

BOIRE FIELD BROOK SUBWATERSHED PROJECT

***2000 Nonpoint Source Program
Local Initiative Grant***

December 31, 2001



Prepared by the



with funding by



This project was funded in part by a New Hampshire Department of Environmental Services Nonpoint Source Program Local Initiative Grant with in-kind services provided by the City of Nashua, Pennichuck Water Works, and NHDES Watershed Bureau.



PROJECT SUMMARY AND GOALS

The goal of the *Boire Field Brook Subwatershed Project* was to assess the impacts of stormwater runoff on a portion of the Boire Field Brook Subwatershed of the Pennichuck Brook Watershed. In addition, the project included a component to educate private landowners that maintenance of stormwater systems is their responsibility and that improperly functioning systems allow non-point source (NPS) pollutants to flow into the public drinking water supply. This study will be used as a case study to develop a citywide stormwater management program for compliance with the EPA Phase II Stormwater Regulations. Steps taken toward accomplishing this goal involved:

- An inventory of existing closed and open drainage systems
- Identifying data needs for planning and best management implementation
- Conducting an initial review of legal issues to enforce current regulations and improve maintenance standards
- Educating the businesses located in the drainage area on the negative impacts of NPS pollution, sedimentation and accidental spills on the City's public water supply
- Increasing public awareness of the link between the stormwater drainage system and the public drinking water supply through a storm drain stenciling program
- Encouraging local businesses to incorporate urban runoff best management practices in the designs of future development in the City
- Assisting private landowners with maintenance plans for systems on their properties

