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Sample Collection and Analysis Volunteers

Helen Simpson Linda Cullivan Elaine Tohler

Technical Staff

John McKinnon, P.E., Watershed Solutions, Inc., figures and maps
Katahdin Analytical Services, zinc testing
Ann Delehanty, project management for Friends of Scarborough Marsh

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In February 2005, the Maine Coastal Program of the Maine State Planning office awarded $1402.00 from their Shore Stewards Grant Program to the Friends of Scarborough Marsh to conduct Water Quality Testing in Mill Brook.

While this project was funded by a grant from the Maine State Planning Office, the contents of this document do not necessarily reflect the view and policies of the Planning Office, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

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INTRODUCTION

This Mill Brook Water Quality Analysis Final Report was prepared by the Friends of Scarborough Marsh (FSM), a coalition of private citizens and organizations pledged to conserve, protect, restore, and enhance the Scarborough Marsh Watershed. The report begins by providing background information on Mill Brook, describes the recent restoration efforts, and gives a historical look at the persistent water quality issues. The report then discusses the purpose and goals of the 2005 water testing, the methodology and the findings. The report concludes with recommendations for restoring and protecting the water quality of Mill Brook.

The Scarborough Marsh, the largest contiguous salt marsh in the state of Maine, has been identified as a high quality estuary and salt marsh by numerous State and Federal agencies (IFW, US Fish and Wildlife Services, National Marine Fisheries Service). Friends of Scarborough Marsh, in partnership with these agencies has initiated salt marsh restoration activities in the Scarborough Marsh Wildlife Management Area, Scarborough, Maine. One such project was restoration of the 350-acre salt marsh in lower Mill Brook.

"The Scarborough Marsh watershed is approximately 38,000 acres (60 square miles) and includes a major drainage (Nonesuch River) as well as several significant tributaries." *(Normandeau 2002) The Mill Brook 2 Sub-basin as described by Normandeau 2002 is one such tributary and is the focus of this report. At that time it was called Mill Brook 2 to distinguish it from another Sub-basin in the Pine Point area of the same name.

The Mill Brook watershed discussed in this report (See report cover) is made up of twin streams that drain 2912 acres and make up 8% of larger Scarborough Marsh Watershed. The Mill Brook watershed boundaries reach from the freshwater uplands of the twin streams in North Scarborough, cross under US Route #1 between Oak Hill and Haigus Parkway, and continue southward thru the Ballentyne and Willowdale neighborhoods. A third stream makes up in this area. The three then pass under the Eastern Trail (Old Eastern Railroad), flow into the tidal salt marsh region, then join up with the Dunstan River offshore from Seavey's Landing.

The drainage areas near Rt#1 are highly commercialized and include many impervious surfaces that shed rainfall such as roads, parking lots and rooftops. Runoff flows quickly into stream and river channels rather than slowly seeping into the ground. The increased volume of freshwater, the speed at which it scours streambeds, and the pollutants it carries from impervious surfaces all have a negative impact on the quality of water and aquatic habitat.

BACKGROUND

A restoration project was undertaken in 2004 to restore the 350-acre salt marsh in the lower Mill Brook watershed. This three phase project was designed to restore the open water habitat of marsh pools and pannes thereby enhancing fish, shorebird, and wading bird populations.**(Mill Brook Saltmarsh Restoration Project, 2002)

To support the project Northern Ecological Associates, Inc. (NEA) was contracted to conduct pre-restoration monitoring. "Monitoring involved the collection of quantitative information on physical characteristics of water on the marsh surface and chemical characteristics of water in the tidal creeks surrounding the study area, and qualitative characterization of distinct vegetative communities in the Project area." ***(Mill Brook Salt Marsh Pre-Restoration Monitoring Addendum to the Data and Documentation Report-Water Quality Analysis, 2004)

Water samples collected by NEA and analyzed by Katahdin Analytical Services detected zinc at 0.106 mg/l at one test site. This zinc level is sufficiently high to be of concern. In addition, water samples collected by NEA, at and downstream from culverts under the Old Eastern Road, were found to have fecal coliform counts >1,100 which indicated a substantial source of fecal coliform.

The zinc and coliform bacterial pollution reported by NEA during their monitoring greatly affected the Cattail Phase of the FSM restoration project. This area of the Mill Brook salt marsh has "excessive stormwater (freshwater) influence", and is dominated by narrow-leaved cattail (Typha angustifolia) and numerous pioneer colonies of the invasive grass, Phragmites australis." **(Mill Brook Saltmarsh Restoration Project, 2002) The restoration initiative recommended ditching of the Cattail Phase area to minimize freshwater intrusion onto the surface of the marsh. Due to the high levels of zinc and coliform pollution, the restoration work was postponed to allow further testing.

