Comprehensive Environmental Inc.

Study of Urban Non-Point Source Pollution
Witches Brook East Subwatershed

PENNICHUCK WATER WORKS
SEPTEMBER 2001

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1.0 PROJECT DESCRIPTION

As part of a follow-on project to a comprehensive watershed management plan for the Pennichuck chain pond system, Comprehensive Environmental Inc. (CEI) assisted Pennichuck Water Works in a detailed evaluation of potential threats to water quality in one of the subwatersheds, the Witches Brook East (WBE) Subwatershed. It included analysis and recommendation of measures to minimize water quality threats to receiving waters in the subwatershed. These recommendations have been presented in this report in a prioritized manner so that logical cost-effective implementation can occur. Pennichuck Water Works and the New Hampshire Department of Environmental Services (NHDES) jointly funded this project.

From July to December 2001, CEI conducted a detailed review of the 1,400-acre subwatershed known as The Witches Brook East Subwatershed as identified in a 1998 *Watershed Management Report* (Comprehensive Environmental Inc., 1998). Subwatershed drainage was evaluated during the summer, with many filed efforts conducted during first flush and/or antecedent rainfall conditions when both contaminant and runoff conditions are likely to be present.

The town line between Amherst and Hollis divides the WBE subwatershed. The Southern portion of the subwatershed (located primarily in Hollis) consists of a relatively low development density and significant vacant land. Water quality protection measures in these areas will take a more preventative approach. The Northern portion of the subwatershed (located primarily in Amherst) represents the typical threat of high-density development and as such, is best addressed through the development of remediation measures recommended in the 1998 Watershed Management Report. The following report presents suggested remedial and preventative measures. Overall, a blend of both structureal and non-structural controls were evaluated to suit the specific character of land use found in the subwatershed and to allow for simultaneous implementation of both capital and non-capital intensive projects.

2.0 DRAINAGE DESCRIPTIONS

The Witches Brook East Subwatershed consists of two major drainage areas, designated areas A and B (Figure 2-1), which correspond with the two major distinctions in development density throughout the subwatershed and the major patterns of runoff to Witches Brook. Area A has a greater density of development. Area A extends from Route 101A south to Witches Brook and east from the intersection of 101A and Old Nashua Rd. to the eastern boundary of the WBE Subwatershed. Area B consists of low-density residential development that extends from the southernmost tip of the WBE Subwatershed north to Witches Brook. Below is a more detailed description of each drainage area. Descriptions of specific sites of water quality concern within the two areas are also detailed.

2.1 Area A – Northern Drainage Area

Figure 2-2 shows drainage area A in more detail. The northern portion of the drainage area is characterized by high-density industrial and commercial development, with some low-density residential development and municipal lands to the south. Much of the commercial development is located along Route 101A and the majority of industrial development is located along Columbia Drive, with some developments located in close proximity to Witches Brook. Along Witches Brook, the buffer protecting the wetlands varies in width.

Land within the WBE subwatershed along Route 101A and just south to the Boston and Maine Railroad forms a long pocket that does not drain directly to Witches Brook. Most developments along this area handle runoff on-site, through infiltration. Furthermore the B&M Railroad acts as a partial barrier to runoff traveling south, leading to more infiltration of runoff in this area.

Some industrial developments to the north of Witches Brook do not have any drainage structures in place to handle runoff and others have taken advantage of the sandy soils with the use of leaching catch basins to direct water back into the porous soils. However, there are additional industrial developments that collect runoff and discharge the concentrated flow to wetlands and tributaries that drain directly to Witches Brook. Field investigation of drainage area A revealed the following areas of concern.

2.1.1 A-1 Columbia Drive Discharges

There is a 24" discharge near a portion of vacant land at the western portion of Columbia Drive. This discharge collects runoff from Columbia Drive and three businesses along Columbia Drive. The outlet discharges into a wetland area that drains to form a tributary to Witches Brook (refer to site A-1 on Figure 2-2). The riprap on the steep slope below has been pushed to the side and is heavily scoured (Figure 2-3). There is a large sediment delta that has extended into and smothered the wetland area (Figure 2-4). Due to heavy flows, much of the sediment discharged from this outlet is no longer being trapped by the wetland area and now flows into the tributary. There are visible signs of scouring and sedimentation of the tributary (Figure 2-5 shows the receiving tributary).

2.1.2 A-2 H&M Metals Discharges

H&M Metals is located east and adjacent to the Atomic Ski Warehouse on Columbia Drive Extension (refer to A-2 on Figure 2-2). This facility includes a large (92,600 S.F.) building with an additional 78,700 square feet of paved parking and drives. Multiple storage trailers are parked on the rear of the site. Runoff from portions of the building and parking area discharges through a 24" pipe at the southwestern portion of the site and feeds the same tributary mentioned in 2.1.1. The area immediately below this outlet is scoured from heavy flows and there is a large sediment delta that extends into the tributary (Figure 2-6).

There is an additional discharge located at the southeastern portion of the site. Runoff from the parking area discharges through a 12" pipe to the tributary below. The area immediately below this outlet is also scoured from heavy flows and there are sediment deposits, which extend into the tributary.

2.1.3 A-3 Norwich Building Discharges

There are two discharges of concern behind the Norwich Building at 13 Columbia Drive.

The first is a 15" discharge that collects runoff from the parking area and building at 13 Columbia Drive. The discharge flows through a forested area immediately below the steep grade to a lowland wetland area that eventually drains to Witches Brook. The area immediately below the discharge is heavily scoured (Figure 2-7) with sediment deltas downgradient, extending into the forested area (Figure 2-8), within 75 feet of the brook.

The second discharge is a surface discharge that originates from the upgradient parking area at 11 Columbia Drive where it combines with

runoff from a portion of the Norwich Building parking area and enters a riprap swale (Figure 2-9) at the southwest corner of the property. The short swale (~30') discharges into the same forested area as the aforementioned pipe and similar scouring and sediment deposits were observed (Figure 2-10).

2.2 Area B – Southern Drainage Area

Figure 2-11 shows drainage area B in more detail. This drainage area is characterized as having low-density residential development throughout with large tracts of undeveloped land and some agricultural lands. The southwestern portion of this drainage area begins at an apple orchard and flows into an unnamed brook, referred to as "Mooar Hill Road Brook", which collects additional runoff from the steep surrounding land. This brook flows through a series of small ponds/swamps before entering Witches Brook. Runoff from residential developments along Mooar Hill Road enters the brook in a concentrated flow during storm events.

There is an additional small brook that collects runoff from the southeastern portion of drainage area B. This brook does not flow as heavily as Mooar Hill Road Brook and follows a meandering path to Witches Brook under Witches Spring Road near its intersection with Fletcher Lane. Witches Brook is bordered by wetlands along drainage area B. Although there is no piped drainage system along Witches Spring Road, the majority of residential properties along Witches Spring Road contribute runoff to the two brooks described above. Field investigation of drainage area B revealed the following areas of concern.

2.2.1 B-1 Mooar Hill Road Brook and Witches Spring Road

Mooar Hill Road Brook flows into a wetland area (refer to B-1 on Figure 2-11) near Witches Spring Road and continues along Witches Spring Road to a small pond area where significant infilling was observed (Figure 2-12). This natural detention area is filled in with sediment and detritus and probably lacks the ability to trap sediment from the Brook and upstream areas or from Witches Spring Road.

The Brook continues east, parallel to Witches Spring Road to a small pond where there is an additional inlet from an isolated wetland area upgradient of the pond. There is a large sediment delta immediately below this inlet (Figure 2-13). The small pond serves as a sediment trap from these two inlets; however, it appears that the pond may be nearing the end of its useful life due to the large sediment delta already present. Once the pond has reached capacity, sediment will eventually travel through the detention area and continue downstream to Witches Brook.

2.2.2 B-2 Junkyard Along Witches Brook

There is a junkyard located along Witches Brook at the westernmost boundary of the WBE subwatershed (Figure 2-14). The junkyard extends to within 200 feet of the Brook in some areas, beyond which is mostly wetlands and forested or grassy areas. Land disturbance, associated with the junkyard, to the west of the WBE subwatershed boundary extends to the edge of the Brook in one area (Figure 2-15). There is no evidence of stressed vegetation or other impacts to the adjacent wetland and/or grassy and forested areas. Because the junk sits in the open on bare ground and the underlying soils are sandy, the junkyard appears to present more of a potential groundwater threat. Nonetheless, local groundwater is associated with Witches Brook, making the junkyard a threat to water quality.

