Town of Lunenburg

Water Resources Management Best Practice

Stormwater Management

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Introduction

In 1999 the Environmental Protection Agency (EPA) implemented regulations for Phase II permitting of small Municipal Separate Storm Sewer Systems (MS4). These regulations required MS4 Systems to file for National Pollution Discharge Elimination System (NPDES) Permits based on the presence of Urbanized Area as defined by the U.S. Census. Since the development of the Phase II program the Town of Lunenburg has been partially classified as having Urbanized Area, thus has been required to comply with the NPDES Phase II permitting requirements. The original Phase II Permit issued in 2003 outlined a number of items the Town was required to address to prevent the introduction of pollutants into Waters of the United States.

The 2003 Permit for Massachusetts was issued to cover a period of 5 years and tasks were divided up throughout the proposed life of the permit. In 2016 a new draft Permit for Massachusetts was issued for comment with an anticipated effective date of 1 July 2017. The 2017 Permit expanded many of the requirements previously included in the 2003 Permit, including additional mapping provisions, asset ranking, and field investigations based on the mapping. Through the Community Compact program the Town of Lunenburg buttressed local funding to review and rank the existing MS4 catch basins and outfalls. The mapping and ranking of the catch basins and outfalls creates a baseline for much of the mapping and systems testing requirements outlined in the 2017 Phase II Permit. Furthermore, the report identifies area of high risk for the introduction of pollutants to rivers, streams, and lakes and outlines structural Best Management Practices (BMPs) that can be implemented at these locations to mitigate the contaminated flow.

Project Description

In the original Community Compact application the Town of Lunenburg identified a list of 7 tasks it hoped to undertake with regard to stormwater and specifically moving toward compliance with the Phase II Permit. In reviewing the list of proposed tasks with the Town's stormwater consultant it was identified that items like surveys, stormwater education, annual information meeting, and public participation can be addressed with limited need for funds, and using a variety of publicly available information and resources. It was noted in this conversation that the Ranking of Critical Outfalls was a crucial component of much of the work required in the first several years of the Phase II Permit and would be an item that could carry a substantial financial outlay.

This resulted in a project designed to rank priority outfalls (high/medium/low) that impact Town waters; to identify Best Management Practices for high priority outfalls and calculate BMP pollutant removal; and provide BMP cost estimates, funding options and maintenance guidance.

Process

In the summer of 2017 the Town of Lunenburg contacted with Design Consultants, Inc. and Massachusetts Watershed Coalition to perform the work of delineating the Town's sub-basins; reviewing and ranking the outfalls; and recommending BMPs, including their proposed pollutant removal, costs estimates, potential funding options and maintenance guidance.

This work was divided into the following six tasks:

1. Initial Ranking: An initial desktop assessment to identify the outfall catchment areas.
2. Site Visits: Each outfall will be visited to evaluate the conditions in the field and determine any potential impairment to critical areas.
3. BMP Selection: Adjust initial outfall priority rankings to protect any critical areas identified by site visits. BMPs will be selected based on soil suitability and the treatment requirements of the Massachusetts DEP Stormwater Standards. Cost and pollutant removal estimates would be developed based on this information.
4. Funding Sources: Develop recommendations for sources of BMP funding by local, state and federal programs, and determine potential in-kind matching sources.
5. Schedule: Recommend a provisional ten year timetable for BMP implementation as a guideline for the future.
6. Maintenance and Monitoring: Prepare an Operation and Maintenance Plan for all recommended BMPs. This would include guidance for outfall inspections and water testing to assess BMPs performance and changes of receiving waters.

Project Schedule

- Task 1: Between November 2017 and March 2018 the team from DCI and Massachusetts Watershed Coalition performed the desktop ranking exercise.
- Task 2: Site visits were conducted between April 2018 and December 2018
- Task 3: BMP Selection was conducted between January 2019 and March 2019
- Task 4: Funding sources were identified between March 2019 and June 2019.
- Task 5: Schedule recommendations were identified between March 2019 and June 2019.
- Task 6: Maintenance and Monitoring recommendations were identified between March 2019 and June 2019.

Deliverables

The Town of Lunenburg received a completed Sub-Basin Report (attached) that outlines 5 Sub-Basin areas. This report is separated in sections by Sub-basin identifying, ranking and recommending BMPs for the outfalls located in each basin. The report additionally includes depictions of each Sub-basin area on a map; Appendices which include, BMP conceptual designs, BMP project cost estimates, BMP Pollutant Load reduction estimates, and Operation and Maintenance Plans with inspection procedures and inspection forms.

The report delivered provides the Town of Lunenburg with a baseline for the development of future actions relative to compliance with the requirements of 2017 Phase II Permit. The outfall ranking will provide a starting point for dry weather screening of outfalls and provide the Department of Public Works with tools for planning future capital and operational improvements to the Town's MS4 system.

Design Consultants, Inc.

Civil Engineering
Transportation/Traffic
Water/Wastewater
Geotechnical
Land Surveying
Environmental
Planning

TOWN OF LUNENBURG, MASSACHUSETTS

SUB-BASIN REPORT

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I. Project Description

The purpose of this project is to rank priority outfalls (high/medium/low) that impact Town waters; to identify Best Management Practices for high priority outfalls and calculate BMP pollutant removal; and to provide BMP cost estimates, funding options and maintenance guidance. The five high value sub-basins included in the analyses are:

a. Upper Mulpus Brook which is a Coldwater Fish Resource (CFR) and is the main surface water source for Hickory Hills Lake.
b. Hickory Hills Lake which has swimming beaches and supplies water to private wells.
c. Catacoonamug Brook which is a CFR that flows over the Town wellfields and is a source of water for Lake Whalom and for Lake Shirley.
d. Easter Brook which is a CFR that flows into Lake Shirley
e. Lake Shirley which has swimming beaches and supplies water to private wells.

This report begins with an introduction of stormwater management issues and Lunenburg water resources, which is followed by project findings for each sub-basin.

II. Background/Introduction

Clean water is important but all is not well with local water resources. The Massachusetts Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) agree that much of the problem is due to stormwater.

Stormwater carries an enormous amount of pollution, including dirt, car oil, chemicals, toxic metals, viruses and bacteria. This dirty runoff is the greatest threat to the quality and health of local rivers, streams, lakes and water supplies. Some of the negative impacts include:

- Dirt and sand create thick deposits that can clog brooks and lakes;
- Pollution harms essential habitat for aquatic insects, fish and wildlife;
- Contaminated runoff can damage reservoirs that supply drinking water;
- Fertilizers stimulate excessive growth of pond weeds and harmful algae blooms;
- Bacteria and pathogens wash into swimming areas and create public health risks;
- Rapid runoff decreases the groundwater that renews stream flows during dry times.

Stormwater is now regulated by State and Federal laws. These DEP and EPA requirements can help communities to manage stormwater and sustain healthy waters.

Federal Stormwater Requirements

EPA requires a municipal permit for stormwater systems under the National Pollutant Discharge Elimination System (NPDES).

EPA's permit regulates the Municipal Separate Storm Sewer System (aka "MS4.") The MS4 is the local drainage system that collects storm runoff and takes it to some water body or wetland. All MS4 discharges must achieve Clean Water Act standards. The goal of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." In 1987, Congress amended the Clean Water Act to better regulate stormwater discharges.

If a city or town fully accomplishes the tasks required by the federal permit, EPA deems the MS4 to have met water quality standards. If a town fails to do everything, EPA assumes some stormwater discharges are "causing or contributing" to violation of clean water standards. EPA can impose fines if compliance falls short of the requirements. To that end, it is important to note that the MS4 includes the entire surface of streets and roads, as well as catch basins, pipes, detention ponds and channels.

EPA and DEP permits requires municipalities to apply Best Management Practices (BMPs) for recharging groundwater and cleaning dirty runoff before it harms surface waters and wetlands. State and federal requirements overlap and apply to varied municipal activities.

EPA and DEP also require permittees to develop a stormwater management program (SWMP) as the means to achieve pollutant reductions. The intent is an iterative process in developing a SWMP consistent with federal and state requirements, implementing the program, evaluating the effectiveness of BMPs, revising those parts of the program that are not effective at controlling pollutants, implementing the revisions, and then evaluating again. This process continues until water quality standards are attained.

Massachusetts Stormwater Requirements

The Department of Environmental Protection (DEP) has established Stormwater Management Standards to protect surface waters and ground waters. DEP requires these Standards in the Massachusetts Stormwater Handbook to promote pollution prevention, to encourage low impact development techniques and to improve maintenance of stormwater BMPs.

Stormwater runoff from rainfall and snow melt is the largest cause for water quality impairments in the Commonwealth's rivers, lakes, ponds, and marine waters. New and existing development can alter natural drainage, increase peak discharge, reduce recharge to wetlands and streams, and increase the discharge of pollutants to wetlands and water bodies.

The Stormwater Management Standards apply to development and redevelopment projects with discharge to wetlands or within 100 feet of a wetland. In summary, the ten Standards are:

- There shall be no new untreated stormwater discharges.
- The peak discharge after development cannot exceed the pre-development peak discharge.
- Minimize loss of groundwater recharge through use of infiltration practices.
- Stormwater treatment must remove at least 80% of the total suspended solids.
- Runoff with high pollutant loads requires treatment that is described in the Massachusetts Stormwater Handbook.
- Water supplies and other "critical" areas require effective pollution prevention methods that are described in the Massachusetts Stormwater Handbook.
- At a minimum, a redevelopment project must improve the existing conditions.
- There must be a plan to control erosion, sedimentation and other pollutant sources during construction and land disturbance activities.
- An operation and maintenance plan is required to ensure stormwater management systems will function as designed.
- All illicit discharges to the local stormwater drainage system are prohibited.

Administration of these Standards is the responsibility of the local Conservation Commission through the Massachusetts Wetlands Protection Act (WPA), which recognizes public benefits provided by wetlands, water bodies and other areas subject to protection. These Stormwater Standards can also be added to local ordinances/bylaws and regulations administered by other municipal officials or boards.

Stormwater discharges to any critical area require specific best management practices described in the Stormwater Handbook. Critical areas include recharge zones for public water supplies, bathing beaches, vernal pools, cold-water fisheries and shellfish growing areas.

<u>Three Components of Stormwater Management</u>

The Stormwater Handbook explains that cost-effective stormwater management requires varied control methods, including careful site design, pollution prevention, structural Best Management Practices and maintenance of BMPs. The best stormwater management plans will mimic natural conditions by recharging groundwater and slowing runoff to storm drains and receiving waters.

To meet state Standards, a project proponent needs to consider the following three stormwater management components in this order of priority:

- *Site Planning*: Apply environmentally sensitive design and low impact development techniques to preserve natural vegetation, minimize impervious surfaces, slow down times of concentration, and reduce runoff;
- *Source Control, Pollution Prevention, Erosion Control:* Implement nonstructural measures to prevent pollution or control it at its source; and
- *Structural BMPs:* Design, construct and maintain structural BMPs to lessen peak flows, capture and treat runoff, and provide recharge to groundwater.

Retaining natural hydrologic conditions through planning and nonstructural measures is a highly effective pollution prevention strategy. Reducing or eliminating the need for structural BMPs will result in a stormwater management system that suits the land and minimizes costs.

Structural Best Management Practices

Volume 2 of the Stormwater Handbook describes structural Best Management Practices (BMPs) that may be used to manage stormwater runoff in accordance with the Stormwater Management Standards. The DEP groups BMPs into several basic types listed below:

Pretreatment BMPs: The first BMPs remove coarse sediments that can clog other BMPs. The settling process generates sediment that must be routinely removed. Maintenance is especially critical for pretreatment BMPs, because they receive stormwater containing the greatest concentrations of suspended solids during the first flush. Pretreatment BMPs include Deep Sump Catch Basins, Oil Grit Separators, Sediment Forebays and Vegetated Filter Strips

Treatment BMPs: The three main types of Treatment BMPs are briefly described below.

Stormwater Treatment Basins: These BMPs provide peak rate attenuation by detaining stormwater and settling out suspended solids. The basins that are most effective at removing pollutants have either a permanent pool of water or a combination of a permanent pool and extended detention, and some elements of a shallow marsh.

Constructed Wetlands: These wetlands will remove pollutants through wetland vegetation uptake, retention and settling. Gravel wetlands remove pollutants by filtering stormwater through a gravel substrate.

Filtration BMPs: Filtration systems use media to remove runoff pollutants. They are typically used where space is limited in an urban setting – or to capture industrial or commercial pollutants. In these circumstances, other BMPs might be cost-prohibitive or not as effective.

Additional Structural BMPs :

Conveyance BMPs: These BMPs collect and transport runoff to other BMPs. These practices may also treat runoff through infiltration, filtration, or temporary storage.

Infiltration BMPs: Infiltration systems put storm water into the ground. Infiltration practices typically cannot provide channel protection and flood detention storage. Infiltration BMPs include: Bioretention Areas, Rain Gardens, Infiltration Basins, Infiltration Trenches, Leaching Catch Basins and Subsurface Structures.

III. Lunenburg Water Resources

Watersheds and sub-basins

"The Town of Lunenburg lies within the Nashua River Watershed Basin, which serves 31 watershed communities in north central Massachusetts and southern New Hampshire. … The Nashua's watershed encompasses 538 square miles. The majority of the Town lies within three sub-basins: Catacunamaug Brook, Mulpus Brook, and Falulah/Baker Brook."

Surface Water

Lunenburg has a number of streams, ponds and lakes within its boundaries. Surface waterbodies account for 2.37 square miles of the Town's twenty-nine square miles of total area. Numerous streams, ranging from small flows to larger streams draining into wetlands and ponds, flow through and within the Town. These brooks are too small for active recreation. In 1996 the Rivers Protection Act became law, providing safeguards for the Town's perennial streams.

Project Sub-basins

The purpose of this project is to rank priority outfalls (high/medium/low) that harm Town waters; to identify best management practices for high priority outfalls and calculate BMP pollutant removal; to provide BMP cost estimates, funding options and maintenance guidance. The five high value sub-basins included in the analysis for the Town are:

- Upper Mulpus Brook which is a Coldwater Fish Resource (CFR) and is the main surface water source for Hickory Hills Lake. The land use in this sub-basin is primarily forest or wetland, with some residential, agricultural, and protected or limited-protection land. Less than 6% of the sub-basin is impervious area, which helps to sustain stable channels, good to excellent water quality, and habitats for fish and aquatic insects.

- Hickory Hills Lake is located in north central Lunenburg. The approximately 331 acre Lake is owned and maintained by Hickory Hills Landowners, Inc., and is used for recreation by residents abutting the water. The average and maximum depths of the Lake are ten feet and twenty feet, respectively. The water quality is suitable for swimming. Like Lake Shirley, the lack of public access limits use of the water for public recreation.

- Catacoonamug Brook is a CFR that flows southerly over the Town wellfields and into Lake Shirley. Lake Whalom and Massapoag Pond are also in the Catacoonamug Brook sub-basin. The 99 acre Lake Whalom is used for swimming, boating and fishing. There is a public boat ramp in Leominster and the Lake is stocked with trout by the state. The Lunenburg Town Beach provides swimming for Town residents and there are other private beach areas. The land use in this sub-basin is primarily forest or wetland with some residential, agricultural, and protected or limited-protection land. About 10 percent is impervious area and the source of stormwater runoff that can decrease the water quality and stream life in this sub-basin.

- Easter Brook is a CFR that flows easterly into Lake Shirley. The land uses include forest or wetland, small residential areas, large protected agricultural lands and commercial/industrial

activities including sand and gravel mining. Stormwater runoff from heavily travelled roads can impact the Brook's water quality and stream life.

- Lake Shirley in southeastern Lunenburg has many swimming beaches and supplies water to private wells. The Lake covers 366 acres and has an average depth of twenty-eight feet. There is no public access to the water; however, private entities on its shores utilize the Lake for recreation and allow launching of boats for a fee. There are high density residential uses along the entire lakeshore, as well as large residential developments across the lake's drainage area. The housing and roads increase impervious areas that are sources of stormwater runoff and other nonpoint pollution. Lake Shirley is in a eutrophic state, enriched by nutrient loading that stimulates algae and weed growth, which deplete oxygen in the lake.

Current Conditions of Project Sub-basins

The objective of the federal Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. As one step toward meeting this goal, each state must provide periodic status reports to the U.S. Environmental Protection Agency and the public.

Local waters are evaluated with respect to uses defined by the states' surface water quality standards. These uses include aquatic life support, fish and shellfish consumption, drinking water supply, and primary (e.g., swimming) and secondary (e.g., boating) contact-recreation. Where possible, the causes and sources of impairment are also identified.

The CWA requires states to identify those waterbodies that are not expected to meet the water quality standards and to schedule them for the development of total maximum daily loads (TMDLs). A TMDL establishes the maximum amount of a pollutant that may be introduced into a waterbody and still ensure attainment of water quality standards.

The Massachusetts Department of Environmental Protection (DEP) reports the conditions of local waters in one of the following five categories:

1) Unimpaired and not threatened for all designated uses;
2) Unimpaired for some uses and not assessed for others;
3) Insufficient information to make assessments for any uses;
4) Impaired or threatened for one or more uses, but not requiring the calculation of a TMDL; or
5) Impaired or threatened for one or more uses and requiring a TMDL

The Draft 2016 DEP Integrated List of Waters reports the following categories for waterbodies in Lunenburg.

Waterbody name	Category	Designated Uses/Impairments	Conditions report details
Upper Mulpus Brook	2	Not impaired for: aesthetic use; primary contact recreation; secondary contact recreation	Aquatic life use not assessed upstream of Hickory Hills Lake
Hickory Hills Lake	4A	Mercury in fish tissues	TMDL for mercury is complete
Upper Catacoonamug Brook	5	Impaired for primary and secondary contact recreation (due to E.coli bacteria)	Aquatic life not assessed upstream of Lake Shirley
Easter Brook	Unlisted	Not assessed	
Lake Shirley	5	Impaired for: aesthetic use; aquatic life; primary recreation; secondary recreation	Harmful algal bloom, turbidity, non-native aquatic plants
Lake Shirley	4A	Mercury in fish tissues	TMDL for mercury is complete
Lake Whalom	4C	Impaired for aquatic life; but not assessed for aesthetic, primary or secondary recreation	Non-native aquatic plants, milfoil

Stormwater damages to water quality, ecosystems and public health

When it rains onto a forest or a field, most of that rain soaks into the ground and becomes the groundwater that replenishes streams, lakes and water supplies. Some of the rain is taken up by plants, and some of it evaporates. In cities and towns, some rain falls onto surfaces such as roofs, sidewalks, parking lots, and driveways that don't allow the water to be absorbed by the ground. The water that you see flowing down the street is called stormwater runoff, which can convey many types of pollutants that may include:

- oil, grease, metals and automotive fluids;
- fertilizer and pesticides from gardens and homes;
- bacteria from pet waste and improperly maintained septic systems;
- soil from improper construction site management;
- sand from wintertime snow removal;
- soap from car washing;
- litter or debris, including lawn grass clipping and leaves.

Many people assume that stormwater flows down storm drains and then to a pollutant treatment facility. But stormwater either flows directly into local waters or into storm drains that discharge into local water bodies. This polluted runoff threatens community water uses, harms natural areas and contributes to flooding.

Pollutant control with federal and state regulations

EPA MS4 Stormwater Permit: Federal and state regulations require the Town to reduce the discharge of pollutants from the stormwater drainage system to protect water quality and to comply with the Clean Water Act. If there is a discharge to a waterbody that is impaired due to nutrients, bacteria/pathogens, solids, metals, chloride or oil and grease, the Town shall comply with all applicable MS4 permit requirements and implementation schedules that will reduce stormwater pollutants.

*Massachusetts Water Quality Standards:*The state's Surface Water Quality Standards designate uses for the waters of the Commonwealth. The anti-degradation provisions of these Standards require the level of water quality necessary to protect designated uses. The surface waters of the Commonwealth are assigned to the Classes listed in the Standards. Each class is identified by the most sensitive water uses to be achieved. Surface waters may be suitable for other beneficial uses, but are regulated by the DEP to protect and enhance the designated uses. Minimum water quality requirements accompany each class and the specific numerical criteria include dissolved oxygen, temperature, pH, bacteria, solids, color and turbidity, oil and grease, taste and odor.

The DEP Stormwater Standards also regulate pollutants from stormwater discharges (the ten standards are described above). Stormwater Standard 6 has more stringent regulations for discharges to critical areas, which include water supplies, vernal pools, swimming beaches and cold-water fisheries. Under the Wetlands Protection Act, the Conservation Commission must require specific BMPs in the DEP Stormwater Handbook for discharges to critical areas.

Description of Sub-basins project activities

- Lunenburg Stormwater Task Force

The Stormwater Task Force is charged with development of a stormwater management program that complies with state and federal regulations and protects surface water quality. The program shall determine which local agency or agencies will be responsible for implementation, establish the estimated cost of the program, as well as provide for the creation of an ongoing funding source to enable its success.

All members are appointed by the Board of Selectmen. The Stormwater Task Force held its initial meeting in January 2016 and helps to involve Town residents in stormwater management. Task Force members have been working to provide education and outreach, including ongoing development of information and materials provided on the Town website.

The Stormwater Task Force is working with Design Consultants, Inc. (DCI) to update the Town's Stormwater Management Program and comply with new requirements of the EPA MS4 Permit. As part of these activities, DCI has assisted with mapping of the storm drainage system and with the sub-basin analysis of discharges (aka outfalls) to Lunenburg streams and lakes.

- Sub-basin project tasks

The sub-basin analysis of outfall priorities began in November 2017. Project work is partly funded by the MA Community Compact Cabinet Best Practices Program. The individual project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

For each of the five project sub-basins, the project describes high, medium and low priority outfalls and the delineation of high priority catchment areas. The sub-basins research included the following activities.

Task 1- Initial Ranking: The DCI Team performed an initial desktop assessment to identify the outfall catchment areas. This data enabled an initial priority ranking (high, medium, and low) used for further assessment by site visits.

Task 2 – Site Visits: The DCI Team visited outfall/catchment sites to evaluate conditions. Site visits detected signs of impairment to critical areas including swimming beaches, cold-water fisheries, vernal pools and water supplies.

Task 3 – BMP Selection: The initial outfall priority ranking was adjusted to protect critical areas identified by site visits. The DCI team also researched soils suitability and the requirements of treatment options described by DEP Stormwater Standard 6 for critical areas. The BMP cost estimates and pollutant removal estimates were then developed.

