

Comprehensive Environmental Inc.

Study of Urban Non-Point Source Pollution Stump Pond Brook Subwatershed



PENNICHUCK WATER WORKS SUMMER/FALL 2002



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1.0 INTRODUCTION

In 1998, Pennichuck Water Works published a comprehensive Watershed Management Plan (Comprehensive Environmental Inc., 1998) that outlined remedial measures to improve and maintain the water quality of the chain pond system. One such measure recommended a detailed review of each of the subwatersheds, starting with the most impervious subwatershed, to identify best management practices that could be applied to minimize pollutant loadings from existing impervious surfaces and to prevent pollutant impacts from future development. This report focuses on one of the ten subwatersheds, the Stump Pond Brook (SPB) Subwatershed (see Figure 1-1). The project was funded jointly by Pennichuck Water Works and the New Hampshire Department of Environmental Services (NHDES).

The project involved a detailed assessment of the 1,500-acre SPB subwatershed to identify drainage patterns, drainage areas and water quality threats to receiving waters. This information was the basis for developing recommendations to minimize negative impacts to receiving waters. The overall approach to the study included the following:

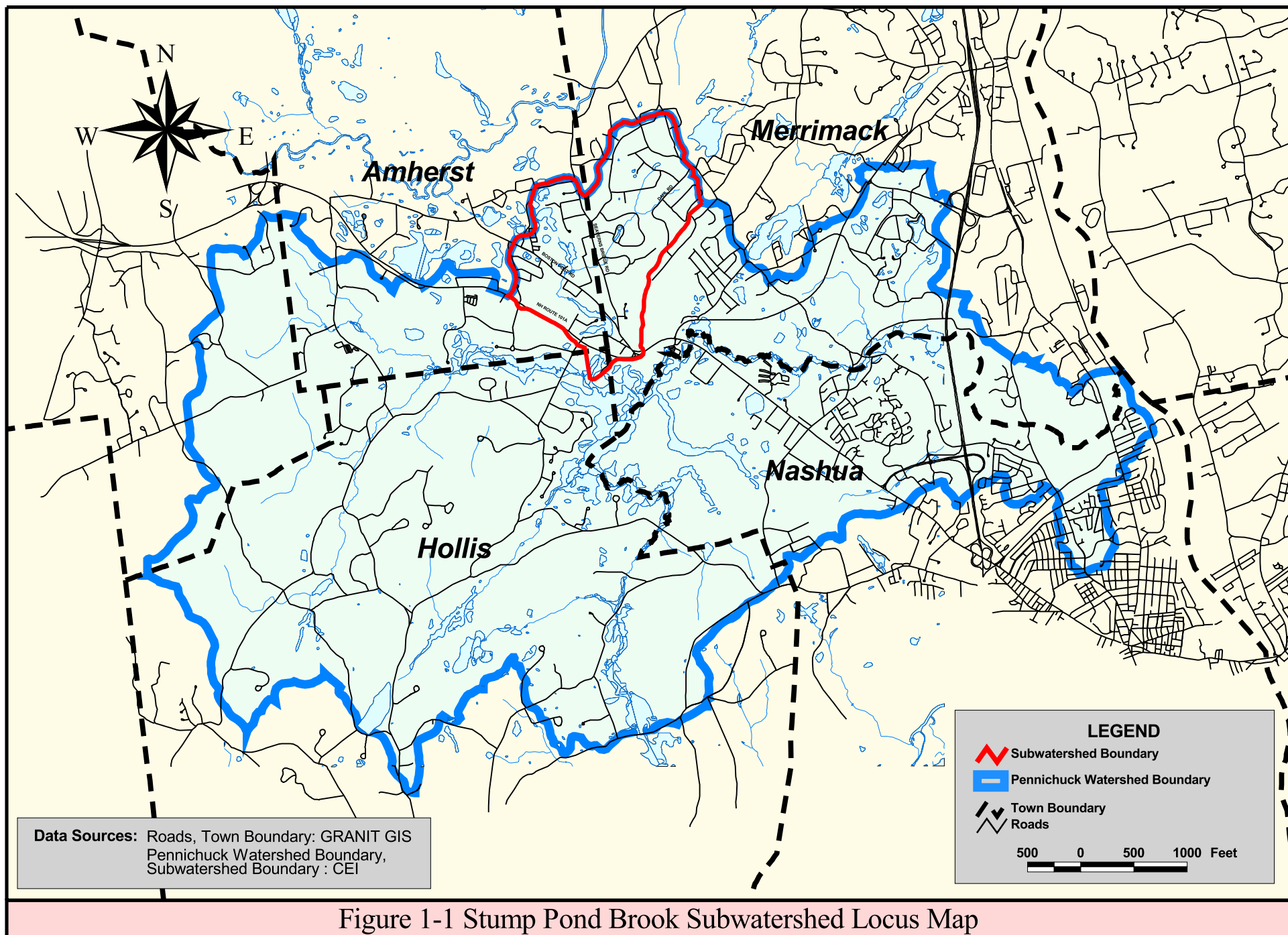
1. Subwatershed Drainage

It is important to understand subwatershed characteristics such as land uses and drainage patterns to effectively identify water quality threats and recommendations to alleviate these threats. CEI conducted detailed field review of the subwatershed during dry and wet weather conditions to identify the key water bodies in the subwatershed and to identify areas and activities contributing to contaminant loadings. A description of the receiving waters and drainage areas is provided in Section 2.0. Areas of concern identified are discussed in Section 3.0.

2. Recommendations

Based on the results of the field investigations, recommendations were developed to minimize threats to receiving waters in the subwatershed. The recommendations are divided into two categories: 1) site specific recommendations to address issues identified at specific sites during field investigations; and 2) general recommendations to address common problems found throughout the subwatershed. Recommendations are provided in Section 4.0.





2.0 SUBWATERSHED DRAINAGE

The Stump Pond Brook (SPB) Subwatershed comprises 1,500 acres, mostly located in Merrimack and Amherst, and primarily consists of residential development. CEI conducted a detailed review of the subwatershed during the 2002 summer and fall season to obtain a better understanding of drainage patterns and to identify water quality threats. Figures noted in the text can be found at the end of this section.

The SPB Subwatershed was divided into two drainage areas, A and B (Figure 2-1), which represent the northern and southern parts of the subwatershed respectively. These drainage areas form the tributaries that feed Stump Pond Brook. A description of each drainage area is described below.

2.1 Drainage Area A

Drainage area A represents the northern portion of the subwatershed and is shown on Figure 2-2. The primary land use in drainage area A is large, single-family homes. Catch basin and piped drainage systems used to collect and transport stormwater has altered much of the natural topography during residential development in several areas. Many of the homes are located in residential subdivisions such as the Williamsburg subdivision that is located on Dahl Road and shown in Figure 2-3. The runoff from the subdivisions in this area is contained through a variety of stormwater treatment methods such as grassy swales, detention ponds and storm drains.

Souhegan Outflow

At the intersection of Maryann Lane and Fields Farm Road, a small portion of the subdivision drains into the Fields Farm Road catch basins, draining downhill to the north into the Souhegan Watershed. While this area represents only a small fraction of the subwatershed, the implications are significant. The natural resource base that feeds the Pennichuck Water Works has been diminished. Precipitation that would normally have recharged the groundwater and fed intermittent tributary streams has been removed from the area altogether. This situation should be prohibited in future developments and existing developments that undergo drainage renovations.

Dahl Road Tributary

Within the eastern segment of drainage area A, Brek Drive, Kyle Road, and a large portion of Dahl Road feed a tributary that winds through the Williamsburg II subdivision before converging with the Four Winds tributary at the Hansom Drive culvert. The combined flow forms the main inlet for Amherst Pond.



Four Winds Tributary

Beginning at the northernmost tip of the subwatershed, Gauthier Road drains southwest toward Peaslee Road, which also drains southwest toward the wetland area on Everest Drive. This wetland area also accepts stormwater discharge from a series of catch basins that collect stormwater from the southeast end of Everest Drive. The majority of Four Winds Road and some of Blueberry Court feed the tributary that drains Everest Drive's wetland area. The Four Winds tributary joins Dahl Road tributary and continues under Hansom Drive toward Amherst Pond.

Bates Road Tributary

The portion of Bates Road that lies north of Charles Road drains to the south. Stormwater from Bates Road and fifty feet of Charles Road discharges on the second property south of Charles Road, feeding a small tributary that passes beneath Bates Road between Four Winds Road and Hansom Drive. The remainder of the Bates Road drainage feeds this tributary, along with Blueberry Court and a portion of Four Winds Road. Figure 2-4 shows Bates Road tributary crossing under Hansom Drive before entering the pond.

Stump Pond Brook

The outlet from Amherst Pond, shown in Figure 2-5, and the entire northwestern face of Cramer Hill, including Coles Rock Road, Cramer Hill Road, Landau Way and a portion of Hansom Drive contribute to Stump Pond Brook. Stump Pond Brook passes south, beneath Cramer Hill Road, then bears west beneath Seaverns Bridge Road (Figure 2-6). The brook receives stormwater from Seaverns Bridge Road (piped drainage) and from the Bates Road intersection to the discharge point at this crossing. Stump Pond Brook then continues under Aglipay Drive before intersecting the fourth tributary, Melody Lane tributary.