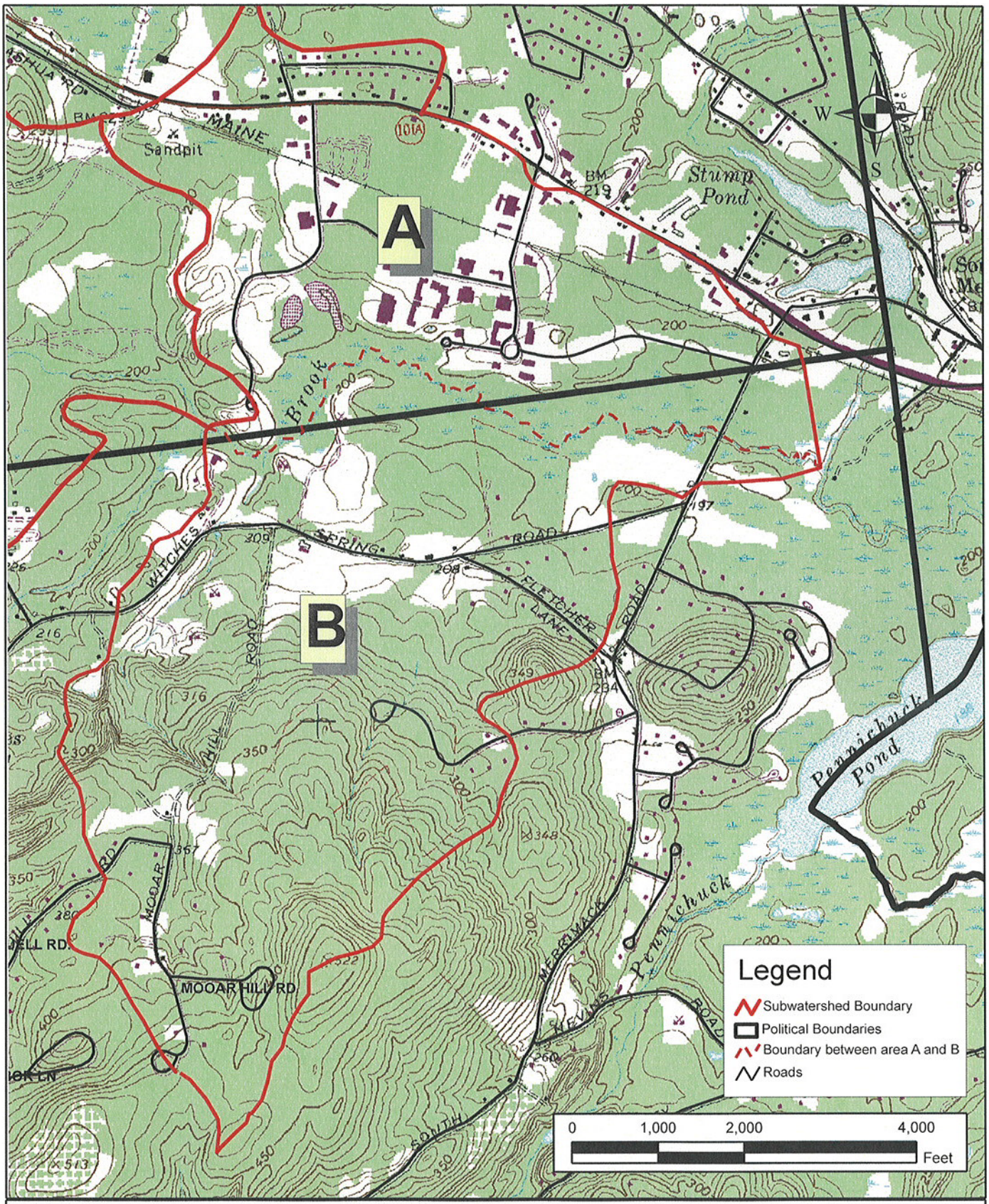


Figure 2-1. Witches Brook East Subwatershed. Areas A and B.

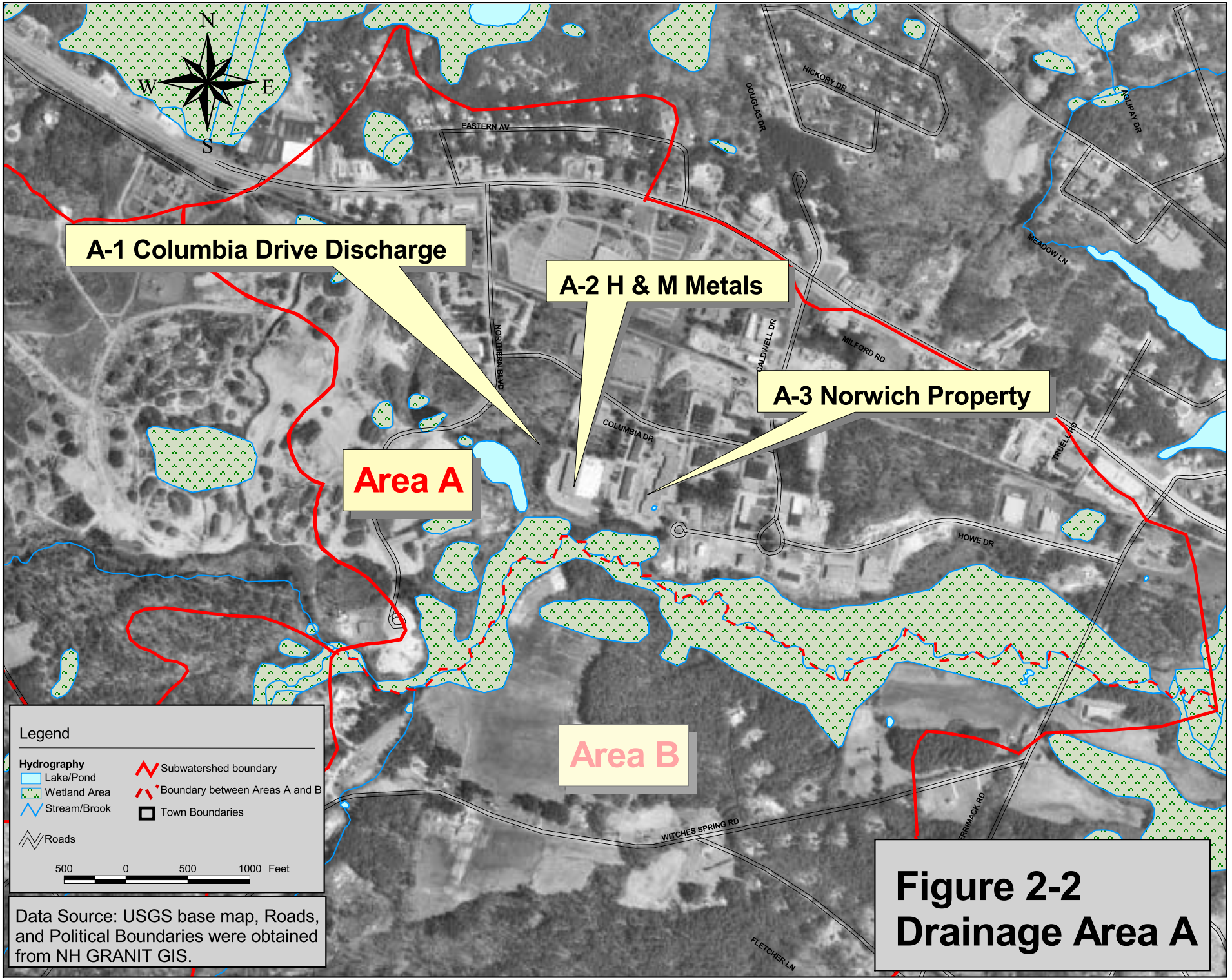


Figure 2-2
Drainage Area A

A-1 Columbia Drive Discharge

Figure 2-3. Swale scouring below discharge.

Figure 2-4. Sediment delta extending into wetland area.

Figure 2-5. Tributary receiving discharge.

A-2 H&M Metals Discharge

Figure 2-6. View of the scoured swale and sediment delta below discharge.