Task 4 – Funding Sources: The DCI Team recommended sources of BMP funding by local, state and federal programs, and determined potential in-kind matching sources.

Task 5 – Schedule: The DCI Team recommended a provisional ten year timetable for BMP implementation, which will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Task 6 – Maintenance and Monitoring: The DCI Team prepared an Operation and Maintenance Plan for each BMP recommended in Task 3. Guidance for outfall inspections and water testing is also provided to assess BMPs performance and changes of receiving waters.

The following sections present project analyses of the five sub-basins. Each of the sub-basin reports includes:

- Recommended priority sites and physical characteristics (e.g., types of soils)
- Delineation of high-priority catchment areas and estimated pollutant loading
- Recommended BMPs and pollutant removal effectiveness

- Estimated BMPs costs
- Funding sources and schedule for BMP implementation
- Operations and maintenance of BMPs

Catacoonamug Brook Sub-basin Report

Introduction

The Catacoonamug Brook Sub-Basin is located in Lunenburg and Leominster. It flows in a southerly direction into Lake Shirley. The watershed is currently dominated by forests, wetlands and agricultural fields, with some roads passing north to south (Leominster Road, Lancaster Avenue, Cross Street and Sunnyhill Road) or east to west (Mass Ave, Prospect Street and Page Street). Catacoonamug Brook is a state-designated Coldwater Fish Resource (CFR).

The individual Project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

The attached map below shows high, medium and low priority outfalls and the delineation of high priority catchment areas in the Catacoonamug Brook sub-basin. In addition, the report findings fulfill many elements required by the US Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP) guidelines for watershed-based planning. Instead of pollutant sources based on general land use data, the sub-basin analysis identifies direct discharges to waterbodies from storm sewers and streets.

Catacoonamug Brook flows over the Town wellfields, then into Houghton's Mill Pond before it enters Lake Shirley. Lake Whalom and Massapoag Pond are also in this sub-basin. The 99 acre Lake Whalom is used for recreational purposes. There is a public boat ramp in Leominster, and the Town Beach is used by Lunenburg residents. The Lake is owned by the state and its water quality is suitable for swimming. The 56 acre Massapoag Pond is privately owned and most of the shoreline is undeveloped agricultural land or wetland. The lack of public access limits recreation uses of the Pond.

The major land uses in this sub-basin are protected forest or wetland, extensive agricultural lands and low density residential neighborhoods. Roughly 10 percent has impervious cover and is a source of stormwater runoff that can harm the water quality and aquatic life in this sub-basin.

Upper Catacoonamug is a Category 5 in the Draft 2016 MassDEP Integrated List of Waters. The Brook is impaired for recreation uses due to E.coli bacteria, but aquatic life has not been assessed upstream of Lake Shirley. Lake Whalom is Category 4C and is impaired due to non-native aquatic plants. Massapoag Pond is Category 3 waterbody that has not been assessed by MassDEP.

Research of the Catacoonamug sub-basin included the tasks described below.

Task 1- Initial Ranking

The DCI Team performed desktop reviews of available computer information (Town GIS, MassGIS, storm drainage systems, etc.) to approximate the outfall catchment areas and pollutant loading. This data was used to prepare an initial priority ranking (high, medium, and low) for further assessment by site visits. The reviews identified one hundred ninety-six (196) stormwater outfalls including discharges at road crossings of the Catacoonamug Brook and its tributaries. Most of the outfalls flow into existing vegetation buffers and wetlands, which provide treatment of stormwater and were considered low priority. Other outfalls were ranked as high or medium priority. All outfalls were examined by site visits.

Task 2 – Site Visits

The DCI Team inspected the outfall/catchment sites to evaluate current conditions and adjust rankings as necessary. Site visits investigated impairments of critical areas for cold-water fish, swimming beaches, water supplies and vernal pools. Impairment indicators included sand/silt deposits in stream bed, water clarity, sand deposits at catch basins and at road crossings, roadside erosion gullies and pet waste management. Site visits also identified:

- Development Density
  - Greater density = more impervious area that causes runoff
  - Greater density = less natural vegetation that cleans runoff
  - Greater density = more automobiles, fertilizers, dogs and other sources of pollutants

- Proximity of runoff discharge to water bodies, wetlands and vernal pools
- Vegetative buffers between stormwater discharges and receiving waters
- Slope (steeper slope = more runoff problems)

The DCI Team also visited sites online using Google Street View and/or Bing Street View. This virtual information augmented actual site visits and revealed previous site conditions that enabled historic comparison (e.g., before and after road paving or other changes). The DCI Catacoonamug Brook sub-basin map (Figure 1) of high, medium, low priorities shows outfall rankings. The final outfall rankings target the protection of critical areas. Table CB-1 is a listing of site locations, site conditions, outfall ranking and critical areas.

Table CB-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Fish Street CA: 1-5	Minor runoff to roadside vegetation	Negligible	Minimal runoff to critical areas
Sunset Avenue CA: 6-7	Minor runoff to vegetation & lake	Low priority	Runoff treatment by vegetation

Table CB-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Cross Street CA: 8-17	Minor runoff to roadside vegetation & wetlands	Negligible	Outfalls >500' from critical areas
Prospect Street CA: 18-20	Minor runoff to roadside vegetation & existing wetlands	Minor (low priority)	Runoff treatment by vegetation
Crocker Avenue CA: 21-22	Minor runoff to lake	Low priority	Minimal runoff to swimming beach
Lakeside Ave CA: 23	Minor runoff to Lake Whalom	Low priority	Minimal runoff to Lake near to beach
Lakefront Street CA: 25-29	Major runoff into catch basins with discharge pipes into Lake Whalom	High priority	Potential pet feces & sediments piped near lake weeds & swimming beaches
Prospect Street CA: 30-31	Minor runoff to wetland swale with discharge pipes into Lake Whalom	Low priority	Road runoff treatment by wetland prior to discharge near swimming beaches
Prospect Street CA: 32-33	Major runoff to catch basins with discharge pipes into Lake Whalom	High priority	Runoff to storm sewer pipes to direct discharge beside Town Beach
Prospect Street CA: 34-39	Moderate runoff to road vegetation & pipes into Lake Whalom	Low priority	Map & monitor outfalls for discharge near beaches & assess need for BMPs
Elm Street CA: 40-42	Minor runoff discharges to existing wetlands & ponds beside road	Minor	Inspect every year for runoff impacts to adjacent wetlands & ponds
Leominster Rd CA: 43-46	Minor runoff to roadside vegetation and wetlands	Low priority	Runoff treatment by vegetation prior to discharge near CFR
West Street CA: 47-48	Minor runoff to roadside vegetation and outfalls to wetlands	Negligible	Runoff treatment by vegetation & wetlands; outfalls >500' from CFR
West Street CA: 49-50	Moderate runoff discharges directly into brook at road crossing	Medium Priority	Gullies & road chute discharge sand & silt with deposits in stream bed of CFR
West street CA: 52-54	Minor runoff to roadside vegetation and woodlands	Negligible	Runoff treatment by vegetation, outfalls >1,000' from CFR
Sunnyhill Road CA: 51, 55-58	Moderate runoff to catch basins, roadside vegetation & woodlands	Low priority	Annually inspect catch basins & outfalls for runoff impacts to CFR

Table CB-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Sunnyhill Road CA: 59-60	Minor runoff to catch basins and road vegetation	Low priority	Treatment by catch basins and vegetation, annually inspect outfall to CFR
Sunnyhill Road CA: 61-64	Minor runoff & direct discharge to east side of road	Low priority	Runoff gully & discharge at culvert for small tributary of CFR
Mass Avenue CA: 65-72	Minor runoff to roadside vegetation and/or small wetlands	Minor	Runoff treatment by vegetation, inspect outfalls for runoff to first order stream
Beal Street CA: 73-78	Minor runoff to roadside vegetation	Minor	Treatment by vegetation and catch basins; inspect/clean catch basins
Mass Avenue CA: 79-90	Minor runoff to roadside vegetation and/or small wetlands	Minor	Runoff treatment by existing vegetation, Outfalls > 800' from CFR
Northfield Road CA: 91-94	Minor runoff to roadside vegetation	Minor	Runoff treatment by existing vegetation
Mass Avenue CA: 95-97	Minor runoff to roadside vegetation and/or wetlands	Low priority	Runoff flows away from potential vernal pool to vegetated wetland areas
Lancaster Avenue CA: 98-99	Moderate runoff to catch basins and roadside vegetation	Low priority	Runoff treatment prior to CFR tributary, inspect outfall, clean catch basins yearly
Rolling Acres CA: 100, 103-104	Moderate runoff to catch basins and small wetlands	Low priority	Treatment by vegetation & catch basins; sweep streets & clean catch basins
Lancaster Avenue CA: 101	Moderate road runoff to catch basin, and chute to stream bank gully	Medium priority	Untreated road discharge of sand/dirt directly into small CFR tributary
Lancaster Ave CA: 102, 105-106	Moderate runoff to road vegetation and woodland	Low priority	Runoff treatment by vegetation, outfalls >500' from CFR tributary
Page Street CA: 107-110	Moderate runoff to catch basins and discharge by chutes at road crossing	Medium priority	Partly treated by catch basins, discharge of sand/silt directly into CFR tributary
Page Street CA: 112-114, 117	Minor runoff to roadside vegetation and small wetlands	Minor	Runoff treatment by existing vegetation
Arbor Street CA: 115-116	Minor runoff to roadside vegetation and small wetlands	Minor	Runoff treatment by existing vegetation

Table CB-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Lancaster Avenue CA: 118-124	Moderate runoff to road vegetation, woodland and wetlands	Low priority	Runoff treatment by existing vegetation, outfalls >500' from CFR
Reservoir Road CA: 111, 125	Minor runoff to road vegetation and woodlands	Minor	Runoff treatment by vegetation, outfalls >500' from CFR tributary
Burrage Street CA: 126-135	Moderate runoff to road vegetation, woodlands and wetlands	Low priority	Runoff treatment by existing vegetation, Outfalls >500' from CFR tributary
Reservoir Road CA: 136-140	Moderate runoff to road vegetation and wetlands	Low priority	Runoff treatment by vegetation, outfalls >500' from CFR
Houghton Mill Road. CA: 141-145	Moderate runoff to road vegetation, catch basins and woodlands	Low priority	Treatment by catch basins & vegetation, Outfalls >500' from CFR
Reservoir Road CA: 146-147	Minor runoff to road vegetation and catch basins	Low priority	Treatment by catch basins & vegetation, Outfalls <100' from CFR
Reservoir Road CA: 148-150	Moderate runoff direct discharges by chute and gully at road crossing	Medium priority	Deposits of sand/silt from road runoff are visible on bottom of brook/CFR
Flat Hill Road CA: 151	Moderate runoff to road vegetation and catch basins piped to outfall	Low priority	Treatment by catch basins & vegetation, outfall discharge to wetland and CFR
Houghton Mill Rd. CA: 152-155	Moderate runoff to road vegetation, catch basins and wetlands	Low priority	Treatment by catch basins & vegetation, outfall discharge to wetlands
Goodrich Street CA: 156-159	Minor runoff to road vegetation and catch basins and wetland	Low priority	Treatment by catch basins & vegetation, annually inspect outfall to CFR tributary
Lancaster Avenue CA: 160-166	Minor runoff to road vegetation and wetland	Low priority	Treatment by road vegetation, annually inspect outfall to CFR tributary
Goodrich Street CA: 167-170	Minor runoff to road vegetation, catch basins, woodland and pond	Low priority	Treatment by catch basins & vegetation, annually inspect outfall to farm pond
Kilburn Street CA: 171-174	Minor runoff to road vegetation, catch basins and wetland	Low priority	Treatment by catch basins & vegetation, outfalls <200' from brook/CFR
Goodrich Street CA: 175-179	Minor runoff to road vegetation, woodlands and wetland	Low priority	Runoff treatment by existing vegetation, outfalls >500' from CFR

Table CB-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Kilburn Street CA: 180-183	Minor runoff to road vegetation, woodlands and wetland	Low priority	Runoff treatment by existing vegetation, outfalls >1000' from CFR
Leominster Road CA: 184-187	Minor runoff to road vegetation, woodlands and wetland	Low priority	Runoff treatment by existing vegetation, outfalls >1000' from CFR
Lancaster Avenue CA: 188-196	Minor runoff to road vegetation, woodlands and wetland	Low priority	Runoff treatment by existing vegetation, outfalls >500' from CFR

Task 3 – BMP Selection

The initial priority ranking was checked by site visits and adjusted to protect critical areas. The DCI Team then reviewed soils mapping by the USDA Natural Resources Conservation Service to determine suitability of onsite soils for infiltration practices and other stormwater BMPs. In addition, the Team looked at right-of-way dimensions for Town roads in relation to size of BMPs that meet DEP Stormwater Standard 6 for critical areas (i.e., how much space is needed to install BMP).

The DCI Team conducted more site visits to develop conceptual designs for stormwater treatment practices, which are provided in the report attachments. BMP cost estimates and pollutant removal estimates are based on BMP designs, catchment areas, soils and related factors. The Team coordinated the site visits with the DPW Director to consider recommended BMPs, cost estimates and pollutant removal options. Table CB-2 shows site priorities, soils types, proposed BMPs and pollutant removal estimates along with brief field notes about site conditions.

Table CB-2 Priority Sites, Soils, Proposed BMPs and Field Notes				
Outfall Location & Site Priority	**Soils HSG A, B, C, D**	**Proposed BMPs**	**Estimated BMP Pollutant Removal**	**Field Notes**
Lakefront Street CA: 25-29 High Priority	C	(4) baffle boxes placed at each manhole of the four outfall pipes	70% TSS 35% TP	Existing catch basins connected to large cast iron pipes that discharge under surface of Lake Whalom

Table CB-2
Priority Sites, Soils, Proposed BMPs and Field Notes

Outfall Location & Site Priority	Soils HSG A, B, C, D	Proposed BMPs	Estimated BMP Pollutant Removal	Field Notes
Prospect Street CA: 30-31 Low Priority	C	Housing project at 274 Prospect St. will require stormwater plan	90% TSS 60% TP (required by new MS4 rules)	Low impact site design & non-structural practices can prevent harm to public & private beaches
Prospect Street CA: 32-33 High Priority	C	Options include baffle boxes and/or leaching catch basins	70-90% TSS 35-70% TP	Mapping of catch basins and storm pipes is required for BMP selection
Prospect Street CA: 34-39 Low Priority	C	Selection of BMP will be based on storm sewer mapping	n/a	Mapping of catch basins and storm pipes is required for BMP selection
West Street CA: 49-50 Medium Priority	C	Bioswale/level spreader to vegetative buffer beside brook	90% TSS 70% TP	Install bioswale on south side of road, east of stream crossing; ROW (road right-of-way) is 10' wide x 80' long
Lancaster Avenue CA: 101 Medium Priority	C	Rock gabion & bioswale with level spreader to streamside vegetation	90% TSS 70% TP	Gabion will slow down road runoff for infiltration by bioswale & level spreader; ROW 15' wide x 70' long
Page Street CA: 107-110 Medium Priority	A	Bioswale/level spreader to roadside vegetation	90% TSS 70% TP	(Existing stone swale on southeast side of brook) add swale southwest side of brook; ROW 20' wide x 60' long
Reservoir Rd CA: 148-150 Medium Priority	A	Bioswale/level spreader to roadside vegetation	90% TSS 70% TP	Add bioswale to divert runoff from chute on northwest side of Brook crossing; ROW 12' wide x 90' long

HSG soils groups definition: A=excessively drained; B=well drained; C=moderately drained; D=poorly drained; Urban=varied perviousness

Task 4 – Funding Sources

The DCI Team recommended potential local, state and federal funding. The Team also identified potential in-kind matching support for priority BMPs to protect the critical areas in the sub-basin. Recommended sources of local, state and federal funding include:

- Lunenburg Pavement Management Program
- Section 319 Nonpoint Source Pollution Program (MassDEP and EPA)

Additional state and federal funding and assistance that may be available include:

- Transportation Improvement Programs (MassDOT, MRPC TIPs process, etc.)
- Clean Water Revolving Fund Loans

Potential BMP funding and in-kind support from builders and community organizations include:

- Wetlands Protection Act stormwater requirements for proposed developments
- Lake Shirley Improvement Corporation
- Private charitable foundations and corporate foundations

Task 5 – Schedule

The DCI Team prepared a provisional ten year timetable for BMP implementation:

- High priority outfall/catchment areas for Years 1-5
- Medium priority areas for years 4-8
- Low priority areas for years 6-10

The BMP implementation schedule will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Table CB-3 is a listing of BMP cost estimates, funding sources and implementation timing for priority sites.

Table CB-3
Priority BMPs Sites, Costs, Funding and Implementation Timing

Outfall location & site priority	Proposed BMPs (see Table 2 for detail)	Estimated BMP Costs	Recommended Funding Sources	Timetable (Estimated)
Lakefront Street CA: 25-29 High Priority	(4) baffle boxes placed at each manhole of the four outfall pipes	$10,000 ea.	DPW Annual Paving program	Year 5
Prospect Street CA: 30-31 Low Priority	Housing project will be required to install BMPs for WPA stormwater plan	n/a	Housing project builder	n/a

Table CB-3 Priority BMPs Sites, Costs, Funding and Implementation Timing				
Outfall location & site priority	**Proposed BMPs (see Table 2 for detail)**	**Estimated BMP Costs**	**Recommended Funding Sources**	**Timetable (Estimated)**
Prospect Street CA: 32-33 High Priority	Baffle boxes and/or leaching catch basins (based on storm drainage mapping)	$10,000 ea.	DPW annual paving program	Year 3
Prospect Street CA: 34-39 Low Priority	Selection of BMPs to be based on storm drainage mapping	n/a	DPW annual paving program	Annual O&M
West Street CA: 49-50 Medium Priority	Bioswale/level spreader	$15 - 20,000	DPW annual paving program	Year 3
Lancaster Ave CA: 101 Medium Priority	Rock gabion & bioswale with level spreader	$10 - 15,000	DPW annual paving program	Year 6
Page Street CA: 107-110 Medium Priority	Bioswale/level spreader	$15 - 20,000	DPW annual paving program	Year 5
Reservoir Rd CA: 148-150 Medium Priority	Bioswale/level spreader	$15 - 20,000	DPW annual paving program MassDEP s.319 Grants program	Year 8

Task 6 – Maintenance and Monitoring

The DCI Team prepared an detailed Operation and Maintenance Plan for each BMP recommended in Table 3, which are provided in Attachment D. Guidance for outfall site inspections and water testing to assess BMPs performance is provided in Attachment E.

Report Attachments include:

(A) Conceptual designs of BMPs for high priority outfall/catchment areas
(B) Calculations of BMP costs for sub-basin priority sites
(C) Calculations of estimated pollutant loads and reductions by BMPs
(D) O&M Plans for each recommended BMP
(E) Outfall monitoring procedures for sub-basin priority sites

Footnote Reference
The Massachusetts Water Quality Standards protect cold-water fisheries, bathing beaches and other critical areas from degradation by stormwater discharges. Cold-water fisheries generally do not exceed 68^{o} F and

support fish that require colder water. Receiving waters designated as cold-water resources by Mass Fisheries & Wildlife or by MassDEP require stormwater discharges to meet specific criteria for temperature, dissolved oxygen, solids, oil, grease, petrochemicals, taste and odor.

Easter Brook Sub-basin Report

Introduction

The Easter Brook Sub-Basin (Sub-Basin) is located in Lunenburg, Leominster and Lancaster. It flows in an easterly direction into Lake Shirley. The watershed is currently dominated by forest and agricultural fields, with roads passing north to south (Lancaster Avenue, Goodrich Street, and Reservoir Road). Leominster Road and the Massachusetts Bay Transportation Authority's Fitchburg Line pass through the sub-basin in the south quadrant of the Sub basin. Easter Brook flows into Lake Shirley and is a state-designated Coldwater Fish Resource (CFR).

The individual Project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

The attached Easter Brook Sub-basin shows the high, medium and low priority outfalls, and the delineation of high priority catchment areas in the Easter Brook Sub-basin. In addition, the report findings fulfill many elements required by the US Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protections (DEP) guidelines for watershed-based planning. Instead of pollutant sources based on general land use data, the sub-basin analysis identifies direct discharges to waterbodies from storm sewers and streets.

The major land uses in the sub-basin include forests, wetlands, small residential areas, large agricultural areas and commercial/industrial areas that include sand and gravel mining. Easter Brook is not in the Draft 2016 DEP Integrated List of Waters and impairments have not been reported. Polluted runoff from heavily travelled roads can harm the Brook's water quality and stream life, as well as transport pollutants to Lake Shirley.

Research of the Easter Brook sub-basin included the tasks described below.

Task 1- Initial Ranking

The DCI Team performed desktop reviews of available computer information (Town GIS, MassGIS, storm drainage systems, etc.) to approximate the outfall catchment areas and pollutant loading. This data was used to prepare an initial priority ranking (high, medium, and low) for further assessment by site visits. These reviews identified thirty-seven (37) stormwater outfalls including discharges at road crossings of Easter Brook and its tributaries. Most of the outfalls flow into existing vegetation buffers and wetlands, which provide treatment of stormwater and were considered low priority. Other outfalls were ranked as high or medium priority. All outfalls were examined by site visits.

Task 2 – Site Visits

The DCI Team inspected the outfall/catchment sites to evaluate current conditions and adjust rankings as necessary. Site visits investigated impairment to critical areas that support cold- water fish and vernal pools. Impairment indicators included sand/silt deposits in stream bed, water clarity, sand deposits at catch basins and at road crossings, roadside erosion gullies and pet waste management. Site visits also identified:

- Development Density
    - Greater density = more impervious area that causes runoff
    - Greater density = less natural vegetation that cleans runoff
    - Greater density = more automobiles, fertilizers, dogs and other sources of pollutants

- Proximity of runoff discharge to water bodies, wetlands and vernal pools

- Vegetative buffers between stormwater discharges and receiving waters

- Slope (steeper slope = more runoff problems)

The DCI Team also visited sites online using Google Street View and/or Bing Street View. This virtual information augmented actual site visits and revealed previous site conditions that enabled historic comparison (e.g., before and after road paving or other changes). The DCI Easter Brook sub-basin map (Figure 1) of high, medium, low priorities shows outfall rankings. The final outfall rankings target the protection of critical areas. Table EB-1 is a listing of site locations, site conditions, outfall ranking and critical areas.