Melody Lane Tributary

From the north, runoff from Windsor Drive, Wildwood Lane, Woodbine Lane, Melody Lane and Junkins Lane flows into a vast wetland that drains into Melody Lane tributary. From the south, runoff from Aglipay Drive, part of Seaverns Bridge Road, and the north side of Boston Post Road flow into Melody Lane Tributary. Melody Lane Tributary combines with the Stump Pond Brook before passing beneath Boston Post Road to enter the SPB inlet wetland (Figure 2-7). Figure 2-8 shows Stump Pond Brook just north of the Boston Post Road crossing. At this crossing, drainage area A drains into drainage area B.



2.2 Drainage Area B

The southern portion of the subwatershed has been identified as drainage area B (Figure 2-9) and differs from drainage area A in land use, topography and by potential negative impact. The potential negative impact is greater due largely to the decreased distance and time that contaminants must travel before reaching Stump Pond Brook.

Drainage area B is bounded by Witches Brook East subwatershed to the West. The Northern boundary consists of Boston Post Road from the western boundary to Aglipay Drive. From the bend in Aglipay Drive it continues to the high point of Seaverns Bridge Road and on up the ridgeline between Cramer and Greenleaf to the top of Cramer Hill. The eastern boundary corresponds with the Southern ridgeline of the hill down to the eastern side of the intersection of Boston Post Road and NH Route 101A. The boundary then continues along the southern side of Route 101A and eastern side of Hall Ave to the confluence of Stump Pond Brook and Witches Brook. There is some commercial development along Route 101A in this area, creating a significant impervious area on either side of the road that uses an extensive stormwater collection system of catch basins. Some of the impervious area is tied into the state drainage system underneath Route 101A.

Western Drainage

Runoff from the western end of this drainage area, including Paul's Avenue and Douglas Drive, drains toward the SPB inlet wetland. Runoff from Boston Post Road drains to the south, along with much of Meadow Lane and the southernmost portion of Aglipay Drive. Stormwater from approximately 1800 feet of Route 101A to the east of Eastern Ave enters the state owned drainage system. This drainage also flows into the SPB inlet wetland.

The portion of Route 101A between the western part discussed previously and the intersection of South Merrimack Road is also collected by the state owned drainage system, but this discharges directly into the southwest portion of Stump Pond. The stormwater system discharge to Stump Pond is discussed further in Section 3.1.

Cramer Hill

Runoff from Cramer Hill flows onto Greenleaf Road where a portion of it flows through a wooded detention pond pictured in Figure 2-10. The pond's discharge then flows down the hill in a wooded channel that passes under Seaverns Bridge Road. Seaverns Bridge Road uses catch basins and culverts to divert drainage south. A portion of this drainage and the Greenleaf road stormwater flow through a small wetland area to another small pond that lies northeast of Boston Post Road. (Figure 2-11) Water leaving the pond outlet travels 100 feet, passing beneath Boston Post Road, before discharging to Stump Pond (Figure 2-12).



Craftsman Lane

A small portion of the area between Boston Post Road and Craftsman Lane drains south, across Craftsman Lane. Most of the drainage enters leaching catch basins. The remainder drains west, directly into the Stump Brook Pond. This area is described in more detail in Section 3.1 due to concerns about erosion and sediment loading.

The region between Craftsman Lane and Route 101A drains to the SPB outlet wetland surrounding Stump Pond Brook, south of the pond. This wetland also receives flow from the intersection of 101A with Boston Post Road via a series of catch basins within the intersection and a small portion of 101A. The drainage from that intersection is described in more detail in Section 3.1.

Confluence of Stump Pond Brook

The sparsely populated triangular tip of the drainage area that lies to the south of Route 101A includes Merrimack Village District wellhead No. 6. This well is located near the confluence of Stump Pond Brook and Witches Brook, which is the most downgradient point for all drainage within the SPB subwatershed (Figure 2-13).