During 2000 the Scarborough Coastal Pollution Committee also found high coliform bacteria counts in Mill Brook. They sampled six test sites at seven times between June and September. Their goal was to eliminate the pollution so that 12 acres of clam-flats could be reopened. The results of the 2000 testing showed widespread coliform contamination but no source could be identified. See DATA TABLE 1 and Figure A-1 – Mill Brook 2000

The Maine Department of Marine Resources (DMR) works with the town of Scarborough to monitor coastal water quality in support of the local commercial clamming industry. Based on DMR test results, coliform bacteria have been polluting Mill Brook since at least 1992 and keeping that area closed to commercial clam digging. (Communication and data Laura Livingston, DMR)

PURPOSE AND GOALS

Our 2005 water quality testing project was undertaken to expand on the NEA testing for the coliform and zinc pollutants. If we could determine their sources eliminate them the results would be at least twofold. It would allow the completion of the Cattail Phase of the restoration project and open the clam-flats. In the past the Old Eastern Rail bed was used for marsh access by clammers and the occasional duck hunter. Due to the recent conversion of the rail bed to a public walking trail the area surrounding Mill Brook is now heavily used for recreation. Improving the water quality would benefit all uses.

METHODS

Water quality sampling occurred at 31 test sites in the Mill Brook during the summer of 2005. (See Figure A-2) To briefly describe the process: All samples were collected in sterile Whirlpak Bags and stored in a portable cooler at 4C for ≤ 2 hours before processing. Samples were analyzed for the presence of fecal coliform bacteria using the membrane filtration technique as described in **Standard Methods for the Examination of Water and Wastewater, 1995
Volunteer training in sample collection and processing was provided by the University of Maine Cooperative Extension: Clean Water/Partners in Monitoring during 2000. 100 ml samples were vacuumed filtered onto unique filters that allow water to pass through but retain any particles greater than 45 um on the filter surface including coliform bacteria. Each filter was then aseptically transferred to a sterile petri dish. The petri dishes contain a small amount of selective liquid media, which promotes the growth of coliform bacteria colonies and causes them to have a blue color. The petri dishes were incubated overnight at 44.5 °C in a constant temperature water bath incubator. After 24 hours the petri dishes were removed from the incubator and the number of blue colonies growing on the filter surface was recorded.

MATERIALS

Precision Water Bath Incubator, Calibrated by Q.C. Services, Inc., Harrison, ME
Gelman GN-6 47 mm Microbial Filters
Gelman Absorbent Media Pads
Petri dishes, plastic, 47 mm
pH 7.0 Phosphate Buffer Solution
Fecal coliform media, Fisher Scientific Cat#SC1M944H8
Lot #s H5DN88068 + H5EN95261
UV lightbox for filter flask sterilization
Isopropyl alcohol

RESULTS

Our water quality testing in Mill Brook during this study was atypical in that it was a scouting mission. Starting at NEA test sites 1, 3, and 6 identified as contaminated in 2004, we tested to reproduce their results. We renamed these sites 1, 2, and 3 for our study and included another sample site further up the Old Eastern that we called site #4. See Figure A-2 NEA 2004 and Volunteer 2005 Sampling Locations where yellow dots are NEA sites and green squares are our test sites. The coliform counts at the original NEA test sites were below 50 but the count at the new site #4 was over 100. See DATA TABLE 2 - Mill Brook 2005. Notice that the site numbers on the map correspond to the site name in column B on the data table.

Believing we were on the trail of something big we conducted many bushwhacking missions upstream from site #4. Our travels upstream from site #4, including test sites 5-13, led us all the way to the intersection of Commerce Drive and Rt#1 and gave consistently high coliform counts the entire way!

On other sampling trips we retested NEA sites 2 and 4, which were accessed from the other side of the marsh through Bayberry Rd. Our test sites in this area including numbers 24, 25, and 26 all gave counts greater than 100 colonies per sample. Our initial though was that we had found another hot spot and pollution source. An unfortunate sampling trip deeper into this cattail jungle, combined with some great mapping work by John McKinnon revealed that our two hot spots were connected and actually part of the same streambed.

Compare photo of ditch in field with Figure A-2 and Figure A-3. The contaminated stream can be traced from the salt marsh to Route 1. Figure A-3 also shows the connectivity of catch basins and outfalls. The first half of Data Table #2 includes results from the contaminated steam.
Insert Photo of Stream through field at R#1-SouthPointDitch
Insert Figure A-2 Mill Brook 2005 Sample Locations
Insert Figure A-3 Mill Brook Rt#1 Drainage

Results for other areas that we tested are given by section in the second half of Data Table #2 and include: NEA-2004 on Old Eastern Rd. Test Sites, Farm Pond and its' Outlet Stream Test Sites, Black Point Road Test Sites, Olde County Road Test Sites, and Bayberry Lane Test Sites. Data for all these areas showed low counts except for the Black Point pond which we found flowed the other direction, away from Mill Brook, not towards it.
Insert Photo of Pond on Black Point-BlackPointRdPond
Insert Photo of Stream on Olde County with Hanson children-OldeCountyRdStream

RESULTS

Coliform bacterial counts at the 16 sites on the contaminated stream were on average 153 colonies per 100 ml sample. All other sites were consistently lower with an average of only 33 colonies per 100 ml sample. The low counts can be attributed to local animal populations. The consistent high counts in the contaminated stream are more of a cause for concern.