A-3 Norwich Building Discharges

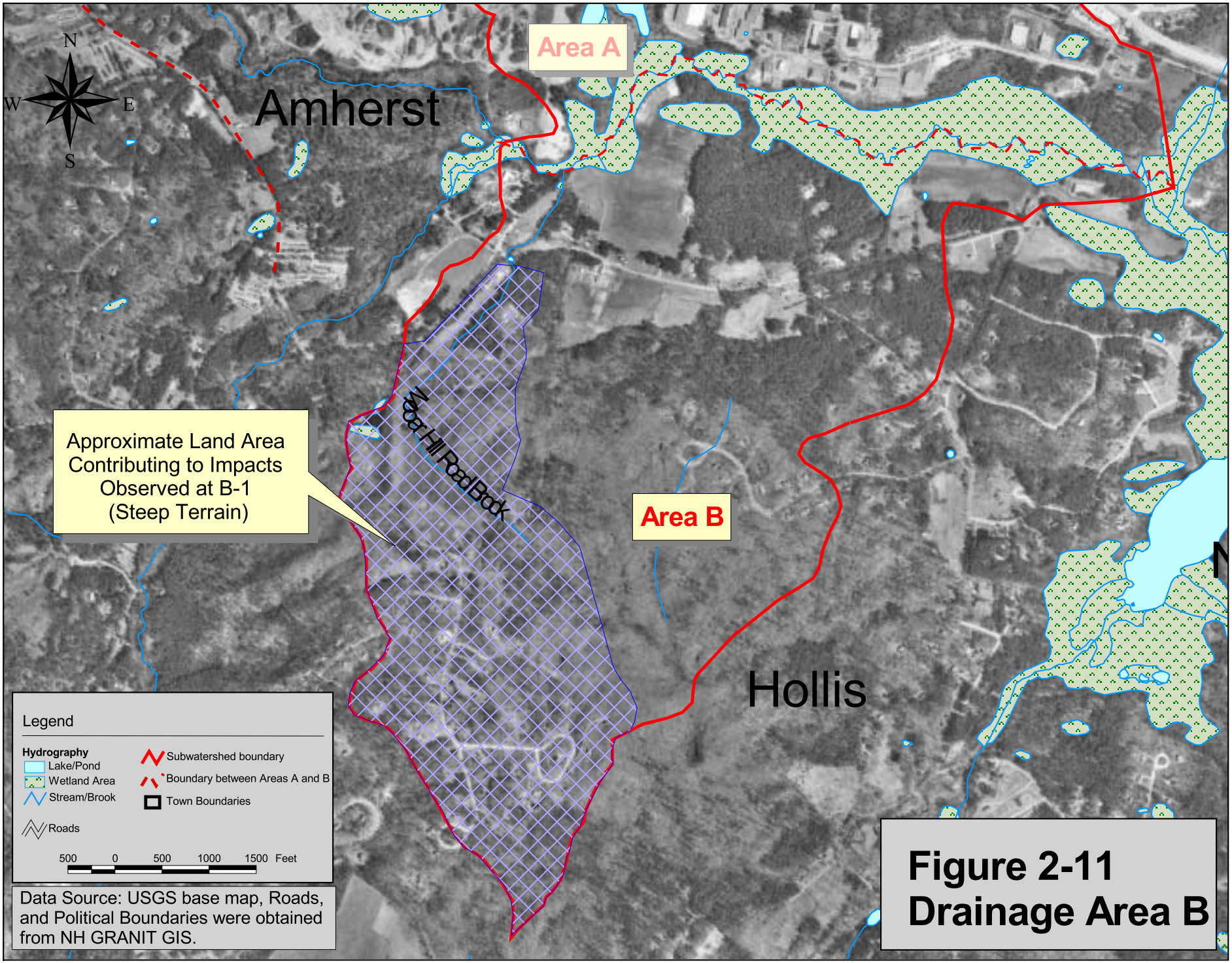
Figure 2-7. View of scoured area below discharge.

Figure 2-8. View of sediment delta extending into the forested area.

Norwich Building Discharges

Figure 2-9. View of riprap swale.

Figure 2-10. View of scouring and sediment deltas below swale.


N
W
E
S
Amherst
Area A
Approximate Land Area Contributing to Impacts Observed at B-1 (Steep Terrain)
Area B
Hollis
Legend
Hydrography
Lake/Pond
Wetland Area
Stream/Brook
Roads
Subwatershed boundary
Boundary between Areas A and B
Town Boundaries
500 0 500 1000 1500 Feet
Data Source: USGS base map, Roads, and Political Boundaries were obtained from NH GRANIT GIS.
Figure 2-11
Drainage Area B

B-1 Mooar Hill Road Brook and Witches Spring Road

Figure 2-12. Infilling observed at detention area along Witches Spring Road.

Figure 2-13. View of sediment delta at pond adjacent to Witches Spring Road.

(Close-up view of sediment delta)

B-2 Junk Yard Along Witches Brook

Figure 2-14. View of junk yard adjacent to Witches Brook.

Figure 2-15. View of land disturbance adjacent to Witches Brook.

3.0 RECOMMENDATIONS

Based upon a thorough review of the subwatershed and evaluation of potential problem areas, two broad categories of recommendations were developed: 1) Primary Water Quality Improvements, and Secondary Water Quality Improvements. Primary Water Quality Improvements are high priority projects that may require greater planning and capital expense compared to Secondary Water Quality Improvement projects. These are described in section 3.1. Secondary Water Quality improvements (described in Section 3.2) are generally of lesser priority, smaller in size, and typically require reporting, investigation, and cooperative efforts by Pennichuck and local authorities.

3.1 Primary Water Quality Improvements

The primary water quality improvements are comprised of four areas/projects. Consistent with an aforementioned project approach the recommended improvements represent a cross section of structural and non-structural measures important to the water quality of the subwatershed. Because the watershed contains developed lands that are contributing heavy sediment loads to wetlands adjacent to Witches Brook, three of the recommendations are remedial in nature and are structural controls. Due to the significant amount of undeveloped lands to the south of Witches Brook in Area B, one recommendation is preventative in nature. It focuses on protecting steep slopes through modification to the Town of Hollis Zoning Ordinance.

Detailed descriptions of these primary water quality recommendations, and their anticipated installation and maintenance costs, challenges, and property owners involved, follow below.

3.1.1 A-1 Columbia Drive Discharge

Recommended Improvement: ***Infiltration Basin***

Concerns of sediment transport to wetlands and eventually Witches Brook from site A-1 (Columbia Drive) and to a lesser extent the Atomic Ski site (see 3.2 Secondary Water Quality Improvements) can be addressed through the installation of an infiltration basin downstream of both. Figure 3-1 shows a conceptual drawing of the proposed basin and Figure 3-2 indicates a suggested location on that parcel (Town of Amherst, Lot 28-15).

There are a number of reasons why this location and particular installation are appropriate:

- The soils in the area are made up of well-sorted coarse sand which should allow for rapid infiltration. If this surficial geology (top 6 feet) is indicative of the native underlying

material it is likely that no material would need to be brought to the site to enhance the basin's infiltration rate.
- The proposed location allows the stormwater from both A-1 and the Atomic Ski Site to be collected and treated through infiltration.

Significant Challenges facing the installation include:

- The depth of excavation (10 ft) needed to intercept the deep stormwater drainage system.
- The potential lack of interest on the part of Atomic Ski to site a basin on their property that serves to treat and recharge the stormwater of others.
- Cooperation by the firm that developed the Atomic Ski site plan in providing Pennichuck CAD files as local Site Plan Review and Wetlands applications will need to be filed.

Parcel: Amherst 2-28-15

Owner: Atomic Realty Corp
9 Columbia Drive
Amherst, NH 03031

Estimated installation costs: $90,000

Operation & Maintenance:
Annual sediment removal
Estimated cost per year (2002): $1,000

3.1.2 A-3 Norwich Building Discharges

Recommended Improvement: ***Infiltration Strip***

An infiltration strip is recommended to capture sediments and infiltrate stormwater from the surface discharge at Area A-3 mentioned in Section 2.1.3. The existing dilapidated rip rap aprons used to dissipate energy on the steep discharge slopes do little to trap sediments contained in the stormwater from the site, and may be doing little to protect the slope as well. Sedimentation of the forested wetlands has resulted.

Proposed at the western discharge is a three-foot deep stone filled infiltration strip (see Figure 3-3) to be located along the edge of the paved delivery access at the top of the bank (refer to Figure 3-4). A pre-filter could be made by installing a layer of filter fabric under the top six inches of stone so that the sediment and debris removal activities would only require that the top 6 inches be dug up rather than the whole trench when full. Alternatively, a biolog prefilter could be installed that would allow the sediment to be trapped just upgradient. When it is time to clean up the sediments, the lightweight biolog could be moved out of the way to facilitate either mechanical or hand sweeping of the sediments. An at-

grade gabion backing wall would serve to provide a pervious bank support.

There are a number of reasons why this location and particular installation are appropriate:

- Relatively low capital cost due to simplicity and scale of the project.
- Potential partnering opportunity with the Amherst Conservation Commission.
- Minimized disturbance of sensitive area.
- May only require small equipment (bobcat) to enter the sensitive area for construction.

Significant Challenges facing the installation include:

- Access from bank to working area is steep.
- If constructed on Norwich property it may require wetlands application, and will require Site Plan Review.

Parcel: Amherst 2-28-13

Owner: Mareld Co. Inc.
400 Amherst St.
Suite 202
Nashua, 03063

Estimated cost: $8,500

Operation & Maintenance:
Sediment removal (1-2 times per year)
Estimated cost: budget $200-$500/yr

A stormwater management structure has not been proposed (for Pennichuck to implement) for the existing piped discharge located at the Norwich site. This is because the existing drainage in the piped discharged is deep under the surface of the ground and thus treatment of this discharge may be rather expensive due to the depth of excavation needed for installation of a subsurface structure. These costs could be minimized through the use of a proprietary device that requires a smaller hole to be dug, however this responsibility should fall on the owners of the property the next time they come in for a site plan review. These systems do not by themselves recharge the stormwater and so its installation would be primarily for water quality improvement as opposed to both quality and quantity management provide in the infiltration strip at the other adjacent discharge. Alternatively, an end of pipe treatment structure could be installed although the difficulty in accessing this area combined with construction related impacts may cause more harm than help. The management of stormwater is no less of a concern at this piped

discharge, but approval of any expansions or significant alterations of the site should be conditioned upon the Norwich *owner* negotiating with the Planning Board to provide a better treated discharge.

3.1.3 A-2 H&M Metals Discharges

Recommendation: ***Institute Features Consistent with Site Plan***

A review of a site plan for the H&M Metals site dated September 14, 1994 shows stormwater treatment features that appear to never have been installed. Although not signed, this site plan provided by the Town of Amherst is the most recent plan on file and is presumed to be the approved site plan. Features shown on approved plans must be installed unless the site plan is amended.

