SANITARY SURVEY REPORT

N26.1 - LOWER PINES RIVER and CENTER BAR
REVERE and SAUGUS, MASSACHUSETTS

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DEPARTMENT OF FISHERIES, WILDLIFE AND ENVIRONMENTAL LAW ENFORCEMENT
MASSACHUSETTS DIVISION OF MARINE FISHERIES
SHELLFISH SANITATION AND MANAGEMENT PROGRAM

EXECUTIVE SUMMARY

The Massachusetts Division of Marine Fisheries (MDMF) conducted a sanitary survey of Shellfish Classification Area N26.1, Lower Pines River and Center Bar located in Revere and Saugus, MA. Data from May 1999 through February 2006 was analyzed for this report. The most recent shoreline survey was begun on September 10, 2002 and was completed in four more legs: April 2, 2003, April 4, 2003, May 21, 2003 and June 2, 2003.
The previous shoreline survey was done in August 1989.

RECOMMENDATION

This area should be classified as CONDITIONALLY RESTRICTED with the following restrictions:
- 4 day closure after a rainfall ≥ 0.25" (24 hour total),
- 7 day closure after a rainfall ≥ 0.40”
- seasonal closure from July 16 – September 30, inclusive.

DESCRIPTION OF GROWING AREA

Area Definition

N26.1 Lower Pines River and Center Bar
The waters and flats of the Pines River in Revere and Saugus from an imaginary line drawn from the manmade spit in Saugus across the Pines River to Gibson Park in Revere to the Route 107 bridge over the Pines River.

Area Description

The location of the headwaters of the Pines River is variously described as the confluence of Town Line Brook and Linden Brook (Army Corps of Engineers, ACOE) or as the tidal creek to the northeast of the Gravel Gerties basin near the old Saugus racetrack and airfield area (so indicated on the USGS topographic map, "Boston North") . The Pines River is a tidal estuary for its entire length. It flows approximately 3.7 miles easterly and northerly to a junction with the Saugus River and is the major tributary of the Saugus River. The Pines River has a watershed of about 8.9 square miles.

Shellfish classification area N26.1 is located in the lower reaches of the Pines River in the City of Revere and the Town of Saugus, Massachusetts. The classification area extends from an imaginary boundary line, near the mouth of the Pines River, drawn from the manmade spit and powerlines, on the Saugus-side of the Pines River easterly to Gibson Park in Revere, south and west to the Route 107 bridge over the Pines River (Figure 1). The classification area consists of approximately 114 acres in Revere and 115 acres in Saugus.

Shellfish classification area N26.1 is located in the Rumney Marsh which has been designated as an Area of Critical Environmental Concern (ACEC) by the Commonwealth of Massachusetts. As an ACEC, the 2,363 acre Rumney Marsh has been identified as a critical environmental resource area and is afforded the highest level of stewardship and management. The ACEC boundary for Rumney Marsh is primarily the 100-year floodplain to the north, west, and south, and follows roads and right-of-ways to the east.

N26.1 has also been designated as class SB by the Commonwealth of Massachusetts Department of Environmental Protection. SB class waters are designated as a habitat for fish, other aquatic life and wildlife and for primary and secondary contact recreation. In authorized areas , SB waters shall be suitable for shellfish harvesting with depuration (Restricted Shellfish Areas). These waters shall have consistently good aesthetic value. (Additionally, as stated in 314 CMR 4.00 "Massachusetts Surface Water Quality Standards", class SB waters are subject to more stringent regulation in accordance with the rules and regulations of the Massachusetts Division of Marine Fisheries pursuant to M.G.L. c. 130, § 75. These include applicable criteria of the National Shellfish Sanitation Program.)

Pines River soils are fluvial and marsh deposits overlying marine clays, glacial till and organic sediments with bedrock, generally, 60-200 feet below surface. Sub-tidal sediments range

from coarse to fine sands with low (<2%) fines content to silts. Intertidal sediments in the River are predominantly silts. (USACE).

Salt marsh lines both banks of the Pines River from Route 107 east to the B&M Railroad Bridge. Downstream of the railroad bridge to the mouth of the river, a narrow ribbon of marsh (maximum width about 700 feet, average 500 feet) forms the Saugus-side border between the railroad embankment and the river while residential, retail and light industry line the Revere side. The Eastern Railroad line (now, B&M Railroad) along the western shore of the river was constructed in the 1840's. What was once a narrow-gauge railroad grade linking Boston to a summer resort community in Revere was constructed in 1874, abandoned in the 1920's is now Route 1A.

Most of the housing along the Revere-side of the Pines River (only that side of the River in the classification area is inhabited) was constructed during the development boom of the 1950's. Gibson Park, at the downstream extent of the shellfish classification area, is a City of Revere-owned recreational park. There are no public restrooms in the park.

Historical Timeline Of Classification Area

1954- Waters and flats of Saugus River and Pines River were determined to be contaminated and were closed to shellfishing.

1961-1970- 12,662 bushels of soft shell clams harvested from Saugus and Revere and processed by the Shellfish Purification Plant in Newburyport, MA (SPP).

1968 (May)- Approved for Purification Purposes: The waters and flats of the Pines River south of a line drawn between the remains of a breakwater the south end of which is in Revere and the north end of which is in Saugus. This is east of the Boston and Maine railroad bed and west of Route 1A.

1971- Waters and flats of Saugus River and Pines River were again determined to be contaminated and were closed to shellfishing except for all waters and flats of the Pines River, including Diamond Creek, from the bridge crossing the Pines River at Route 107 northwesterly to Route C-1, Saugus

1983(July, September)- Shellfish from N26.1(Pines River mouth to B&M railroad bridge) and N26.1A (Center Bar) analyzed for metals. Results were below FDA alert levels. Sediment samples also collected (September).

1983(August)- Shoreline Survey N26.1A and N26.1.

1984(December) A Sanitary reappraisal of N26.1A, commonly known as Center Bar,"The waters and flats to mean low water of the Pines River in Revere and Saugus from the B&M Railroad crossing over the Pines River in a westerly direction to Rt. 107 (Salem Turnpike)"

having identified no definite sources of pollution recommends that the area be reclassified to harvest with depuration.

1986(April)- Shellfish classification area N26.1A, meets the standards for harvest with depuration and is reclassified as restricted.

1986(August)- Shellfish classification area N26.1, "The waters and flats to mean low water of the Pines River in Revere and Saugus situated east of the Boston and Maine Railroad Tracks and extending from the mouth of the Pines River southwesterly to the Boston and Maine Railroad Crossing over the Pines River," has been classified as Prohibited since 1972 (or earlier) and continues to be unsuitable for the harvesting of shellfish for depuration.' The file states that the pollution in this area is from individual homes, as well as the Saugus River and the harbor.

1987(October)- N26.1A reclassified as Prohibited due to elevated bacterial counts in the clams at the SPP.

1988(June)- N26.1A reclassified as Restricted.

1989(August)- MDMF Shoreline Survey of N26.1A

1989(October)- N26.1A Last time commercially harvested for depuration.

1992(February)- Memorandum of 1992 MDMF N26 areas sampling results.

2002(September)- 2003(April-June)-Shoreline Survey of Lower Pines River and Center Bar

2006- Sanitary Survey

Area Resources

Softshell clams (*Mya arenaria*) and blue mussels (*Mytilus edulis*) are the only shellfish species in commercial quantities found in the growing area. *M. arenaria* are found over all the flats. The Conditionally Restricted classification only applies to soft shell clams and only clams may be harvested from the area.

There are no shellfish grants within GBH26.1.

Figure 1 – N26.1 "Lower Pines River and Center Bar" and sampling stations:

a. #30 "Pines River at Mouth",
b. #28 “Pines River at Archer Street”,
c. #16 “Pines River at B&M R.R. Bridge”,
d. #P18 “Pines River at Rt 107”,
e. P19 “Diamond Creek at Rt 107” and
f. #11 “Point of Pines (e. and f. are located outside of N26.1)

POLLUTION SOURCE SURVEY

Shoreline Survey- Leg 1

The Shoreline Survey of N26.1 was started on September 10, 2002 at 0730 and completed over four additional days in 2003 (April 2, April3, May 21 and June 2). The first leg

of the Shoreline Survey began during ebb 2 (low 0814) at the General Edwards Bridge (Rt 1A) and proceeded south along the east bank of the Pines River to the B&M Railroad Bridge. Leg 1 was conducted during dry conditions (Day 7 after 0.24" rainfall) with an air temperature of 80 degrees and winds from the southwest at 10-15 knots. MDMF biologists Glenn Casey and Denis Nault conducted the investigation.