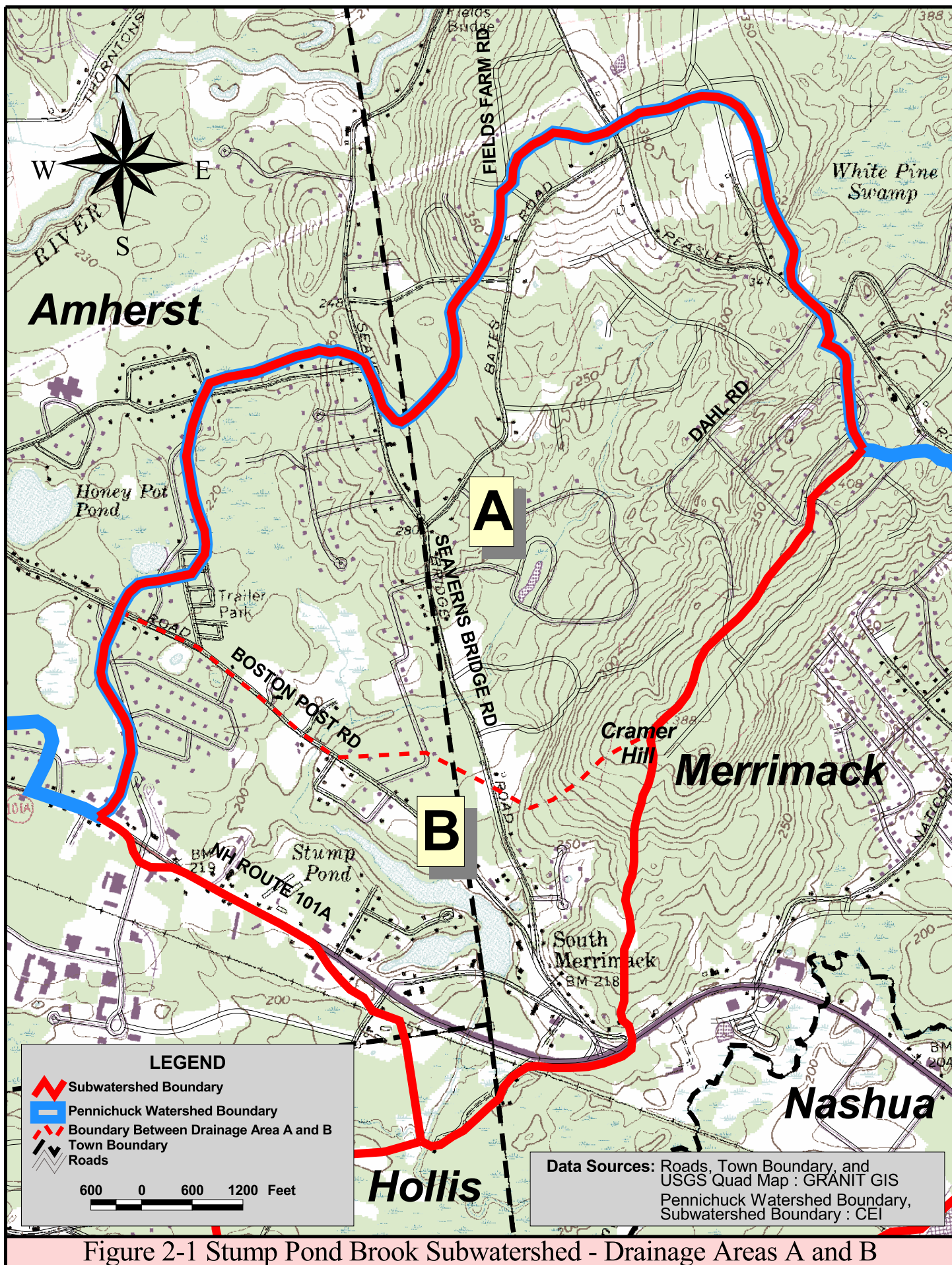


Figure 2-1 Stump Pond Brook Subwatershed - Drainage Areas A and B

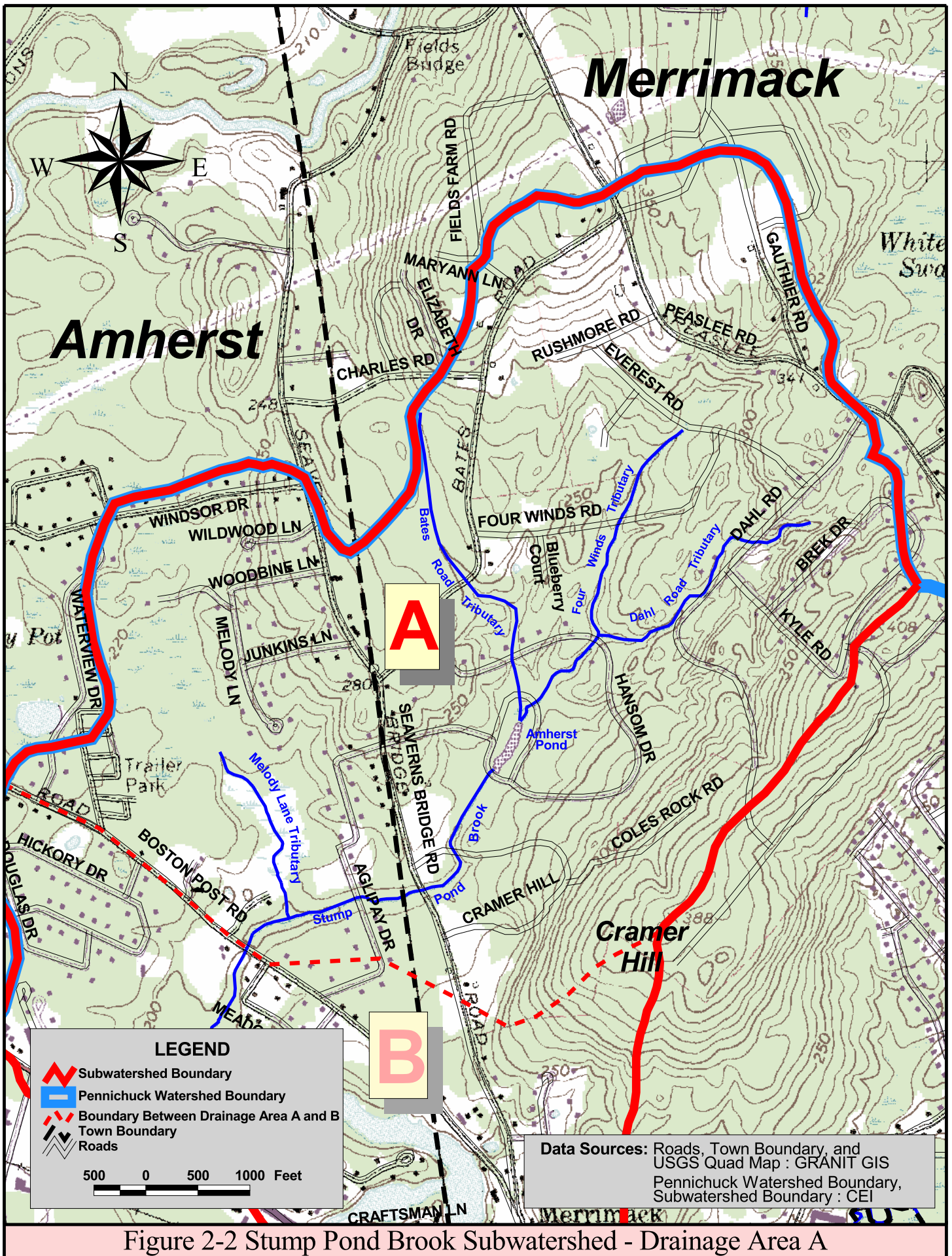


Figure 2-2 Stump Pond Brook Subwatershed - Drainage Area A



Figure 2-3. Typical Residential Subdivision on Dahl Road.



Figure 2-4. Bates Road Tributary Passing under Hansom Drive

Stump Pond Brook
Subwatershed



Figure 2-5. View of Amherst Pond Looking North from Hansom Drive



Figure 2-6. Stump Pond Brook Crossing under Seaverns Bridge Road

Stump Pond Brook
Subwatershed



Figure 2-7. Wetland Area Surrounding Stump Pond Brook
(Looking south from Meadow Lane)



Figure 2-8. Stump Pond Brook (looking north) Upgradient of Boston
Post Road

Stump Pond Brook
Subwatershed

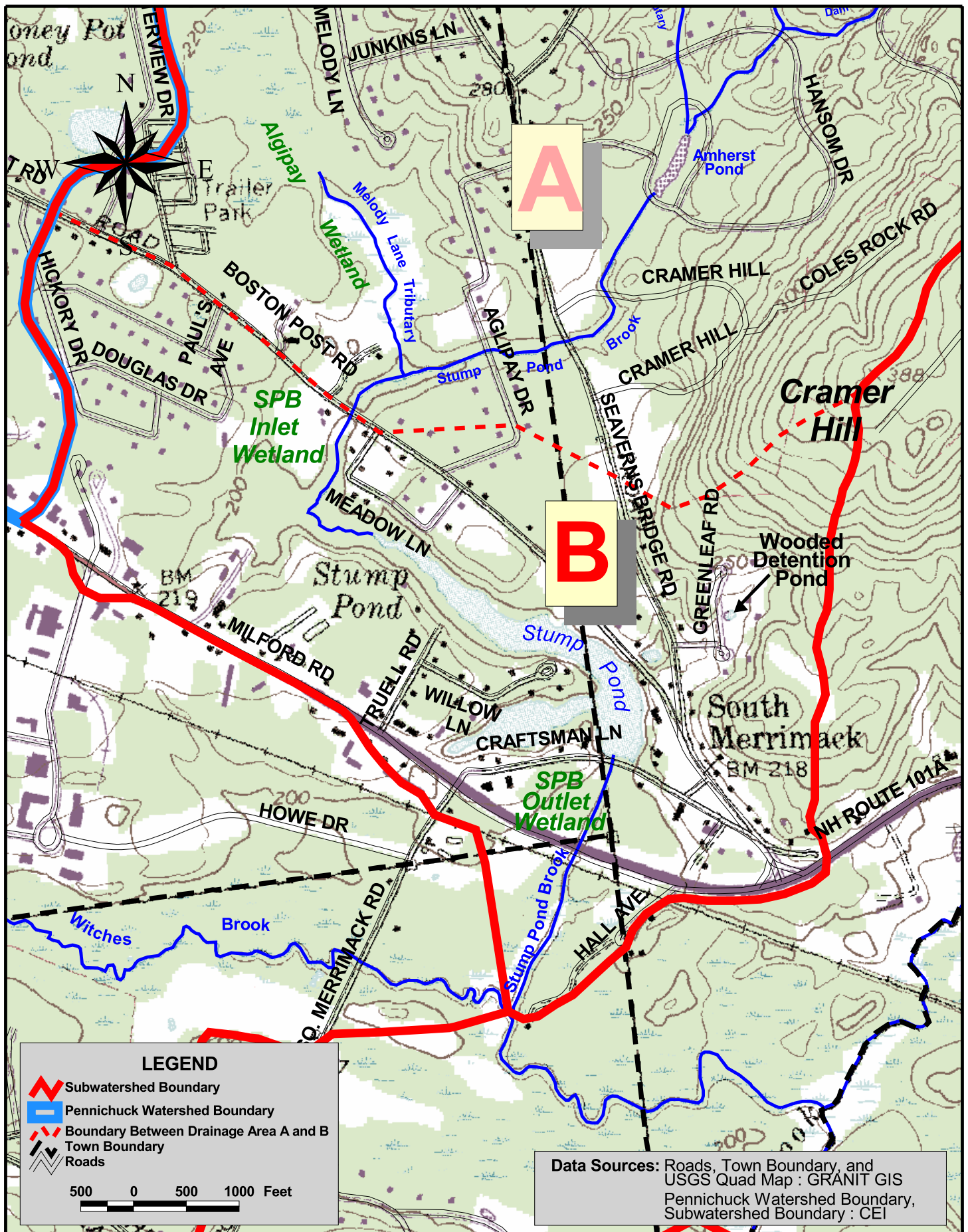


Figure 2-9 Stump Pond Brook Subwatershed - Drainage Area B



Figure 2-10. Wooded Detention Pond on Greenleaf Road



Figure 2-11. Small Unnamed Pond Across from Greenleaf Road Entrance

Stump Pond Brook
Subwatershed



Figure 2-12. Sump Pond Looking West from Boston Post Road



Figure 2-13. Confluence of Stump Pond Brook and Witches Brook

Stump Pond Brook
Subwatershed

3.0 Areas of Concern

Specific areas of concern that CEI discovered during field investigations are described in Section 3.1 below. General issues of concern that apply on a subwatershed-wide basis are found in Section 3.2. Figures noted in the text can be found at the end of this section.

3.1 Site Specific Concerns

Three site specific areas of concern were identified in the subwatershed. All three were located in Drainage Area B (Figure 3-1).

3.1.1 Route 101A Discharge to SPB Wetland

Sediment transported from this area of Route 101A is slowly filling in the Stump Pond Brook (SPB) outlet wetland, effectively reducing the natural settling and filtering processes that protect water quality downstream. Stormwater generated on the impervious surfaces at the intersection of Route 101A and Boston Post Road is collected in nine catch basins that drain to a twenty-four inch reinforced concrete pipe. Six more catch basins collect the runoff from an 800-foot section of 101A west of the intersection. All of these basins connect to the same twenty-four inch pipe that discharges runoff into a short channel that leads to the SPB outlet wetland (Figure 3-2 and 3-3).

Another source of stormwater to the Stump Pond outlet wetland is overland flow not captured by the catch basins. The majority of this water will enter as sheet flow leaving the road surface downgradient of the last two catch basins (Figure 3-4). While some infiltration occurs in the sandy soils that underlie the shoulder, it appears that much of the runoff flows through at a significant velocity during large runoff events. There is little vegetation on the road's shoulder most likely due to road salt, winter plowing and from recent grading activities.

3.1.2 Craftsman Lane Bridge

Stormwater runoff from portions of Craftsman Lane is washing sediment and non-point source pollutants such as vehicle fluids directly into Stump Pond Brook. Craftsman Lane crosses Stump Pond Brook at the pond's outlet. Stormwater runoff flowing east and west of the outlet travels down the road shoulders toward the bridge entering Stump Pond Brook. The road shoulders are very sandy and large quantities of sediment are being transported by stormwater along this path into the brook (Figure 3-5). Portions of the flow are diverted into wooded slope areas where sediment deposits lead to the brook. Some runoff is generated on the opposite shoulder, which crosses to the southern side of the road once it reaches the bridge. The ground around the road culvert has been paved over to reduce bank erosion caused by runoff (Figure 3-6).

3.1.3 Route 101A Discharge to Stump Pond

Sediment and non-point source pollutants from Route 101A enter the pond with very little treatment. Approximately 2100 feet of Route 101A contributes stormwater to two



pipes that discharge within 30 feet of Stump Pond at the bottom of a steep bank into a small marshy area (Figure 3-7, 3-8, and 3-9). Additionally, stormwater from a portion of the roof and the entire front parking lot (five catch basins) of the commercial plaza called Heritage Place (located directly across from the discharge point) is collected and discharged into the drainage system. High velocity flows have caused a foot deep gully to form between the outfall area and the pond. Drainage in this area includes stormwater from the 101A drainage system along with any areas that contribute overland flow.