The site plan shows a small detention basin referred to on the plans as a stillings basin (see Figure 3-5). It is clear from this feature's name and design that the intent was not only to attenuate runoff flows, but also to settle out particles entrained in the runoff. Had this stillings basin been installed (and maintained), it is likely that scouring and sediment deposition downgradient of the discharge would not be a significant issue.

The issue of legal latches[1] aside, the Town of Amherst is within its rights to ask the developer to install the stilling basin as shown on the site plan. The following are recommendations relating to its design and installation:

- Modify the design of the basin to include a hood or elbow at the outlet, as it will provide treatment of a broader array of pollutants (floatables) than that of just sediments.

- During construction adequate erosion and sediment controls should be in place. Due to the steep slopes both inside and outside the basin, vegetation establishment may be challenging. The use of a permanent turf reinforcing fabric is highly recommended in both applications.

- A temporary pipe spanning the basin inlet to outlet (i.e. bypassing the basin) is an effective way to convey stormwater temporarily to the discharge while the vegetation is becoming established.

- Care should be taken to preserve existing tree canopy in the vicinity of the basin (especially to the south and west of the installation) so that stormwater captured in the basin does not become a solar-heated discharge to the receiving stream.

[1]Towns that do not exercise their rights within a reasonable amount of time may loose such ability.

- Sediment accumulations from previous discharges (at both the new basin site and the unmarked discharge south/southwest of the basin), as well as any that may be construction related, should be removed.

Parcel: Amherst 2-28-17

Owner: Hendrickson Trustee Alan R
Columbia Drive Realty Trust
9A Columbia Drive
Amherst, NH 03031

Estimated installation costs: N/A

Operation & Maintenance:
Annual sediment removal
Estimated cost per year (2002): $750-$1,000

3.1.4 Additional Protection Needed from Drainage Discharges on Steep Slopes and Unregulated Parcels

Steep Slope Recommendation: ***Require More Suitable Receiving Slopes***

The steep slopes that are present in the Town of Hollis in Area B can rapidly convey stormwater sediments and the streams themselves may be a source of sediments from erosion and bank cutting if subject to increased volumes and flow rates as a result of development.

Hollis has provided protection for steep slopes over 25% within its zoning ordinance by prohibiting the placement of buildings and associated features (water supply and sewage) within these areas. Drainage discharges onto such slopes are not prohibited however.

Discharging stormwater onto steep slopes has a number of problems associated with it. Very little stormwater is infiltrated on steep slopes, and erosion can be significant. Attempts to stabilize steep receiving slopes with rip rap can work however the stone, heated by summertime sun, can raise the temperature of stormwater running over it. Thermal impacts to receiving streams and their fish populations result. To avoid these potential problems associated steep slope discharges, the Town of Hollis should require gently sloped (preferably 1%-6%) receiving areas. It is recommended that at a minimum, the Town of Hollis include drainage discharges within its delineation of the building area (must be under 25% slope) to address this concern.

Recommendation for Unregulated Areas: ***Expand Applicability of Stormwater Standards***

The Town's Subdivision regulations and wetland overlay district contain basic stormwater management objectives and references, however they are only applicable to properties that are being subdivided or are located within the Wetland Overlay Zone, respectively. Although wording in the Hollis Section C. Wetland Conservation Overlay Zone (WCO) 4. a. states "There shall be no net increase in peak flow or overall volume of stormwater runoff in the WCO Zone as a result of any development.", this standard would not apply to parcels developed for residential land use outside the WCO that connect drainage into existing conveyances that transport water to nearby brooks.

The no net increase standard should be applied townwide as it will help protect wetlands, will help with upcoming Phase II regulatory compliance (for which a portion of the Town will be subject to), and given the large lots and thus plentiful space to manage runoff, should not be much of a burden for the average homeowner to implement.

Parcel: N/A-Various

Owner: N/A

Estimated installation costs: N/A

Operation & Maintenance: N/A

3.2 Secondary Water Quality Improvements

3.2.1 Atomic Warehouse Swale

Recommendation: ***Address with Proposed Infiltration Basin***

This site is a distributing warehouse located at 9 Columbia Drive. There is a 12" discharge at the southern portion of the site that collects runoff from the building and parking areas and travels through a 175 foot sandy swale adjacent to the Columbia Drive discharge mentioned in Section 2.1.1 (Figure 3-6 shows the swale area). The swale is currently in good condition and probably infiltrates most small rainfall events. During larger events however, it likely contributes to the heavy flow and scouring observed in the tributary below. The large sandy swale area provides a good location for the infiltration basin mentioned in Section 3.1.1 and as such, the discharge at this site should be incorporated into the design. As proposed in Section 3.1.1 the structure has been designed to capture the Atomic drainage.

Parcel: Amherst 2-28-15

Owner: Atomic Realty Corp
9 Columbia Drive
Amherst, NH 03031

Estimated installation costs: See Sec. 3.1.1

Operation & Maintenance: See Sec. 3.1.1

3.2.2 Tool Company Discharge

Recommendation: ***Sample Discharge Effluent***

There is a 6" PVC discharge adjacent to Witches Brook behind the J.R. Poirier Tool and Machine Company property located on Manhattan Drive in drainage area A. This discharge is from runoff collected at a single catch basin from the parking area around the loading dock at the southwest corner of the building (Figure 3-7). At the time of inspection, there was a milky white substance at the point of discharge that appeared to be some type of detergent or paint (Figure 3-8). It appears that the area surrounding the catch basin is occasionally used as a washout area. Discharges from this pipe flow over a grassy area that is contained by a deteriorating row of hay bales approximately 50 feet from the brook (Figure 3-9). Vegetation in this area did not appear stressed despite the unusual liquid present. Nonetheless, periodic sampling of this effluent is recommended and at the very least educational materials already developed by Pennichuck should be given to employees. Perhaps a non-confrontational site visit to explain the importance of their role in protecting water quality is warranted.

Parcel: Amherst 2-31-4

Owner: Raymond Gauthier Trustee
6 Manhattan Drive
Amherst, NH 03031

Estimated costs: $1,500

Operation & Maintenance: N/A

3.2.3 B-2 Junk Yard Along Witches Brook

Recommendation: ***Institute Licensing Requirements.***

According to local officials the junkyard located on the Hollis/Amherst town line has been in existence for quite a while and likely predates zoning controls. This junkyard is therefore not subject to these controls and is considered “grandfathered”. This does not relieve them of state and federal compliance to run a clean operation, however inspections from these non-local agencies tend to be lacking.

To address this lack of enforcement attention many communities have opted to require licensing of junkyards at the local level. A license to operate is granted/renewed once a compliance inspection has been preformed. Most towns develop their own compliance checklist based on

federal requirements and then add other requirements that address local conditions. For instance, Hollis might institute their licensing requirement and have a provision that requires the junkyard operator to drain and recycle hazardous fluids at least 300 feet from a waterbody. Another might be to perform these activities on an impervious surface that is roofed to minimize contaminant transport to ground and surface waters. The details can be refined over time, but it is essential to institute the licensing requirement so that an inspection/educational visit can be performed yearly.

Note that a nuisance cannot be grandfathered, and if these conditions develop (CEI was unable to determine if this was/is the case) normal cessation procedures apply.

Parcel: Amherst 2-1-0
Hollis 46-15-0

Owner: James Bristol
80 Witches Spring Road
Hollis, NH 03049

Estimated installation costs: N/A

Operation & Maintenance: License fees should cover cost of administering program

3.2.4 Drainage Easement Along Eastern Portion of Norwich Property

Recommendation: ***Preserve Integrity of Existing Drainage Easement-Provide Improvements as New Developments Connect.***

There is a twenty-foot drainage easement along the eastern boundary of the Norwich Building property. Within this easement is a 30" pipe that receives runoff from: the property north of the Norwich Property; the property east of the Norwich Property; and the northern and eastern portions of the Norwich Property. The point of discharge is located in an area of flat relief approximately 650' from Witches Brook. The area immediately below the point of discharge has filled with sediment approximately 8" above the bottom of the pipe outlet (Figure 3-10), forcing water and sediment to back-up in the pipe. Despite the condition of the pipe, the area downgradient of the sediment delta is forested with minimal evidence of the impact of stormwater. Due to the relatively long travel time stormwater has before it reaches the brook, negative stormwater impacts may not be observed for quite some time. However, the site presents a good location to improve stormwater management in the area on an unused portion of the property should other drainage connections be made as a result of upgradient development that may occur along Manhattan Drive.

Parcel: Amherst 2-28-13

Owner: Mareld Co. Inc.
400 Amherst St.
Suite 202
Nashua, 03063

Estimated installation costs: Determined/sized/constructed by new connector at the time of development

Operation & Maintenance: Unknown- see above

3.2.5 New Construction at Poly-Ject Inc.

Recommendation: ***Retrofit New Catch Basin***

There is an addition being built at Poly-Ject Inc. located at 8 Manhattan Drive. The property is within 100 feet of Witches Brook. Currently, the only drainage system for the site is located along the cul-de-sac of Manhattan Drive. Runoff from the northern portion of the site and Manhattan Drive combine and flow to the forested area described in Section 3.2.3. The property owner is building an addition that will likely require additions to the drainage system to handle runoff from the new building and parking areas.

