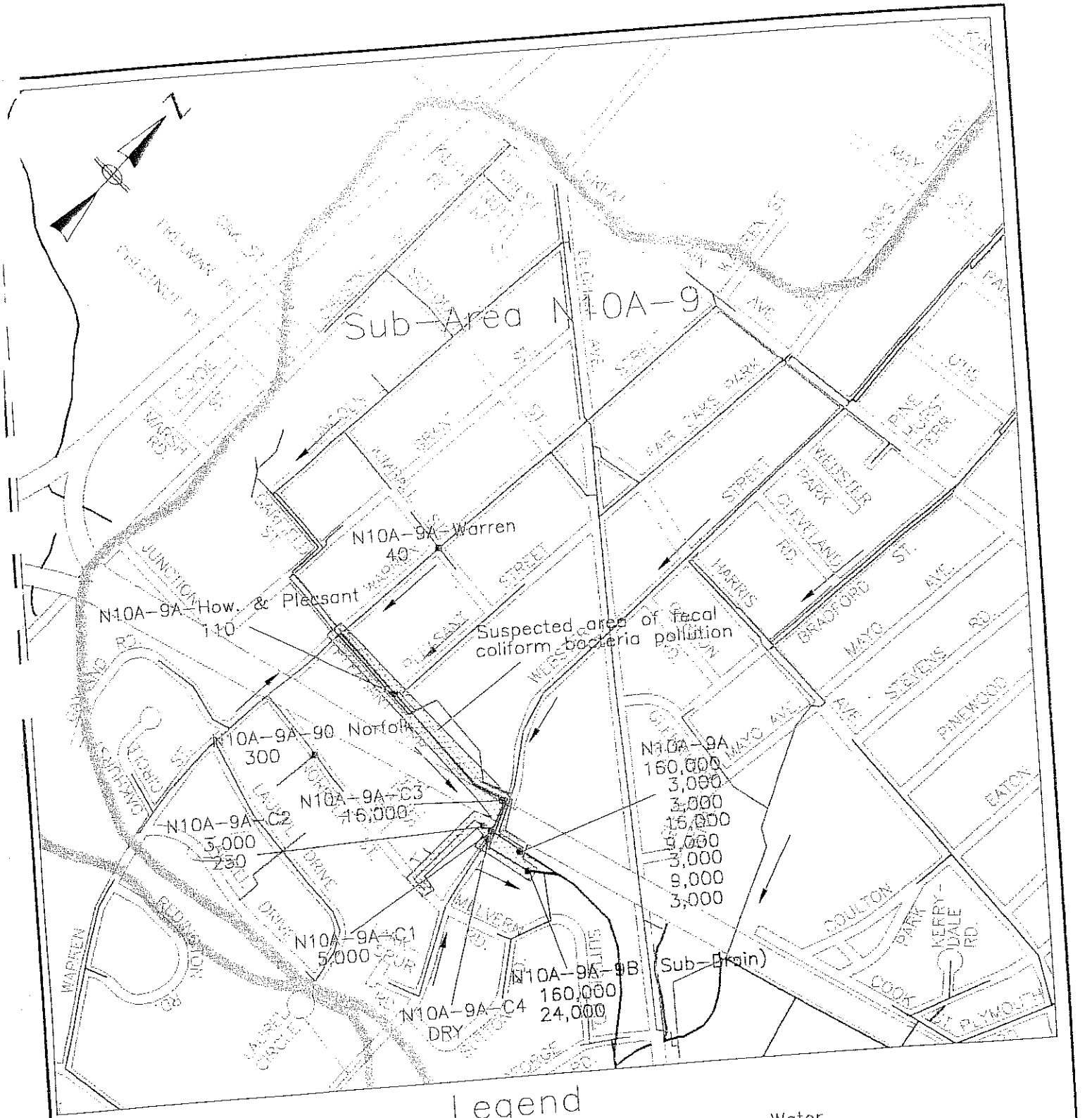
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



Not to Scale

Figure 3.27 – Area Layout
Drainage Area – N10A
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Not to Scale

Figure 3.41 – Sampling Results
Sub-Area – N10A-9
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-9

Date: 10/17/96 Time: 1:50 p.m.

Location: East of Webster St. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS umhos

Chloride: NS mg/l

Fluoride: NS mg/l

Fecal Coliform Bacteria: 1,600 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: 36 in.

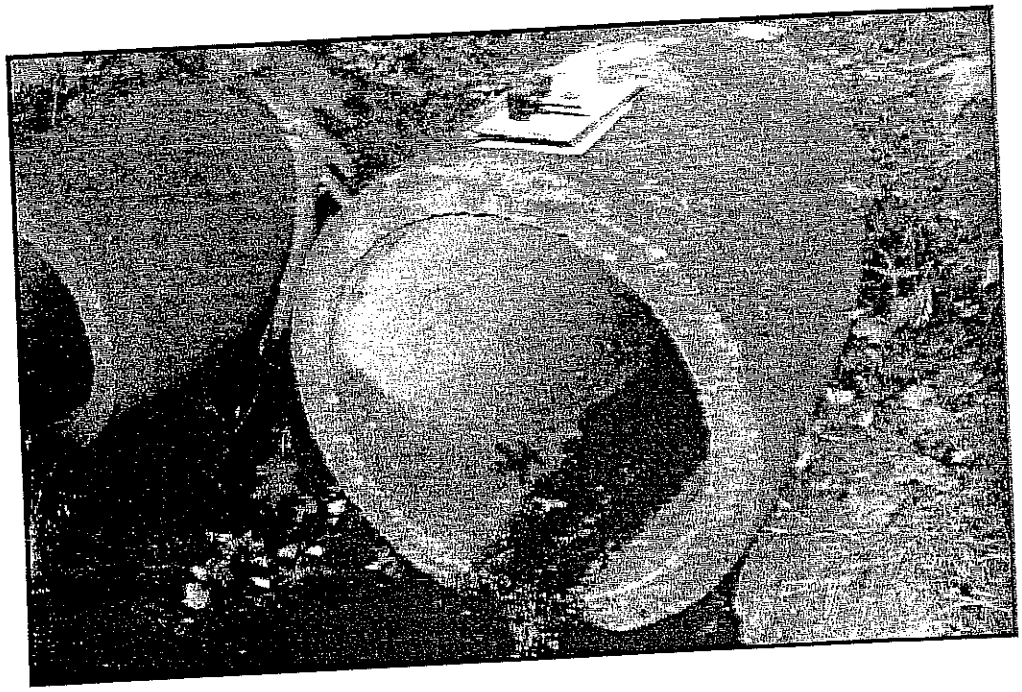
Pipe Material/Condition: RCP/Good

Flow Estimate: 3 gpm

Last Precipitation: 10/9/96

Clarity of Flow/Turbidity: Clear

Comments: No organic material was noted in the pipe.



BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.42

File name: N10A-9.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-9A

Date: 10/2/96 Time: 3:00 p.m.

Location: East of Webster St. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS uohms

Chloride: 120 mg/l

Fluoride: ND mg/l

Fecal Coliform Bacteria: 160,000 MPN/100ml

Temperature: 11.5 °c

SAMPLING DATA

Pipe Size: 24 in.

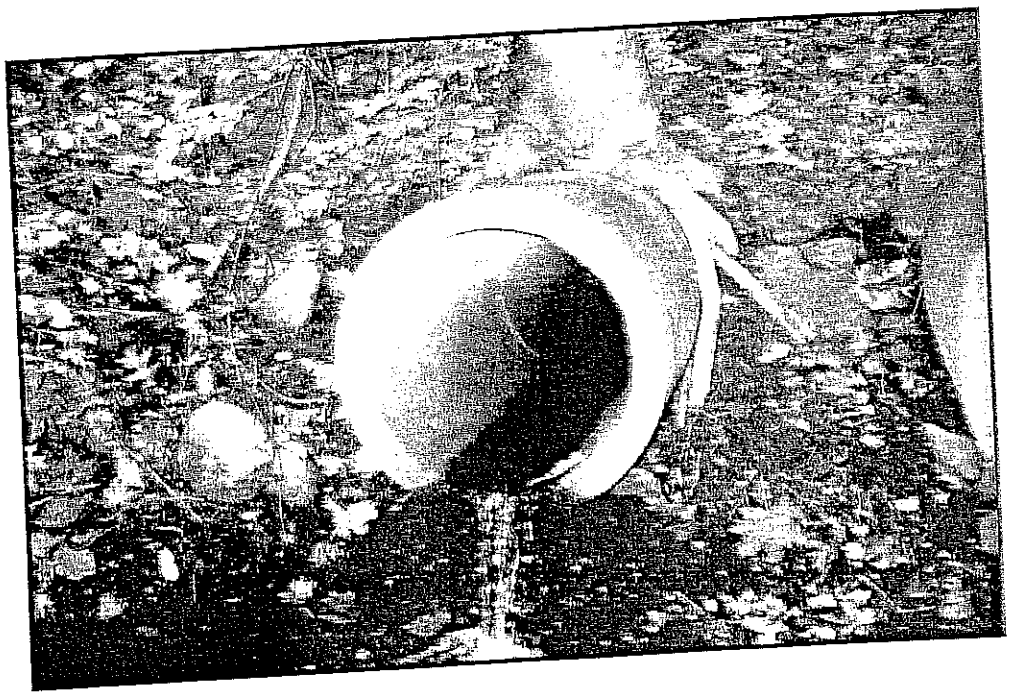
Pipe Material/Condition: RCP/Good

Flow Estimate: 10 gpm

Last Precipitation: 9/29/96

Clarity of Flow/Turbidity: Clear

Comments: A slime layer was noticed on the bottom of the pipe.



BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.43

File name: N10A-9A.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-9B

Date: 11/7/96 Time: 10:30 a.m.

Location: East of Webster St. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS umhos

Chloride: 93 mg/l

Fluoride: ND mg/l

Fecal Coliform Bacteria: 24,000 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: 8 in

Pipe Material/Condition: Asbestos Concrete/ Good

Flow Estimate: 5 gpm

Last Precipitation: 11/7/96

Clarity of Flow/Turbidity: Clear

Comments: Brown flocculent was observed at the outfall.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.44

File name: N10A-9A.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-10

Date: 10/8/96 Time: 2:22 p.m.

Location: Northwest of Sutton Rd. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: 6.97

Conductivity: 440 mohms

Chloride: NS mg/l

Fluoride: NS mg/l

Fecal Coliform Bacteria: 3,000 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: 12 in.

Pipe Material/Condition: RCP/Good

Flow Estimate: Stagnant gpm

Last Precipitation: 10/2/96

Clarity of Flow/Turbidity: Clear

Comments: No floatables were observed at the outfall. Flow partially blocked with debris.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.45

File name: N10A-10.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-11

Date: 10/2/96 Time: 3:20 p.m.

Location: East of Dedham Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH:	NS		Fluoride	ND	mg/l
Conductivity:	NS	umhos	Fecal Coliform Bacteria	80	MPN/100ml
Chloride:	75	mg/l	Temperature	12.4	°c

SAMPLING DATA

Pipe Size:	42	in	Flow Estimate	10	gpm
Pipe Material/Condition	RCP/Good		Last Precipitation:	9/29/96	
			Clarity of Flow/Turbidity:	Clear	

Comments: A slime layer was observed on the bottom of the discharge pipe.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.46

File name: N10A-11.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-11A

Location: East of Dedham Avenue
Needham, MA

Date: 10/8/96 Time: 12:30 p.m.

Weather: Dry

ANALYTICAL DATA

pH:	6.50	
Conductivity:	390	uohm
Chloride:	38	mg/l
Fluoride	ND	mg/l
Fecal Coliform Bacteria	500	MPN/100ml
Temperature	NS	°c

SAMPLING DATA

Pipe Size:	12	in
Pipe Material/Condition:	RCP/Fair	
Flow Estimate	3	gpm
Last Precipitation:	10/2/96	
Clarity of Flow/Turbidity:	Clear	

Comments: Iron bacteria noticed on the inside of the pipe and at the outfall.

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.47

File name: N10A-11A.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-12

Date: 10/8/96 Time: 2:50 p.m.

Location: East of Canterbury Lane, Needham, MA

Weather: Dry

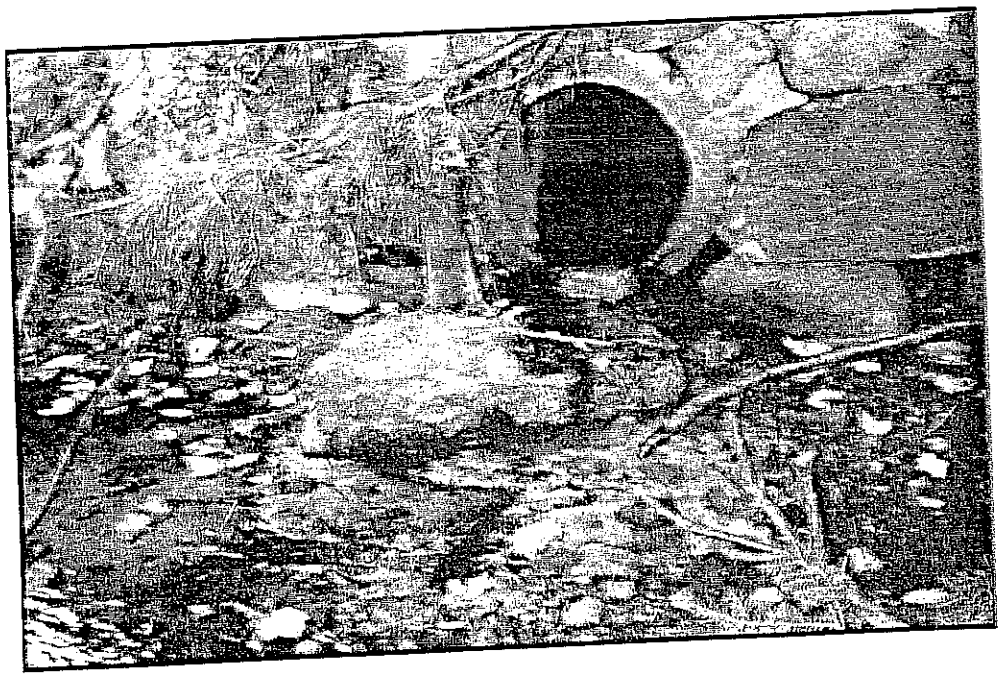
ANALYTICAL DATA

pH:	7.15		Fluoride	ND	mg/l
Conductivity	390	µohms	Fecal Coliform Bacteria	23	MPN/100ml
Chloride:	74	mg/l	Temperature	11.9	°c

SAMPLING DATA

Pipe Size:	12	in	Flow Estimate:	<0.5	gpm
Pipe Material/Condition:	RCP/Good		Last Precipitation:	10/2/96	
			Clarity of Flow/Turbidity:	Clear	

Comments: Iron bacteria was located in the pipe and on the outfall rocks.



BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.48

File name: N10A-12.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-13

Date: 10/8/96 Time: 2:15 p.m.

Weather: Dry

Location: George Aggot Road
Needham, MA

ANALYTICAL DATA

pH: NA

Conductivity: NA umhos

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: NS in

Pipe Material/Condition: RCP/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/2/96

Clarity of Flow/Turbidity: NA

Comments: **Animal feces located in a manhole on George Aggot Road.**

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.49

File name: N10A-14.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-14

Date: 10/8/96 Time: 2:55 p.m.

Location: West of Great Plain Avenue
Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA mohms

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 24 in

Pipe Material/Condition: RCP/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/2/96

Clarity of Flow/Turbidity: NA

Comments: N10A-14 is located on the right hand side of the picture below, adjacent to N10A-6.