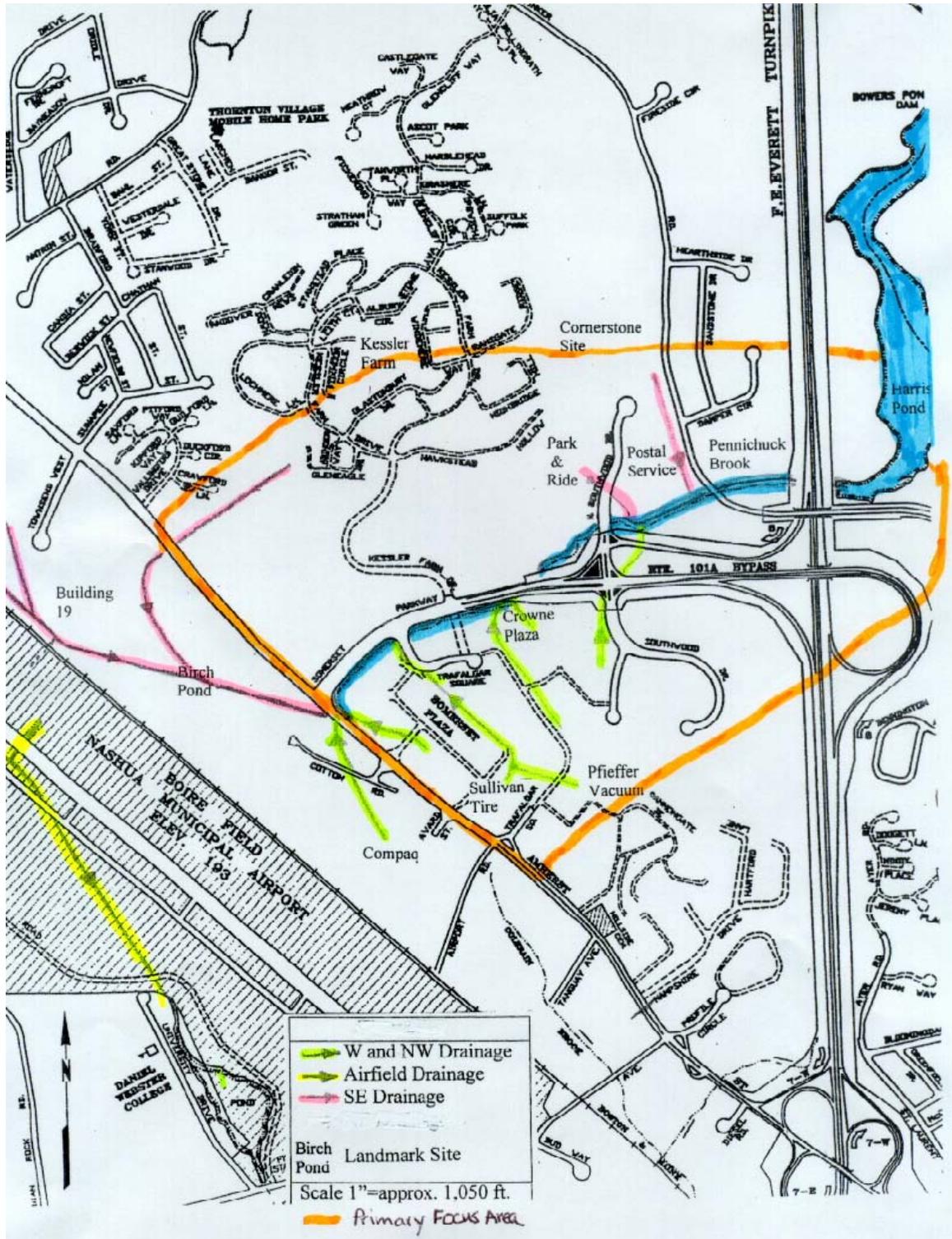
INTRODUCTION

The Pennichuck Brook system is the major water supply source for the Nashua region and serves as the primary source of water (approximately 75%) for the Pennichuck Water Works. The Boire Field Brook flows directly into Harris Pond, which is the closest pond to the Pennichuck Water Works treatment facility. The Boire Field Brook Subwatershed is impacted by urban runoff from industrial, commercial and high-density residential uses as well as the region's major transportation networks, the FE Everett Turnpike and NH Route 101A. The primary focus was along the Boire Field Brook from Amherst Street (Route 101A) along Somerset Parkway to Harris Pond (see Figure 1, Project Area).

In an effort to protect the region's water supply, the *Boire Field Brook Subwatershed Project* focused on inventorying and evaluating existing stormwater drainage systems. In 1999 and 2000, Nashua obtained new Geographic Information System (GIS) data for catch basins and other stormwater information derived from aerial photography. The existing data was field checked to verify accuracy and to account for possible omissions on the mapping. The City needed to evaluate existing data for completeness and determine what type of information will be necessary for a citywide stormwater drainage program for EPA Phase II compliance expected in 2003. The project also involved identifying areas for the construction of a larger treatment system similar to the one constructed behind the Technical College next to Holt Pond. This watershed will be used as a case study by the City of Nashua to prepare an effective citywide drainage plan.



Figure 1. Project Area





PROJECT TASKS

TASK 1 *Research, Inventory and Assessment of Existing Stormwater Drainage Systems in the Subwatershed*



Figure 2.

Sedimentation and Litter in Drainage Swale

NRPC and the City of Nashua Planning staff researched all site plans in the project area. A landowner mailing database was created and a letter was sent to the property owners/managers. The letter and mailing list is in Task 1 of the Appendix. The letter gave an overview of the project and requested permission to access the property to inspect stormwater drainage systems. The City of Nashua Planning, Pennichuck Water Works Engineering Department and NRPC reviewed the plans for potential areas to conduct wet weather water quality monitoring based on the age of the stormwater systems and their accessibility. Pennichuck and NRPC field checked the project area in April 2001. Two sites were chosen for sampling and all problems or deficiencies were noted at this time. Problems on private property were photographed and turned over to the City of Nashua Code Enforcement Department. The majority of the problems were clogged pipes, sedimentation and litter in drainage swales (Figure 2).

TASK 2 *Develop Database*

Assess the quality of existing data and determine what information will be needed for citywide stormwater compliance based on this sub-watershed.

A Geographic Information System (GIS) map was generated to show catch basin, flow direction, and public stormwater systems (pipes, basins and swales). Private stormwater systems were taken from individual site plans and incorporated into the map and database. A grid system was designed for the database but it proved too cumbersome and the scale was not useful. Rather, the database was designed to access property/stormwater drainage systems by the City Tax Assessors number, Sheet/Lot number or the street address. The closest street and directional indicator will identify swales. This will enable all City departments to access the information. Properties or area can be accessed by the Tax Assessors code or by Sheet/Lot number. The complete engineering summary is in Task 2 of the Appendix.