A review of the May 2000 site plan indicates that the proposed drainage system will create a new discharge at the edge of wetlands and within 100 feet of Witches Brook (Refer to Figure 3-11). It appears that this discharge will collect runoff from a loading dock area and portions of the new building. Although the plan notes that the catch basin shall be inspected/cleaned once a year, additional steps should be taken to protect the stream and wetlands. For instance, adding a hooded outlet in the basin would serve to contain petroleum products and other floatable contaminants, allowing them to be removed at the time of cleaning.

Parcel: Amherst 2-31-3

Owner: Larry Thibeault
8 Manhatten Drive
Amherst, NH 03031

Estimated installation costs: $750

Operation & Maintenance: Hood replacement estimated at 7-10 years.

3.2.6 B-1 Mooar Hill Road Brook

Recommendation: ***Require O&M Plans***

Runoff from an apple orchard at the southern tip of Drainage Area B travels northwest through the residential developments along Mooar Hill Road, forming Mooar Hill Road Brook.

The Mooar Hill Road area, including Sargent Road, contributes significant drainage to the Brook named as Mooar Hill Road Brook. The upper portion of the Brook does not flow during dry weather conditions, however, the steep grade of this area leads to significant flows during rain events, despite the relatively small percentage of impervious surfaces in the area. Drainage flows through a few detention areas (Figure 3-12) before it connects with Mooar Hill Road Brook just before the Brook passes under Mooar Hill Road. From this point, the land surrounding the Brook is considerably steep (See Figure 3-13 for view of steep terrain), lending to heavy bank cutting during storm events (Figure 3-14 shows bank cutting). Future development in this area will lead to even greater flows and bank cutting/ erosion downstream (see discussion in Section 3.14).

A review of the Town of Hollis's Zoning and Subdivision controls shows that the Town requires that stormwater flows from post construction runoff be no greater than that which occurred before construction for all plans that are reviewed by the planning board. This is a very powerful tool that the Town can use to prevent further bank cutting in that area if properly adhered to. To ensure that the standard is met as the stormwater attenuation devices age, it is recommended that a maintenance requirement be added to project approvals.

Requiring submission of and subsequent adherence to an Operation and Maintenance (O&M) Plan is an effective way to accomplish this objective if it is made a condition of Subdivision and/or Site Plan approval. To be effective, towns should require that the applicant specify: the inspection and maintenance activities to be performed, the anticipated frequency of such actions, and a person/party responsible for the each action. Lastly the Town should specify, and the owner should agree in signature, that if the activities are not adhered to, the town may (after notification) contract out the work and bill the owner. Liens are an appropriate next step if the owner refuses to pay.

Parcel: N/A

Owner: N/A

Estimated installation costs: N/A

Operation & Maintenance: N/A

3.2.7 Emerson Road Drainage

Recommendation: ***Improve Post-construction Cleanup***

Emerson Road is a more recent residential development in drainage area B. It is located in close proximity to Witches Brook, although drainage from the development does not drain directly to Witches Brook. Portions of drainage from this area flow into the unnamed brook near Fletcher Lane.

Numerous BMPs (Figure 3-15) were observed as part of the drainage system for the road and residential lots. However, due to construction activities and associated sedimentation, these BMPs need to be cleaned out (Figure 3-16) and readied for their design purpose of handling typical, post construction levels of residential pollutants once construction is complete.

The building inspector should only issue the Certificate of Occupancy once he has verified that such clean up has occurred.

Parcel: Various-Emerson Road

Owner: Various

Estimated installation costs: N/A

Operation & Maintenance: N/A

3.2.8 Woodmont Orchards – Hollis Farm

Recommendation: ***Follow up call-***Completed[2]

The apple and peach orchard (Figure 3-17) located at the southernmost portion of drainage area B is Woodmont Orchards. The orchard is a potential source of pesticides and fertilizers that may enter Hill Road Brook in the event of a spill or inappropriate application equipment washout. The orchard is expanding, meaning that the use of such chemicals will likely increase. This orchard was sent an educational brochure pertaining to agriculture developed by Pennichuck Water Works. A follow up call or site visit may be helpful (see footnote below) in reminding them of the importance of safe handling and disposal of pesticides and fertilizers.

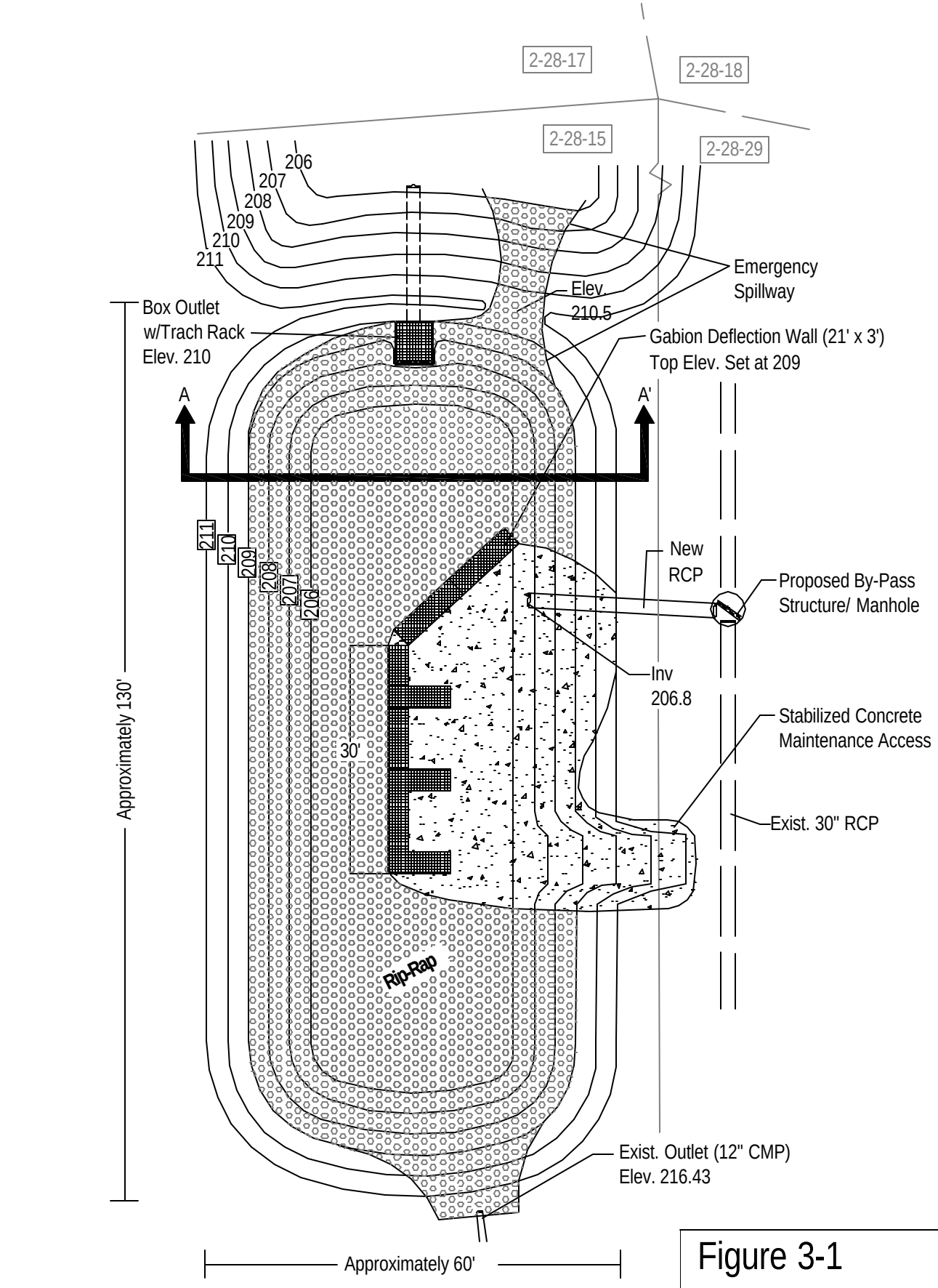
Parcel: Hollis 36-18-0

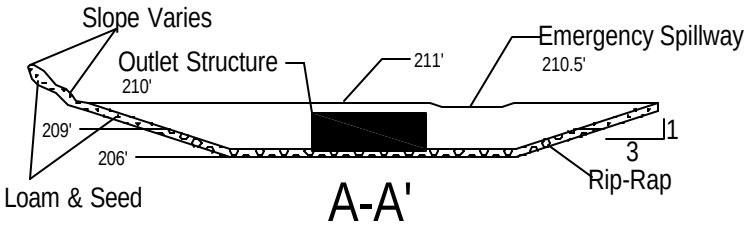
Owner: Millicent Gardener (estate)
80 S. Merrimack Road
Hollis, NH 03049

Estimated installation costs: N/A

[2] CEI staff had performed a follow up with the owners at the time of printing.