3.2 Subwatershed Wide Concerns

The concerns discussed below were found throughout the SPB subwatershed.

Lawn & Landscaping Care

Several lush, green lawns were observed with some bordering streams. These high maintenance lawns tend to require greater irrigation and chemical (pesticides and fertilizers) use. The chemicals can be washed off the lawn degrading natural ecosystems and water quality downstream. Studies have shown that homeowners often over-apply lawn chemicals and/or incorrectly apply them before irrigation and rain events. Many pesticides are known or suspected carcinogens.

The natural buffers around streams were also reduced in some areas with lawns to the edge of streams. For example, the residential lawns in Rushmore Court extend to all corners of the property, including intermittent stream channels. Rushmore Court is just one subdivision of many that share this problem. Without buffers, sediment, lawn/landscape chemicals and non-point-source pollutants have a direct path leading into streams and wetlands.

Figure 3-10 and 3-11 demonstrates the difference between a healthy stream channel and a vulnerable one. It is remarkable that these two scenes are only thirty feet apart. The Seaverns Bridge Road resident has chosen to clear and establish a lawn right up to the edge of the water. This practice leaves little protection for the water body from runoff, the sun's heat, UV radiation, pesticides and fertilizers that may be used by the resident. On the other side of the bridge, there are trees and healthy undergrowth providing shade, diverse wildlife habitat, soil stabilization and nutrient uptake to protect against runoff. While this site provides a rather stark example of buffer loss, the entire subwatershed faces the water quality threat of buffer loss.

Unstable Roadside Shoulders

Throughout the subwatershed, unstable roadside shoulders are eroding and washing into nearby wetlands and waterways, eventually reaching Stump Pond Brook. A dramatic example can be found at the bend in Willow Lane. Unstable shoulders on both sides of the road contribute a large amount of sediment to two nearly clogged catch basins that discharge to a short, steep slope fifteen feet from Stump Pond. (Figures 3-12, 3-13) There is no vegetated buffer on the slope and as a result, runoff has scoured the bare ground, washing the soils into the pond.



Surface Disturbance

Lawn and landscaping projects can expose large areas of soil to erosion, which do not currently fall within a local review process. Bare ground is much more susceptible to erosion and runoff without a natural vegetated or duff layer (leaves, twigs) to absorb and slow rainfall. Without roots or a duff layer to stabilize the soil surface, the runoff will more easily carve channels through the soil. As the channels enlarge, the flow increases, carrying even more sediment downgradient. The sediment can enter nearby waterways, degrading water quality.

A graphic illustration of the fate of sites without sufficient erosion and sediment controls was found on Wildwood Lane. The Wildwood Lane subdivision has a series of problems that culminate in the discharge of significant amounts of sediment to the wooded buffer area immediately downgradient of the subdivision. Wildwood Lane slopes down away from Seaverns Bridge Road. The first property on the south side of the Lane landscaped their lawn in May 2002. This lawn was only beginning to establish when spring rainstorms arrived in late May 2002. The freshly graded soil was easily eroded and a network of small channels formed as the sediment was carried off the property (Figure 3-14). A considerable portion of this sediment fell out of suspension where water was pooling in front of the next driveway, clogging that culvert (Figure 3-15). The runoff overtopped the driveway and carved a wide channel through the neighbor's property before slowly dissipating in the wooded buffer at the end of the lane.



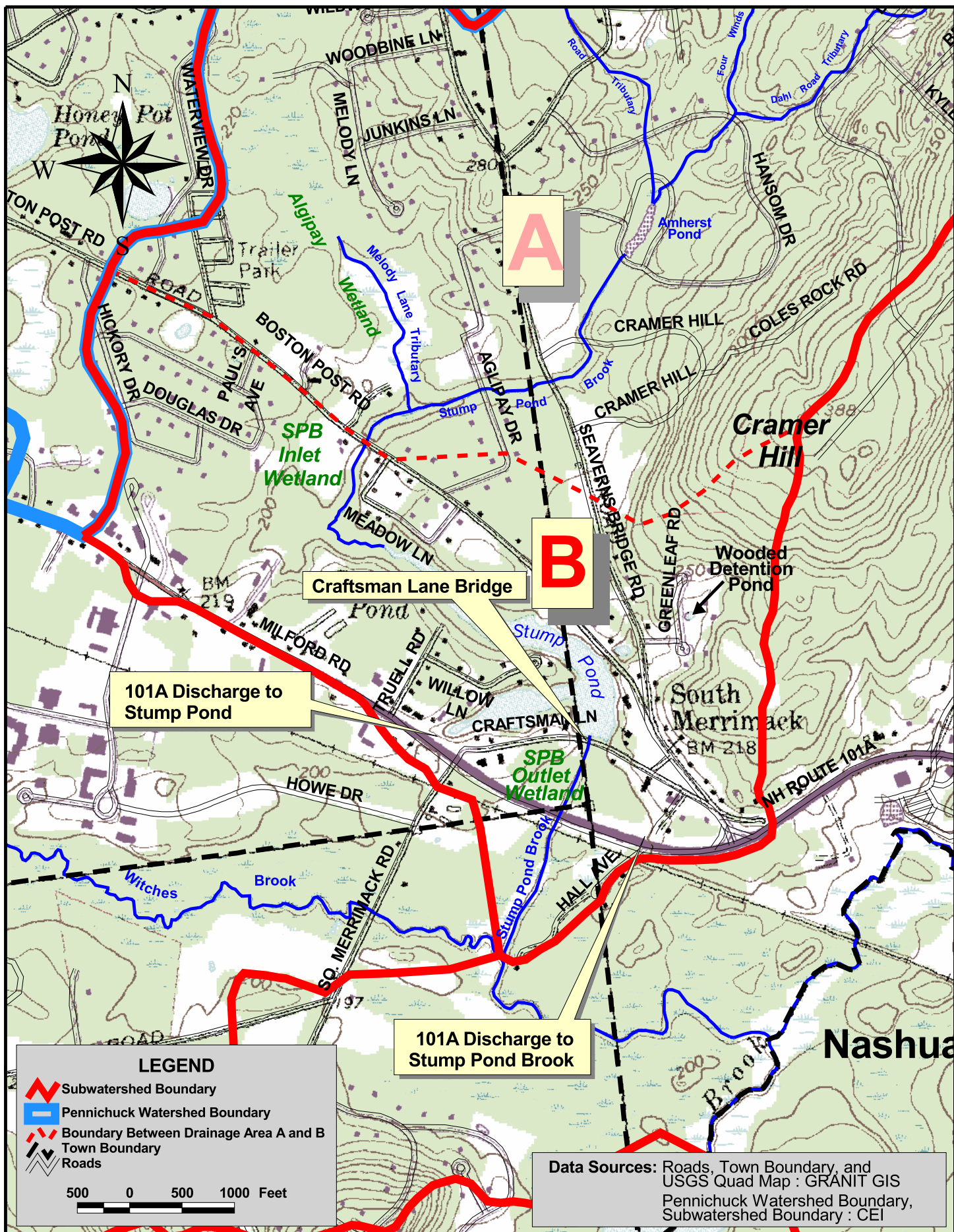




Figure 3-2. Route 101A 24” Discharge Looking Southeast Facing Road



Figure 3-3. Route 101A 24” Discharge Upgradient of the SPB Outlet Wetland (Note heavy sediment deposits at pipe bottom)