Recommendations

- Upon final approval and/or final inspection of a site plan, the Planning Department should forward the site plan to the Engineering Department for inclusion in the database before filing the plan with the Hillsborough County Registry of Deeds. This will enable the Engineering Department to automatically set a maintenance reporting schedule.
- Maintenance reports should be generated monthly to enable the enforcement entity to schedule visits or notification in the most time efficient manner.



- The City of Nashua should form a committee to discuss the role and personnel involved for enforcement of maintenance or remediation of stormwater drainage systems on private properties.
- A systematic inspection schedule of all citywide stormwater drainage systems should be developed and added to the database.
- When plans are submitted to the Department of Environmental Services (DES) for Site Specific Review, the DES project number should be reported to the Engineering Department for inclusion in the database.

TASK 3 *Legal Review*

An initial review of the City's rights to improve stormwater management on private property based on current regulations was completed. This includes annual maintenance (vacuuming catch basins), dredging swales or remediation measures based on field observation and water quality data collected during 2001.

This task is a brief review of the City of Nashua's legal rights to enforce existing and improved stormwater maintenance standards on private property. Existing regulatory measures, which could include stormwater maintenance standards, would apply in connection to new applications for land use control permits, such as subdivision and site plan applications. There is no means of imposing stormwater maintenance standards on unimproved land or on improved land whose improvements predate the stormwater maintenance regulations.

With respect to land approved for development since the effective date of the stormwater management regulations, stormwater management can be enforced to the extent that it has been required as a condition of the site plan approval. However, land approved for development by subdivision or site plan approval, but not yet actually improved before the enactment of the stormwater (or any other) regulations, is, to some extent, exempt from such regulations under RSA 676:12 and 674:39. The exception under RSA 674:39 is for "regulations and ordinances which expressly protect public health standards such as water quality and sewerage treatment requirements." This is a question of technical and scientific fact.

In addition to those regulations that are applicable to private development, the City may, of course, enforce stormwater management practices that are reasonably required to protect streets and other public infrastructure, provided that the City has obtained easements for that purpose. Finally, in the event that accumulations of water constitute a public nuisance, the City has the common law power to abate such a nuisance by legal action.

The City's current ordinances have been reviewed. When the City enacted ordinances concerning stormwater in December of 1998, it required stormwater management to be a part of every subdivision and site plan. For subdivisions, the applicant must submit a stormwater management report, signed by a state-registered engineer, detailing the stormwater practices used in the subdivision and their compliance with established stormwater management standards (NRO 16-107 (a)(15)). One of the subdivision approval factors is a review of the areas provided for detention, treatment, infiltration or other handling of stormwater (NRO 16-108 (b)(7)). There are also equivalent provisions for site plans, including the submission of a stormwater management report (NRO 16-122 (f)(13)) and an adequate means of handling stormwater runoff as a factor in approval (NRO 16-123 (b)(8)). Therefore, any subdivisions or site plans approved since December of 1998 should have enforceable stormwater management components in place, although they still may not be to the level or extent that may be desired in the future. The original legal summary is located in Task 3 of the Appendix.



TASK 4 Develop a Quality Assurance Protection Plan (QAPP)

The EPA final approval letter and signature sheet of the QAPP is in Task 4 of the Appendix.

TASK 5 Wet Weather Water Quality Monitoring

Wet weather water quality was measured at two (2) sites in the subwatershed. Water quality at the two sites was tested at the inlet and outfall of a new and an older open drainage system. The original results and receipts are in Task 5 of the Appendix. The new system is located at the Department of Transportation (DOT) Park and Ride Facility off of Somerset Parkway (Exit 8 of the FE Everett Turnpike) on North Southwood Drive. It was designed to be an infiltration system with an overflow pipe at the outlet (east end). Vegetation and sediment were present and therefore some trapping of sediment and nutrient uptake has occurred. The system is wide and deep and has the potential to hold water compared to the older system.