Table EB-1 **Outfall Locations, Conditions, Ranking and Critical Areas**			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Gibson St EA: 1-5	Minor runoff to roadside vegetation	Negligible (i.e., low)	Minimal signs of runoff into CFR (Coldwater Fish Resource)
Gibson St EA: 6	Small erosion gully from road runoff Discharge at brook crossing	Medium	Sand/silt deposits in CFR stream bed
Lancaster Ave. EA: 7-11	Minor runoff to roadside vegetation	Negligible	Minimal signs of runoff into CFR; EA: 11 >1,000' from brook
Goodrich St EA: 12-19	Most runoff into roadside vegetation and adjacent woodlands	Minor (i.e., low)	Outfalls >1,000' from brook, some runoff conveyed by Goodrich Street
Reservoir Rd EA: 20-23	Minor runoff to roadside vegetation or adjacent wetland	Negligible	Minimal signs of runoff into CFR, or potential vernal pool
Reservoir Rd EA: 24	Minor runoff treated by rock riprap at road culvert inlet and outlet	Minor	Minimal signs of runoff to CFR; culvert requires annual inspection
Goodrich Stt EA: 25	Major road runoff discharges at inlet & outlet of brook culvert	High priority	Sand deposits/gully at road crossing & deposits in stream bed of CFR
Easter Brook Rd. EA: 26	Storm drain outfall to detention pond	Negligible	Outfall >500' from CFR with runoff released into pond
Leominster - Shirley Rd EA: 27-28; 31-34	Major runoff to roadside vegetation, former sediment forebay & wetlands beside brook	Minor	Inspect outfalls every year for runoff impacts to wetlands & CFR
Fort Pond Rd EA: 29-30	Minor runoff discharges to existing wetlands & ponds beside road	Minor	Inspect every year for run-off impacts to adjacent wetlands & ponds
Leominster - Shirley Rd, EA: 35	Storm pipe discharge to wooded wetland & potential vernal pool	Low	Outfall >300' from potential vernal pool; inspect yearly for runoff impacts

Table EB-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Rod & Gun Club Rd EA: 36-37	Minor runoff to vegetation beside private road	Negligible	Minimal signs of runoff to CFR or the potential vernal pool, inspect yearly
Lancaster Avenue EA: 38-39	Catch basins drain to storm sewer	Unknown	Map storm sewer pipes & inspect outfall for impacts to potential vernal pool

Task 3 – BMP Selection:

The initial priority ranking was checked by site visits and adjusted to protect critical areas. The DCI Team then reviewed soils mapping by the USDA Natural Resources Conservation Service to determine suitability of the onsite soils for infiltration practices and other stormwater BMPs. In addition, the Team looked at the right-of-way dimensions for Town roads in relation to size of BMPs that meet DEP Stormwater Standard 6 for critical areas (i.e., how much space is needed to install BMP).

The DCI Team conducted more site visits to develop conceptual designs for stormwater treatment practices, which are provided in the report attachments. BMP cost estimates and pollutant removal estimates are based on BMP designs, catchment areas, soils and related factors. The Team coordinated the site visits with the DPW Director to consider recommended BMPs, cost estimates and pollutant removal options. Table EB- 2 is a table of site priorities, soils types, proposed BMPs and pollutant removal estimates along with brief field notes about site conditions.

Table EB-2 Priority Sites, Soils, Proposed BMPs and Field Notes				
Outfall Location & Site Priority	**Soils HSG A, B, C, D**	**Proposed BMPs**	**Estimated BMP Pollutant Removal**	**Field Notes**
Gibson Road EA: 6; medium	C or D	Catch basin or divert runoff to vegetation	25% TSS; TP n/a 50% TSS; TP n/a	Catch basin to retain road sand & silt; Or diversion to roadside vegetation

Table EB-2
Priority Sites, Soils, Proposed BMPs and Field Notes

Outfall Location & Site Priority	Soils HSG A, B, C, D	Proposed BMPs	Estimated BMP Pollutant Removal	Field Notes
Goodrich Street EA: 25; High priority	A	Leaching catch basin Curb to bioretention & level spreader	80% TSS; _% TP 90% TSS; _% TP	Leaching CB with pre-treatment CB; 6" asphalt curb to divert runoff past brook crossing into bioretention with overflow outlet to existing woodland vegetation
Leominster-Shirley Road EA: 35; low	Urban fill	Baffle box if needed	70% TSS; 35% TP	Complete storm sewer system map & evaluate outfall water quality to determine if runoff impairs potential vernal pool

HSG soils groups definition: A=excessively drained; B=well drained; C=moderately drained; D=poorly drained; Urban=varied perviousness

Task 4 – Funding Sources

The DCI Team recommended potential local, state and federal funding. The Team also identified potential in-kind matching support for priority BMPs to protect the critical areas in the sub-basin. Recommended sources of local, state and federal funding include:

- Lunenburg Pavement Management Program
- Section 319 Nonpoint Source Pollution Program (MassDEP and EPA)

Potential BMP funding and in-kind support from builders and community organizations include:

- Wetlands Protection Act stormwater requirements for proposed developments
- Lake Shirley Improvement Corporation

Task 5 – Schedule

The DCI Team prepared a provisional ten year timetable for BMP implementation:

- High priority outfall/catchment areas for Years 1-5
- Medium priority areas for years 4-8
- Low priority areas for years 6-10

The BMP implementation schedule will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Table EB-3 is a table listing of BMP cost estimates, funding sources and implementation timing for priority sites.

Table EB-3
Priority BMPs Sites, Costs, Funding and Implementation Timing

Outfall location & site priority	Proposed BMPs (see Figure 3 for detail)	Estimated BMP Costs	Recommended Funding Sources	Timetable (Estimated)
Gibson Road EA: 6; medium	Catch basin or diversion to roadside vegetation	$ 5,000 - 10,000	DPW Annual Paving Program MassDEP s.319 Grants Program	Year 4
Goodrich Street EA: 25; High priority	Leaching catch basin; Curb to bioretention & level spreader	$10,000 - 12,000; $10,000	DPW annual paving program MassDEP s.319 Grants Program	Year 3
Leominster-Shirley Road EA: 35; low	Baffle box, if needed (pending evaluation)	$15,000 - 20,000	DPW annual paving program	Year 3

Task 6 – Maintenance and Monitoring

The DCI Team prepared a detailed Operation and Maintenance Plan for each BMP recommended in Figure 3, which are provided in Attachment D. Guidance for outfall site inspections and water testing to assess BMPs performance is provided in Attachment E.

Footnote Reference
The Massachusetts Water Quality Standards protect cold-water fisheries, bathing beaches and other critical areas from degradation by stormwater discharges. Cold-water fisheries generally do not exceed 68° F and support fish that require colder water. Receiving waters designated as cold-water resources by Mass Fisheries & Wildlife or by MassDEP require stormwater discharges to meet specific criteria for temperature, dissolved oxygen, solids, oil, grease, petrochemicals, taste and odor.

Report Attachments include:

(A) Conceptual designs of BMPs for high priority outfall/catchment areas
(B) Calculations of BMP costs for sub-basin priority sites
(C) Calculations of estimated pollutant loads and reductions by BMPs
(D) O&M Plans for each recommended BMP
(E) Outfall monitoring procedures for sub-basin priority sites

Hickory Hills Sub-Basin Report

Introduction

The Hickory Hills Lake Sub-Basin is located in Lunenburg and Townsend. The watershed is currently dominated by forests and housing, with some roads passing north to south (Townsend Harbor Road and Gilchrest Street) or east to west (Island Road, South Row Road, Hemlock Drive). The Lake has many private swimming beaches and supplies water to private wells.

The individual Project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

The attached map below shows medium and low priority outfalls in the Hickory Hill Lake sub-basin. In addition, the report findings fulfill many elements required by the EPA and MassDEP guidelines for watershed-based planning. Instead of pollutant sources based on land use data, the sub-basin analysis identifies direct discharges to waterbodies from storm sewers and streets.

The 331 acre Lake is owned and maintained by the Hickory Hills Landowners Inc. The dam that forms the Lake impounds upper Mulpus Brook, which is the primary source of water. The Lake affords boating, swimming, fishing and other uses for nearby residents. The lack of access limits public use of the Lake for recreation.

The Draft 2016 MassDEP Integrated List of Waters shows Hickory Hills Lake is a Category 4A due to mercury in fish tissue. There are high density residential areas along the entire lakeshore and several large subdivisions within the Lake's watershed. Housing and roads in the watershed increase impervious areas that are sources of stormwater runoff and other pollution. Sediments carried by Mulpus Brook create thick deposits at its inlet to the Lake and nutrients in runoff promote growth of invasive aquatic plants. Hickory Hills Landowners Inc. formed a Lake Management Group to identify and evaluate issues that affect the health of the lake.

Research of the Hickory Hills Lake sub-basin included the tasks described below.

Task 1- Initial Ranking

The DCI Team performed desktop reviews of available computer information (Town GIS, MassGIS, storm drainage systems, etc.) to approximate the outfall catchment areas and pollutant loading. This data was used to prepare an initial priority ranking (high, medium, and low) for further assessment by site visits. These reviews identified sixty-two (62) stormwater outfalls including discharges at road crossings of the Lake. Most of the outfalls flow into existing vegetation buffers and wetlands, which provide treatment of stormwater and were considered low priority. Other outfalls were ranked as medium priority. All outfalls were examined by site visits.

Task 2 – Site Visits

The DCI Team inspected the outfall/catchment sites to evaluate current conditions and adjust rankings as necessary. Site visits investigated impairment to critical areas that support swimming beaches and vernal pools. Impairment indicators included sand/silt deposits in water bodies, water clarity, sand deposits at catch basins and at road crossings, roadside erosion gullies and pet waste management. Site visits also identified:

- Development Density
  - Greater density = more impervious area that causes runoff
  - Greater density = less natural vegetation that cleans runoff
  - Greater density = more automobiles, fertilizers, dogs and other sources of pollutants

- Proximity of runoff discharge to water bodies, wetlands and vernal pools
- Vegetative buffers between stormwater discharges and receiving waters
- Slope (steeper slope = more runoff problems)

The DCI Team also visited sites online using Google Street View and/or Bing Street View. This virtual information augmented actual site visits and revealed previous site conditions that enabled historic comparison (e.g., before and after road paving or other changes). The DCI Hickory Hills Lake sub-basin map (Figure 1) shows outfall rankings as medium and low priorities. The final outfall rankings target the protection of critical areas. Table HH-1 is a listing of site locations, site conditions, outfall ranking and critical areas.

Table HH-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Townsend Harbor Road HH: 1	Minor runoff to roadside vegetation	Negligible (i.e., low)	No signs of runoff into lake or potential vernal pools
Hemlock Drive HH: 2-5	Minor runoff to roadside vegetation & adjacent wetland areas	Minor (i.e., low)	Minimal signs of runoff to lake, or potential vernal pool
Hemlock Drive HH: 6	Moderate runoff to catch basins; Roadside gullies & sand deposits	Medium priority	3 catch basins & asphalt road chute discharge near Hickory Hills Landowners' member beach
Hemlock Drive HH: 8	Most runoff into roadside vegetation or downhill to HH: 6	Minor	Inspect yearly for sand/silt deposits; sweep street & clean catch basins
Birch Island Way HH: 7	Minor runoff to roadside vegetation	Minor	Minimal signs of discharge to lake

Table HH-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Pine Acres Rd HH: 9-12	Minor runoff to road vegetation & adjacent wetlands	Low priority	Gullies & culvert discharge minimal runoff >150' from lake
Northfield Rd HH: 13-15	Minor runoff to roadside vegetation	Negligible	No signs of runoff to lake
Gilchrest Street HH: 16-20	Road runoff from catch basins and outfalls to vegetation & wetlands	Minor	Minimal signs of runoff to lake
Cliffview Terrace HH: 21-22	Road runoff from catch basins and outfalls to vegetation & wetlands	Minor	Minimal signs of discharge to lake
Brookview Terrace HH: 23-25	Minor runoff to roadside vegetation & adjacent wetlands	Minor	Minimal signs of discharge to lake,
Island Road HH: 26-30 & 33	Moderate runoff to catch basins flows to 6 outfalls that discharge into lake	Low priority	Inspect yearly for sand/silt deposits; sweep street & clean catch basins
Horizon Island Rd; HH: 31-32	Minor runoff to roadside vegetation	Low priority	Minimal runoff, inspect yearly for possible impacts to lake
Williams Drive HH: 34	Moderate runoff to 8 catch basins that discharge to vegetation	Minor	No signs of runoff to lake
Island Road HH: 35-38	Moderate runoff from catch basins flow to outfall discharge at lake inlet	Medium priority	14 catch basins & culvert discharge near Hickory Hills Landowners' member beach
Beachview Drive HH: 39-40	Moderate runoff from 12 catch basins flows to outfall at Island Road inlet	Low priority	Inspect catch basins for sand deposits Sweep street & clean catch basins
Wildwood Road HH: 41-43	Moderate runoff to 8 catch basins that discharge to vegetation	Low priority	Minimal runoff to lake; clean catch basins, sweep street
South Cove Rd & Cove Road HH: 44-50	Moderate runoff to vegetation; 18 catch basins flow to outfalls that discharge to wetlands	Low priority	Minimal runoff to lake; clean catch basins and sweep street
Peninsula Drive HH: 51-55	Moderate runoff to catch basins & road vegetation	Low priority	Inspect & clean catch basins, sweep street; 4 outfalls to lake
South Row Road HH: 56	Moderate runoff discharge to roadside vegetation (i.e., no catch basins)	Low priority	Inspect yearly for runoff to lake; sweep streets

Table HH-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Crescent Road HH: 57	Minor runoff to 4 catch basins piped to outfall that discharges to wetland	Low priority	Minimal runoff to lake
Townsend Harbor Road, HH: 58-59	Moderate runoff to road vegetation & adjacent wetlands	Minor	Minimal runoff to lake or potential vernal pool; Sweep street yearly
Townsend Harbor Road, HH: 60-62	Moderate runoff to road vegetation & catch basins that are piped to outfalls	Low priority	Catch basins outfalls to lake; Sweep street & clean catch basins

Task 3 – BMP Selection

The initial priority ranking was checked by site visits and adjusted to protect critical areas. The DCI Team then reviewed soils mapping by the USDA Natural Resources Conservation Service to determine suitability of the onsite soils for infiltration practices and other stormwater BMPs. In addition, the Team looked at the right-of-way dimensions for Town roads in relation to size of BMPs that meet DEP Stormwater Standard 6 for critical areas (i.e., how much space is needed to install BMP).

The DCI Team conducted more site visits to consider potential stormwater treatment practices. BMP cost estimates and pollutant removal estimates are based on potential BMP designs, catchment areas, soils and related factors. Table HH-2 shows site priorities, soils types, proposed BMPs and pollutant removal estimates along with brief field notes about site conditions.

Table HH-2 Priority Sites, Soils, Proposed BMPs and Field Notes				
Outfall Location & Site Priority	**Soils HSG A, B, C, D**	**Proposed BMPs**	**Estimated BMP Pollutant Removal**	**Field Notes**
Hemlock Drive, HH: 6 Medium priority	A	Leaching catch basin for bacteria control [Or Baffle box]	90% TSS; 70% TP [Or] 70% TSS; 35% TP	3 catch basins & asphalt chute near beach; Monitor runoff discharge for bacteria [Baffle box is option if bacteria control is not needed]
Island Road HH: 35-38 Medium priority	C	Baffle box to reduce TSS from Beachview Dr. catch basins	70% TSS; 35% TP	14 catch basins outfall is near HHL beach; Monitor outfall for bacteria [Leaching catch basin is option if bacteria control is needed and if soils are suitable]

Table HH-2 Priority Sites, Soils, Proposed BMPs and Field Notes				
Outfall Location & Site Priority	**Soils HSG A, B, C, D**	**Proposed BMPs**	**Estimated BMP Pollutant Removal**	**Field Notes**
South Row Road HH: 56 Low priority	A	Street sweeping & homeowner guides to help reduce TSS	Up to 10% TSS	Monitor road gullies & other runoff impact to lake; inform homeowners along road about sediment and erosion controls

HSG soils groups definition: A=excessively drained; B=well drained; C=moderately drained; D=poorly drained; Urban=varied perviousness

Task 4 – Funding Sources

The DCI Team recommended potential local, state and federal funding. The Team also identified potential in-kind matching support for priority BMPs to protect the critical areas in the sub-basin. Recommended sources of local, state and federal funding include:

- Lunenburg Pavement Management Program
- Section 319 Nonpoint Source Pollution Program (MassDEP and EPA)

Potential BMP funding and in-kind support from builders and community organizations include:

- Wetlands Protection Act stormwater requirements for proposed developments
- Hickory Hills Landowners Inc.
- Private charitable foundations and corporate foundations

Task 5 – Schedule

The DCI Team prepared a provisional ten year timetable for BMP implementation:

- High priority outfall/catchment areas for Years 1-5
- Medium priority areas for years 4-8
- Low priority areas for years 6-10

The BMP implementation schedule will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Table 3 is a listing of BMP cost estimates, funding sources and implementation timing for priority sites.

Table HH-3 Priority BMPs Sites, Costs, Funding and Implementation Timing				
Outfall location & site priority	**Proposed BMPs (see Table 2 for detail)**	**Estimated BMP Costs**	**Recommended Funding Sources**	**Timetable (Estimated)**
Hemlock Drive HH: 6 Medium priority	Leaching catch basin For bacteria control [Or a Baffle box]	$10,000	DPW Annual Paving Program Hickory Hills Landowners Inc.	Year 5
Island Road HH: 35-38 Medium priority	Baffle box	$15,000	DPW annual paving program Hickory Hills Landowners Inc.	Year 5
South Row Road, HH: 56 Low priority	Street sweeping and homeowner guides to help reduce TSS	< $1,000/year	DPW annual road sweeping Hickory Hills Landowners Inc.	Annual

Task 6 – Maintenance and Monitoring

The DCI Team prepared a detailed Operation and Maintenance Plan for each BMP recommended in Table 3, which are provided in Attachment D. Guidance for outfall site inspections and water testing to assess BMPs performance is provided in Attachment E.

Report Attachments include:

(A) Conceptual designs of BMPs for high priority outfall/catchment areas
(B) Calculations of BMP costs for sub-basin priority sites
(C) Calculations of estimated pollutant loads and reductions by BMPs
(D) O&M Plans for each recommended BMP
(E) Outfall monitoring procedures for sub-basin priority sites

Footnote Reference
The Massachusetts Water Quality Standards protect bathing beaches and other critical areas from degradation. Stormwater discharges near bathing beaches require stormwater discharges to meet specific criteria for temperature, dissolved oxygen, solids, oil, grease, petrochemicals, taste and odor.

Lake Shirley Sub-Basin Report

Introduction

The Lake Shirley Sub-Basin is located in Lunenburg and Shirley. The watershed is currently dominated by forest and housing, with roads passing north to south (Reservoir Road, Flat Hill Road and Sunset Lane) or east to west (Burrage Street and Leominster-Shirley Road). Lake Shirley has many private swimming beaches and supplies water to private wells.

The individual Project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

The attached map shows high, medium and low priority outfalls and the delineation of high priority catchment areas in the Lake Shirley sub-basin. In addition, the report findings fulfill many elements required by the EPA and MassDEP guidelines for watershed-based planning. Instead of pollutant sources based on general land use data, the sub-basin analysis identifies direct discharges to waterbodies from storm sewers and streets.

Underlying Lake Shirley is a high-yield aquifer with a medium-yield aquifer extending along the southeastern Town boundary. There are high density residential uses along the entire lakeshore, as well as large residential subdivisions throughout the Lake's watershed. The housing and roads increase the impervious areas that are sources of stormwater runoff and other pollution. Lake Shirley is in eutrophic state, enriched by nutrient loading that stimulates algae and weed growth, which deplete oxygen in the lake. Symptoms are harmful algal blooms, invasive aquatic plants and high turbidity. Limited public access to the water curtails public recreation uses.

Research of the Lake Shirley sub-basin included the tasks described below.

Task 1- Initial Ranking

The DCI Team performed desktop reviews of available computer information (Town GIS, MassGIS, storm drainage systems, etc.) to approximate the outfall catchment areas and pollutant loading. This data was used to prepare an initial priority ranking (high, medium, and low) for further assessment by site visits. These reviews identified sixty-eight (68) stormwater outfalls including discharges at road crossings of Lake Shirley and its tributaries. Most of the outfalls flow into existing vegetation buffers and wetlands, which provide treatment of stormwater and were considered low priority. Other outfalls were ranked as high or medium priority. All outfalls were examined by site visits.

Task 2 – Site Visits

The DCI Team inspected the outfall/catchment sites to evaluate current conditions and adjust rankings as necessary. Site visits investigated impairment to critical areas that support swimming beaches and vernal pools. Impairment indicators included sand/silt deposits in water bodies, water clarity, sand deposits at catch basins and at road crossings, roadside erosion gullies and pet waste management. Site visits also identified:

- Development Density
  - Greater density = more impervious area that causes runoff
  - Greater density = less natural vegetation that cleans runoff
  - Greater density = more automobiles, fertilizers, dogs and other sources of pollutants

- Proximity of runoff discharge to water bodies, wetlands and vernal pools
- Vegetative buffers between stormwater discharges and receiving waters
- Slope (steeper slope = more runoff problems)

The DCI Team also visited sites online using Google Street View and/or Bing Street View. This virtual information augmented actual site visits and revealed previous site conditions that enabled historic comparison (e.g., before and after road paving or other changes). The DCI Lake Shirley sub-basin map (Figure 1) of high, medium, low priorities shows outfall rankings. The final outfall rankings target the protection of critical areas. Table LS-1 is a listing of site locations, site conditions, outfall ranking and critical areas.