Operation & Maintenance: N/A





A-A'

Figure 3-1

Proposed Infiltration Basin at Columbia Drive Discharge

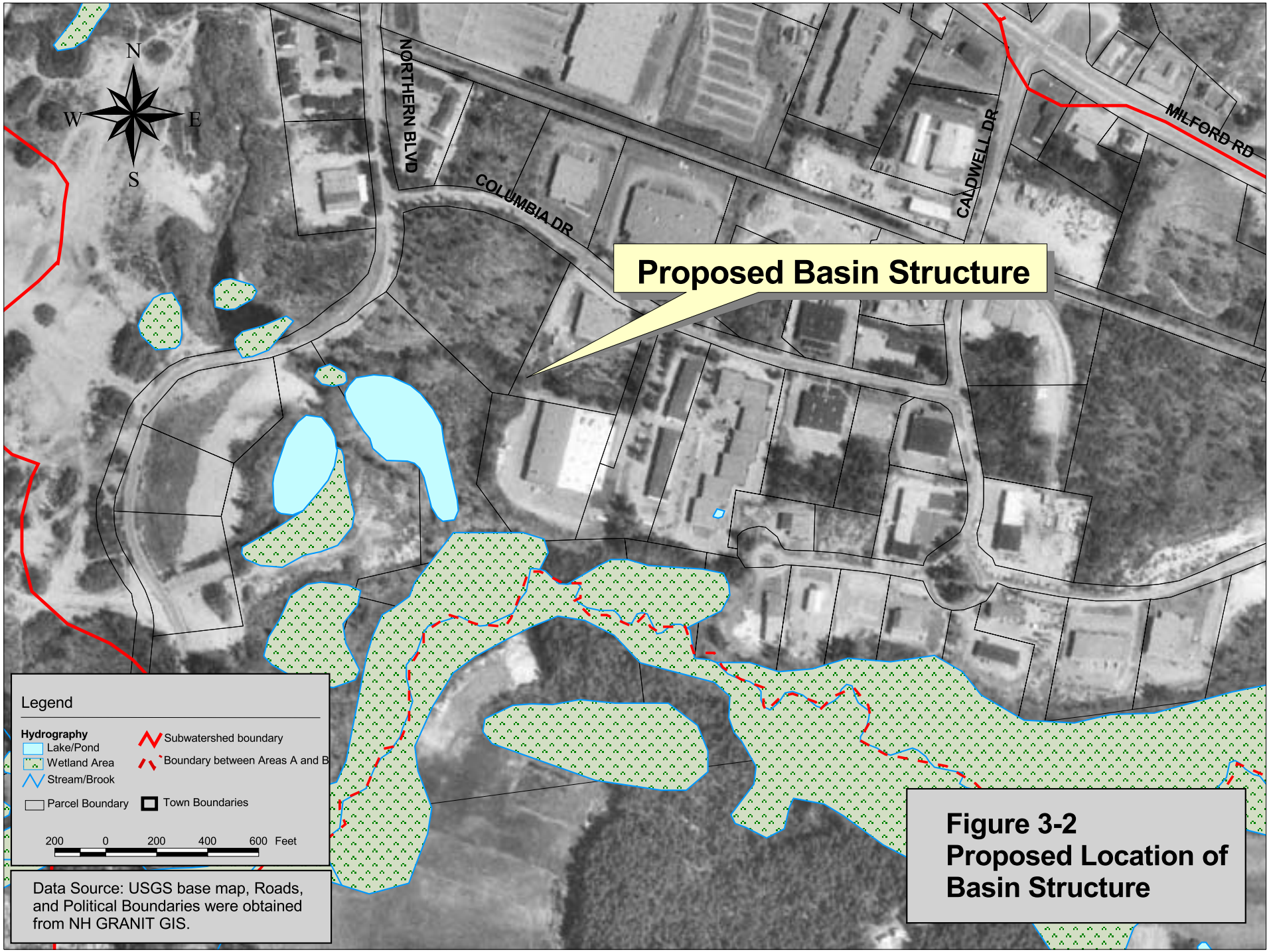
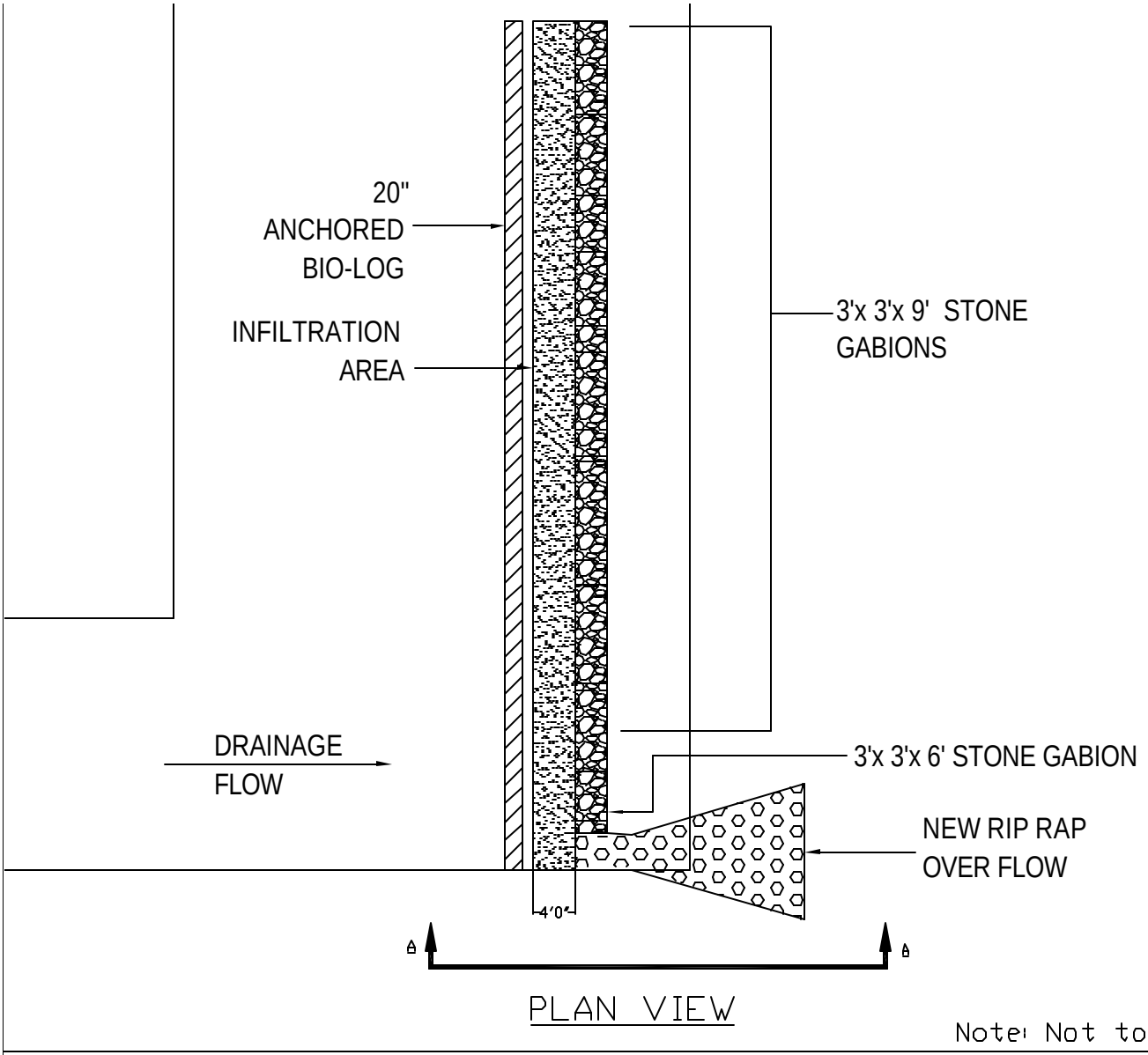
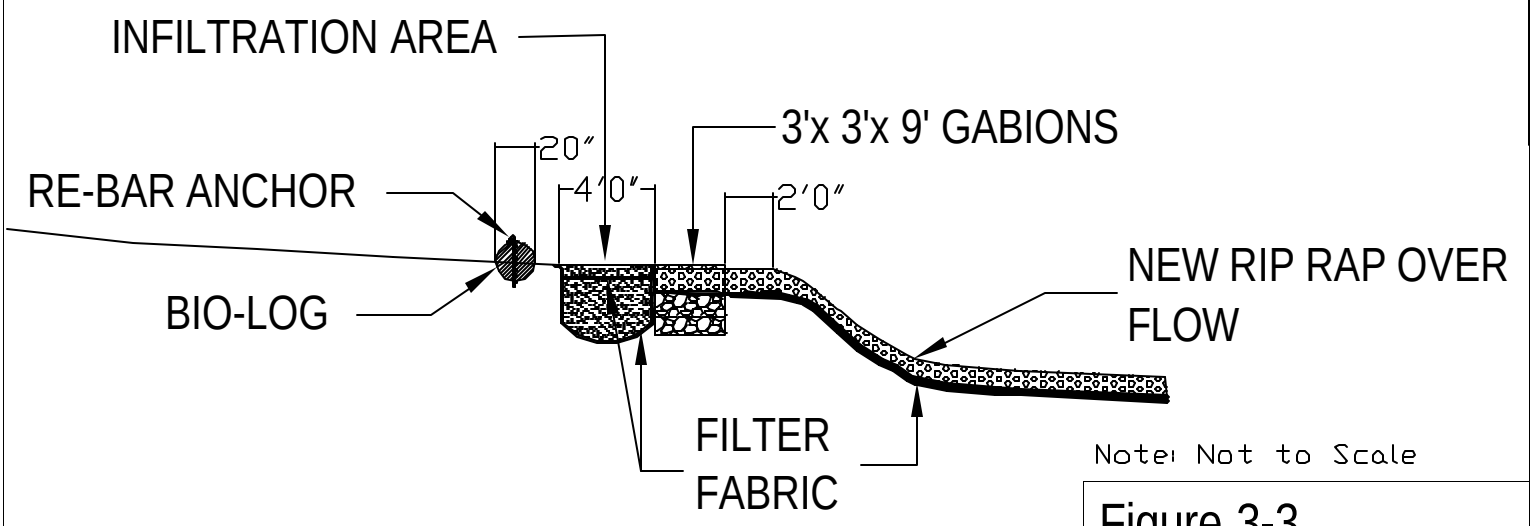


Figure 3-2
Proposed Location of Basin Structure



PLAN VIEW

Note: Not to Scale



ELEVATION VIEW A-A

Note: Not to Scale

Figure 3-3

Proposed Infiltration Strip at Norwich Property

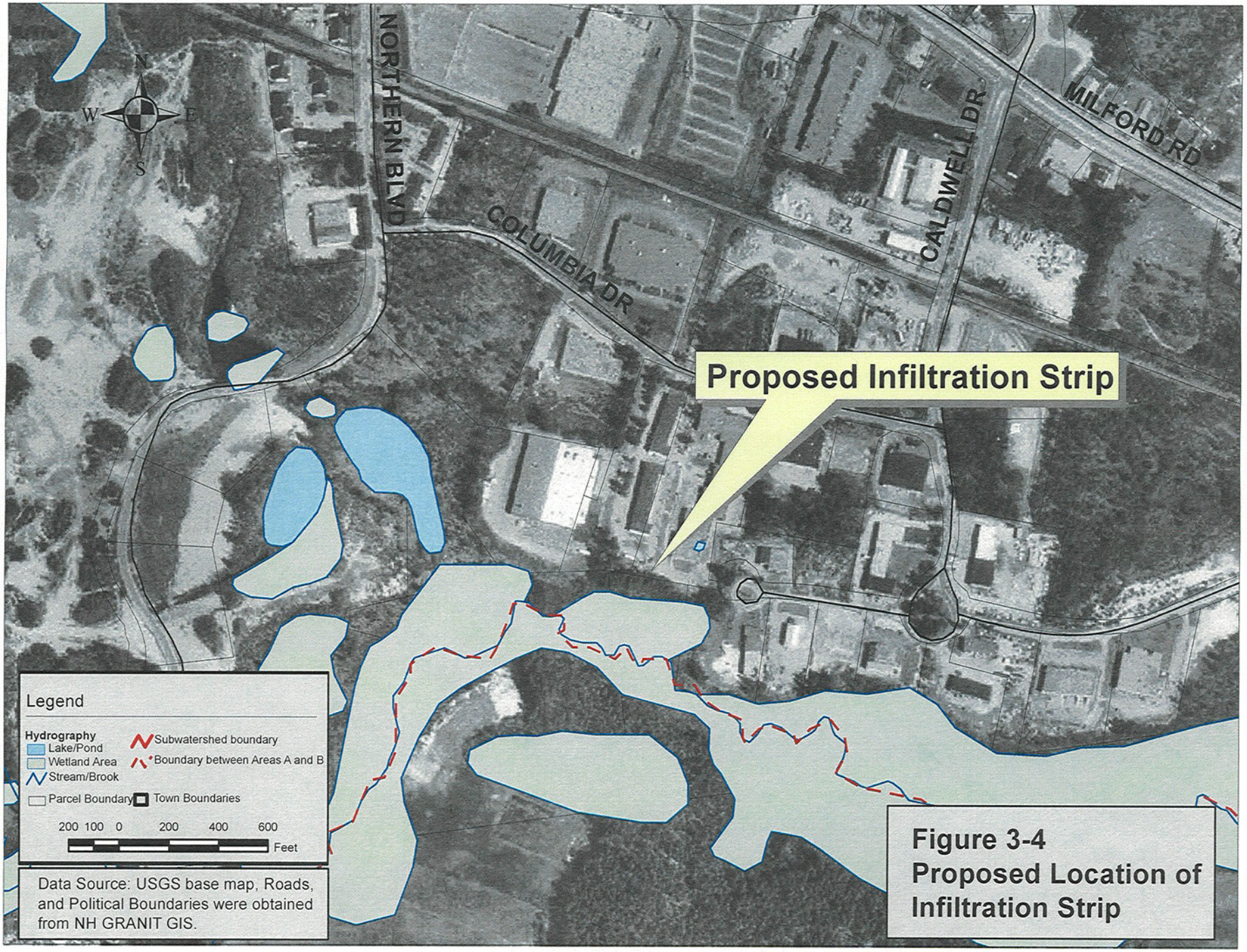


Figure 3-4
Proposed Location of Infiltration Strip

H&M Metals Site Plan

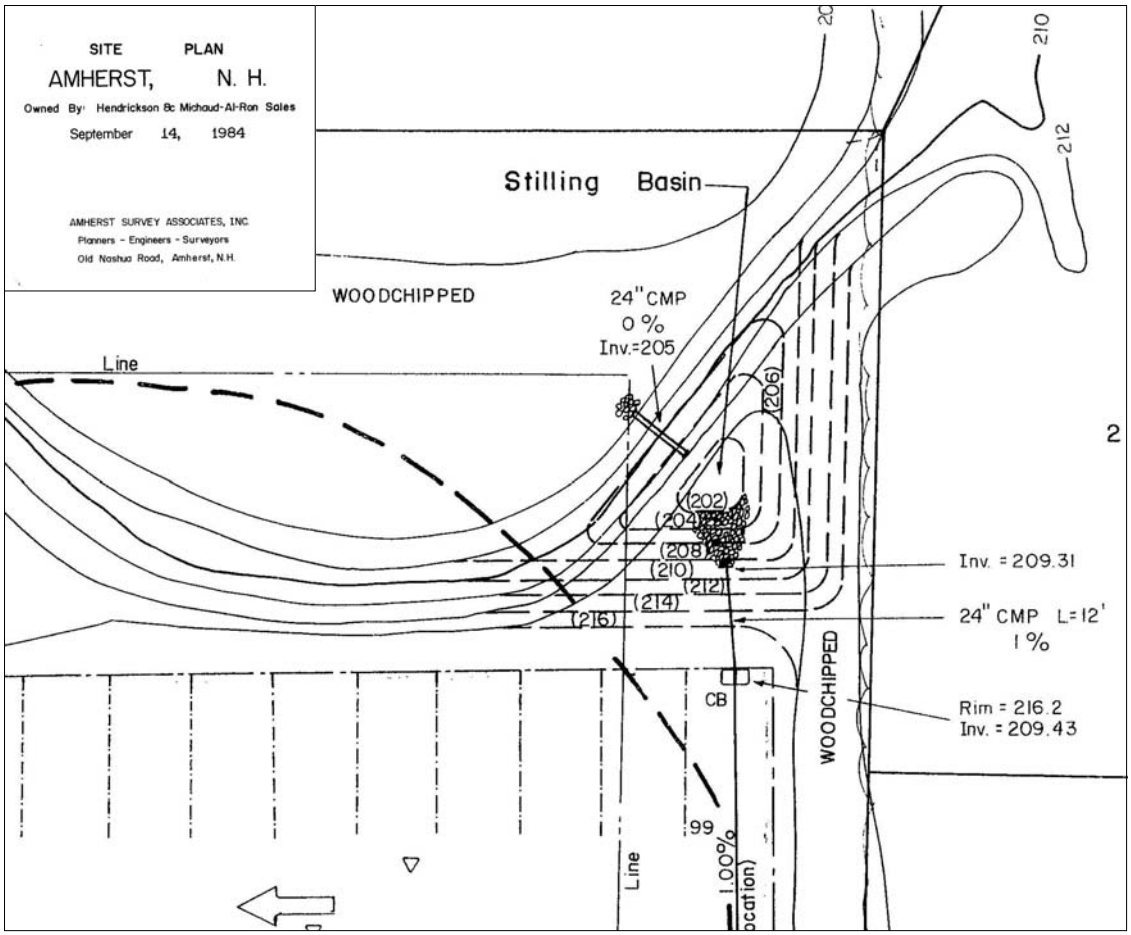


Figure 3-5

Atomic Warehouse Swale

Figure 3-6. View of the sandy swale (looking upstream) behind the Atomic warehouse.

Tool Company Discharge

Figure 3-7. View of catch basin and contributing drainage area.

Figure 3-8. View of effluent observed at outlet location.

Figure 3-9. View of hay bales adjacent to Witches Brook.

Drainage Easement Along Norwich Property

Figure 3-10. View at outlet location.