Insert GRAPH 1 – MILL BROOK 2005

We also retested NEA site MB5 where high concentrations of zinc (0.106 mg/L) had been reported in 2004. We collected one sample upstream and one sample downstream from MB5 on September 9, 2005. The samples were collected according to instructions provided by Katahdin Analytical Services using containers provided by them. The samples were then analyzed by Katahdin Analytical Services. The zinc concentration was 0.034 mg/L above and 0.025 below MB5. This does not reproduce the toxic levels seen in 2004. We repeated the testing again on September 27th and the results were similar; 0.025 mg/L above and 0.025 mg/L below test site MB5.

Notes on Data Tables: Data tables include total colonies counted in each sample in column I, but lots of other information too. Included are test date and site #, air and water temperatures, weather info, names of the people who collected the samples and observations they made that day. Plates with 40 or more colonies were recorded as TNTC (Too Numerous To Count). Samples found to have high colony counts were routinely run in duplicate on the next sampling date, once undiluted and a second time by filtering only 10mls of sample with 90 mls of sterile buffer solution, i.e. diluted. For diluted samples the data tables show the number of colonies counted, the dilution factor, and the total colony count (=# counted times dilution factor). Undiluted samples are given a dilution factor of 1 for consistency. All original field data sheets and data tables for the 2000 and 2005 studies will be preserved by Dick Harvey in his web-based data site: Mill Brook, Understanding our Watershed.

CONCLUSIONS AND RECCOMENDATIONS

Increased use of lands adjacent to Scarborough Marsh for recreation and residential housing brings the issue of water pollution to the forefront. Homeowners and visitors alike want to enjoy the marsh for its natural beauty; but invasive plants and polluted streams create an eyesore and a plague on the aquatic habitat. Mill Brook has a long history of water pollution as this and many other test programs have shown. This pollution issue, which was known by clammers and DMR, is now general knowledge among conservation groups and recreational visitors and all want to see a solution. This long phase of testing should end and remediation plans should be designed and initiated. Representatives from the town of Scarborough including the Directors of Public Works and Sanitary District have reviewed the findings of this 2005 study and kindly contributed ideas for next steps.

The contamination stream described above should be the initial focus of remediation, although there may be other sources of pollution.

The Sanitary District was able to verify that 3 properties on Route #1 close to the contaminated stream are on septic and not town sewer. Test stations 12 and 13 are close to one of the properties and their colony counts were 240 and 150 respectively. Gary suggested that these counts do not represent what would be seen in the event of a failed system. Public Works provided Figure A-3 that shows culverts and ditches that drain towards the contaminated stream. None jump out as a possible coliform source except that during stormy weather large numbers of gulls congregate on the pictured vacant parking lots and runoff from their waste could be a factor, which was proposed by John Lyon. DNA fingerprinting of the coliform bacteria is recommended and would help to sort out whether the source is human or animal.

The Orion center across Rt#1 from the contaminated stream is undergoing redevelopment and a new residential development is planned for land adjacent to the Old Eastern.

It is the recommendation of this group and the town officials noted that these new growth projects described above should incorporate designs to detain the polluted runoff and prevent it from entering the salt marsh at Mill Brook.

REFERENCES

*Strategic Plan for Restoration and Enhancement of Important Habitats in Scarborough Marsh and Its Watershed, Normandeau Associates, Jan 2002

**Mill Brook Saltmarsh Restoration Project, Scarborough, Maine, A Partnership: Maine Department of Inland Fisheries and Wildlife, Friends of Scarborough Marsh, USDA Natural Resources Conservation Service, US Fish and Wildlife Service, Gulf of Maine Program, Corporate Wetland Restoration Partnership, National Fish and Wildlife Foundation, Ducks Unlimited, Inc., and SWAMP, Inc., 2002

***Mill Brook Salt Marsh Pre-Restoration Monitoring Addendum to the Data and Documentation Report-Water Quality Analysis, Prepared for US Fish & Wildlife Service Gulf of Maine Program and Friends of Scarborough Marsh by Northern Ecological Associates, October 2004

****Standard Methods for the Examination of Water and Wastewater, Eaton A., Clesceri L., and Greenberg A., pub: American Public Health Association, 1995, Section 9222.

Communication with Laura Livingston, DMR and review of DMR site #27 data

Communication: Mike Shaw, Director Scarborough Public Works Dept
(See Figure A-3 Mill Brook Drainage)

Communication Gary Lafarno, Director Scarborough Sanitary District

Communication Bob Mitchell: It seems likely that the two streams now joined under the name Mill Brook 2 may have once been known by separate names. Bob has recently communicated to us that the stream feeding into the more westerly basin was once called Moses Creek.