Table LS-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Leominster Shirley Road LS: 1-4	Minor runoff to roadside vegetation	Negligible (i.e., low)	Minimal signs of runoff into lake or potential vernal pools
Reservoir Road LS: 5-9	Minor runoff to roadside vegetation & adjacent wetland areas	Negligible	Minimal signs of runoff to lake, Or potential vernal pool
Ruth/Johnson Streets LS: 10-13	Minor runoff to roadside vegetation & catch basin outfalls to lake	Minor	Inspect yearly for sand/silt deposits; Sweep street & clean catch basins
Round Road LS: 14-16	Most runoff into roadside vegetation & adjacent wetland	Minor (i.e., low)	Inspect yearly for sand/silt deposits; Sweep street & clean catch basins
Reservoir Road LS: 17-22	Minor runoff to roadside vegetation & adjacent wetland areas	Minor	Minimal signs of runoff to potential vernal pools or lake

Table LS-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Reservoir Road LS: 23-26	Moderate runoff discharges at road culvert inlet and outlet	Medium Priority	Gullies & culvert discharge to Lake and wetland on west side of road
Reservoir Road LS: 27-29	Minor runoff to roadside vegetation & adjacent wetland	Minor	Minimal signs of runoff to lake or Potential vernal pool
Autumn Road LS: 30	Minor runoff from catch basins & piped outfall to vegetation	Negligible	Outfall >300' from wetland
Flat Hill Road LS: 31-32	Major road runoff discharges sand/silt at brook inlet to lake	High priority	Sediment deposits at asphalt aprons & road gullies into lake
Flat Hill Road LS: 33-39	Minor runoff to roadside vegetation & adjacent wetland	Minor	Minimal signs of runoff to lake, Or potential vernal pools
Flat Hill Road LS: 40-42	Culvert & gullies runoff to wetland that has potential vernal pool	Medium Priority	Runoff discharge <40' from potential vernal pool
Burrage Street LS: 43-52	Minor runoff to roadside vegetation & adjacent wetlands	Negligible	Minimal signs of runoff to potential vernal pools, inspect yearly
Sunset Lane LS: 53	Minor runoff to roadside vegetation	Negligible	Minimal signs of runoff to potential vernal pools, inspect yearly
Sunset Lane LS: 54-57	Moderate runoff from catch basins has direct discharge to lake inlet	Medium priority	8 catch basins & culvert discharge to Geosyntec s.319 BMP & lake
Sunset Lane LS: 58, 61-64	Minor runoff to roadside vegetation & adjacent wetlands	Minor	Minimal signs of runoff to lake
Robbs Hill Rd LS: 59-60	Minor runoff to roadside vegetation & adjacent wetlands	Negligible	Catch basins outfall >200' to potential vernal pools
Robbs Terrace LS: 65-68	Minor runoff to roadside vegetation & adjacent wetlands	Minor	Minimal runoff <100' from potential vernal pool, clean catch basins yearly

Task 3 – BMP Selection

The initial priority ranking was checked by site visits and adjusted to protect critical areas. The DCI Team then reviewed soils mapping by the USDA Natural Resources Conservation Service to determine suitability of the onsite soils for infiltration practices and other stormwater BMPs. In addition, the Team looked at the right-of-way dimensions for Town roads in relation to size of BMPs that meet DEP Stormwater Standard 6 for critical areas (i.e., how much space is needed to install BMP).

The DCI Team conducted more site visits to develop conceptual designs for stormwater treatment practices, which are provided in the report attachments. BMP cost estimates and pollutant removal estimates are based on BMP designs, catchment areas, soils and related factors. The Team coordinated the site visits with the DPW Director to consider recommended BMPs, cost estimates and pollutant removal options. Table LS-2 shows site priorities, soils types, proposed BMPs and pollutant removal estimates along with field notes about site conditions.

Table LS-2
Priority Sites, Soils, Proposed BMPs and Field Notes

Outfall Location & Site Priority	Soils HSG A, B, C, D	Proposed BMPs	Estimated BMP Pollutant Removal	Field Notes
Reservoir Road LS: 23-26	D	Water quality swale to road vegetation	90% TSS; 70% TP	WRS noted TP load in 2016 water sample; Road ROW 9' wide x 200+ feet long
Flat Hill Road LS: 31-32	A	(2) catch basins to baffle box	70% TSS; 35% TP	Add new catch basins piped to baffle box; ROW (right-of-way) 20' wide x 200' long
Flat Hill Road LS: 31-32	A	(2) catch basins to baffle box	70% TSS; 35% TP	Add new catch basins piped to baffle box; ROW (right-of-way) 20' wide x 200' long
Flat Hill Road LS: 40-42	B or C	Water quality swale to road vegetation	90% TSS; 70% TP	Impervious <1/2 ac.; ROW 12' wide x 200'; monitor water quality yearly to determine if road runoff impairs potential vernal pool
Sunset Lane LS: 54-57	A	Baffle box	70% TSS; 35% TP	Road + driveway impervious >2 ac. Collected by catch basins outfall to wetland & lake
Robbs Terrace LS: 65-68	A	Leaching CB	25% TSS	catch basins capture >350lbs TSS Clean catch basins yearly

HSG soils groups definition: A=excessively drained; B=well drained; C=moderately drained; D=poorly drained; Urban=varied perviousness

Task 4 – Funding Sources

The DCI Team recommended potential local, state and federal funding. The Team also identified potential in-kind matching support for priority BMPs to protect the critical areas in the sub-basin. Recommended sources of local, state and federal funding include:

- Lunenburg Pavement Management Program
- Section 319 Nonpoint Source Pollution Program (MassDEP and EPA)

Potential BMP funding and in-kind support from builders and community organizations include:

- Wetlands Protection Act stormwater requirements for proposed developments
- Lake Shirley Improvement Corporation
- Private charitable foundations and corporate foundations

Task 5 – Schedule

The DCI Team prepared a provisional ten year timetable for BMP implementation:

- High priority outfall/catchment areas for Years 1-5
- Medium priority areas for years 4-8
- Low priority areas for years 6-10

The BMP implementation schedule will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Table LS-3 is a listing of BMP cost estimates, funding sources and implementation timing for priority sites.

Table LS-3
Priority BMPs Sites, Costs, Funding and Implementation Timing

Outfall location & site priority	Proposed BMPs (see Table 2 for detail)	Estimated BMP Costs	Recommended Funding Sources	Timetable (Estimated)
Reservoir Road LS: 23-26 Medium priority	Water quality swale To roadside vegetation	$10,000 - 15,000	DPW Annual Paving Program MassDEP s.319 Grants Program	Year 6
Flat Hill Road LS: 31-32 High priority	(2) catch basins piped to baffle box	$18,000 - 20,000;	DPW annual paving program	Year 1

Table LS-3 Priority BMPs Sites, Costs, Funding and Implementation Timing				
Outfall location & site priority	**Proposed BMPs (see Table 2 for detail)**	**Estimated BMP Costs**	**Recommended Funding Sources**	**Timetable (Estimated)**
Flat Hill Road LS: 40-42 Medium priority	Water quality swale To roadside vegetation	$10,000 - 15,000	DPW annual paving program	Year 1
Sunset Lane LS: 54-57 Medium priority	Baffle box	$15,000	DPW annual paving program MassDEP s.319 Grants Program	Year 7

Task 6 – Maintenance and Monitoring

The DCI Team prepared an detailed Operation and Maintenance Plan for each BMP recommended in Table 3, which are provided in Attachment D. Guidance for outfall site inspections and water testing to assess BMPs performance is provided in Attachment E.

Report Attachments include:

(A) Conceptual designs of BMPs for high priority outfall/catchment areas
(B) Calculations of BMP costs for sub-basin priority sites
(C) Calculations of estimated pollutant loads and reductions by BMPs
(D) O&M Plans for each recommended BMP
(E) Outfall monitoring procedures for sub-basin priority sites

Footnote Reference
The Massachusetts Water Quality Standards protect bathing beaches and other critical areas from degradation. Stormwater discharges near bathing beaches and vernal pools require stormwater discharges to meet specific criteria for temperature, dissolved oxygen, solids, oil, grease, petrochemicals, taste and odor.

Mulpus Brook Sub-Basin Report

Introduction

The Upper Mulpus Brook Sub-Basin is located in Lunenburg and Townsend. It flows in an easterly direction into Hickory Hills Lake. The watershed is currently dominated by forest and agricultural fields, with roads passing north to south (Chase Road, West Townsend Road and Holman Street) or east to west (Northfield Road and Howard Street). Mulpus Brook is a state-designated Coldwater Fish Resource (CFR).

The individual Project tasks are:

- to rank municipal drainage system outfalls;
- to recommend Best Management Practices (BMPs) for high priority outfalls and calculate BMP pollutant removal; and
- to provide BMP cost estimates, funding options and maintenance guidance.

The attached Mulpus Brook Sub-basin map shows high, medium and low priority outfalls, and the delineation of high priority catchment areas in the Mulpus Brook Sub-basin. In addition, the report findings fulfill many elements required by the US Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (DEP) guidelines for watershed-based planning. Instead of pollutant sources based on general land use data, the sub-basin analysis identifies direct discharges to waterbodies from storm sewers and streets.

Upper Mulpus Brook is impounded behind the dam that forms the Hickory Hills Lake. The major land uses in the sub-basin include forests, wetlands, several small farms, low-density residential areas and large conservation lands. Less than 6% of the sub-basin is impervious, which helps sustain stable channels, excellent habitat structure, good to excellent water quality, and diverse communities of both fish and aquatic insects.

The Upper Mulpus is a Category 2 in the Draft 2016 MassDEP Integrated List of Waters. The Brook is not impaired for aesthetic and recreation uses, but aquatic life has not been assessed upstream of Hickory Hills Lake. Dirty runoff from busy traffic and parking areas on Chase Road (Route 13) is a source of pollutants that can harm the Brook's water quality and stream life. Stormwater sediments and other pollutants are also carried downstream, which buildup thick deposits at the inlet of Hickory Hills Lake.

Research of the Mulpus Brook sub-basin included the tasks described below.

Task 1- Initial Ranking

The DCI Team performed desktop reviews of available computer information (Town GIS, MassGIS, storm drainage systems, etc.) to approximate the outfall catchment areas and pollutant loading. This data was used to prepare an initial priority ranking (high, medium, and low) for further assessment by site visits. The reviews identified ninety-nine (99) stormwater outfalls including discharges at road crossings of Mulpus Brook and its tributaries. Most of the outfalls

flow into existing vegetation buffers and wetlands, which provide treatment of stormwater and were considered low priority. Other outfalls were ranked as high or medium priority. All outfalls were examined by site visits.

Task 2 – Site Visits

The DCI Team inspected the outfall/catchment sites to evaluate current conditions and adjust rankings as necessary. Site visits investigated impairments of critical areas that support cold-water fish and vernal pools. Impairment indicators included sand/silt deposits in stream bed, water clarity, sand deposits at catch basins and at road crossings, roadside erosion gullies and pet waste management. Site visits also identified:

- Development Density
  - Greater density = more impervious area that causes runoff
  - Greater density = less natural vegetation that cleans runoff
  - Greater density = more automobiles, fertilizers, dogs and other sources of pollutants

- Proximity of runoff discharge to water bodies, wetlands and vernal pools
- Vegetative buffers between stormwater discharges and receiving waters
- Slope (steeper slope = more runoff problems)

The DCI Team also visited sites online using Google Street View and/or Bing Street View. This virtual information augmented actual site visits and revealed previous site conditions that enabled historic comparison (e.g., before and after road paving or other changes). The DCI Mulpus Brook sub-basin map (Figure 1) of high, medium, low priorities shows outfall rankings. The final outfall rankings target the protection of critical areas. Table MB-1 is a listing of site locations, site conditions, outfall ranking and critical areas.

Table MB-1
Outfall Locations, Conditions, Ranking and Critical Areas

Outfall Locations & Site ID #Nos	Site Conditions for Runoff treatment	Outfall Ranking	Discharge to Critical Areas
Howard St. UM: 1-3	Minor runoff to roadside vegetation	Negligible (i.e., low)	Minimal signs of runoff into CFR (Coldwater Fish Resource)
Howard St. UM: 4-5	Small erosion gullies from runoff & direct discharge at brook crossing	Medium	Sand/silt deposits in CFR stream bed
West Townsend Rd UM: 6-9	Minor runoff to roadside vegetation & perched wetlands	Negligible	Outfalls > 500' from CFR

Table MB-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Chase Road UM: 10-23	Minor runoff to roadside vegetation & existing wetlands along tributaries	Minor	Runoff treatment by vegetation
Holman St. UM: 26-28	Minor runoff to roadside vegetation	Negligible	Outfalls >500' from CFR
Holman Street UM: 29-30	Major runoff carried by steep road to abandoned bridge crossing	High priority	Large sand deposits/gullies at bridge & thick deposits in CFR bridge pool
Holman Street UM: 31-34	Major runoff creates road side gullies & large sand deposit at bridge crossing	High priority	Sand deposits/gully at bridge crossing & deep deposits in CFR bridge pool
Northfield Road UM: 35-36	Major runoff carried by steep road to crossings of two tributary brooks	Medium Priority	Erosion gullies along road & sediment deposits in both tributaries to CFR
Holman Street UM: 37-43	Minor runoff to roadside vegetation	Minor	Inspect outfalls every year for runoff impacts to vernal pool & CFR tributary
Highland Street UM: 44-56	Minor runoff to roadside vegetation	Minor	Inspect outfalls every year for runoff impacts to wetlands & CFR tributary
Northfield Road UM: 57-60; 98-99	Minor runoff discharges to existing wetlands & ponds beside road	Minor	Inspect every year for runoff impacts to adjacent wetlands & ponds
Chase Road UM: 61-68	Minor runoff to roadside vegetation and woodlands	Negligible	Runoff treatment by vegetation, outfalls >350' from CFR;
Old Farm Road UM: 69-73	Minor runoff to roadside vegetation & outfalls to detention basins	Negligible	Runoff treatment by vegetation & ponds; outfalls >500' from CFR
Northfield Road UM: 74-77	Gullies along steeper road slopes & direct discharges at Brook crossing	Medium Priority	Sand/silt deposits in pond on south side & sediment deposits in CFR stream bed
Chase Road UM: 78-81	Minor runoff to roadside vegetation and woodlands	Negligible	Runoff treatment by vegetation, outfalls >500' from CFR
Chase Road UM: 82-84	Moderate runoff collected by catch basins is discharged at Brook crossing	Medium priority	Annually inspect catch basins & outfalls for runoff impacts to CFR
Chase Road UM: 85-88	Moderate runoff from road & DPW lot receives treatment by existing BMPs	Low priority	Inspect every year for runoff impacts from direct discharges to CFR

Table MB-1 Outfall Locations, Conditions, Ranking and Critical Areas			
Outfall Locations & Site ID #Nos	**Site Conditions for Runoff treatment**	**Outfall Ranking**	**Discharge to Critical Areas**
Chase Road UM: 89	Erosion gully from runoff east side of road & direct discharge via culvert	Medium priority	Sediment discharge at culvert inlet to small tributary of CFR
Chase Road UM: 90-97	Minor runoff to roadside vegetation	Minor	Runoff treatment by vegetation, outfalls >1,000' from CFR

Task 3 – BMP Selection

The initial priority ranking was checked by site visits and adjusted to protect critical areas. The DCI Team then reviewed soils mapping by the USDA Natural Resources Conservation Service to determine suitability of onsite soils for infiltration practices and other stormwater BMPs. In addition, the Team looked at right-of-way dimensions for Town roads in relation to size of BMPs that meet DEP Stormwater Standard 6 for critical areas (i.e., how much space is needed to install BMP).

The DCI Team conducted more site visits to develop conceptual designs for stormwater treatment practices, which are provided in the report attachments. BMP cost estimates and pollutant removal estimates are based on BMP designs, catchment areas, soils and related factors. The Team coordinated the site visits with the DPW Director to consider recommended BMPs, cost estimates and pollutant removal options. Table MB-2 is a table of site priorities, soils types, proposed BMPs and pollutant removal estimates along with brief field notes about site conditions.

Table MB-2 Priority Sites, Soils, Proposed BMPs and Field Notes				
Outfall Location & Site Priority	**Soils HSG A, B, C, D**	**Proposed BMPs**	**Estimated BMP Pollutant Removal**	**Field Notes**
Howard Street EA: 4-5; Medium priority	C	(2) Leaching catch basins & bioswale	90% TSS 70% TP	Leaching catch basins south side of road; bioswale north side of road with outlet to existing woodland
Holman Street UM: 29-30; High priority	B	Catch basin & bioswale with level spreader to woodland vegetation	90% TSS 70% TP	Catch basin pretreatment on west side of road piped to bioswale with outlet to Town owned woodland

Table MB-2
Priority Sites, Soils, Proposed BMPs and Field Notes

Outfall Location & Site Priority	Soils HSG A, B, C, D	Proposed BMPs	Estimated BMP Pollutant Removal	Field Notes
Northfield Road UM: 35-36 Medium priority	A & B	(2) bioswales with leaching chamber	90% TSS 70% TP	Water quality swale with beehive leaching chamber at each crossing by 2 small tributaries of Brook
Northfield Road UM: 75-76 Medium priority	A & B	(2) bioswale with level spreader to woodland	90% TSS 70% TP	Bioswale north side of road, east of pond & bioswale south side of road, west of pond
Chase Road UM: 89 Medium priority	Urban	Catch basin with outlet to bioswale	90% TSS 70% TP	6" berm to channel runoff for catch basin pretreatment on north side of road, piped into bioswale
Chase Road UM: 82-84 Medium priority	A or D	Existing catch basins connected to baffle box	70% TSS 35% TP	Map catch basins outfalls to brook, Monitor outfalls, install baffle box to capture TSS if needed

HSG soils groups definition: A=excessively drained; B=well drained; C=moderately drained; D=poorly drained; Urban=varied perviousness

Task 4 – Funding Sources

The DCI Team recommended potential local, state and federal funding. The Team also identified potential in-kind matching support for priority BMPs to protect the critical areas in the sub-basin. Recommended sources of local, state and federal funding include:

- Lunenburg Pavement Management Program
- Section 319 Nonpoint Source Pollution Program (MassDEP and EPA)

Additional state and federal funding and assistance that may be available include:

- Transportation Improvement Programs (MassDOT, MRPC TIPs process, etc.)
- Clean Water Revolving Fund Loans
- Assistance programs of USDA Natural Resources Conservation Service

Potential BMP funding and in-kind support from builders and community organizations include:

- Wetlands Protection Act stormwater requirements for proposed developments
- Hickory Hills Landowners Inc.
- Private charitable foundations and corporate foundations

Task 5 – Schedule

The DCI Team prepared a provisional ten year timetable for BMP implementation:

- High priority outfall/catchment areas for Years 1-5
- Medium priority areas for years 4-8
- Low priority areas for years 6-10

The BMP implementation schedule will be adjusted periodically by the Lunenburg DPW and the Stormwater Task Force contingent on current factors that are likely to include:

- Correlation with MS4 permit requirements
- Timing of potential funding sources
- Town budget process

Table MB- 3 is a listing of BMP cost estimates, funding sources and implementation timing for priority sites.

Table 3
Priority BMPs Sites, Costs, Funding and Implementation Timing

Outfall location & site priority	Proposed BMPs (see Table 2 for detail)	Estimated BMP Costs	Recommended Funding Sources	Timetable (Estimated)
Howard Street EA: 4-5; Medium priority	(2) Leaching catch basins & bioswale	$10,000 ea. + $10,000 for bioswale	DPW Annual Paving Program MassDEP s.319 Grants Program	Year 4
Holman Street UM: 29-30; High priority	Catch basin & bioswale with level spreader	$20,000	DPW annual paving program MassDEP s.319 Grants Program	Year 1
Northfield Rd UM: 35-36 Medium priority	(2) bioswales with leaching chamber	$15,000 ea.	DPW annual paving program MassDEP s.319 Grants Program	Year 3
Northfield Rd UM: 75-76 Medium priority	(2) bioswale with level spreader to woodland	$10,000 ea.	DPW annual paving program MassDEP s.319 Grants Program	Year 5
Chase Road UM: 89 Medium priority	Catch basin with outlet to bioswale	$15,000	DPW annual paving program MassDEP s.319 Grants Program	Year 6

Table 3
Priority BMPs Sites, Costs, Funding and Implementation Timing

Outfall location & site priority	Proposed BMPs (see Table 2 for detail)	Estimated BMP Costs	Recommended Funding Sources	Timetable (Estimated)
Chase Road UM: 82-84 Medium priority	Baffle box if needed (pending evaluation)	$15,000 - 20,000	DPW annual paving program MassDOT/MRPC Transportation Improvement Program	Year 6 TBD

Task 6 – Maintenance and Monitoring

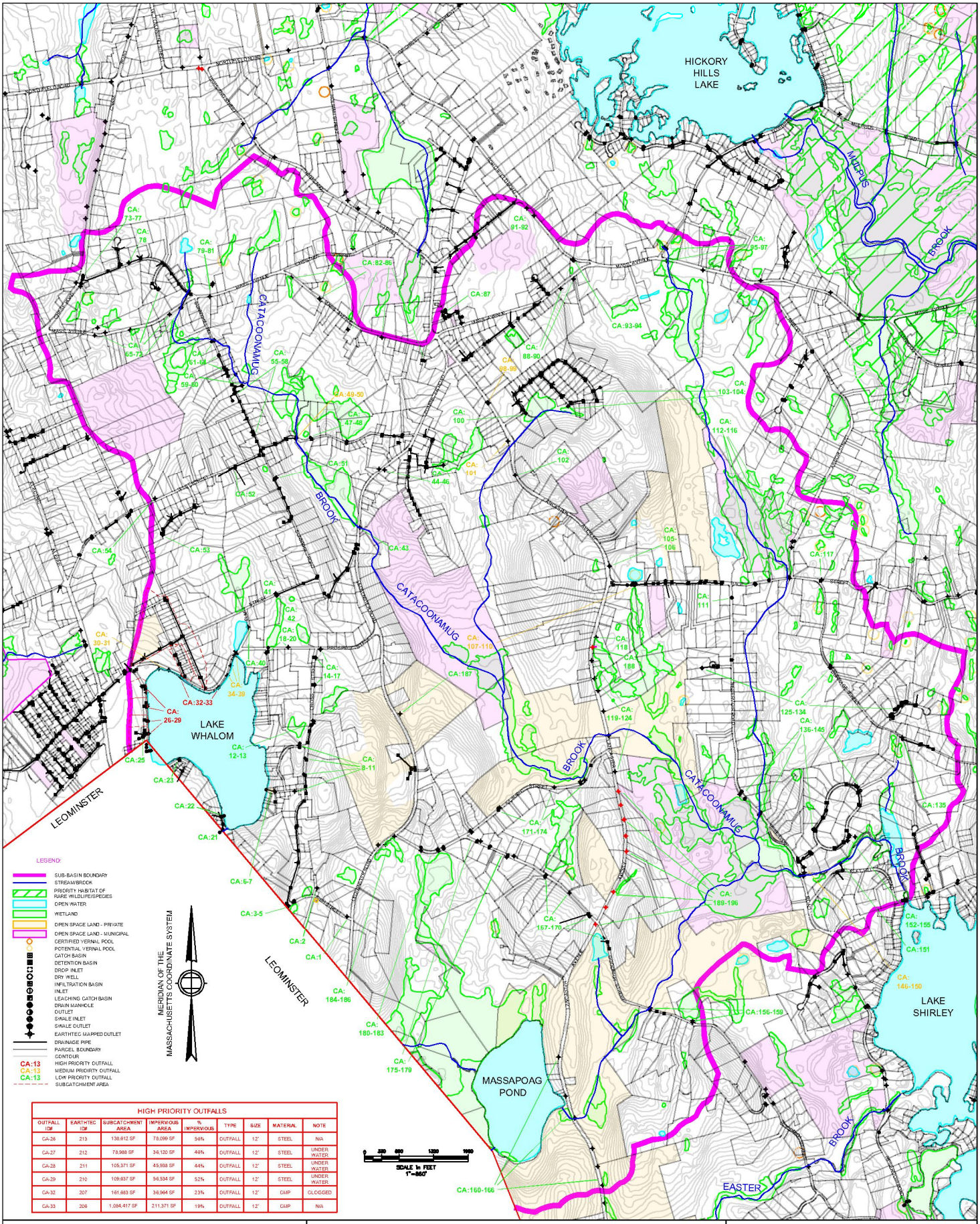
The DCI Team prepared an detailed Operation and Maintenance Plan for each BMP recommended in Table 3, which are provided in Attachment D. Guidance for outfall site inspections and water testing to assess BMPs performance is provided in Attachment E.