Poly-Ject Inc. Site Plan

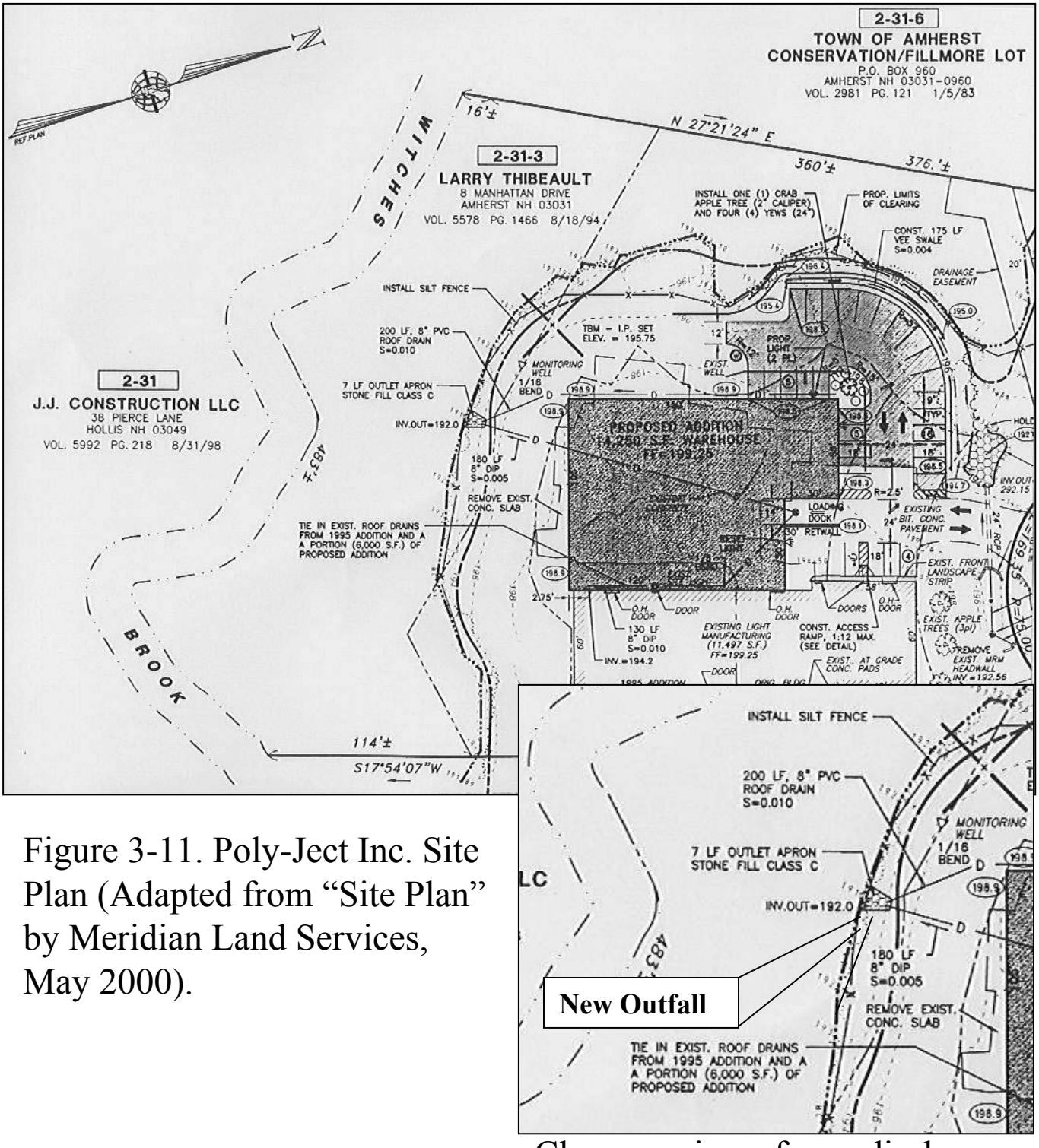


Figure 3-11. Poly-Ject Inc. Site Plan (Adapted from "Site Plan" by Meridian Land Services, May 2000).

Close-up view of new discharge.

Mooar Hill Road Brook

Figure 3-12. Example of detention area for brook.

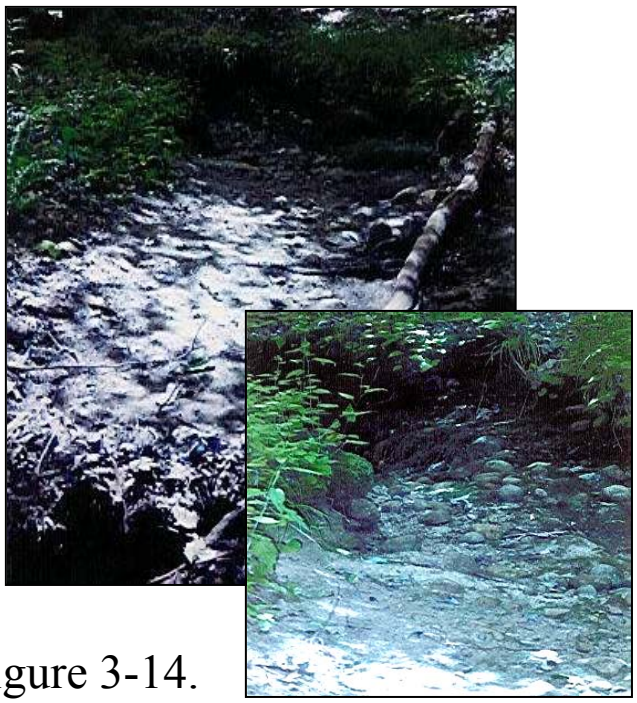


Figure 3-14. Example of bank cutting/ erosion along brook.

Figure 3-13.View of steep terrain along brook. The CEI employee in the center of the photo is standing in the streambed to provide a sense of scale.

Emerson Lane BMPs

Figure 3-15. Example of BMP observed at the new development along Emerson Road.

Figure 3-16. Examples of sedimentation issues during construction.

Woodmont Orchards – Hollis Farm

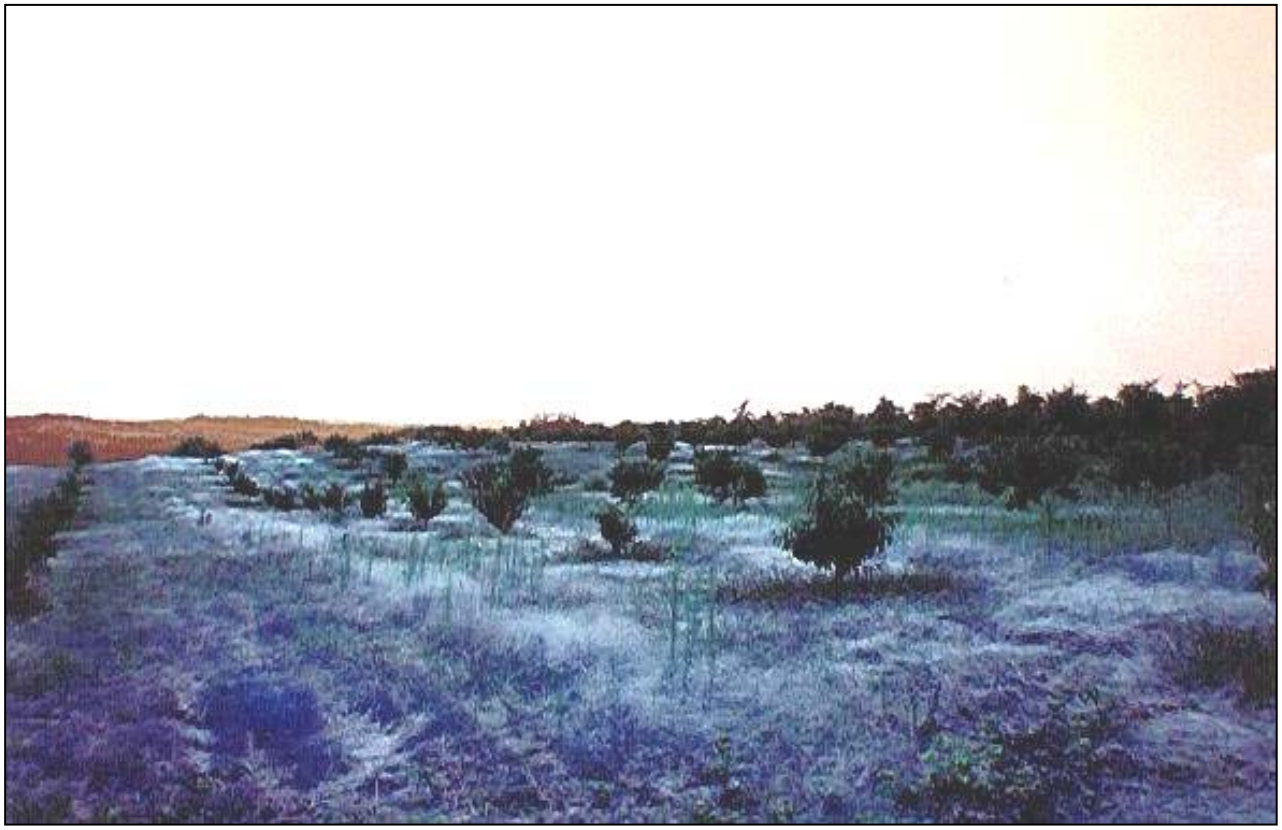


Figure 3-17. View of apple and peach orchard at the southern tip of the WBE Subwatershed.