Stump Pond Brook
Subwatershed

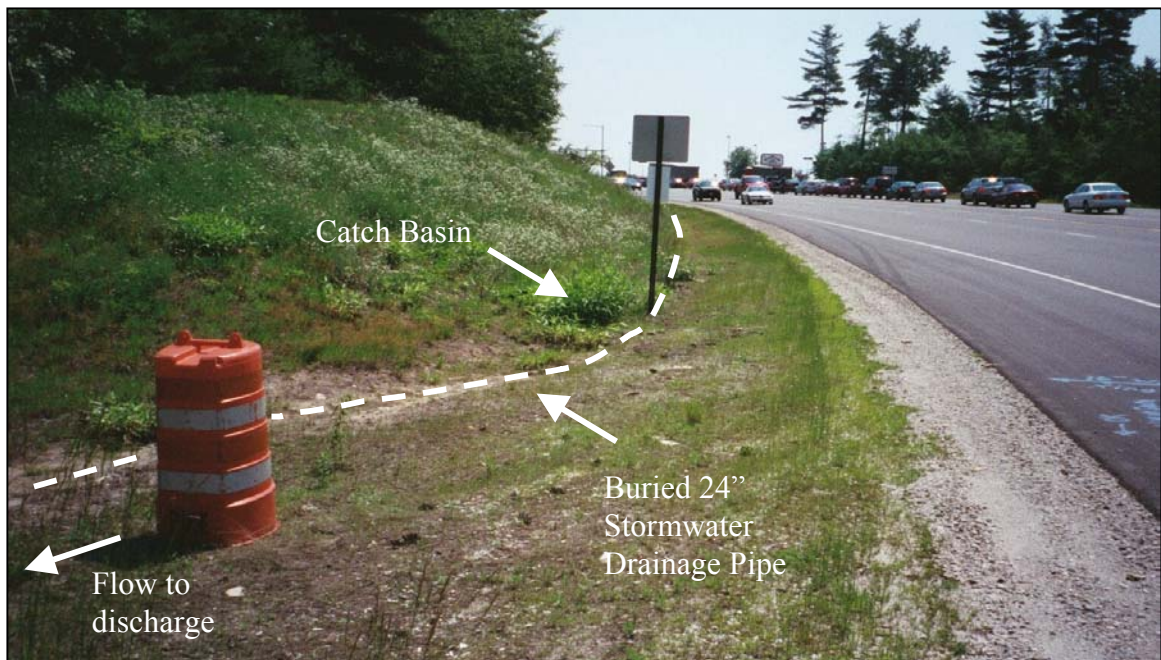


Figure 3-4. Shoulder of Route 101A Upgradient from 24" Discharge Pipe

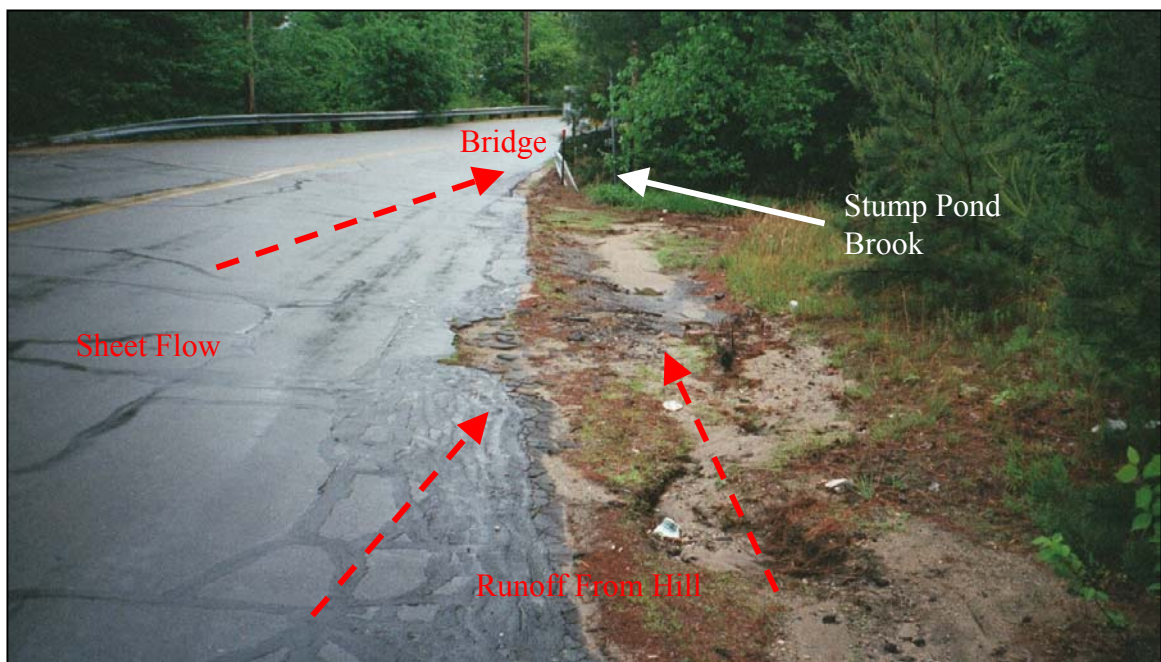


Figure 3-5. Shoulder on Craftsman Lane Eroded by Stormwater

Stump Pond Brook
Subwatershed



Figure 3-6. Asphalted bank Around Culvert of Craftsman Lane Bridge



Figure 3-7. Route 101A Discharge to Stump Pond Facing Road

Stump Pond Brook
Subwatershed



Figure 3-8. Route 101A 24" Discharge Pipe



Figure 3-9. Route 101A Discharge to Stump Pond Facing Pond

Stump Pond Brook
Subwatershed



Figure 3-10. Stump Pond Brook Channel with Buffer



Figure 3-11. Stump Pond Brook without Buffer

Stump Pond Brook
Subwatershed



Figures 3-12. Clogged Catch Basin on Willow Road



Figure 3-13. Willow Road Drainage Discharges into Stump Pond
(Steep unstable bank is being eroded)

Stump Pond Brook
Subwatershed



Figure 3-14. Scouring of Recently Seeded Lawn on Wildwood Lane



Figure 3-15. Wildwood Lane Clogged Driveway Culvert

Stump Pond Brook
Subwatershed

4.0 RECOMMENDATIONS

Based upon a thorough review of the subwatershed and evaluation of potential problem areas, recommendations were developed to minimize threats to receiving waters in the subwatershed. The recommendations are divided into two categories:

- 1) Site specific recommendations to address issues identified at specific sites as outlined in Section 3.1 and,
- 2) General recommendations to address common problems found throughout the subwatershed as discussed in Section 3.2.

Figures noted in the text can be found at the end of this section.

4.1 Site Specific Recommendations

Three recommendations are made in this section to address the areas of concern identified in the subwatershed. Refer to Figure 3-1 for locations of the sites.

4.1.1. Reduce Pollutant Loadings to Stump Pond

The Problem:

Sediment and non-point source pollutants from Route 101A and the Heritage Place commercial plaza enter the pond with very little treatment. Two pipes discharge stormwater within 30 feet of Stump Pond at the bottom of a steep bank.

Recommendation:

Construct a small sediment forebay and vegetated swale with check dams to slow stormwater velocity trapping sediment as described below.

1. Sediment Forebay

A shallow sediment forebay constructed with the headwall structure would reduce flow velocities and precipitate many suspended particles before allowing water to enter into the pond. For ease of maintenance, a cement slab should be poured within the boundaries of the headwall structure. Gabion check dams (riprap held in place with heavy wire mesh) placed downgradient of the headwall will disperse stormwater flow energy and trap sediment. Figure 4-1 is a conceptual drawing provided for the purpose of illustration.

A vegetated swale with two gabion check dams downstream of the forebay area will further slow and trap sediment before it enters the pond. These dams will serve as secondary treatment to the forebay, removing even more sediment. The check dams and swale will help prevent channeling.



2. Install Bio-cells and a Drywell at Heritage Place

Pennichuck should encourage the installation of bio-cells around the five catch basins located in Heritage Place plaza parking lot and a drywell to contain and infiltrate the roof runoff. Bio-cells are landscaped depressions designed to contain and infiltrate runoff. (plaza is located directly across 101A from Stump Pond) Excess water flows into the existing catch basins. Appendix B and C describe in more detail the design and operation of the bio-cell and drywell.

Implementation Details

Coordination with landowners will be important so that the installation of infiltration structures do not interfere with future curb cuts or access.

Cost Estimate

Construction cost: \$20,000

Maintenance cost: \$500 for annual repairs/maintenance

Property Owner:

Parcel: Route 101A Right-of-Way

Owner: New Hampshire DOT

1 Hazen Drive

Concord, NH 03301

4.1.2 Reduce Sediment Loadings into Wetland Near Boston Post Road

The Problem:

Runoff from Route 101A is discharged into a short channel that leads to the SPB outlet wetland. In addition, overland flow from 101A is eroding the adjacent shoulder. Sediment transported from this area of Route 101A is slowly filling in the Stump Pond Brook (SPB) outlet wetland.

Recommendation:

Stabilize road shoulder and install a constructed pond/wetland with sediment forebay to reduce sediment loading as described below.

1. Stabilize Shoulder

Road banks and shoulders contribute to the sediment load that enters the storm drain system. These areas, notably the areas on either side of Boston Post Road immediately past the intersection's curb, should be re-vegetated using loam and grass seed. Gravel should also be used to add further protection from erosion in pull off areas.



2. Constructed Pond/Wetland with Sediment Forebay

A pond/wetland basin with a shallow sediment forebay constructed near the current discharge point would reduce flow velocities, increase infiltration and precipitate many suspended particles before allowing water to enter the existing wetland. Figure 4-2 is a conceptual drawing provided for the purpose of illustration.

The structure should be excavated alongside Route 101A in the area between the current discharge point and the sixteen inch water main that lies approximately 63 feet upgradient. Discharge from the detention area will travel through the hooded outlet structure. If the system becomes overloaded, excess discharge will flow over the spillway into the existing channel to prevent water from encroaching on the road.

The hooded outlet structure will consist of a standpipe that is connected to the existing section of 24-inch pipe near the discharge point. The standpipe will accept water from near the water's surface in order to reduce the amount of suspended solids washing downstream. The hood will prevent floatables such as large objects or petroleum products from entering the standpipe.

3. Check Dams

Installation of two check dams downstream of the discharge pipe will further slow and trap sediment before it enters the wetland (Figure 4-2). These dams will serve as secondary treatment removing even more sediment. Check dams will also maintain a smooth controlled flow through the channel, preventing unnecessary scouring and streambed deterioration.

Implementation Details:

This site is situated on the inside of a curve in a reduced speed zone and there is a large bank directly uphill from the site. These conditions reduce the chance that a vehicle will slide off the road into the sedimentation area. In the unlikely event that a vehicle does, the slope of the basin walls will be four to one, which is gradual enough to avoid concerns about vehicle rollover.

Cost Estimate:

Construction cost: \$20,000

Maintenance cost: \$1000 for annual repairs/maintenance

Property Owners:

Parcel: Route 101A Right-of-Way

Owner: State of New Hampshire DOT
1 Hazen Drive
Concord, NH 03301



4.1.3 Reduce Erosion at Craftsman Lane Bridge

The Problem:

Stormwater runoff from either side of the bridge is washing sediment and non-point source pollutants into Stump Pond Brook. Additionally, stormwater is eroding the adjacent sandy shoulders of Stump Pond Brook.