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.50

File name: N10A-14.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A
Discharge Point: N10A-15

Date: 10/8/96
Time: 2:10 p.m.
Weather: Dry
Location: West of Great Plain Ave. Needham, MA

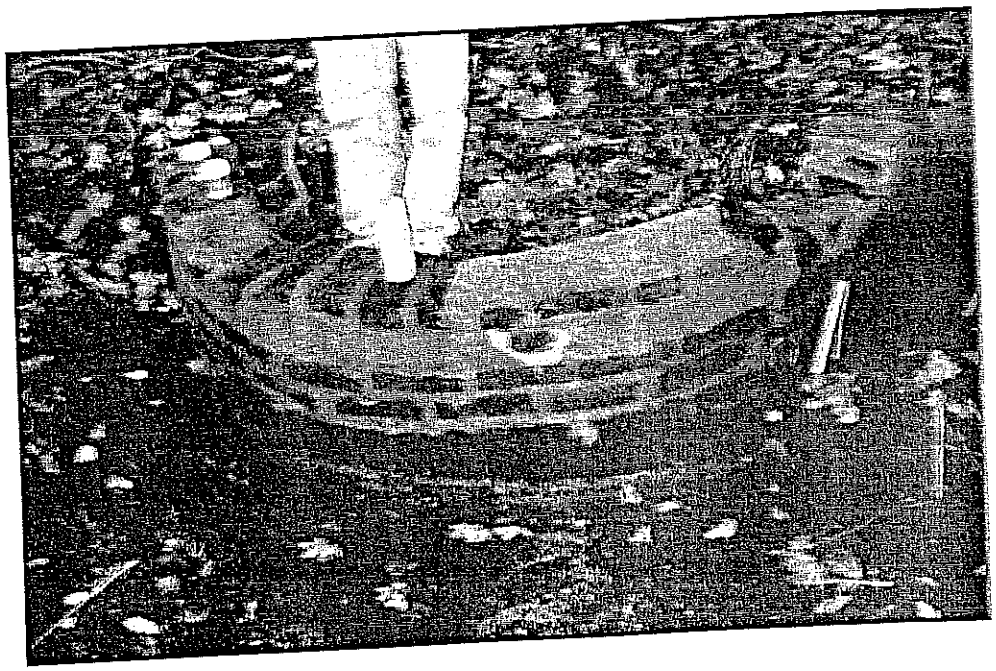
ANALYTICAL DATA

pH:	6.70		Fluoride:	ND	mg/l
Conductivity:	550	mohms	Fecal Coliform Bacteria	300	MPN/100ml
Chloride:	120	mg/l	Temperature:	12.1	°c

SAMPLING DATA

Pipe Size:	NA	in	Flow Estimate:	<0.5	gpm
Pipe Material/Condition:	NA		Last Precipitation:	10/2/96	
			Clarity of Flow/Turbidity:	Clear	

Comments: The water appears to be groundwater flowing out of the ground.



BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.51

File name: N10A-15.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-16

Date: 11/5/96 Time: 11:30 a.m.

Location: Southwest of Great Plain Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH:	6.23	Fluoride:	ND mg/l
Conductivity:	450 umhos	Fecal Coliform Bacteria:	500 MPN/100ml
Chloride:	94 mg/l	Temperature	13.2 °c

SAMPLING DATA

Pipe Size:	21 in.	Flow Estimate:	15 gpm
Pipe Material/Condition:	Clay/Good	Last Precipitation:	10/30/96
		Clarity of Flow/Turbidity	Clear

Comments: No floatables or discoloration was noticed in the outfall or discharging pipe.

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.52

File name: N10A-16.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-16A

Date: 11/5/96

Time: 11:30 a.m.

Location: Southwest of Great Plain Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA umhos

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 15 in.

Pipe Material/Condition: Clay/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/30/96

Clarity of Flow/Turbidity: NA

Comments: No floatables were observed at the outfall.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.53

File name: N10A-16A.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-17

Date: 11/5/96 Time: 1:10 p.m.

Weather: Dry

Location: Northwest of Livingston Circle
Needham, MA

ANALYTICAL DATA

pH: NA

Conductivity: NA mohms

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 12 in

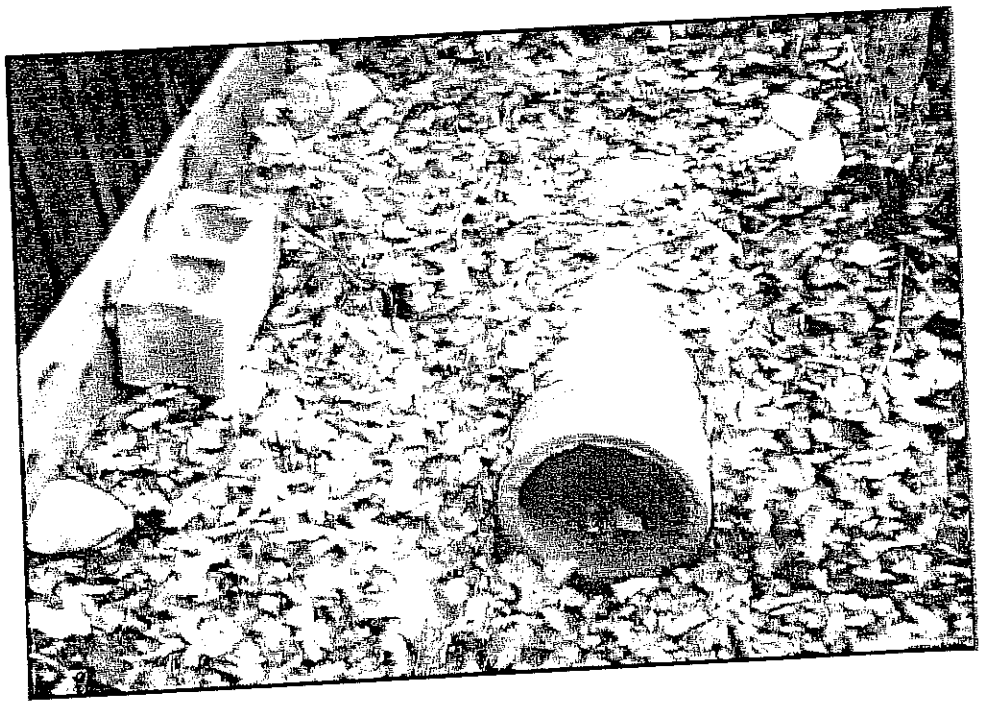
Pipe Material/Condition: RCP/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/30/96

Clarity of Flow/Turbidity: NA

Comments: No evidence of recent flow.



BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.54

File name: N10A-17.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-18

Date: 11/5/96 Time: 1:20 p.m.

Weather: Dry

Location: Southwest of South Street
Needham, MA

ANALYTICAL DATA

pH: NA

Conductivity: NA mohms

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 12 in

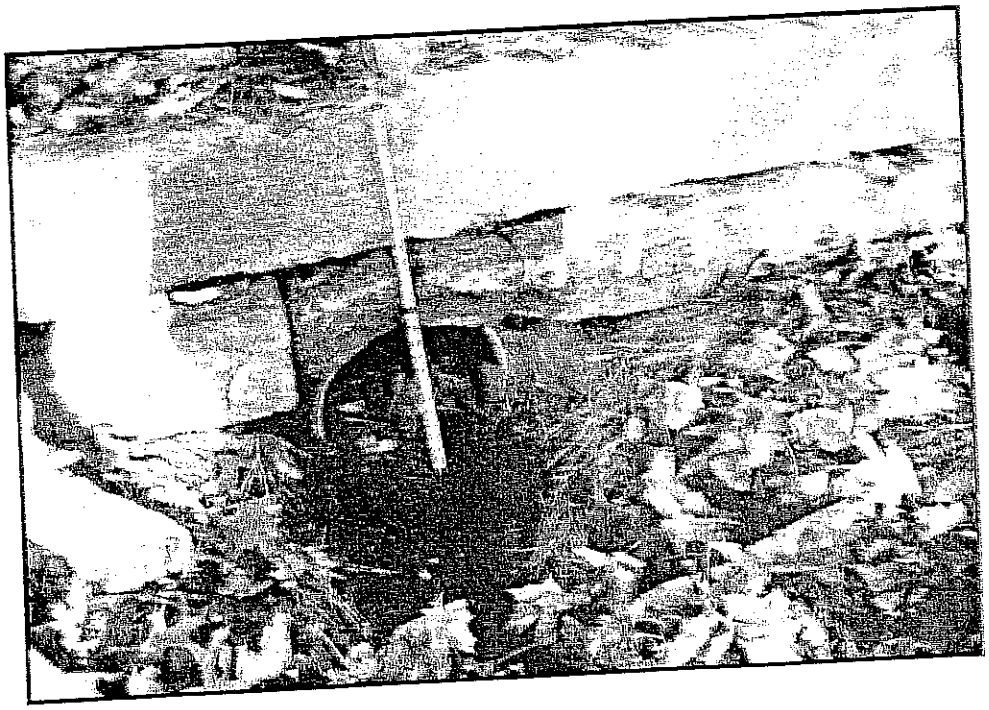
Pipe Material/Condition: PVC/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/30/96

Clarity of Flow/Turbidity: NA

Comments: No evidence of recent flow.



BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.55

File name: N10A-18.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-19

Date: 11/5/96 Time: 1:25 p.m.

Weather: Dry

Location: Southwest of Great Plain Ave. Needham, MA

ANALYTICAL DATA

pH: NA

Conductivity: NA umhos

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 15 in

Pipe Material/Condition: PVC/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/30/96

Clarity of Flow/Turbidity: NA

Comments: No evidence of recent flow.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.56

File name: N10A-19.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-22

Date: 11/5/96 Time: 10:00 a.m.

Location: DPW Parking Lot, Needham, MA

Weather: Dry

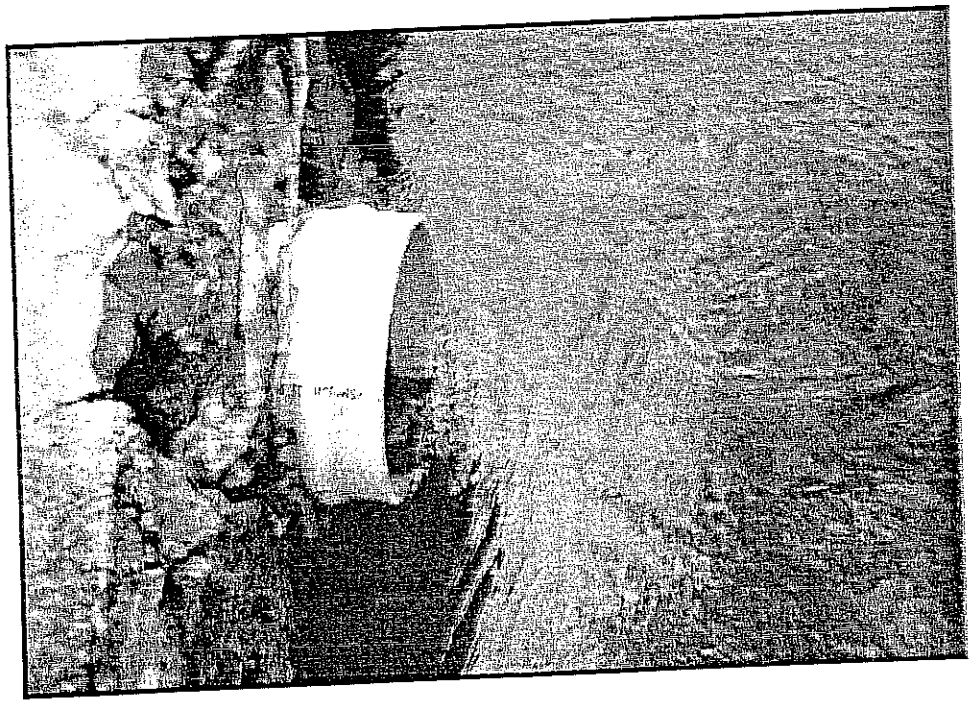
ANALYTICAL DATA

pH:	6.55		Fluoride	0.23	mg/l
Conductivity:	410	mohms	Fecal Coliform Bacteria	ND	MPN/100ml
Chloride:	410	mg/l	Temperature	NS	°c

SAMPLING DATA

Pipe Size:	12	in	Flow Estimate	0.5	gpm
Pipe Material/Condition:	PVC/Good		Last Precipitation:	10/30/96	
			Clarity of Flow/Turbidity:	Clear	

Comments: Some iron bacteria was noticed on the bottom of the pipe.



BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.57

File name: N10A-22.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N10A

Discharge Point: N10A-23

Date: 11/6/96 Time: 2:00 p.m.

Location: South of Dedham Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS mohm

Chloride: NS mg/l

Fluoride: NS mg/l

Fecal Coliform Bacteria: 130 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: 12 in

Pipe Material/Condition: RCP/Poor

Flow Estimate: Stagnant gpm

Last Precipitation: 10/30/96

Clarity of Flow/Turbidity: Clear

Comments: Sample was taken from inside the submerged pipe.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.58

File name: N10A-23.pm6

Drainage Area - N11

This drainage area is approximately 70 acres in size. The area is characterized by residential and commercial land uses. There is one (1) drainage discharge point to the Charles River. It is located to the east of South Street (see Figures 3.59 and 3.60).

Characteristics which could effect the water quality of this area include the following:

- total length of drain pipe in this area is approximately 7,200 linear feet
- drainage systems within area N11 include 72 catch basins
- all streets within the sub-area have sanitary sewers
- St. Sebastian's School has a major septic system, handling a flow from 320 students, and an additional 40 staff, located adjacent to the Charles River
- geese are problematic in the lower recreational fields of the school
- drainage from this pipe flows to a wetland area located to the east of the N-11 discharge.
- the discharge of N-11 is approximately 20 feet from the Charles River. This allows for some VOC volatilization, and settlement of oil, grease, total solids, total suspended solids, and associated metals.

Sub-area N11-1

This discharge point is located south of South Street. The sampling point was taken from a catch basin located down a steep embankment in a residential backyard (see Figure 3.61). The inflow pipe of the manhole had no flow, but BETA observed what appeared to be visually clear water infiltrating into the manhole from holes in the bricks. The manholes concrete bricks were deteriorated, indicating the presence of acidic groundwater. No flow was discharging from the manhole to the Charles River (N11).