Footnote Reference
The Massachusetts Water Quality Standards protect cold-water fisheries, bathing beaches and other critical areas from degradation by stormwater discharges. Cold-water fisheries generally do not exceed 68^{o} F and support fish that require colder water. Receiving waters designated as cold-water resources by Mass Fisheries & Wildlife or by MassDEP require stormwater discharges to meet specific criteria for temperature, dissolved oxygen, solids, oil, grease, petrochemicals, taste and odor.

Report Attachments include:

(A) Conceptual designs of BMPs for high priority outfall/catchment areas
(B) Calculations of BMP costs for sub-basin priority sites
(C) Calculations of estimated pollutant loads and reductions by BMPs
(D) O&M Plans for each recommended BMP
(E) Outfall monitoring procedures for sub-basin priority sites

FIGURES



HIGH PRIORITY OUTFALLS

OUTFALL ID#	EARTHTEC ID#	SUBCATCHMENT AREA	IMPERVIOUS AREA	% IMPERVIOUS	TYPE	SIZE	MATERIAL	NOTE
CA-26	213	138,612 SF	78,099 SF	56%	OUTFALL	12"	STEEL	N/A
CA-27	212	78,988 SF	34,120 SF	43%	OUTFALL	12"	STEEL	UNDER WATER
CA-28	211	105,371 SF	45,938 SF	44%	OUTFALL	12"	STEEL	UNDER WATER
CA-29	210	109,637 SF	56,534 SF	52%	OUTFALL	12"	STEEL	UNDER WATER
CA-32	207	161,683 SF	36,964 SF	23%	OUTFALL	12"	CMP	CLOGGED
CA-33	206	1,084,417 SF	211,371 SF	19%	OUTFALL	12"	CMP	N/A

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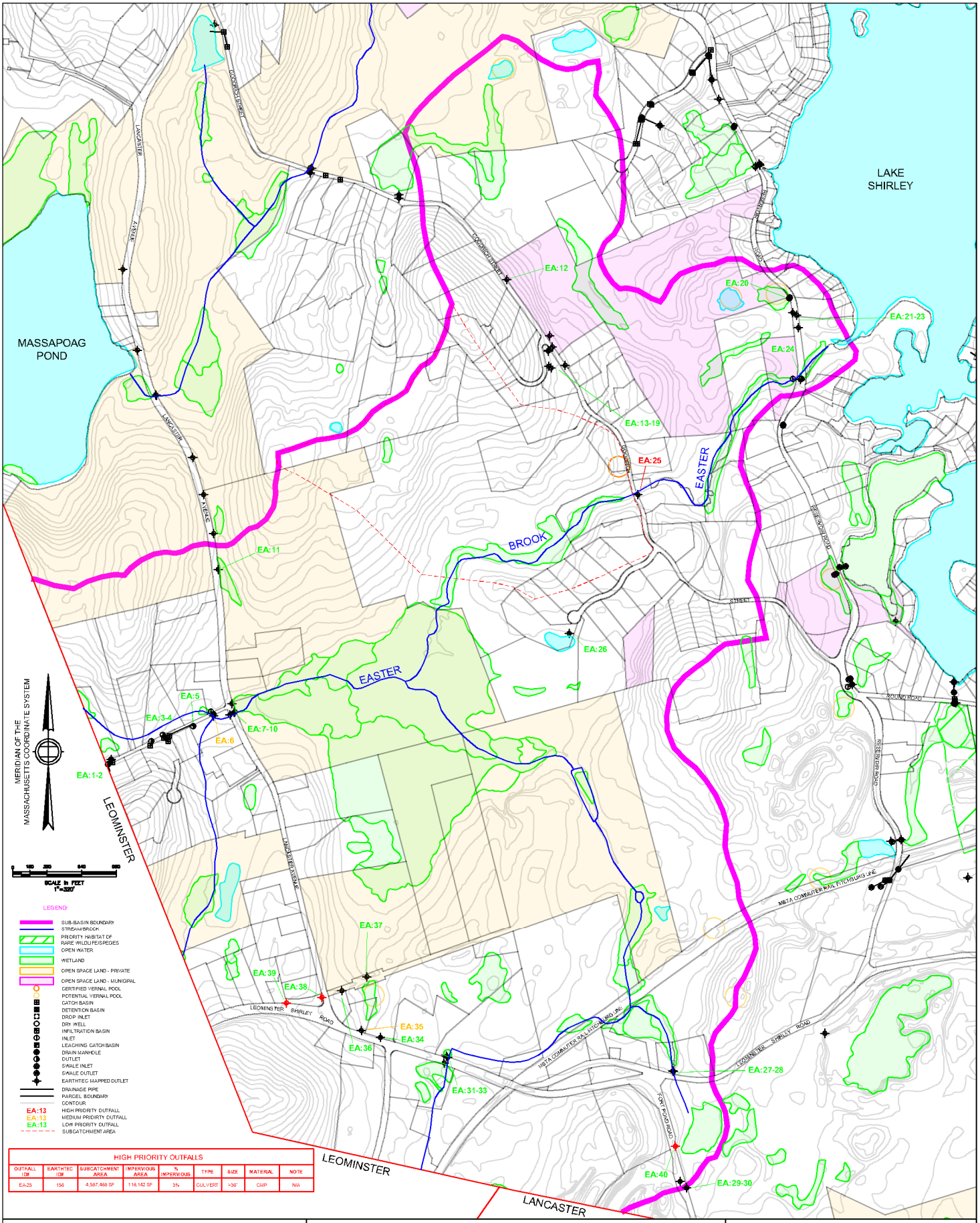
LUNENBURG SUB-BASINS
LUNENBURG, MA

DATE: 01.25.18

CATACOONAMUG BROOK SUB-BASIN

DCI PROJECT: 2017-106



HIGH PRIORITY OUTFALLS

OUTFALL ID#	EARTHTEC ID#	SUBCATCHMENT AREA	IMPERVIOUS AREA	% IMPERVIOUS	TYPE	SIZE	MATERIAL	NOTE
EA-25	156	4,587,468 SF	114,142 SF	3%	CULVERT	>36"	CMP	N/A

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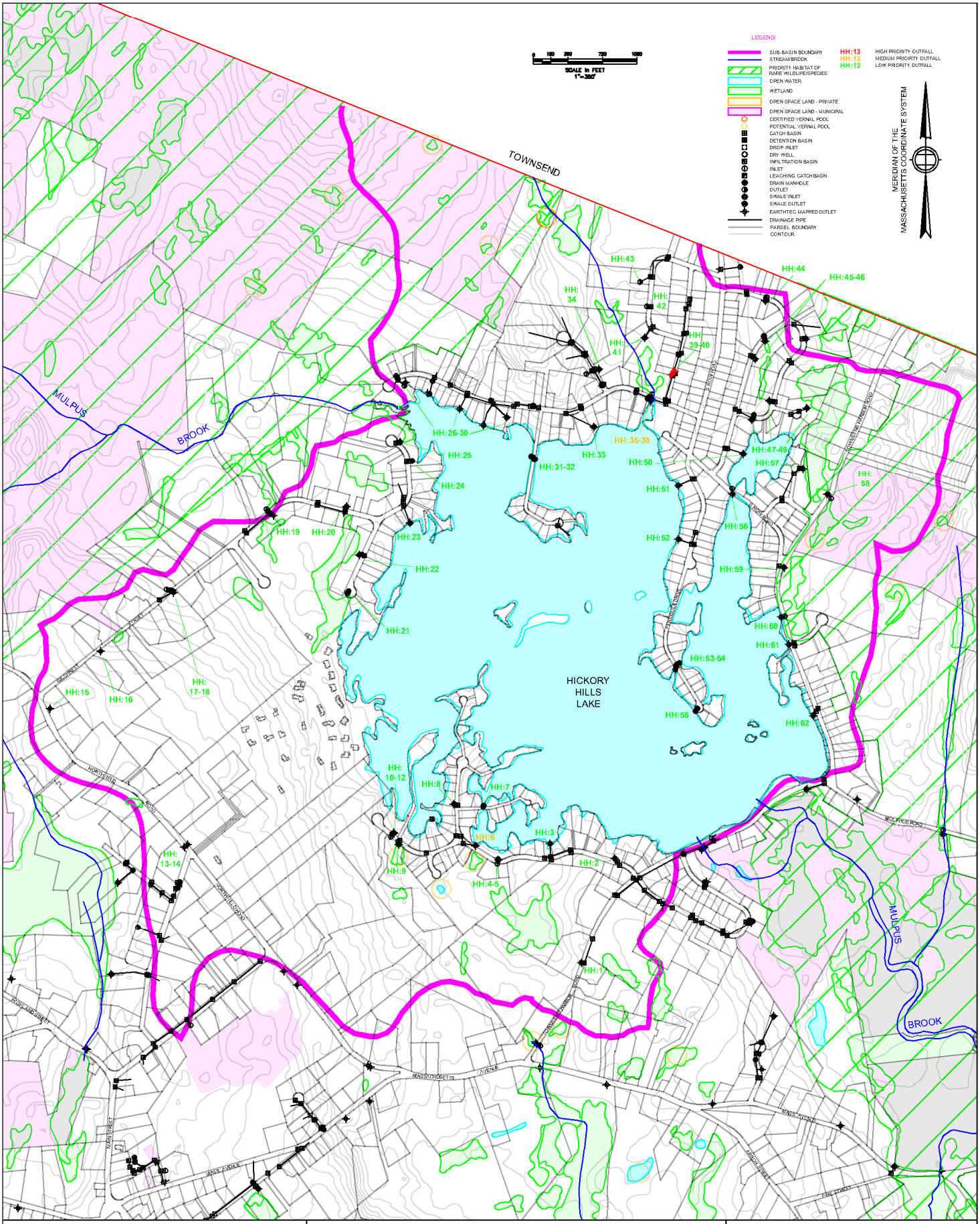
EASTER BROOK SUB-BASIN

DCI PROJECT: 2017-106



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LUNENBURG, MA

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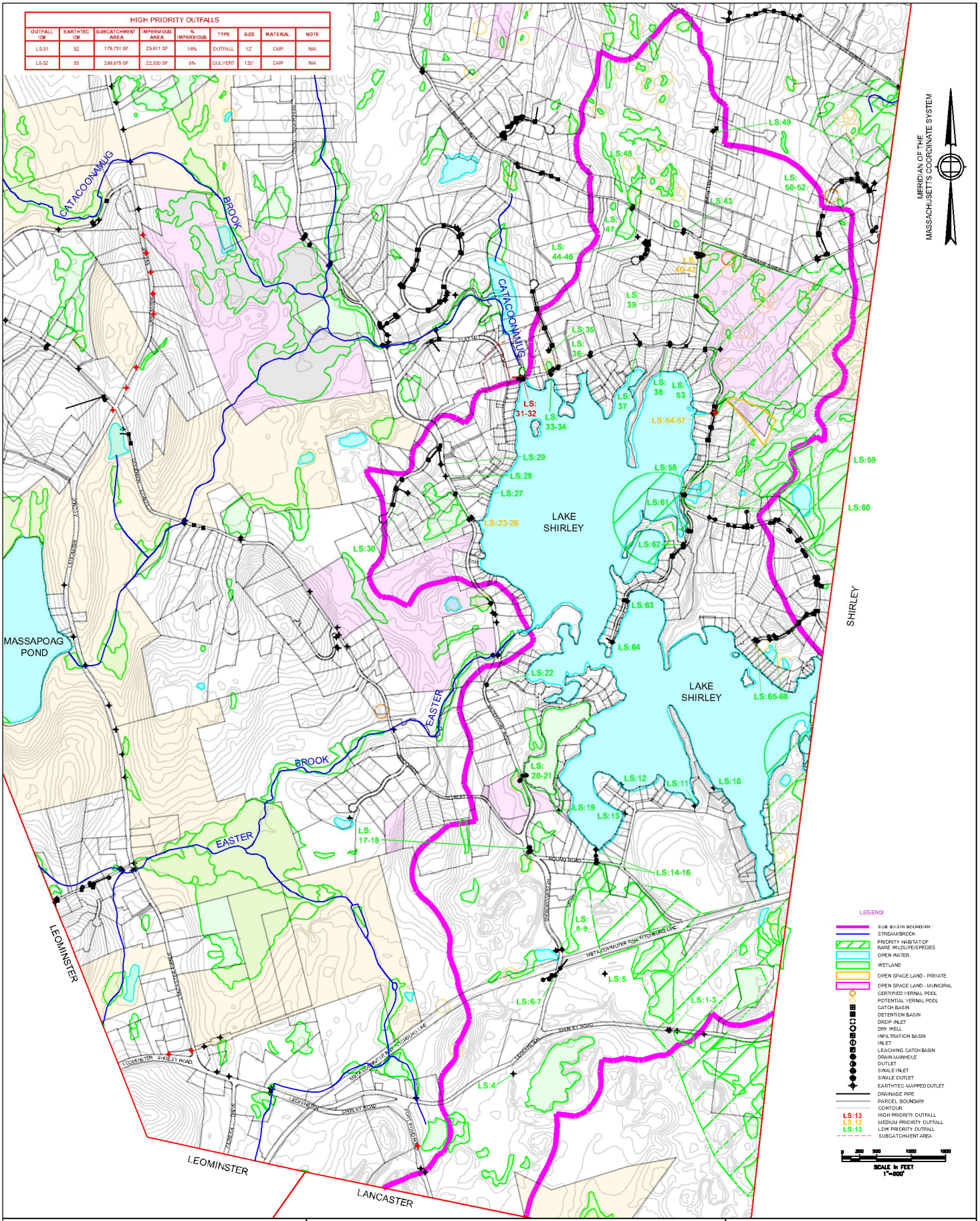
HICKORY HILLS LAKE SUB-BASIN

DCI PROJECT: 2017-106



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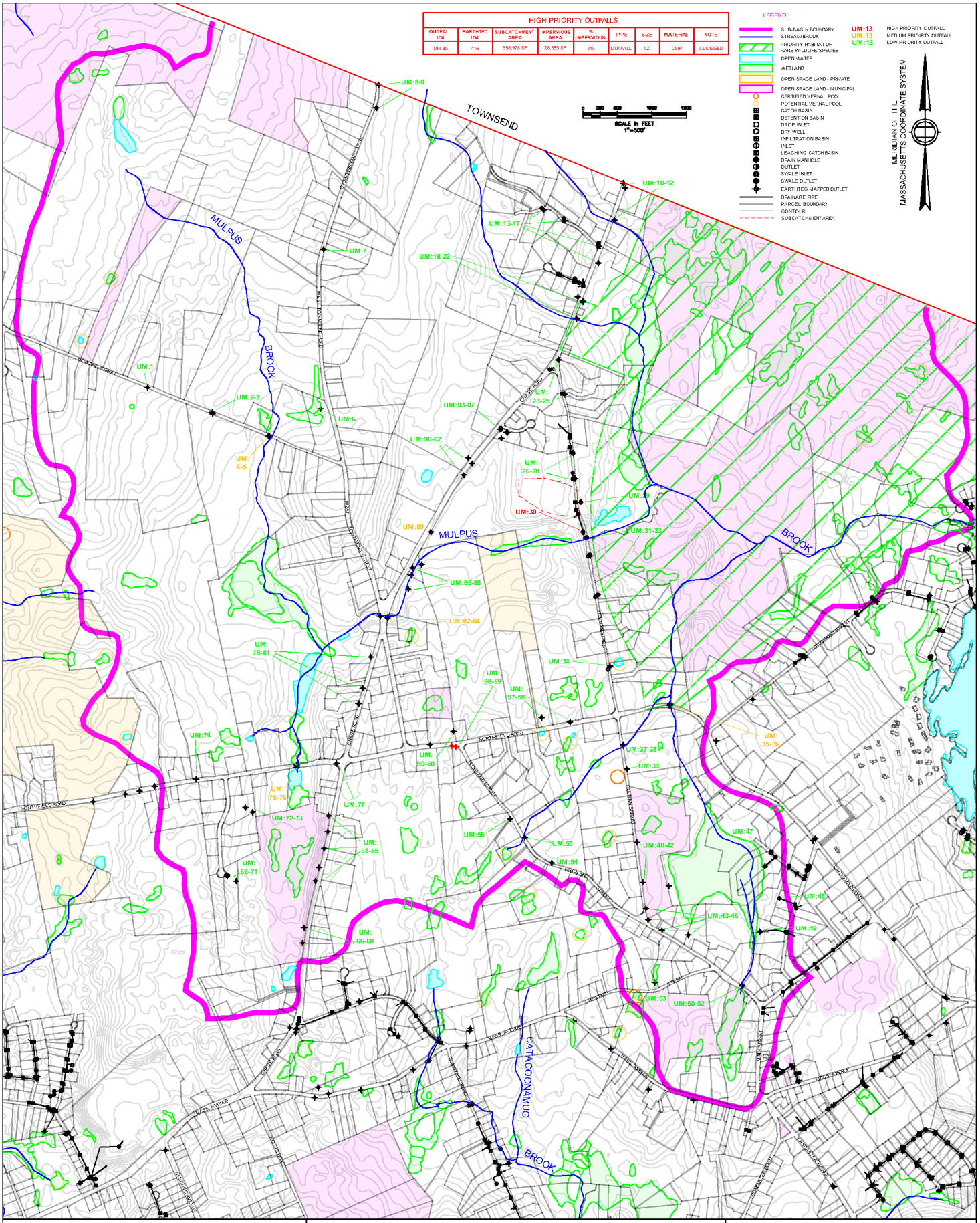
LUNENBURG SUB-BASINS
LUNENBURG, MA

DATE: 01.25.18

LAKE SHIRLEY SUB-BASIN

DCI PROJECT: 2017-106



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LUNENBURG, MA

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UPPER MULPUS BROOK SUB-BASIN

DCI PROJECT: 2017-106

Appendix A: Conceptual Designs

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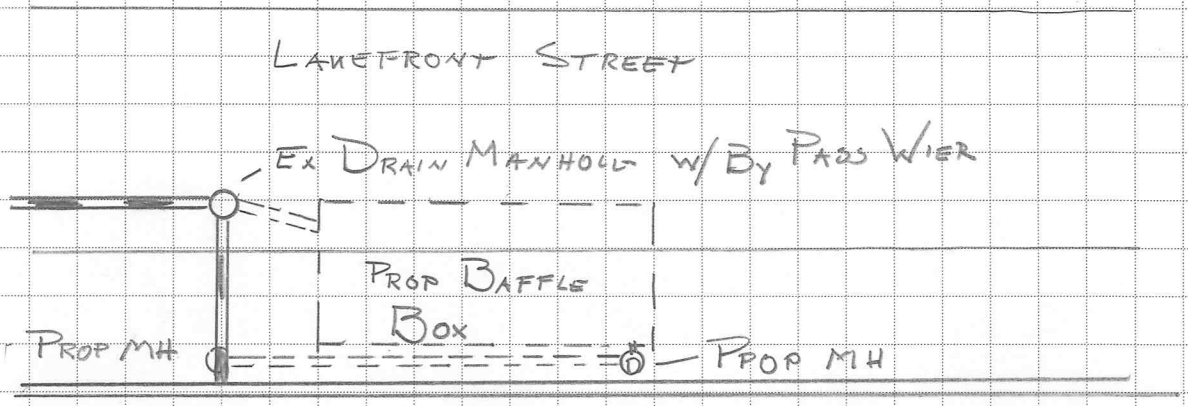
CATACOOXAMUG BROOK - CONCEPTUAL DESIGN