Recommendation:

Stabilize road shoulders and install shallow containment swales and filter berms to reduce erosion and sedimentation as described below.

1. Stabilize Shoulder

The shoulders of Craftsman Lane on either side of the bridge should be stabilized with a durable material such as hand-placed riprap. This will reduce the sediment load and help prevent erosion.

3. Containment Swale

Containment swales should be installed on the shoulders of Craftsman Lane (on either side of the bridge) in the areas that are currently free of trees to capture and infiltrate the diverted roadside runoff (Figure 4-3). By working around the existing landscape, the impacts of the project will be reduced, resulting in less surface disturbance and habitat destruction. The swales can be dug with a loader and only need to be a foot deep. The grade should be sufficient to carry water away from the road. The swales should be constructed in a manner that will release excess water evenly across a wide path rather than one spillway, in order to reduce any scouring. Excess water will overflow into the surrounding vegetated areas. Appendix A describes in more detail the design and function of a containment swale. The proposed containment swale for this location is a simpler version of the one described in Appendix A.

4. Filter Berm

In order to minimize the stormwater entering SPB directly, a filter berm (coconut fiber bio-log) should be installed behind the existing guardrail from the bridge on both sides, redirecting water to the nearest containment swale described above. Some minor re-grading may be necessary to implement this portion of the design, but this could be accomplished quickly by hand.

Implementation Details:

Cooperation of landowners will be necessary to implement this project. Sediment deposits in the swales can be quickly removed with a bobcat or loader, restoring the original grade.

Cost Estimate:

Construction cost: \$6000

Maintenance cost: \$500 for annual repairs/maintenance



Property Owners:

The shoulder of the road is the jurisdiction of the Town of Amherst, while the bank and buffer areas are the property of Pennichuck Water Works and William & Eleanor Balcom.

Parcel: Amherst tax map 12, block 1
9 Craftsman Lane, Amherst, NH 03031

Owner: Pennichuck Water Works
4 Water St, Nashua, NH 03060

Parcel: Amherst tax map 12, block 2
7 Craftsman Lane, Amherst, NH 03031

Owner: William & Eleanor Balcom
10 Craftsman Lane
Amherst, NH 03031

Parcel: Craftsman Lane Right-of-Way
Owner: Town of Amherst Highway Department
Dodge Road
Amherst, NH 03031

4.2 General Recommendations

During the evaluation of the subwatershed, several common problems were noted. These included lawn care practices, unstable roadside shoulders and unregulated land disturbance. The following recommendations are provided to address these problems.

Educate the Public on Proper Lawn Practices

Educational brochures, workshops, and the Master Gardener Program are three approaches that can be used to influence homeowner behavior. These approaches are outlined in the Witches Brook North (WBN) Subwatershed report.

Provide Funding to Homeowners to Reduce Pollutant Impacts

Another option for reaching homeowners is to provide funding for homeowners to modify their properties in a manner that benefits the Pennichuck Water Works water resources. The appropriate project sponsor could be the local conservation commission. They could screen the applications for problem areas and determine to what extent individual projects merit funding. Then the proposals that offer the greatest water resource improvement for the money would be implemented each year. The results could be published as part of the educational outreach programs described in the Witches Brook North (WBN) subwatershed report.



Stabilize Roadside Shoulders

Planting vegetation such as grass and groundcovers suitable to the site conditions can stabilize roadsides effectively. Re-vegetation of roadsides provides root structure for soil stabilization, can enhance infiltration, beautifies the area and provides shade to keep the area cool.

In areas where re-vegetation is not possible, combinations of filter fabric, gravel and riprap can be used without reducing infiltration. However, these treatments lack the beneficial treatment provided by a healthy organic layer and can be expensive.

In some areas, the instability of the roadside is due to frequent traffic on the roadside. This is common on corners that people cut too closely, areas where people pull around left-turning traffic and pull-offs for popular recreational areas. In these situations, planting low growing vegetation barriers that will not obstruct vision, such as flowers or shrubs, less than three feet in height can prevent traffic on the shoulder without creating a hazard. For pull-offs, a gravel area may serve for parking spaces, with the remainder of the area planted with these vegetative barriers or fenced off to allow re-establishment of vegetation.

Encourage Stormwater Design Guidelines

Pennichuck should encourage towns to adopt new stormwater design guidelines if they haven't done so already. Stormwater guidelines help insure more consistent controls to stormwater treatment.



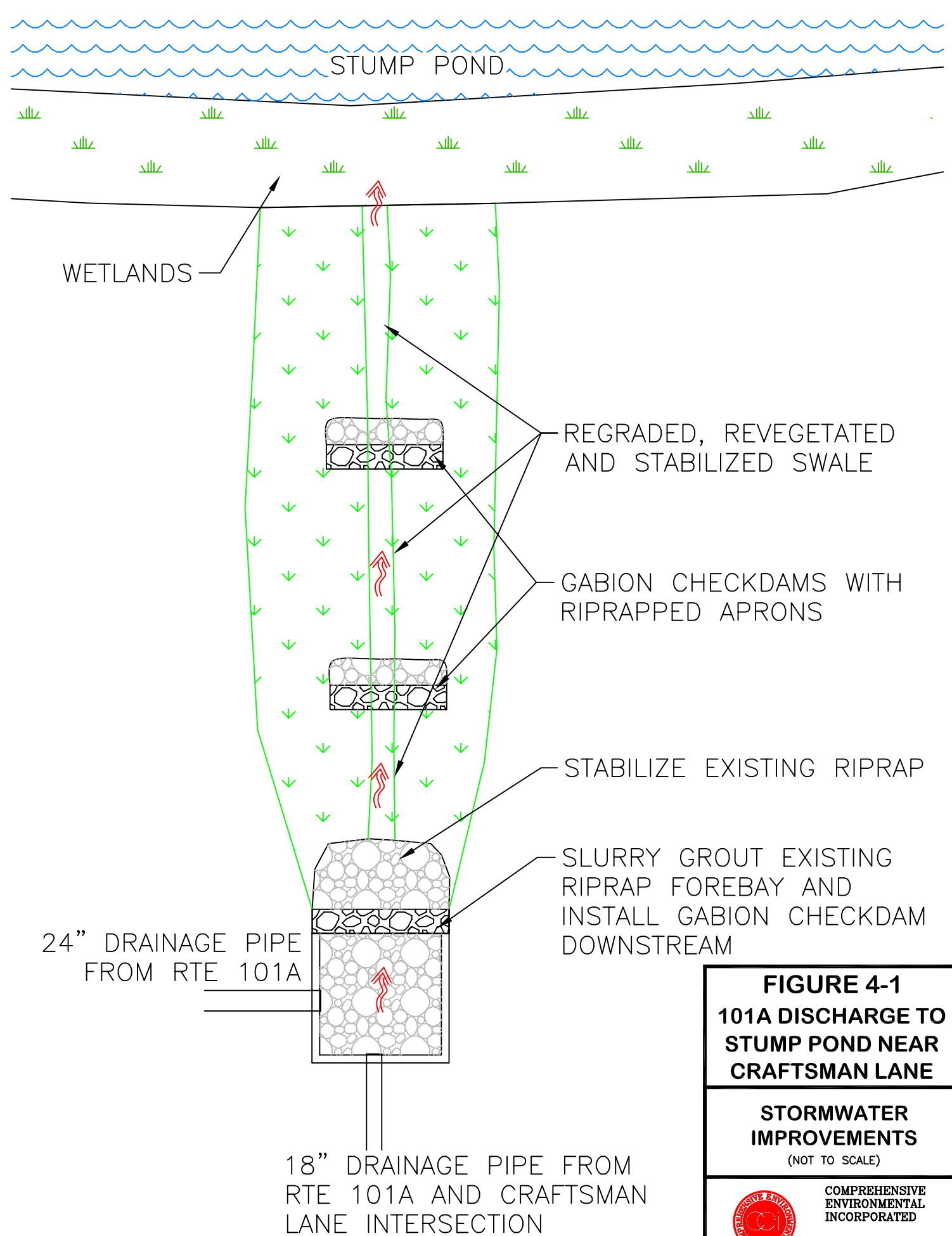
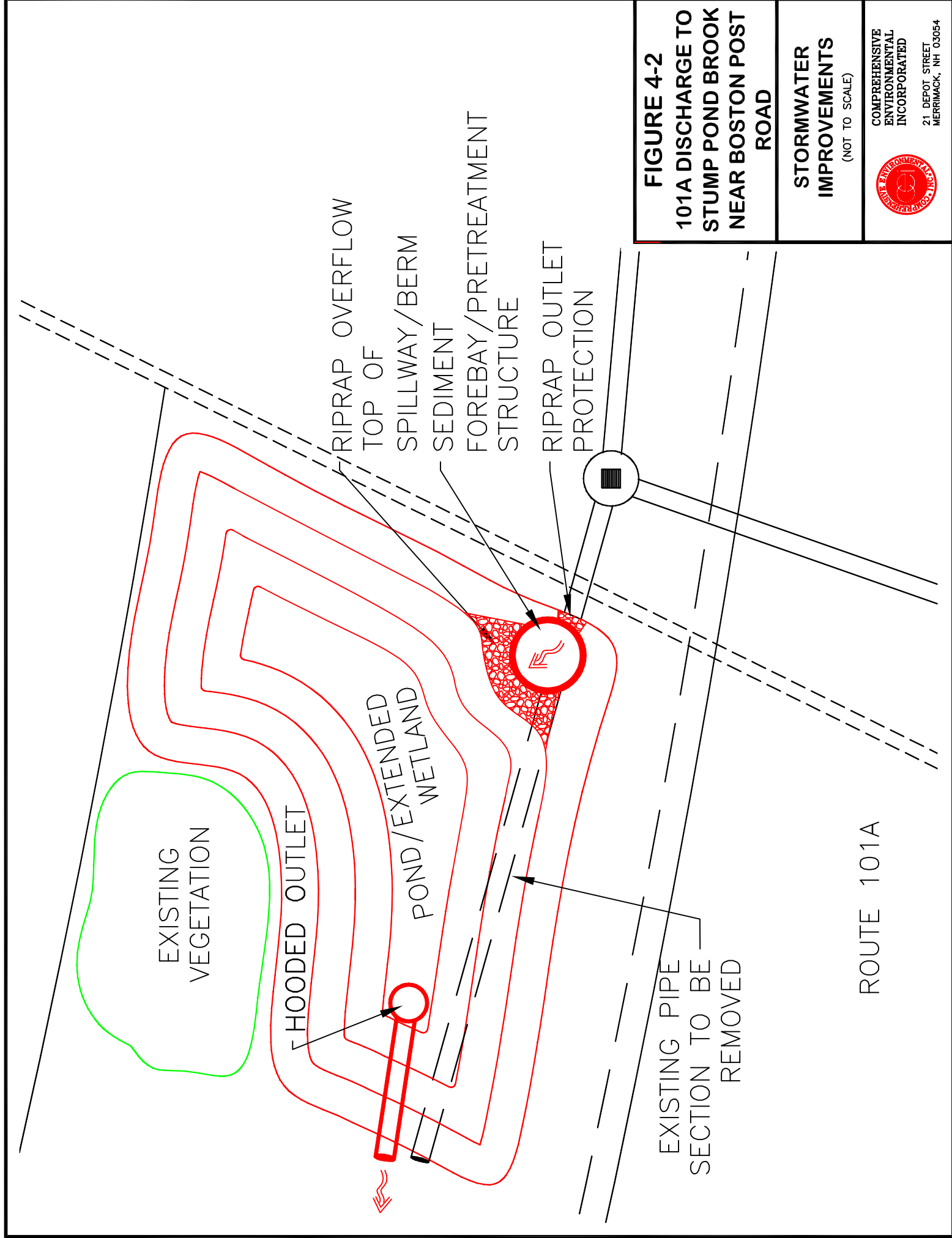