Figure 3. DOT Retention Basin Inlet



Figure 4. DOT Retention Basin Outlet (overflow)

The older system is located along Amherst Street (Route 101A) in the Somerset Plaza. The Plaza was built in the late 1980's. The swale collects water from 14 catch basins located on the main parking lot in front of the complex. The stormwater is hardpiped directly to the swale. The swale is heavily vegetated and filled with coarse-grained sediment. It is shallow, narrow and runs for approximately 100 feet before reaching the confluence of Boire Field Brook. It probably allows a great deal of sediment to flow into the Boire Field Brook due to lack of maintenance.



Figure 5. Somerset Plaza Swale Inlet



Figure 6. Somerset Plaza Swale Outlet (above confluence of Boire Field Brook)

During all sampling events, the older drainage swale at Somerset Plaza was tested first. The water moves through the system at a greater rate. Three of the four sampling runs caught the first flush.

Although petroleum hydrocarbons and metals may be a problem, we elected not to test for them due to the expense and scope of the overall grant. Rather, we wanted to get a very basic assessment of the water quality in the project area. Sampling was conducted for the following: 1) total suspended solids (TSS); 2) total Kjeldahl nitrogen (TKN); 3) total phosphorous (TP); and 4) *E. coli*. The four parameters were chosen for the following reasons:

- TSS - Large volumes of urban runoff flow from parking lots and other impervious areas in the watershed.
- TKN - Commercial fertilizer use and stagnating water is found in the subwatershed.
- TP - Commercial landscaping is prevalent and high numbers of waterfowl are found throughout the subwatershed.
- *E. coli* - The housing developments allow dogs, and waterfowl is attracted to the detention ponds near the Crown Plaza Hotel.

Total Suspended Solids (TSS)

The 1997 Stormwater Characterization study, conducted in Concord by NHDES, found a range of <1 to 146 mg/L with a study mean of 143mg/L for TSS. The samples at both sites ranged from <4 to 17mg/L which is well below the study mean of 143mg/L.

Total Kjeldahl Nitrogen (TKN)

This is a measure of inorganic ammonia nitrogen and total organic nitrogen. High readings indicate nutrient rich waters, generally characterized by high levels of biological production. In general, TKN and relative nitrogen species will be higher than phosphorus levels. Nitrogen is readily soluble and its levels usually increase as flow increases. The 1997 Stormwater Characterization study found a range of 0.53 to 13.7 mg/L with a study mean of 3.394mg/L. The samples at both sites ranged between 0.100 and 1.35mg/L, which is well below the study mean for stormwater.



Phosphorous-P

Phosphorous along with nitrogen is a plant nutrient that determines the amount of an alga growth that can occur. In freshwater in New Hampshire, phosphorus is considered the limiting nutrient. Phosphorus is not readily soluble and is more closely related to erosion. Phosphorus levels were extremely high throughout the season with a range of 0.050 – 0.211 mg/L. The level of concern established by NHDES is 0.02 mg/L. The season average at site 1 was 0.155 mg/L and site 2 was 0.074mg/L. Values >0.04 mg/L is considered excessive. The levels are indicative of the high levels of sediment and dissolved materials flowing through the swale.

E. coli

This bacteria is used as an indicator of human sewage but elevated numbers can occur in the presence of waterfowl or any other warm-blooded animal. The State of New Hampshire sets water quality standards for Class B waters. Designated uses for Class B waters includes fishing, swimming and other recreational purposes. The testing sites are not used for these purposes but are used to illustrate that the water flowing from these stormwater drainage systems enter into Class A waters which are designated drinking water supplies. Drinking water should have no *E. coli* after treatment. The acceptable level of *E. coli* is determined by risk analysis based on statistics to protect human health. *E. coli* levels at designated swimming beaches should not exceed 88 per 100 milliliter (mg/L) in any one sample, or exceed a three-sample average over a 60-day period of 47/100mL. Recreational waters that are not designated beaches should not have more than 406 *E. coli*/100mL in any one sample, or more than 126/100mL in a 60-day, three-sample average. Occasional higher numbers are not unusual, particularly after storm events and where urban or agricultural runoff occurs. These levels are generally not considered unsafe unless investigation indicates the source to be sewage. At both sites all tests exceeded 200mg/L.

September 14, 2001

This was the first rain event in approximately a month and the samples were collected late morning during the first flush. Rainfall readings at Pennichuck Water Works (Pennichuck) in Nashua registered 0.25 inches on the 14th. Due to the failure of ziplock bags during incubation, all bacteria samples for *E. Coli* analysis were lost. A duplicate sample for *E. coli* was taken at the Somerset Inlet but was also lost at the lab.

Analyte and Method	Somerset Inlet Pipe	Somerset Outlet Pipe	Park & Ride Inlet Pipe	Park & Ride Outlet Pipe	Detection Limit PQL
Total Suspended Solids 160.2	6 mg/L	17 mg/L	16 mg/L	9 mg/L	4 mg/L
Kjeldahl-N 351.3	0.486 mg/L	0.341 mg/L	1.23 mg/L	0.136 mg/L	0.100 mg/L
Phosphorous-P 365.2	0.209 mg/L	0.174 mg/L	0.099 mg/L	0.055 mg/L	0.050 mg/L
<i>E. Coli</i> SM 9213D	Lab Failure	Lab Failure	Lab Failure	Lab Failure	NA

September 21, 2001

This was the first rain event since the September 14th sampling. The samples were taken at 9 am approximately 9 hours after it started raining. Rainfall readings at Pennichuck registered 0.74 inches on the 21st. A duplicate sample was taken at the Somerset Outlet for TKN and Phosphorous since they use the same preservative (H₂SO₄). The lab did not process the duplicates even though they were listed on the chain of custody sheet.



Analyte and Method	Somerset Inlet Pipe	Somerset Outlet Pipe	Park & Ride Inlet Pipe	Park & Ride Outlet Pipe	Detection Limit PQL
Total Suspended Solids 160.2	8 mg/L	5 mg/L	5 mg/L	5 mg/L	4 mg/L
Kjeldahl-N 351.3	1.35 mg/L	1.3 mg/L	0.119 mg/L	0.186 mg/L	0.100 mg/L
Phosphorous-P 365.2	0.211 mg/L	0.183 mg/L	<0.050 mg/L	<0.05 mg/L	0.050 mg/L
E. Coli SM 9213D	>200 mg/L	>200 mg/L	>200 mg/L	>200 mg/L	0 Colonies per 100mls

September 25, 2001

This was the first rain event since the September 21st sampling. The samples were taken late morning during the first flush. A duplicate sample was taken at the Park & Ride Outlet for *E.coli*. Rainfall readings at Pennichuck registered a trace on the 25th and .63 inches on the 26th. The readings are generally taken in the morning, which would explain why only a trace was registered on the 25th.

Analyte and Method	Somerset Inlet Pipe	Somerset Outlet Pipe	Park & Ride Inlet Pipe	Park & Ride Outlet Pipe	Detection Limit PQL
Total Suspended Solids 160.2	<4 mg/L	5 mg/L	<4 mg/L	17 mg/L	4 mg/L
Kjeldahl-N 351.3	0.972 mg/L	1.11 mg/L	0.417 mg/L	0.769 mg/L	0.100 mg/L
Phosphorous-P 365.2	0.12 mg/L	0.124 mg/L	0.075 mg/L	0.122 mg/L	0.050 mg/L
E. Coli SM 9213D	>200 mg/L	>200 mg/L	>200 mg/L	>200 mg/L Duplicate >200 mg/L	0 Colonies per 100mls

October 15, 2001

This was the first rain event since September 14th sampling. The samples were taken at approximately 9 am. Rainfall readings at Pennichuck registered 0.21 inches.