Only the sample from the 24" corrugated steel pipe west of John Avenue had an elevated bacterial count (2400fc/100ml). This pipe was re-sampled on January 4, 2006 with a much lower result (<20fc/100ml, flow=0.75GPM). While it is believed that all these sources pose no significant risk to the classification of the area, these sources should be re-sampled or re-evaluated under rainfall conditions <0.25", approximating sub-closure conditions.

N26.1 SHORLINE SURVEY OF POLLUTION SOURCES- LEG 1

Pollution Source	Location	fc/100ml	Flow	Follow-up?
1. 12" corr steel	W. of Gibson Park field	No sample	No flow	Yes, wet wx
2. 10" cast iron.	N. of River Ave.	No sample	No flow	Yes, wet wx
3. 24" corr steel	W. of John Ave	2400	Not noted	<20
4. freshet(?)	W. of Gilbert Ave.	No sample	No flow	Yes, wet wx
5. 10" cast iron	Between Wadleigh & Blanchard	No sample	drip	Yes, wet wx
6. 10" cast iron	Across from Lawson St.	No sample	drip	Yes, wet wx
7. 8" corr steel	In rip-rap, W of Archer	No sample	No flow	Yes, wet wx
8. Tide gate	S. of Mills St	80	30GPM	Yes, wet wx
8A. 10" cast iron	Across from Mills, in rip rap	No sample	No flow	Yes, wet wx
9. Tide gate	South of #8, above	<20	pooled	Yes, wet wx
10. 24" corr iron	South of DiMare	20	10GPM	Yes, wet wx
10A. 12" conc culvert	S. corner DiMare Parking lot	No sample	No flow	Yes, wet wx
10B.pvc pipes: 1 (6") 4 (2"); also, pipe in river	Under DiMare Seafood	No sample	No flow	Yes, wet wx
10C. freshet	30' SW abandoned bldg	No sample	Minimal	Yes, wet wx
10D. 24" steel	NW corner Wharf Rest.	20	6GPM	Yes, wet wx
11. 24" steel	N of Auto repair	330	5.4cfs	Yes, wet wx
12. slough creek	Behind tool rental	220	1.5GPM	Yes, wet wx
13. Head of creek	N. of tool rental	490	Pooled	Yes, wet wx
13A. seep	Near #13, south bank	No sample	No flow	Yes, wet wx

Table 1 – Shoreline Survey, September 10, 2002, leg one.

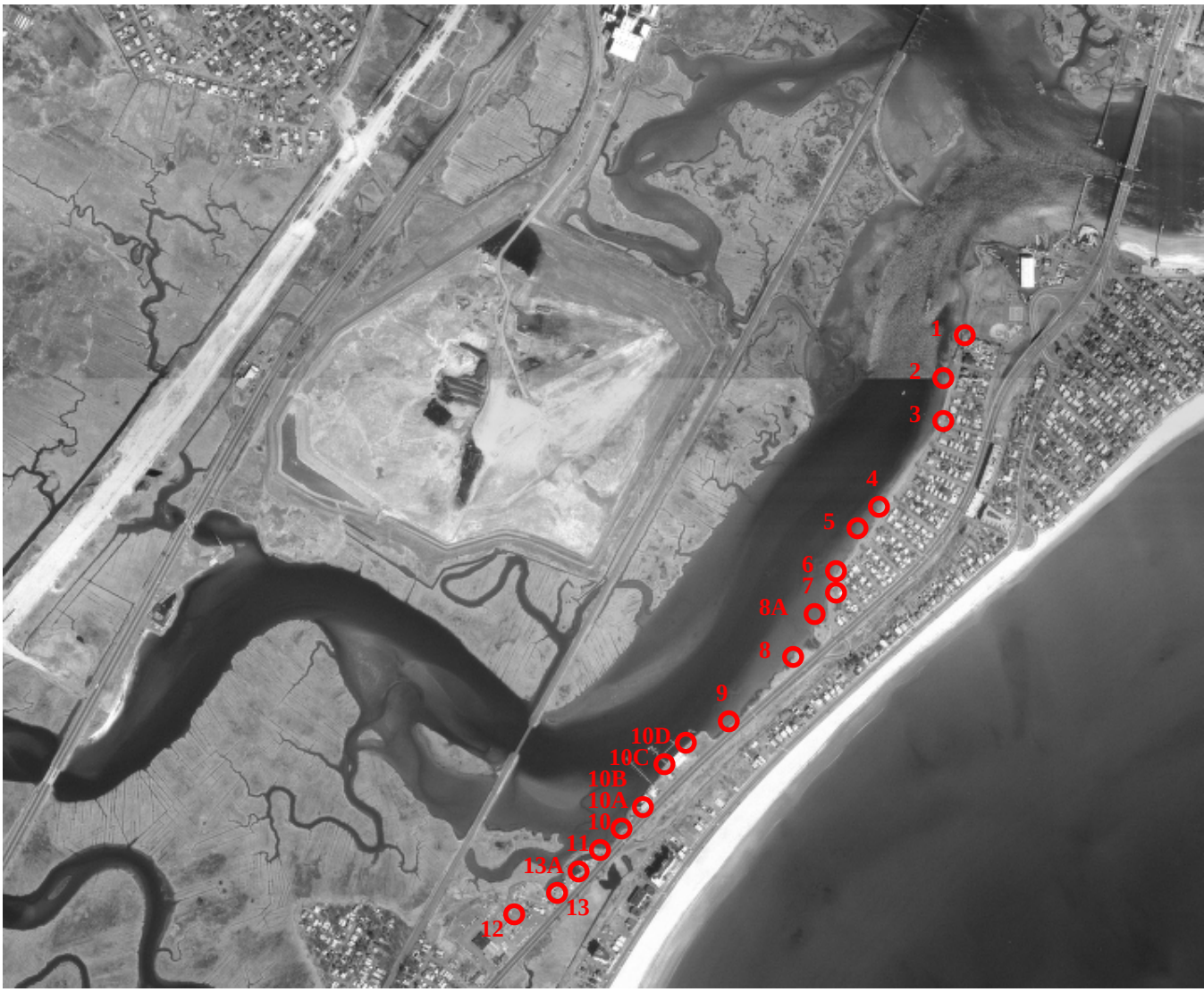

Figure 2 – N26.1 and N26.3 "Lower Pines River and Center Bar" Shoreline Survey of Pollution Sources, Leg 1, September 10, 2002.

Shoreline Survey- Leg 2

On April 2, 2003, MDMF biologist Glenn Casey began the second leg of the N26.1 Shoreline Survey. The Survey was begun during an early flood (low 0530) at the Route #107 bridge over the Pines River and proceeded easterly along the Saugus bank of the Pines River, across the B&M Railroad Bridge and westerly along the Revere side of the river back to Route #107. The Leg 2 Survey was conducted on Day 3 following 0.89" rainfall and Day 4 following 1.46". The air temperature was 38 degrees and the winds were from the east at 3-6 knots.

Source #15, drainage ditch west of Route #107, had the most elevated bacterial count (80fc/100ml) of the Leg 2 samples. The flow rate at this source was estimated to be 0.25GPM. It is believed that all the sources documented on Leg 2 pose no significant risk to the classification of the area however Source #10 should be re-investigated.

N26.1 SHORLINE SURVEY OF POLLUTION SOURCES- LEG 2

Pollution Source	Location	fc/100ml	Flow	Follow-up?
1. 10” cast iron	E. of Rt107, in stone revetment	No sample	No flow	No
2. seep	E. of Rt107, under concrete slab	50	trickle	No
3. 10” clay	E. of Rt107	No sample	No flow	No
4. Landfill, debris	E. of Rt107, right bank to B&M bridge	No sample	No flow	No
5. 10” clay	E. of Rt107, South of Bay State Lobster	<20	trickle	No
6. 12” corrugated steel	Above #5	No sample	No flow	No
7. 4” pvc in cast iron	E. of Rt107, South of Bay State Lobster	No sample	No flow	No
8. seep	E. of Rt107, South of Bay State Lobster	<20	1LPM	No
9. Drain holes in foundation	E. side of Bay State Lobster bldg.	No sample	No flow	No
10. 8” cast iron	E. side of Bay State Lobster bldg., in rip rap	No sample	No flow observed	Yes
11. 24” concrete	E. of Bell Isle Boatyard prop.	20	0.5GPM	No
12. 12” cast iron	E. of Rt107, @ bridge N. of radio, road drain	No sample	No flow	No
13. manhole w/ 12” corr steel outfall	E. of Rt107, nr. bridge	<20	0.5LPM	No
14. 36”-48” steel	E. of Rt 107, nr. bridge	20	2GPM	No
15. Drainage ditch	W. of Rt 107	80	0.25GPM	No
16. Drainage ditch	W. of Rt 107	<20	.06cfs	No
17. Creek	W. of R.R. tracks	20	Not est.	No
18. Runoff, landfill	S.of landfill	20	0.2cfs	No

Table 2 – N26.1 Shoreline Survey, Leg 2, April 2, 2003.

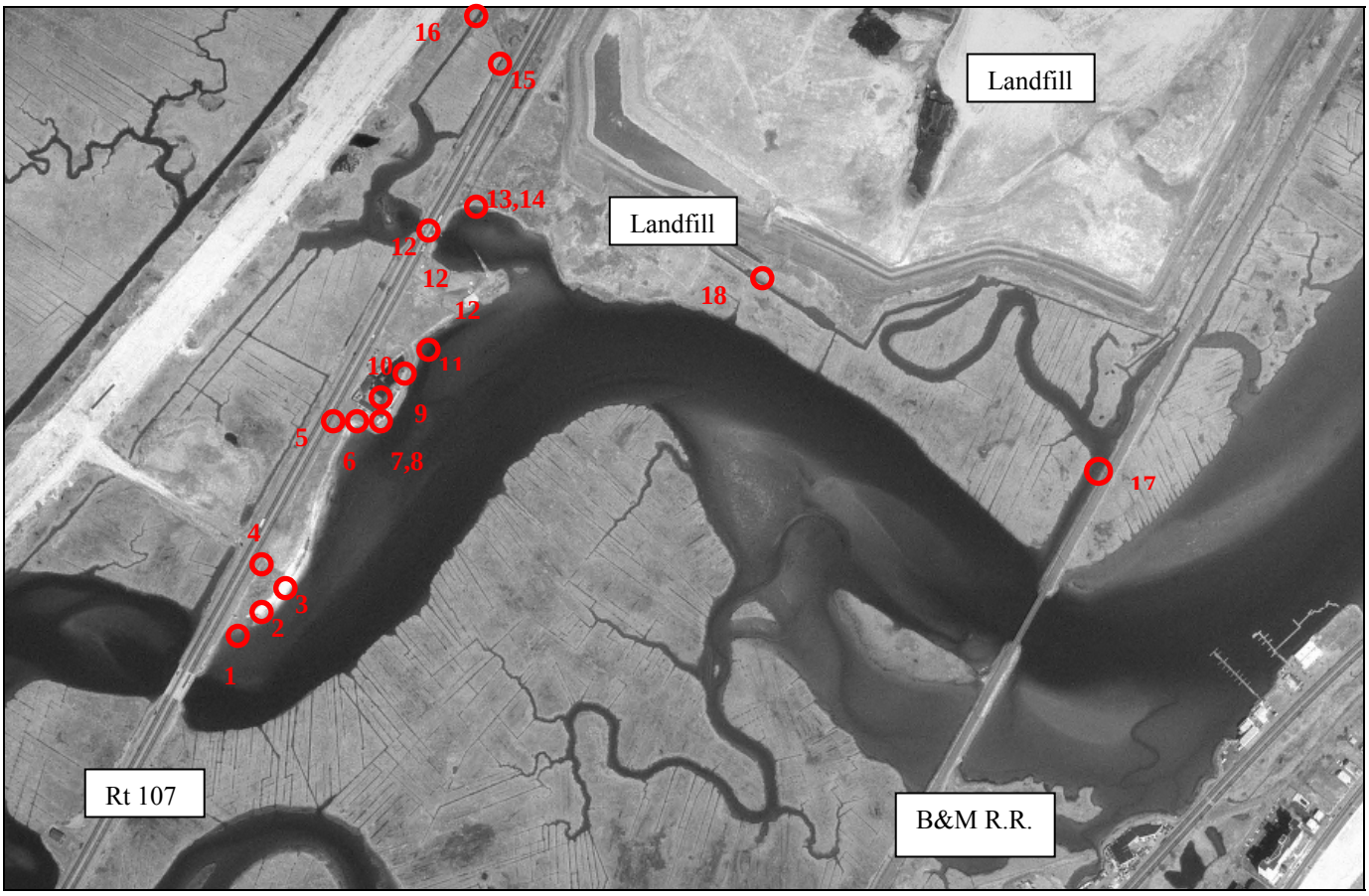

Figure 3 – N26.1 "Lower Pines River and Center Bar" Shoreline Survey of Pollution Sources, Leg 2, April 2, 2003.

Shoreline Survey- Leg 3 (and 5/21/2003 follow-up)

On April 3, 2003, MDMF biologists Glenn Casey and Mark Rousseau began the third leg of the N26.1 Shoreline Survey. The Survey was begun during an early flood (low 0608). The first samples were grabbed from pollution source locations #'s 1-3 on the Eastern County Ditch and source location #4 on the Central County Ditch. The Survey then proceeded from the northern side of Oak Island south and west to Route 107. The Leg 3 Survey was conducted on Day 1 following 0.16" rainfall, Day 4 following 0.89" rainfall and Day 5 following 1.46". The air temperature was 37 degrees and the winds were from the north-east at 5-10 knots.

Water samples from sources #1-4 in the two County drainage ditches had the most elevated bacterial counts (330, 2800, 310 and 700fc/100ml, respectively) of the Leg 3 samples. The Eastern County Ditch joins the Central County Ditch approximately 100 feet west of pollution source location #3. The three samples taken in the Eastern County Ditch indicate a decreasing downstream trend from #2 near the Wonderland parking lot to #3 (2800, 330 , 310fc/100ml). The Ditches make up, essentially, the headwaters of Diamond Creek, a major tributary to the Pines River. The confluence of Diamond Creek and Pines River is approximately 1.3 miles downstream of the confluence of the two Ditches. Routinely, Diamond Creek is

sampled, on ebb tides, at the Route 107 bridge to determine its bacterial impact on the Pines River (see following analysis of pollution sources). While it is believed that all these sources pose no significant risk to the classification of the area, these sources should be re-sampled or re-evaluated under rainfall conditions <0.25", approximating sub-closure conditions.

On May 21, 2003, Leg 4 follow-up investigation was conducted of the sewer chimneys noted on Leg 3 Shoreline Survey of N26.1 (see figure 3 and table 3). Although one of the sewer domes was broken at the base, no signs of a sewer breakout were noted.

N26.1 SHORLINE SURVEY OF POLLUTION SOURCES- LEG 3

Pollution Source	Location	fc/100ml	Flow	Follow-up?
1. drainage ditch	Foot of Acadia St.	330	Not est.	Yes
2. drainage ditch	Foot of Calumet St., across from Wonderland parking	2800	Not est.	Yes
3. drainage ditch	W. of R.R. at culvert	310	1.98cfs	Yes
4. drainage ditch	W. of R.R. at tide gate	700	Not estimated	Yes
5. 12" steel w/ clapper	Foot of Abruzzi St.	50	.25GPM	No
6. stream	E. of Rt107, N. of Rt 60	130	.33GPM	No
7. runoff	From parking lot	No sample	No flow	No
8. seep	Creek bank, behind #7	<20	0.5LPM	No
9. construction equipment, debris	E. of Rt107, N. of Rt 60	No sample	No flow	No
10. sewer chimneys (2)	N. of Ford Street	No sample	No flow	No

Table 3 – N26.1 Shoreline Survey, Leg 3, April 3, 2003.

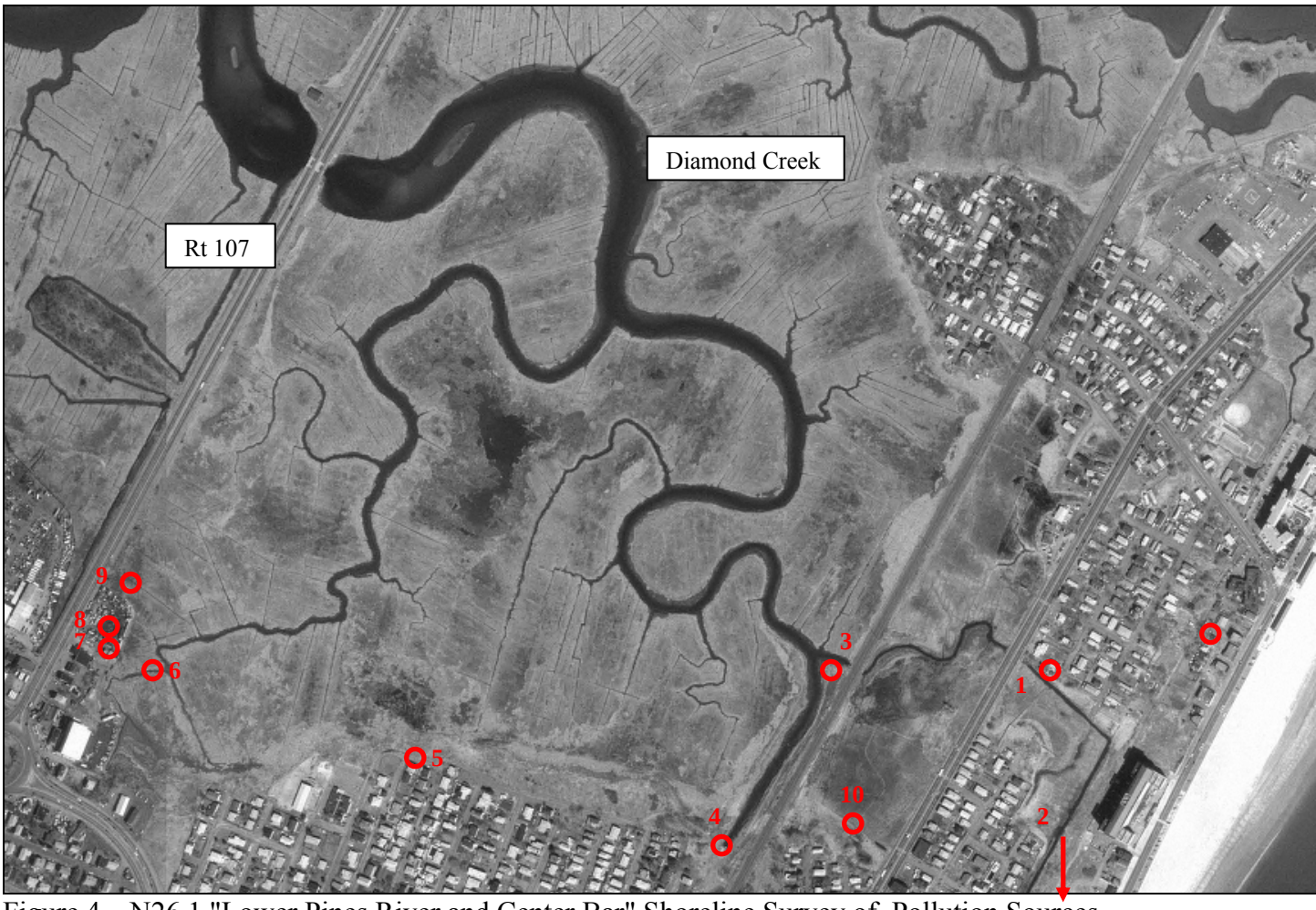

Figure 4 – N26.1 "Lower Pines River and Center Bar" Shoreline Survey of Pollution Sources, Leg 3, April 3, 2003.

Shoreline Survey- Leg 4

On May 21, 2003, MDMF biologist Glenn Casey conducted the fourth leg of the N26.1 Shoreline Survey. The Survey was begun during low tide (0736). The Survey proceeded from the Route 107 bridge over the Pines River south to end point of Leg 3 . The Leg 4 Survey was conducted during dry weather conditions. The air temperature was 62 degrees and the winds were from the north-west at 10-15 knots. Only one pollution source was sampled.

N26.1 SHORLINE SURVEY OF POLLUTION SOURCES- LEG 4

Pollution Source	Location	fc/100ml	Flow	Follow-up?
1.street drain	East side of Rt 107, south of Pines River bridge	No sample	No flow	No
2-12same as above				
13.4" pvc	SW corner Roach Plumbing lot	No sample	No flow	No
14.Stream	West of 107, south of Diamond Creek bridge	80	0.8 cfs	No

Table 4– N26.1 Shoreline Survey, Leg 4 May 21, 2003.

Figure 5 – N26.1 "Lower Pines River and Center Bar" Shoreline Survey of Pollution Sources, Leg 4, May 21, 2003.

Shoreline Survey- Leg 5

On June 2, 2003, MDMF biologist Glenn Casey conducted the fifth leg of the N26.1 Shoreline Survey. The Survey was begun during low tide (0736). The Survey proceeded from the north-eastern end of the B&M bridge north to the N26.1 boundary line at the manmade spit and powerlines, on the Saugus-side of the Pines River. The Leg 5 Survey was conducted on Day

1 following 1.47” rainfall, Day 2 following 0.30” rainfall and Day 4 following 1.21”.No pollution sources were noted. No pollution source samples were taken.

Figure 6– N26.1 "Lower Pines River and Center Bar" Shoreline Survey of Pollution Sources, Leg 5, June 2, 2003

POLLUTION SOURCES – DISCUSSION

The primary sources of bacterial pollution to N26.1 can be discussed in broad, general groupings:

- Rainfall and Summer Season
-Saugus River, CSO’s and Flood Tide
-Diamond Creek and tributaries
-Town Line Brook and tributaries.

Other pollution-related issues include:
-Marina Closure Zones
-Landfills and metals, PCB’s.
-Lynn Wastewater Treatment Plant Effluent

Rainfall and Season

There are four sample stations in the Lower Pines River classification area and two sample stations located contiguous to either end of N26.1(see Figure 1) Water quality results at these stations, to varying degrees, reflect a quick response, to rainfall events. While the response at any particular station, to any specific rainfall is variable, the common denominator throughout most of the year appears to be the magnitude of the rainfall event. Rainfall amounts greater than or equal to 0.25" can produce contaminating results (i.e. bacterial counts >173fc/100ml). The contaminating effects of a rainfall ≥ 0.25"(but <0.40") may last as long as four days. Two out of the five sampled rainfalls ≥ 0.25" but < 0.40" produced a bacterial count greater than or equal to173fc/100ml at, minimally, one of the four classification stations within 4 days of the rainfall event.

Rainfalls greater than or equal to 0.40" sometimes produce a contaminating event that might take as long as 7 days before waters return to the NSSP's restricted standard. Sixteen out of the thirty-nine sampled rainfalls ≥ 0.40" produced a bacterial count greater than or equal to173fc/100ml at, minimally, one of the four classification stations within 7 days of the rainfall event. By the seventh day, the deleterious effects of a rainfall of 0.40" or greater had abated.

The time necessary for the Pines River to naturally recover from rainfalls of these magnitudes seems to increase from the second half of July until the end of September. The data indicates that, during that time of the year, it may take longer than 7 days for bacterial counts to return to pre-rainfall levels, i.e. levels consistent with those of a conditionally restricted area. On 11 occasions samples were taken in N26.1 on the next to last or last day or a rainfall closure (either ≥ 0.25 or ≥ 0.40"). This would normally be a time when bacterial counts were either below or approaching the standard for a conditionally restricted area. On three of those dates, bacterial counts were still elevated at, minimally, one of the classification stations in N26.1. Those dates occurred in the warm weather months of July, August and September.

On only one sampling date of the thirty defined dry sampling events, has there been a dry weather count in excess of 173fc/100ml at any of the four classification stations. The cause of the high count on 7/21/2004 is unknown but is believed to be associated with warm weather prolonging the contaminating effects of rainfall (Day 8, 0.85").

The geometric means and percent variability for each station **(5/1999-2/2006)** for defined wet and dry conditions follow:

WET (Day 1-4 following rainfalls ≥0.25") or Day 1-7 following rainfalls ≥ 0.40")

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #30 Pines River at Mouth	32	72.3	18.8
Sta. #28 at Archer Street	36	66.5	22.2
Sta. #16 at B&M Bridge	40	64.7	25.0
Sta. #P18 at Rt.107	40	67.6	20.0

DRY

<0.25"
or Day 5 following ≥ .25 but <0.40"
or Day 8 following ≥ 0.40")

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #30 Pines River at Mouth	28	32.2	3.6
Sta. #28 at Archer Street	29	27.0	3.4
Sta. #16 at B&M Bridge	29	22.4	0.0
Sta. #P18 at Rt. 107	29	29.3	0.0

DRY and SEASONAL (Open October 1- July 15, inclusive)

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #30 Pines River at Mouth	20	31.5	0.0
Sta. #28 at Archer Street	21	23.4	0.0
Sta. #16 at B&M Bridge	22	22.3	0.0
Sta. #P18 at Rt. 107	22	29.6	0.0

Saugus River and Flood Tide

From a bacterial standpoint, degraded water quality from rain runoff is transported to N26.1 by three main conveyances: Saugus River, Town Line Brook and Diamond Creek. This Survey concludes that the greatest source of bacterial contamination to the Lower Pines River is the Saugus River. (As documented by the Saugus River Watershed Council, the most significant contributors of this pollution to the Saugus River are Shute Brook in Saugus, Town of Saugus Pump Station at Lincoln street and CSO #003 (Summer Street Overflow in Lynn).

MarineFisheries samples the Saugus River at the Point of Pines station, #11, downstream from the confluence of the Pines and Saugus Rivers. This station has a higher geometric means and percent variability than the four classification stations in the N26.1 area.

WET (Day 1-4 following rainfalls ≥0.25") or Day 1-7 following rainfalls ≥ 0.40")

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #11 Point of Pines	42	95.6	33.3

DRY

<0.25"
or Day 5 following ≥ .25 but <0.40"
or Day 8 following ≥ 0.40"

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #11 Point of Pines	29	32.2	6.9

DRY and SEASONAL (closed July 16- September 30, inclusive)

<0.25"
or Day 5 following ≥ .25 but <0.40"
or Day 8 following ≥ 0.40"

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #11 Point of Pines	22	50.3	4.5

Sampling results suggest that the recently ebbed Saugus River waters likely enter the Pines River on at least part of the flood tide. The degree to which the Saugus River affects the water quality of the Pines is revealed in the table below. On flood tide, the geometric mean of fecal bacteria counts drop as sampling progresses upstream, away from the Saugus River(Table 1). This may be a factor of dilution by Pines River waters. However, that bacterial counts begin to rise again at the B&M Railroad bridge may reflect the influence of Diamond Creek and Town Line Brook.

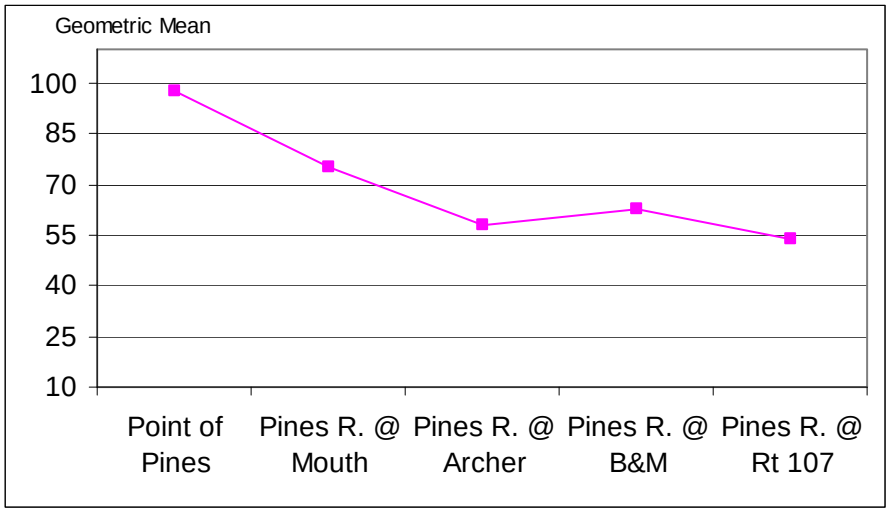

Table 5.Geometric Mean vs. Station. Wet and Dry Flood Tide Sampling.

Diamond Creek

Diamond Creek enters the Pines River to the west of Route 107. This stream is a significant source of fecal bacteria, especially during defined wet weather (see below). Eastern County Ditch and Central County Ditch are two major drainage ditches in Revere which discharge into Diamond Creek. A handful of samples taken along these ditches indicate moderately elevated bacterial loadings.

WET (5/1999 – 12/2005)
Day 1-4 following rainfalls ≥0.25"
or Day 1-7 following rainfalls ≥ 0.40"

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #P19 Diamond Creek	35	114	40

DRY (5/1999 – 12/2005)
<0.25"
or Day 5 following ≥ .25 but <0.40"
or Day 8 following ≥ 0.40"

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #P19 Diamond Creek	17	21	0

Town Line Brook

Town Line Brook is a wide, paved drainage canal under the jurisdiction of Massachusetts Department of Conservation and Recreation. Drainage flows from the Brook through a multiple opening tide gate structure on the east side of Route 1 at Seaplane Basin. This waterway, also known as Malden Canal, forms the corporate boundary between the Cities of Revere and Malden and with the confluence of Linden Brook forms the headwaters of the Pines River according to the Army Corps of Engineers. Several tributaries (e.g. Linden Brook, Trifone Brook) and outfalls in Town Line Brook have been sampled by MDMF. Bacterial results have been variable and indicate contributing sources of fecal bacteria. The tide gates are located approximately 3.7 miles from the mouth of the Pines River. Town Line Brook is not in classification area N26.1 and not in either the upstream or downstream areas contiguous to N26.1.

Town Line Brook has a higher geometric mean and percent variability than the Saugus River but contributes significantly less discharge and undergoes greater dilution due to its greater distance from the Lower Pines River classification area. For this reason, it is believed to have less of an impact on the lower reaches of the Pines River. Samples collected on an ebbing tide downstream of Town Line Brook at Pines River at Route 107 confirm this. The station at Route 107 meets NSSP conditionally restricted standards during defined dry conditions.

WET (Day 1-4 following rainfalls ≥0.25") or Day 1-7 following rainfalls ≥ 0.40")

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #P1 Town Line Brook	36	432	72

DRY (5/1999 – 12/2005)
<0.25"
or Day 5 following ≥ .25 but <0.40"
or Day 8 following ≥ 0.40"

Station	N	Geometric Mean	% > 173 fc/100ml
Sta. #P1 Town Line Brook	24	230	50

METALS and PCB's

The three landfills in the vicinity of Pines River shellfish classification area N26.1 are potential, non-point sources for contaminants such as heavy metals and PCB's. These landfills encompass approximately 250-300 acres in the vicinity of the Lower Pines River. They are:

1.RESCO Landfill (formerly DeMatteo Landfill, also known as Saugus Landfill) is an active landfill. It was previously used for municipal solid waste (MSW) but is now used for ash from RESCO. RESCO began operation in 1975.

2.GE Landfill is now closed. It consists of construction and demolition debris.

3.Dewy Daggot Landfill has been inactive since 1979. It was used for MSW and was listed as a 21E site (Massachusetts Oil and Hazardous Material Release Prevention Act) in 1989.

In the 1976 Environmental Impact Report on the Saugus Landfill, metals and PCB's were found to leach from the landfill but settled out or were absorbed in the marsh muds within 100 to 400 feet downstream from the landfill. A 1980 report by William Hall indicated that leaching of pollutants was still taking place with some contaminants such as zinc, cadmium, chromium, lead and PCB's exceeding safe levels for sensitive aquatic life. It was "noted that the pollutants entered adjacent salt marshes and tidal creeks where they were quickly absorbed by the sediments and in some cases taken up by vegetation. He also noted that since the pollutants are bound up in the fine material, they are essentially immobilized unless the area is disturbed." (Saugus River and Tributaries Flood Damage Reduction Study Lynn, Malden, Revere and Saugus Massachusetts-Hydrology and Hydraulics Appendix C, Army Corps of Engineers, 1989).

Metals and PCB's in Water Quality Studies

Lower Pines River water quality results from three studies were examined. In 1982, the Massachusetts Division of Water Pollution Control (MWPC) collected water quality samples from the Lower Pines River and analyzed them for aluminum, cadmium, chromium, iron, mercury and zinc. Only cadmium approached the EPA-established Marine Acute Criteria ("Gold Book").

The ACOE collected water samples from the Lower Pines River for heavy metals and PCB analyses in December 1982 and April 1984 for the Pines River Small Navigation Project. In the Navigation Project study, water samples were analyzed for: arsenic, cadmium, chromium, copper, lead, manganese, mercury, nickel, zinc and PCB's. At the three Pines River sampling locations, copper exceeded the EPA's Marine Acute Criteria. Lead and nickel exceeded the more-stringent Marine Chronic Criteria at one station, zinc at two stations and mercury exceeded the Acute Criteria at one station and the Chronic Criteria at another. PCB's did not exceed the EPA criteria at any of the Pines River stations.

In August 1986, the ACOE again analyzed water samples from the Pines (and Saugus) Rivers for metals and PCB's for the Saugus/Pines Flood Reduction study. Water samples were

collected at the Rt.107 crossing, Diamond Creek, Town Line Brook and in the Saugus River at the mouth of the Pines River. The samples were analyzed for arsenic, cadmium, chromium, iron, lead, mercury and zinc. Copper results were discarded due to sample contamination. Some stations also had PCB analysis. Results frequently exceeded of the EPA's Chronic Criteria for mercury and an occasional exceeded Chronic Criteria standards for zinc. PCB results did not exceed either Criteria.

Metals and PCB's in Elutriate Testing

In December 1982, elutriate testing of surface sediments for metals was done on samples from two locations in the Lower Pines River. ACOE conducted this testing for the Pine River Small Navigation Project. On comparison of a virgin water sample from each site with the elutriate sample, it was found that copper and arsenic (to a lesser extent, lead) were released to the water column. There was no release of PCB's.

Metals and PCB's in Sediment Analyses

Four Pines River sediment samples were obtained from 1982-1986. These samples were analyzed for mercury, lead, zinc, arsenic, cadmium, chromium, copper, and nickel. The sediments were also analyzed for PCB's and oil and grease. Results of bulk chemical analysis of the four Pines River sediment samples generally fell within the DEP guidelines for a Category I classification for means and range. Only lead was found to range from Category I to II.

Metals and PCB's in Shellfish Analyses

The Commonwealth of Massachusetts conducted chemical analysis for silver, cadmium, chromium, copper, nickel, lead, zinc, mercury, arsenic and PCB's (Arochlor 1254) on soft shell clams from this area in 1983. The results were well below today's FDA action or alert levels. Clam samples were taken from flats along the main stem of the Pines River, downstream from the Route 107 bridge.

Additional testing for metals and PCB's was done on mussels in the Pines River by Maine Gulfwatch in 1995 at a single location approximately midway between the Rt.107 bridge and the mouth of the Pines River. That study concluded, that "all reported organic concentrations are within acceptable concentrations for those compounds that have established FDA Action Limits in fish and shellfish", that "admissible levels of methyl mercury…(were) "well below federal action concentrations", and that cadmium, chromium, lead and nickel do not approach FDA alert levels.

Comparing its findings to U.S.EPA "screening values", the Gulfwatch study found that the screening value for ΣPCB_{24} in the Lower Pines River was as much as 243 times higher than the screening value and recommended that those areas "be examined in much more detail in order to adequately assess the potential human health risk to PCB's."

Based on a review of available studies in the Pines River, the following contaminants have been found to be present in the immediate environment of the shellfish flats (water and sediment): PCB's , Cadmium, Copper, Lead, Nickel, Zinc, Mercury and Arsenic. Therefore, in order to give a recent and clean bill of health to the clams in N26.1, MDMF collected soft shell

clams for multiple analyses at three locations in the Lower Pines River: Archer Street, Center Bar and across from Northside Marine. Three sample lots were collected by MDMF on May 13, 2005 and analyzed by MDEP at the Wall Experimental Station (See analytical results in the Appendices/Attachments).

Figure 7 – N26.1 Trace Metals/PCB's sample sites (clams). 1) Pines River at Archer Street 2) Pines River at Center Bar 3) Pines River across from Northside Marine. (5/13/2005)

Both MDMF and Massachusetts Department of Public Health reviewed the analytical results and determined that results were below US Food and Drug Administration's Action and/or Guidance Levels for Poisonous or Deleterious Substances in Seafood. (The National Shellfish Sanitation Program (NNSP) has established Action Level standards for Mercury and PCB's. Sample results are well below these standards as established for shellfish. Only Guidance Documents have been issued by NSSP for the other heavy metals and results from the Pines River clams fall below the Guidance Levels.)

LYNN WASTEWATER TREATMENT PLANT OUTFALLS

Lynn Water and Sewer Commission has permitted effluent outfalls in Broad Sound (# 001 main outfall) and in Lynn Harbor (#002 alternate outfall). The #002 alternate outfall is approximately 3400 feet northeast of the mouth of the Saugus River (and, approximately 5400 feet from the mouth of the Pines River). The permit authorizes discharge from #002 when influent flows exceed 75mgd. Such discharges are required to be reported and are reported monthly to Massachusetts Department of Environmental Protection (DEP). Monitoring of fecal coliform bacteria in the effluent is required by the permit. Daily grab samples are taken. The discharge limitations for outfall #001 are a monthly geometric mean of 88fc/100ml with a maximum daily limit 260fc/100ml. Fecal coliform results from outfall #002 are only required to be "reported". There appear to be no limits on this outfall.

A phone conversation between MDMF biologist Glenn Casey and Carl Hendrickson, project manager of the Lynn Regional Wastewater Treatment Facility, was held on 9/13/2004. Mr. Hendrickson stated that activation of outfall #002 occurs, on average, three times a year, only during a significant rain storm coinciding with high tide (average discharge duration is 4 hours). This outfall, although permitted to discharge when influent plant flows exceed 75mgd, is not always activated when flows reach that level. The plant is capable of handling flows of 120mgd and any discharge from #002 has received, at a minimum, 60% secondary treatment, according to Mr. Hendrickson.

LYNN COMBINED SEWER OVERFLOWS (CSO's)/ SAUGUS PUMP STATION

Lynn Water and Sewer Commission has one permitted CSO (#003, Summer Street) which discharges into the Saugus River and two which discharge into Lynn Harbor (#'s 004 and 005). A CSO remediation project is currently progressing under court order. The "Lynn Water and Sewer Commission Overflow Response Plan" was issued by DEP to the Commission in November 2005. The plan establishes the procedures to be undertaken by the Commission to monitor discharges from its CSO's and to report the occurrence of discharges to appropriate agencies. The MDMF Gloucester emergency phone number (978/282-0308 ext160) is included on the notification list.

Overflows from the Town of Saugus' pump station at Lincoln Avenue are required to be reported to MDMF. The most recent incident, 6/27/2005, involved the bypass of 800,000 gallons of sewage into the Saugus River due to a power outage at the pump station. The Town of Saugus is under a consent order to develop a plan to halt the discharge of wastewater at the Lincoln Avenue site. Saugus must also start to eliminate the amount of sewage running through its system. Meters will be installed in 30 manholes across the town to determine where waste water is entering the system.

MARINAS AND MOORING AREAS

There are three marina/boat clubs in the N26.1 classification area (Figure 8). These marinas are seasonal and closure zones will be established around each marina. Because operations at these marinas have ceased for the winter, marina appraisals have not been completed at this time but will be completed by the spring/summer of 2007.

Figure 8 – Marinas : 1) Northside Marine 2) Broad Sound Tuna Club and 3) ?????????

SUMMARY Of POLLUTION INFORMATION

-Water quality of Lower Pines River area is effected by rainfall $\geq$ 0.25" during the months of October through mid July. Duration of a contaminating event is conservatively estimated at 4 days.

-Effects from rainfalls ≥ 0.40" can be longer lasting and should trigger a 7 day closure from October through mid-July.

-Based on the water quality results that indicate that some rainfalls from late July to the end of September may have much longer lasting effects, the area should be not be opened for harvest during that time.

-MDMF has been added to the notification list for discharges from LWSC CSO's and discharges at the Saugus Pump Station on Lincoln Avenue.

-The Saugus River is the most significant source of bacterial contamination and only enters the Lower Pines River on a Flood tide. Adverse sampling of N26.1 should target flood tides. However, due to the potential deleterious influence of Town Line Brook and Diamond Creek, ebb tides should also be sampled periodically.

-Three Marina closure zones will need to be established.

-Clams from this area were analyzed for PCB, Mercury, Arsenic, Cadmium, Chromium, Lead, Nickel and Zinc. Results did not exceed NSSP Action and/or Guidance Levels

HYDROGRAPHIC AND METEOROLOGICAL CHARACTERISTICS

Tides

The tides in N26.1 are similar to the tides in Boston Harbor which are semi-diurnal with a mean range of tide of 9.5 feet and a mean spring range of tide of 11.0 feet. The maximum and minimum predicted astronomic tide ranges at Boston have been estimated at about 14.7 and 5.0 feet, respectively.

The 1989 U.S.Army Corps of Engineers' (ACOE) study, Saugus River and Tributaries Flood Damage Reduction Study Lynn, Malden, Revere and Saugus Massachusetts-Hydrology and Hydraulics Appendix B, found that:

> In general, for normal non-storm tide conditions, the smaller the tide range, the less reduction there is in tide heights as one proceeds upstream from the mouth of Pines River. Mean tide range produces nearly the same heights inland as at the coast. Normal spring high tides at the Town Line Brook gage near Seaplane Basin appear to be about one-half foot lower than at Boston and the timing appears to be about 50-minutes later than Boston. This seems due to the restrictive channel opening at the abandoned highway embankment and the relatively large storage available in the Saugus marsh. The largest differences occur at low water where the river gages show a distinctly higher and later low tide, relative to Boston.

Sediment Load

Sediment transport in the Pines River is tidally dependent. The fresh water influence, under average flow conditions, is minor because of "the hydrologically slow basin characteristics (short stream lengths interconnected by large wetland areas)" (ACOE).