CA-26 TO CA-29

- CONNECT BAFFLE BOX BETWEEN MANHOLE AND OUTLET PIPE



LAKE WHALOM

USE 10,000 GALLON CHAMBERS

- ADD WIER
- TWO NEW MANHOLES
- 3 FRAME, COVERS AND RIDERS FOR BAFFLE BOX
- 25'± NEW 12" HDPE PIPE
- REPAIR SURFACE

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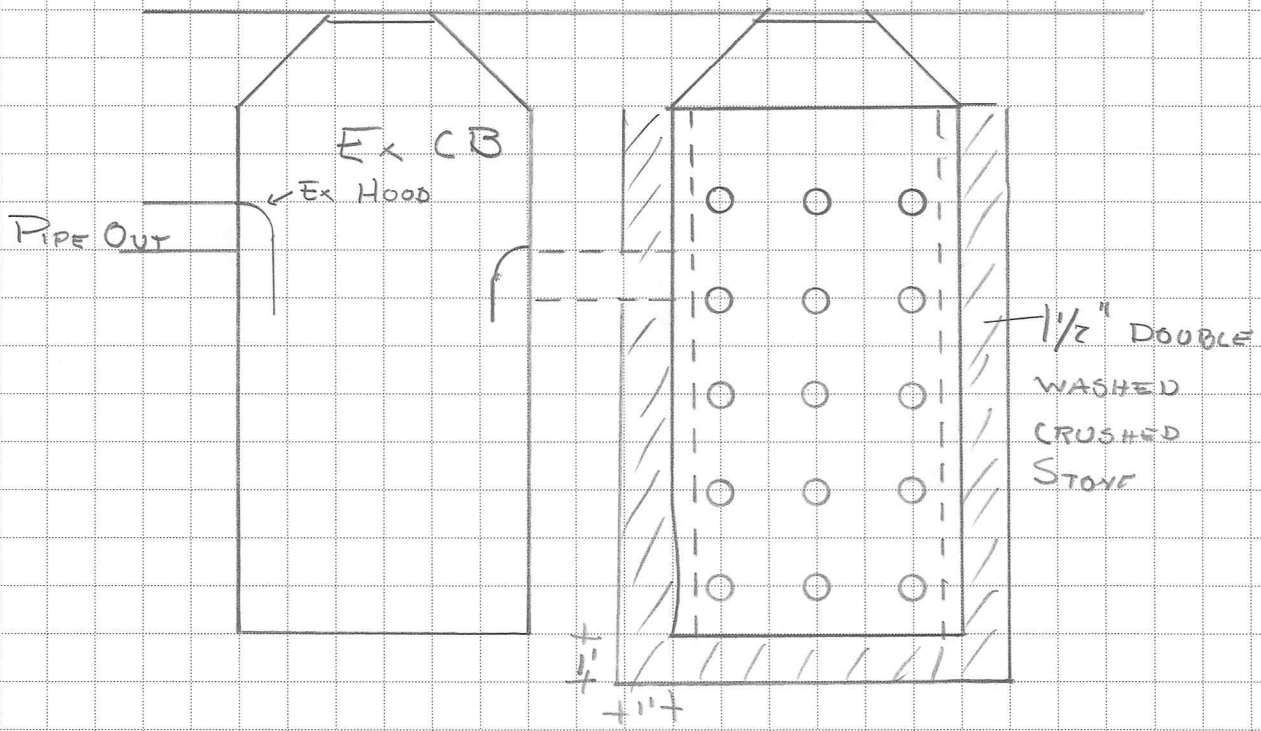
CATACOONAMUG BROOK (CONT)

PROSPECT ST

CA 32-33

ADD LEACHING CATCH BASINS TO 11 EX CB



- 11 LEACHING CBs
- 33' HDPE PIPE
- 11 HOODS
- 40 CY CRUSHED STONE

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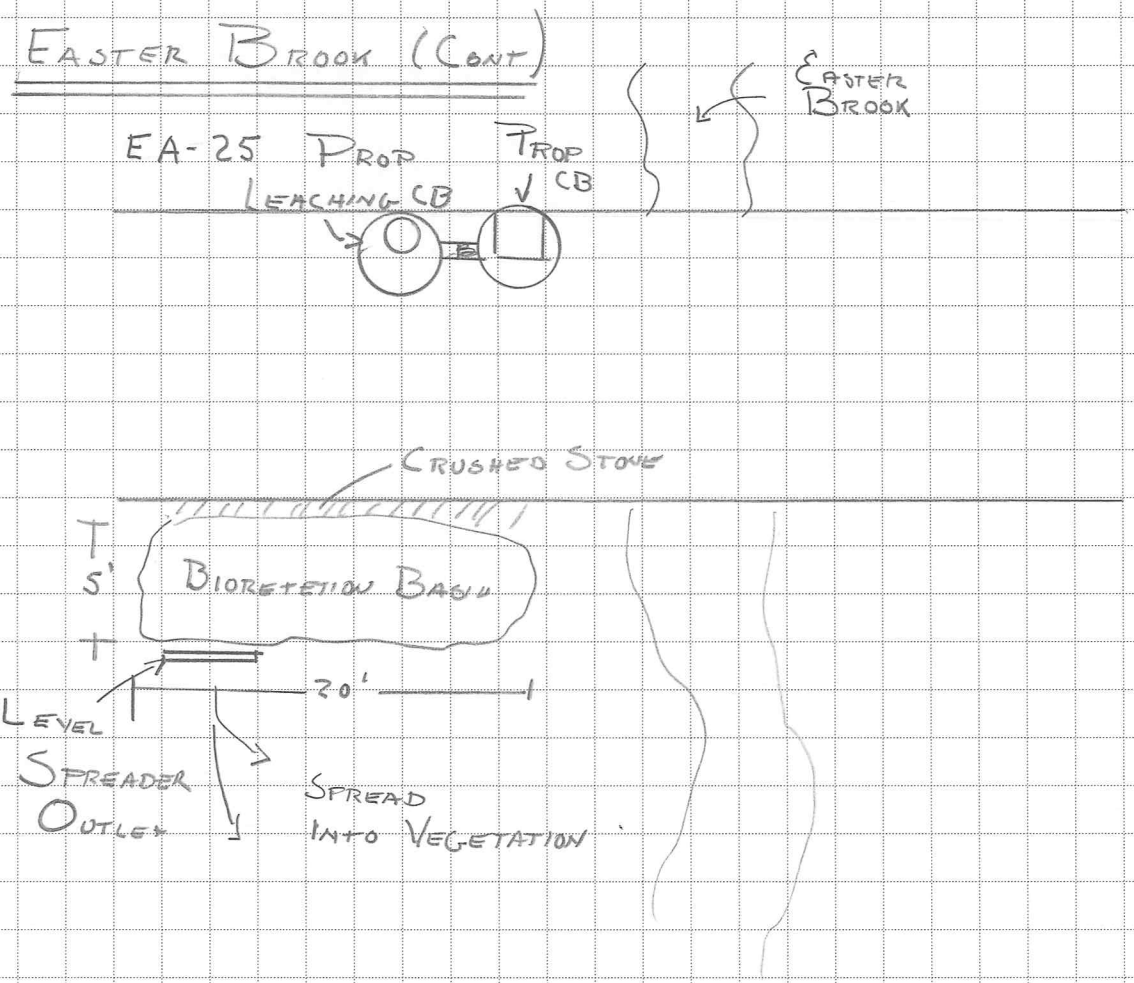
EASTER BROOK (CONT)



- CB
- LEACHING CB
- 4' PIPE
- 5'x20' BIORETENTION BASIN
- LEVEL SPREADER

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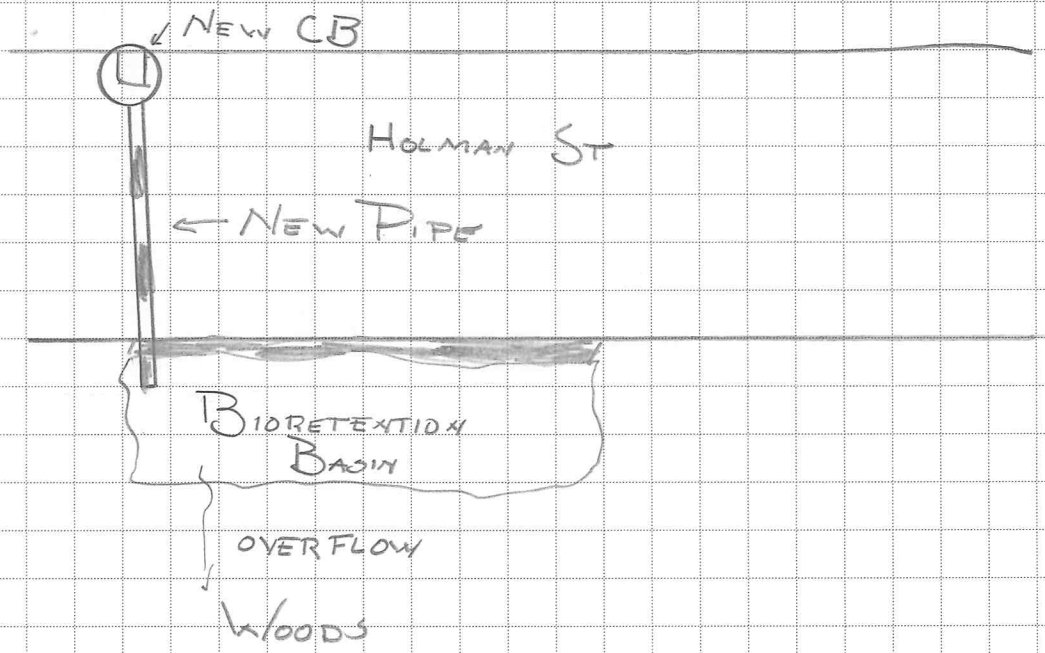
LAKE SHIRLEY (CONT)

LS-31 & LS-32

SEE BAFFLE BOX DESIGN

- 2 CATCH BASINS
- 2 10,000 GALLON TANKS

MULPHUS BROOK (CONT)



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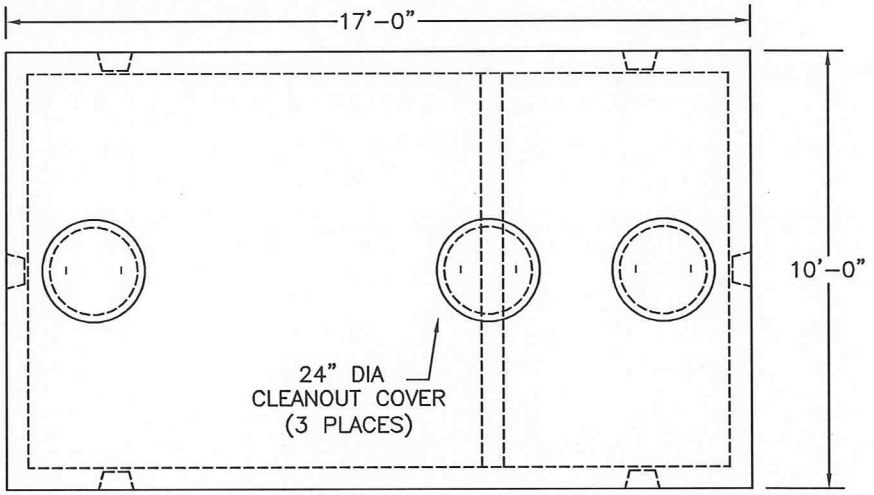
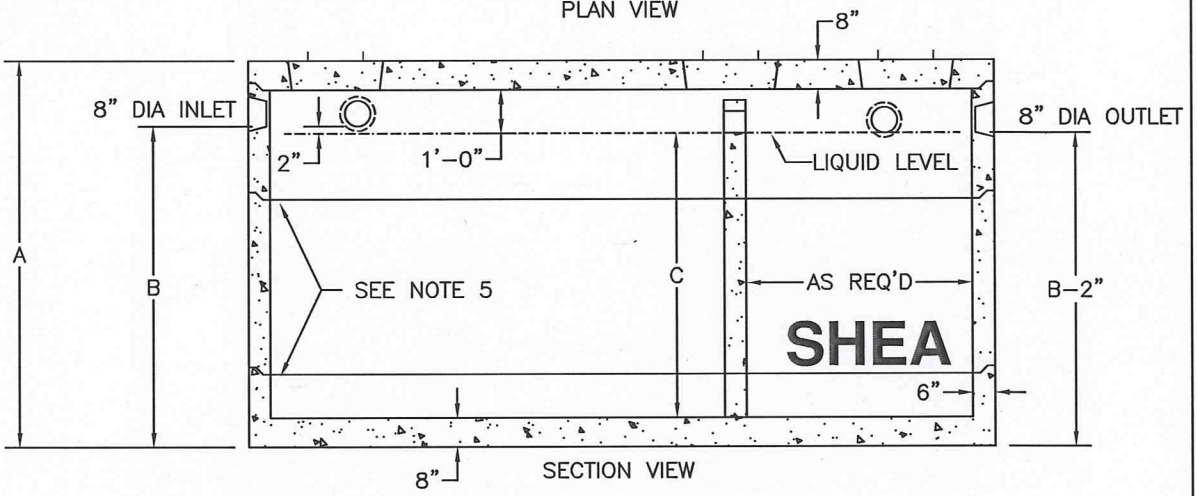
COMMERCIAL 2-COMP TANK
4000 TO 12000 GALLON

NOTES:
1. CONCRETE. 5,000 PSI MINIMUM AFTER 28 DAYS.
2. DESIGN CONFORMS WITH 310 CMR 15.00, DEP TITLE 5 REGS, FOR SEPTIC TANKS.
3. ALL REINFORCEMENT PER ASTM C1227.
4. DESIGNED FOR AASHTO HS-20 LOADING, COVER 1-5 FEET.
5. TONGUE AND GROOVE JOINT SEALED WITH BUTYL RESIN. INLET HEIGHT MAY INCREASE SLIGHTLY DUE TO THE BUTYL RESIN USED.
6. TEES AND BAFFLES SOLD SEPARATELY.
7. SPANNERS USED IN CENTER SECTIONS FOR TANKS GREATER THAN 7000 GALLONS.



PLAN VIEW



SECTION VIEW

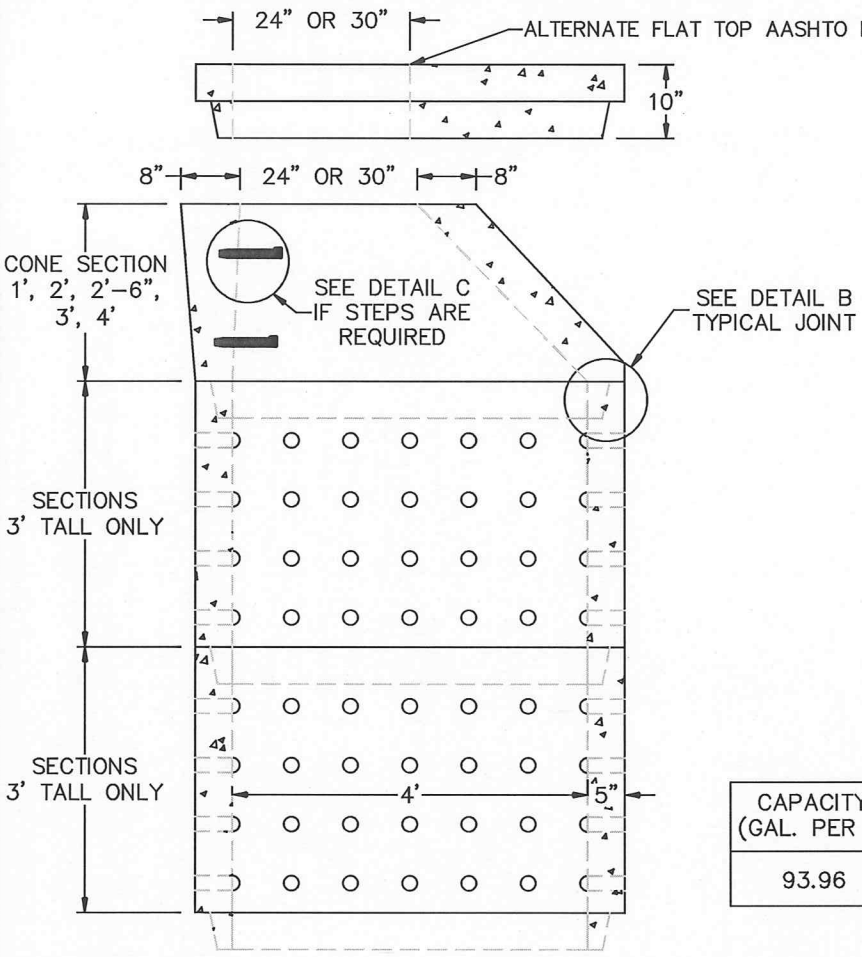
GALLONS	A (HEIGHT)	B (INLET)	C (LIQUID)	TOTAL WEIGHT	RISER 1 SIZE	RISER 2 SIZE	RISER 3 SIZE	ITEM NO.
4,000	76"	58"	48"	55,366	48"	0	0	10X17-402C
5,000	88"	70"	60"	59,812	30"	30"	0	10X17-502C
5,500	92"	74"	64"	61,296	30"	34"	0	10X17-552C
6,000	96"	78"	68"	62,780	34"	34"	0	10X17-602C
6,500	100"	82"	72"	64,258	30"	42"	0	10X17-652C
7,000	106"	88"	78"	66,482	30"	48"	0	10X17-702C
7,500	112"	94"	84"	68,704	42"	42"	0	10X17-752C
8,000	118"	100"	90"	70,928	42"	48"	0	10X17-802C
8,500	124"	106"	96"	73,152	48"	48"	0	10X17-852C
9,000	130"	112"	102"	75,374	30"	30"	42"	10X17-902C
9,500	136"	118"	108"	77,598	30"	30"	48"	10X17-952C
10,000	140"	122"	112"	79,082	30"	34"	48"	10X17-1002C
10,500	146"	128"	118"	81,304	34"	42"	42"	10X17-1052C
11,000	152"	134"	124"	83,528	34"	42"	48"	10X17-1102C
11,500	158"	140"	130"	85,752	34"	48"	48"	10X17-1152C
12,000	162"	144"	134"	87,232	38"	48	48"	10X17-1202C

ITEM SIZE	WEIGHT
8" TOP	16,312#
21" BOTTOM	20,517#
30" RISER	11,116#
34" RISER	12,600#
38" RISER	14,080#
42" RISER	15,562#
48" RISER	17,786#

ALL RISERS HAVE SPANS

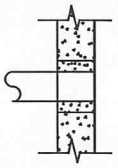
SHEA PRODUCT ID: SEE TABLE	PREPARED FOR:	FILE NAME: ctk10x172C.dwg	
WEIGHT (LBS): SEE TABLE	DRAWN BY: ARO	DATE: 03/01/2018	PAGE: I8. 2

4' DIA DRYWELL



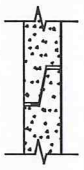
A

MORTAR BY CONTRACTOR



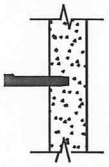
B

BUTYL RUBBER SECTION JOINT



C

POLYPROPYLENE MANHOLE STEPS



CAPACITY (GAL. PER FT)	WEIGHT (PER VERT. FT)
93.96	865 lbs.

DESIGN NOTES:

1. MANUFACTURED TO MEET OR EXCEED: ASTM C-478 & AASHTO M 199 SPECS.
2. CONCRETE = 4,000 PSI. MINIMUM CEMENT PER ASTM C-478 (6.1)
3. REINFORCED STEEL COMFORMS TO LATEST ASTM A 185 SPECIFICATIONS. 0.12 SQ. IN / LINEAL FT. AND 0.12 SQ. IN (BOTH WAYS) BASE BOTTOM
4. STEEL REINFORCEMENT TO MEET OR EXCEED AASHTO HS-20 LOADING
5. MANHOLE STEPS MEET LATEST OSHA REGULATION 29 CFR1910.27, SECTION 16 OF ASTM SPECIFICATION C478 AND SECTION 10 OF ASTM SPECIFICATION C497
6. BUTYL RUBBER JOINT SEALANT PER ASTM C-990 & ASHTO M-198
7. WATER PROOFING PER CONTRACT SPECS. AS REQUIRED

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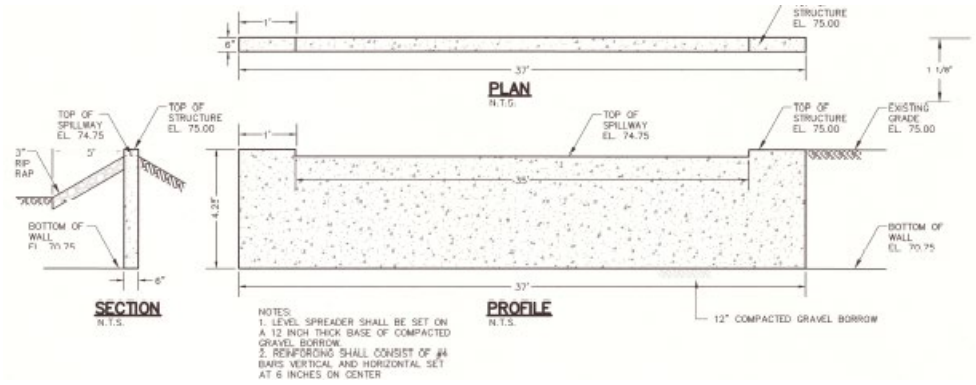
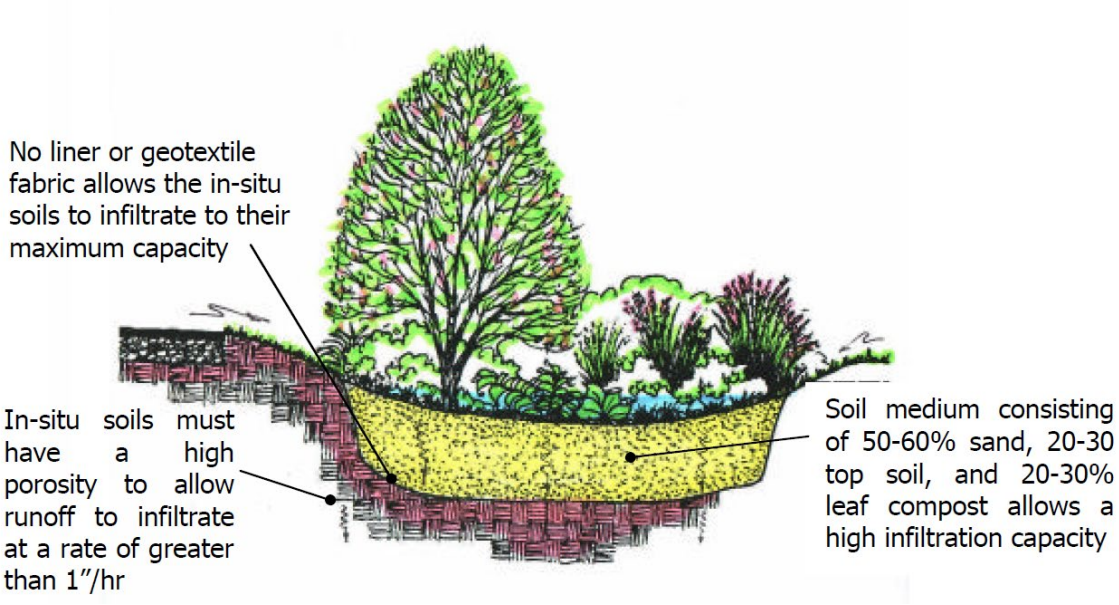
MARSHFIELD, MA 02050
PHONE # 1-800-440-0009
FAX # 781-837-4320