Analyte and Method	Somerset Inlet Pipe	Somerset Outlet Pipe	Park & Ride Inlet Pipe	Park & Ride Outlet Pipe	Detection Limit PQL
Total Suspended Solids 160.2	5 mg/L	<4 mg/L	<4 mg/L	<4 mg/L	4 mg/L
Kjeldahl-N 351.3	1.28 mg/L	1.08 mg/L	<0.100 mg/L	0.643 mg/L	0.100 mg/L
Phosphorous-P 365.2	0.124 mg/L	0.091 mg/L	0.066 mg/L	0.073 mg/L	0.050 mg/L
E. Coli SM 9213D	>200 mg/L	>200 mg/L	>200 mg/L	>200 mg/L	0 Colonies per 100mls

TASK 6 Storm Drain Stenciling

The public storm drains in the project area were stenciled to increase awareness of the connection between stormwater runoff and the drinking water supply. This included all of the catch basins on Amherst Street from Sullivan Tire to Building 19. Somerset Parkway was stenciled from Amherst Street to North Southwood Drive. This accounts for 37 drains stenciled in the Project area. We did not receive any response to our offer to stencil the drains on private property. Since landowner permission was required, no drains were stenciled.



TASK 7 Landowner and Business Education Program

A packet was developed using existing information on NPS BMPs for landowners and businesses. Pennichuck Water Works developed flyers specifically for automotive and landscaping businesses. Each of the landowners and business complexes in the drainage area was mailed information on controlling NPS pollution, snow removal/storage and road salt. Specific maintenance programs were developed for the landowners based on field observations and water quality results. The mailing list is in Task 1 of the Appendix and the letter and educational materials are in Task 7 of the Appendix.

TASK 8 Identifying Sites for Future Treatment Measures

Identify sites with high sedimentation, failing systems and poor water quality for future treatment systems based on the field observations and water quality/sedimentation data.

On field visits within the Boire Field Brook Subwatershed there are three observations that relate to water quality. Most stormwater treatment devices appear to be overtaxed by sediment buildup. First, the removal of the sediment will add both longevity and treatment effectiveness (phosphorus adhering to particles) of the existing stormwater systems. There is no means of imposing stormwater maintenance standards on unimproved land or on improved land whose improvements predate the stormwater maintenance regulations of 1998. A systematic inspection schedule of private stormwater drainage systems could be developed using the existing GIS database. It is recommended that the City of Nashua should form a committee to discuss the role and personnel involved in identification of problems and enforcement of maintenance or remediation of stormwater drainage systems using health code or site plan violations.

Second, the chain of detention ponds and swales attract an abundance of waterfowl throughout the watershed. The ponds are a favorite lunch spot and workers enjoy feeding the ducks. Educational materials could be developed that explain that the waterfowl are the source of bacteria and phosphorus. Water quality is not the only issue; feeding bread to ducks is harmful to their health. Waterfowl can develop metabolic bone disease and other nutritional diseases. The City of Nashua should consider adopting an ordinance that prohibits the feeding of wildlife throughout the Pennichuck watershed.

Finally, another prevalent problem in the watershed is the improper storage and disposal of street sand. It is common practice to dump sand in a corner of a parking lot or in the drainage swales. The City of Nashua Public Works Department should undertake an educational mailing directed at contractors in the snow removal trade.

Specific problems noted for future improvements include:

- The swale on the south and east sides of Somerset Plaza needs to have the litter and sediment removed to allow for maximum nutrient uptake and retention of suspended solids in the stormwater. The City of Nashua Code Enforcement has been notified that parking lot sand and ripped fertilizer bags have been dumped into the swale.
- The Park and Ride infiltration basin appears to be leaking water at the base of the outfall pipe. This was observed during the four sampling runs. The water seepage does not allow the basin to fill beyond half a foot for maximum infiltration.
- The Exit 8 detention area is quite large and equipped with a control valve. The gate was in the upright position, which allows the water to flow untreated directly in Boire Field Brook just above the convergence of Pennichuck Brook. This is close to the water supply uptake pond at Pennichuck Water Work's Treatment Plant. The Department of Transportation will be notified.



TASK 9 Final Report

The final report was prepared by the Nashua Regional Planning Commission and reviewed by Pennichuck Water Works and the City of Nashua Engineering, Legal and Planning Departments.

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APPENDICES NOT INCLUDED IN DIGITAL VERSION