Rainfall

The mean annual precipitation in the Revere-Lynn area is 42 inches based on more than 100 years of continuous record at neighboring Boston. Short duration intense rainfall often accompanies fast moving frontal systems, thunderstorms and coastal storms. These storms may frequently be localized in the Revere-Saugus area. This possibility emphasizes the need for local weather/precipitation information, either in Revere or Saugus, in order for MDMF to manage this area.

Because rainfall has been found to have deleterious effects on water quality in this area, a rainfall policy has been instituted and is controlled by MDMF. Any event generating ≥0.25" but <0.40" of rainfall results in a four day closure of the shellfish beds. Any event generating ≥0.40" will result in a seven day closure of the shellfish beds. Rainfall amounts will be monitored by MDMF biologists. Closures will be based on 7 a.m (EST). rainfall amounts recorded at the NWS gauge at Logan Airport from the previous 24 hour period and/or the twenty four hour total from the WBZ Weathernet station at Veterans Memorial School in Saugus. **Closures will be based on 24 hour rainfall totals exceeding the rainfall action levels at either station (not averages)**.

The URL for NWS Logan Airport station is:
http://www.erh.noaa.gov/box/obs/BOSobs.html .

The URL for the Veterans Memorial School station is :
http://wbz.instaweather.com/stationOb.asp?id=SAUGS
To determine the 24 hour total at the Saugus station

-Type in above URL.
-Click on Historical Observations>72 hour.
-Compute ***Previous Day***'s rainfall (2300-0600 EST or 2300-0700 DST)
-Add ***Current Day's*** rainfall 0600 entry (EST) or 0700 (DST) to above = 24 hour Total.

The information is then entered into an Oracle database developed by MDMF personnel. The following table illustrates the frequency and type of rainfall events occurring in 2000-2005 averaged from nearby NWS staions at Logan Airport, Blue Hills and a NWS cooperative weather station in Hingham. The complete MDMF Rainfall Policy can be found in the central files**.**

FREQUENCY OF RAINFALL EVENTS

	< .50"	.50" - <1.00"	≥1.00"	>2.00"	>3.00"
2000	42	24	8	2	1
2001	41	12	4	3	0
2002	50	23	9	1	0
2003	58	22	12	0	0
2004	64	12	13	2	1
2005	62	17	9	3	2

Table 6. Based on averages from daily recordings at three Greater Boston Harbor weather stations: NWS Logan Airport, NWS Blue Hills Observatory and a cooperative station in Hingham, MA.

Wind

Wind speed and direction are recorded during each sampling event. Winds tend to prevail from the north/northeast direction during the winter months and from the south/southwest during the summer months.

WWTP

The nearest wastewater treatment plant outfall to the N26.1 study area is the Lynn Wastewater Treatment Facility outfall #002. This outfall is located at 42 27' 02" North 70 57' 15" West, approximately 5400 feet from the mouth of the Pines River. This outfall is permitted to be activated when flows at the Lynn Wastewater Treatment Facility reach 75mgd at the plant. The plant has a 120 mgd capacity. According to Carl Hendrickson, project manager for the Lynn WWTF, outfall #002 is not always activated when flows reach 75mgd. Generally, this outfall is activated approximately three times a year for approximately 4 hours, during periods of sizable rains and elevated tides (It is not activated during dry weather). It is metered and in the process of being alarmed. Effluent receives 60% secondary treatment, at a minimum. When it is activated, it is required by the NPDES permit to be tested 3 times a day. Lynn WWTF uses a membrane filter test for fecal bacteria.

AREA MANAGEMENT

Any soft-shelled clams harvested in the Pines River must be transported to the Shellfish Purification Plant for depuration treatment via the prescribed transportation route. The prescribed transportation route is located in the central files.

A copy of the Pines River Management Plan and Memoranda of Understanding are attached at the end of this Survey.

PARALYTIC SHELLFISH POISONING

The Paralytic Shellfish Poisoning (PSP) toxin has been monitored by the Commonwealth of Massachusetts since the first major outbreak occurred in 1972. From 1972 through 1987 this duty was carried out by the Department of Environmental Quality and Engineering (DEQE). In 1988 the responsibility was transferred, along with the rest of the shellfish program to MDMF. The PSP toxin occurs in the marine dinoflagellate *Alexandrium tamarensis* commonly found in coastal waters of Massachusetts, New Hampshire, Maine, and northeast Canada. Optimal environmental conditions allow the dinoflagellate to increase in numbers producing a "bloom." When this occurs, the toxin, which is normally synthesized by Alexandrium, increases with the numbers of organisms. Shellfish filter out the dinoflagellates during normal feeding. During a "bloom", the shellfish accumulate concentrated levels of the toxin in their digestive systems and tissues. These elevated levels of PSP toxin in the shellfish pose a severe threat to public health.

Levels of the PSP toxin in shellfish on the North Shore are estimated based on test results from four MDMF primary PSP monitoring stations located in shellfish growing areas in Gloucester, Essex, Ipswich, and Newburyport. The closest primary PSP station to N26.1 is located at the Annisquam Yacht Club in Gloucester. When N26.1 opens for harvest, blue mussels from the Pines River will also be tested every other week for the presence of PSP. Sampling begins in March and is conducted weekly through November for *Mytilus* until a rise in toxin levels is detected. At that time, sampling of mussels can be increased to twice a week. *Mya* are sampled at least weekly at the four primary PSP stations once levels begin to climb in the mussel populations. Once toxin levels reach detectable levels in soft shell clams, >40ug/100g, sampling is expanded to include 7 secondary stations for *Mya*, 7 secondary stations for *Spisula*, and 1 secondary station for *Mytilus*.

A minimum of 12 animals is collected for a sample. Animals are taken which are submerged or which have been recently submerged by the receding tide. Only live, undamaged animals are collected. The sample is rinsed in seawater at the collection site, placed in a 12" x 18", .002 mm gauge plastic bag, and then sealed. The plastic bags are pre-marked in permanent ink with the location, date, species, and collector's name(s). The samples are then placed on ice in coolers for transport to the MDMF Shellfish Purification Plant for shucking. A MDMF PSP field sheet is filled out for each PSP sample trip with the date, time, tide, air temperature, water temperature, wind direction, location, and collector's name(s).

At the MDMF Annisquam River shellfish lab, the samples are washed, shucked, then drained for five minutes before being placed in covered, 8 oz., polyethylene specimen containers. The containers are pre-marked in permanent ink with the information from the sample bag. The mouse bioassay procedure for the testing for paralytic shellfish poison in shellfish is run according to methods set forth in "Recommended Procedures for the Examination of Sea Water and Shellfish," fourth edition (1970) and the N.E.T.S.U. (FDA) lab evaluation checklist, 1994 version.

Closures are instituted when the PSP toxin levels reach the international standard of 80 ug/100g. Once a closure is made, three samples below the 80 ug/100g within a two week period are necessary for the reopening of an area. Separate samples are run on each species for the reopening of mussels, soft shell clams, and surf clams.

There has never been an outbreak of PSP recorded in Boston Harbor. However, during PSP outbreaks that occur on the North Shore, incoming lots of shellfish are tested for PSP at the Shellfish Purification Plant in Newburyport.

WATER QUALITY STUDIES

Sampling Plan

All water and soft shell clam samples were collected according to NSSP guidelines as outlined in the 2003 revision of the National Shellfish Sanitation Program (NSSP) Manual of Operations, Guide for the Control of Molluscan Shellfish. The Massachusetts Division of Marine Fisheries conducts adverse condition sampling on all shellfish growing areas from the Hull/Cohasset town line north to the New Hampshire border. The predominant adverse condition for N26.1 indicates the need for sampling during the early flood tide as well as following rainfall events. However, ebb tides will be sampled periodically.

Beginning April 17, 1995, water and clam samples were transported to the MDMF lab at the NMFS building in Gloucester, Ma., within six (6) hours of their being collected. Water samples were collected in sterile 250ml wide mouth Nalgene bottles or 250ml Duraglas glass bottles. All samples were transported on ice and kept below 10°C but above 0°C. The temperature of the water samples was checked using a water blank placed in the cooler at the time of the last sample taken. Taylor and Fisher brand pocket thermometers were used to record surface water temperatures in the field.

Water samples were tested for fecal coliform and salinity. Salinities were recorded from a hand held ATAGO refractometer used in the lab at constant temperature and calibrated weekly.

Prior to July 2001, a 5-tube 3 dilution MPN using A-1 media was used to quantify fecal coliform from the water samples taken . A 5-tube 3 dilution MPN using lauryl tryptose broth for the presumptive test and E broth for the confirmed test was used on shellfish samples. All of the tests were run according to Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association.