CONTRACTOR:	JOB NAME:	
DATE:	DRAWING: SRP-DW46	DRAWING BY: C.J. SCOTT



Level Spreader Detail



Bioretention Basin

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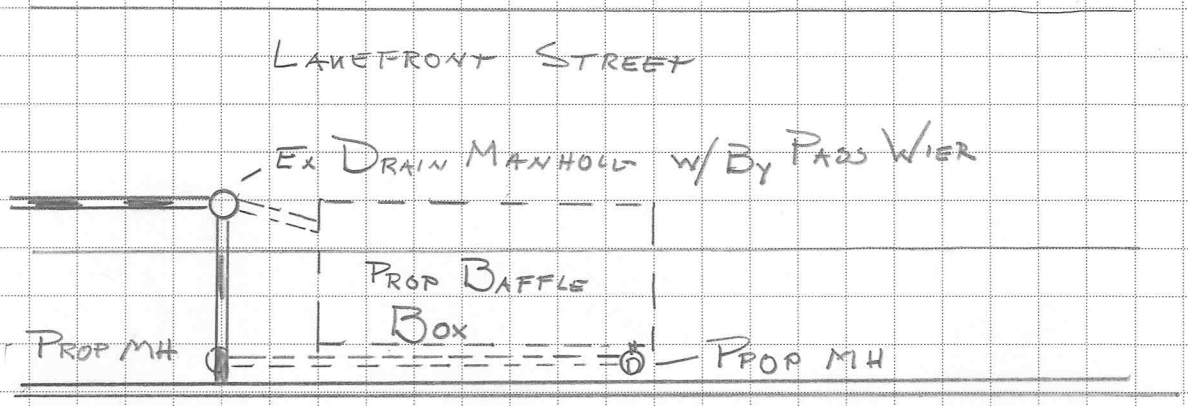
CATACOOXAMUG BROOK - CONCEPTUAL DESIGN

CA-26 TO CA-29

- CONNECT BAFFLE BOX BETWEEN MANHOLE AND OUTLET PIPE



LAKE WHALOM

USE 10,000 GALLON CHAMBERS

- ADD WIER
- TWO NEW MANHOLES
- 3 FRAME, COVERS AND RIDERS FOR BAFFLE BOX
- 25'± NEW 12" HDPE PIPE
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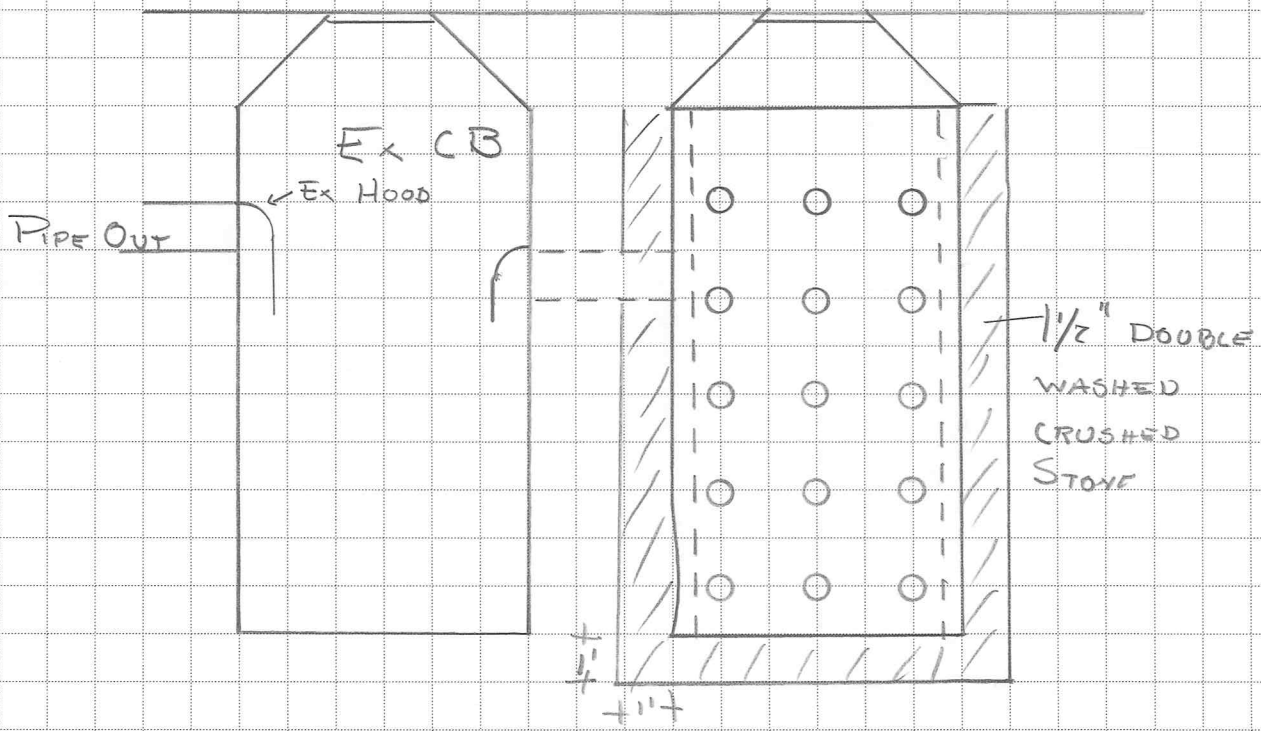
CATACOONAMUG BROOK (CONT)

PROSPECT ST

CA 32-33

ADD LEACHING CATCH BASINS TO 11 EX CB



- 11 LEACHING CBs
- 33' HDPE PIPE
- 11 HOODS
- 40 CY CRUSHED STONE

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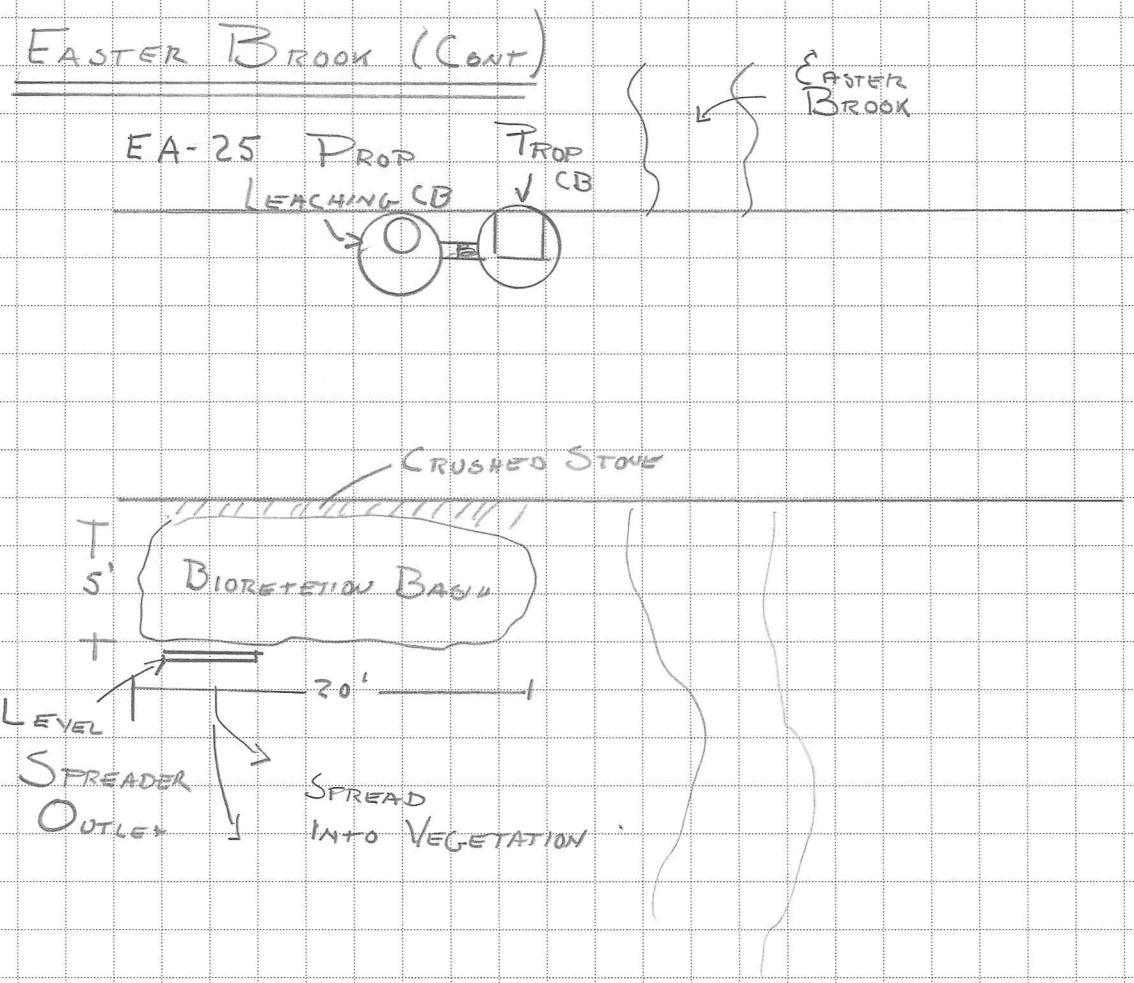
EASTER BROOK (CONT)



- CB
- LEACHING CB
- 4' PIPE
- 5'x20' BIORETENTION BASIN
- LEVEL SPREADER

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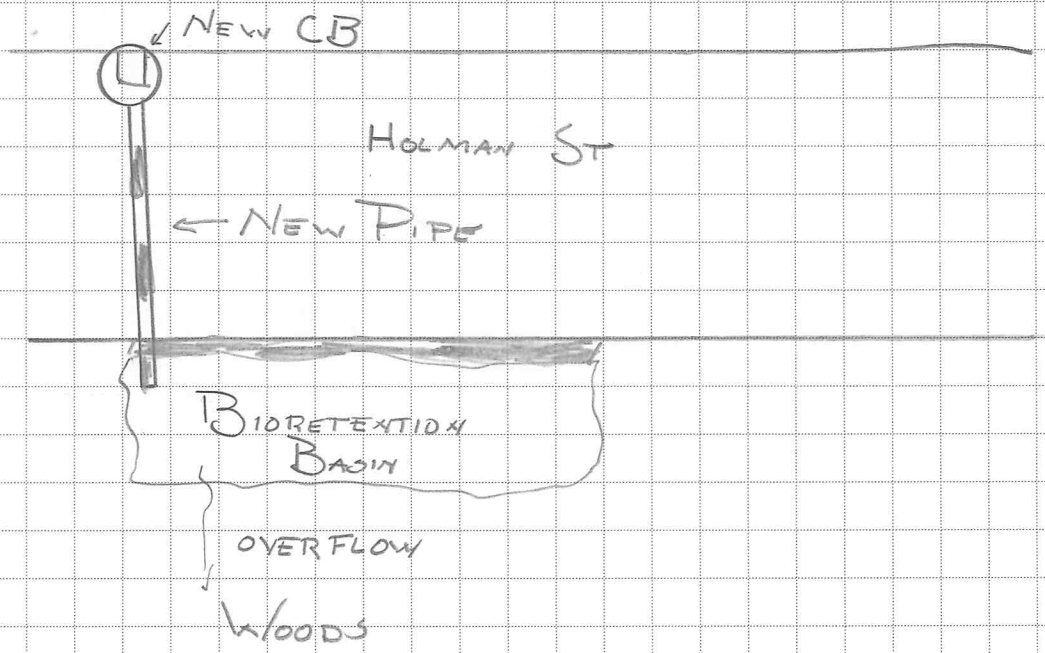
LAKE SHIRLEY (CONT)

LS-31 & LS-32

SEE BAFFLE BOX DESIGN

- 2 CATCH BASINS
- 2 10,000 GALLON TANKS

MULPHUS BROOK (CONT)



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COMMERCIAL 2-COMP TANK
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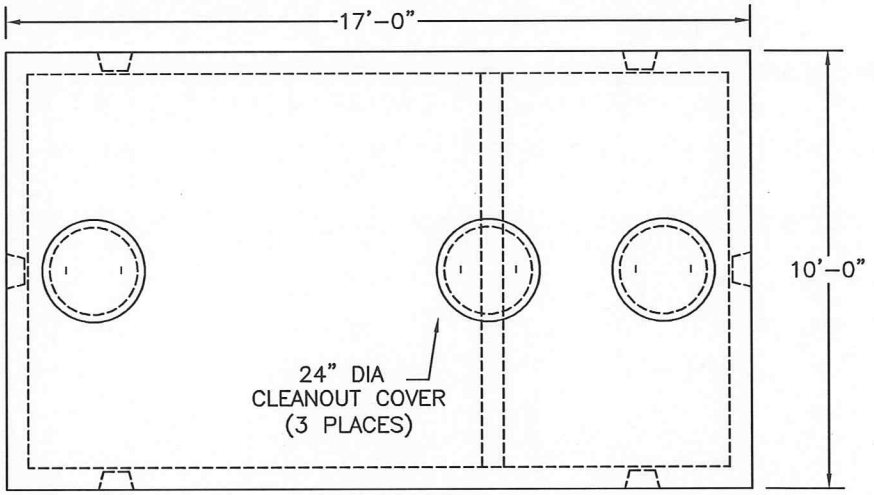
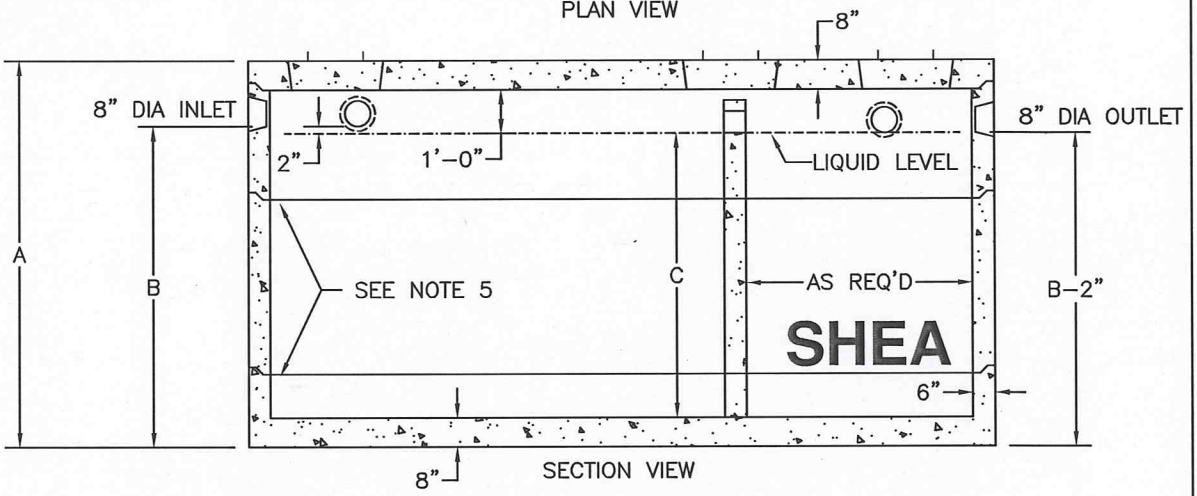


PLAN VIEW



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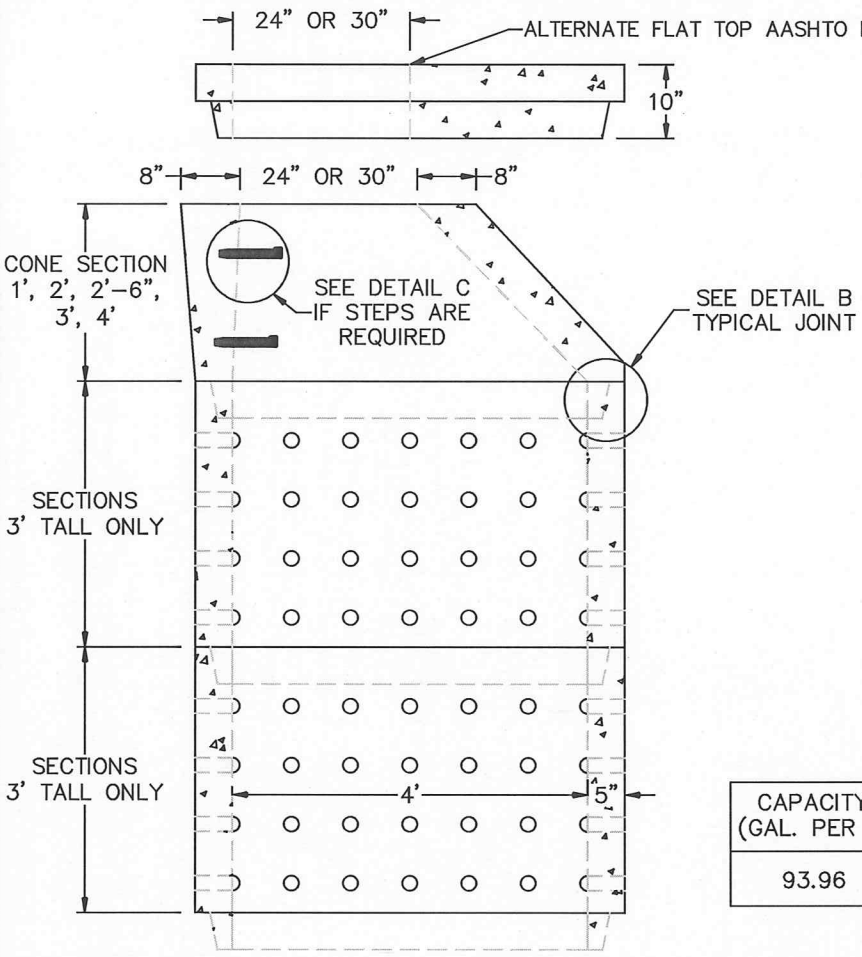
8,000	118"	100"	90"	70,928	42"	48"	0	10X17-802C
8,500	124"	106"	96"	73,152	48"	48"	0	10X17-852C
9,000	130"	112"	102"	75,374	30"	30"	42"	10X17-902C
9,500	136"	118"	108"	77,598	30"	30"	48"	10X17-952C
10,000	140"	122"	112"	79,082	30"	34"	48"	10X17-1002C
10,500	146"	128"	118"	81,304	34"	42"	42"	10X17-1052C
11,000	152"	134"	124"	83,528	34"	42"	48"	10X17-1102C
11,500	158"	140"	130"	85,752	34"	48"	48"	10X17-1152C
12,000	162"	144"	134"	87,232	38"	48	48"	10X17-1202C

ITEM SIZE	WEIGHT
8" TOP	16,312#
21" BOTTOM	20,517#
30" RISER	11,116#
34" RISER	12,600#
38" RISER	14,080#
42" RISER	15,562#
48" RISER	17,786#

ALL RISERS HAVE SPANS

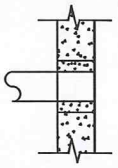
SHEA PRODUCT ID: SEE TABLE	PREPARED FOR:	FILE NAME: ctk10x172C.dwg	
WEIGHT (LBS): SEE TABLE	DRAWN BY: ARO	DATE: 03/01/2018	PAGE: I8. 2

4' DIA DRYWELL



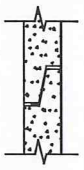
A

MORTAR BY CONTRACTOR



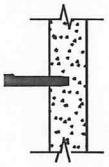
B

BUTYL RUBBER SECTION JOINT



C

POLYPROPYLENE MANHOLE STEPS



CAPACITY (GAL. PER FT)	WEIGHT (PER VERT. FT)
93.96	865 lbs.

DESIGN NOTES:

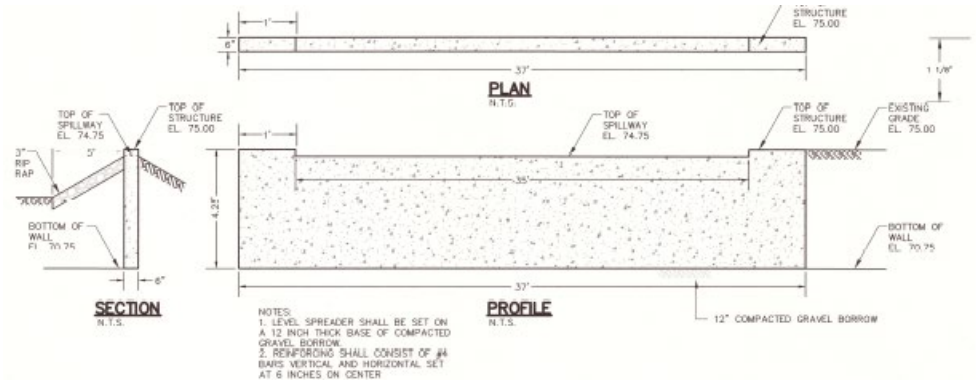
1. MANUFACTURED TO MEET OR EXCEED: ASTM C-478 & AASHTO M 199 SPECS.
2. CONCRETE = 4,000 PSI. MINIMUM CEMENT PER ASTM C-478 (6.1)
3. REINFORCED STEEL COMFORMS TO LATEST ASTM A 185 SPECIFICATIONS. 0.12 SQ. IN / LINEAL FT. AND 0.12 SQ. IN (BOTH WAYS) BASE BOTTOM
4. STEEL REINFORCEMENT TO MEET OR EXCEED AASHTO HS-20 LOADING
5. MANHOLE STEPS MEET LATEST OSHA REGULATION 29 CFR1910.27, SECTION 16 OF ASTM SPECIFICATION C478 AND SECTION 10 OF ASTM SPECIFICATION C497
6. BUTYL RUBBER JOINT SEALANT PER ASTM C-990 & ASHTO M-198
7. WATER PROOFING PER CONTRACT SPECS. AS REQUIRED

NPCA
Precast ... The Concrete Solution.