Dry Weather Sampling

A sample was taken on October 2, 1996 at 2:45 p.m. from this location. BETA sampled the water entering through the bricks. The laboratory results revealed the following:

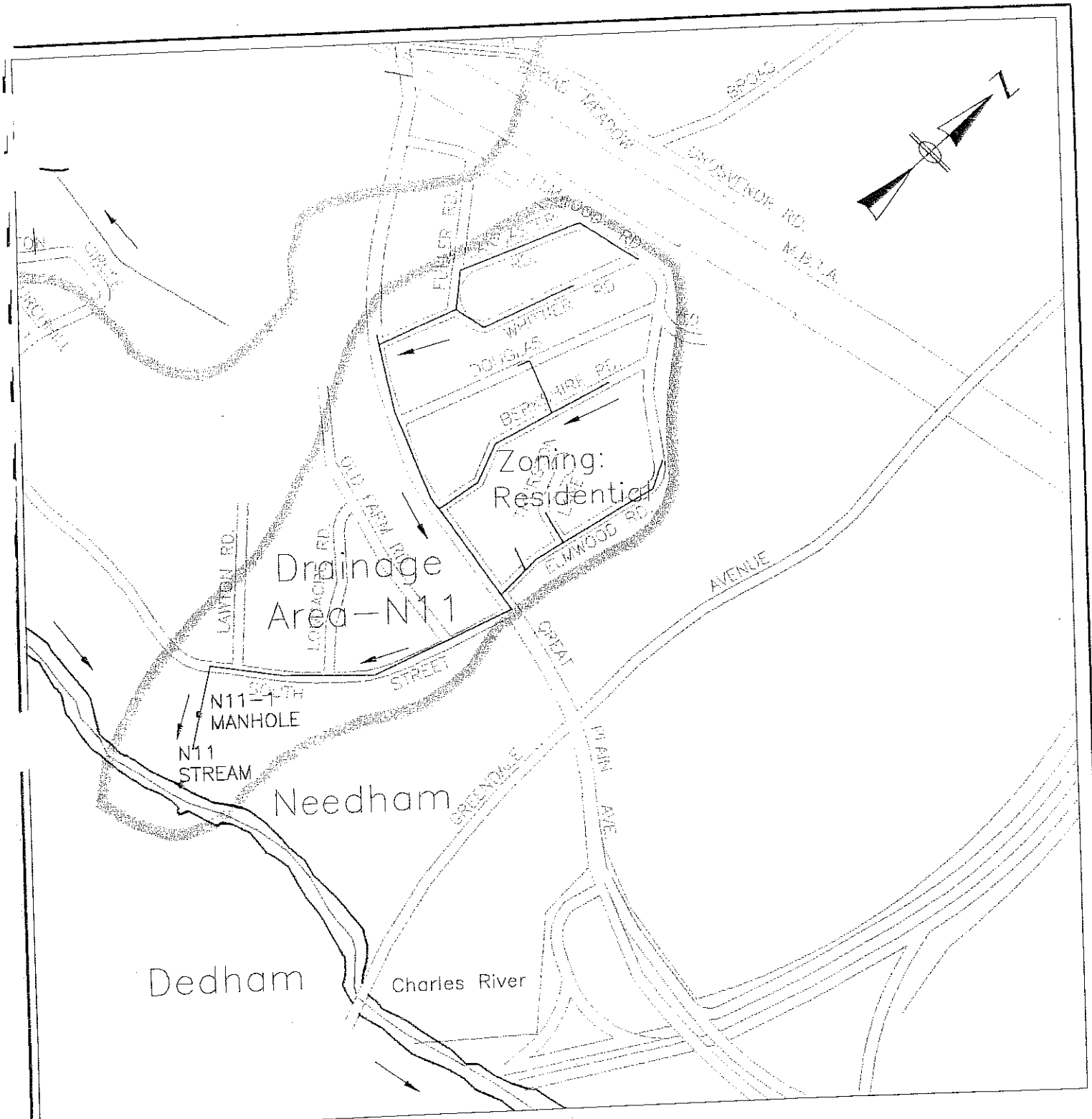
- chloride - 190 mg/l
- fluoride - ND
- fecal coliform - 50 MPN/100 ml.

Table 3.6 summarizes the dry weather sampling locations and results.

Table 3.6 Summary of Dry Weather Sampling for N11

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N11								
N11	South of South Street	12-RCP	DRY	10/2/96	14:40	NA	NA	NA
N11-1	South of South Street	12-RCP	0.1	10/2/96	14:45	190	ND	50

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



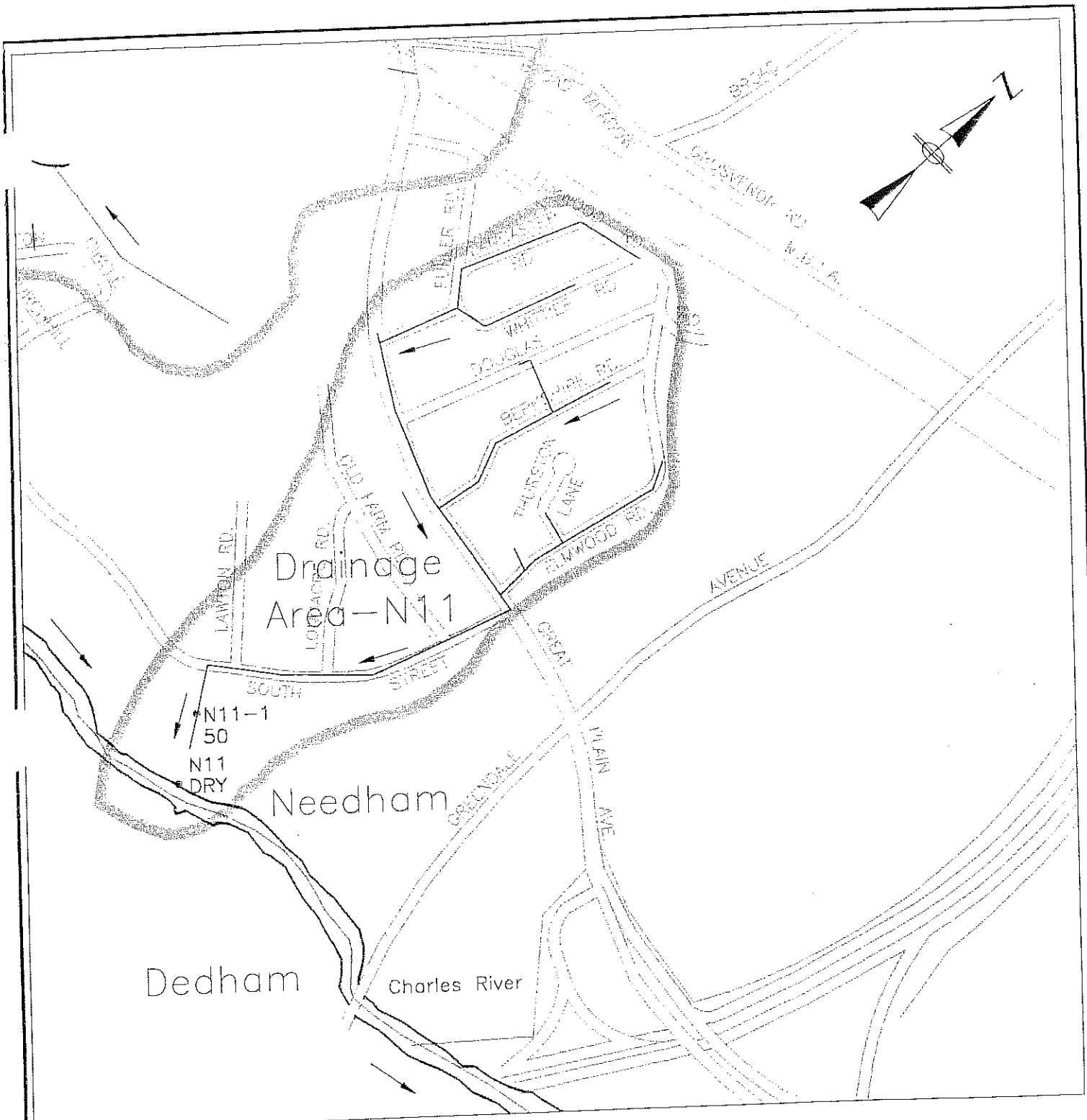
Legend

* N11—1	—	Sub—area Discharge/Sampling Location
N11	—	Discharge Point
12"	—	Pipe Size in Inches
RCP	—	Pipe Material
———	—	Water
———	—	Town Line
▒▒▒▒	—	Drainage Area Boundary
←———	—	Stormwater Flow Direction

Not to Scale

Figure 3.59 — Area Layout
Drainage Area — N11
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Legend

N11—1	— Sub—area Discharge
N11	— Discharge Point
300	— Fecal Coliform Bacteria
•	— Sampling Location
———	— Water
———	— Town Line
▒▒▒	— Drainage Area Boundary
←———	— Stormwater Flow Direction

Not to Scale

Figure 3.60 — Sampling Results
Drainage Area — N11
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N11

Discharge Point: N11-1

Date: 10/2/96 Time: 12:40 p.m.

Location: South of South St. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA uohms

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 12 in.

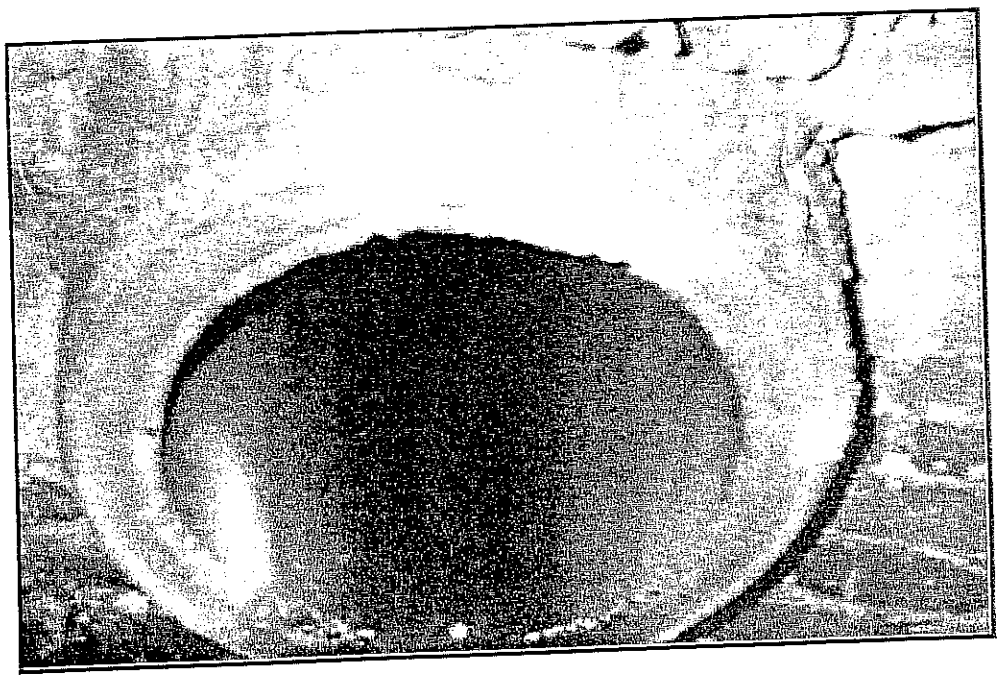
Pipe Material/Condition: RCP/Fair

Flow Estimate: Dry gpm

Last Precipitation: 9/29/96

Clarity of Flow/Turbidity: NA

Comments: Visually clear water was observed infiltrating into the manhole from holes in the bricks.



BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.61

File name: N10A-9A.pm6

Drainage Area - N14B

This drainage area is approximately 20 acres in size. The area is characterized by commercial land use. There is one (1) discharge point to the Charles River within the area, located south of Kendrick Street. The discharge pipe is approximately 300 feet from the Charles River (see Figures 3.62 and 3.63).

Some of the land use characteristics which could effect the water quality of this area include the following:

- total length of pipe in this area is approximately 1,320 linear feet
- drainage systems within area N14B include 72 catch basins
- all streets have sanitary sewers
- the land is industrial/commercial, with an abundance of impervious area
- roof drains and pigeons were noted during site inspection
- Flow is discharged to a wetland area approximately 300 feet from the Charles River. Flow of small storms infiltrate into the wetland soils, resulting in water quality improvements. The infiltration results in a reduction in total solids, total suspended solids and associated metals, nutrients and organic compounds.
  One industry has a "General Permit" under the National Discharge Pollutant Elimination System (NPDES) program to discharge to the stormwater system and the Charles River. This industry is:

  Polaroid Corp.
  140 Kendrick Street
  (SIC Code 3861) manufactures photographic equipment
  Permit No. MAR000A413

Discharge Point - N14B-1

This 30 inch RCP is located east of the intersection of Fourth Avenue and Kendrick Street (see Figure 3.64). The length of pipe in this sub-area is approximately 1,320 linear feet.

Dry Weather Sampling #1

This discharge was sampled on September 24, 1996 at 2:00 p.m. There was a flow of less than one (1) gpm Also, some foam was located at the outfall. The laboratory results revealed the following:

- chloride - 28 mg/l
- fluoride - 0.54 mg/l
- fecal coliform - 2,400 MPN/100 ml.

Dry Weather Sampling #2

The discharge was re-sampled on October 2, 1996 at 2:00 p.m. There was again minimal flow (0.2 gpm) of clear water discharging from the pipe. Again, some foam was located at the outfall. The laboratory results revealed the following:

- chloride - 14 mg/l
- fluoride - 0.77 mg/l
- fecal coliform - 80 MPN/100 ml.

Dry Weather Sampling #3
The discharge was re-sampled on October 17, 1996 at 12:30 p.m. There was minimal flow (0.1 gpm) of clear water discharging from the pipe. Again, some foam was located at the outfall. The laboratory results revealed the following:

- pH - 7.30 mg/l
- conductivity - 260 umhos
- fecal coliform - 4 MPN/100 ml.

Dry Weather Sampling #4

- The discharge was re-sampled on November 14, 1996 at 7:55 a.m. There was no flow discharging from the pipe.

Dry Weather Sampling #5
The discharge was re-sampled on November 15, 1996 at 6:50 a.m. There was minimal flow (0.1 gpm) of turbid water discharging from the pipe. Some foam was located at the outfall. The laboratory results revealed the following:

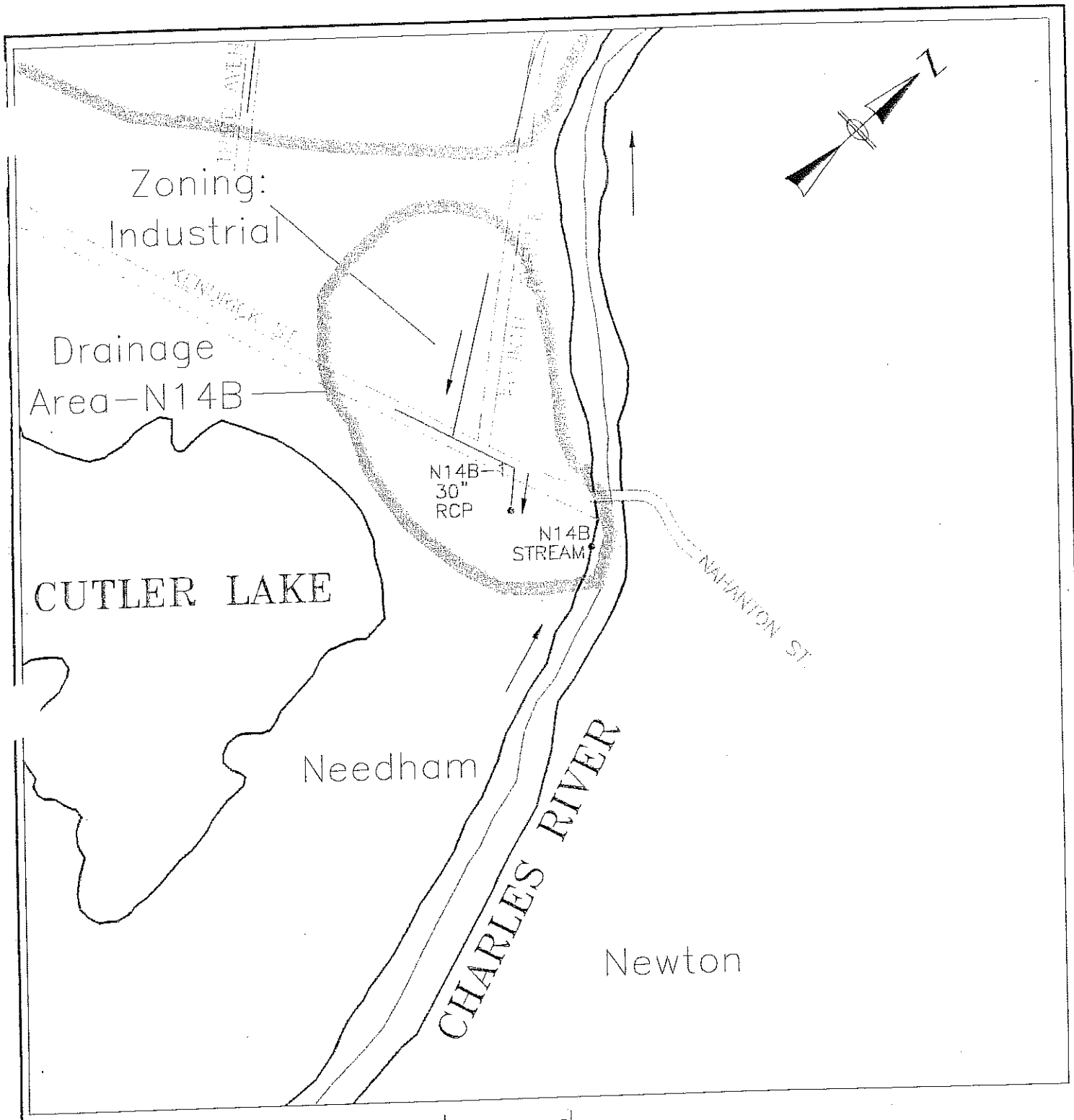
- fecal coliform - 16,000 MPN/100 ml.