FIGURE 4-1
101A DISCHARGE TO
STUMP POND NEAR
CRAFTSMAN LANE

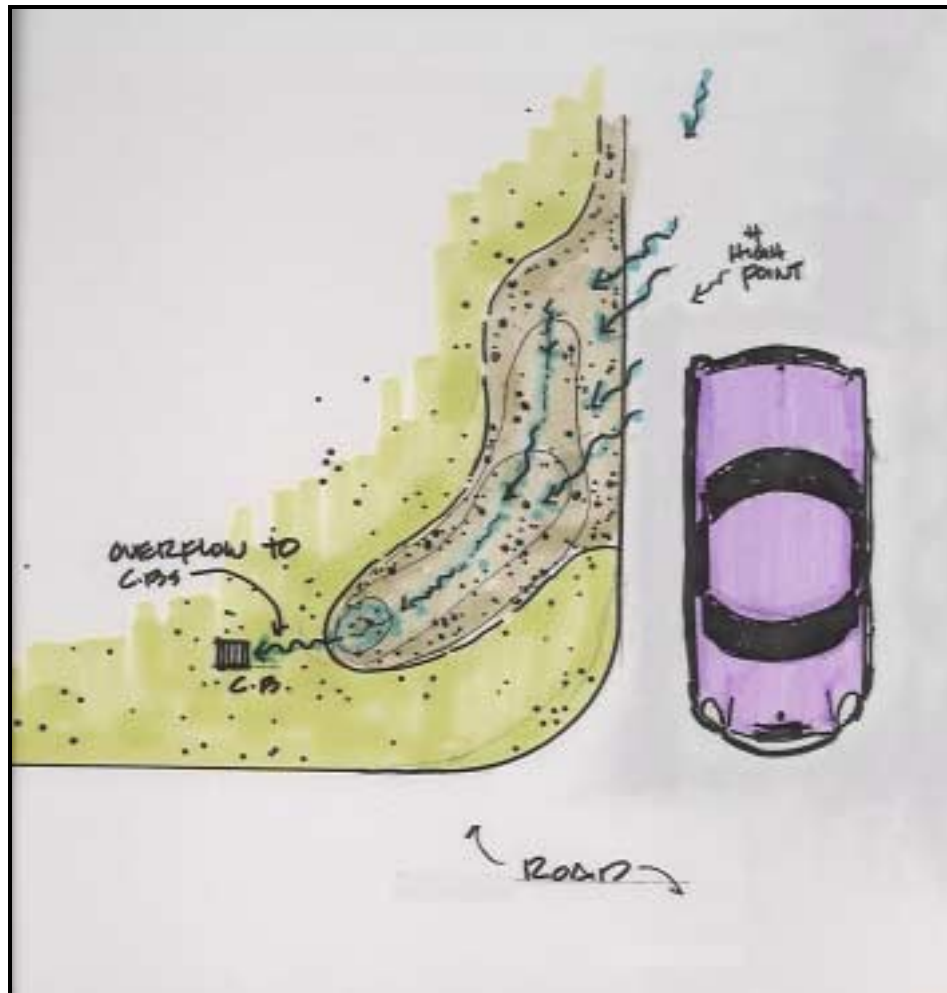
STORMWATER
IMPROVEMENTS
(NOT TO SCALE)



COMPREHENSIVE
ENVIRONMENTAL
INCORPORATED
21 DEPOT STREET
MERRIMACK, NH 03054



Appendix A – Containment Swale Design



Containment Swale

Description

A shallow depression located adjacent to a roadway shoulder that is used to capture and infiltrate roadway runoff and/or lawn runoff before it enters a catchbasin. Although similar to a typical swale, this RPM is designed to pond and infiltrate water to the maximum extent possible, rather than as a means of conveyance. Excess water overflows into a nearby catch basin.

Application

There are two applications for this design. The first would be to collect roadway runoff from a street without an existing curb and gutter system. The RPM is constructed along the edge of the street allowing runoff to enter into it before discharging to a downgradient catch basin. The second application is to collect runoff from lawn areas that would

normally flow into the roadway. The RPM could be installed between the lawn area and roadway. When the unit fills with water, it would overflow back into the street drainage system (as if the RPM had not been there).

Advantages

Roadside Stormwater Diverters are relatively inexpensive given the large amount of water that can be captured, treated, and recharged.

Disadvantages

Some road agents may be resistant to infiltrating water adjacent to a road's subgrade for fear of frost damage.

Design Considerations

Shoulder slopes should be maintained particularly in areas where the roadway is narrow and around corners.

Using an impervious barrier to shield a road's subgrade may be necessary to ameliorate concerns of frost heaves damaging pavement.

Maintenance

Sediment and accumulated debris should be removed in the Spring and late Fall after the leaves have dropped.

If stormwater ponds on the surface of the structure for longer than 48 hours after the end of a storm¹, the filter fabric pre-filter may be clogged. In this case, the filter fabric and material covering the upper most layer of filter fabric should be removed. Owners may then either replace both the filter fabric and the cover material or, alternatively, clean the clogging material from them. This material should not need to be disposed of at a landfill, however it should not be placed on an area that will be subject to runoff which might resuspend it.

The frequency of this rehabilitation will depend on the ratio of filter fabric surface to contributing drainage area, the amount of sand applied to the impervious drainage area, and the frequency with which preventative maintenance has been performed.

The Diverter should be inspected occasionally to make sure erosion is not occurring on any of its surfaces.

¹ This is a storm of normal duration during the growing season and would not include prolonged periods of rainfall, or spring thaw conditions for example.

Appendix B – Bio-Cell Design

Application

Other than scale, both Bio-RPMs may be used at a variety of sites. Their high organic component means that it can be used as a landscape focal point in a prominent location on the site, however infiltration rates may be compromised for the same reason. These systems (particularly the smaller Bio-cell) are better adapted to handling drainage from smaller, flatter, less “flashy” drainage areas.

Advantages

These systems provide a more complete habitat for beneficial microorganisms and thus excellent stormwater treatment can be expected. The high organic content and free form nature of the Bio-Island lends it to a wealth of colors and textures in the plantings. Separate planting zones within these structures can be created to support plants of complementing treatment efficiency and appearance.

Disadvantages

The trade off for having a higher organic content with greater planting choices is that the ability of the device to accept and quickly infiltrate water may be compromised.