On July 1, 2001, the DMF lab in Gloucester switched from a five tube, multiple dilution MPN test to a 12 tube, single dilution MPN test for the analyses of most North Shore waters. It was recognized by the 8th National Shellfish Sanitation Workshop in 1974 " that the single dilution MPN test is a simpler approach than either the five or 3-tube, multiple dilution MPN test because it requires fewer tubes than the 5-tube multiple dilution MPN test, media of one strength, no diluent, quicker inoculation, less incubator and/or waterbath space, fewer pipets, and, generally yields better data."

The National Shellfish Sanitation Program requires that water quality results be analyzed for both the measure of central tendency (geometric mean) and the variability (the 90th percentile or upper ten percent). According to "Manual Interpretation Number I-B-1-100" in the "Guidance Documents" section of the *Model Ordinance,* it was determined that changing the inoculum volumes for the 12 tube, single dilution test would maintain the median value for the microbiological standard at 88 MPN/100ml for an area classified as Restricted. The median standards for the 12-tube, single dilution and the 5-tube, multiple dilution are the same. However, the 90th percentile (variability) standard of a 12-tube test, single dilution test would be set at 173 MPN/100ml for a Restricted area. Water samples collected after July 1, 2001 will be analyzed with respect to the change in the variability standard of the 12-tube, single dilution test.

Method of Data Analysis

Data was entered and stored in an Oracle database developed by MDMF personnel. The database is housed on a VAX in the EOEA Data Center at 100 Cambridge Street in Boston. Data was downloaded into Microsoft Excel v. 5.0 and analyzed for geometric mean and 10 percentile.

Analytical results were reviewed in light of the fecal coliform standards that NSSP has set for the classification of waters. The standards are summarized below:

Approved/Conditionally Approved:

Geometric mean MPN $\leq$14fc/100ml [1]

…not more than 10 percent of the samples exceed an MPN of 28 per 100ml for a 12-tube single dilution test…[2]

Restricted/Conditionally Restricted:

Geometric mean MPN $\leq$88fc/100ml

…not more than 10 percent of the samples exceed an MPN of 173 per 100ml for a 12-tube single dilution test…

There are no NSSP standards for the bacterial quality of shellfish meat for area classifications. The classification of shellfish areas is based on water quality not shellfish. The Massachusetts Department of Public Health, Division of Food and Drug (DPH/DFD) has

[1] Geometric Mean is an average of common logarithms (log10).

[2] The intent of the 10 percentile criteria is not to permit an area to exceed the 14/88standard for 10 percent of the time but rather to allow for the inherent variability of the MPN test

adopted a "market standard" of 230fc/100g. This is in fact a defacto national standard. Though the market standard can be used as an aid in setting management policy for a conditionally approved area it is not appropriately used in the management of restricted areas.

The DMF SPP alert level for fecal coliform concentration for incoming shellfish is 1600fc/100g shellfish meat. This level was set by DMF after depuration effectiveness studies in 1974[3] and again in 1992[4] to determine the highest fecal coliform count the Shellfish Plant could reliably depurate. These levels were developed for and are unique to the Newburyport facility. Since Newburyport is the only depuration plant in Massachusetts, all shellfish taken from restricted waters for controlled purification must conform to those limits.

WATER QUALITY DATA

Data Analysis

Water quality from December 1999 through February 2006 for growing area N26.1 is summarized below. Water samples for fecal bacterial analysis were collected year-round during wet and dry conditions for this Sanitary Survey. Defined dry sampling data was used in determining when N26.1 would be available for commercial harvest with depuration. It has been determined that N26.1 may be open for digging on the fifth day after a rain event ≥ 0.25" but < 0.40", or on the eighth day following a rain event ≥ 0.40" during the period of time October 1-July 15, inclusive. N26.1 would be closed seasonally from July 16 – September 30, inclusive. The following table of water quality results reflects those dry weather/seasonal parameters. All individual sampling dates and results are detailed in Appendix A.

ALL Sampling Results 5/1999 - 2/2006

St. #	St. Name	GM	%>173	N
C30	Pines River at Mouth	49.6	11.7	60
C28	Pines River at Archer St	44.5	13.8	65
C16	Pines River at B&M Bridge	42.7	15.7	70
P18	Pines River at Rt 107	55.2	15.5	71

[3] Edward Piel et al., Analysis of Depuration for Soft Shelled Clams at Newburyport, Massachusetts, and a Program for Bacteriological Standards, (Chesapeake Science, 1974).
[4] Verification Studies Newburyport Soft Clam Depuration Plant, (Massachusetts Division of Marine Fisheries and United States Food and Drug Administration, 1992).

DRY Sampling Results 5/1999 -2/2006

St. #	St. Name	GM	%>173	N
C30	Pines River at Mouth	32.2	3.6	28
C28	Pines River at Archer St	27.0	3.4	29
C16	Pines River at B&M Bridge	22.4	0.0	29
P18	Pines River at Rt 107	29.3	0.0	29

DRY/SEASONAL Sampling Results 5/1999 -2/2006

St. #	St. Name	GM	%>173	N
C30	Pines River at Mouth	31.5	0	20
C28	Pines River at Archer St	23.4	0	21
C16	Pines River at B&M Bridge	22.3	0	22
P18	Pines River at Rt 107	29.6	0	22

INTERPRETATION OF DATA / DISCUSSION

Water Quality

Water quality results at all four stations in N26.1 meet the NSSP requirements for a "conditionally restricted" area both in terms of the geometric means ($\leq$ 88 FC/100ml) and variability (no more than 10% > 173FC/100ml) for data collected **when this area would be open to harvest**. Results from year-round, wet and dry sampling indicate that water quality in N26.1 is impacted by rainfall and three sources of sometimes elevated bacterial levels: Saugus River, Town Line Brook and Diamond Creek. (For greater detail, see pollution source discussion.) It is because of bacterial variability in water quality, and not the geometric means of any individual station, that N26.1 can not be opened for year-round harvest, and has a significantly restrictive rainfall/closure policy.

As previously noted, rainfall has a degrading effect on water quality in the Pines River, the impact of which is more pronounced in the warm weather months of July 15 through September 30 (i.e. “closed” season). When rainfall data is examined by “open” season (October1 – July 15) vs. “closed” season , a significant difference becomes apparent: the geometric means of rainfall-influenced *open-seasonal* bacterial counts are an average of 63fc/100ml lower and have a lower variability by 26% than rainfall data collected in the “closed” season.(Bacterial results from sampling during rainfall closures (during the ‘open” season) had an average variability of 12-17%). The effects of rainfall on levels of bacteria in the Pines River seem to be

of limited duration. While the sample set is small (N=5), results of sampling on the *last day* of a rainfall closure during the open season were below 173fc/100ml at all stations.

July 21, 2004 was the only date during defined dry weather when bacterial counts exceeded NSSP standards. On that date, bacterial counts were greater than 173fc/100ml at two of the four classification stations in N26.1. This was on day 8 after a 0.85" rainfall event and represents the only date during year-round, defined dry weather when bacterial counts exceeded NSSP standards for a Conditionally Restricted area (N=29). The cause of the high counts on that date is unknown but is believed to be related to warmer water temperatures/bacteria survivability. Water temperatures recorded on that date were 70-74 F. During the seasonal/dry conditions when N26.1 would be open to harvest, there have been 0% bacterial counts >173fc/100ml (N=21). The geometric means of water samples collected during that period of time ranged from 22.3 - 31.5fc/100ml.

Shellfish

Nineteen shellfish samples were collected from N26.1 for bacterial analysis during defined dry weather conditions and during that time of year when the flats would be open for harvest (i.e. October1 – July 15). Fifteen samples were collected from the "Blue Bar" flat and four from the flat at the foot of Archer Street. Bacterial results from "Blue Bar"had a geometric means of 805fc/100g while results at Archer Street had a geometric means of 2100fc/100g.

CONCLUSIONS

All stations in N26.1 meet the criteria for a Conditionally Restricted classification, based on season and rainfall level

The City of Revere has a shellfish constable, Conditionally Restricted Management Plan and a Memorandum of Understanding regarding overflows from their waste water collection system.

Soft shell clams harvested from N26.1 must be transported to the Shellfish Purification Plant for depurative treatment, via the prescribed transportation route.

Below is the definition and recommended classification of the area that has been determined as a result of this survey.

Classification: Conditionally Restricted
Status: Open to Shellfishing with Depuration October 1 – July 15, inclusive

N26.1 Lower Pines River and Center Bar
The waters and flats of the Pines River in Revere and Saugus from an imaginary line drawn from the manmade spit in Saugus across the Pines River to Gibson Park in Revere to the Route 107 bridge over the Pines River.

Appendix A

Detailed Sampling Results
And
Data Analysis

Attachments