Table 3.7 summarizes the dry weather sampling locations and results.

Table 3.7 Summary of Dry Weather Sampling for N14B

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N14B								
N14B-1	South of Kendrick Street	30-RCP	1	9/24/96	14:00	28	0.54	**2,400**
N14B-1	South of Kendrick Street	30-RCP	0.2	10/2/96	14:00	14	0.77	**80**
N14B-1	South of Kendrick Street	30-RCP	0.1	10/17/96	12:30	NS	NS	**4**
N14B-1	South of Kendrick Street	30-RCP	DRY	11/14/96	7:55	NA	NA	**NA**
N14B-1	South of Kendrick Street	30-RCP	<0.1	11/15/96	6:50	NS	NS	**16,000**

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



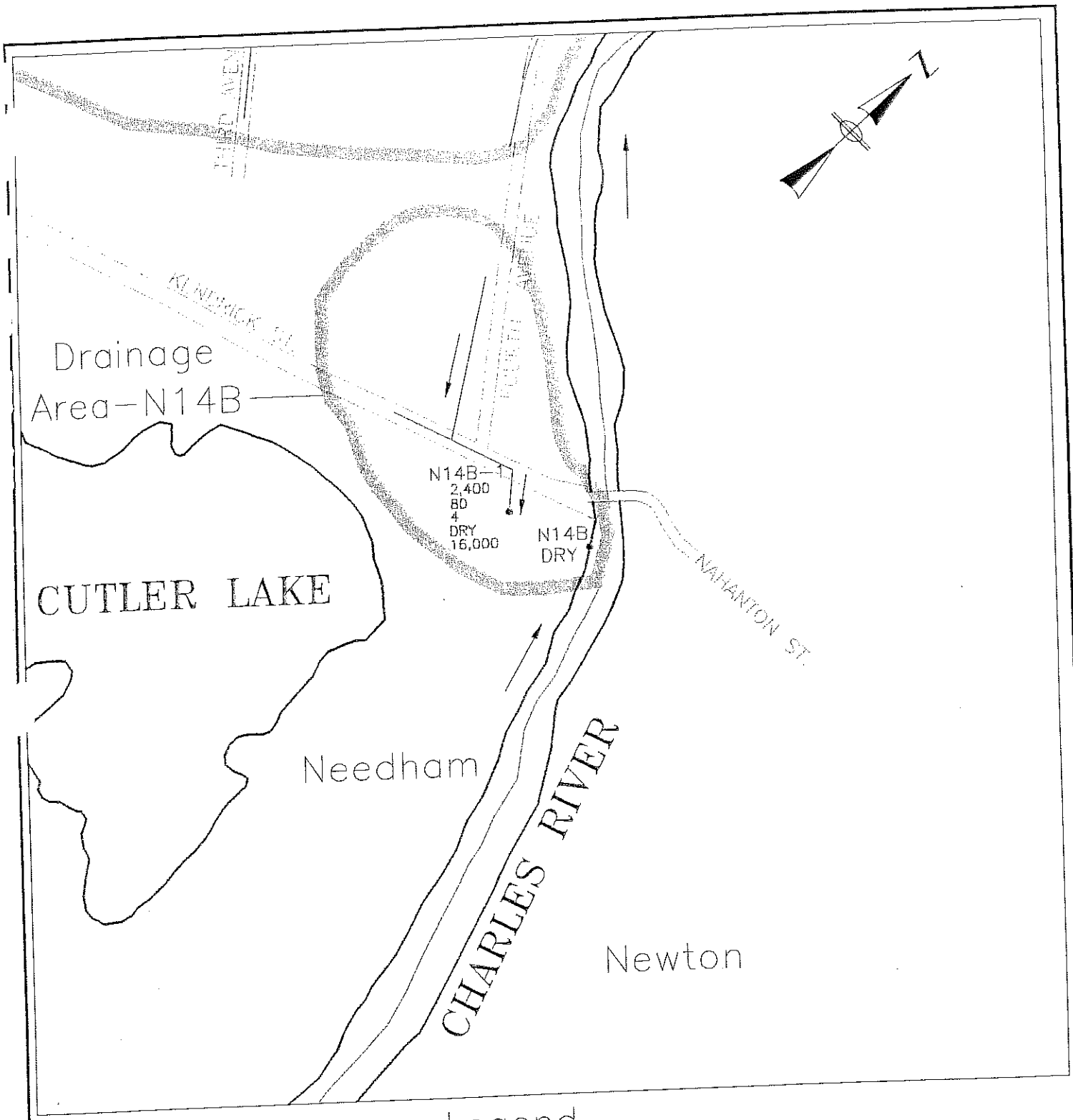
Legend

- N14B–1 – Sub–area Discharge/Sampling Location
- N14B – Discharge Point
- 12" – Pipe Size in Inches
- RCP – Pipe Material
- Water
- Town Line
- Drainage Area Boundary
- Stormwater Flow Direction

Not to Scale

Figure 3.62 – Area Layout
Drainage Area – N14B
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Legend

N14B–1	–	Sub–area Discharge
N14B	–	Discharge Point
300	–	Fecal Coliform Bacteria
•	–	Sampling Location
———	–	Water
———	–	Town Line
▒▒▒	–	Drainage Area Boundary
←———	–	Stormwater Flow Direction

Not to Scale

Figure 3.63 – Sampling Results
Drainage Area – N14B
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N14-B

Discharge Point: N14-B-1

Date: 10/2/96 Time: 2:00 p.m.

Location: South of Kendrick Street, Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS uohms

Chloride: 14 mg/l

Fluoride: 0.77 mg/l

Fecal Coliform Bacteria: 80 MPN/100ml

Temperature: 11.2 °c

SAMPLING DATA

Pipe Size: 30 in

Pipe Material/Condition: RCP/Good

Flow Estimate: 0.2 gpm

Last Precipitation: 9/29/96

Clarity of Flow/Turbidity: Clear

Comments: Some foam was located at the outfall.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.64

File name: N14B-1.pm6

Drainage Area - N14

This drainage area is approximately 175 acres in size. The area is characterized by industrial and commercial business land use. There is one (1) discharge point to the Charles River within this area. The discharge is located northeast of Second Avenue, approximately fifteen (15) feet east of a railroad bridge (see Figure 3.65 and 3.66).

Some of the land use characteristics which could effect the water quality of this area include the following:

- total length of drain pipe in this area is approximately 10,860 linear feet
- drainage systems within area N14 include 63 catch basins
- the land use is industrial/commercial, with an abundance of impervious area
- all streets have sanitary sewers
- although no geese problem exists, other birds and associated feces (pigeons) were noted during site inspections. Numerous roof drains from buildings are connected to the drainage system.
- the discharge pipe flows directly into the Charles River
- Three industries have "General Permits" to discharge to the stormwater system and the Charles River under the NPDES program. These include the following:

GTE Government Systems
77 A Street
(SIC Code 3663) manufacture radio/television equipment
Permit No. MAROOA439

NRC, Inc.
110 A Street
(SIC Code 3339) smelting and refining non-ferrous
Permit No's. MAROOA392
MAROOA393

Coca Cola Bottling, New England
9 B Street
(SIC Code 2086) manufacture soft drinks
Permit No. MAROOB249

Discharge Point - N14-1

This discharge point is a 48 inch RCP that discharges directly to the Charles River, located north of Second Avenue (see Figure 3.67). The length of pipe in this sub-area is approximately 10,850 linear feet.

Dry Weather Sampling #1
The discharge point was sampled on October 2, 1996 at 1:30 p.m. Flow was approximately one (1) gpm. No floatables or discoloration were noted in flow of the discharge pipe. The laboratory results revealed the following:

- chloride - 270 mg/l
- fluoride - 0.27 mg/l
- fecal coliform - 1,600 MPN/100 ml.

Dry Weather Sampling #2
The discharge point was re-sampled on October 17, 1996 at 12:50 p.m. Flow was approximately one (1) gpm. Clear flow was again noted. The laboratory results revealed the following:

- pH - 7.30
- conductivity - 300 umhos
- fecal coliform - 30 MPN/100 ml.

Dry Weather Sampling #3
The discharge point was re-sampled on November 14, 1996 at 7:50 a.m. Flow was approximately one (1) gpm. Clear flow was again noted. The laboratory results revealed the following:

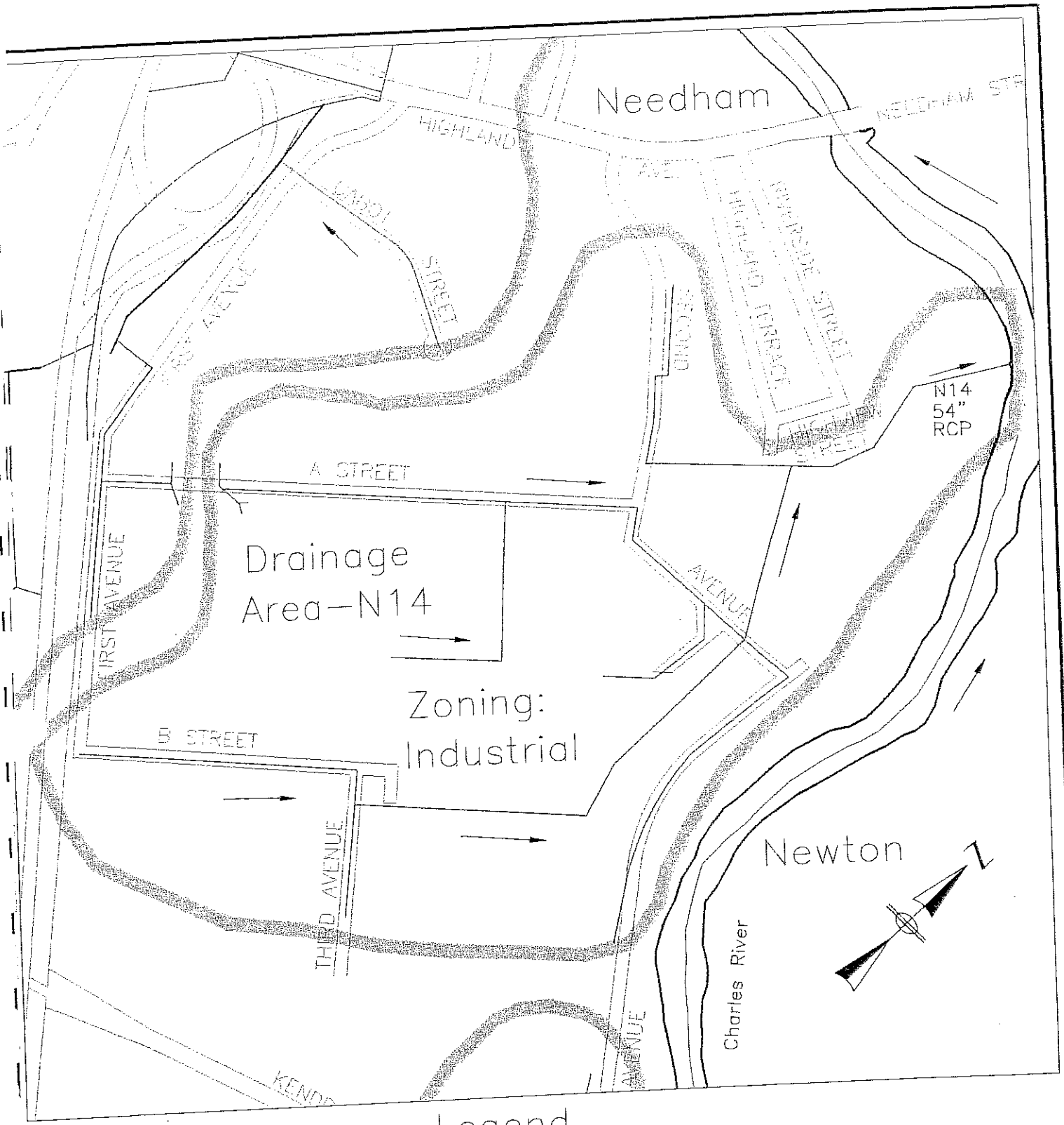
- chloride - 180 mg/l
- fluoride - 0.28 mg/l
- fecal coliform - 130 MPN/100 ml.

Table 3.8 summarizes the dry weather sampling locations and results.

Table 3.8 Summary of Dry Weather Sampling for N14

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N14								
N14	North of Second Avenue	54-RCP	1	10/2/96	13:30	270	0.27	1,600
N14	North of Second Avenue	54-RCP	1	10/17/96	12:50	NS	NS	30
N14	North of Second Avenue	54-RCP	1	11/14/96	7:50	180	0.28	130

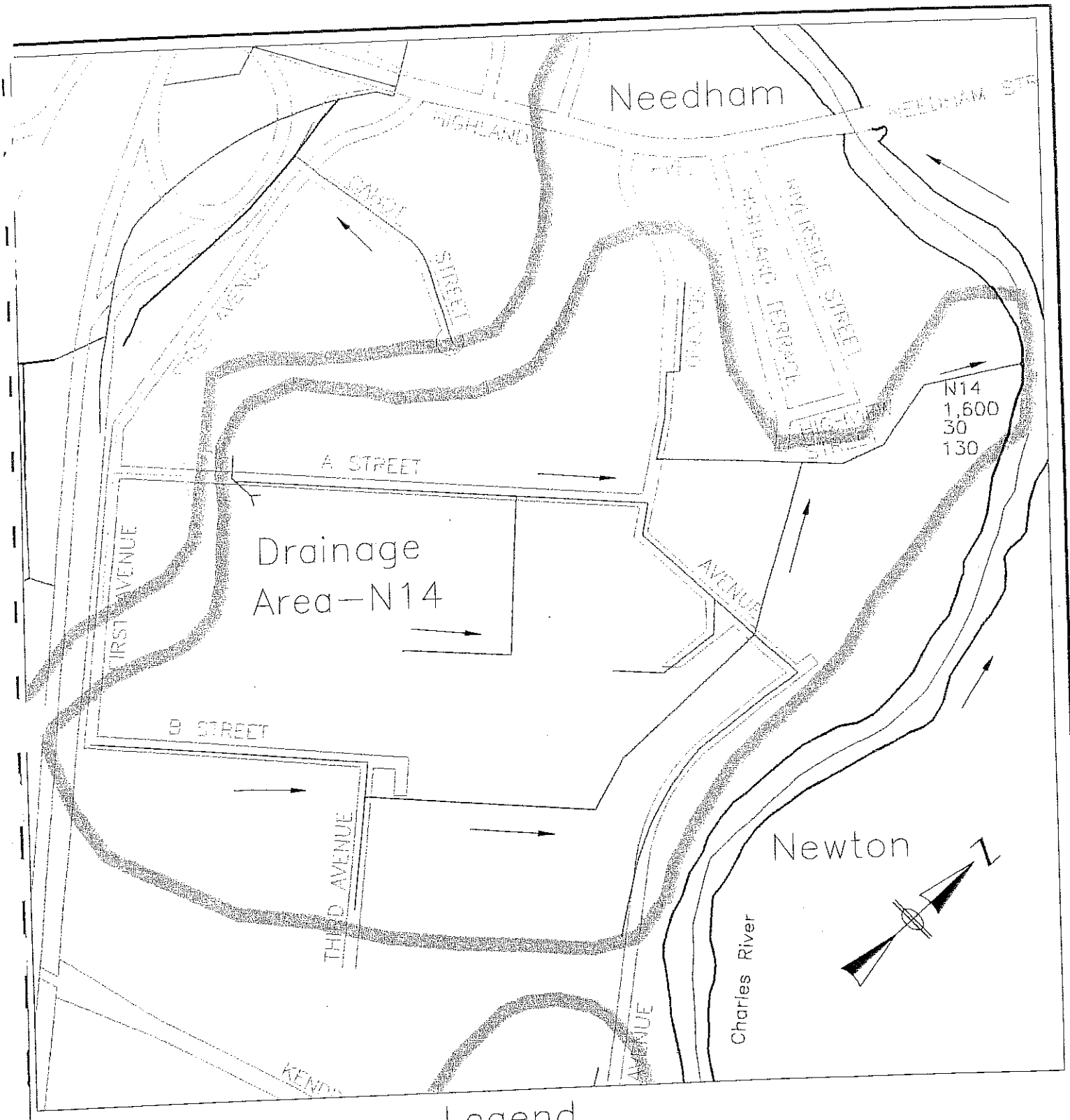
Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



Not to Scale

Figure 3.65 – Area Layout
Drainage Area – N14
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Legend

N14—1	— Sub—area Discharge
N14	— Discharge Point
300	— Fecal Coliform Bacteria
•	— Sampling Location
———	— Water
———	— Town Line
———	— Drainage Area Boundary
←———	— Stormwater Flow Direction

Not to Scale

Figure 3.66 — Sampling Results
Drainage Area — N14
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N14

Discharge Point: N14-1

Date: 10/2/96 Time: 1:30 p.m.

Location: North of Second Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NS

Conductivity: NS

Chloride: 270

Fluoride: 0.27 mg/l

Fecal Coliform Bacteria: 1,600 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: 48 in

Pipe Material/Condition: RCP/Good

Flow Estimate: 1 gpm

Last Precipitation: 9/29/96

Clarity of Flow/Turbidity: Clear

Comments: No floatables or discoloration were observed in the pipe.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.67

File name: N14-1.pm6

Drainage Area - N19

This drainage area is approximately 325 acres in size. The area is characterized by residential and commercial land uses which are separated by Route 128. All of the cumulative flow enters the Charles River through a discharge pipe located northeast of Charles Street (see Figures 3.68 and 3.69). The pipe flows directly into the Charles River.

Some of the characteristics which may effect the water quality of this area include the following:

- total length of drain pipe in this area is approximately 24,600 linear feet
- drainage systems within area N19 include 144 catch basins
- all of the streets have sanitary sewers
- investigations by the Town revealed that commercial floor drains were connected to main drain pipes during renovation projects at Casey Petroleum

Discharge Point N19-1

This 48 inch RCP discharges directly to the Charles River northeast of Charles Street. The length of pipe in this sub-area is approximately 2,400 linear feet (Figure 3.70).

Dry Weather Sampling #1

A sample was taken from this discharge on October 2, 1996 at 1:15 p.m. An approximate flow of 30 gpm of clear water was observed. BETA also observed iron bacteria flocculent in the pipe and on the stones of the outfall. The laboratory results revealed the following:

- chloride - 220 mg/l
- fluoride - ND
- fecal coliform - 70 MPN/100 ml.

Dry Weather Sampling #2

The flow was re-sampled on October 17, 1996 at 12:10 p.m. There was approximately 25 gpm discharging from the pipe. The iron bacteria flocculent was still present on the pipe and at the outfall. The laboratory results revealed the following:

- chloride - 190 mg/l
- fluoride - ND
- pH - 7.15
- conductivity - 850 umhos
- fecal coliform - 50 MPN/100 ml.

Dry Weather Sampling #3

The flow was re-sampled on November 14, 1996 at 8:10 a.m. There was approximately 25 gpm discharging from the pipe. The iron bacteria flocculent was still present on the pipe and at the outfall. The laboratory results revealed the following:

- chloride - 150 mg/l
- fluoride - ND mg/l
- fecal coliform - 80 MPN/100 ml.

Sub-area - N19-2
This twelve (12) inch RCP discharges into a stream west of First Avenue. The length of pipe in this sub-area is approximately 900 linear feet.

Dry Weather Sampling
BETA observed no flow from this pipe on November 15, 1996 at 9:45 a.m.

Sub-area - N19-3
This 18 inch RCP discharges into a stream west of First Avenue (see Figure 3.71). The length of pipe in this sub-area is approximately 120 linear feet.

Dry Weather Sampling
BETA observed no flow from this pipe on October 17, 1996 at 12:15 p.m.

Sub-area - N19-3A
This sampling location is a stream located perpendicular to discharge location N19-3 (see Figure 3.72).

Dry Weather Sampling
This stream flow was sampled on October 17, 1996 at 12:17 p.m. There was a flow of approximately 20 gpm in the stream. A flocculent layer of iron bacteria was noticed on the rocks and bottom of the entire stream. The laboratory results revealed the following:

- chloride - 210 mg/l
- fluoride - ND mg/l
- pH - 7.30
- conductivity - 900 umhos

Sub-area - N19-4
This twelve (12) inch RCP discharges into a stream west of First Avenue. The length of pipe in this sub-area is approximately 1,500 linear feet.

Dry Weather Sampling
No flow was observed from this pipe on October 17, 1996 at 11:50 a.m. The pipe was covered with debris (see Figure 3.73)

Sub-area - N19-5
This sub-area is located in the middle of Route 128. Due to the heavy traffic of that roadway, BETA did not sample or inspect this discharge. It is unlikely that an illicit connection exists in this area.

Sub-area - N19-6
This fifteen (15) inch RCP discharges northeast of Hunting Road. The length of pipe in this sub-area is approximately 1,740 linear feet.

Dry Weather Sampling
No flow was observed from this pipe on November 15, 1996 at 7:30 a.m.

Sub-area - N19-7
This pipe discharges in the middle of Route 128. Due to the heavy traffic, BETA did not inspect this discharge. Although a sample was taken from a manhole upstream of the discharge at the end of Woodbine Street. The length of pipe in this sub-area is approximately 7,980 linear feet.

Dry Weather Sampling
The manhole at Woodbine Street was sampled on November 15, 1996 at 7:50 a.m. A flow of approximately one (1) gpm was observed discharging from the upstream pipe. The laboratory results revealed the following:

- fecal coliform - 20 MPN/100 ml.

Sub-area - N19-8
This pipe discharges south of Wexford Street. The length of pipe in this sub-area is approximately 5,100 linear feet.

Dry Weather Sampling
No flow was observed from this pipe on November 15, 1996 at 9:40 a.m.

Manhole N19-8A
This manhole is located at the on ramp of Route 128. This manhole is upstream of the discharge point at N19-8. Please refer to the attached map for the approximate location.

Dry Weather Sampling
A sample was taken from the stagnant water at the bottom of the manhole on November 15, 1996 at 9:30 a.m. The laboratory results revealed the following:

- fecal coliform - ND

Sub-area - N19-9
This 42 inch RCP is located south of Wexford Street. The length of pipe in this sub-area is approximately 4,080 linear feet.

Dry Weather Sampling #1
This discharge was sampled on November 15, 1996 at 8:25 a.m. There was a flow of approximately twenty (20) gpm. The laboratory results revealed the following:

- chloride - 150 mg/l
- fluoride - ND
- fecal coliform - 70 MPN/100 ml.

Sampling Point - N19-9A
This sampling point was located downstream of N19-9. The sample was taken from the edge of the bank where iron bacteria and seepage were noted.

Dry Weather Sampling

This point was sampled on November 15, 1996 at 8:15 a.m. There was minimal flow coming from the side of the bank. The laboratory results revealed the following:

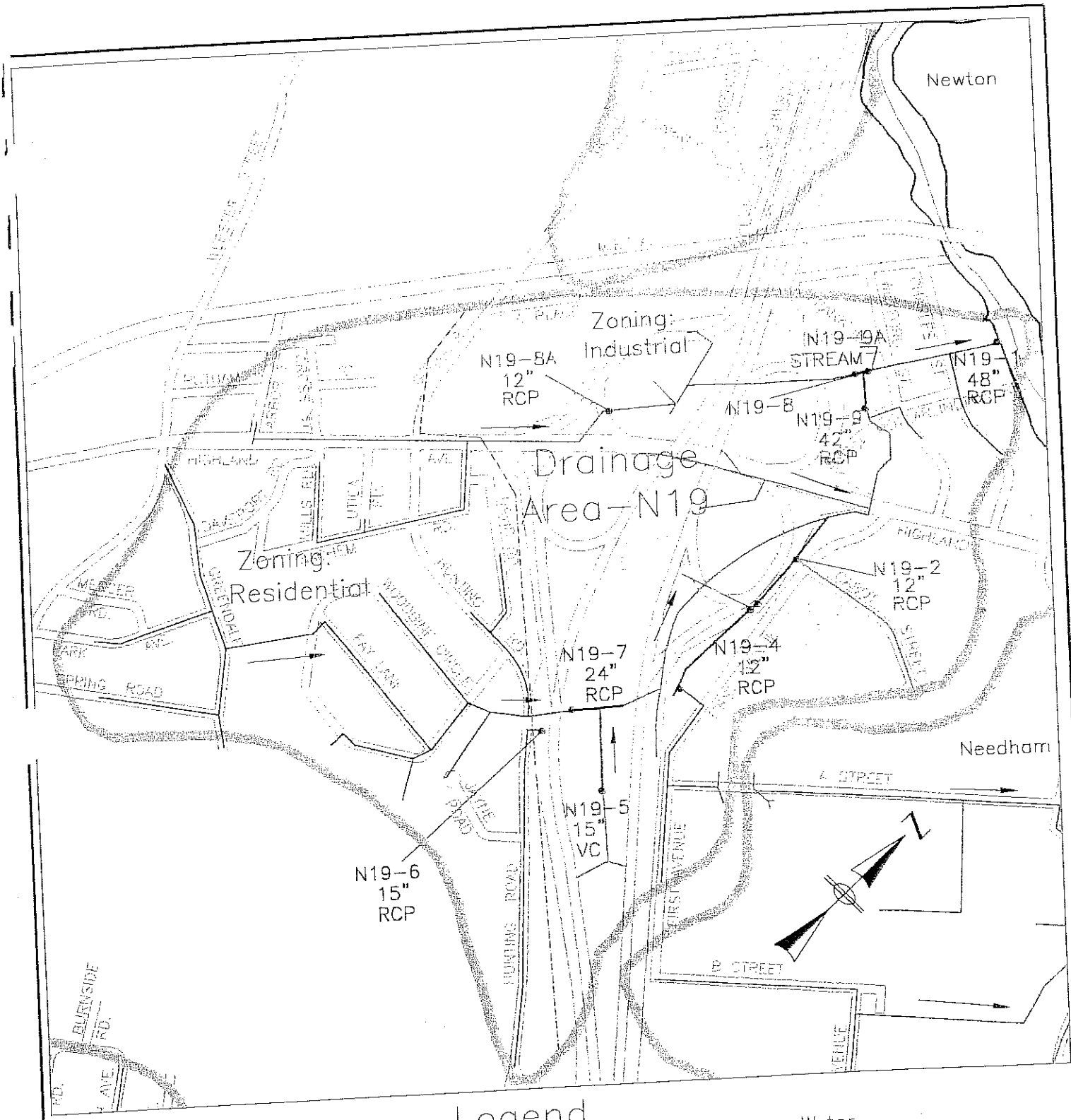
- fecal coliform - 40 MPN/100 ml.

Table 3.9 summarizes the dry weather sampling locations and results.

Table 3.9 Summary of Dry Weather Sampling for N19

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N19								
N19	Northeast of Charles Street	48-RCP	30	10/2/96	13:15	220	ND	70
N19	Northeast of Charles Street	48-RCP	25	10/17/96	12:10	190	ND	50
N19	Northeast of Charles Street	48-RCP	25	11/14/96	8:10	150	ND	80
N19-2	West of First Avenue	12-RCP	Dry	11/15/96	9:45	NA	NA	NA
N19-3	West of First Avenue	18-RCP	Dry	10/17/96	12:15	NA	NA	NA
N19-3A	West of First Avenue	STREAM	20	10/17/96	12:17	210	ND	170
N19-4	West of First Avenue	12-RCP	Dry	10/17/96	11:50	NA	NA	NA
N19-5	Off of Route 128	15-VC	NA	NA	NA	NS	NS	NS
N19-6	Off of Hunting Road	15-RCP	Dry	11/15/96	7:30	NA	NA	NA
N19-7	Off of Route 128	24-RCP	NA	NA	NA	NS	NS	NS
N19-8	Off of Route 128	NS	DRY	11/15/96	9:40	NA	NA	NA
N19-8A	On ramp of Route 128 South	12-RCP	Stagnant	11/15/96	9:30	NS	NS	ND
N19-9	South of Wexford Street	42-RCP	20	11/15/96	8:25	150	ND	70
N19-9A	South of Wexford Street	STREAM	0.1	11/15/96	8:15	NS	NS	40
N19-Woodbine	Woodbine Street	NS	1	11/15/96	7:50	NS	NS	20

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



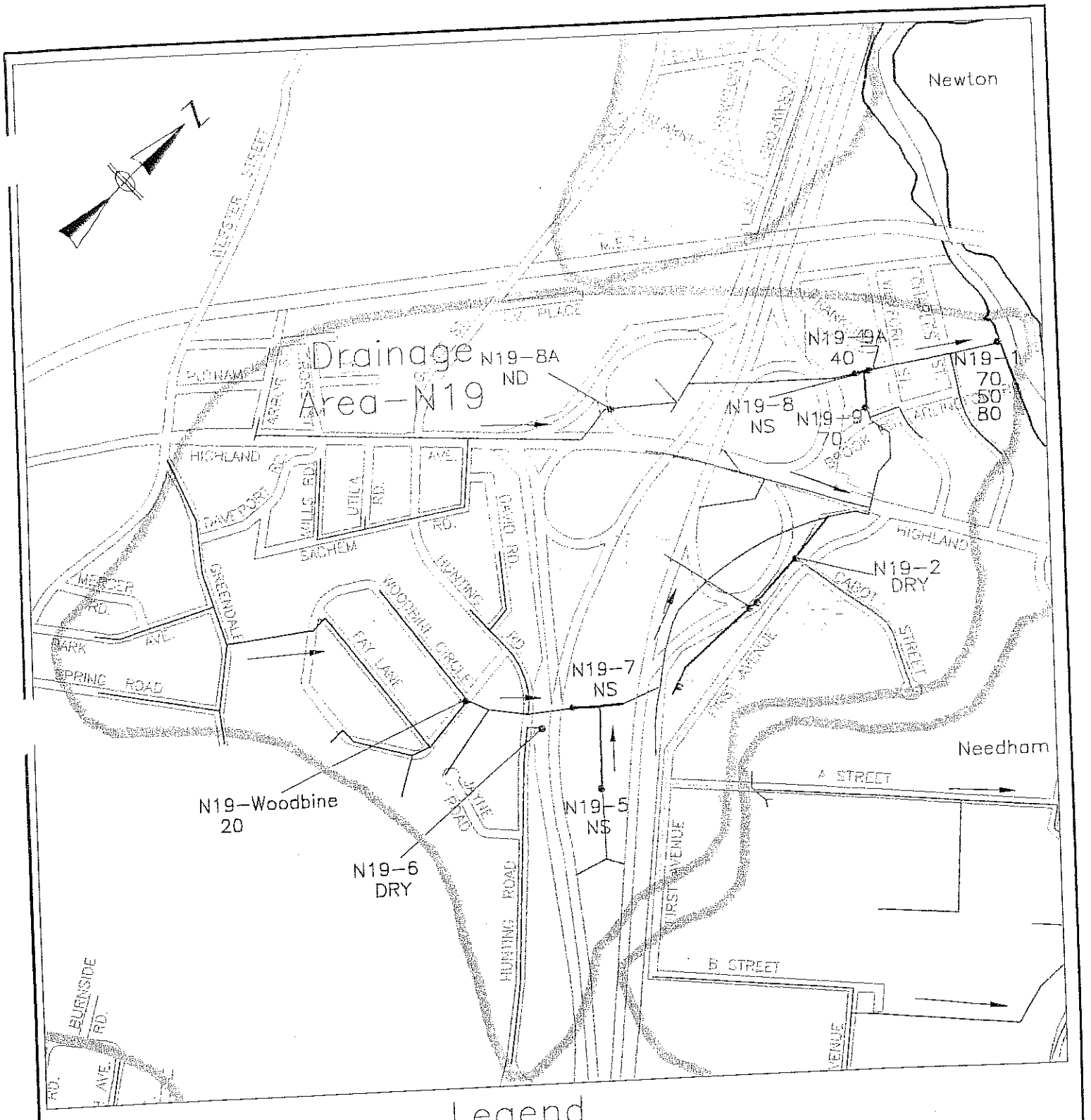
Legend

• N19-1	– Sub-area Discharge/Sampling Location
N19	– Discharge Point
12"	– Pipe Size in Inches
RCP	– Pipe Material
———	– Water
———	– Town Line
———	– Drainage Area Boundary
←———	– Stormwater Flow Direction
———	– Zoning Boundary

Not to Scale

Figure 3.68 – Area Layout
Drainage Area – N19
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Legend

- N19–1 — Sub–area Discharge
- N19 — Discharge Point
- 300 — Fecal Coliform Bacteria
- • — Sampling Location
- Water
- Town Line
- Drainage Area Boundary
- Stormwater Flow Direction

Not to Scale

Figure 3.69 – Sampling Results
Drainage Area – N19
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N19

Discharge Point: N19-1

Date: 10/17/96 Time: 12:10 p.m.

Location: Northwest of Charles St. Needham, MA

Weather: Dry

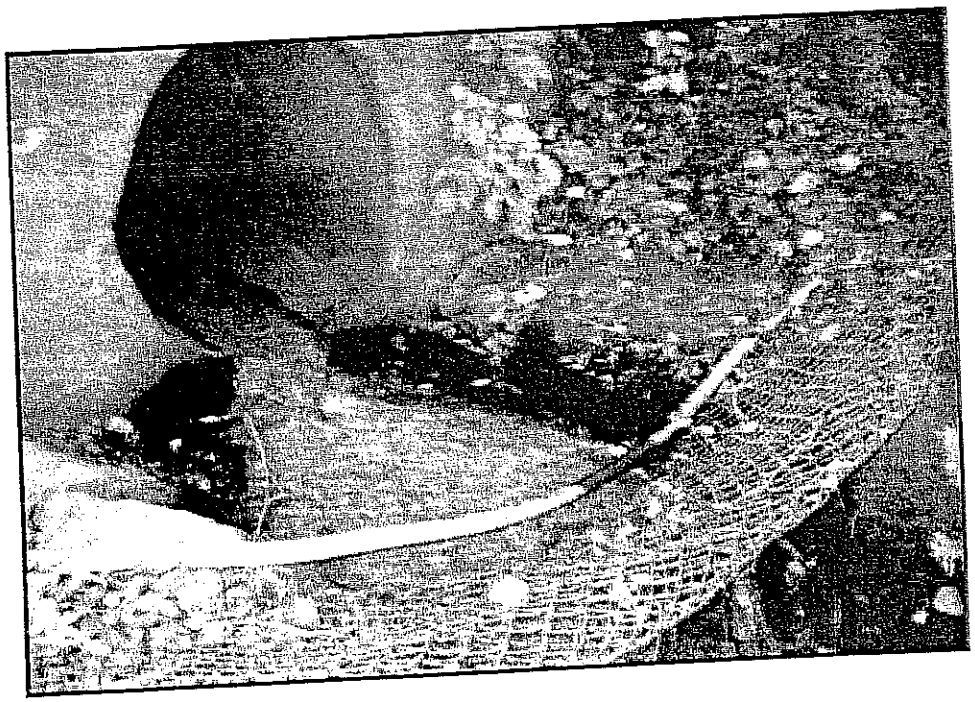
ANALYTICAL DATA

pH:	7.15		Fluoride:	ND	mg/l
Conductivity:	850	umhos	Fecal Coliform Bacteria:	50	MPN/100ml
Chloride:	190	mg/l	Temperature:	12.2	°c

SAMPLING DATA

Pipe Size:	48	in	Flow Estimate:	25	gpm
Pipe Material/Condition:	Concrete/Good		Last Precipitation:	10/9/96	
			Clarity of Flow/Turbidity:	Clear	

Comments: Iron bacteria was observed in the pipe and on the stones of the outfall.



BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.70

File name: N19-1.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N19

Discharge Point: N19-3

Date: 10/17/96 Time: 12:15 p.m.

Location: West of First Avenue
Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA umhos

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 18 in.

Pipe Material/Condition: RCP/Good

Flow Estimate: Dry gpm

Last Precipitation: 10/9/96

Clarity of Flow/Turbidity: NA

Comments: No evidence of recent flow.

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.71

File name: N19-3.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N19

Date: 10/17/96 Time: 12:17 p.m.

Weather: Dry

Discharge Point: N19-3A

Location: Stream perpendicular to N19-3
Needham, MA

ANALYTICAL DATA

pH: 7.30

Conductivity: 170 uohm

Chloride: 900 mg/l

Fluoride: ND mg/l

Fecal Coliform Bacteria: 170 MPN/100ml

Temperature: NS °c

SAMPLING DATA

Pipe Size: NA in

Pipe Material/Condition: NA

Flow Estimate: 20 gpm

Last Precipitation: 10/9/96

Clarity of Flow/Turbidity: Clear

Comments: Iron bacteria layer was noticed on the rocks and bottom of the stream.

BETA Engineering, Inc.
Scientists/Engineers/Planners

Figure 3.72

File name: N19-3A.pm6

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N19

Discharge Point: N19-4

Date: 10/17/96 Time: 11:50 a.m.

Location: West of First Ave. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA

Chloride: NA

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 12 in

Pipe Material/Condition: RCP/Fair

Flow Estimate: Dry gpm

Last Precipitation: 10/9/96

Clarity of Flow/Turbidity: NA

Comments: Pipe was covered with debris.

BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.73

File name: N19-4.pm6

Drainage Area - N22

This drainage area is approximately 50 acres in size. The area is characterized by residential and commercial land uses. There is one (1) discharge point to the Charles River (see Figures 3.74 and 3.75). The flow enters the Charles River through a rock lined channel behind a wastewater pump station on Reservoir Street.

Some of the land use characteristics which could effect the water quality of this area include the following:

- total length of the drain pipe in this area is approximately 6,000 linear feet
- drainage systems within area N22 include 32 catch basins
- all of the municipal streets in the area have sanitary sewers
- Route 128 divides the commercial and residential land uses. Commercial land use predominates east of 128, and residential land use to the west.
- the rip-rapped swale provides some treatment prior to stormwater discharge

Discharge Point N22-1

This discharge point is located east of Reservoir Street. The flow enters the Charles River through a rock lined channel behind a wastewater pump station on Reservoir Street (see Figure 3.76)

Dry Weather Sampling

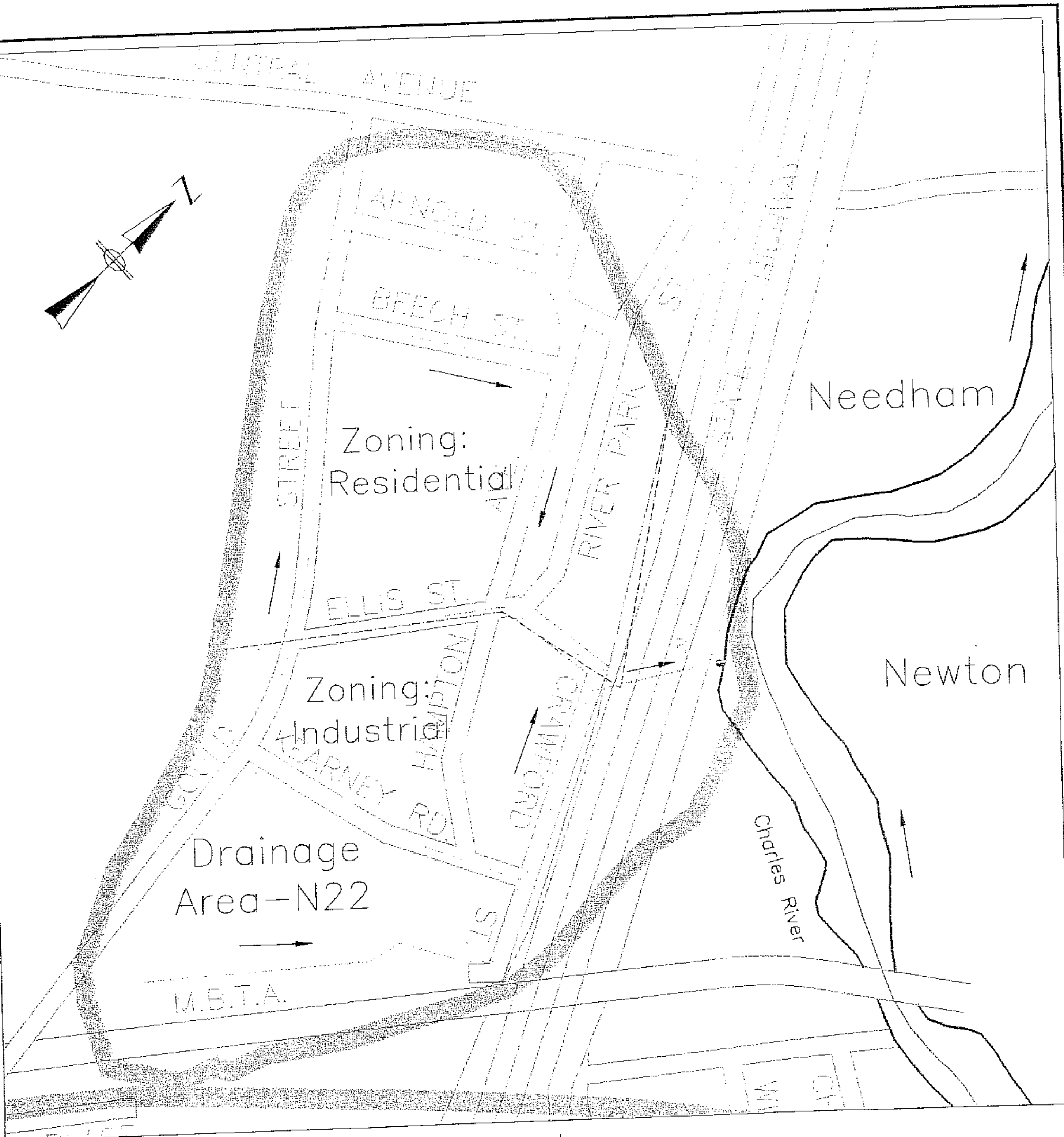
BETA observed no flow from this discharge point on October 2, 1996 at 12:50 p.m., October 17, 1996 at 11:30 a.m., November 14, 1996 at 8:25 a.m., or November 15, 1996 at 7:50 a.m.

Figure 3.10 shows the flow direction of the drainage system and the dry weather sampling locations and results.

Table 3.10 Summary of Dry Weather Sampling for N22

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N22								
N22	East of Reservoir Street	18-RCP	Dry	10/2/96	12:50	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	10/17/96	11:30	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	11/14/96	8:25	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	11/15/96	7:10	NA	NA	NA

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled



Legend

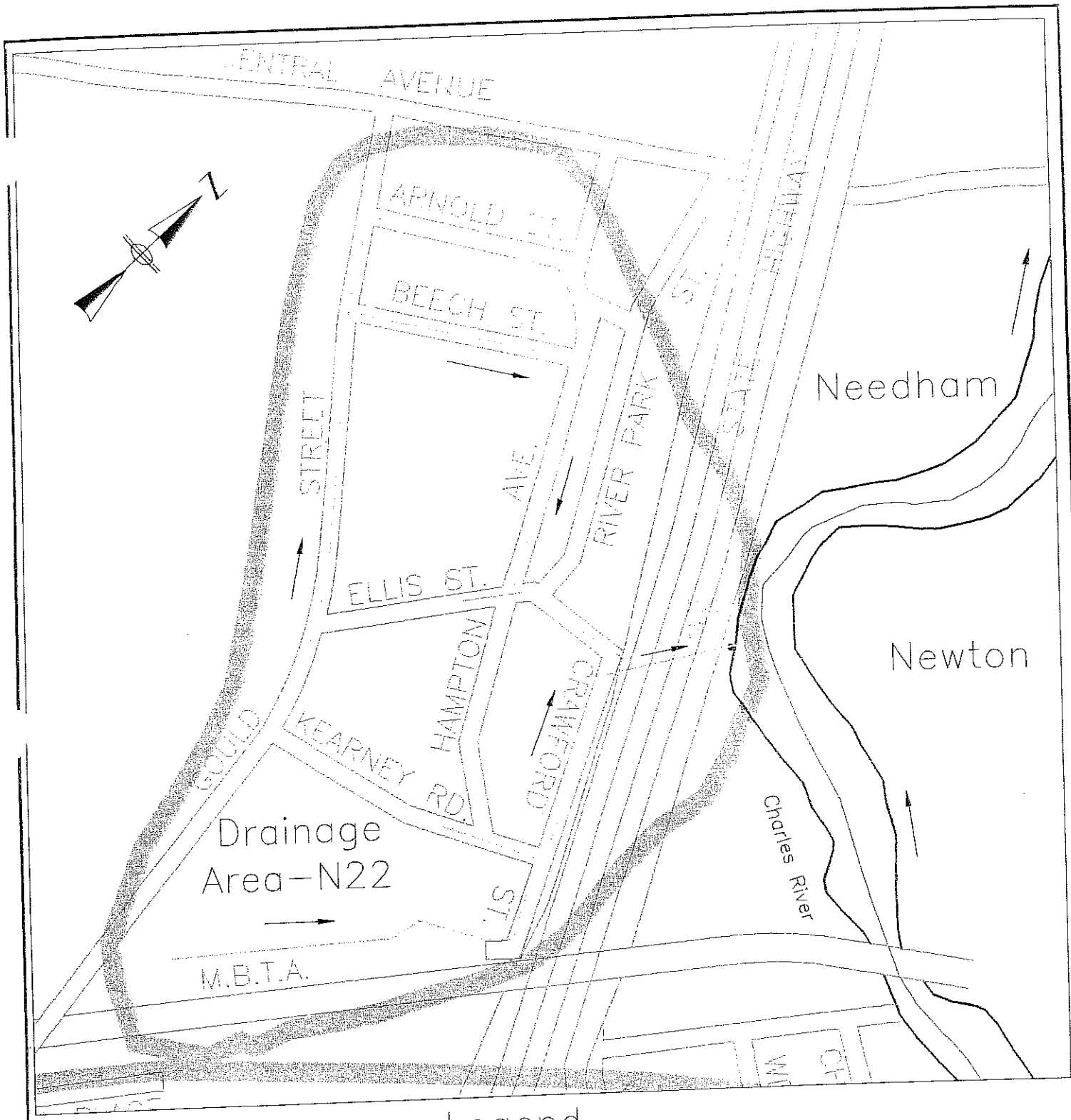
• N22–1	–	Sub–area Discharge/Sampling Location
N22	–	Discharge Point
12"	–	Pipe Size in Inches
RCP	–	Pipe Material

- Water
- Town Line
- Drainage Area Boundary
- Stormwater Flow Direction
- Zoning Boundary

Not to Scale

Figure 3.74 – Area Layout
Drainage Area – N22
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners



Legend

N22–1	– Sub–area Discharge
N22	– Discharge Point
300	– Fecal Coliform Bacteria
•	– Sampling Location
———	– Water
———	– Town Line
▒▒▒	– Drainage Area Boundary
←——	– Stormwater Flow Direction

Not to Scale

Figure 3.75 – Sampling Results
Drainage Area – N22
Needham Stormwater Management

BETA ENGINEERING, INC.
Engineers/Planners

Stormwater Drain Outfall Inspection Report

PROJECT NAME: Needham, MA Stormwater Investigation

Subarea: N22

Discharge Point: N22-1

Date: 10/2/96 Time: 12:50 p.m.

Location: East of Reservoir St. Needham, MA

Weather: Dry

ANALYTICAL DATA

pH: NA

Conductivity: NA umhms

Chloride: NA mg/l

Fluoride: NA mg/l

Fecal Coliform Bacteria: NA MPN/100ml

Temperature: NA °c

SAMPLING DATA

Pipe Size: 18 in.

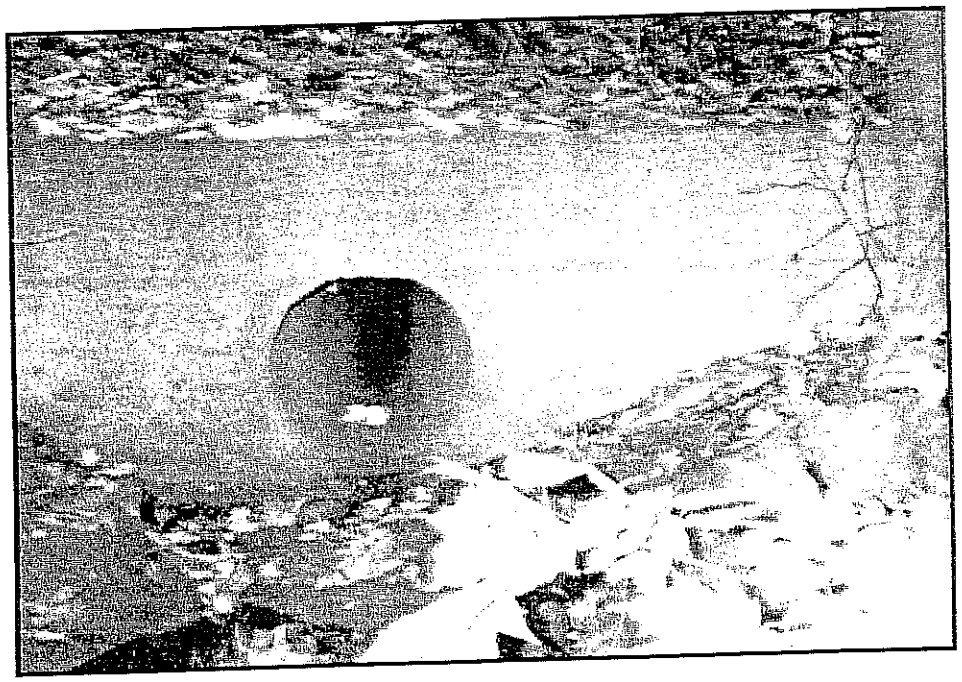
Pipe Material/Condition: RCP/Good

Flow Estimate: Dry gpm

Last Precipitation: 9/29/96

Clarity of Flow/Turbidity: NA

Comments: No evidence of recent flow.



BETA Engineering, Inc.

Scientists/Engineers/Planners

Figure 3.76

File name: N22-1.pm6

Charles River Entrance to Needham - C1

This sampling location is located north of Charles River Street where the Charles River enters Needham.

Dry Weather Sampling

BETA sampled the Charles River entering Needham on September 24, 1996 at 1:45 p.m. BETA observed a clean flow with minimal turbidity or floatable materials. The sample results revealed the following:

- fecal coliform - 170 MPN/100 ml.

Charles River Exit from Needham - C2

This sampling location is located north of Bridge Street where the Charles River enters Needham.

Dry Weather Sampling

BETA sampled the Charles River flowing out of Needham on September 24, 1996 at 2:10 p.m. The laboratory results of the sample revealed the following:

- chloride - 43 mg/l
- fluoride - ND
- fecal coliform - 80 MPN/100 ml.

Dry Weather Sampling Summary and Conclusions

Summary

The dry weather sampling results revealed that at least one (1) laboratory sample from six (6) out of the ten (10) drainage areas exceeded the fecal coliform bacteria limit for swimmable water of 200 MPN/100 ml. Correspondingly, the four (4) remaining drainage areas were below the 200 MPN/100ml limit. Thus, the investigation focused on the six (6) drainage areas (N1B, N1, N8, N10A, N14 and N14B) to determine the source of the fecal coliform bacteria. No further work was conducted for the four (4) remaining drainage areas (N6C, N11, N19 and N22).

Two areas, N14 and N14B, have industries which are permitted under the NPDES General Permit program to discharge to stormwater systems. For this reason, dry weather flows from these two areas might be expected. Certain types of non-stormwater discharges are allowed under this program, such as air conditioning condensate, etc. Table 3.11 provides a description of the NPDES discharges, including the company name and SIC codes.

Table 3.11

Permit Number	Facility Name	Operator Name	Facility Address	Receiving Water	SIC Code
Area N14					
MAROOA439	GTE Government Sys.	GTE Government Sys.	77 A Street	Charles River	3663
MAROOA392	NBC, Inc.	NBC, Inc.	110 A Street	Charles River	3339
MAROOA393	NBC, Inc.	NBC, Inc.	110 A Street	Charles River	3339
MAROOB249	Coca Cola Bottling/N.E.	Coca Cola Bottling/N.E.	9 "B" Street	Charles River	2086
Area N14B					
MAROOA411	Polaroid Corp.	Polaroid Corp.	140 Kendrick Street	Charles River	3861

SIC Codes

3663	Manufacturing radio/television broadcast equipment
3339	Primary smelting and refining
3861	Manufacturing photographic equipment
2086	Manufacturing soft drinks and carbonated waters

Drainage Area N1B

Drainage Area N1B exceeded the swimmable water criteria during the first sampling round (900 MPN/100ml.). The sample was taken on September 24, 1996, from a stagnant pool of water where the pipe discharges. There was no flow coming from the pipe. Twelve inspections of the pipe revealed no dry weather discharges at any time. Subsequent sampling revealed a level of 4 MPN/100 ml. during the second round, and "none detected" during the third round. Based upon available data, all of the homes on Whitman Road have sanitary sewers.

During the first sampling event, numerous geese were noted in the field south of the cul-de-sac of Whitman Road. Additionally, geese feces were noted in the field adjacent to the discharge. Geese were not noted during subsequent inspections or sampling events, corresponding with less fecal coliform bacteria. These results indicate that the elevated coliform was not due to sanitary sewage or illicit connections, but native geese populations.

Drainage Area N1

Drainage area N1 also exceeded the swimmable water criteria. One sample in this drainage area, sampling point N1-3A, had a fecal coliform bacteria count of 16,000 MPN/100 ml. This location was at Walker Gordon Pond, where numerous geese were noted. A sample was taken from the shore of the Pond, in the location of the geese, to determine if the geese were resulting in fecal coliform bacteria pollution. The laboratory results showed a direct correlation with the geese population and fecal coliform bacteria. All sub-area discharge points, other than the pond sample, met the swimmable water criteria. For this reason, no further work is proposed for this drainage area.

Drainage Area N8

Several sub-areas in drainage area N8 exceeded the swimmable water criteria. Samples from N8 (300 MPN/100 ml) and N8-3 (500 MPN/100 ml) exceeded the fecal coliform bacteria criteria of 200 MPN/100 ml.

The elevated fecal coliform bacteria of Area N8 was likely caused by the geese population that live in and around the small pond. As detailed previously, numerous geese and geese feces were noted during the study, in the vicinity of the pond. Additionally, all samples taken from the two discharges into the Pond (N8-1) met swimmable water criteria. While the Pond likely improves water quality with respect to suspended solids removal, etc., the geese population generally increases the fecal coliform bacteria levels prior to discharge to the River.

These results indicate that the fecal coliform bacteria in this area were not due to illicit connections or sanitary sewage.

Drainage Area N10A

General

Drainage Area 10-A is the largest drainage area investigated during this study. The swimmable water criteria was exceeded at numerous locations. The exceedences were generally within three (3) sub-areas, however. These three sub-areas, N10A-9, N10A-9A and N10A-7, had results as high as 160,000 MPN/100 ml. of fecal coliform bacteria.

Sub-area 10A-7

The discharge of sub-area N10A-7 has consistently revealed elevated levels of fecal coliform bacteria. As shown in Figure 3.37, the highlighted area of drainage system was determined to be the area where fecal coliform pollution is impacting the drainage system. Field inspections have revealed that sanitary sewers, which parallel the drainage pipes, contribute to elevated levels of fecal coliform bacteria.

Two samples were taken from the 10A-7 discharge on October 8, 1996, approximately 45 minutes apart. The second sample was taken due to a rapid color change which was noted. The results revealed fecal coliform bacteria rose from 900 to 90,000 within 45 minutes. Drains in this area are scheduled for television inspection.

Sewers in this area have been documented by the Town to surcharge under wet weather conditions. This was confirmed by inspections during several storm events. The Town of Needham recently (November, 1996) replaced the sewers on Washington Street. The older clay sanitary sewers were likely leaking during the peak flow and/or surcharge conditions, and sewage migrating into the drainage system through groundwater and cracks/joints of the drain pipes. The new sewers will resolve this issue.

A television inspection program of the drain pipes is ongoing in the area which are not effected by the sewer rehabilitation project. The drain on Ivy Rd. was recently inspected. This drain discharges constant dry weather flow, and elevated fecal coliform have been consistent. The television inspection revealed infiltration at several joints, and an abundance of animal feces within the pipe and on the sill of the drain manhole. Evidently, a mammal, such as a raccoon, resides in this structure.

Subarea 10A-9A

Sub-area N10A-9A was tested numerous times due to a consistent elevated level of fecal coliform bacteria. BETA conducted testing throughout the system to determine the source of the fecal coliform pollution. The results revealed that the area of elevated fecal coliform was limited to a short section of drain pipe on Webster Street and Norfolk Street.

TV inspection of the sewer and drain pipes in the area was conducted to determine the location of "potential illicit connections", and to determine the integrity of the 15 inch and 18 inch sanitary sewers adjacent to the drainage pipes. The sewers were constructed in the 1920's and 1960's, and, due to their age, may be impacting the drainage system. TV inspection results revealed hairline cracks and sagging in the older (1926) sewer. Under surcharge conditions, which have been noted during this study, sewage may exfiltrate to the adjacent storm drains beneath them.

An illicit connection is suspected near Webster Street and the outfall of Area N10A-9A. Detergent suds were noted during several inspections, but only for a brief period of time. Television inspection of a private drain which flows into the municipal drainage system at this location revealed several connections. While these could be sump pumps, detergent suds and elevated fecal coliform have been documented from this private drain. The Town is currently investigating this issue.

Subarea N10A-9B

An area identified as sub-area N10A-9B consists of a sub-drain installed to drain the sewer trench during construction of the 15 inch sewer in 1926. The 8 inch sub-drain was constructed of asbestos concrete. The subdrain is directly beneath the sewer, and within the sewer trench. The excessive quantities of fecal coliform pollution discharging from the sub-drain are likely a result of the sewer leaking and sewage migrating into the sub-drain through cracks or joints, or overflow connections of the sewer to the subdrain. The sub-drain discharges approximately 25 gallons per minute to Alder Brook.

Other Area N10A issues

Elevated levels of fecal coliform bacteria detected in N10A-10 and N10A-Stream #4 are likely due to the areas being down-stream of the N10A-9A discharge. Additionally, N10A-Stream #6 and N10A-15 revealed elevated levels of fecal coliform bacteria as a result from being down-stream of N10A-7.

Two (2) other sampling locations, N10A-1B and N10A-16, exceeded the EPA criteria. Subarea N10A-1B is located on the Needham Country Club property, where geese are a problem. Subarea N10A-16 is located the Needham Country Club property also, but receives a majority of flow from the MBTA parking lot and rail system along Great Plain Avenue. Both of these areas drain into the Needham Reservoir. The water exiting the Reservoir had fecal coliform levels below the 200 MPN/100 ml. criteria.

Drainage Area N14

Drainage Area N14 collects stormwater from a large commercial/industrial area. Fecal coliform level were initially detected at 1,600 MPN/100ml. The majority of this area consists of commercial buildings and parking facilities. Subsequent inspections and testing have revealed levels of fecal coliform which meet the "swimmable water criteria". As discussed previously, three industries may discharge to the stormwater system under the NPDES program.

Drainage Area N14B

Sampling results of Area N14B, a relatively small commercial area, have revealed a possible illicit connection to the drainage system. The discharge pipe is located on Kendrick Street.

The first sampling event revealed a fecal coliform level of 2,400 MPN/100 ml. Due to this level, two additional samples were taken. These samples revealed minimal bacteria levels of 80 and 4 MPN/100 ml. The subsequent inspection revealed the RCP was dry, with no evidence of recent flow.

The drainage discharge pipe on Kendrick Street was dry on November 14th, but on November 15th (6:50 AM), the pipe discharged a small flow with a fecal coliform bacteria level of 16,000 MPN/100 ml. No evidence of flow was noted which would cause dry weather flows to increase during this period. This indicates that an illicit connection to the drainage system may exist, since no precipitation occurred, nor was any significant "water-use" activity noted during the inspection. An investigation and TV inspection of this drainage area is scheduled for this area. Polaroid Corp. is permitted to discharge to the drainage system under the NPDES program.

A summary of all of the dry weather sampling results is shown in Table 3.12. Laboratory data sheets for dry weather samples were submitted in BETA's November, 1996 Report.

Table 3.12 Summary of Dry Weather Sampling Results

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
			N1B					
N1B-1	South of Whitman Road	18-RCP	Stagnant	9/24/96	13:40	230	ND	900
N1B-1	South of Whitman Road	18-RCP	0.1	10/16/96	15:30	200	ND	4
N1B-1	South of Whitman Road	18-RCP	Stagnant	11/14/96	6:55	NS	NS	ND
N1B-2	Culvert at Charles River St.	12-RCP	Dry	11/5/96	11:45	NA	NA	NA
			N1					
N1	South of Oxbow Road	42-RCP	25	11/14/96	7:05	42	ND	20
N1-1	Oxbow Road	12-RCP	1	10/2/96	15:15	29	ND	130
N1-2	Oxbow Road	30-RCP	20	10/2/96	15:15	35	ND	11
N1-3	Culvert at Charles River St.	36-RCP	20	10/16/96	14:35	39	ND	22
N1-3A	Walker Gordon Pond	Pond	NA	10/16/96	14:40	32	ND	16,000
N1-4	Northwest of Walker Lane	12-RCP	Dry	10/16/96	15:05	NA	NA	NA
N1-5	North of Walker Lane	12-RCP	Dry	10/16/96	15:10	NA	NA	NA
N1-6	Southwest of Country Way	24-RCP	7	10/16/96	14:55	33	ND	8
N1-6A	Southwest of Country Way	6-AC	Dry	10/16/96	14:55	NA	NA	NA
			N6C					
N6C	Southwest of Crestview Road	18-RCP	Stagnant	9/24/96	13:50	54	ND	240
N6C	Southwest of Crestview Road	18-RCP	Stagnant	11/15/96	7:10	NS	NS	ND
			N8					
N8	South of Wildwood Drive	10'-Archway	5	9/24/96	13:15	54	ND	300
N8-1	South of Wildwood Drive	30-RCP	5	9/24/96	13:20	79	ND	140
N8-1	South of Wildwood Drive	30-RCP	12	11/14/96	6:45	74	ND	40
N8-2	South of Wildwood Drive	30-RCP	Dry	9/24/96	13:25	NA	NA	NA
N8-2	South of Wildwood Drive	30-RCP	Dry	10/16/96	13:40	NA	NA	NA
N8-3	Southeast of Fox Hill Road	15-CM	1	10/16/96	13:25	56	ND	500
N8-4	South of High Rock Street	20-RCP	0.1	10/16/96	13:15	66	ND	80
N8-5	South of Lantern Lane	12-AC	3	10/16/96	13:30	61	0.42	2
			N10A					
N10A-1	West of Green Street	24-RCP	Dry	10/8/96	13:20	NA	NA	NA
N10A-1A	West of Green Street	12-RCP	Dry	10/8/96	13:20	NA	NA	NA
N10A-1B	West of Green Street	12-RCP	2	10/8/96	13:20	130	ND	3,000
N10A-2	South of Great Plain Avenue	NS	Dry	11/5/96	13:28	NA	NA	NA
N10A-3	DPW Parking Lot	12-RCP	Dry	10/8/96	13:30	NA	NA	NA
N10A-4	Dedham Avenue	12-RCP	Dry	11/5/96	13:35	NA	NA	NA
N10A-5	West of Needham Athletic Fields	48-RCP	10	10/8/96	12:48	78	ND	80
N10A-5	West of Needham Athletic Fields	48-RCP	15	11/14/96	7:25	86	ND	60
N10A-5A	Dedham Golf Course	36-RCP	3	10/8/96	12:40	120	ND	170
N10A-6	Northwest of Harris Avenue	24-RCP	Dry	10/8/96	12:55	NA	NA	NA
N10A-7	South of Ivy Road	48-RCP	15	10/8/96	13:40	130	ND	900
N10A-7	South of Ivy Road	48-RCP	15	10/8/96	14:40	120	ND	90,000

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N10A-7	South of Ivy Road	48-RCP	NS	10/17/96	14:10	99	ND	5,000
N10A-7	South of Ivy Road	48-RCP	20	10/18/96	14:20	110	ND	1,100
N10A-7	South of Ivy Road	48-RCP	NS	11/7/96	9:30	NS	NS	1,700
N10A-7-Ivy Road	Ivy Road	12-RCP	0.5	10/18/96	14:35	NS	NS	9,000
N10A-7-Ivy Road	Ivy Road	12-RCP	0.5	11/5/96	12:00	NS	NS	1,900
N10A-7-C1	South of Wilshire Park	42-RCP	NS	10/18/96	12:15	69	ND	1,700
N10A-7-C2	Great Plain Avenue	36-RCP	NS	10/18/96	12:20	NS	NS	700
N10A-7-C3	Great Plain Avenue	24-RCP	5	11/6/96	11:30	57	ND	300
N10A-7-C4	Great Plain Avenue	42-RCP	25	11/6/96	11:30	86	ND	170
N10A-7-C5	Great Plain Avenue	36-RCP	5	11/6/96	11:30	73	ND	2,200
N10A-7-Beaufort	Beaufort Street	NS	DRY	11/18/96	15:00	NA	NA	NA
N10A-7-Ellicot	Ellicot Street	18-RCP	20	11/6/96	10:20	28	0.21	1,700
N10A-7-Greenwood	Greenwood Avenue	NS	DRY	11/6/96	9:40	NA	NA	NA
N10A-7-Wash/GT. Plain	Corner of Washington and Great Plain Avenue	36-RCP	NS	11/6/96	11:15	NS	NS	1,400
N10A-7-Washington	Washington Avenue	24-RCP	5	11/6/96	10:20	53	ND	2,400
N10A-7-Washington #2	Washington Avenue	NS	DRY	11/6/96	10:30	NA	NA	NA
N10A-7-Seargent St.	Sergeant Street	24-RCP	NS	10/18/96	15:15	77	ND	40
N10A-7-Woodlawn	Woodlawn Avenue	NS	DRY	11/6/96	9:30	NA	NA	NA
N10A-8	Southwest of Canterbury Lane	12-RCP	1	10/8/96	14:45	75	ND	80
N10A-9	East of Webster Street	36-RCP	3	10/2/96	15:00	50	ND	110
N10A-9	East of Webster Street	36-RCP	NS	10/17/96	13:50	NS	NS	1,600
N10A-9	East of Webster Street	36-RCP	NS	11/7/96	9:40	NS	NS	3,000
N10A-9A	East of Webster Street	24-RCP	10	10/2/96	15:00	120	ND	160,000
N10A-9A	East of Webster Street	24-RCP	NS	10/11/96	14:20	NS	NS	3,000
N10A-9A	East of Webster Street	24-RCP	NS	10/11/96	14:30	NS	NS	3,000
N10A-9A	East of Webster Street	24-RCP	5	10/16/96	13:00	NS	NS	16,000
N10A-9A	East of Webster Street	24-RCP	NS	10/17/96	13:50	NS	NS	9,000
N10A-9A	East of Webster Street	24-RCP	NS	10/18/96	12:00	130	ND	3,000
N10A-9A	East of Webster Street	24-RCP	NS	11/5/96	14:30	NS	NS	9,000
N10A-9A	East of Webster Street	24-RCP	NS	11/7/96	9:40	NS	NS	3,000
N10A-9A-C1	Webster Street	24-RCP	NS	10/18/96	12:15	130	ND	5,000
N10A-9A-C2	Webster Street	15-CLAY	NS	10/18/96	12:20	NS	NS	3,000
N10A-9A-C2	Webster Street	15-CLAY	NS	11/7/96	11:00	57	ND	230
N10A-9A-C3	Webster Street	14-RCP	NS	10/18/96	12:30	NS	NS	16,000
N10A-9A-C4	Webster Street	NS	DRY	10/18/96	11:30	NA	NA	NA

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N10A-9A-Corner of Howland and Pleasant	Corner of Howland and Pleasant	NS	NS	10/17/96	15:00	210	ND	110
N10A-9A-90 Norfolk St.	90 Norfolk Street	12-CLAY	2	10/18/96	13:50	160	ND	300
N10A-9A-302 Warren St.	302 Warren Street	12-CLAY	4	10/18/96	13:00	120	ND	40
N10A-9B	Northeast of Webster Street	8-AC	5	11/7/96	10:30	93	ND	24,000
N10A-9B	Northeast of Webster Street	8-AC	5	11/7/96	10:30	NS	NS	160,000
N10A-10	Northwest of Sutton Road	12-RCP	NS	10/8/96	14:22	NS	NS	3,000
N10A-11	East of Dedham Avenue	42-RCP	10	10/2/96	15:20	75	ND	80
N10A-11	East of Dedham Avenue	42-RCP	20	11/14/96	7:30	71	0.24	ND
N10A-11A	East of Dedham Avenue	12-RCP	3	10/8/96	12:30	38	ND	500
N10A-11A	East of Dedham Avenue	12-RCP	2	11/15/96	7:30	NS	NS	ND
N10A-12	East of Canterbury Lane	12-RCP	0.5	10/8/96	14:50	74	ND	23
N10A-13	George Abbot Lane	NS	Dry	10/8/96	14:15	NA	NA	NA
N10A-14	West of Great Plain Avenue	24-RCP	Dry	10/8/96	14:55	NA	NA	NA
N10A-15	West of Great Plain Avenue	Brick	0.5	10/8/96	14:10	120	ND	300
N10A-16	Needham Golf Course	21	15	11/5/96	11:30	94	ND	500
N10A-16A	Needham Golf Course	15	Dry	11/5/96	11:30	NA	NA	NA
N10A-17	Northwest of Livingston Circle	12-RCP	Dry	11/5/96	13:10	NA	NA	NA
N10A-18	Southwest of South Street	12-PVC	Dry	11/5/96	13:20	NA	NA	NA
N10A-19	Southwest of Great Plain Avenue	15-PVC	Dry	11/5/96	13:25	NA	NA	NA
N10A-20	South of Washington Avenue	12-RCP	Dry	11/5/96	13:45	NA	NA	NA
N10A-21	South St. and Dedham Avenue	NS	DRY	11/5/96	13:23	NA	NA	NA
N10A-22	DPW Parking Lot	12-PVC	0.5	11/5/96	10:00	410	0.23	ND
N10A-23	South of Dedham Avenue	12-RCP	NS	11/6/96	14:00	NS	NS	130
N10A-Stream #1	Southwest of Dedham Avenue	STREAM	NS	11/5/96	13:50	NS	NS	20
N10A-Stream #2	Southwest of Dedham Avenue	STREAM	NS	11/5/96	14:10	NS	NS	130
N10A-Stream #3	West of Needham Reservoir	STREAM	NS	11/5/96	14:10	NS	NS	80
N10A-Stream #4	Southwest of Dedham Avenue	STREAM	NS	11/5/96	14:15	NS	NS	500
N10A-Stream #5	Northwest of Needham Reservoir	STREAM	NS	11/5/96	14:30	NS	NS	220
N10A-Stream #6	North of Needham Reservoir	STREAM	NS	11/5/96	14:35	NS	NS	1,300
			N11					
N11	South of South Street	12-RCP	DRY	10/2/96	14:40	NA	NA	NA
N11-1	South of South Street	12-RCP	0.1	10/2/96	14:45	190	ND	50
			N14					
N14	North of Second Avenue	54-RCP	1	10/2/96	13:30	270	0.27	1,600
N14	North of Second Avenue	54-RCP	1	10/17/96	12:50	NS	NS	30
N14	North of Second Avenue	54-RCP	1	11/14/96	7:50	180	0.28	130
			N14B					
N14B-1	South of Kendrick Street	30-RCP	1	9/24/96	14:00	28	0.54	2,400
N14B-1	South of Kendrick Street	30-RCP	0.2	10/2/96	14:00	14	0.77	80
N14B-1	South of Kendrick Street	30-RCP	0.1	10/17/96	12:30	NS	NS	4

Sampling Location #	Sampling Location	Pipe Size (in.)-Material	Flow (gpm)	Date	Time	Chloride (mg/l)	Fluoride (mg/l)	Fecal Coliform Bacteria (MPN/100 ml)
N14B-1	South of Kendrick Street	30-RCP	DRY	11/14/96	7:55	NA	NA	NA
N14B-1	South of Kendrick Street	30-RCP	<0.1	11/15/96	6:50	NS	NS	16,000
N19								
N19	Northeast of Charles Street	48-RCP	30	10/2/96	13:15	220	ND	70
N19	Northeast of Charles Street	48-RCP	25	10/17/96	12:10	190	ND	50
N19	Northeast of Charles Street	48-RCP	25	11/14/96	8:10	150	ND	80
N19-2	West of First Avenue	12-RCP	Dry	11/15/96	9:45	NA	NA	NA
N19-3	West of First Avenue	18-RCP	Dry	10/17/96	12:15	NA	NA	NA
N19-3A	West of First Avenue	STREAM	20	10/17/96	12:17	210	ND	170
N19-4	West of First Avenue	12-RCP	Dry	10/17/96	11:50	NA	NA	NA
N19-5	Off of Route 128	15-VC	NA	NA	NA	NS	NS	NS
N19-6	Off of Hunting Road	15-RCP	Dry	11/15/96	7:30	NA	NA	NA
N19-7	Off of Route 128	24-RCP	NA	NA	NA	NS	NS	NS
N19-8	Off of Route 128	NS	DRY	11/15/96	9:40	NA	NA	NA
N19-8A	On ramp of Route 128 South	12-RCP	Stagnant	11/15/96	9:30	NS	NS	ND
N19-9	South of Wexford Street	42-RCP	20	11/15/96	8:25	150	ND	70
N19-9A	South of Wexford Street	STREAM	0.1	11/15/96	8:15	NS	NS	40
N19-Woodbine	Woodbine Street	NS	1	11/15/96	7:50	NS	NS	20
N22								
N22	East of Reservoir Street	18-RCP	Dry	10/2/96	12:50	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	10/17/96	11:30	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	11/14/96	8:25	NA	NA	NA
N22	East of Reservoir Street	18-RCP	Dry	11/15/96	7:10	NA	NA	NA
Charles River								
C1	North of Charles River Street	River	NA	9/24/96	13:45	NS	NS	170
C2	North of Bridge Street	River	NA	9/24/96	14:10	43	ND	80

Note: 1) Please refer to the drawings attached in the report for the approximate sampling locations

Abbreviations:
AC - Asbestos Concrete
PVC - Polyvinylchloride Pipe
RCP - Reinforced Concrete Pipe
VC - Vitrified Clay
NA- Not Applicable
ND- Not Detected
NS- Not Sampled

Conclusions

Illicit Connections and Fecal Coliform Bacteria

No correlation was noted between fecal coliform bacteria, chloride and fluoride during this investigation, with the exception of Area N14 and N14-B. These two areas are the only two which have facilities with General Permits under the NPDES permit program. These permits allow certain non-stormwater discharges to the drainage system.

The Charles River was tested for fecal coliform bacteria on September 24, 1996, where the River flows into and out of Needham's Corporate limits. The samples were taken approximately 30 minutes apart. Fecal coliform levels were measured at 170 and 80 MPN/100 ml., respectively. This indicates that dry weather fecal coliform loads into the Charles River are minimal within Needham.

Four (4) of the ten (10) study areas either were dry or met the 200 MPN/100 ml. bacteria criteria during dry weather conditions (Areas N6C, N11, N19 and N22).

Areas N1B, N1, N8 and a portion of N10A-7 were documented to have fecal coliform levels which were the direct result of animal populations. The animals included mammals living within the pipes (N10A-13, N8 and N10A-7) and geese (N1B, N1, N8).

TV inspections of sewer and drain pipes in the areas identified in the Consent Order is ongoing. The investigation is focusing on four areas where possible illicit connections or other sources of pollutants exist in the municipal drainage system, owned and maintained by the Town of Needham.

Television inspection of approximately 1,200 feet of sewer and drain pipe have been inspected during this investigation. Wet weather conditions have hindered progress, however. In addition, the Town is conducting TV inspections of sewers independently under their infiltration/inflow (I/I) program.

Areas N10A-7, N10A-9A, N10A-9 and N14B have revealed consistently elevated fecal coliform bacteria levels which are not deemed due to wildlife impacts or non-point source pollution. Additional inspections are being conducted in these areas of high fecal coliform bacteria, as shown on Figure 3.77. The bacteria is possibly due to illicit connections and/or indirect connections from leaking sewers.

The Town recently reconstructed sewers in Washington Street (Area 10A-7). Coincidentally, our scope of work proposed a TV inspection of municipal sewers on Washington Street, due to the elevated fecal coliform bacteria levels detected during dry weather sampling. Follow-up testing of this drainage system is planned in January of 1997. Additionally, inspection of the drain on Ivy Rd. revealed animal feces and groundwater seepage to be the cause of elevated fecal coliform bacteria (see Figure 3.39).

Costs of Removal of Illicit Connections

The costs of removal of illicit connections to the drainage system, as well as potential municipal sewer impacts to the drains, are currently being developed. The television inspection program has revealed the condition of the sewer and drain pipes in several areas of our study. Due to inclement weather, several areas of television inspection are pending.

The following alternatives are being evaluated to remove illicit connections and sewer impacts to the municipal stormwater system:

- replacement of the impacted municipal storm drains on Norfolk and Webster Streets
- replacement of the leaking municipal sanitary sewers (Webster Street, Washington Street completed)
- repair of storm drains (sealing pipe joints, structural cracks)
- repair of sanitary sewers (inversion lining, slip lining)
- physically sealing the sewer sub-drain in Area 10A-9B (concrete plug)

As detailed in the Administrative Consent Order (ACO), the Town is required to complete the design of projects necessary to remove illicit connections to the identified storm drains by February 28, 1997. In accordance with the ACO, the design will include an analysis of alternatives to remove the connections. The design will also include cost estimates to for the repairs.

Additionally, methods of limiting animal access to storm drains, such as metal grating, will be evaluated. Animal feces, as previously discussed, are a problem in at least four areas which were studied.