Design Considerations

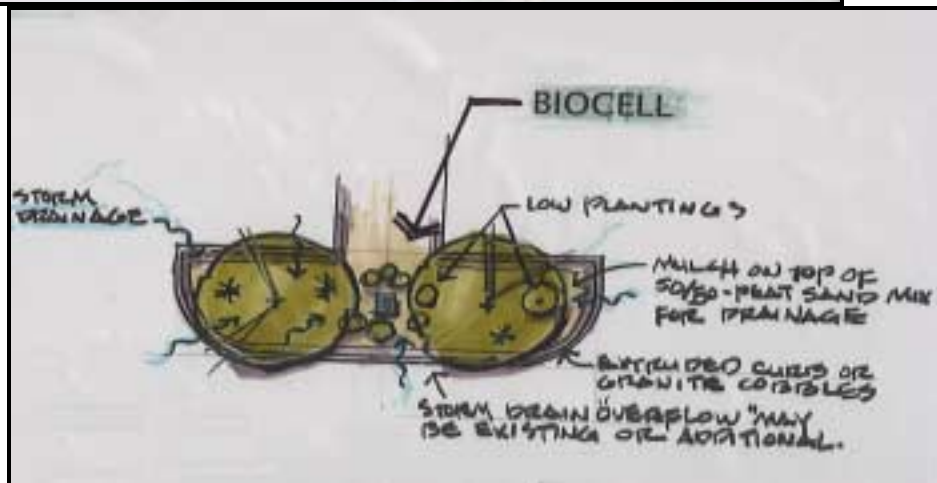
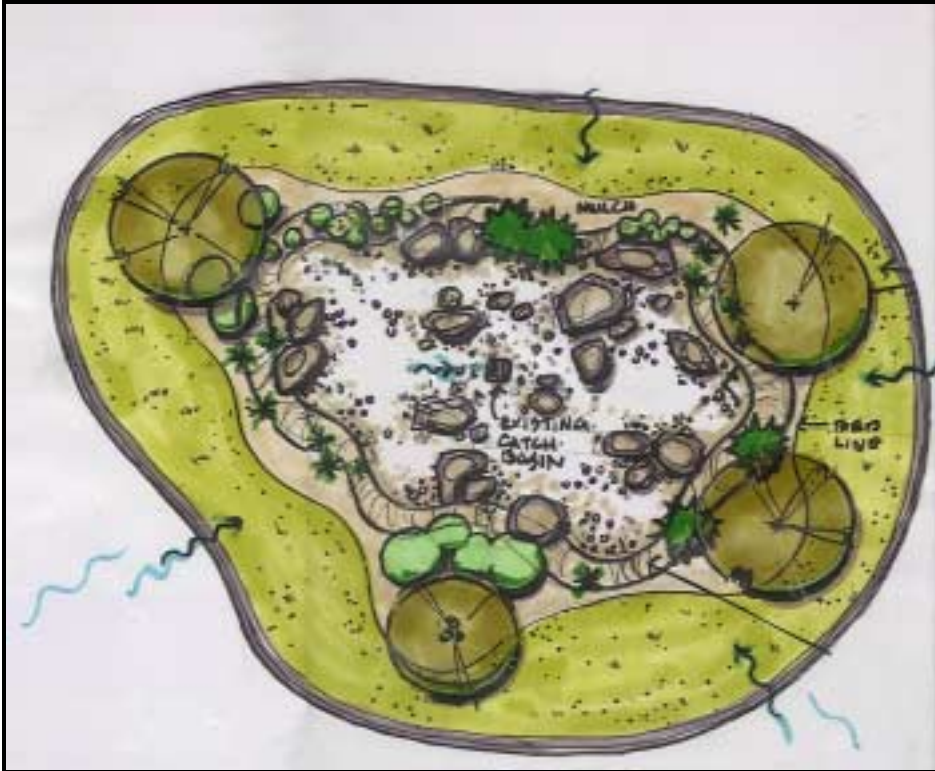
Care must be taken in estimating the proper storage volume within the reservoir area. Different blends of planting media (which occupy a substantial portion of the subsurface area) will yield considerably different available storage space.

When bark mulch is used for the surfacing material, fresh mulch is preferable to aged for nutrient assimilation. If shredded wood chips are used as a substitute, hardwood varieties are known to be less likely to float when the structure has surface ponding.

In the larger Bio-Island application, designers should note that two treatment areas are intended. The outer layer is meant to settle out and assimilate reasonable amounts of sand and the coarse grass is meant to act as a living leaf/debris rack. This enables the inner area to receive water that is relatively free of debris and particulates, and thus preserves the surface infiltration rate and prolongs the time needed between clean up.

Maintenance

The leaves that fall onto the surface of these structures can quickly form a surface barrier to incoming water and so a Spring and Fall clean-up is recommended. The higher maintenance frequency in these structures relative to other RPMs is a function of their landscaping requirements. Owners want these structures well maintained to preserve and support their planting investment for a number of years.



Bio-Islands & Bio-Cells

Description

An installation of varying proportions (Bio-Cell being small to medium in size and Bio-Island being a larger more centralized treatment and landscaping feature) that may be designed to support a wide variety of plantings and provides a beneficial “habitat” for pollutant removal.

Appendix C – Drywell Design

Drywells can be fully hidden from view. Because there are few above ground features, maintenance is minimal.

Drywells may be installed deep enough (below the frost line) that they would continue to infiltrate meltwater from roofs during the freeze thaw cycles that occur in late Fall and early Spring.

Disadvantages

Installations near foundations can cause leaky basements.

Design Considerations

Drywells have been historically used to capture water from one area and disperse it over another, however the drywells presented in this manual have a number of features that address weaknesses inherent in some of the past designs.

The improved drywells presented in this document utilize filter fabric to preserve the capacity of the leaching structure and stone reservoir. Early drywells were just stone filled pits with no protection against slumping and migration of the surrounding soil into the void spaces. A gradual reduction in capacity resulted. Small sinkholes or areas where the earth has settled are usually an indication that the drywell has failed. The use of non-woven filter fabric to completely encapsulate the stone reservoir area will prevent both of these conditions. The common practice of using straw as a pervious separation barrier is discouraged since over time it can consolidate and form a semi-pervious layer.

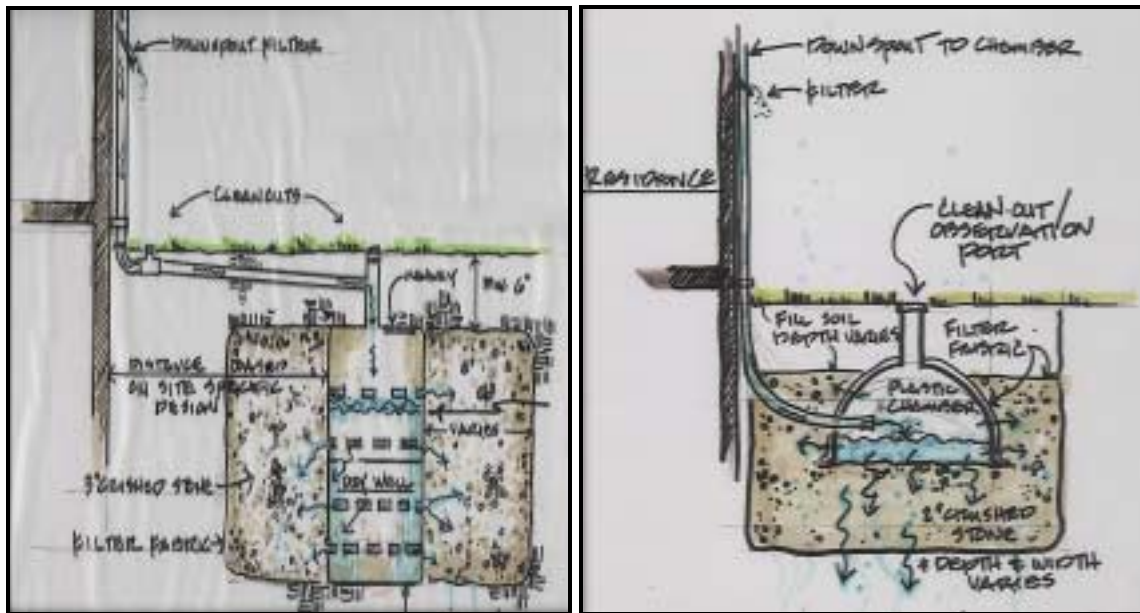
Cleanouts should be installed wherever acute bends in the pipe occur. One cleanout/observation port should be provided directly into the main leaching area so that the interior can be inspected without disturbing the ground surface over the Drywell. This port can be designed to serve as an overflow for large storms, so that once the capacity of the drywell has been used up water will just overflow to the ground.

Because leaves could quickly “seal” off the interior of a drywell, some form of gutter screen should be installed for all gutters contributing stormwater to the drywell.

Maintenance

Maintenance for drywells is mainly preventative. Gutter screens should be cleaned as needed and drywells should be inspected through the observation port occasionally to ensure that they are draining completely within 3 days of the end of a storm.

In larger Drywells, manways are usually a standard component in the concrete leaching chamber. The location of these manways should be noted on plans or as-builts so that once buried, they can be found later and used to provide access for cleaning the inside of the structure.



Drywells

Description

Drywells are underground areas that have been excavated and filled with stone. The voids between the stone are where stormwater is stored until it can be leached to the underlying native soils. The greatest benefit of using drywells is to remove roof runoff from the flowstream, and to recharge groundwater. This preserves the capacity of other RPMs to address runoff from other sources that may contain higher pollutant loads.

Application

Drywells have been used for a variety of purposes, usually as a passive drain for foundations, or to receive periodic discharges from sump pumps. More recently, drywells have been used to accept roof runoff. The drywells presented here are mainly used to accept roof runoff, which typically is free of most material that would otherwise clog a system.

Sizes of drywells can range from small installations that handle under 100 gallons in small lightweight plastic chambers, to very large installations using preformed concrete leaching chambers.

Advantages

Drywells are simple structures that are typically inexpensive to install and with the variety of products available to construct them, many homeowners will find installation within their capabilities.