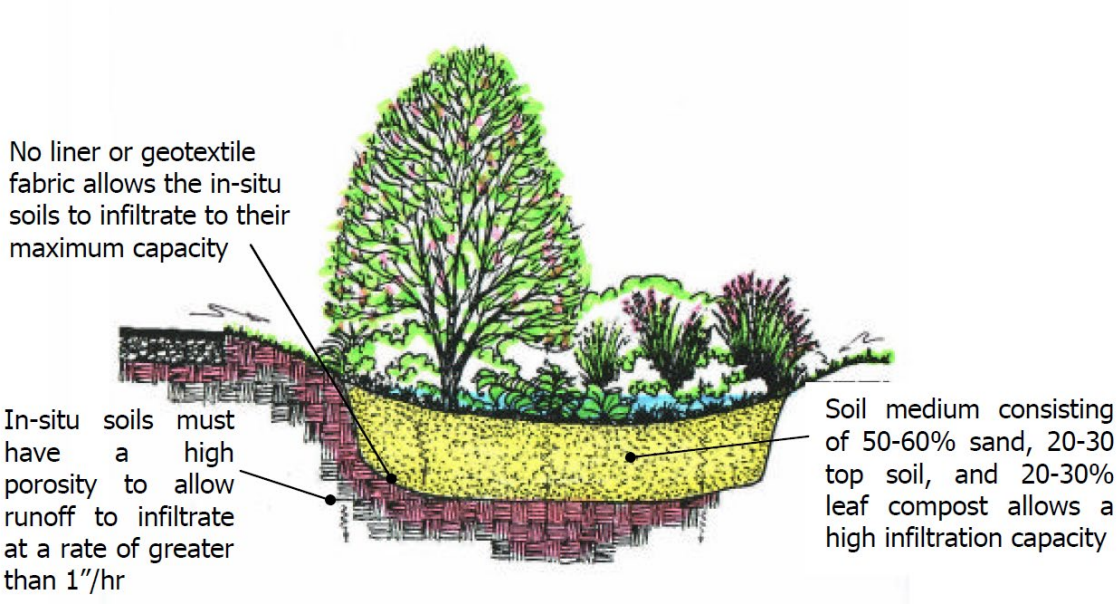
SCITUATE COMPANIES

SCITUATE RAY PRECAST
120 CLAY PIT ROAD
MARSHFIELD, MA 02050
PHONE # 1-800-440-0009
FAX # 781-837-4320

CONTRACTOR:	JOB NAME:	
DATE:	DRAWING: SRP-DW46	DRAWING BY: C.J. SCOTT



Level Spreader Detail



Bioretention Basin

PROJECT COSTS
Lunenburg Sub-basin Project

Catacoonamug Brook

Build weir in Manhole	$500
Two New Manholes	$6,000
3 Frame Grates and Riser for Baffle Box	$750
25 Feet of Pipe	$6,250
Baffle Box	$15,000
Sub-Total	$28,500
CA-26 to CA-29 Four Units	$114,000
Engineering 15%	$17,100
Permitting 5%	$5,700
Construction Administration 10%	$11,400
Baffle Box Total	**$148,200**

Prospect Street

11 Leaching Catch Basins Total	**$82,500**

Easter Brook

Catch Basin/Leaching Catch Basin	$12,000
Bioretention Basin	$10,000
Survey	$2,500
Design / Notice of Intent	$5,000
Total	**$29,500**

Lake Shirley

Baffle Box Cost	$28,500
Survey	$2,500
Design / Notice of Intent	$5,000
Total	**$36,000**

Upper Mulphus Brook

Catch Basin	$6,000
Bioretention Basin	$10,000
Survey	$2,500
Design / Notice of Intent	$5,000
Total	**$23,500**

The Simple Method Loading Calculation and Reduction Calculation Worksheet

Comprehensive Environmental Inc.
Modified by Design Consultants Inc.

No.	Watershed Name	Landuse	Area (acres)	Sanded?	Sanded Area (acres)	% Impervious	Runoff (in)	Annual Runoff (cf)	Annual TSS (lbs)	Annual TP (lbs)	Annual TN (lbs)
1	CA-26	Multifamily	1.79	Yes	1.79	100	51	331,383	8,950	8.25	45.4
2	CA-27	Multifamily	0.83	Yes	0.83	60	51	153,658	4,150	3.83	21.0
3	CA-28	Multifamily	1.06	Yes	1.06	60	30	115,434	5,300	2.87	15.8
4	CA-29	Multifamily	1.30	Yes	1.30	60	51	240,669	6,500	5.99	33.0
5	CA-32	Residential-Med. Density	0.85	Yes	0.85	30	51	157,361	4,250	3.92	21.6
6	CA-33	Residential-Med. Density	4.85	Yes	4.85	30	20	352,110	24,250	8.77	48.2
7	EA-25	Residential-Low Density	1.33	Yes	1.33	10	51	246,223	6,650	6.13	33.7
8	EA-25	Residential-Low Density	1.33	Yes	1.33	10	30	144,837	6,650	3.61	19.8
9	LS-31	Residential-Low Density	0.59	Yes	0.59	10	38	81,385	2,950	2.03	11.1
10	LS-32	Residential-Low Density	0.51	Yes	0.51	10	51	94,416	2,550	2.35	12.9
11	UM-30	Residential-Low Density	0.61	Yes	0.61	10	51	112,929	3,050	2.81	15.5
12						0	0	0	0	0.00	0.0
13						0	0	0	0	0.00	0.0
14						0	0	0	0	0.00	0.0
15						0	0	0	0	0.00	0.0
Total			15		15			2,030,404	**75,250**	**50.6**	**278.1**

Landuse[1]	% Impervious	TSS (mg/l)	TP (mg/l)	TN (mg/l)
Commerical	85	75	0.2	2
Industrial	75	120	0.4	2.5
Multifamily	60	100	0.4	2.2
Open Urban Land	9	48.5	0.31	0.74
Residential-High Density	40	100	0.4	2.2
Residential-Low Density	10	100	0.4	2.2
Residential-Med. Density	30	100	0.4	2.2
Residential Roof	100	19	0.11	1.5
Roadway/Parking Lot	100	150	0.5	3

[1] High density residential (<1/4 acre lots); Medium density residential (1/4 to 1/2 acre lots); Low density residential (>1 acre lots); Multifamily (>7 dwellings per acre).

Annual Rainfall	46	inches; user specified
P_j	0.9	%; default
Sanding Rate	500	lbs/acre; default
Sanding Applications	10	times/year; default

Simple Method Equations:

L = 0.226 * R * C * A
Where:
L = Annual Load (lbs)
R = Annual Runoff (inches)
C = Pollutant Concentration (mg/l)
A = Area (acres)
0.226 = Unit Conversion Factor

$R = P * P_j * Rv$
Where:
R = Annual Runoff (inches)
P = Annual Rainfall (inches)
P_j = % of rainfall events producing runoff
Rv = Runoff Coefficient

Rv = 0.05+0.9 * Ia
Ia = Impervious Fraction (%)

References:
Pitt, Robert. (2004, February 16). The National Stormwater Quality Database (NSQD, version 1.1). Retrieved July 22, 2005 from the World Wide Web: http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/recentpaper.htm
The New York Stormwater Management Design Manual Appendix A. Retrieved July 22, 2005 from the World Wide Web: http://www.dec.state.ny.us/website/dow/toolbox/simple.pdf
The Simple Method to Calculate Urban Stormwater Loads. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/monitoring%20and%20assessment/simple%20meth/simple.htm

The Simple Method Loading Calculation and Reduction Calculation Worksheet

Comprehensive Environmental Inc.
Modified by Design Consultants Inc.

No.	Watershed Name	BMP Type	BMP Drainage Area (acres)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Annual TSS Removed (lbs)	Annual TP Removed (lbs)	Annual TN Removed (lbs)
1	CA-26	Baffle Box	0.25	25%	5%	5%	313	0.06	0.3
2	CA-27	Baffle Box	0.25	25%	5%	5%	313	0.06	0.3
3	CA-28	Baffle Box	0.25	25%	5%	5%	313	0.03	0.2
4	CA-29	Baffle Box	0.25	25%	5%	5%	313	0.06	0.3
5	CA-32	Infiltration - 1"	0.25	90%	70%	58%	1,125	0.81	3.7
6	CA-33	Infiltration - 1"	0.25	90%	70%	58%	1,125	0.32	1.4
7	EA-25	Infiltration - 1"	1.33	90%	70%	58%	5,985	4.29	19.6
8	EA-25	Raingarden - 1"	1.33	90%	70%	58%	5,985	2.52	11.5
9	L-31	Baffle Box	0.59	25%	5%	5%	738	0.10	0.6
10	L-32	Baffle Box	0.51	25%	5%	5%	638	0.12	0.6
11	UM-30	Raingarden - 1"	0.61	90%	70%	58%	2,745	1.97	9.0
12									
13									
14									
15									
Total							**19,590**	**10.33**	**47.5**

BMP Type	TSS Removal (%)	TP Removal (%)	TN Removal (%)
Baffle Box	25%	5%	5%
Constructed Wetland	80%	55%	30%
Detention Basin (dry)	48%	30%	30%
Infiltration - 1"	90%	70%	58%
Raingarden - 1"	90%	70%	58%
Catch Basin	25%	0%	0%

Modified by Design Consultants Inc.

References:

Comparative Pollutant Removal Capability of Stormwater Treatment Practices, Technical Note #95 from Watershed Protection Techniques. 2(4): 515-520, Article 64. Retrieved July 22, 2005 from the World Wide Web: http://www.stormwatercenter.net/Practice/64-Comparative%20Pollutant%20Removal.pdf

Choi, J & Engel, B. Urban BMPs and Cost Estimation, Structural BMP Expected Pollutant Removal Efficiency & Median Event Mean Concentration for Urban Land Uses. US EPA. (1993) Handbook Urban Runoff Pollution and Control Planning. Retrieved July 22, 2005 from the World Wide Web: http://danpatch.ecn.purdue.edu/~jychoi/ubmp0/emc2.htm

STORMWATER BEST MANAGEMENT PRACTICES (BMPS)
FOR

LUNENBURG SUB-BASIN PROJECT
OPERATIONS & MAINTENANCE PLAN

May 2019

Prepared for:

Town of Lunenburg
Stormwater Task Force
17 Main Street
P.O. Box 135
Lunenburg, MA

Prepared by:

Design Consultants Inc.
120 Middlesex Avenue
Suite 20
Somerville, MA

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2.0 Purpose 1
3.0 BMP Descriptions 1
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BIO-SWALE MAINTENANCE INSPECTION FORM
WATER QUAILTY SWALE MAINTENANCE INSPECTION FORM
LEACHING CATCH BASIN MAINTENANCE INSPECTION FORM
OIL/GRIT SEPERATOR MATNTENANCE INSPECTION FORM
DEEP SUMP CATCH BASIN

OPERATION & MAINTENANCE PLAN

1.0 INTRODUCTION

The Town of Lunenburg (Town) is implementing a program to improve the quality of surface water in the five key watersheds by reducing nutrients, total suspended solids and other pollutants as a result of Non-Point Source Pollution Discharge (NPDES). As part of this program, the Department has initiated a project utilizing Low Impact Development *(LID)* techniques, known as Best Management Practices (BMPs), to collect, treat, infiltrate and reduce peak stormwater runoff at the Site. The BMPs utilized in this project consist of Deep Sump Catch Basins, Water Quality Swales, Bioretention Cells, Leaching Catch Basins, and Baffle Boxes.

2.0 PURPOSE

This Operation & Maintenance Plan (O&M Plan) is intended to provide a mechanism for the consistent inspection and maintenance of BMPs installed during the project. Included in this O&M Plan is a description of each BMP type, the location of individual BMPs, an inspection schedule, an inspection checklist for the BMP, and forms to be utilized to document the BMP inspection and maintenance.

3.0 BMP DESCRIPTIONS

3.1 Bio-swales

Bio-swales (Bioretention) function as soil and plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes. The bioretention system consists of a soil bed planted with native. Stormwater runoff entering the Bioretention system is filtered first through the vegetation and then the bioretention soil mixture before being infiltrated into the underlying soil. Runoff storage depths are between two and three feet and are designed to be lowered below the ground surface in less than 72 hours. Bioretention systems are used to remove a wide range of pollutants, such as suspended solids, nutrients, metals, hydrocarbons, and bacteria from stormwater runoff. They also reduce peak runoff rates and temperatures, and increase stormwater infiltration when designed as a multi-stage, multi-function facility.

3.2 *Leaching Catch Basin*

The Leaching Catch Basins are classified by the MA DEP's Stormwater Handbook, Volume 2, Chapter 2 as a Subsurface Structure. Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the soil.

3.3 Water Quality Swale

Water quality swales are vegetated open channels designed to treat the required water quality volume and to convey runoff from the 10-year storm without causing erosion.

3.4 *Oil/Grit Separator (Baffle Box)*

Oil/Grit separators are underground storage tanks with three chambers designed to remove particulates, floating debris and hydrocarbons from stormwater.

3.5 *Deep Sump Catch Basins*

Deep sump catch basins are collection systems that are designed to remove trash, debris, and coarse sediment from stormwater runoff.

4.0 INSPECTION AND MAINTENANCE CHECKLIST AND SCHEDULE

4.1 *Bio-swales* (*Bioretention)*

The primary maintenance requirement for Bio-swales is that of inspection, and repair or replacement of the Bio-swales's individual components. Typically, these activities consist of nothing more than that which is required of any landscaped area. The primary maintenance function is the removal of accumulated sediment and debris. Other potential tasks include the replacement of dead vegetation, soil pH regulation, erosion repair at inflow points, mulch replenishment, inspection and unclogging of the underdrain if necessary and repair of inflow structures.

Table 4-1 **Bio-swale, Tree Filter, Bioretention Cell Maintenance Schedule**
Soil
• Visually inspect and repair in the Spring and Fall. • Remove accumulated sediment, debris, and litter • Check the soil pH every other Spring. Apply appropriate product to adjust pH, as required. The recommended soil pH levels should range from 5.0 to 6.0.
Mulch
• Re-mulch any void areas by hand, as needed. • Every Spring, add a fresh mulch layer. • Every 3rd year, remove and replace mulch.
Plants
• Once a month, during the growing season visually inspect vegetation for disease and pest problems. • Every Spring and Fall, remove and replace all dead and diseased vegetation. • Weed, as needed.

• Prune excess growth and dead branches every Spring. • During periods of drought, inspect for signs of stress (unrevied wilting, yellow, spotted or brown leaves, loss of leaves, etc.). Water in the early morning as needed.
Inlet
• Every Spring and Fall, inspect inlet. Remove accumulated sediment, fallen leaves and debris.
General
• Annually, after a heavy rainstorm, inspect Bio-swales for signs of ponding and to make sure water dissipates after a period of 24 to 36 hours.

4.2 *Leaching Catch Basin*

Inspection shall be completed annually or more frequently as indicated by BMP performance. Remove sediment if the basin is more than 50% filled. In the event the basin is flooded or the system is failed, it should be evaluated by a Professional Engineer.

4.3 *Water Quality Swales*

Inspect swales to make sure vegetation is adequate and slopes are not eroding. Check for rilling and gullying. Repair eroded areas and revegetate. Mow swales and collect cuttings. Remove sediment and debris manually at least once a year. Reseed as necessary.

4.4 *Oil/Grit Separator (Baffle Box)*

Oil/grit Separators shall be inspected monthly and every after every major storm event, and cleaned, at a minimum twice per year. In the event that the total depth of sediment and debris reaches 6-inches or the water surface is covered the oil/grit separator shall be cleaned. Cleaning consists of removal of accumulated floatables and sediment using a vacuum truck. Water and solids should be disposed of in accordance with local, state and federal regulations.

4.6 Deep Sump Catch Basins

Deep sump catch basins should be inspected four times per year to determine the depth of sediment in the basin. In the event the depth of sediment in the basin is two-feet or greater, the catch basin should be cleaned. Each basin should be cleaned a minimum of four times per year. Water, sediment and debris should be disposed of in accordance with local, state and federal regulations.

4.8 Inspections and Record Keeping

- An inspection form should be filled out each and every time maintenance work is performed.

- A binder should be kept at the Department of Public Works that contains all of the completed inspections forms and/or photos and related material.
- A review of all Operation & Maintenance actions should take place annually to ensure that these Stormwater BMPs are being taken care of in the manner illustrated in this Operation & Maintenance plan.

APPENDIX A

BIORETENTION, BIO-SWALES, AND TREE FILTER MAINTENANCE INSPECTION FORM

Facility No.: _____ Date/Time; _____
Weather: _____ Inspector(s): _____
Date of Last Rainfall: _____ Amount: _____ Inches
Street Location: _____ GPS Coordinates: _____

Scoring Breakdown: **N/A – Not Applicable** **N/I – Not Investigated** **0 – Not a Problem**	**1 – Monitor for future problems.** **2 - Routine Maintenance Required** **3 – Immediate Repair Necessary**						**Use Column to further explain scoring as needed.**
Outlet							
Broken	N/A	N/I	0	1	2	3	
Clogging	N/A	N/I	0	1	2	3	
Submerged Outlet Pipe	N/A	N/I	0	1	2	3	
Bioretention Soil Mix							
Sediment > 1-inch	No	Yes					
Ponding 72 hours after rain	No	Yes					
Sediment in Soil bed	N/A	N/I	0	1	2	3	
Oil/Chemical in soil bed	N/A	N/I	0	1	2	3	
Trash	N/A	N/I	0	1	2	3	
Other	N/A	N/I	0	1	2	3	
Underdrain							
Broken	N/A	N/I	0	1	2	3	
Clogging	N/A	N/I	0	1	2	3	
Plants							
Disease/Pest Problems	N/A	N/I	0	1	2	3	
Weeds	N/A	N/I	0	1	2	3	
Excess growth/dead vegetation	N/A	N/I	0	1	2	3	
Inlet							
Accumulated Sediment	N/A	N/I	0	1	2	3	
Mulch							
Overall Condition	N/A	N/I	0	1	2	3	
Erosion							
Soil erosion or debris	N/A	N/I	0	1	2	3	

Overall Condition of Facility
Total number of concerns receiving a:
____ ***(1) Need Monitoring***
____ ***(2) Routine Repair***
____ ***(3) Immediate Repair Needed***

Inspector's Summary:

Photographs:

(1) _____
(2) _____
(3) _____
(4) _____
(5) _____
(6) _____
(7) _____
(8) _____

Sketches, as necessary:

LEACHING CATCH BASIN MAINTENANCE INSPECTION FORM

Facility No.: _____ Date/Time; _____
Weather: _____ Inspector(s): _____
Date of Last Rainfall: _____ Amount: _____ Inches
Street Location: _____ GPS Coordinates: _____

Scoring Breakdown: **N/A – Not Applicable** **N/I – Not Investigated** **0 – Not a Problem**	**1 – Monitor for future problems.** **2 - Routine Maintenance Required** **3 – Immediate Repair Necessary**						**Use Column to further explain scoring as needed.**
Inlet							
Broken	N/A	N/I	0	1	2	3	
Clogging	N/A	N/I	0	1	2	3	
Inspection Manhole							
Water Present	N/A	N/I	0	1	2	3	
Sediment Present	N/A	N/I	0	1	2	3	Sediment >50% Clean

Overall Condition of Facility
Total number of concerns receiving a:
____ ***(1) Need Monitoring***
____ ***(2) Routine Repair***
____ ***(3) Immediate Repair Needed***

Inspector's Summary:

Photographs:

(1) _____
(2) _____
(3) _____
(4) _____

Sketches, as necessary:

WATER QUALITY SWALE MAINTENANCE INSPECTION FORM

Facility No.: _____ Date/Time; _____
Weather: _____ Inspector(s): _____
Date of Last Rainfall: _____ Amount: _____ Inches
Street Location: _____ GPS Coordinates: _____

Scoring Breakdown: **N/A – Not Applicable** **N/I – Not Investigated** **0 – Not a Problem**	**1 – Monitor for future problems.** **2 - Routine Maintenance Required** **3 – Immediate Repair Necessary**						**Use Column to further explain scoring as needed.**
Surface							
Sediment and debris accumalation	N/A	N/I	0	1	2	3	
Inspect for Surface Deterioration	N/A	N/I	0	1	2	3	
Water Present	N/A	N/I	0	1	2	3	
Inspect for Erosion	N/A	N/I	0	1	2	3	

Overall Condition of Facility
Total number of concerns receiving a:
____ ***(1)*** ***Need Monitoring***
____ ***(2)*** ***Routine Repair***
____ ***(3)*** ***Immediate Repair Needed***

Inspector's Summary:

Photographs:

(1) _____
(2) _____
(3) _____
(4) _____

Sketches, as necessary:

OIL/GRIT SEPARATOR (BAFFLE BOX) MAINTENANCE INSPECTION FORM

Facility No.: _____ Date/Time; _____
Weather: _____ Inspector(s): _____
Date of Last Rainfall: _____ Amount: _____ Inches
Street Location: _____ GPS Coordinates: _____

Scoring Breakdown: **N/A – Not Applicable** **N/I – Not Investigated** **0 – Not a Problem**	**1 – Monitor for future problems.** **2 - Routine Maintenance Required** **3 – Immediate Repair Necessary**						**Use Column to further explain scoring as needed.**
Inlet and Outlet							
Submerged Outlet Pipe	N/A	N/I	0	1	2	3	
Clogging	N/A	N/I	0	1	2	3	
Sediment							
Sediment > 6 inches	N/A	N/I	0	1	2	3	
Frame and Covers							
Broken	N/A	N/I	0	1	2	3	
Buried	N/A	N/I	0	1	2	3	

Overall Condition of Facility ***Total number of concerns receiving a:*** ____ ***(1)*** ***Need Monitoring*** ____ ***(2)*** ***Routine Repair*** ____ ***(3)*** ***Immediate Repair Needed*** ***Inspector's Summary:***

Photographs:

(1) _____
(2) _____
(3) _____
(4) _____

Sketches, as necessary:

DEEP SUMP CATCH BASIN MAINTENANCE INSPECTION FORM

Facility No.: _____ Date/Time; _____
Weather: _____ Inspector(s): _____
Date of Last Rainfall: _____ Amount: _____ Inches
Street Location: _____ GPS Coordinates: _____

Scoring Breakdown: **N/A – Not Applicable** **N/I – Not Investigated** **0 – Not a Problem**	**1 – Monitor for future problems.** **2 - Routine Maintenance Required** **3 – Immediate Repair Necessary**						**Use Column to further explain scoring as needed.**
Inlet and Outlet							
Submerged Outlet Pipe	N/A	N/I	0	1	2	3	
Clogging	N/A	N/I	0	1	2	3	
Sump							
Sediment > 2-feet	N/A	N/I	0	1	2	3	
Frame and Covers							
Broken	N/A	N/I	0	1	2	3	
Buried	N/A	N/I	0	1	2	3	
Hood	N/A	N/I	0	1	2	3	

Overall Condition of Facility			
Total number of concerns receiving a:	____	***(4)***	***Need Monitoring***
	____	***(5)***	***Routine Repair***
	____	***(6)***	***Immediate Repair Needed***
Inspector's Summary:			

Photographs:

(5) _____
(6) _____
(7) _____
(8) _____

Sketches, as necessary: