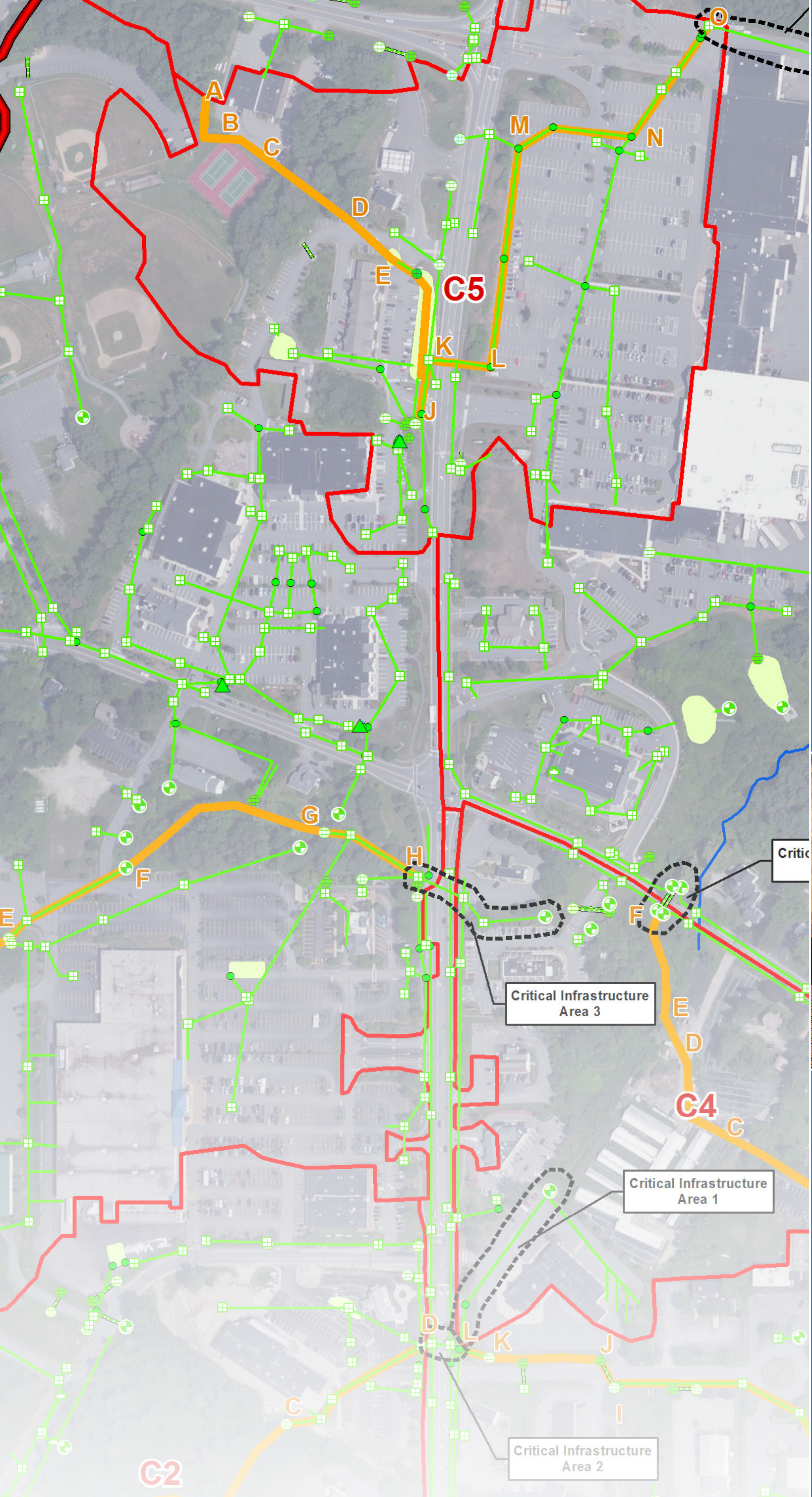
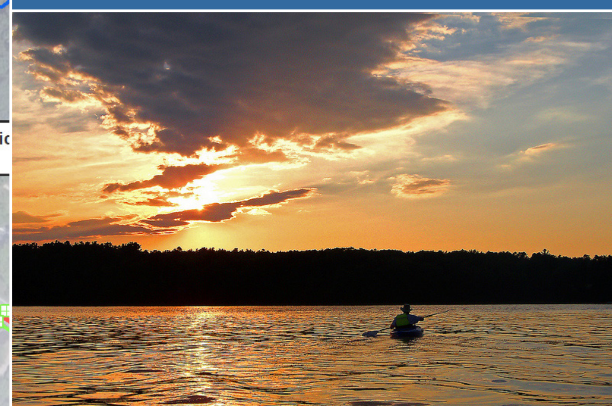


Route 1 Falmouth Commercial District

Stormwater Management Plan



Town of Falmouth, ME

January 2013

WOODARD & CURRAN

Maine Coastal Program

This report was prepared for the Town of Falmouth under award NOAA CZM NA10NOS4190188 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

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EXECUTIVE SUMMARY

The Route 1 corridor in Falmouth is an important commercial center for the community. In 2011, the Town commissioned a Route 1 Infrastructure Plan for the area between Route 88 and the Turnpike Spur to coordinate future improvements in the public right-of-way. The Town of Falmouth envisions a denser pattern of development along the commercial Route 1 corridor with activities day and night. In order to further inform the redevelopment of this corridor, the Town acquired a National Oceanic and Atmospheric Administration - U.S. Department of Commerce grant through the Maine Coastal Program.

This study accomplished the following:

- identified the linkage of private and public stormwater runoff in the commercial Route 1 area;
- developed an integrated strategy that will complement the Route 1 Infrastructure Plan;
- provided a demonstration of the potential for integration of traditional infrastructure and Green Infrastructure management for a commercial district in Maine;
- began the process towards addressing polluted stormwater discharges into Mussel Cove, which is currently closed for shellfishing due to pollution; and
- identified an appropriate demonstration project from this plan in collaboration with MaineDOT along Bucknam Road.

Webes Creek is a small tributary of Mill Creek which discharges into Mussel Cove and Casco Bay. A large portion of the Route 1 commercial district is within the 341-acre Webes Creek watershed. This small watershed area contains over 112 acres of impervious surfaces (i.e. roadways, rooftop, pavements, etc.), or approximately 33% of the watershed area, which makes the tributary likely to be impaired due to polluted stormwater runoff. Twelve commercially developed parcels within the watershed currently provide some form of stormwater management for peak rate of runoff and/or water quality. Many of these systems are outdated under current standards, but can be cost-effectively retrofitted to provide advanced stormwater management. Several other areas within the Webes Creek watershed were identified as priorities for future stormwater management retrofitting, particularly for runoff from Route 1 itself. Stormwater drainage infrastructure was mapped and field verified as a part of this project and several critical pieces of drainage infrastructure along Route 1 were identified as having “sensitive” hydraulic capacity. These locations were recommended for improvements during future upgrades to Route 1 in order to alleviate upstream flooding problems and to maximize the potential for additional growth in the corridor.

Additionally, recommendations were made to evaluate and modify local codes and ordinances to maximize the potential for enhanced management of stormwater of future redevelopment projects in order to offset existing impacts and to accommodate future growth. Alternatives to addressing existing untreated stormwater discharges through redevelopment may include public-private partnerships for strategic retrofitting. Total cost for identified retrofits may range between $2 and $5 MM. Further evaluation of these retrofits was recommended to determine implementation feasibility and priority. Recommendations for financing retrofits included user fee implementation, use of Tax Increment Financing (TIF) funds, or special assessment districts.

1. INTRODUCTION

1.1 PROJECT BACKGROUND

Most of the commercially developed corridor along Route 1 in Falmouth is located within the Mill Creek watershed. The Mill Creek watershed is identified as a “priority watershed” by the Town of Falmouth in its municipal stormwater discharge permit program plan which obligates special attention by the Town to addressing polluted stormwater runoff.

Webes Creek is a small tributary of Mill Creek, which accepts the majority of stormwater runoff from the commercial corridor along Route 1. Mill Creek discharges into the Casco Bay at Mussel Cove, which lies within what the Maine Department of Marine Resources (DMR) calls “Growing Area 13”, which is currently closed for shellfishing due to pollution. Mussel Cove is also a part of a coastal area (DMR 14-A) identified in the Statewide Bacteria Total Maximum Daily Load (TMDL) (approved September 2009) as “impaired” for bacteria. A Total Maximum Daily Load is a calculation of the maximum amount of a pollutant that a waterbody can receive and still safely meet water quality standards. Due to increasing levels of development within the area, the Mill Creek watershed is thought to be susceptible to becoming an “Urban Impaired Stream” in the future.

Urban Impaired Streams are designations under State of Maine Stormwater Management Law, as a subset of impaired waters, and which are thought to be impaired due to stormwater runoff. Urban Impaired waterbodies have negative consequences environmentally, economically, and financially. The Town has been working proactively towards preventing this impairment from occurring.

In 2011, the Town commissioned a Route 1 Infrastructure Plan for the area between Route 88 and the Turnpike Spur to coordinate future improvements in the public right-of-way. This plan examines traffic, utilities, drainage, and streetscape. It is one component of an overall redevelopment plan for the Route 1 area. This infrastructure planning effort is being conducted in parallel with the development of recommended zoning ordinance amendments for this section of Route 1. The Town of Falmouth envisions a denser pattern of development along the commercial Route 1 corridor with activities day and night, and an emphasis on pedestrians and sidewalks with attractive landscaping which appeals to businesses and shoppers.

Well-managed stormwater runoff is imperative to good redevelopment planning. While it is known that stormwater runoff from private lands discharge into the public drainage system along Route 1, it is not well understood how the private lands impact stormwater volumes, or stormwater quality, which is then conveyed via the public drainage system into Webes Creek and eventually into Mill Creek and Casco Bay. A more detailed understanding of the interaction between private runoff and the public drainage system will enhance the Route 1 Infrastructure Plan both in terms of capacity for growth and also for a greater understanding of the need for public-private partnerships (such as shared stormwater treatment facilities, rather than parcel by parcel treatment) that can improve stormwater quality entering the public drainage system.

The Town identified the following key issues as the basis for this project:

- The Town lacks a good perspective on the contributions of private and public stormwater runoff to the overall drainage system;
- The Town lacks a good measure of the impervious surface area and build-out capacity for development in the project watershed;
- Just as the Town understands the linkage between the zoning for private properties and improvements to public right-of-way infrastructure, it wants to develop a similar understanding of the linkage of private and public stormwater runoff;

- The Town desires to build on, and not duplicate, past study efforts and use a comprehensive, holistic approach to redevelopment planning;
- The Town seeks to balance planning efforts with actual implementation and evaluation;
- The Town desires to update its stormwater regulations to the current best management practices for new treatment systems; and
- The Town desires to explore innovative public-private partnerships and funding mechanisms to enhance stormwater quality entering Webes Creek, to reduce peak flows to ensure the capacity required for growth, and to make an efficient and effective use of private and public funds.

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1.2 PROJECT GOALS

The project goals are to:

- examine the linkage of private and public stormwater runoff in the commercial Route 1 area;
- develop an integrated green infrastructure strategy that will complement the Route 1 Infrastructure Plan;
- provide a demonstration of the potential for integration of traditional infrastructure and Green Infrastructure management for a commercial district in Maine;
- begin the process towards addressing polluted discharges into Mussel Cove, which is currently closed for shellfishing due to pollution; and
- commit to implementing an appropriate demonstration project from this plan in collaboration with MaineDOT.

1.3 REPORT OBJECTIVES

Consistent with the Project Scope of Work, to be completed by December 31, 2012, the objectives of this Report are to:

- Document the methods utilized to execute the Route 1 Falmouth Commercial District Stormwater Management Plan Tasks;
- Define the Webes Creek subwatershed boundary (i.e. project boundary), which includes:
  - Enhanced drainage infrastructure mapping.
- Provide evaluations of the private stormwater management facilities, which includes:
  - Confirmation of the presence of such facilities;
  - Any noticeable deviations or defects from the original design intent;
  - A general performance rating of the system; and
  - Noting potential locations to consider in future retrofitting efforts.
- Conduct a Build-Out Analysis, which includes:

  - Projected increases in project area impervious surface coverage;
  - Projected capacities of the Town's drainage infrastructure under future build-out; and
  - Recommendations for management enhancements.
- Conduct a Stormwater Retrofit Analysis based on results from the private stormwater management evaluations and the build-out analysis, which includes:
  - Suggested modifications to existing stormwater management facilities;
  - Proposed new stormwater quality treatment systems for enhanced stormwater quality or reduced peak flow rates; and
  - Planning-Level Opinion of Costs.
- Provide suggestions for adjustments to Town Ordinance or Rule Changes to enhance Stormwater Management.

2. MAPPING THE WEBES CREEK SUBWATERSHED

2.1 METHODS

Multiple steps were taken to define the Webes Creek subwatershed boundary, which also defines the limits of this study. The first step towards defining the drainage boundary consisted of an evaluation of Falmouth's Geographic Information System (GIS) including topographic contours, existing stormwater drainage system, parcel boundaries and other relevant geographic information. Next, a more in-depth analysis of the drainage area was conducted utilizing site plans provided by the Town of Falmouth (Town) for certain developments within the subwatershed. These site plan sheets provided information on the site-specific storm drain piping networks necessary to refine the previous draft of the subwatershed boundary by incorporating missing storm drain data. Additionally, site plans were used to identify stormwater management facilities (i.e. detention basins, treatment units, etc.) for incorporation into the Town's GIS and as a basis for facility evaluation discussed in Section 3.

Site plans were obtained for the following facilities:

- CDC, Parcel ID U24-007 (no detail sheets included in plan set)
- Bangor Savings, Parcel ID U11-035A (no detail sheets included in plan set)
- Falmouth Inn, Parcel ID U11-035 (no detail sheets included in plan set)
- Gorham Savings, Parcel ID U52-004
- Maine Med, Parcel ID U58-010
- Morong Service Center, Parcel ID U52-001B
- Norway Savings, Parcel ID U58-010-A1
- Rite Aid, Parcel ID U12-011
- Wal-Mart, Parcel ID U52-002 (no detail sheets included in plan set)
- Key Bank, Parcel ID U58-006
- Falmouth Shopping Center, Parcel ID U12-002
- Family Ice, Parcel ID U52-005 (no detail sheets included in plan set)
- Foreside Assoc., Parcel ID U11-026 (no detail sheets included in plan set)
- Fundy Circle, Parcel ID U11-035C
- Shops at Falmouth Village, Parcel ID U24-005
- Tidewater Development, Parcel ID R04-028 (no detail sheets included in plan set)
- Athletic Fields, Parcel ID U58-004 (no detail sheets included in plan set)

The final step in refining the subwatershed boundary was to field verify locations where drainage flow direction was not clear based on pipe networks or contour data. A site visit was conducted on August 6, 2012. After observing the physical drainage features and localized topography in the field, the subwatershed boundary was finalized and is shown in Figure 2-1.

2.2 CLARIFICATIONS

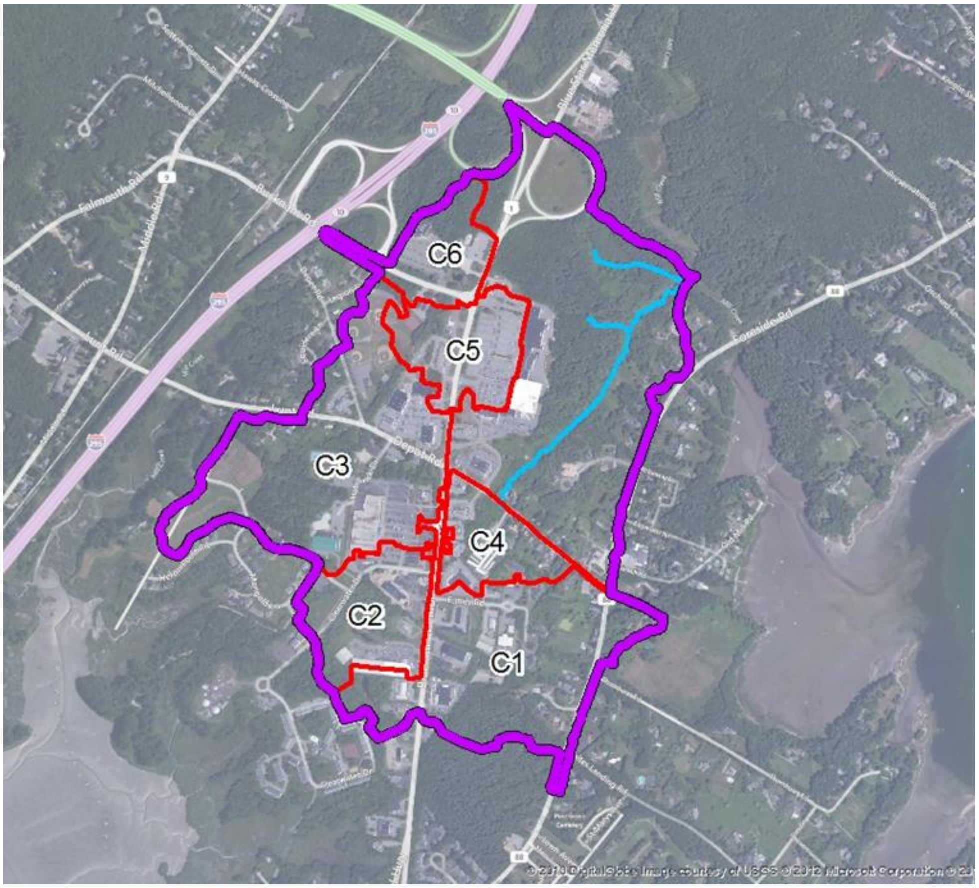
The following is a list of the key assumptions utilized in the development of this task:

- The site plans/details provided by the Town are the most up-to-date records available; and
- Existing data layers within GIS for the Town of Falmouth (drainage, contours, parcels, etc.) are accurate.

2.3 FINDINGS

The figure below shows the final Webes Creek Subwatershed Boundary, as it has been delineated utilizing the methods discussed above. It encompasses an area of approximately 341 acres, and consists of several important commercial properties along the Route 1 corridor in addition to residential properties primarily on the eastern side of the subwatershed. Through impervious cover mapping evaluation (discussed in Section 4), it was determined that the subwatershed contains approximately 112 acres of impervious surfaces. These surfaces, such as rooftop, roadway and parking area, restrict infiltration of precipitation and increase runoff. Numerous studies in a variety of geographies and climates indicate that small urban streams with watersheds that have greater than 10% of their land area covered by impervious surfaces are generally impaired from pollution associated with stormwater runoff. Currently, the Webes Creek subwatershed area is approximately 33% impervious cover. It is our understanding that Webes Creek has not been assessed for impairment and therefore is not currently classified as an impaired water despite its high percentage of impervious surface. The subwatershed has been further subdivided into smaller hydrologic units (catchments) in order to conduct hydrology evaluations for the build-out analysis, as discussed in Section 4 of this Report. These catchment areas were selected for delineation in order to assess the influence of these areas on critical drainage infrastructure within the overall project area and they do not constitute the entirety of the Webes Creek subwatershed. The Webes Creek subwatershed boundary is the basis for all further evaluation in this Report and is considered to be the "project area".

Figure 2-1: Webes Creek Subwatershed Boundary



Key:

Purple = Webes Creek Subwatershed Boundary
Red = Catchment Areas
Light Blue = Webes Creek

3. EVALUATING PRIVATE STORMWATER MANAGEMENT FACILITIES

3.1 BACKGROUND AND METHODS

The objectives of this task of the project is primarily to 1) identify where designed stormwater management (quality or quantity) is occurring within the subwatershed, 2) identify what types of systems are within the project area for consideration of future upgrade or improved management, and 3) provide a qualitative assessment of the systems' effectiveness for both stormwater quality and quantity management. Stormwater management facility locations were identified from review of aerial photography and from site plans obtained and discussed in the previous Report section.

Stormwater management facilities, as identified in this project area, typically consist of detention basins designed to manage stormwater quantity (i.e. peak flow rates) or newer systems designed to manage both stormwater peak runoff rates and also improve stormwater quality. Performance inspections of ten above-grade stormwater management facilities were conducted in the field on August 6, 2012, and the remaining two (Gorham Savings Bank and Fundy Road Pond) were conducted on October 30, 2012. Each inspection consisted of an initial visual evaluation of the site against site plans and other available documentation, and included photographs, measurements, and notes on the inspection forms. Performance inspections were largely based on visual inspection forms developed by The University of Minnesota. Copies of the inspection forms completed during the site visits conducted on August 6, 2012, as well as photographs taken of the site, are included as Appendix B of this Report.

The "Stormwater Treatment: Assessment and Maintenance" forms primarily focus on facility structural condition which is one of the four components of our evaluation for stormwater management system effectiveness. The performance rankings provided in this section are not quantitative, but are instead a qualitative evaluation based on best professional judgment and the following characteristics of each facility: structural condition, design intent, system type, and apparent level of maintenance

It is important to note that without comprehensive water quality and quantity sampling/monitoring it is not possible to fully evaluate the effectiveness of a stormwater system to provide water quality or quantity benefit.

For reference, the following table summarizes the typical pollutant removal efficiency up to the 1-inch storm event, as reported in the Stormwater Best Management Practices Performance Analysis prepared by Tetra Tech, Inc. on behalf of the USEPA and dated March 2010, for the types of stormwater management facilities identified within the project area. Stormwater filters are generally the most effective system for both water quantity and quality management if designed and constructed correctly. Dry detention basins are the least effective for quality control, but can be very effective for peak runoff rate attenuation (i.e. quantity control).

Table 3-1: Stormwater Management Facility Typical Performance Summary

System Category	Metals Removal Efficiency[1]	Nutrient Removal Efficiency[2]	TSS Removal Efficiency[3]
Filter System (includes all proprietary and non-proprietary systems with aerobic filter components	70-99%	30-80%	65-99%
Dry Detention Basin	50-70%	5-15%	20-45%
Wet Pond	60-90%	5-20%	30-80%

[1] Zinc used as representative "metal"; Zinc is the primarily detectable metal in non-industrial stormwater.
[2] Varying filter media components will influence nutrient removal efficiency in filtration systems.
[3] TSS = Total Suspended Solids

3.2 CLARIFICATIONS

The following is a list of the key assumptions utilized in the development of this section of the Report:

- Detention Basins that did not have a specified permanent pool elevation on project site plans were assumed to be Dry Detention Basins, even if standing water was visible within the system;
- Performance evaluations conducted via visual inspection provide minimal evidence of a system's overall effectiveness. For detailed analysis of effectiveness, comprehensive monitoring is necessary; and
- Due to access limitations, below-grade stormwater management facilities, such as the one located at the Shops at Falmouth Village (Parcel ID U24-005) and Norway Savings Bank (Parcel ID U58 010-A1), were not evaluated. Additionally, there are two below-grade stormwater management facilities that have been proposed and approved at the Wal-Mart site (Parcel ID U52-002) that have not been constructed at this time;

3.3 FINDINGS

A qualitative ranking system of Poor, Fair, Good, and Excellent was used to identify the effectiveness of each system to provide BOTH quality and quantity treatment.

The ten stormwater management facilities and their assumed performance ranking are summarized in the table below, and described in more detail in the following sections. A location map of these facilities has been provided in Figure 1 Appendix A of this Report.

Table 3-2: Private Stormwater Management Facility Performance Rankings

Parcel ID	Facility Name	Type of System	Performance Ranking
U11-035-C	Fundy Circle (Basin 1)	Dry Detention Basin	Poor
U11-035-C	Fundy Circle (Basin 2)	Dry Detention Basin	Fair
U11-035-D	Fundy Road (Basin 3)	Dry Detention Basin	Fair
U58-010	Maine Medical Center	Dry Detention Basin	Good
U52-001-B	Morong Service Center	Dry Detention Basin	Good
U12-002	Falmouth Shopping Center	Dry Detention Basin	Good
U58-006	Key Bank (SF 1)	Soil Filter	Excellent
U58-006	Key Bank (SF 2)	Soil Filter	Excellent
U52-004-ON	Gorham Savings Bank	Soil Filter	Excellent
U12-011	Rite Aid	Wet Pond	Excellent
U24-001 & U24-005	Shops at Falmouth Village	Below-Grade Storage	Not Evaluated
U58 010-A1	Norway Savings Bank	Below-Grade Filter	Not Evaluated

3.3.1 Fundy Circle (Dry Detention Basin 1) Parcel ID: U11-035C

The stormwater management facility at Fundy Circle consists of two Dry Detention Basins located on the eastern end of the Fundy Circle parking lot. Detention Basin 1 has one inlet, which discharges from a catch basin within the parking lot and which is almost completely clogged with sediment and vegetation. The standing water in both the catch basin and the pond (a.k.a. detention basin) was noted as having visible surface sheen, which may be indicative of oil contamination from the adjacent parking lot. In addition to having sheen, the water in this pond had evidence of suspended solids and algal blooms. It should be noted that no sampling was conducted on the standing water, so the pollutants resulting in the sheen remain unknown.

The pond has about 80% vegetation cover and is overrun by cattails. There is an estimated 1.5 feet of standing water, and close to one foot of sediment deposition. All of the flow from this pond ultimately discharges into Fundy Circle Pond 2 (see below). A local employee of Normandeau Associates (whose office is adjacent to these ponds) stated that these ponds had been dredged twice since their construction, and that local residents of Fundy Circle had complained that they did not want the cattails removed.

Based on the condition of the pond's water, its historic issue with sediment, and the excessive vegetation and standing water (which are not components of properly constructed Dry Detention Basin), this facility was evaluated as Poor.

3.3.2 Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

The second of the two Dry Detention Basins located in series at Fundy Circle (as noted above) is located slightly north of the walking path between the two ponds. It accepts discharge from two outlets, one from Pond 1 and the other from a catch basin in a more northern part of the lot. The pond has an outlet control structure. The outlet of the pond consists of a catch basin with overflow pipe, a trash rack, and an emergency spillway. The low-flow inlet from the pond to the outlet structure could not be located in the field; it may be submerged and potentially clogged. Both inlets into the pond have much less sedimentation than Detention Basin 1, but still have excessive vegetation growth in front of the culvert. Just as in Pond 1, there was approximately 1-foot of sediment deposit, about 1.5-feet of standing water, and approximately 90% vegetated cover consisting largely of cattails. In addition to having an oily sheen, the water in this pond had evidence of suspended solids and algal blooms.

Based on the condition of the pond's water (which appeared slightly better than Detention Basin 1), its historic issue with sediment, and the excessive vegetation and standing water (which are not components of properly constructed Dry Detention Basin), this pond was evaluated as Fair.

3.3.3 Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

This stormwater management facility located off of Fundy Road is a Dry Detention Basin, just east of the Falmouth Inn. There is one riprap lined inlet to the pond, which accepts runoff via surface flow from the parking lot to the south and east. The pond has an outlet control structure consisting of a grated concrete structure with a partially clogged V-notch weir and three 15-inch diameter Corrugated Metal Pipe (CMP) outlets. There did not appear to be a designed emergency spillway and erosion, due to the high flow bypass of the system, was occurring across the detention basin impoundment. There is excessive vegetation growth in the pond consisting largely of cattails.

Based on the presence of excessive vegetation and standing water (which are not components of properly constructed Dry Detention Basin), this pond was evaluated as Fair.

3.3.4 Maine Medical Center (Dry Detention Basin) Parcel ID: U58-010

The stormwater management facility at the Maine Medical Center is a Dry Detention Basin located on the eastern side of the entrance to the Center, and has a security fence around the perimeter of the basin. There is one inlet to the pond, which is located at the end nearest to the parking lot and appeared clear of obstructions. On the opposite end of the pond, there are three outlets, which vary in elevation (the smallest pipe being at the lowest elevation). The lowest outlet was completely submerged and appeared to be mostly clogged, despite flow discharging at the outlet.

There were no visible signs of major erosion within the pond, but there were several animal burrow holes, as well as trees along the slopes, both of which can jeopardize the embankment's stability. The standing water in the pond appeared to have evidence of suspended solids and had approximately 50% vegetative cover consisting largely of cattails.

Based on the condition of the pond's water and embankments, and the presence of vegetation and standing water (which are not components of properly constructed Dry Detention Basin), this pond was evaluated as Good.

3.3.5 Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

This stormwater management facility is a Dry Detention Basin located at the northwest end of the parking lot. It has two inlets to the pond, one of which has a Downstream Defender, a subsurface proprietary sediment pretreatment unit, upstream of the detention basin discharge. The outlet of the pond is abutted by an emergency spillway with a wooden berm/weir. The outlet control structure, a catch basin with a flow control panel, was enclosed in a concrete structure and therefore could not be inspected. There was a tree growing on top of one of the inlets, which restricts maintenance access and threatens stability. The length to width ratio of the pond slightly hinders its functionality, as the west end of the system only sees flow during high storm events. The standing water in the pond appeared to have evidence of suspended solids and sediment deposition, and had approximately 60% vegetative cover consisting largely of cattails.

Based on the condition of the pond's water, and the shape of the pond, the presence of vegetation and standing water (which are not components of properly constructed Dry Detention Basin), this pond was evaluated as Good.

3.3.6 Falmouth Shopping Center (Dry Detention Basin) Parcel ID: U12-002

The stormwater management facility for the Shaw's Shopping Plaza is a Dry Detention Basin. It is located to the south of the parking lot. The provided site plan indicated that a sediment pretreatment unit was located upstream of the pond's inlet, but this device could not be located.

There were no signs of erosion and the one inlet to the pond had very minor evidence of sedimentation. The Dry Detention Basin had extensive vegetative growth and very little standing water, but was covered by cattails. This system also has a buffer between its outlet and the nearby Webes Creek. For its intended purpose, the pond seemed to have effective flow control, evidenced by its still-functioning V-notch weir, which had unobstructed flow discharging from the system.

Based on the field evaluation of Dry Detention Basins, this pond was evaluated as Good.

3.3.7 Key Bank (Soil Filter 1) Parcel ID: U58-006

The stormwater management facility at Key Bank is comprised of two Underdrained Soil Filters (USF). USF 1 is the smaller of the two and has one inlet and one outlet with an outlet control structure located in the southern end of the basin. There is very minor sedimentation at the inlet pipe. The outlet control structure which this soil filter discharges to was found to have two unknown connections; these connections could not be identified on the plans and should be investigated, as it is unclear as to whether the site plans are out-of-date, or if the systems have adequate capacity to accept these additional flows. There was also evidence of minor sediment deposition at the discharge point of the outlet structure.

Based on the field evaluation of the USF, this facility was evaluated as Excellent.

3.3.8 Key Bank (Soil Filter 2) Parcel ID: U58-006

The second of the two USFs at Key Bank has two inlets located on either end of the system. Overflow control consists of an existing catch basin, the inlet of which was raised for the soil filter's construction, and ties into the Route 1 drainage system. There is very good vegetation growth throughout the system. There was also evidence of minor sediment deposition at the discharge point of the outlet structure.

Based on the field evaluation of the USF, this facility was evaluated as Excellent.

3.3.9 Gorham Savings Bank (Soil Filter) Parcel ID: U52-004-ON

The stormwater management facility for Gorham Savings Bank is located in the center of the parking lot. Review of the site plans proved inconclusive in determining what type of system this was intended to be, given a lack of details, unknown subsurface conditions, and the at-grade overflow control structure, so this system was assumed to be a soil filter for evaluation purposes. The outlet control consists of a catch basin, which according to the site plan, includes a "bio-skirt" and snout oil and debris separator, and sits approximately at-grade within the soil filter, and ties into the Route 1 drainage system. The outlet control structure accepts stormwater runoff via surface flow from the surrounding parking lot, and from nearby catch basins. There is very good vegetation growth throughout the system.

It should be noted that there was evidence of standing water in the system, and it is unclear as to whether this is due to the recent storm event, clogging of the filter media, or if the design intent was for the system to provide detention prior to discharging to the outlet control structure.

Based on the field evaluation of the USF, this facility was evaluated as Excellent.

3.3.10 Rite Aid (Wet Pond) Parcel ID: U12-011

The stormwater management facility for Rite Aid is a wet pond located downslope of the parking lot in the woods. It has a security fence around its perimeter, and one riprap lined inlet. It also has an emergency spillway close to the outlet control structure. This wet pond appeared to be functioning well at the time of the site visit, as it had evidence of ponded water being retained, its trash rack was free of debris, and its outlet control structure had very minor sediment deposition. Being a fairly new stormwater control system (installed in 2007), it also has an underdrained gravel trench per current MaineDEP guidance, designed to reduce stormwater effluent temperature. There were minimal signs of erosion and only some spotty cattail growth throughout. The quality of the standing water appeared to be good, and the pond had approximately 60% vegetative cover.

Based on the field evaluation of this Wet Pond, this facility was evaluated as Excellent.

It should be noted that this facility is adjacent to an open area with a downstream buffer before discharging to Webes Creek.

3.3.11 The Shops at Falmouth Village (Below-Grade Stormwater Management Facility) Parcel ID: U24-001 & U24-005, and Norway Savings Bank (Below-Grade Stormwater Management Facility) Parcel ID: U58-010-A1

As previously noted, due to access limitations, the below-grade stormwater management facilities located at the Shops at Falmouth Village and Norway Savings Bank were not evaluated. It is assumed that both systems provide at least peak flow attenuation and perhaps other stormwater management benefits.

3.4 CONCLUSION

As noted above, stormwater management system effectiveness can only be understood through comprehensive monitoring. Stormwater management systems can vary in their ability to treat common stormwater pollutants and effectiveness can even vary amongst the same systems depending upon design details, storm event duration, intensity and seasonality. If a system has been poorly constructed or maintained, it may be achieving very little of its potential for peak flow attenuation and/or pollutant removal.

Despite the shortcomings of a qualitative evaluation, the value of the facility evaluation component of this project is primarily to 1) identify where stormwater management (quality or quantity) is occurring within the project area and 2) identify what types of systems are within the project area for future upgrade or management considerations. Modifications through retrofitting an older type of treatment system (i.e. Dry Detention Basins) could be implemented to maximize the effectiveness of the existing systems. Potential retrofits are discussed further in Section 5 of this Report.

4. BUILD-OUT ANALYSIS

4.1 BACKGROUND AND METHODS

A build-out analysis of the Webes Creek Subwatershed was conducted to determine the available hydraulic capacity of critical drainage infrastructure under existing and future conditions. This analysis can be used by the Town as a means of determining the potential impact of future development on stormwater contribution to the Town's drainage infrastructure, and therefore inform the Town on drainage improvements that may be necessary to accommodate future development.

The first step in this evaluation was to identify critical infrastructure. The Town's drainage infrastructure was evaluated to determine what areas contained critical infrastructure that may be impacted by existing and future development. From our analysis of the subwatershed hydrology, it appears that there are six key locations within the project area that convey upstream stormwater drainage, and which may be most impacted by future development.

After identifying the critical pieces of the Town's drainage infrastructure, appropriate catchments were delineated for the areas draining to each of these locations, for a total of six catchments. As this part of the study focused on critical infrastructure, other portions of the subwatershed that do not drain to major Town or private drainage infrastructure were not included in the analysis associated with peak flow impacts under build-out conditions. The remainder of the subwatershed was included in Table 4-1 given the potential of several parcels to be developed within these areas.

The catchments were delineated utilizing the same methods executed in defining the Webes Creek subwatershed boundary; much of the data compiled during that phase of the project helped to guide the development of the catchments. However, additional data on the impervious surface cover of the subwatershed was utilized for input into the hydrologic model, which was in-turn utilized to determine the peak flows of each catchment. Kappa Mapping, Inc. was subcontracted to conduct an impervious surface cover analysis of the area. GIS was employed to provide an analysis of the impervious surface cover data by each catchment area as shown in Table 4-1.

Based on feedback from a meeting with Town staff on October 1, 2012, the following parcels were identified as having potential for future development:

- R02-011 in Catchment 1;
- U52-001 in Catchment 2;
- U52-006 in Catchment 2;
- U52-005 in Catchment 3;
- U52-008 in Catchment 3;
- U24-006 in Catchment 3; and
- U24-007 in Catchment 3.

Of the six catchments, three (Catchments C1, C2 & C3) contained parcels identified as potential future development sites. The potential impervious area on each developable parcel was determined based on the average impervious coverage on adjacent parcels, excluding residential or undeveloped parcels. The approximate increase in impervious surface coverage for those parcels was then added to the catchment's overall impervious surface cover; this data, summarized in the table below, was then used as the basis for the hydrologic analysis. An average of 50% build-out of an average commercial parcel was used in the remainder of the subwatershed to account for possible development of U12-007-A, U13-002-B, and U12-006-A.

Table 4-1: Impervious Cover Projections by Catchment

Catchment	Total Catchment Area (acres)	Existing Impervious Cover (acres)	Projected Impervious Cover (acres)
C1	64.82	22.39	25.79
C2	25.98	10.68	13.68
C3	76.63	27.60	37.50
C4	17.34	6.67	6.67
C5	22.45	14.02	14.02
C6	17.76	7.06	7.06
Remainder of Subwatershed	115.82	23.88	38.27
Total	340.8	112.30	142.99

Peak runoff rates (cubic feet per second) were determined using the Rational Method. The main inputs for determining peak runoff rates via the Rational Method are drainage areas, impervious surface cover, and rainfall intensity. The size of the drainage areas was determined using GIS measurements of the delineated catchments, and the percentage of impervious surface cover was determined utilizing the GIS analysis described above. Rainfall intensity is based on geographic and storm-type-sensitive coefficients and the Time of Concentration (TC) for the catchment's stormwater runoff. Consistent with the Town's ordinance requirements for flood control, coefficients for the 2, 10, and 100-year storm events were taken from Table 12-2.4 of the *State of Maine Urban & Arterial Highway Design Guide*, dated January 2005, and the TC was defined using catchment topography. The HydroCAD Stormwater Modeling System by Applied Microcomputer Systems was then used to compute the TC time calculations using sheet flow, shallow concentrated flow, pipe flow, pond flow, and channel flow. It should be noted that the TC for Catchments C2 and C6 bypass the stormwater management facilities in these catchments, and therefore do not account for the impact the ponds may have on the TC. Refer to Figure 2-Appendix A of this Report for the Webes Creek Drainage Map, which shows parcels, catchments, existing stormwater management facilities, TC, and the critical infrastructure areas evaluated.

Once the projected peak runoff rate discharging to the Town's critical drainage infrastructure was determined, it was compared to the available capacity of the existing storm drain system. The capacity of these pipes was determined utilizing Manning's Equation, which uses pipe size, material, and slope to determine the maximum flow rates the system can accommodate. The size, material, and slope of the six pieces of critical drainage infrastructure were determined from the available site plans obtained from the Town as part of previous tasks. In areas where site plans were unavailable and GIS data was incomplete, field verifications were conducted on October 30, 2012. On this site visit, pipe sizes and materials were noted, and depth measurements of catch basin inverts were recorded and compared to GIS topography to approximate pipe slopes. The specific sources of pipe data is noted in the Build-Out calculations included as Appendix C of this Report, which consist of the Rational Method spreadsheet and the TC HydroCAD Calculations.

It should be noted that the objective of this assessment was to identify possible hydraulic capacity issues at priority drainage infrastructure and not to identify pollutant loads under build-out conditions. As stated in previous report sections, the Webes Creek watershed area is already beyond the "10% impervious cover threshold" that is linked to water quality impairment and any new impervious surface will continue to create challenges for management of runoff quality or quantity.

4.2 FINDINGS

Table 4-2 is a summary of the projected flow rates in each catchment, and the drainage system's available capacity. It should be noted that, in some cases, multiple catchments may impact a single piece of the Town's drainage infrastructure. Figure 4-1 shows a drainage diagram of the subwatershed.

Figure 4-1: Webes Creek Subwatershed Drainage Diagram

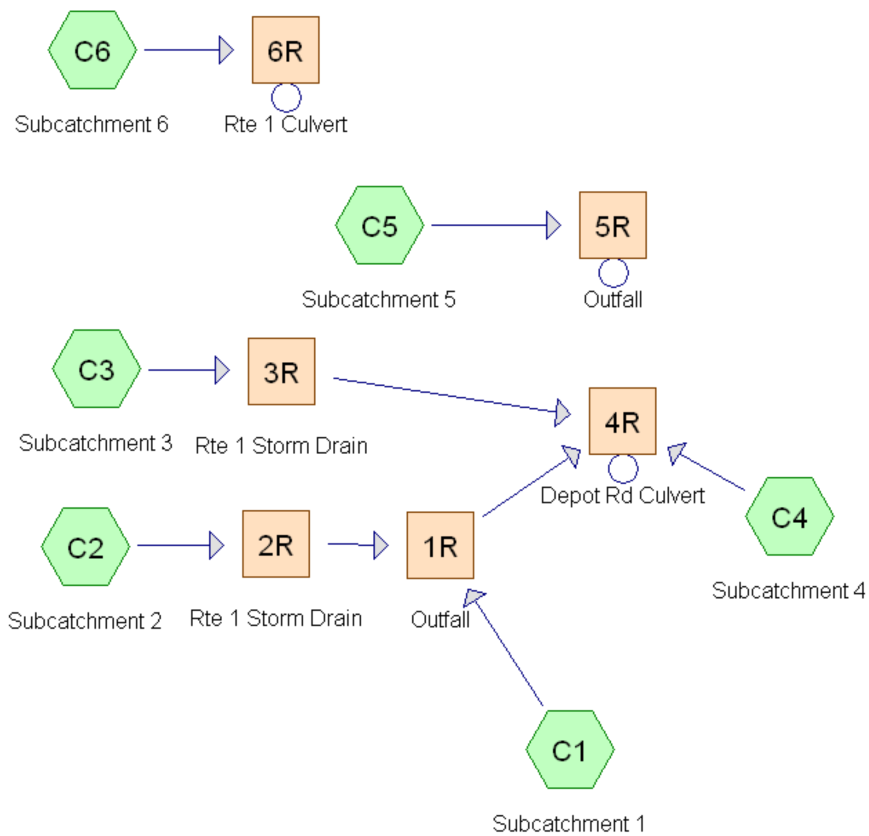


Table 4-2: Impact of Build-Out Conditions on Stormwater Contribution to Town's Drainage Infrastructure

Critical Infrastructure Area[1]	Catchments Draining to Infrastructure	Existing Infrastructure Diameter (inches)	2-Year Storm Flow (CFS)	10-Year Storm Flow (CFS)	100-Year Storm Flow (CFS)	Approximate System Capacity (CFS)
1 (1R Outfall)	C1, C2	36	59	87	124	31
2 (2R Rte 1 Storm Drain)	C2	36	14	21	31	74
3 (3R Rte 1 Storm Drain)	C3	42	46	70	101	80
4 (4R Depot Rd Culvert)	C1, C2, C3, C4	Two 40	123	181	260	172[2]
5 (5R Outfall)	C5	36	27	39	55	147
6 (6R Route 1 Culvert)	C6	18	14	20	28	9

[1] Refer to Figure 2-Appendix A of this Report for the Webes Creek Drainage Map, which shows parcels, catchments, existing stormwater management facilities, TC, and the critical infrastructure areas evaluated.

[2] Critical Infrastructure Area 4 consists of two 40-inch diameter culverts.

4.3 RESULTS AND CONCLUSIONS

Based on the results summarized above, it appears that critical infrastructure areas 1, 3, 4, and 6 may currently be experiencing storm drain capacity issues during the 100-year storm event, and that areas 1 and 6 may be experiencing storm drain capacity issues during the 2 and 10-year storm events as well. These infrastructure areas are sensitive to upstream development and may need to be evaluated and/or improved to accommodate additional development. Critical infrastructure areas 2 and 5 appear to have ample available hydraulic capacity and may be able to adequately accommodate future developments. As noted above, Catchments C1, C2, and C3 have been identified as areas most likely to experience future development which would impact areas 1, 2, 3, and 4. A summary of this discussion has been provided in the following table.

Table 4-3: Build-Out Potential of the Webes Creek Subwatershed Area

Critical Infrastructure Area	Catchments Draining to Infrastructure	Parcels with Future Development Potential? (Y/N)	Infrastructure Capacity
1	C1, C2	Y	Sensitive Storm Drain Capacity
2	C2	Y	Available Capacity
3	C3	Y	Sensitive Storm Drain Capacity
4	C1, C2, C3, C4	Y	Sensitive Storm Drain Capacity
5	C5	N	Available Capacity
6	C6	N	Sensitive Storm Drain Capacity

We would recommend that the critical infrastructure areas 1, 3, and 4 be further evaluated and potentially improved as part of the Town's current/ongoing Route 1 Planning Study or as a part of future developments in Catchment C1, C2, and C3. Even though Catchment C6 was not identified as a potential site for future development, the improvement of the critical infrastructure in this area may still be beneficial to improve the existing condition.

The excel spreadsheet describing the Build-Out calculations has been included as Appendix C for reference. Please note that, due to access issues and a lack of project records for the Route 1 drainage infrastructure, this model is considered preliminary, and the pipe slope can have a significant influence on culvert hydraulics. Further evaluation will be needed before this model is used in determining the acceptability of future development applications.

5. STORMWATER RETROFIT ANALYSIS

5.1 BACKGROUND AND METHODS

In general, the intent of a structural stormwater retrofit inventory is to identify specific locations within a watershed area that may allow the construction of updated stormwater management infrastructure. For the purposes of this project, the term retrofit is used to describe any engineered modification to existing infrastructure or land area(s) to improve stormwater quality or reduce peak runoff rates from impervious and developed areas.

Stormwater management retrofits can be implemented as modifications to existing stormwater management facilities or as new stormwater management facilities to be incorporated into an existing storm drain system or built area. Retrofit opportunity areas for this project were selected based on one or more of the following criteria:

- Available undeveloped or underdeveloped area to provide stormwater management;
- Impervious area without an engineered treatment system to addresses stormwater quality; or
- Developed area that discharges to one of the critical infrastructure locations identified as having “sensitive storm drain capacity”.

There are three primary management goals considered for stormwater management retrofit facilities. These include:

- Stormwater quantity control (i.e. reducing peak rate of runoff) to prevent flooding using systems typically designed to manage 2, 10, or 100-year recurrence storm events;
- Stormwater quality or Water Quality Volume (WQV) treatment typically associated with the 1-inch, 24 hour storm event; and
- Peak runoff rate attenuation for the Channel Protection Volume (CPV) typically associated with the 1-year recurrence storm event. The CPV helps to minimize erosion and other such impacts to downstream natural stream systems.

The following represent the types of systems considered for retrofits within the project area and a brief description of the system.

Below-Grade Storage with Below-Grade Filter: Below-grade storage with below-grade filter refers to a combination system designed to detain a particular volume of flow and provide filtration for that storage volume. These systems are well suited to areas where surface land-use limits the development of a surface storage system and/or if stormwater is already routed via below-grade drainage infrastructure. The system considered for this analysis is a Stormtech™ chamber storage and “isolator row” filtration system. This system has the potential to attenuate peak flows and provide pollutant removal; in appropriate locations, it can provide volume reductions via infiltration.

Filter Box: Esplanade filter boxes refer to at-grade, vertical flow media filtration systems. These systems are well-suited to roadways or other developed areas were surface constraints limit installation of a soil filter. The Filterra™ tree box filters are used as model systems in this analysis; they range in footprint from 24 to 91 square feet of surface area. The filter has the potential to provide pollutant removal, but does not provide peak flow attenuation or volume reduction. These systems must be placed just upstream of existing catch basins (which will then act as overflow devices) and are connected via storm piping to the existing catch basins. Overflows from the box filters are collected at grade via the existing catch basins.

Soil Filter (aka Rain Garden, Bioretention or Filter Swale): Soil filter systems are vertical flow media filters that are typically vegetated with grass and/or landscape plantings. Often, these systems require an underdrain in poorly draining subsoils, but can provide some volumetric reduction via evapotranspiration and can be designed to promote infiltration below the underdrain if appropriate. Soil filter systems have the potential to reduce overall stormwater volumes and peak flows and have been shown to be effective in generally reducing loads of certain pollutants, including bacteria. Dry Swales are a subset of soil filters, but are developed as a linear filter and conveyance system for roadways. Rain gardens are a subset of soil filters that rely primarily on simple modified soil media and infiltration for treatment. Costs for soil filter systems can vary significantly depending on design complexity and site conditions.

Gravel Wetland: Gravel wetlands are horizontal flow retention and filter systems. The Gravel Wetland utilizes temporary storage and solids settling and soil media filtration as the primary mechanisms for pollutant removal. These systems can also provide peak flow attenuation and, through evapotranspiration, can reduce stormwater volumes. These systems are especially well-suited on poorly draining soils or in locations with limited hydraulic head. This is one of the University of New Hampshire Stormwater Center's most successful systems for overall pollutant removal.

Flow Control Structure: Flow control structures as retrofits are modifications to an existing culvert or storm drain inlet that is designed to control outflow into "downstream" stormwater management or conveyance structures. A flow control structure can take a variety of forms such as a weir, orifice, or a combination of the two. Flow control structures will not significantly reduce the total volume of runoff, but will redistribute the rate of runoff over a period of time by providing temporary storage of a certain amount of stormwater upstream of the control structure. The purpose is to reduce downstream flooding, peak rates of runoff and/or erosion problems.

Temperature Control Structure (Underdrained Gravel Trench): Temperature control structures are modifications to the outlet control structure of wet or dry ponds in order to reduce effluent temperature. In Maine, this is called the Underdrained Gravel Trench and extends horizontally from an existing or new outlet control structure along the edge of a wet pond. These are relatively inexpensive retrofits, are the current design standard for wet ponds in Maine and can also provide additional water quality or quantity management. The water quality volume is discharged solely through the underdrained gravel trench.

The following table provides a general summary of typical pollutant removal efficiency up to the 1-inch storm event, as reported in the Stormwater Best Management Practices Performance Analysis prepared by Tetra Tech, Inc. on behalf of the USEPA and dated March 2010, and average unit costs of several typical types of stormwater management systems considered in the project for retrofits. Each of the following systems can be designed for peak rate flooding or channel protection.

Table 5-1: Stormwater Retrofit Performance Summary

System Category	Metals Removal Efficiency	Nutrient Removal Efficiency	TSS Removal Efficiency
Filter System (includes all proprietary and non-proprietary systems with aerobic filter components)	70-99%	20-80%	45-99%
Gravel Wetland	60-90%	20-60%	50-99%
Flow/Temperature Control Structure Modification	N/A	N/A	N/A

As previously discussed, potential areas for stormwater retrofits were identified during the evaluations of private stormwater management facilities, and with consideration of the results of the build-out analysis. To summarize, the private stormwater management facility evaluation determined that the only stormwater management facilities considered to be in excellent condition were the soil filters located at Key Bank and Gorham Savings Bank, and the wet pond located at Rite Aid. The remaining facilities, which included low performing and outdated dry detention basins, all were evaluated as being in less than excellent condition and have room for improvement. Furthermore, the build-out analysis determined that critical infrastructure areas 1, 3, 4, and 6 have sensitive storm drain capacities; so, catchment areas C1, C2, C3, and C6, which discharge to these infrastructure areas, were evaluated for retrofit opportunities to improve the existing hydraulic condition and to accommodate future development.

5.2 CLARIFICATIONS

The following is a list of the key assumptions utilized in the development of this section of the Report:

- Unit costs utilized in the budget-level opinion of costs for the stormwater retrofits are derived from retrofit estimates developed for theoretical systems managing a unit of impervious area in order to develop an installation cost per unit; and
- Stormwater Quality Retrofits are sized based on available space for budgetary purposes, and should be evaluated in regards to MaineDEP stormwater management system design intent prior to implementation.

5.3 FINDINGS

The following subsections of this Report outline the priority areas for stormwater quality or quantity management identified throughout the course of this project, and the recommended potential retrofits associated with each site. The proposed modifications to existing stormwater management features will help to enhance water quality or quantity performance.

The following is a list of the stormwater retrofit opportunity areas, which have been identified for both quantity and quality, in reference to the numbered areas shown in the Webes Creek Retrofit Site Location Map (see Figure 3 - Appendix A of this Report). The list is not in order of priority.

<u>The Falmouth Shopping Center Dry Detention Basin Retrofit</u>

The Falmouth Shopping Center Dry Detention Basin (adjacent to Shaws) was reviewed as part of the evaluation of private stormwater management facilities. Existing infrastructure at this facility consists of an 18-inch HDPE pipe discharging into a dry detention basin approximately 5,000 Square-Feet (SF) in size, with a single outlet consisting of a V-notch weir. As was previously discussed in Section 3 of this Report, based on the field evaluation of this Dry Detention Basin, this system was evaluated as Good. However, a Dry Detention Basin is an outdated stormwater management system; so, this facility was noted as a good location for a potential stormwater retrofit opportunity.

An appropriate stormwater quality retrofit for this facility would be a gravel wetland retrofit, which would provide better quality treatment.

<u>The Falmouth Shopping Center Plaza Quality Enhancements</u>

The Falmouth Shopping Center contains a large amount of impervious surface consisting of buildings and a parking lot;. Portions of this development discharge untreated stormwater runoff directly to Webes Creek. Existing infrastructure in the developed area consists of a storm drain network comprised of manholes, catch basins, and HDPE piping ranging from 15 to 36-inches beneath the plaza parking lot. This discharges to a 36-inch RCP outfall in a densely vegetated, undeveloped area at the bottom of a steep slope behind the Falmouth Shopping Center, ultimately forming channelized flow to Webes Creek.

However, within Catchment C5, stormwater quality treatment is provided via the underdrained soil filters, located at Key Bank, upstream of the untreated area. In order to maximize the benefits associated with the upstream treatment provided by the underdrained soil filters located at Key Bank, which were found to be in excellent condition as discussed in Section 3 of this Report, stormwater quality and quantity retrofits should be considered for this area.

Systems that may function within existing parking areas, such as below-grade filter systems, can be expensive upgrades. A gravel wetland system in the undeveloped area at the outfall may be an appropriate alternative.

Clearwater Drive Flow Control

There is a large undeveloped forested wetland area behind the Morong Service Center, which discharges to a 24-inch PVC inlet south of the Foreside Place. Parcel U52-001 was identified by the Town during the build-out analysis as an area that is anticipated to undergo future development, and is also part of a catchment that has sensitive storm drain capacity. This undeveloped location is a good stormwater quality retrofit opportunity for a proposed flow control structure at the existing 24-inch PVC inlet. These can be highly cost effective to install for channel protection or flood control, but evaluation of upstream flooding is a crucial consideration. This type of retrofit may compromise future development of the parcel, and will therefore need to be evaluated as part of future land development plans. This retrofit option could be presented to prospective commercial developers to implement as part of future private site improvement projects.

The Fundy Circle Pond Retrofits

Fundy Circle, as discussed in Section 3 of this Report, currently has two ponds in series. Existing infrastructure consists of a 24-inch HDPE pipe discharging into two dry detention basins in series, which total approximately 8,000 SF in size, with a single outlet control structure that discharges to the Fundy Road storm drain system comprised of 24-inch HDPE piping, 15-inch PVC culverts, and roadside ditches. In their current state, these ponds are operating as poorly functioning stormwater management facilities, as noted in Section 3 of this Report, and could benefit from additional stormwater quality retrofits.

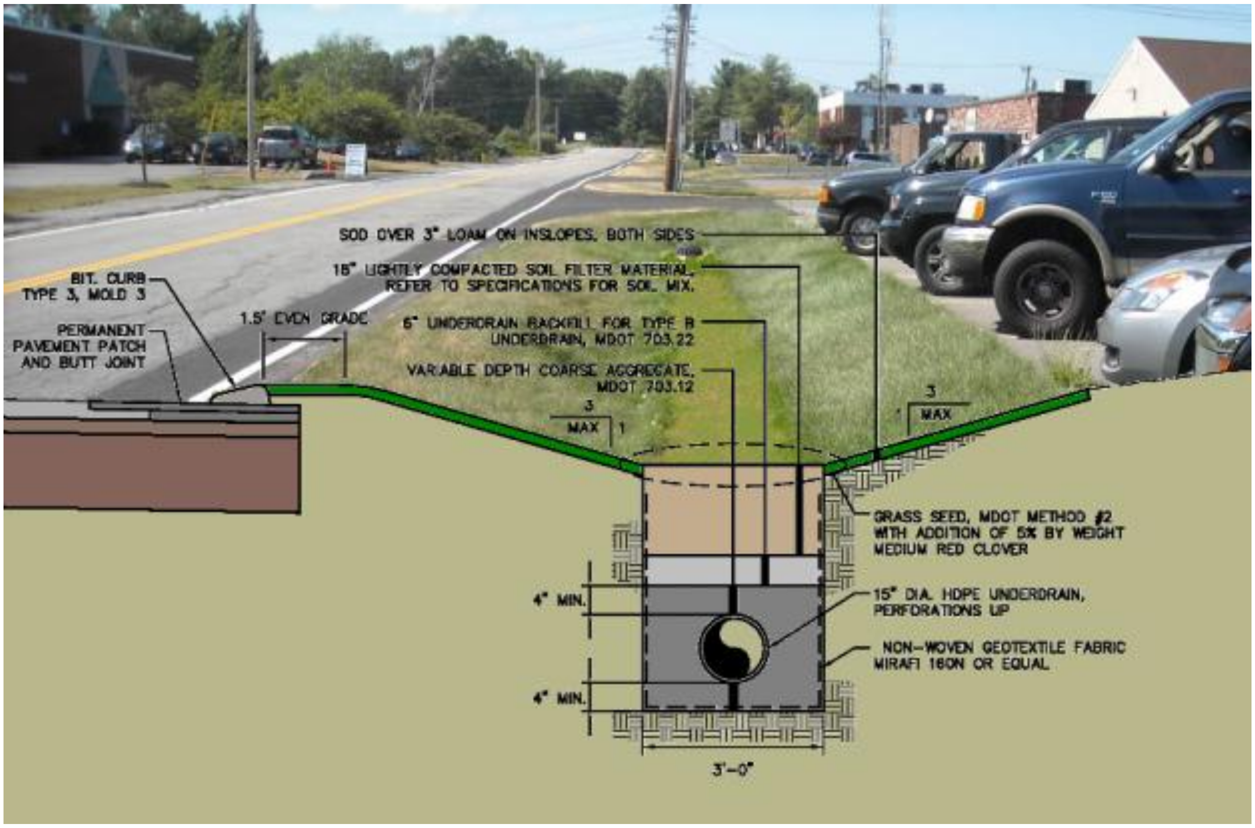
An appropriate stormwater quality retrofit for this facility would be a gravel wetland retrofit, which would provide improved stormwater quality treatment and channel protection.

Fundy Roadside Retrofit

There is an existing ditch that runs along Fundy Road which drains toward Route 1. The ditch collects runoff from surrounding developments and the Fundy Circle ponds. The ditch has two culvert inlets and discharges to a storm drain network consisting of 30-inch RCP piping, which ultimately discharges to a nearby 36-inch CMP outfall. This space within the roadway Right-of-Way could be better utilized to add to the area’s aesthetic and safety, and provide stormwater quality treatment through a roadside filter retrofit. The installation of a filtration swale would not only provide stormwater quality treatment for Fundy road, but would also eliminate the need to have a deep and unattractive roadside ditch with the inclusion of a below grade conveyance pipe to accommodate upstream drainage.

The following figure demonstrates what a filtration swale may look like and is also applicable to the Bucknam Road Gateway retrofit concept.

Figure 5-1: Example Filtration Swale



The Falmouth Inn Greenspace Retrofit

East of the Falmouth Inn is a large, open, undeveloped vegetated area which straddles two parcels. The Fundy Road Dry Detention Basin #3 discharges to this area. Existing infrastructure consists of three, 15-inch CMP outlets from the existing dry detention basin into a well-vegetated, undeveloped, channelized area populated by cattails, which conveys stormwater runoff to the Fundy Road storm drain network of culverts.

This location would provide a good opportunity for additional stormwater quality treatment and channel protection volume discharge control, and would not disrupt existing uses, as it already functions as a wetland area. A viable retrofit for this area would be a gravel wetland.

The Greenway Waterlane

The Town has expressed interest in developing a Veteran's Memorial Park in the undeveloped space just north of the intersection of Depot Road and Lunt Road. This area is currently known as "The Lane" and collects runoff from the nearby Town baseball fields. This location would provide an excellent opportunity to incorporate a stormwater quality treatment system into an aesthetically pleasing memorial park, in place of the existing site, which has suffered in the past from severe erosion (as shown in the photograph below), where runoff bypassed the existing storm drain system completely. This erosion has recently been repaired by the Town. The existing infrastructure consists of a single catch basin structure, which ties into the depot road storm drain system. A viable retrofit for this area would be a gravel wetland.

Figure 5-2: Recent Conditions at The Lane Prior to Erosion Repair

Hat Trick Drive Flow Control Structure

There is a large, undeveloped area on Town-owned land, which discharges to two inlets, an 18-inch and a 24-inch CMP, at the Wal-Mart plaza off of Hat Trick Drive. Existing infrastructure consists of the two inlets located in a densely vegetated undeveloped area northeast of Wal-Mart, which conveys stormwater runoff from a natural channelized area to another channel north of the Wal-Mart parking lot, before discharging to the Route 1 storm drain system.

This area was identified by the Town during the build-out analysis as an area that is anticipated to undergo future development and is also part of a catchment that has sensitive storm drain capacity. This is a potential location for a flow control structure retrofit to reduce peak rates of runoff at downstream critical infrastructure areas. These can be highly cost effective retrofits to install for channel protection or flood control, but the extent of upstream flooding that can be accommodated is a crucial consideration.

The Morong Service Center Pond Outlet Modification

The Morong Service Center, as discussed in Section 3 of this Report, currently has a large dry detention basin, which was evaluated as being in relatively good condition. Furthermore, it is located in a catchment that has sensitive storm drain capacity. Existing infrastructure consists of two inlets, an 8-inch PCV and an 18-inch HDPE pipe, discharging into a dry detention basin approximately 16,500 SF in size, with a single outlet control structure, which discharges to a large, densely vegetated, undeveloped area.

An appropriate stormwater quality retrofit for this facility would be a Temperature Control Structure, or a more extensive gravel wetland retrofit, which would provide enhanced quality treatment, but would be more costly to implement. For the purposes of this Report, a simple modification of the outlet control system to provide temperature control is recommended for this location.

Bucknam Road Gateway Retrofit

There is an existing ditch on both sides of Bucknam Road, near the intersection of Route 1, which collects runoff from surrounding developments, existing culverts, and the Maine Med Pond, which was found to be in good condition, as discussed in Section 3 of this Report. The existing ditch collects runoff from Bucknam Road and the three Maine Med Dry Detention Basin outlets. The outlet ultimately discharges to an 18-inch RCP culvert outfall across Route 1. This space is part of a developed area that could be better utilized, and add to the area's aesthetic and safety through a stormwater quality retrofit, such as a roadside filtration swale. Furthermore, it is located in a catchment that has sensitive storm drain capacity.

The installation of a filtration swale would not only provide stormwater quality treatment, but would also eliminate the need to have a deep and unattractive roadside ditch.

An additional level of design concept and opinion of cost has been developed for this retrofit based on a potential collaborative project between the Town and MaineDOT. This concept and cost estimates are contained in Appendix E.

Route 1 Roadway

There is a large network of catch basins within the Route 1 Right-of-Way, which ultimately discharges untreated stormwater runoff to several outfalls. There are several different kinds of proprietary and non-proprietary structures, such as catch basin inserts, filter boxes, or green stormwater planters, which could be installed along the Route 1 roadway depending on available funds and redevelopment plans. The existing infrastructure consists of a large network of catch basins and associated storm drain piping, which present opportunities for placement of these stormwater treatment structures. This retrofit recommendation reflects what we understand is being considered as part of the Route 1 Infrastructure Plan redevelopment and does not constitute a separate retrofit project.

The Wal-Mart Plaza Quality Retrofits

The Wal-Mart plaza contains a large amount of impervious surface consisting of buildings and a parking lot, which discharges untreated stormwater runoff directly to Webes Creek via a culvert across Route 1. Existing infrastructure in the developed area consists of two storm drain networks comprised of manholes, catch basins, and 15-inch HDPE piping beneath the plaza parking lot, both of which discharge to a densely vegetated, undeveloped area north of the parking lot, which ultimately forms channelized flow to a 42-inch RCP inlet to the Route 1 storm drain system.

Extensive stormwater quality retrofits could be installed in this area, such as a below-grade filter treatment system in the developed lot and/or a modified rain garden system along the northern edge of the lot, which currently produces sheet flow to the vegetated area north of the parking lot. It should be noted that stormwater management improvements are planned for portions of this parking area as part of an approved redevelopment plan.

5.4 OPINION OF COST

It should be noted that these proposed stormwater retrofit sites have been preliminarily sized based on available space and anticipated water quality volumes for planning purposes only, and will require additional survey and engineering prior to implementation. It is important that appropriate retrofits be selected and designed, so that they can adequately accommodate stormwater quantity, channel protection volume and stormwater quality requirements. A planning-level opinion of costs for the proposed stormwater retrofits follows.

A planning-level opinion of cost for design, permitting, and construction has been developed for the proposed retrofit opportunity areas, so that they can be considered as part of future municipal capital improvement projects or presented to commercial property owners for consideration as part of future private site improvement projects. The stormwater management systems utilized to develop the cost estimate were selected to provide a range of anticipated costs, depending on a variety of design options. Before selecting specific retrofits, a more detailed analysis of each site should be conducted; it should be noted that proper modifications to an existing system can produce good performance for a significantly lower construction cost relative to a newly constructed retrofit.

The typical unit costs for each type of proposed stormwater management system used in this opinion of costs have been developed by Woodard & Curran during retrofit studies using specific site constraints, as noted in the calculations contained in Appendix D of this Report. These costs are being used for planning purposes only based on the size of the system anticipated to be installed, or the volume of stormwater anticipated to be treated, and should be re-evaluated upon determining appropriate retrofits for each specific site. The total cost for all identified retrofits range between $2.5 and $5.0 Million. The following table is a summary of the anticipated range of budgetary costs associated with each proposed retrofit site.

Table 5-2: Summary of Opinion of Costs Associated with the Retrofit Opportunity Area

Stormwater Retrofit Opportunity Area	Stormwater Management Benefit	System Type considered for this Location	Opinion of Cost (+/-)	Unit Used as Cost Basis	Quantity of Unit
1. The Falmouth Shopping Center Dry Detention Basin Retrofit	Quality	Gravel Wetland Retrofit	$135,000	Per SF of Available Space	6,910 SF
2. The Falmouth Shopping Center Plaza Quality Enhancements	Quality & Quantity	Gravel Wetland/Below-Grade Filter System	$795,000/$1,315,000	Per CF of WQV	36,400 CF
3. Clearwater Drive Flow Control	Quantity	Flow Control	$30,000	Per Each unit	1
4. The Fundy Circle Pond Retrofits	Quality	Gravel Wetland Retrofit	$230,000	Per SF of Available Space	11,520 SF
5. Fundy Roadside Retrofit	Quality	Filtration Swale/Soil Filter	$105,000/$130,000	Per SF of Available Space	7,260 SF
6. The Falmouth Inn Greenspace Retrofit	Quality	Gravel Wetland	$220,000	Per SF of Available Space	10,970 SF
7. The Greenway Waterlane	Quality	Gravel Wetland	$715,000	Per SF of Available Space	36,100 SF
8. Hat Trick Drive Flow Control Structure	Quantity	Flow Control	$30,000	Per Each unit	1
9. The Morong Service Center Pond Outlet Modification	Quality	Outlet Temperature Control/Gravel Wetland Retrofit	$60,000/$535,000	Per SF of Available Space	26,900 SF
10. Bucknam Road Gateway Retrofit	Quantity & Quality	Filtration Swale/Soil Filter	$210,000/$260,000	Per SF of Available Space	14,790 SF
11. Route 1 Roadway	Quality	Catch Basin Insert/Filter Box	$35,000/$45,000[1]	Per Each Unit	1
12. The Wal-Mart Plaza Quality Retrofits	Quality	Raingarden/ Below-Grade Filter System	$90,000/$1,305,000	Per CF of WQV	36,100 CF

1 The costs associated with Route 1 Roadway Retrofits reflect the costs associated with a single unit; the Town may elect to install multiple units along the Route 1 Roadway, which is not reflected in this estimate.

5.5 RETROFIT CONSIDERATIONS

The previously discussed retrofit inventory and recommended opportunity areas provide a preliminary assessment of locations within the Webes Creek watershed that will provide water quality, channel protection and/or peak runoff rate control. In any retrofitting scenario, there are numerous possibilities depending on a community's priorities and long-term management interest. As retrofitting existing built areas is expensive and will likely require extensive public/private dialogue and legal agreements, it is important to acknowledge that prioritization is an important next step.

This study now provides the fundamental information that can be utilized for stormwater management prioritization. Ideally a prioritization process would include engagement of a technical advisory committee made up of community leaders, property owner representatives, experts and Town staff. Prioritization matrices for stormwater management retrofitting may include, but not be limited to, the following:

- water quality benefit;
- peak runoff attenuation;
- available space;
- overlap with a planned project;
- landowner acceptance;
- community engagement potential; and
- community aesthetic improvement, and others.

Water quality benefit can be difficult to quantify and at a minimum will require additional investigation of specific retrofit locations, site survey and water quality modeling. The relative weighting of each of these criteria should be developed through collaborative committee process.

This study can be considered a first step in the process of more active management of stormwater discharges in this district, but the preliminary nature of the evaluation should not preclude consideration of a few selected retrofits. Given the extensive consideration for re-visioning and reconstruction of Route 1 and the potential for addressing a significant untreated impervious area in the district, the Route 1 roadway retrofits would likely end up as a high priority retrofit. Additionally, the Bucknam Road Gateway Retrofit would extend the benefits of the Route 1 corridor improvements and address aesthetic and water quality benefits through a "gateway" improvement at a main entry into the Commercial District of Falmouth. The cooperation of the Maine Department of Transportation both financially and technically makes this an attractive retrofit for short-term consideration as a green infrastructure demonstration project.

6. ORDINANCE REVIEW AND FUTURE CONSIDERATIONS

6.1 BACKGROUND

Land use, which is largely directed by local zoning, influences the distribution of stormwater discharges and the magnitude of pollutant loads. The National Stormwater Quality Database uses land use types (e.g. residential, commercial, industrial) as a basis for classifying the predicted "typical" level of pollutant concentrations in stormwater runoff. As such, consideration of land use regulatory tools for the Webes Creek subwatershed, including water quality-related performance standards and/or an overlay zone with provisions intended to mitigate stormwater pollutants, can become important considerations within the overall strategy for effective watershed management. Additionally, maximum impervious surface cover ratios and other such dimensional requirements dictated by zoning can help anticipate future build out scenarios.

The implementation of local and regional planning policies may be one of the most economical and effective long-term strategies for stormwater pollution mitigation in urban water bodies.

- The American Rivers publication, Local Water Policy Innovation – A Road Map for Community Based Stormwater Solutions[1,] indicates that "local environmental protection ultimately relies on local solutions… Regardless of federal laws, our local and regional water quality will not be protected unless we take action at home." The report goes on to identify why local policy is important to stormwater management, including:
    - Local governments have the experience and authority to regulate land use,
    - Zoning and development review regulations are ideal processes for stormwater regulations,
    - Local governments can remove barriers to Low Impact Development (LID),
    - Local action is vital to the federal Clean Water Act permitting system, and
    - Individuals have great power to create change on a local level.
- The Center for Watershed Protection contends that requiring stormwater retrofits during redevelopment is the most effective method to achieve maximum water quality improvements over time in impaired water bodies.

The Town of Falmouth has identified water quality protection and conserving natural resources as some of the key goals and objectives in its Comprehensive Plan. The objective of this task was to review Town zoning ordinances and stormwater standards to identify possible changes that will help enhance future stormwater quality or quantity management and provide enhanced flexibility for developers and landowners.

6.2 ORDINANCE REVIEW METHODS

The Town conducted a review of its zoning ordinance in regards to identifying impediments to green infrastructure concepts and low impact development principles. Town staff reviewed and utilized a Code and Ordinance Worksheet created by the Center for Watershed Protection to assist communities to identify sections of code that may be revised to accommodate current stormwater management design

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[1] Brent, Denzin, 2008. *Local Water Policy Innovation – A Road Map for Community Based Stormwater Solutions.* American Rivers.

practices both for stormwater treatment systems and to minimize the impact of development on receiving water bodies and infrastructure.

The Town's stormwater standards were then reviewed to determine if modifications to the standards may be beneficial to provide improvements for stormwater management in the project area. The Town's stormwater standards must, at a minimum, meet or exceed state and federal regulatory guidance but should provide maximum flexibility for cost-effective and science-based management.

The Town anticipates reviewing recommendations in concept form with the Planning Board and the Town Council to get their feedback prior to preparing actual proposed zoning language. It is anticipated that some of the proposed amendments, such as reducing parking requirements to reduce impervious surfaces and stormwater runoff, will be incorporated in a comprehensive zoning package that is currently being developed by Town staff for the Route 1 commercial district. The Route 1 zoning package is expected to be finalized by mid-2013. The remaining recommended zoning amendments are expected to be completed prior to the end of 2013.

6.3 SUMMARY OF FALMOUTH'S EXISTING STORMWATER MANAGEMENT STANDARDS

The Town of Falmouth's Land Subdivision Ordinance (Chapter 701) includes an Appendix section specific to "Stormwater Management" (Appendix 7). In addition to Subdivisions, projects that are subject to "Site Plan Review" must also comply with the "Stormwater Management" section (by reference). Although not specifically noted in the standard, any project that meets or exceeds the applicability requirements for State Stormwater Law must comply with both the State standards and the Town standards. A summary of Town and State Stormwater Standards has been developed in a Table format and included as Table 6.1 and Table 6.2.

Table 6-1: Town of Falmouth Stormwater Standards (Chapter 701 Land Subdivision Ordinance; Appendix 7)

Applicability	**A Stormwater Management Plan is required for** Subdivision and Site Plan Applications for projects which will expose more than 60,000 sq ft of soil at one time or which will produce more than 10,000 sq ft of additional impervious surface (unless direct discharge to Presumpscot River or Atlantic Ocean)
Performance Standards	**Quantity:** Peak discharge for developed site shall not exceed the peak discharge for the undeveloped site for the 2, 10 and 100 year storm events **Quality:** Sediments and other pollutants shall be limited, through appropriate management practices, to prevent adverse downstream water quality impacts (no quantitative criteria or prescriptive water quality measures required)

Table 6-2: State of Maine Stormwater Management Law (Chapter 500)

	Requirements of the Standards	*Applicability Under MaineDEP Chapter 500*
Basic Standards	• Erosion and Sediment Control • Inspection and Maintenance • Housekeeping • ***Submit:*** Plan(s) that address each	Disturbances of 1 acre or more
General Standards	• Water quality volume treatment utilizing: ○ Wet pond ○ Filter ○ Infiltration ○ Buffer ○ MaineDEP approved alternative device • ***Submit:*** Narrative, Plans, Calculations, Details	Disturbances of 1 acre or more AND Creation of 1 or more acres of impervious area, 20,000 SF impervious in UIS watershed, or 5 acres or more of developed area
Flooding Standard	• Detain, retain, or infiltrate stormwater from the 2, 10 & 25 year, 24-hr storm event • Post-development peak flowrates cannot exceed pre-development peak flowrates • ***Submit:*** Stormwater subcatchment plans with flow paths and hydrology computations (model) of pre- & post-development conditions	Creation of 3 acres or more of impervious area, or 20 acres or more of developed area

Urban Impaired Stream (UIS) Standard	• Mitigate project impacts by treating, reducing, or eliminating an off-site or on-site predevelopment impervious stormwater source; or, • Pay a compensation fee in-lieu of treatment, reduction, or elimination of impervious stormwater source • ***Submit:*** Calculations showing compliance, and compensation fee, as applicable	Creation of 3 acres or more of impervious area, or 20 acres or more of developed area in UIS watershed listed in Chapter 502

Falmouth's Stormwater Management requirements (Appendix 7 of the Subdivision Standards) are broken out into six sections:

- Intent
- Stormwater Management Plan Required
- Performance Standards
- Design Standards
- Storm Drainage Construction Standards
- General Construction Requirements

The standards are clearly written, flow smoothly from section to section, and appear to provide a sufficient level of information for a design professional to develop a plan that incorporates and addresses the Town's requirements.

The Stormwater Management Section (Appendix 7) is primarily stand-alone, with little cross reference to other sections of the Town's Ordinances. The exception being cross references to the Town's Erosion and Sediment requirements (Zoning and Site Plan Review Ordinance, Section 5.39), Post-Construction Monitoring Requirements (Zoning and Site Plan Review Ordinance, Section 5.39A), and Section 3 (Guidelines) of the Land Subdivision Ordinance. This allows for ease of use and limits the likelihood of misinterpretation or misunderstanding by Applicants. A design engineer can determine applicability, design criteria, and the materials required for construction in this one section of the code.

Applicability requirements are as follow: Projects that expose more than 60,000 square feet of soil at one time or produce 10,000 square feet or more of new impervious surface are required to evaluate runoff through the development of a Stormwater Management Plan. Exceptions are provided for projects with direct discharge to the Presumpscot River or the Atlantic Ocean, as discharge to these resources poses little flooding risk to Town or adjacent private infrastructure. Projects that meet or exceed the State criteria for Stormwater Management Law must prepare a plan that addresses both the State and Town stormwater management standards.

For projects that require a Stormwater Management Plan, the Town's code is primarily focused on keeping the stormwater discharge rate from a site at or below the pre-development condition. These are generally known as "flooding" standards and engineering design associated with these standards may not specifically address runoff quality. The code requires that the applicant evaluate the 2, 10 and 100 year storm events. Reference is made to the rainfall records for the City of Portland. The 2, 10 and 100 year, 24-hour storm events provided in MaineDEP guidance for southeast Cumberland County are 3.0, 4.7 and 6.7 inches, respectively. These storm events are often considered to be the design storm events for sizing conveyance systems to limit flooding impact on properties and adjacent or downstream infrastructure.

Under the Town's Performance Standards, projects that require a Stormwater Management Plan must limit sediments and other pollutants through appropriate management practices to prevent adverse downstream water quality impacts. The language utilized in the Performance Standards is not prescriptive of a stormwater treatment methodology, a water quality treatment goal (percentage of area treated) or a water quality storm event (which allows a design professional to calculate the runoff quantity that must be managed). The reference to "sediment" is in-line with older State of MaineDEP water quality guidance, which primarily focused on reduction of suspended solids in stormwater. Recent State guidelines broaden water quality treatment goals beyond a focus on suspended solids to a broad range of pollutants, including suspended solids, metals, nutrients, bacteria and temperature control.

6.4 POLICY CONSIDERATIONS

The intent behind the following recommendations is to allow for smart growth and redevelopment of the project area, preserving and enhancing the economic viability of the area while limiting, and ultimately reducing the water quality impacts that the Commercial District has on the receiving waterbodies such as Webes Creek, Mill Creek, Mussel Cove and Casco Bay. Fundamentally, the value of a stormwater master plan allows greater flexibility within the management area that focuses regulations via redevelopment where it is most needed and makes the most sense. A "one-size-fits-all" stormwater management standard(s) works well without a master plan but can obligate property owners to increased development/redevelopment costs for limited environmental or runoff management benefit.

The current local standards, as written, do not focus on water quality, and can be costly and difficult to implement, particularly related to the detention of large quantities of stormwater under 10 and 25-yr storm events. Managing stormwater by focusing on detaining large storm events provides limited water quality benefit, and can take up valuable real estate that may serve a better purpose for economic development. "Flooding" standards are meant to reduce the impact of a facility on downstream infrastructure and can be important in particular areas. Under a stormwater management plan, as described herein, more informed decisions can be made about the relative benefit of requiring flooding standards for specific parcels versus focusing primarily on smaller storm event filtration and retention.

In the context of the specific development patterns within the Webes Creek watershed area, recommended modifications to the Town's Stormwater Management Ordinance may be best applied by way of a stand-alone overlay district ordinance that encompasses the Webes Creek watershed area. The Webes Creek watershed is largely commercial with somewhat unique development in comparison to the rest of the community. This area also is largely "built-out" where modifications to code that focus on new development may be less applicable than a focus on redevelopment.

As identified in Section 4 of this report, the project study area is largely built-out at this time, and anticipated impervious surfaces associated with new commercial development is limited to approximately 16 acres, or 5% of the overall watershed. Water quality improvement within Webes Creek and Mussel Cove will not be realized if the Town's water quality standards primarily focus on new development. To improve water quality within the Town's drainage system and waterways, redevelopment projects should incorporate stormwater quality treatment measures as practicable. As existing commercial sites are redeveloped over time, drainage of the untreated commercial areas will become treated. Setting stormwater quality treatment requirements for redevelopment projects will result in enhancement to overall water quality over time, but clearly come with a cost. Any increased requirements for quality treatment should be balanced by reduced requirements for large storm detention (as discussed below) where appropriate in order to offset increased costs associated with quality treatment. However, this can only be allowable for projects that are not subject to meeting State stormwater flooding standards.

The Town's ordinance, as currently written, requires water quality treatment for redevelopment projects having 60,000 sq ft of soil exposed "at one time". We recommend identifying a new threshold to define the applicability of redevelopment projects that require water quality treatment. This value should be small enough to require treatment for redevelopment of the majority of the commercial lots within the watershed. An example of this would be "Water Quality Treatment is required for a redevelopment area of 10,000 square feet or more". To ensure that the standards apply to situations where a large percentage of a small lot is being redeveloped, a percentage standard could also be included; "Water Quality Treatment is required for a redevelopment area equal to 25% or more of a total lot area" (note that these numbers are for example purposes and have not been specifically evaluated for suitability). The term "Redevelopment" will need to be defined within the standard. The Town may also want to include lower applicability thresholds for sites that result in particularly high pollutant loads, such as gas stations or busy parking areas with high vehicle turnover.

The standards should identify the percentage of the new development or redevelopment area that should be treated by means of a water quality treatment measure, keeping in mind that full treatment (100%) of a site is often difficult to achieve, especially the entry areas or linear areas of projects. Providing the option to treat an existing, equivalent surface area and surface type on the site (for redevelopment projects) may provide more flexibility for applicants to meet the design standards and water quality goals.

Where applicable (e.g. facilities where capacity is available in downstream infrastructure), we recommend moving local standards away from requiring onsite detention for managing large storm events (2, 10, 100 year, 24 hour events), and focus on the smaller, more frequent storm events such as the water quality storm event (1" in 24 hours) and the 1-year channel protection event (2.5" in 24 hours). These storms are likely to be more manageable onsite, potentially by means of treatment systems incorporated into the landscaping of the site (i.e. treatment in landscaped areas versus stand-alone wet detention ponds). Applicants should still be required to ensure the storm drain collection and conveyance system on the site is sized to limit the potential for flooding conditions, typically sized to handle the 25 year event (5.5" in 24 hours). This report provides a basis for identifying critical upstream and downstream hydrology and infrastructure that could be utilized by applicants during design of their stormwater management systems.

As noted in Section 4 of the Report, there are several areas within the watershed where critical drainage infrastructure may be undersized to fully convey larger storm events. Drainage infrastructure renewal investment via general fund, TIF or other financing to maximize capacity in priority sections of drainage infrastructure would reduce management requirements for large storm detention. If investments are not made to "priority" drainage infrastructure, we recommend maintaining language in the standard that requires the applicant to ensure that the impact of their project does not adversely affect upstream drainage conveyance across their site or downstream public or private drainage capacity, but does not automatically obligate them to meet "flooding" standards (unless required under State Stormwater Management Law).

The Town's ordinance currently includes a general requirement for limiting "sediment and other pollutants" from impacting downstream resources. We recommend referencing more prescriptive water quality treatment measures, whether identified by the MaineDEP in their Stormwater Best Management Practices Manual or potentially from other local communities (i.e. South Portland Small Sites Stormwater Solutions web-based manual). Sizing requirements for these stormwater management systems are often included within the manual or system summary sheet.

This stormwater management plan may allow the Town and State to grant exemptions to State Stormwater Management Law Standards (Section 9 - Chapter 500), so long as an overall plan is approved by the MaineDEP and actively implemented. Shared stormwater management responsibilities between the Town and landowners can provide for an environmentally friendly and economically viable approach to smart growth planning but will require some level of investment for implementation of shared management facilities. It is recommended that the Town of Falmouth discuss this document as basis for a stormwater management plan as described in Section 9.

Additional recommendations are as follows and refer to Appendix 7 Stormwater Management of Chapter 701 Land Subdivision Ordinance of the Town of Falmouth:

- (A) Intent: Provide a reference to the MaineDEP Stormwater Management Law, stating that projects that qualify for a Stormwater Management Law or Site Location of Development Law permit are required to meet both State and Town Stormwater Management Standards.
- (C) Performance Standards & (D) Design Standards: For storm event data, reference MaineDEP BMP Technical Design Manual, Chapter 2 Stormwater Hydrology, Table 2-1 "24 Hour Duration

Rainfalls for Various Return Periods Natural Resources Conservation Service County Rainfall Data"; Cumberland County SE.

- (D) Design Standards: Standard number 9 should state "All pipe shall be designed to flow at a minimum velocity of two feet per section when flowing ¼ full."

The Stormwater Management ordinance references Section 5.39A of the Zoning and Site Plan Review Ordinance. Section 5.39A provides the requirements for Post-Construction Stormwater Management following MaineDEP standards for compliance with the Town's stormwater NPDES permit. The applicability requirement for Post-Construction Stormwater management is listed as projects encompassing 43,560 sq ft (1 acre). We recommend matching the project area covered under this standard to coincide with the applicability requirements for the treatment standards that will be defined within the Stormwater Management Ordinance (note that the applicability for this standard cannot be increased above the number prescribed by MaineDEP; 1 acre).

6.5 LID STRATEGIES WITHIN CODE

To evaluate whether the Town's Ordinances are environmentally friendly, or whether they are prohibitive to Low Impact Development (LID) design, the Town of Falmouth Planning Department reviewed their Code against the Massachusetts Low Impact Development Toolkit (a production of the Metropolitan Area Planning Council, in coordination with the I-495 MetroWest Corridor Partnership, with financial support from the US EPA). Planners use this Toolkit to review their local codes for consistency with LID principles. A copy of the Town's evaluation of their code is contained in Appendix G.

We identified the following "Improvement Methods" from the Toolbox as items that should be encouraged in a potential overlay district for the Webes Creek Watershed. The Town has acknowledged that many of these items are allowed or acceptable under their Code, we foresee further encouraging these items as part of development within the Webes Creek Watershed:

- Dimensional Requirements
  - Permit the location of bioretention areas, rain gardens, filter strips, swales, and constructed wetlands in required setback areas and in buffer strips.
- Open Space Developments
  - Permit construction of LID stormwater management techniques (bioretention, swales, filter strips) on land held in common.
- Site Plan Requirements
  - Allow bioretention areas, filter strips, swales, and constructed wetlands to count towards to fulfillment of site landscaping/open space requirements.
- Street Cross Sections
  - Establish criteria for the design of roadside swales to ensure adequate stormwater treatment and conveyance capacity.
- Site Work
  - Require contractors to reestablish permeability of soils that have been compacted by construction vehicles. For example, contractor can rototill lawn areas prior to seeding to re-establish void space (hence permeability and infiltration) of the soils.

- Wetlands Bylaw and Regulations
    - Permit the use of low impact stormwater structures (such as bioretention areas, infiltration trenches, or grass swales) within the buffer zone of (state or local jurisdictional) wetland resource areas, provided the location of these structures is not in conflict with any other setback criteria required by NRPA
- Department of Public Works / Building Inspector
    - Local plumbing codes should permit the use of harvested rainwater for interior non-potable uses such as toilet flushing.

6.6 FUNDING CONSIDERATIONS

There are a limited number of alternatives available to fund the development of the proposed stormwater management activities. The revenue alternatives generally fall into three different categories: user based, infrastructure/economic development/grants/loans, and general fund based. As is typical with other municipal infrastructure projects, a combination of these categories could be used to fund the Webes Creek Stormwater Management Plan. This Plan section focuses on the Town of Falmouth for financing alternatives. However, the responsibility for water quality improvements in Webes Creek should be a joint effort between regulated dischargers in the watershed including the Town, private property owners, and the Maine Department of Transportation.

Within Maine, our understanding of the most common mechanism for financing stormwater and stream restoration efforts is through the use of grants. The following are other common mechanisms for funding infrastructure and natural resource management and improvement programs.

- User based revenue is generated from the use of the stormwater drainage, water or sanitary wastewater system through user fees. User fees are generated from residential, commercial, industrial, public sector, and other users. The Town of Falmouth maintains an existing user based revenue source that provides funding for sanitary wastewater management services.
- Infrastructure/economic/grant based revenue are generated by grants and low interest loans obtained from the federal or state government agencies, used to reduce the debt load generally associated with the capital requirements of projects.
- General fund revenue is taxation based, given the universal public benefit and economic and community development components of infrastructure and restoration projects.

6.6.1 User Based

Utility Districts/User Fee

Revenues generated from the use of the stormwater drainage, water or sanitary wastewater systems are typically the means of paying for capital operations and maintenance of the system, with a depreciation account to fund repairs and infrastructure replacement once its service life is reached, and debt service incurred to construct the structural components of the management system.

User fees based on “equivalent users” for stormwater, ensures that each user pays proportionally for the stormwater they generate; properties that generate more stormwater will pay more in user fees than properties that generate less. This creates an equitable and legal fee structure. Typically, the amount of impervious cover on a property is used as the means of estimating stormwater infrastructure usage.

Special Assessment Districts

Several methods can be used to recover the carrying costs on large municipal capital projects. Special Assessment Districts (aka Betterments) represent one of the methods that a municipality can use. A Special Assessment District (SAD) is a special property tax or fee that is assessed to a property due to the benefit the property receives as a result of a construction project. SADs are assessed upon the property in proportion to the amount of such benefit. A municipality may formally adopt an ordinance which describes the area to be improved by the construction project and states the special assessment that will be levied for the improvement(s). There are several methods for estimating the special assessment. SADs can be assessed using a uniform unit method. The uniform unit method calculates assessment costs by dividing the project cost by the total number of "units" contributing to the project in this manner.

6.6.2 Infrastructure/Economic Development Grant and Loans

Grant programs are available from various state and federal agencies such as the MaineDEP, the Department of Economic and Community Development (DECD), and often through Congressional earmarks for worthy projects. Each funding agency has its own unique requirements but they often collaborate to fund projects.

Maine Department of Environmental Protection

The MaineDEP offers grant/loan packages for towns to improve their wastewater and stormwater management systems. In addition, loan money is available through the Clean Water State Revolving Loan Fund (SRF) at 2-percent below the market interest rates for terms up to 20-years. Recent changes in the State Revolving Load Fund program provide for principle forgiveness on up to 50% of the loan. The amount of principle forgiveness is based on specific economic criteria and environmental worthiness. Grant eligibility is determined by comparing user rates to the users' or municipality's Median Household Income (MHI). A town will be classified as disadvantaged, and therefore grant eligible if rates exceed a certain percentage of the MHI. Applications to the SRF program are accepted throughout the year with bond sales generally occurring twice per year in April and October to coincide with the Maine Municipal Bond Bank (MMBB) schedule of bond sales. The MMBB assists the DEP in the administration of the SRF program. Twenty percent of the federal capitalization grants are set-aside for funding "green" projects. Green projects include: a.) green infrastructure, projects that mimic natural biological systems, rain gardens, swales; b.) water and energy conservation, reduced use; and c.) environmentally innovative activities, including planning studies that integrate resources in a more sustainable manner, utility sustainability, greenhouse gas inventory, LEED buildings, etc. These projects are eligible for principle forgiveness.

Additionally, the MaineDEP maintains the Nonpoint Source Grant Program which is administered by the MaineDEP in consultation with the U. S. Environmental Protection Agency (EPA). The grant program provides funding for nonpoint source implementation projects once an approved watershed management plan exists. The development of the Webes Creek Stormwater Management Plan provides the basis for grant funding, or development of a more comprehensive Mill Creek Watershed Management Plan may open more opportunities for grant funds. The MaineDEP states that the implementation project must be designed to substantially contribute to protection or improvement of a waterbody. MaineDEP accepts applications for funding annually in the spring of each year. These are generally highly competitive grants.

It should be noted that the financing of implementation projects cannot be for projects that "undertake, complete or maintain erosion or stormwater control work otherwise required by existing permits or orders" (examples: Maine Pollutant Discharge Elimination System Stormwater Permit, Site Location of Development Permit or Stormwater Law permit).

U.S. EPA STAG

U.S. EPA's State and Tribal Assistance Grant (STAG) grants are requested by Congress, i.e. Maine delegation, as an allocation to address a specific project within a State. STAG applications are available through the delegation's local offices.

Other Grants

The following grants were identified as possible funding opportunities which appear to be well suited to actions identified in the Webes Creek Stormwater Management Plan.

Watershed Protection and Flood Prevention - USDA/NRCS

The Wetlands Protection and Flood Prevention program funds projects related to watershed protection, flood mitigation, water supply, water quality, erosion and sediment control, wetland creation and restoration, fish and wildlife habitat enhancement, agricultural water conservation, and public recreation are eligible for assistance. Technical and financial assistance is also available for planning new watershed surveys.

Five Star Restoration Program – US EPA/US Fish and Wildlife

EPA supports the Five-Star Restoration Program by providing funds to the National Fish and Wildlife Foundation and its partners, the National Association of Counties, NOAA's Community-based Restoration Program and the Wildlife Habitat Council. These groups then make subgrants to support community-based wetland and riparian restoration projects. Competitive projects will have a strong on-the-ground habitat restoration component that provides long-term ecological, educational, and/or socioeconomic benefits to the people and their community. Preference is given to projects that are part of a larger watershed or community stewardship effort and include a description of long-term management activities. Projects must involve contributions from multiple and diverse partners, including citizen volunteer organizations, corporations, private landowners, local conservation organizations, youth groups, charitable foundations, and other federal, state, and tribal agencies and local governments.

6.6.3 General Fund Revenues

Revenues generated from taxation have been a method that municipalities typically use for stormwater drainage infrastructure capital projects, operations and compliance. The intent behind the use of the general fund is to distribute the cost among the broader beneficiaries of the project, extending beyond the direct drainage system users. This funding source is particularly appropriate in watershed pollution issues where pollution sources are a contributor to water quality impairment in important community resources such as Mussel Cove.

Tax Increment Financing

Tax increment financing (TIF) is a tax incentive program that is used to help communities finance public investments, including infrastructure improvement projects. A TIF provides a municipality a mechanism to use some of the general fund property taxes that result from investment projects within a designated area, commonly referred to as "district", for a variety of improvements. The equalized assessed value of the taxable property can be frozen for up to 30 years in the designated district. The incremental equalized assessed value is used to pay for the project costs. One benefit of a TIF is that the incremental equalized assessed value is sheltered from the computation of adjustments and state education subsidies based on its total municipal valuation. The municipality may use the taxes to retire bonds issued to finance the project or pay for project costs. Portions of the Webes Creek subwatershed are within the existing Route One North and Route One South TIF districts.

7. PUBLIC OUTREACH

7.1 BACKGROUND

Two public meetings were conducted for the project. The Town and Woodard & Curran presented the background to the study, along with the approach and outcomes of the work performed to date. These meetings were organized by the Town of Falmouth, and held on July 25 and December 13, 2012 at the Town's Public Library. 22 attendees on July 25, 2012 and 17 attendees on December 13, 2012. Woodard & Curran prepared a PowerPoint presentation for each, and presented the study to members of the public, which included residents and commercial property owners. Formal meeting minutes were not produced for the meetings; however, an open forum discussion was held both during and after each meeting.

Copies of the meeting presentations are included in Appendix F of this report.

General discussion topics with members of the public are as follows:

- Community members identified several areas in the watershed where flooding or high water has been previously noted;
- Discussed importance of non-structural stormwater quality controls (sweeping / ice application)
- What are the overall benefits of this study; how will the Town, businesses and residents benefit from implementing water quality improvements?
- Careful consideration should be made for any "detention" or hydrologic modifications of infrastructure as part of stormwater management;
- Infrastructure design and standards should consider climate change; specifically storm frequency & size;
- General discussion of viable stormwater quality/quantity retrofits; and
- Project next steps.

APPENDIX A: GIS FIGURES


Legend
Stormwater System Structures
Catchbasin
Manhole
Open System Inlet
Open System Outlet
Outfall
Inlet
Outlet
Overflow
Tee
Stormwater Treatment
Pipe
Culvert
Stormwater Management Facility
Webes Creek Subwatershed
Watershed Parcels
Natural Drainage
Channel
Water
Norway Savings Bank Below-Grade Stormwater Management Facility
Maine Med Dry Detention Basin
Key Bank Soil Filter 2
Key Bank Soil Filter 1
Falmouth Shopping Center Dry Detention Basin
The Shops At Falmouth Village Below-Grade Stormwater Management Facility
Rite Aid Wet Pond
Approved Below-Grade Stormwater Management Facilities (Not Yet Constructed)
Gorham Savings Bank Soil Filter
Fundy Circle Dry Detention Basin 2
Fundy Road Dry Detention Basin 3
Fundy Circle Dry Detention Basin 1
Morong Service Center Dry Detention Basin
0 100 200 400 Feet
Stormwater Management Plan
WEBES CREEK EXISTING STORMWATER MANAGEMENT FACILITY LOCATION MAP
Figure 1
WOODARD &CURRAN
DATE: November 2012
SCALE: 1 "=200 '
DRAWN BY: JS
DOC: WebesCreek_Facilities.MXD
Basemap Source:
© 2010 DigitalGlobe Image courtesy of USGS © 2012 Microsoft Corporation
bing

Stormwater Management Plan

WEBES CREEK DRAINAGE MAP AND HYDROLOGIC ANALYSIS

Figure 2

WOODARD & CURRAN

DATE: November 2012	SCALE: 1 "=200 '
DRAWN BY: JS	DOC: WebesCreek_Drainage.MXD

Basemap Source:
© 2010 DigitalGlobe Image courtesy of USGS © 2012 Microsoft Corporation


Legend
Stormwater System Structures
Catchbasin
Manhole
Open System Inlet
Open System Outlet
Outfall
Inlet
Outlet
Overflow
Tee
Stormwater Treatment
Pipe
Culvert
Stormwater Management Facility
Webes Creek Catchments
Webes Creek Subwatershed
Watershed Parcels
Natural Drainage
Channel
Water
N
C1
C2
C3
C4
C5
C6
1
2
3
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7
8
9
10
11
12
0 100 200 400
Feet
bing
Stormwater Management Plan
WEBES CREEK
RETROFIT SITE
LOCATION MAP
Figure 3
WOODARD & CURRAN
DATE: November 2012
SCALE: 1 "=200 '
DRAWN BY: JS
DOC: WebesCreek_Retrofit.MXD
Basemap Source:
© 2010 DigitalGlobe Image courtesy of USGS © 2012 Microsoft Corporation

APPENDIX B: PRIVATE STORMWATER MANAGEMENT FACILITY INSPECTION FORMS & PHOTOGRAPHS

UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Ashley Auger & Mat Hardison

Date of Inspection: 8/6/2012

Location of the wet pond: Fundy Circle Pond 1

Address or Intersection: Fundy Rd.

Latititude, Longitude: 43.717327, -70.230140

Date the wet pond began operation: 2002

Wet pond dimensions. Depth (ft.): 1/3'

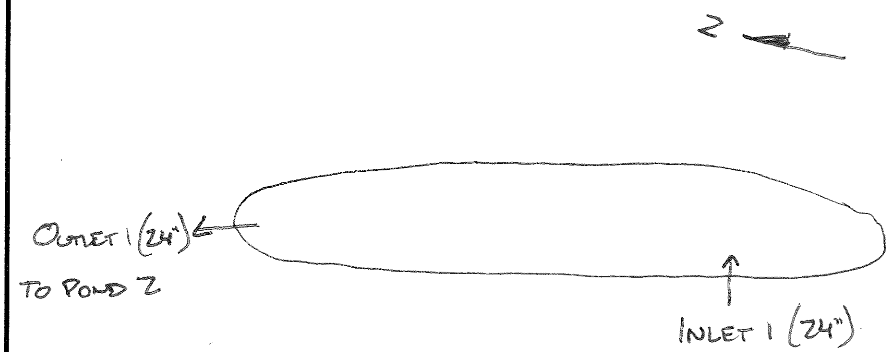
Area (ft. x ft.) 150' x 30'

Time since last rainfall (hr): 6

Quantity of last rainfall (in): 0.2"

Rainfall Measurement Location: ______

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ______
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments

Vegetation cover 80%

Good Length to width ratio; inlet perpendicular to pond flow

4. Inlet Structures
   4. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5
   4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #: 1	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely	Sediment				
Not Applicable					

   4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason					

5. Is there standing water in the dry pond? ☑ Yes ☐ No
   5. a) If yes, does the water have:
      ☑ Surface sheen (from oils or gasoline)
      ☑ Murky color (from suspended solids)
      ☑ Green color (from algae or other biological activity)
      ☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?
   ☐ Yes ☐ No ☑ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)
   ☑ Sediment deposition
   ☐ Erosion or channelization
   ☑ Excessive or undesirable vegetation (that needs mowing or removal)
   ☐ Bare soil or lack of healthy vegetation significantly different from the original design
   ☐ Litter or debris
   ☐ Other
   ☐ No
   7. a) If sediment deposition is evident, what is the source?
      ☐ Erosion or channelization inside the dry pond
      ☐ Erosion or channelization outside the dry pond
      ☐ Construction site erosion
      ☐ Other
      ☑ Unknown

Comments

Water in parking lot CB leading to Pond 1 had oily sheen

Major cattail growth within pond

About 1' of deposited sediment in pond

Inlet to Pond 1 almost completely plugged with sediment and plant growth

Spoke with local who stated that residents of Fundy Rd. "don't want to get rid of cattails."

Local (an employee of Normandeau Associates) also informed that the ponds had been dredged twice since construction.

8. Are there indications of any of the following on the banks of the dry pond:
   - ☐ Erosion or channelization
   - ☐ Soil slides or bulges
   - ☐ Excessive animal burrows
   - ☐ Seeps and wet spots
   - ☐ Poorly vegetated areas
   - ☑ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? ☑ No ☐ Partially ☐ Completely ☐ NA

   9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

   9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
   - ☐ Before the next rainfall
   - ☐ Before the next rainy season
   - ☐ Within a year or two
   - ☐ No sign that any is required

Comments

Fundy Circle (Dry Detention Basin 1) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 1) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 1) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 1) Parcel ID: U11-035C

UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Ashley Auger & Mat Hardison

Date of Inspection: 8/6/2012

Location of the wet pond: Fundy Circle Pond 2

Address or Intersection: Fundy Rd.

Latititude, Longitude: 43.717658, -70.230104

Date the wet pond began operation: 2002

Wet pond dimensions. Depth (ft.): 1/3'

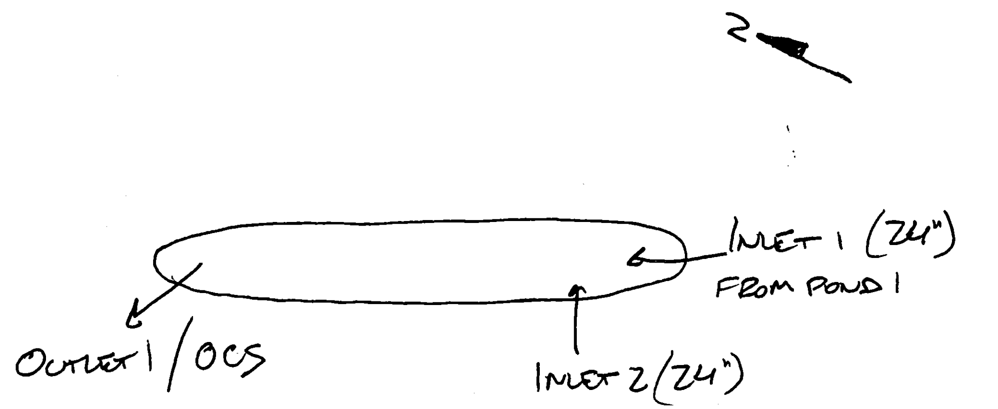
Area (ft. x ft.) 110' x 25'

Time since last rainfall (hr): 6

Quantity of last rainfall (in): 0.2"

Rainfall Measurement Location: ______

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ______
   1. b) Based on previous visual inspections, have any corrective actions been taken? ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments
Vegetation cover 90% Two Inlets, one from parking lot CB and the other from Pond 1 Good Length to Width ratio; inlet 2 perpendicular to pond flow

4. Inlet Structures

4. a) How many inlet structures are present? ☐ 0 ☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #: 1	Inlet #: 2	Inlet #:	Inlet #:	Inlet #:
Partially	Sediment	Sediment			
Completely					
Not Applicable					

4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason					

5. Is there standing water in the dry pond? ☑ Yes ☐ No

5. a) If yes, does the water have:

☑ Surface sheen (from oils or gasoline)
☑ Murky color (from suspended solids)
☑ Green color (from algae or other biological activity)
☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?

☐ Yes ☐ No ☑ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)

☑ Sediment deposition
☐ Erosion or channelization
☑ Excessive or undesirable vegetation (that needs mowing or removal)
☐ Bare soil or lack of healthy vegetation significantly different from the original design
☐ Litter or debris
☐ Other
☐ No

7. a) If sediment deposition is evident, what is the source?

☐ Erosion or channelization inside the dry pond
☐ Erosion or channelization outside the dry pond
☐ Construction site erosion
☐ Other
☑ Unknown

Comments

Both inlets are mostly open for flow, partial sedimentation

Major cattail growth within pond

About 1' of deposited sediment in pond

Outlet overflow trash rack free of debris

Spoke with local who stated that residents of Fundy Rd. "don't want to get rid of cattails."

Local also stated that Pond 2 had "been dredged a couple of times"

Local was employee of neighboring Normandeau Associates office.

Sedimentation Practices

University of Minnesota

8. Are there indications of any of the following on the banks of the dry pond:
   - ☐ Erosion or channelization
   - ☐ Soil slides or bulges
   - ☐ Excessive animal burrows
   - ☐ Seeps and wet spots
   - ☐ Poorly vegetated areas
   - ☑ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? ☑ No ☐ Partially ☐ Completely ☐ NA

9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
    - ☐ Before the next rainfall
    - ☐ Before the next rainy season
    - ☐ Within a year or two
    - ☐ No sign that any is required

Comments

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

Fundy Circle (Dry Detention Basin 2) Parcel ID: U11-035C

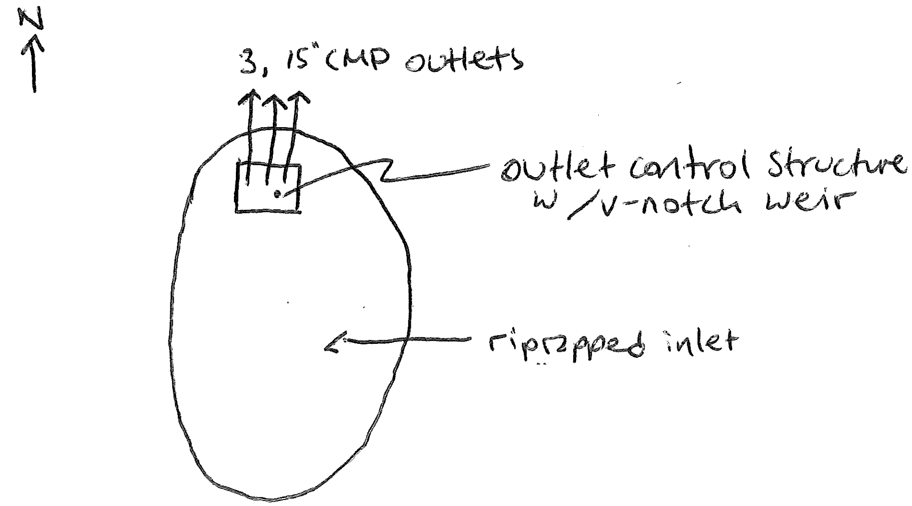
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Ashley Auger & Zach Henderson
Date of Inspection: 10/30/2012
Location of the wet pond: Off of Fundy Road, next to USF&W
Address or Intersection: Fundy Rd.
Latititude, Longitude: 43.717664, -70.231494
Date the wet pond began operation: Unknown
Wet pond dimensions. Depth (ft.): Unknown
Area (ft. x ft.) 1300 SF
Time since last rainfall (hr): 1
Quantity of last rainfall (in): 0.81"
Rainfall Measurement Location: ______

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ______
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments
Vegetation Cover 80% Good Length to Width Ration; inlet perpendicular to pond flow

4. Inlet Structures

4. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason					

5. Is there standing water in the dry pond? ☑ Yes ☐ No

5. a) If yes, does the water have:
- ☐ Surface sheen (from oils or gasoline)
- ☐ Murky color (from suspended solids)
- ☐ Green color (from algae or other biological activity)
- ☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?

☐ Yes ☑ No ☐ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)
- ☐ Sediment deposition
- ☐ Erosion or channelization
- ☑ Excessive or undesirable vegetation (that needs mowing or removal)
- ☐ Bare soil or lack of healthy vegetation significantly different from the original design
- ☐ Litter or debris
- ☐ Other
- ☐ No

7. a) If sediment deposition is evident, what is the source?
- ☐ Erosion or channelization inside the dry pond
- ☐ Erosion or channelization outside the dry pond
- ☐ Construction site erosion
- ☐ Other
- ☐ Unknown

Comments

8. Are there indications of any of the following on the banks of the dry pond:
   - ☐ Erosion or channelization
   - ☐ Soil slides or bulges
   - ☐ Excessive animal burrows
   - ☐ Seeps and wet spots
   - ☐ Poorly vegetated areas
   - ☐ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? ☐ No ☑ Partially ☐ Completely ☐ NA

9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
   - ☐ Before the next rainfall
   - ☐ Before the next rainy season
   - ☑ Within a year or two
   - ☐ No sign that any is required

Comments

The V-notch weir is partially clogged with sediment

The outlet control structure should be cleaned

Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

Fundy Road (Dry Detention Basin 3) Parcel ID: U11-035D

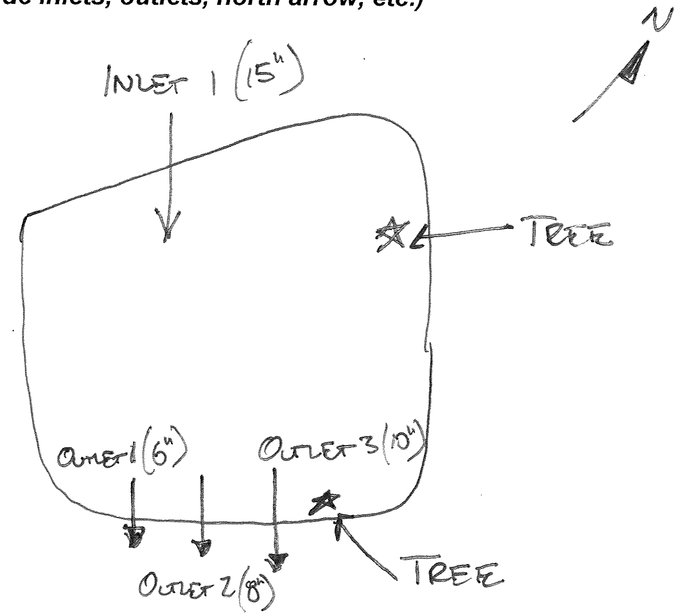
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Zach Henderson, Ashley Auger & Mat Hardison
Date of Inspection: 8/6/2012
Location of the wet pond: Maine Med, located near entrance
Address or Intersection: 5 Bucknam Rd
Latititude, Longitude: 43.726382, -70.232801
Date the wet pond began operation: 1995
Wet pond dimensions. Depth (ft.): 1-1.5'
Area (ft. x ft.) 80 x 160
Time since last rainfall (hr): 6
Quantity of last rainfall (in): 0.2"
Rainfall Measurement Location: ________

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ________
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments

Vegetation cover 50%

No major sediment desposited at inlet

Good vegetation growth

No visible signs of erosion

Security fence with gate around perimeter of pond

1-1.5' water depth

4. Inlet Structures

4. a) How many inlet structures are present? □ 0 ☑ 1 □ 2 □ 3 □ 4 □ 5 □ > 5

4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #: 1	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason					

5. Is there standing water in the dry pond? ☑ Yes □ No

5. a) If yes, does the water have:
- □ Surface sheen (from oils or gasoline)
- ☑ Murky color (from suspended solids)
- □ Green color (from algae or other biological activity)
- □ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?

□ Yes ☑ No □ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)
- □ Sediment deposition
- □ Erosion or channelization
- ☑ Excessive or undesirable vegetation (that needs mowing or removal)
- □ Bare soil or lack of healthy vegetation significantly different from the original design
- □ Litter or debris
- □ Other
- ☑ No

7. a) If sediment deposition is evident, what is the source?
- □ Erosion or channelization inside the dry pond
- □ Erosion or channelization outside the dry pond
- □ Construction site erosion
- □ Other
- ☑ Unknown

Comments
Major cattail growth within pond No mowing seems to have taken place Landscaping waste had been disposed of within the discharge area, which could be contributing nutrients to the stormwater

Sedimentation Practices

University of Minnesota

8. Are there indications of any of the following on the banks of the dry pond:
   - ☐ Erosion or channelization
   - ☐ Soil slides or bulges
   - ☑ Excessive animal burrows
   - ☐ Seeps and wet spots
   - ☐ Poorly vegetated areas
   - ☑ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? ☐ No ☑ Partially ☐ Completely ☐ NA

9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:1	Outlet #:	Outlet #:
Material	See Note		
Partial or Comp.			

9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
   - ☐ Before the next rainfall
   - ☐ Before the next rainy season
   - ☐ Within a year or two
   - ☐ No sign that any is required

Comments

Lowest outlet (6" INV. 48.00) submereged, appears to be somewhat clogged. Small flow coming out at the end of the pipe

No emergency spillway

Numerous animal burrows throughout pond berm

Maine Med (Dry Detention Basin) Parcel ID: U58-010

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Maine Med (Dry Detention Basin) Parcel ID: U58-010

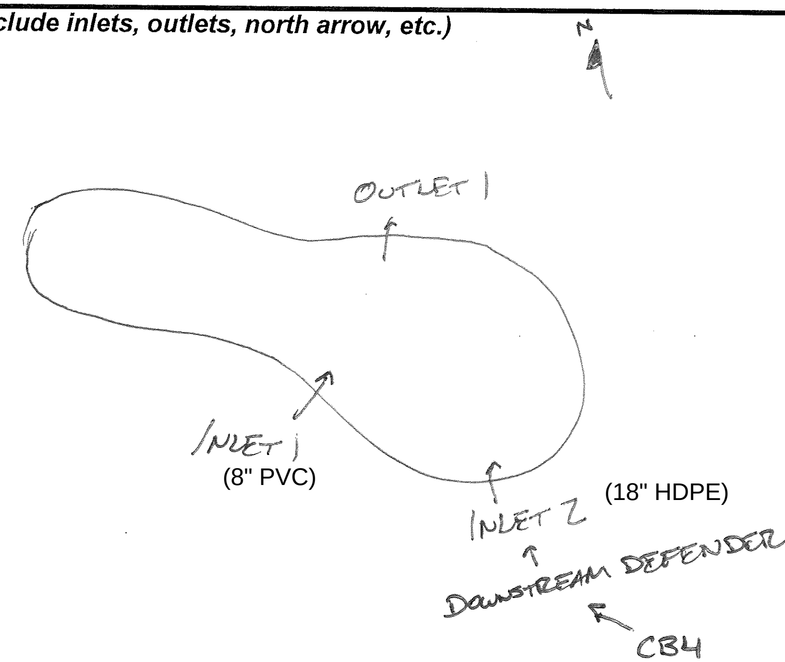
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Ashley Auger & Mat Hardison
Date of Inspection: 8/6/2012
Location of the wet pond: Morong, NW End of Parking Lot
Address or Intersection: Route 1
Latititude, Longitude: 43.717528, -70.235145
Date the wet pond began operation: 2006
Wet pond dimensions. Depth (ft.): 2/3'
Area (ft. x ft.) 290' x 80'
Time since last rainfall (hr): 6
Quantity of last rainfall (in): 0.2"
Rainfall Measurement Location: ____________

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ____________
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments
Vegetation cover 60%
Downstream Defender in place prior to discharge from CB4
Grassed Maintenance access to outlet
Poor length to width ratio

4. Inlet Structures
   4. a) How many inlet structures are present? ☐ 0 ☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5
   4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #: 1	Inlet #: 2	Inlet #:	Inlet #:	Inlet #:
Partially	Sediment				
Completely					
Not Applicable					

   4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #: 2	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason	See Note				

5. Is there standing water in the dry pond? ☑ Yes ☐ No
   5. a) If yes, does the water have:
      - ☐ Surface sheen (from oils or gasoline)
      - ☑ Murky color (from suspended solids)
      - ☐ Green color (from algae or other biological activity)
      - ☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?
   ☐ Yes ☑ No ☐ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)
   - ☑ Sediment deposition
   - ☐ Erosion or channelization
   - ☑ Excessive or undesirable vegetation (that needs mowing or removal)
   - ☐ Bare soil or lack of healthy vegetation significantly different from the original design
   - ☐ Litter or debris
   - ☐ Other
   - ☐ No

   7. a) If sediment deposition is evident, what is the source?
      - ☐ Erosion or channelization inside the dry pond
      - ☐ Erosion or channelization outside the dry pond
      - ☐ Construction site erosion
      - ☐ Other
      - ☑ Unknown

Comments
Inlet 2 from CB4 has a tree growing on top of it. Makes access limited for maintenance Major cattail growth within pond Approx. 6" of sediment buildup in pond

Sedimentation Practices

University of Minnesota

8. Are there indications of any of the following on the banks of the dry pond:
   - □ Erosion or channelization
   - □ Soil slides or bulges
   - □ Excessive animal burrows
   - □ Seeps and wet spots
   - □ Poorly vegetated areas
   - □ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? □ No □ Partially □ Completely □ NA

9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
    - □ Before the next rainfall
    - □ Before the next rainy season
    - □ Within a year or two
    - □ No sign that any is required

Comments
1 Outlet Control Structure. View inside the structure was inaccessible, appears to be unobstructed. 1 Emergency Spillway with wooden berm/weir.

Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

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Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

Morong Service Center (Dry Detention Basin) Parcel ID: U52-001B

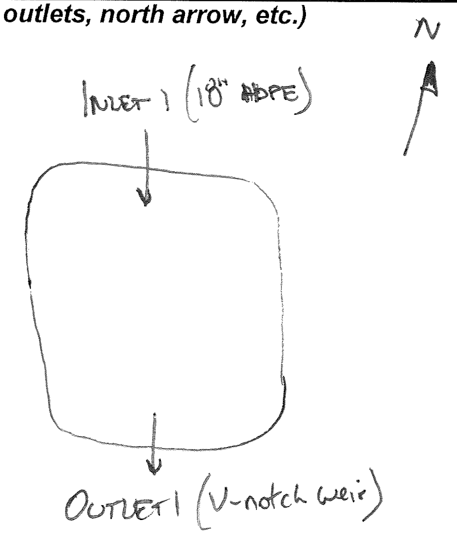
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Dry Ponds

Inspector's Name(s): Zach Henderson, Ashley Auger & Mat Hardison
Date of Inspection: 8/6/2012
Location of the wet pond: Shopping Center (Shaws)
Address or Intersection: Route 1
Latititude, Longitude: 43.722217 -70.229980
Date the wet pond began operation: 2005
Wet pond dimensions. Depth (ft.): 1/3'
Area (ft. x ft.) 60' x 90'
Time since last rainfall (hr): 6
Quantity of last rainfall (in): 0.2"
Rainfall Measurement Location: ____

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ____
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the dry pond is:
      ☐ Clear ☐ Partially obstructed ☑ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☑ permanent **and** ☐ before or during installation **or** ☑ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☐ Clear ☑ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☑ permanent **and** ☐ before or during installation **or** ☑ new since installation

Comments
Vegetation cover 95% Good vegetation growth No signs of erosion; riprapped inlet w/metal header One inlet, 18" HDPE Access to pond was difficult. No signs of mowing or maintenance Access was inhibited by excessive vegetation (thorn bushes) *Note presence of bees No security fence

Sedimentation Practices

4. Inlet Structures

4. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #: 1	Inlet #: 2	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #: 1	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason	See Note				

5. Is there standing water in the dry pond? ☑ Yes ☐ No

5. a) If yes, does the water have:
- ☐ Surface sheen (from oils or gasoline)
- ☐ Murky color (from suspended solids)
- ☐ Green color (from algae or other biological activity)
- ☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?
☐ Yes ☑ No ☐ I don't know (if yes, describe in comment box)

7. Are there indications of any of the following in the dry pond? (If yes, mark on site sketch)
- ☐ Sediment deposition
- ☐ Erosion or channelization
- ☑ Excessive or undesirable vegetation (that needs mowing or removal)
- ☐ Bare soil or lack of healthy vegetation significantly different from the original design
- ☐ Litter or debris
- ☐ Other
- ☐ No

7. a) If sediment deposition is evident, what is the source?
- ☐ Erosion or channelization inside the dry pond
- ☐ Erosion or channelization outside the dry pond
- ☐ Construction site erosion
- ☐ Other
- ☐ Unknown

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Comments
Could not locate Downstream Defender. No evidence of maintenance or access location Major cattail growth within pond Some standing water within detention pond

Sedimentation Practices

8. Are there indications of any of the following on the banks of the dry pond:
   - ☐ Erosion or channelization
   - ☐ Soil slides or bulges
   - ☐ Excessive animal burrows
   - ☐ Seeps and wet spots
   - ☐ Poorly vegetated areas
   - ☐ Trees on constructed slopes

9. Are any outlet or overflow structures clogged? ☑ No ☐ Partially ☐ Completely ☐ NA

9. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

9. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

10. Inspector's Recommendations. When is maintenance needed?
   - ☐ Before the next rainfall
   - ☐ Before the next rainy season
   - ☐ Within a year or two
   - ☐ No sign that any is required

Comments
1 Outlet Control Structure (V-notch weir). Good flow out, unobstructed

Falmouth Shopping Center (Dry Detention Basin) Parcel ID: U12-002

Falmouth Shopping Center (Dry Detention Basin) Parcel ID: U12-002

Falmouth Shopping Center (Dry Detention Basin) Parcel ID: U12-002

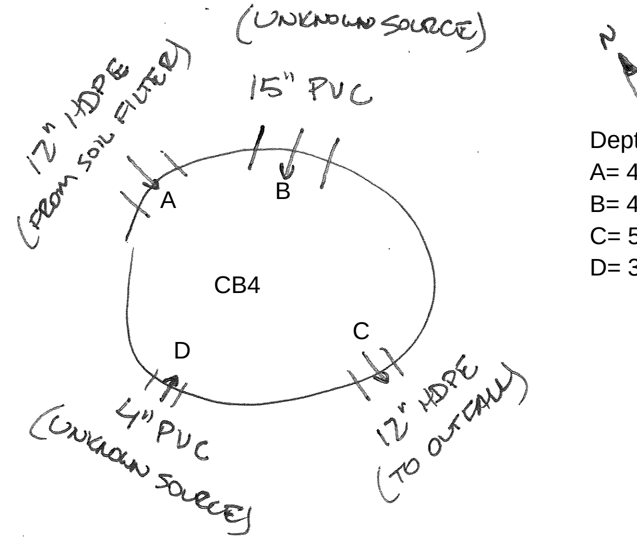
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Filtration Practices

Inspector's Name(s): Ashley Auger & Mat Hardison
Date of Inspection: 8/6/2012
Location of the filtration practice: Key Bank (Soil Filter 1)
Address or Intersection: Route 1
Latititude, Longitude: 43.724471, -70.233235
Date the filtration practice began operation: 2006
Filter Size (ft. x ft.): 40' x 40'
Time since last rainfall (hr): 6
Quantity of last rainfall (in): 0.2"
Rainfall Measurement Location: ____________

Site Sketch (include inlets, outlets, etc.)



Depths to invert
A= 4'-8"
B= 4'-8"
C= 5'-1"
D= 3'-9"

Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ____________
   1. b) Based on previous visual inspections, have any corrective actions been taken?
   ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)

2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know

3. Does this filtration practice untilize pretreatment practices upstream?
   ☐ Yes ☑ No ☐ I don't know (If yes, describe pretreatment practices in comment box)

4. Access
   4. a) Access to the filtration practice is:
   ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. b) If obstructed, the obstruction is (choose and provide comments) :
   ☐ temporary **and** ☐ no action needed **or** ☐ action needed
   ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   4. c) Access to the upstream and downstream drainage is:
   ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. d) If obstructed, the obstruction is (choose and provide comments) :
   ☐ temporary **and** ☐ no action needed **or** ☐ action needed
   ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments

5. Inlet Structures

5. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

5. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

5. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Yes					
No					

6. Is there standing water in the filtration practice? ☐ Yes ☑ No

6. a) If yes, does the water have:
   - ☐ Surface sheen (from oils or gasoline)
   - ☐ Murky color (from suspended solids)
   - ☐ Green color (from algae or other biological activity)
   - ☐ Other (describe In comment box)

7. Is there evidence of illicit storm sewer discharges?
   ☑ Yes ☐ No ☐ I don't know (if yes, describe in comment box)

8. What is the approximate percentage of vegetation coverage in the practice? 100 %

9. Are there indications of any of the following in the filtration practice? (If yes, mark on site sketch)
   - ☐ Sediment deposition
   - ☐ Erosion or channelization
   - ☐ Excessive or undesirable vegetation (that needs mowing or removal)
   - ☐ Bare soil or lack of healthy vegetation significantly different from the original design
   - ☐ Litter or debris
   - ☐ Other
   - ☑ No

9. a) If sediment deposition is evident, what is the source?
   - ☐ Erosion or channelization inside the filtration practice
   - ☐ Erosion or channelization outside the filtration practice
   - ☐ Construction site erosion
   - ☐ Other
   - ☐ Unknown

Comments

Minor sedimentation at inlet and outlet pipe

See above sketch for possible illicit tie-in

Soil Filter not connected to nearby wetland

10. Are there indications of any of the following on the banks of the filtration practice:
    - □ Erosion or channelization
    - □ Soil slides or bulges
    - □ Excessive animal burrows
    - □ Seeps and wet spots
    - □ Poorly vegetated areas
    - □ Trees on constructed slopes

11. Is the bottom of the filtration practice covered with a layer of silts and/or clays?
    □ Yes ☑No

12. Are any outlet structures or the emergency spillway clogged? □ No ☑Partially □ Completely □ NA

12. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:1	Outlet #:	Outlet #:
Material	Sediment		

12. b) Are any of the outlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

13. Is there any evidence of any of the following downstream of the outlet structure?
    ☑Sediment deposition □ Erosion or channelization □ Other □ No

13. a) If sediment deposition is evident, what is the source?
    - □ Erosion or channelization inside the filtration practice
    - □ Erosion or channelization outside the filtration practice
    - □ Construction site erosion
    - □ Other, Specify____
    - ☑Unknown

14. Inspector's Recommendations. When is maintenance needed?
    - □ Before the next rainfall
    - □ Before the next rainy season
    - □ Within a year or two
    - □ No sign that any is required

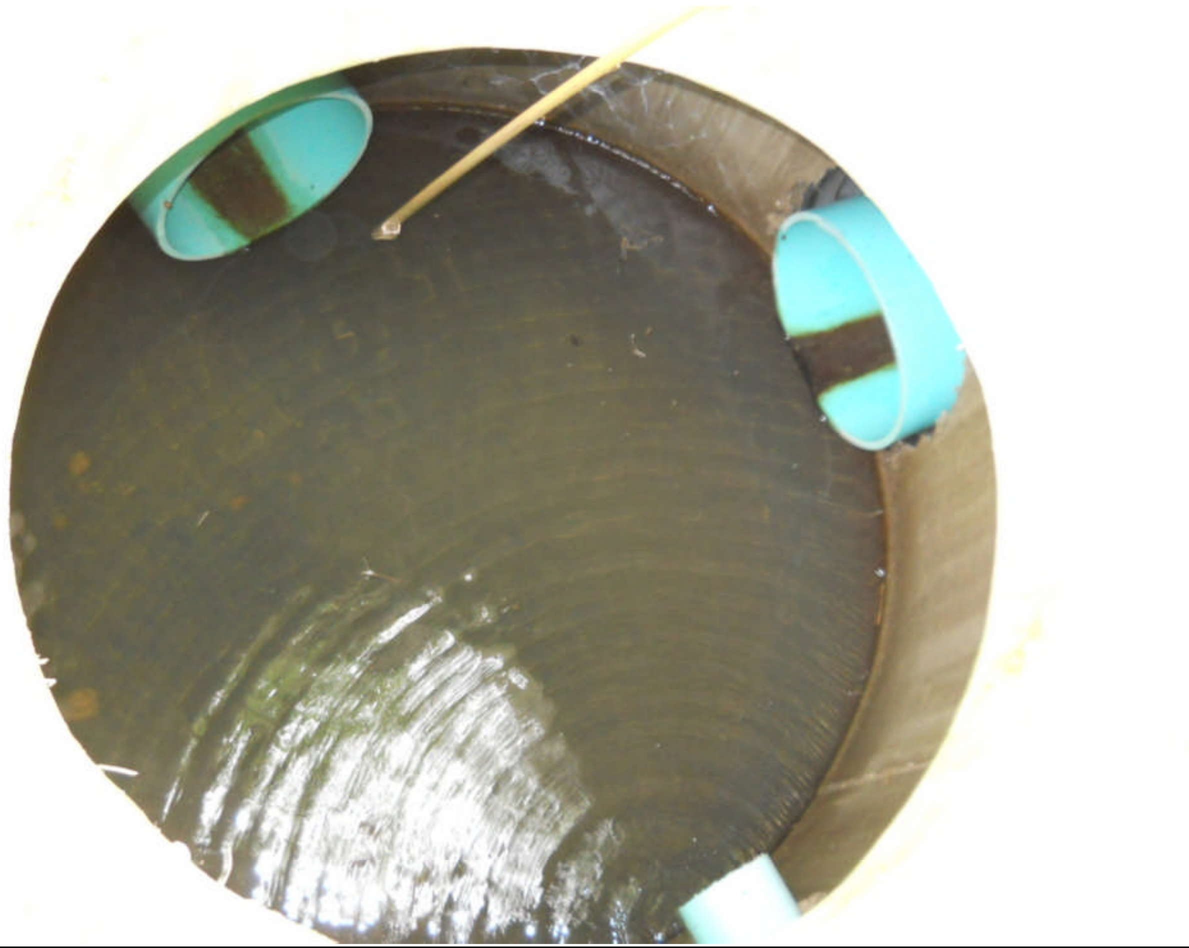
Comments

Key Bank (Soil Filter 1) Parcel ID: U58-006

Key Bank (Soil Filter 1) Parcel ID: U58-006

Key Bank (Soil Filter 1) Parcel ID: U58-006

Key Bank (Soil Filter 1) Parcel ID: U58-006



UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Filtration Practices

Inspector's Name(s): Ashley Auger & Mat Hardison

Date of Inspection: 8/6/2012

Location of the filtration practice: Key Bank (Soil Filter 2)

Address or Intersection: Route 1

Latitude, Longitude: 43.724471, -70.233235

Date the filtration practice began operation: 2006

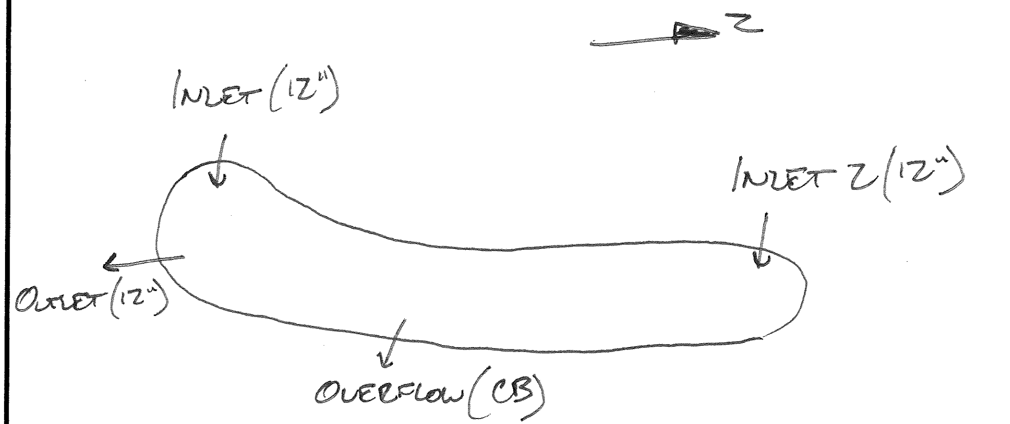
Filter Size (ft. x ft.): 200' x 40'

Time since last rainfall (hr): 6

Quantity of last rainfall (in): 0.2"

Rainfall Measurement Location: ______

Site Sketch (include inlets, outlets, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ______
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)

2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know

3. Does this filtration practice untilize pretreatment practices upstream?
   ☐ Yes ☑ No ☐ I don't know (If yes, describe pretreatment practices in comment box)

4. Access
   4. a) Access to the filtration practice is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   4. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments

Filtration Practices

University of Minnesota

5. Inlet Structures

5. a) How many inlet structures are present? ☐ 0 ☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

5. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

5. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Yes					
No					

6. Is there standing water in the filtration practice? ☐ Yes ☑ No

6. a) If yes, does the water have:
- ☐ Surface sheen (from oils or gasoline)
- ☐ Murky color (from suspended solids)
- ☐ Green color (from algae or other biological activity)
- ☐ Other (describe In comment box)

7. Is there evidence of illicit storm sewer discharges?
☐ Yes ☐ No ☑ I don't know (if yes, describe in comment box)

8. What is the approximate percentage of vegetation coverage in the practice? 100 %

9. Are there indications of any of the following in the filtration practice? (If yes, mark on site sketch)
- ☐ Sediment deposition
- ☐ Erosion or channelization
- ☐ Excessive or undesirable vegetation (that needs mowing or removal)
- ☐ Bare soil or lack of healthy vegetation significantly different from the original design
- ☐ Litter or debris
- ☐ Other
- ☑ No

9. a) If sediment deposition is evident, what is the source?
- ☐ Erosion or channelization inside the filtration practice
- ☐ Erosion or channelization outside the filtration practice
- ☐ Construction site erosion
- ☐ Other
- ☐ Unknown

Comments
Soil Filter not connected to nearby wetland

10. Are there indications of any of the following on the banks of the filtration practice:
    - ☐ Erosion or channelization
    - ☐ Soil slides or bulges
    - ☐ Excessive animal burrows
    - ☐ Seeps and wet spots
    - ☐ Poorly vegetated areas
    - ☐ Trees on constructed slopes

11. Is the bottom of the filtration practice covered with a layer of silts and/or clays?
    ☐ Yes ☑ No

12. Are any outlet structures or the emergency spillway clogged? ☐ No ☑ Partially ☐ Completely ☐ NA

12. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #: 1	Outlet #:	Outlet #:
Material	Sediment		

12. b) Are any of the outlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

13. Is there any evidence of any of the following downstream of the outlet structure?
    ☑ Sediment deposition ☐ Erosion or channelization ☐ Other ☐ No

13. a) If sediment deposition is evident, what is the source?
    - ☐ Erosion or channelization inside the filtration practice
    - ☐ Erosion or channelization outside the filtration practice
    - ☐ Construction site erosion
    - ☐ Other, Specify_______________________________________
    - ☑ Unknown

14. Inspector's Recommendations. When is maintenance needed?
    - ☐ Before the next rainfall
    - ☐ Before the next rainy season
    - ☐ Within a year or two
    - ☐ No sign that any is required

Comments

Key Bank (Soil Filter 2) Parcel ID: U58-006

Key Bank (Soil Filter 2) Parcel ID: U58-006

Key Bank (Soil Filter 2) Parcel ID: U58-006

Key Bank (Soil Filter 2) Parcel ID: U58-006

Key Bank (Soil Filter 2) Parcel ID: U58-006

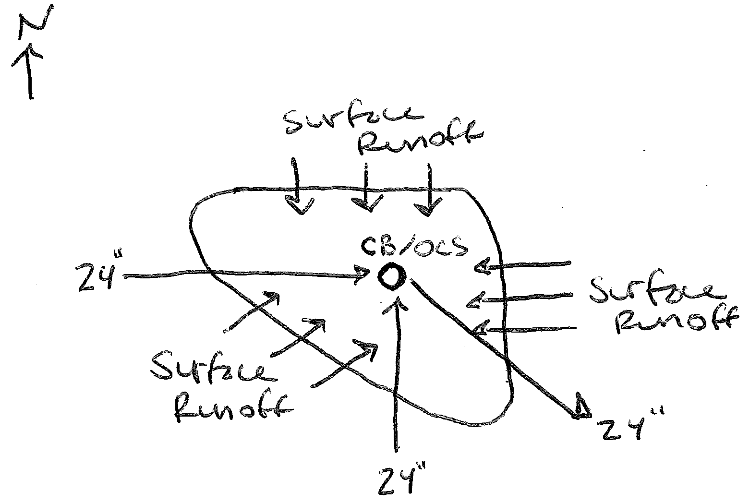
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Filtration Practices

Inspector's Name(s): Ashley Auger & Zach Henderson
Date of Inspection: 10/30/2012
Location of the filtration practice: Gorham Savings Bank
Address or Intersection: 202 US Route 1, Falmouth, ME
Latititude, Longitude: 43.718992, -70.233681
Date the filtration practice began operation: 2010
Filter Size (ft. x ft.): 950 SF
Time since last rainfall (hr): 1
Quantity of last rainfall (in): 0.81"
Rainfall Measurement Location: ______

Site Sketch (include inlets, outlets, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ______
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Does this filtration practice untilize pretreatment practices upstream?
   ☐ Yes ☑ No ☐ I don't know (If yes, describe pretreatment practices in comment box)
4. Access
   4. a) Access to the filtration practice is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation
   4. c) Access to the upstream and downstream drainage is:
      ☑ Clear ☐ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   4. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☐ permanent **and** ☐ before or during installation **or** ☐ new since installation

Comments

5. Inlet Structures

5. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5

5. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

5. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Yes					
No					

6. Is there standing water in the filtration practice? ☑ Yes ☐ No

6. a) If yes, does the water have:
- ☐ Surface sheen (from oils or gasoline)
- ☐ Murky color (from suspended solids)
- ☐ Green color (from algae or other biological activity)
- ☐ Other (describe In comment box)

7. Is there evidence of illicit storm sewer discharges?
☐ Yes ☐ No ☑ I don't know (if yes, describe in comment box)

8. What is the approximate percentage of vegetation coverage in the practice? 100 %

9. Are there indications of any of the following in the filtration practice? (If yes, mark on site sketch)
- ☐ Sediment deposition
- ☐ Erosion or channelization
- ☐ Excessive or undesirable vegetation (that needs mowing or removal)
- ☐ Bare soil or lack of healthy vegetation significantly different from the original design
- ☐ Litter or debris
- ☐ Other
- ☑ No

9. a) If sediment deposition is evident, what is the source?
- ☐ Erosion or channelization inside the filtration practice
- ☐ Erosion or channelization outside the filtration practice
- ☐ Construction site erosion
- ☐ Other
- ☐ Unknown

Comments

10. Are there indications of any of the following on the banks of the filtration practice:
    - ☐ Erosion or channelization
    - ☐ Soil slides or bulges
    - ☐ Excessive animal burrows
    - ☐ Seeps and wet spots
    - ☐ Poorly vegetated areas
    - ☐ Trees on constructed slopes

11. Is the bottom of the filtration practice covered with a layer of silts and/or clays?
    ☐ Yes ☑ No

12. Are any outlet structures or the emergency spillway clogged? ☑ No ☐ Partially ☐ Completely ☐ NA

12. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			

12. b) Are any of the outlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

13. Is there any evidence of any of the following downstream of the outlet structure?
    ☐ Sediment deposition ☐ Erosion or channelization ☐ Other ☑ No

13. a) If sediment deposition is evident, what is the source?
    - ☐ Erosion or channelization inside the filtration practice
    - ☐ Erosion or channelization outside the filtration practice
    - ☐ Construction site erosion
    - ☐ Other, Specify________________________________
    - ☐ Unknown

14. Inspector's Recommendations. When is maintenance needed?
    - ☐ Before the next rainfall
    - ☐ Before the next rainy season
    - ☐ Within a year or two
    - ☑ No sign that any is required

Comments

Gorham Savings Bank (Soil Filter) Parcel ID: U52-004-ON

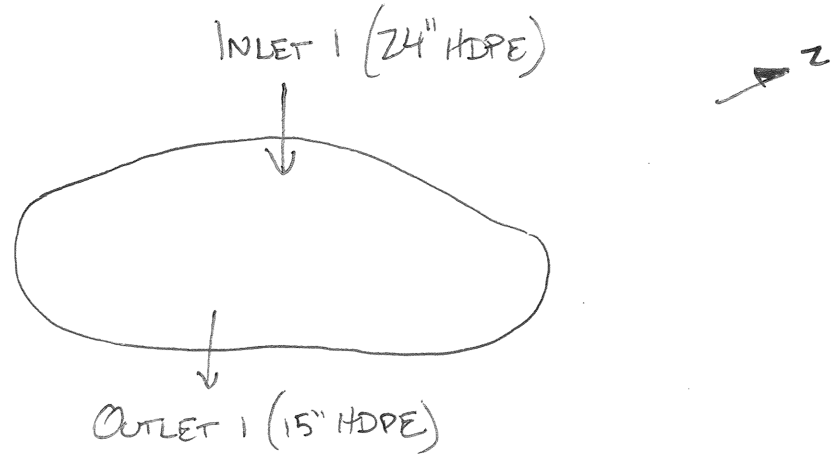
UNIVERSITY OF MINNESOTA

Stormwater Treatment: Assessment and Maintenance

Field Data Sheet for Level 1 Assessment: Visual Inspection Wet Ponds

Inspector's Name(s): Zach Henderson, Ashley Auger & Mat Hardison
Date of Inspection: 8/6/2012
Location of the wet pond: Rite Aid
Address or Intersection: Route 1
Latititude, Longitude: 43.722081, -70.230512
Date the wet pond began operation: 2007
Wet pond dimensions. Depth (ft.): 8'
Area (ft. x ft.) 80' x 60'
Time since last rainfall (hr): 6
Quantity of last rainfall (in): 0.2"
Rainfall Measurement Location: ____________

Site Sketch (include inlets, outlets, north arrow, etc.)



Based on visual assessment of the site, answer the following questions and make photographic or video-graphic documentation:

1. Has visual inspection been conducted at this location before? ☐ Yes ☐ No ☑ I don't know
   1. a) If yes, enter date: ____________
   1. b) Based on previous visual inspections, have any corrective actions been taken?
      ☐ Yes ☐ No ☑ I don't know (If yes, describe actions in comments box)
2. Has it rained within the last 48 hours at this location? ☑ Yes ☐ No ☐ I don't know
3. Access
   3. a) Access to the wet pond is:
      ☐ Clear ☑ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. b) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☑ permanent **and** ☐ before or during installation **or** ☑ new since installation
   3. c) Access to the upstream and downstream drainage is:
      ☐ Clear ☑ Partially obstructed ☐ Mostly obstructed ☐ Inaccessible
   3. d) If obstructed, the obstruction is (choose and provide comments) :
      ☐ temporary **and** ☐ no action needed **or** ☐ action needed
      ☑ permanent **and** ☐ before or during installation **or** ☑ new since installation

Comments
Inlet and outlet both relatively clear and free of sediment Good vegetation growth, no signs of erosion 60% vegetation Riprapped inlet with 24" HDPE Security fence with gate around perimeter of pond Pond is located at the bottom of a steep slope and surrounded by dense vegetation Poor Length to Width ratio

4. Inlet Structures
   4. a) How many inlet structures are present? ☐ 0 ☑ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ > 5
   4. b) Are any of the inlet structures clogged? (If yes, mark location on site sketch above and fill in boxes below with items causing clogging (ie. debris, sediment, vegetation, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Partially					
Completely					
Not Applicable					

   4. c) Are any of the inlet structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Inlet #:	Inlet #:	Inlet #:	Inlet #:	Inlet #:
Reason					

5. How many cells are in the wet pond system? 1
   5. a) Does the water in the pond have:
      - ☐ Surface sheen (from oils or gasoline)
      - ☐ Murky color (from suspended solids)
      - ☐ Green color (from algae or other biological activity)
      - ☐ Other (describe In comment box)

6. Is there evidence of illicit storm sewer discharges?
   ☐ Yes ☑ No ☐ I don't know (if yes, describe in comment box)

7. Does the wet pond smell like gasoline or oil? ☐ Yes ☑ No

8. Are there indications of any of the following in the wet pond? (If yes, mark on site sketch)
   - ☐ Sediment deposition in excess of 50% of the sediment storage capacity
   - ☐ Erosion or channelization
   - ☑ Excessive or undesirable vegetation (that needs mowing or removal)
   - ☐ Bare soil or lack of healthy vegetation significantly different from the original design
   - ☐ Litter or debris
   - ☐ Other
   - ☐ No

   8. a) If sediment deposition is evident, what is the source?
      - ☐ Erosion or channelization inside the wet pond
      - ☐ Erosion or channelization outside the wet pond
      - ☐ Construction site erosion
      - ☐ Other
      - ☐ Unknown

Comments
Trash rack was free of debris and litter

Sedimentation Practices

9. Are there indications of any of the following on the banks of the wet pond:
- □ Erosion or channelization
- □ Soil slides or bulges
- □ Excessive animal burrows
- □ Seeps and wet spots
- □ Poorly vegetated areas
- □ Trees on constructed slopes

10. Are any outlet or overflow structures clogged? ☑No □ Partially □ Completely □ NA

10. a) If yes, specify the clogging material (i.e. debris, sediment, vegetation, etc.) in the box below.

	Outlet #:	Outlet #:	Outlet #:
Material			
Partial or Comp.			

10. b) Are any of the outlet or overflow structures askew or misaligned from the original design or otherwise in need of maintenance? (if yes, write in reason: frost heave, vandalism, unknown, etc.)

	Outlet #:	Outlet #:	Outlet #:
Reason			

11. Is there any evidence of any of the following downstream of the outlet structure?
□ Sediment deposition □ Erosion or channelization □ Other ☑No

11. a) If sediment deposition is evident, what is the source?
- □ Erosion or channelization inside the filtration practice
- □ Erosion or channelization outside the filtration practice
- □ Construction site erosion
- □ Other, Specify________________________________
- □ Unknown

12. Inspector's Recommendations. When is maintenance needed?
- □ Before the next rainfall
- □ Before the next rainy season
- □ Within a year or two
- □ No sign that any is required

University of Minnesota

Comments
System has underdrained gravel trench, but no flow control orifice

Rite Aid (Wet Pond) Parcel ID: U12-011

Rite Aid (Wet Pond) Parcel ID: U12-011

Rite Aid (Wet Pond) Parcel ID: U12-011

Rite Aid (Wet Pond) Parcel ID: U12-011

Rite Aid (Wet Pond) Parcel ID: U12-011

Norway Savings Bank (Below-Grade Stormwater Management Facility) Parcel ID: U58-010-A1

Norway Savings Bank (Below-Grade Stormwater Management Facility) Parcel ID: U58-010-A1

APPENDIX C: BUILD-OUT MODEL

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor			
C=	0.5265	*Runoff coefficient = %impervious	%impervious =	0.5265	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b	tc (min.) =	69.9	*Time of Concentration from AutoCAD
A (ac) =	25.98	*Watershed Area			
Q (CFS) =	CALCULATED BELOW	*Peak Runoff			

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921
I (in/hr) =	1.008	1.551	2.238
Q (CFS) =	13.788	21.221	30.611

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	6,692	0.010	0.865	0.601	0.020	0.012	-0.98	-1.37046	0.40067
2	29,860	0.046	1.369	0.851	0.040	0.034	-0.96	-1.287	0.567588
3	71,436	0.110	1.788	1.044	0.059	0.062	-0.94	-1.22263	0.696332
4	132,404	0.205	2.159	1.208	0.079	0.095	-0.92	-1.16808	0.805432
5	213,371	0.330	2.498	1.353	0.098	0.132	-0.9	-1.11977	0.902054
10	927,659	1.435	3.900	1.931	0.191	0.368	-0.8	-0.9273	1.287002
15	2,159,847	3.341	5.024	2.386	0.279	0.665	-0.7	-0.7754	1.590798
20	3,891,035	6.018	5.980	2.782	0.362	1.006	-0.6	-0.6435	1.85459
25	6,086,479	9.414	6.812	3.142	0.440	1.382	-0.5	-0.5236	2.094395
30	8,701,319	13.458	7.546	3.478	0.513	1.784	-0.4	-0.41152	2.318559
35	11,683,141	18.070	8.196	3.798	0.580	2.205	-0.3	-0.30469	2.532207
40	14,973,294	23.158	8.771	4.108	0.643	2.640	-0.2	-0.20136	2.738877
45	18,507,556	28.625	9.279	4.412	0.699	3.085	-0.1	-0.10017	2.941258
50	22,216,376	34.361	9.722	4.712	0.750	3.534	0	0	3.141593
55	26,024,748	40.251	10.104	5.013	0.795	3.984	0.1	0.100167	3.341927
60	29,851,709	46.170	10.426	5.316	0.833	4.428	0.2	0.201358	3.544308
65	33,609,308	51.982	10.688	5.626	0.864	4.864	0.3	0.304693	3.750978
70	37,200,773	57.536	10.887	5.947	0.889	5.285	0.4	0.411517	3.964626
75	40,517,235	62.666	11.020	6.283	0.905	5.687	0.5	0.523599	4.18879
80	43,431,544	67.173	11.081	6.643	0.913	6.062	0.6	0.643501	4.428595
85	45,785,304	70.814	11.058	7.039	0.910	6.404	0.7	0.775397	4.692388
90	47,356,309	73.243	10.931	7.494	0.894	6.701	0.8	0.927295	4.996183
95	47,743,639	73.843	10.646	8.072	0.859	6.936	0.9	1.11977	5.381132
100	44,432,812	68.722	9.722	9.425	0.750	7.069	1	1.57079	6.283173

Diam. (in)	36	*From Site Plans
Manning n	0.011	*From Site Plans
Slope(ft/ft)	0.00756	*Estimate from GIS Topography & Field Measurements

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor			
C=	0.3978	*Runoff coefficient = %impervious	%impervious =	0.3978	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b	tc (min.) =	29.9	*Time of Concentration from AutoCAD
A (ac) =	64.82	*Watershed Area			
Q total(CFS) =	CALCULATED BELOW	*Peak Runoff from Catchments 1 & 2			

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921

I (in/hr) =	1.741	2.540	3.636
Q total(CFS) =	58.671	86.717	124.369

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	2,833	0.004	0.366	0.601	0.020	0.012	-0.98	-1.37046	0.40067
2	12,642	0.020	0.580	0.851	0.040	0.034	-0.96	-1.287	0.567588
3	30,245	0.047	0.757	1.044	0.059	0.062	-0.94	-1.22263	0.696332
4	56,058	0.087	0.914	1.208	0.079	0.095	-0.92	-1.16808	0.805432
5	90,339	0.140	1.057	1.353	0.098	0.132	-0.9	-1.11977	0.902054
10	392,762	0.607	1.651	1.931	0.191	0.368	-0.8	-0.9273	1.287002
15	914,458	1.414	2.127	2.386	0.279	0.665	-0.7	-0.7754	1.590798
20	1,647,426	2.548	2.532	2.782	0.362	1.006	-0.6	-0.6435	1.85459
25	2,576,955	3.986	2.884	3.142	0.440	1.382	-0.5	-0.5236	2.094395
30	3,684,053	5.698	3.195	3.478	0.513	1.784	-0.4	-0.41152	2.318559
35	4,946,527	7.651	3.470	3.798	0.580	2.205	-0.3	-0.30469	2.532207
40	6,339,546	9.805	3.714	4.108	0.643	2.640	-0.2	-0.20136	2.738877
45	7,835,918	12.119	3.928	4.412	0.699	3.085	-0.1	-0.10017	2.941258
50	9,406,196	14.548	4.116	4.712	0.750	3.534	0	0	3.141593
55	11,018,623	17.042	4.278	5.013	0.795	3.984	0.1	0.100167	3.341927
60	12,638,921	19.548	4.414	5.316	0.833	4.428	0.2	0.201358	3.544308
65	14,229,852	22.009	4.525	5.626	0.864	4.864	0.3	0.304693	3.750978
70	15,750,443	24.360	4.609	5.947	0.889	5.285	0.4	0.411517	3.964626
75	17,154,600	26.532	4.666	6.283	0.905	5.687	0.5	0.523599	4.18879
80	18,388,490	28.441	4.691	6.643	0.913	6.062	0.6	0.643501	4.428595
85	19,385,049	29.982	4.682	7.039	0.910	6.404	0.7	0.775397	4.692388
90	20,050,197	31.011	4.628	7.494	0.894	6.701	0.8	0.927295	4.996183
95	20,214,189	31.264	4.507	8.072	0.859	6.936	0.9	1.11977	5.381132
100	18,812,417	29.096	4.116	9.425	0.750	7.069	1	1.57079	6.283173

Diam. (in)	36	*Field Verified (Site Plans Specified 48")
Manning n	0.025	*Field Verified (Site Plans Specified RCP - .011)
Slope(ft/ft)	0.007	*From Site Plans

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor			
C=	0.4893	*Runoff coefficient = %impervious	%impervious =	0.4893	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b	tc (min.) =	51.5	*Time of Concentration from AutoCAD
A (ac) =	76.63	*Watershed Area			
Q (CFS) =	CALCULATED BELOW	*Peak Runoff			

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921
I (in/hr) =	1.236	1.866	2.687
Q (CFS) =	46.328	69.956	100.750

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	7,278	0.011	0.691	0.701	0.023	0.016	-0.98	-1.37046	0.40067
2	32,475	0.050	1.094	0.993	0.046	0.046	-0.96	-1.287	0.567588
3	77,692	0.120	1.429	1.219	0.069	0.084	-0.94	-1.22263	0.696332
4	143,999	0.223	1.725	1.410	0.092	0.129	-0.92	-1.16808	0.805432
5	232,057	0.359	1.996	1.579	0.114	0.180	-0.9	-1.11977	0.902054
10	1,008,901	1.560	3.116	2.252	0.222	0.501	-0.8	-0.9273	1.287002
15	2,349,001	3.633	4.015	2.784	0.325	0.905	-0.7	-0.7754	1.590798
20	4,231,801	6.545	4.778	3.246	0.422	1.370	-0.6	-0.6435	1.85459
25	6,619,516	10.238	5.443	3.665	0.513	1.881	-0.5	-0.5236	2.094395
30	9,463,357	14.636	6.029	4.057	0.598	2.428	-0.4	-0.41152	2.318559
35	12,706,319	19.652	6.549	4.431	0.677	3.001	-0.3	-0.30469	2.532207
40	16,284,615	25.187	7.008	4.793	0.750	3.594	-0.2	-0.20136	2.738877
45	20,128,399	31.132	7.414	5.147	0.816	4.199	-0.1	-0.10017	2.941258
50	24,162,027	37.370	7.768	5.498	0.875	4.811	0	0	3.141593
55	28,303,927	43.776	8.074	5.848	0.927	5.422	0.1	0.100167	3.341927
60	32,466,042	50.214	8.331	6.203	0.972	6.027	0.2	0.201358	3.544308
65	36,552,722	56.534	8.540	6.564	1.009	6.620	0.3	0.304693	3.750978
70	40,458,718	62.575	8.699	6.938	1.037	7.194	0.4	0.411517	3.964626
75	44,065,627	68.154	8.805	7.330	1.056	7.740	0.5	0.523599	4.18879
80	47,235,163	73.056	8.854	7.750	1.065	8.251	0.6	0.643501	4.428595
85	49,795,059	77.015	8.836	8.212	1.061	8.716	0.7	0.775397	4.692388
90	51,503,649	79.658	8.734	8.743	1.043	9.120	0.8	0.927295	4.996183
95	51,924,899	80.309	8.506	9.417	1.003	9.441	0.9	1.11977	5.381132
100	48,324,119	74.740	7.768	10.996	0.875	9.621	1	1.57079	6.283173

Diam. (in)	42	*From Site Plans
Manning n	0.011	*From Site Plans
Slope(ft/ft)	0.00393	*Estimate from GIS Topography & Field Measurements

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor			
C=	0.3847	*Runoff coefficient = %impervious	%impervious =	0.3847	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b	tc (min.) =	13.7	*Time of Concentration from AutoCAD
A (ac) =	17.34	*Watershed Area			
Q total(CFS) =	CALCULATED BELOW	*Peak Runoff from Catchments 4 & 1+2,3			

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921

I (in/hr) =	2.673	3.717	5.235
Q total(CFS) =	122.831	181.468	260.043

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	7,768	0.012	0.813	0.668	0.022	0.015	-0.98	-1.37046	0.40067
2	34,662	0.054	1.287	0.946	0.044	0.042	-0.96	-1.287	0.567588
3	82,926	0.128	1.681	1.161	0.066	0.076	-0.94	-1.22263	0.696332
4	153,699	0.238	2.030	1.342	0.087	0.117	-0.92	-1.16808	0.805432
5	247,689	0.383	2.348	1.503	0.109	0.163	-0.9	-1.11977	0.902054
10	1,076,864	1.666	3.667	2.145	0.212	0.454	-0.8	-0.9273	1.287002
15	2,507,237	3.878	4.724	2.651	0.310	0.821	-0.7	-0.7754	1.590798
20	4,516,869	6.986	5.623	3.091	0.402	1.242	-0.6	-0.6435	1.85459
25	7,065,428	10.928	6.405	3.491	0.489	1.706	-0.5	-0.5236	2.094395
30	10,100,839	15.622	7.095	3.864	0.570	2.202	-0.4	-0.41152	2.318559
35	13,562,258	20.976	7.706	4.220	0.645	2.722	-0.3	-0.30469	2.532207
40	17,381,599	26.883	8.247	4.565	0.714	3.260	-0.2	-0.20136	2.738877
45	21,484,313	33.229	8.724	4.902	0.777	3.809	-0.1	-0.10017	2.941258
50	25,789,659	39.887	9.142	5.236	0.833	4.363	0	0	3.141593
55	30,210,570	46.725	9.501	5.570	0.883	4.918	0.1	0.100167	3.341927
60	34,653,059	53.596	9.804	5.907	0.925	5.467	0.2	0.201358	3.544308
65	39,015,031	60.342	10.049	6.252	0.960	6.005	0.3	0.304693	3.750978
70	43,184,147	66.791	10.236	6.608	0.987	6.525	0.4	0.411517	3.964626
75	47,034,029	72.745	10.362	6.981	1.006	7.021	0.5	0.523599	4.18879
80	50,417,075	77.977	10.419	7.381	1.014	7.484	0.6	0.643501	4.428595
85	53,149,414	82.203	10.398	7.821	1.011	7.906	0.7	0.775397	4.692388
90	54,973,100	85.024	10.278	8.327	0.993	8.272	0.8	0.927295	4.996183
95	55,422,727	85.719	10.010	8.969	0.955	8.564	0.9	1.11977	5.381132
100	51,579,387	79.775	9.142	10.472	0.833	8.727	1	1.57079	6.283173

Diam. (in)	40	*Field Verified
Manning n	0.025	*Field Verified
Slope(ft/ft)	0.03	*From GIS Topography

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor
C=	0.6247	*Runoff coefficient = %impervious
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b
A (ac) =	22.45	*Watershed Area
Q (CFS) =	CALCULATED BELOW	*Peak Runoff

%impervious =	0.6247	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
tc (min.) =	25.8	*Time of Concentration from AutoCAD

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921

I (in/hr) =	1.900	2.747	3.923
Q (CFS) =	26.644	38.522	55.013

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	13,330	0.021	1.723	0.601	0.020	0.012	-0.98	-1.37046	0.40067
2	59,482	0.092	2.727	0.851	0.040	0.034	-0.96	-1.287	0.567588
3	142,304	0.220	3.562	1.044	0.059	0.062	-0.94	-1.22263	0.696332
4	263,754	0.408	4.301	1.208	0.079	0.095	-0.92	-1.16808	0.805432
5	425,044	0.657	4.975	1.353	0.098	0.132	-0.9	-1.11977	0.902054
10	1,847,941	2.858	7.769	1.931	0.191	0.368	-0.8	-0.9273	1.287002
15	4,302,518	6.654	10.009	2.386	0.279	0.665	-0.7	-0.7754	1.590798
20	7,751,126	11.988	11.912	2.782	0.362	1.006	-0.6	-0.6435	1.85459
25	12,124,555	18.752	13.570	3.142	0.440	1.382	-0.5	-0.5236	2.094395
30	17,333,442	26.809	15.031	3.478	0.513	1.784	-0.4	-0.41152	2.318559
35	23,273,374	35.996	16.326	3.798	0.580	2.205	-0.3	-0.30469	2.532207
40	29,827,515	46.133	17.472	4.108	0.643	2.640	-0.2	-0.20136	2.738877
45	36,867,935	57.022	18.483	4.412	0.699	3.085	-0.1	-0.10017	2.941258
50	44,256,080	68.449	19.367	4.712	0.750	3.534	0	0	3.141593
55	51,842,540	80.182	20.128	5.013	0.795	3.984	0.1	0.100167	3.341927
60	59,466,028	91.973	20.770	5.316	0.833	4.428	0.2	0.201358	3.544308
65	66,951,344	103.550	21.290	5.626	0.864	4.864	0.3	0.304693	3.750978
70	74,105,714	114.615	21.687	5.947	0.889	5.285	0.4	0.411517	3.964626
75	80,712,264	124.833	21.952	6.283	0.905	5.687	0.5	0.523599	4.18879
80	86,517,706	133.812	22.073	6.643	0.913	6.062	0.6	0.643501	4.428595
85	91,206,509	141.064	22.029	7.039	0.910	6.404	0.7	0.775397	4.692388
90	94,336,026	145.905	21.774	7.494	0.894	6.701	0.8	0.927295	4.996183
95	95,107,605	147.098	21.207	8.072	0.859	6.936	0.9	1.11977	5.381132
100	88,512,280	136.897	19.367	9.425	0.750	7.069	1	1.57079	6.283173

Diam. (in)	36	*From Site Plans
Manning n	0.011	*From Site Plans
Slope(ft/ft)	0.03	*From Site Plans

Rational Method - Peak Runoff Determination:

Key:

(yellow)	Input
(red)	Output

Q=uCiA

u=	1	*Constant Unit conversion factor
C=	0.3973	*Runoff coefficient = %impervious
i (in/hr) =	CALCULATED BELOW	*Rainfall intensity = a/(tc+c)^b
A (ac) =	17.76	*Watershed Area
Q (CFS) =	CALCULATED BELOW	*Peak Runoff

%impervious =	0.3973	*From GIS Analysis & projected Buildout Calcs (GIS Tables)
tc (min.) =	24.9	*Time of Concentration from AutoCAD

Rainfall Intensity Coefficients from Table 12-2.4 of State of Maine Urban & Arterial Highway Design Guide, January 2005

	2-year	10-year Storm	100-year Storm
a =	25.76	30.82	47.59
b =	0.746	0.686	0.698
c =	7.141	8.133	9.921

I (in/hr) =	1.939	2.798	3.993
Q (CFS) =	13.685	19.742	28.176

Manning's Equation - Infrastructure Capcity Determination:

Percent Full	Flow Rate (gpd)	Flow Rate (cfs)	Velocity (fps)	Wetted Perimeter (feet)	Hydraulic Radius (feet)	Flow Area (sq. ft.)	X	a	Angle
0	0	0	0	0	0	0	-1	0	0
1	848	0.001	0.439	0.301	0.010	0.003	-0.98	-1.37046	0.40067
2	3,786	0.006	0.694	0.426	0.020	0.008	-0.96	-1.287	0.567588
3	9,057	0.014	0.907	0.522	0.030	0.015	-0.94	-1.22263	0.696332
4	16,788	0.026	1.095	0.604	0.039	0.024	-0.92	-1.16808	0.805432
5	27,054	0.042	1.267	0.677	0.049	0.033	-0.9	-1.11977	0.902054
10	117,619	0.182	1.978	0.965	0.095	0.092	-0.8	-0.9273	1.287002
15	273,850	0.424	2.548	1.193	0.139	0.166	-0.7	-0.7754	1.590798
20	493,351	0.763	3.033	1.391	0.181	0.252	-0.6	-0.6435	1.85459
25	771,714	1.194	3.455	1.571	0.220	0.345	-0.5	-0.5236	2.094395
30	1,103,254	1.706	3.827	1.739	0.256	0.446	-0.4	-0.41152	2.318559
35	1,481,324	2.291	4.156	1.899	0.290	0.551	-0.3	-0.30469	2.532207
40	1,898,488	2.936	4.448	2.054	0.321	0.660	-0.2	-0.20136	2.738877
45	2,346,603	3.629	4.706	2.206	0.350	0.771	-0.1	-0.10017	2.941258
50	2,816,850	4.357	4.931	2.356	0.375	0.884	0	0	3.141593
55	3,299,720	5.104	5.125	2.506	0.397	0.996	0.1	0.100167	3.341927
60	3,784,946	5.854	5.288	2.658	0.416	1.107	0.2	0.201358	3.544308
65	4,261,378	6.591	5.420	2.813	0.432	1.216	0.3	0.304693	3.750978
70	4,716,746	7.295	5.521	2.973	0.444	1.321	0.4	0.411517	3.964626
75	5,137,245	7.946	5.589	3.142	0.453	1.422	0.5	0.523599	4.18879
80	5,506,755	8.517	5.620	3.321	0.456	1.516	0.6	0.643501	4.428595
85	5,805,192	8.979	5.608	3.519	0.455	1.601	0.7	0.775397	4.692388
90	6,004,382	9.287	5.544	3.747	0.447	1.675	0.8	0.927295	4.996183
95	6,053,492	9.363	5.399	4.036	0.430	1.734	0.9	1.11977	5.381132
100	5,633,707	8.713	4.931	4.712	0.375	1.767	1	1.57079	6.283173

Diam. (in)	18	*From Site Plans
Manning n	0.011	*From Site Plans
Slope(ft/ft)	0.0049	*From Site Plans

Summary for Subcatchment C1: Subcatchment 1

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	100	0.1500	0.10		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.00"
8.8	696	0.0690	1.31		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.2	63	0.0500	4.54		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.3	54	0.0040	3.33	4.09	**Circular Channel (pipe), D-E** Diam= 15.0" Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013 Corrugated PE, smooth interior
0.3	97		5.67		**Lake or Reservoir, E-F** Mean Depth= 1.00'
0.1	40	0.0063	5.72	17.96	**Circular Channel (pipe), F-G** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
0.2	71		5.67		**Lake or Reservoir, G-H** Mean Depth= 1.00'
2.0	544	0.0040	4.55	14.31	**Circular Channel (pipe), H-I** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Corrugated PE, smooth interior
0.2	63	0.0050	4.84	5.94	**Circular Channel (pipe), I-J** Diam= 15.0" Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
0.4	225	0.0200	8.44	219.52	**Trap/Vee/Rect Channel Flow, J-K** Bot.W=7.00' D=2.00' Z= 3.0 '/' Top.W=19.00' n= 0.030 Short grass
0.2	63	0.0050	6.98	34.28	**Circular Channel (pipe), K-L** Diam= 30.0" Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.011 Concrete pipe, straight & clean
29.9	2,016	Total			

Summary for Subcatchment C2: Subcatchment 2

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	100	0.0300	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.00"
50.3	1,169	0.0060	0.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.7	329	0.0070	7.83	24.61	**Circular Channel (pipe), C-D** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.010 PVC, smooth interior
69.9	1,598	Total			

Summary for Subcatchment C3: Subcatchment 3

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.6	100	0.0300	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.00"
21.6	628	0.0048	0.48		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.3	37	0.0022	2.13	1.67	**Circular Channel (pipe), C-D** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
12.2	1,095	0.0100	1.50		**Shallow Concentrated Flow, D-E** Grassed Waterway Kv= 15.0 fps
4.4	281	0.0008	1.06	3.33	**Circular Channel (pipe), E-F** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
4.1	457	0.0153	1.86		**Shallow Concentrated Flow, F-G** Grassed Waterway Kv= 15.0 fps
0.3	214	0.0100	12.36	118.90	**Circular Channel (pipe), G-H** Diam= 42.0" Area= 9.6 sf Perim= 11.0' r= 0.88' n= 0.011 Concrete pipe, straight & clean
51.5	2,812	Total			

Summary for Subcatchment C4: Subcatchment 4

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	100	0.0600	0.26		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.00"
5.1	408	0.0368	1.34		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	220	0.0500	4.54		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.8	78	0.0600	1.71		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
0.5	223	0.0090	7.49	299.49	**Trap/Vee/Rect Channel Flow, E-F** Bot.W=2.00' D=4.00' Z= 2.0 '/' Top.W=18.00' n= 0.030 Earth, grassed & winding
13.7	1,029	Total			

Summary for Subcatchment C5: Subcatchment 5

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0250	0.18		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.00"
2.8	111	0.0090	0.66		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
5.2	219	0.0200	0.71		**Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps
0.7	119	0.0200	2.87		**Shallow Concentrated Flow, D-E** Paved Kv= 20.3 fps
0.1	20	0.0250	2.37		**Shallow Concentrated Flow, E-F** Grassed Waterway Kv= 15.0 fps
0.2	45	0.0050	3.21	2.52	**Circular Channel (pipe), F-G** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
2.5	214	0.0090	1.42		**Shallow Concentrated Flow, G-H** Grassed Waterway Kv= 15.0 fps
0.5	88	0.0050	3.21	2.52	**Circular Channel (pipe), H-I** Diam= 12.0" Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.0	5		5.67		**Lake or Reservoir, I-J** Mean Depth= 1.00'
0.5	114	0.0040	3.76	6.64	**Circular Channel (pipe), J-K** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.013 Corrugated PE, smooth interior
2.0	128	0.0008	1.06	3.33	**Circular Channel (pipe), K-L** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.025 Corrugated metal
1.0	449	0.0100	7.20	22.62	**Circular Channel (pipe), L-M** Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013 Concrete pipe, bends & connections
0.5	244	0.0100	8.36	41.02	**Circular Channel (pipe), M-N** Diam= 30.0" Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.013 Corrugated PE, smooth interior
0.5	277	0.0090	8.95	63.28	**Circular Channel (pipe), N-O** Diam= 36.0" Area= 7.1 sf Perim= 9.4' r= 0.75' n= 0.013 Corrugated PE, smooth interior
25.8	2,133	Total			

Summary for Subcatchment C6: Subcatchment 6

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Rainfall not specified

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.0	100	0.1800	0.10		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.00"
7.0	513	0.0600	1.22		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.3	194	0.0150	2.49		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
0.6	128	0.0137	3.62	6.39	**Circular Channel (pipe), D-E** Diam= 18.0" Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.025 Corrugated metal
24.9	935	Total			

APPENDIX D: STORMWATER RETROFIT COST ESTIMATE

COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN
41 HUTCHINS DRIVE
PORTLAND, MAINE 04102
TEL.(207)774-2112

CLIENT	TYLin		
PROJECT	Route 1 Falmouth Commercial District Stormwater Management Plan		
DESIGNED BY	ZLH & AEA	DATE	10/30/2012
COST BY	AEA	DATE	11/8/2012
CHECKED BY	ZLH	DATE	
PROJECT NO.	225740.00	SHEET NO.	1 of 2

Stormwater Retrofits - Opinion of Probable Cost

Assumptions: Unit costs are derived from retrofit estimates developed for theoretical systems managing a unit of impervious area in order to develop an installation cost per unit. Flow through proprietary systems were sized for a given contributing area and time of concentration assumed to be typical for the study area setting. Raw materials including crushed stone, asphalt, gravel, and pavement demolition costs were based on a "bulk rate"--approximately 10 units of each BMP type installed. Costs are for delivered and in place materials unless otherwise noted. The ENR Construction Cost Index for this estimate is 9290 as of April 2012.

Pond Retrofits - Temperature Control							Notes
The following system was sized for an existing pond							***Pond Area = 27000 sf***
	Quantity	*Unit*	*Unit Cost*	*Price*		*Total*	
Excavation & Disposal	280	CY	$ 30.00	$ 8,400.00			Excavate to 8' wide berm and for gravel placement
Gravel Trench							
Gravel Trench (3' depth)	100	CY	$ 30.00	$ 3,000.00			Trench area
Geotextile	260	SY	$ 2.25	$ 585.00			Sides and bottom of gravel trench
6" Underdrain	230	LF	$ 25.00	$ 5,750.00			Gravel trench drain line and connection to overflow, including pipe only
Overflow Structure (4' diameter)	1	EA	$ 3,500.00	$ 3,500.00			New structure or modify existing
12" Diameter PVC Pipe	50	LF	$ 85.00	$ 4,250.00			Outlet pipe, including excavation, pipe, bedding, backfill
Loam and Seed (bench and slope)	1770	SY	$ 6.00	$ 10,620.00			Bench and slope areas around gravel
Erosion & Sedimentation Control	1	LS	$ 2,500.00	$ 2,500.00			
				Construction Subtotal:	*$*	*38,605.00*	
				Mobilization & Administration (5%):	*$*	*1,940.00*	
				Contingency (25%):	*$*	*9,660.00*	
				Total Construction:	***$***	***50,210.00***	
				Engineering, Permitting, & Survey (20%):	*$*	*10,050.00*	(Minimum $10,000, includes survey, evaluation of drainage area, system volume, and water quality requirements)
				Total System Cost:	***$***	***60,260.00***	
				Total Cost per Square Foot :	***$***	***2.23***	

New Retrofits							Notes
The following systems were sized for a .5 acre impervious drainage area and 1-inch 24-hour precipitation event							***Water Quality Volume = 1815 cf***
Gravel Wetland Sample (installation in unpaved setting)							*Includes: Pretreatment Basin and 2 Cells*
Excavation & Disposal	400	CY	$ 30.00	$ 12,000.00			*Assume: Design based on UNH Stormwater Center Draft Design Criteria*
Wetland Soil (8")	200	SY	$ 10.00	$ 2,000.00			*Assumed Excavated Area - 2,000 sf*
3/4" Crushed Stone (24")	150	CY	$ 40.00	$ 6,000.00			
Riprap (5")	2	CY	$ 65.00	$ 130.00			
Underdrain (6")	91	LF	$ 25.00	$ 2,275.00			
3' Diameter Perforated Riser	1	EA	$ 650.00	$ 650.00			
6" Diameter Galvanized Riser	1	EA	$ 500.00	$ 500.00			
Loam	150	SY	$ 4.00	$ 600.00			
Seed	150	SY	$ 2.00	$ 300.00			
				Construction Cost per Unit:	***$***	***24,455.00***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%):	***$***	***8,559.25***	
				Contingency (20%):	***$***	***6,602.85***	
				Total Cost per System:	***$***	***39,617.10***	
				Total Cost per Cubic Foot :	***$***	***21.83***	
				Total Cost (System & Connection) per SF :	***$***	***19.81***	
Soil Filter (installation in unpaved setting)							*Assumed Dimension: 1210 SF surface area with 1.5' storage over media*
Excavation & Disposal	180	CY	$ 30.00	$ 5,400.00			*Assumed Excavated Area - 1600 sf*
Riprap Inlet	1	CY	$ 65.00	$ 65.00			*Assumed Dimension: 3' W x 6'L x 1.5' D*
Soil Filter (18")	68	CY	$ 80.00	$ 5,440.00			
Coarse Gravel (12")	45	CY	$ 35.00	$ 1,575.00			
Geotextile Fabric	175	SY	$ 2.25	$ 393.75			
Underdrain (6" Diameter)	150	LF	$ 25.00	$ 3,750.00			
Loam	135	SY	$ 4.00	$ 540.00			
Seed	135	SY	$ 2.00	$ 270.00			
				Construction Cost per Unit:	***$***	***17,433.75***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%):	***$***	***6,101.81***	
				Contingency (20%):	***$***	***4,707.11***	
				Total Cost per System:	***$***	***28,242.68***	
				Total Cost per Cubic Foot :	***$***	***15.56***	
				Total Cost (System & Connection) per SF :	***$***	***17.65***	
Raingarden (installation in unpaved setting)							*Assumed Dimensions: 3' D x 605 SF*
Excavation & Disposal	68	CY	$ 30.00	$ 2,040.00			*Assumed require organic soil amendments.*
Organic Soil Modification	4	CY	$ 65.00	$ 260.00			*Assumed outlet conveyance is existing*
Loam	70	SY	$ 4.00	$ 280.00			*Assumed Excavated Area - 605 sf*
Seed	70	SY	$ 2.00	$ 140.00			
				Construction Cost per Unit:	***$***	***2,720.00***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%):	***$***	***952.00***	
				Contingency (20%):	***$***	***734.40***	
				Total Cost per System:	***$***	***4,406.40***	
				Total Cost per Cubic Foot :	***$***	***2.43***	
				Total Cost per SF :	***$***	***7.28***	

Below Grade Filter (installation in paved setting)						*Assumed Area: Controlled by width - 13.82'(W) x 115.57'(L) (1600 sf)*
						Controlled by length - 10.49'(W) x 158.27'(H) (1660 sf)
Pavement Demolition	70	SY	$ 10.00	$ 700.00		*Area can range depending on chamber arrangement: assume 1600 sf - 2000 sf*
Sawcut	60	LF	$ 3.00	$ 180.00		*Assumed Excavated Area - 2,500 sf*
Excavation & Disposal	180	CY	$ 30.00	$ 5,400.00		
Stormwater Chamber (SC-310)	60	EA	$ 160.00	$ 9,600.00		*Assume storage chamber located in impervious surface*
3/4" Angular Stone	137	TON	$ 40.00	$ 5,480.00		
Geotextile Fabric	30	SY	$ 2.25	$ 67.50		
Hot Mix Asphalt (4")	17	TON	$ 100.00	$ 1,700.00		
Aggregate Base (3")	6	CY	$ 30.00	$ 180.00		
Aggregate Subbase (18")	35	CY	$ 30.00	$ 1,050.00		
Gravel	24	CY	$ 35.00	$ 840.00		
Filter Sand	35	CY	$ 50.00	$ 1,750.00		
6" Underdrain	100	LF	$ 25.00	$ 2,500.00		
Police Detail	2	DAYS	$ 300.00	$ 600.00		
				Estimated Cost for Storage Chambers $	***30,047.50***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%): $	***10,516.63***	***Notes: Costs are given for delivery and installation of Stormtech Chambers with Isolator Row. Design is based on manufacturer recommendations plus 18" sand filter for bacteria reduction as described in Maine BMP manual.***
				Contingency (20%): $	***8,112.83***	
				Total Cost per System: $	***48,676.95***	
For connection with existing system. Assume one connection per unit.						
Pavement Demolition	25	SY	$ 10.00	$ 250.00		
Sawcut	50	LF	$ 3.00	$ 150.00		
Excavation & Disposal	45	CY	$ 30.00	$ 1,350.00		
Manhole (4')	2	EA	$ 3,500.00	$ 7,000.00		
12" Piping	20	LF	$ 85.00	$ 1,700.00		
				Estimated Cost for Connection $	***10,450.00***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%): $	***3,657.50***	
				Contingency (20%): $	***2,821.50***	
				Total Cost per Connection to System: $	***16,929.00***	
				Total Cost (System & Connection) : $	***65,605.95***	
				Total Cost (System & Connection) per Cubic Foot : $	***36.15***	
				Total Cost (System & Connection) per SF : $	***26.24***	*Design assumes removal and replacement of pavement.*
The following systems are on a per unit basis.						
Catchbasin Insert						*Unit Costs based on HydroInternational Up-Flo Filter*
6 module system	1	EA	$ 30,000.00	$ 30,000.00		*Dimensions based on design peak flow, 6 module system treats only 0.27 cfs*
				Construction Cost per Unit: $	***30,000.00***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%): $	***-***	
				Contingency (20%): $	***6,000.00***	
				Total Cost per System: $	***36,000.00***	
Esplanade Filter Box (installation in unpaved setting)						*Assumed Dimension: 6' x 12' Box*
Sawcut	60	LF	$ 3.00	$ 180.00		*Treats up to 0.81 acres for residential where C=0.50 & up to 0.48 acres for commercial*
Pavement Demolition	35	SY	$ 10.00	$ 350.00		
Excavation & Disposal	4	CY	$ 30.00	$ 120.00		
Bacterra Unit w/ tree grate	1	EA	$ 22,300.00	$ 22,300.00		
Crushed Stone (12")	1	CY	$ 40.00	$ 40.00		
4" Connection Pipe	50	LF	$ 30.00	$ 1,500.00		
Coring	1	EA	$ 1,000.00	$ 1,000.00		
Police Detail	2	DAYS	$ 300.00	$ 600.00		
				Construction Cost per Unit: $	***26,090.00***	
				Engineering (15%), Survey (10%) and Construction Bonds, Insurance, etc. (10%): $	***9,131.50***	
				Contingency (20%) $	***7,044.30***	
				Total Cost per System: $	***42,265.80***	
The following system was sized for an existing swale or drainage ditch.						***Example Swale Area = 3750 sf***
Filtration Swale Sample						
Excavation & Disposal	220	CY	$ 30.00	$ 6,600.00		Excavate for filter media and forebay construction
Soil Filter Media:						
Soil Filter (18" depth)	70	CY	$ 80.00	$ 5,600.00		Filter area
Coarse Gravel (12" depth)	50	CY	$ 35.00	$ 1,750.00		Filter area
6" Underdrain	200	LF	$ 25.00	$ 5,000.00		Single run, length of filter, including pipe only
Overflow Structure (4' diameter)	1	EA	$ 3,500.00	$ 3,500.00		New structure
12" Diameter PVC Pipe	10	LF	$ 85.00	$ 850.00		Tie overflow structure into existing culvert, including excavation, pipe, bedding & backfill
Loam and Seed	900	SY	$ 6.00	$ 5,400.00		Filter area, side slopes, and forebay
Landscaping	1	LS	$ 2,000.00	$ 2,000.00		Additional landscaping around filter
Erosion & Sedimentation Control	1	LS	$ 2,500.00	$ 2,500.00		
				Construction Subtotal: $	*33,200.00*	
				Mobilization & Administration (5%): $	*1,660.00*	
				Contingency (25%): $	*8,300.00*	
				Total Construction: $	***43,160.00***	
				Engineering, Permitting, & Survey (20%): $	*10,000.00*	(Minimum $10,000, includes survey, evaluation of drainage area, system volume, and water quality requirements)
				Total Cost per SF : $	***14.18***	

COMMITMENT & INTEGRITY DRIVE RESULTS
WOODARD & CURRAN
41 HUTCHINS DRIVE
PORTLAND, MAINE 04102
TEL.(207)774-2112

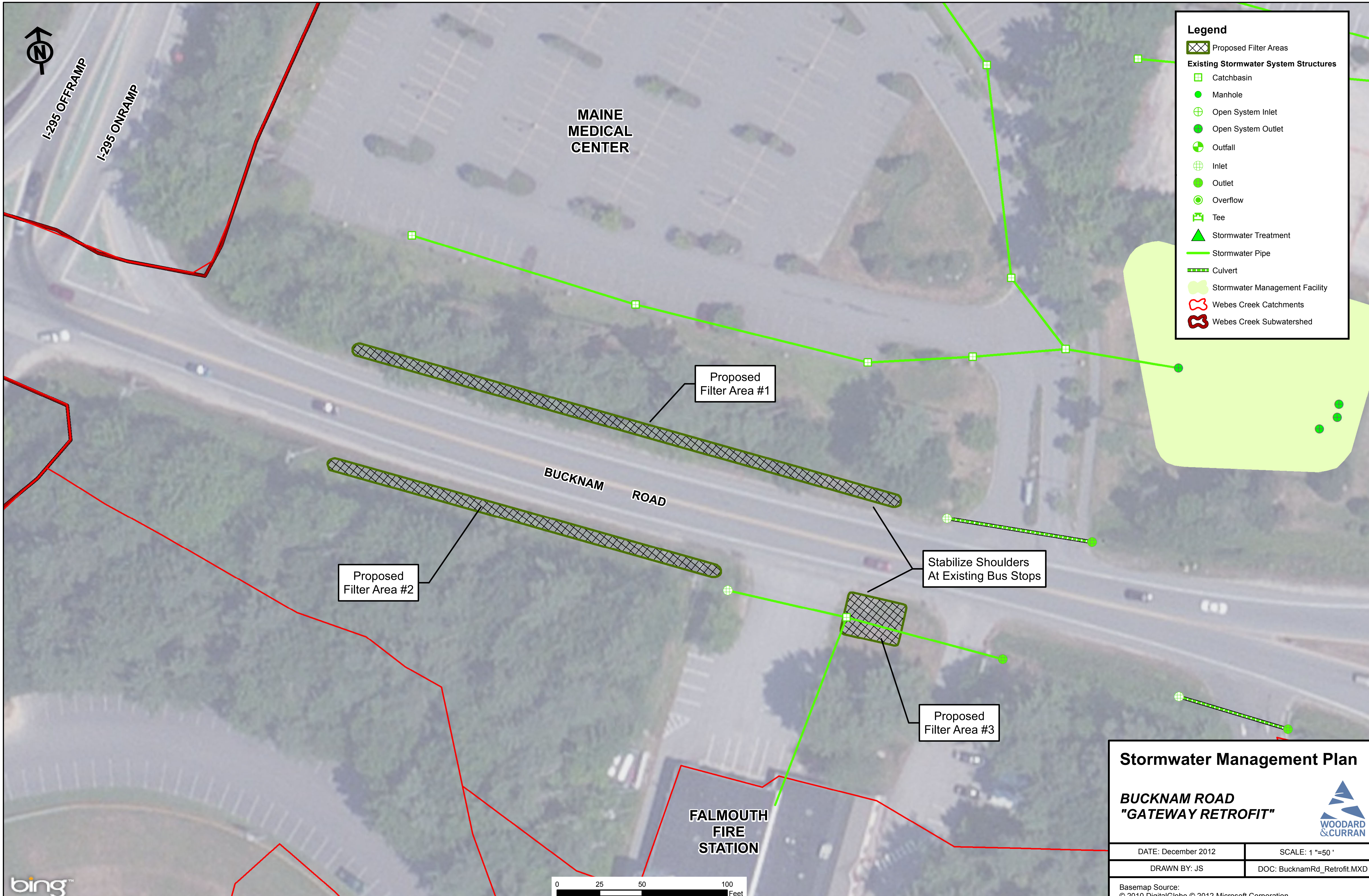
CLIENT	TYLin		
PROJECT	Route 1 Falmouth Commercial District Stormwater Management Plan		
DESIGNED BY	ZLH & AEA	DATE	10/30/2012
COST BY	AEA	DATE	11/8/2012
CHECKED BY	ZLH	DATE	
PROJECT NO.	225740.00	SHEET NO.	2 of 2

Stormwater Retrofits - Opinion of Probable Cost

Assumptions:

Retrofits - Flood Control	*Quantity*	*Unit*	*Unit Cost*	*Price*	*Total*	***Notes***
Excavation & Disposal	84	CY	$ 30.00	$ 2,520.00		Excavate for 4' diameter structure
Overflow Structure (4' diameter)	1	EA	$ 3,500.00	$ 3,500.00		New structure or modify existing
12" Diameter PVC Pipe	50	LF	$ 85.00	$ 4,250.00		Outlet pipe, including excavation, pipe, bedding, backfill
Erosion & Sedimentation Control	1	LS	$ 2,500.00	$ 2,500.00		
				Construction Subtotal:	*$ 12,770.00*	
				Mobilization & Administration (5%):	*$ 640.00*	
				Contingency (25%):	*$ 3,200.00*	
				Total Construction:	***$ 16,610.00***	
				Engineering, Permitting, & Survey (20%):	*$ 10,000.00*	(Minimum $10,000, includes survey, evaluation of drainage area, system volume, and water quality requirements)
				Total System Cost:	***$ 26,610.00***	

APPENDIX E: BUCKNAM ROAD GATEWAY RETROFIT CONCEPT



I-295 OFFRAMP
I-295 ONRAMP
MAINE MEDICAL CENTER
BUCKNAM ROAD
Proposed Filter Area #1
Proposed Filter Area #2
Proposed Filter Area #3
Stabilize Shoulders At Existing Bus Stops
FALMOUTH FIRE STATION
Legend
Proposed Filter Areas
Existing Stormwater System Structures
Catchbasin
Manhole
Open System Inlet
Open System Outlet
Outfall
Inlet
Outlet
Overflow
Tee
Stormwater Treatment
Stormwater Pipe
Culvert
Stormwater Management Facility
Webes Creek Catchments
Webes Creek Subwatershed
0 25 50 100 Feet
Stormwater Management Plan
BUCKNAM ROAD "GATEWAY RETROFIT"
WOODARD & CURRAN
DATE: December 2012
SCALE: 1 "=50 '
DRAWN BY: JS
DOC: BucknamRd_Retrofit.MXD
Basemap Source:
© 2010 DigitalGlobe © 2012 Microsoft Corporation

WOODARD &CURRAN
41 HUTCHINS DRIVE
PORTLAND, MAINE 04102
TEL. (207) 774-2112
FAX (207) 774-6635

CLIENT TYLin
PROJECT Falmouth Rte 1 SW Plan
DESIGNED BY AEA DATE 12-12-12
CHECKED BY ______ DATE ______
PROJECT NO. 225740 SHEET NO. 1 OF 2

Bucknam Road Conveyance - Water Quality Sizing & Cost

(Note: These estimates are preliminary)

* Area 1:

Watershed = 47,713 SF = 27,648 SF Pervious
20,065 SF Impervious

Water Quality Volume (WQV) = (0.5" × Impervious)

$\rightarrow WQV = [(\frac{0.5''}{12''/1'})(20{,}065\ SF)]$
$= 836\ CF$

Assuming 4" deep Swales,

$\rightarrow A_{req'd} = \frac{WQU}{4''} = \frac{836\ CF}{4''/12''/1'} = 2{,}508\ SF$

Available Space = 3,135 SF ✓ OK

Approximate Cost per SF of Filtration Swale = $15/SF

*Note: Unit cost from Stormwater Retrofit Cost estimate - Appendix D of Route 1 Falmouth Commercial District Stormwater Management Plan

$\therefore$ Cost = $\frac{\$15}{SF}$ × 2,508 SF = $ 37,620

*Area 2:

Watershed = 61,328 SF = 46,994 SF Pervious
14,334 SF Impervious

$\rightarrow WQV = [(\frac{0.5''}{12''/1'})(14{,}334\ SF)]$
$= 597\ CF$

$\rightarrow A_{req'd} = \frac{597\ CF}{4''/12''/1'} = 1{,}791\ SF$

Available Space = 2,685 SF ✓OK

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PORTLAND, MAINE 04102
TEL. (207) 774-2112
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CLIENT TYLin
PROJECT Falmouth Rte 1 SW Plan
DESIGNED BY AEA DATE 12-12-12
CHECKED BY ______ DATE ______
PROJECT NO. 225740 SHEET NO. 2 OF 2

Bucknam Road Conveyance - Water Quality Sizing & Cost

*Area 2 Cont'd...

Cost = $15/SF × 1,791 SF = $ 26,865

*Area 3:

Watershed = 13,401 SF = 6,597 SF Pervious
6,804 SF Impervious

→ WQV = [(0.5"/12"/1')(6,804 SF)]
= 284 CF

→ $A_{req'd}$ = 284 CF / (4"/12"/1') = 852 SF

Available Space = 2,245 SF ✓ OK

Cost = $15/SF × 852 SF = $ 12,780

Total Cost = $37,620
$ 26,865
$ 12,780
$ 77,265

APPENDIX F: MEETING PRESENTATIONS

Route 1 Falmouth Commercial District

Stormwater Planning for Long-Term Sustainable Growth

This presentation was prepared by the Town of Falmouth under award NOAA CZM NA10NOS4190188 to the Maine Coastal Program from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author(s) and do not necessarily reflect the views of the National Oceanic and Atmospheric Administration or the Department of Commerce.

Introductions

Theo Holtwijk, Director of Long Range Planning
Mel Dickenson, Conservation Commission

Zach Henderson, Woodard & Curran
Curtis Bohlen, Casco Bay Estuary Partnership

Meeting Goals

To provide overview of Stormwater Management Plan project.

To get your input.

Town officials have made no decisions on any matters that will be discussed here.

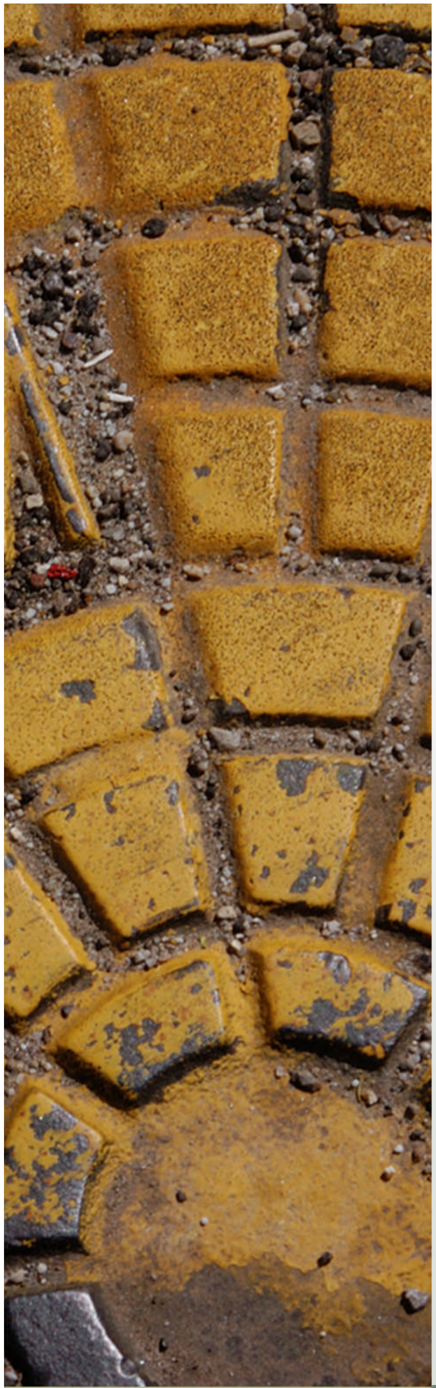
How did this Project come about?

The future of Route 1 has been discussed since 2002.

Current work has two components:

- Zoning - Town land use rules
- Infrastructure -Town financial investment
  - Traffic
  - Utilities, incl. stormwater
  - Streetscape/Landscaping

February 2012: Maine Competitive Coastal Grant Program



Project Goals

Our project hopes to accomplish the following through a collaborative partnership between state, town and private property owners:

1. Identification of opportunities for shared runoff management versus conventional approach where each property owner manages stormwater runoff on their own property.

2. Evaluation of the potential cost savings and reduced permitting requirements for managing stormwater runoff in the project area.

3. Enhanced capacity for future commercial growth.

4. A roadmap to better water quality in Mill Creek, Mussel Cove and Casco Bay.

What About Drainage?

- Drainage is not the sewer we often think of, but it *is* an underground system of pipes that maintains our urban built environment.
- Drainage systems convey fallen rainwater, called *stormwater*, from paved streets, parking lots, our lawns and basements (via sump pump) to prevent pooling and flooding.

Drainage Prevents Damage

Stormwater is drained away to prevent expensive damage to our infrastructure.

basements	→	**cracking**
streets	→	**flooding**
beneath roadways	→	**heaving**

Polluted Stormwater

- Unfortunately, our drainage systems also carry pollutants like oil, fertilizers, sediment and trash.
- Rainwater that falls on paved streets, lawns, parking lots and sidewalks becomes polluted stormwater.

Stormwater & Maine Water Pollution

So, polluted stormwater from our neighborhoods runs directly to streams and water bodies, including the Casco Bay.

- **Did You Know:** polluted stormwater runoff is the largest source of water quality problems for Maine's waters?

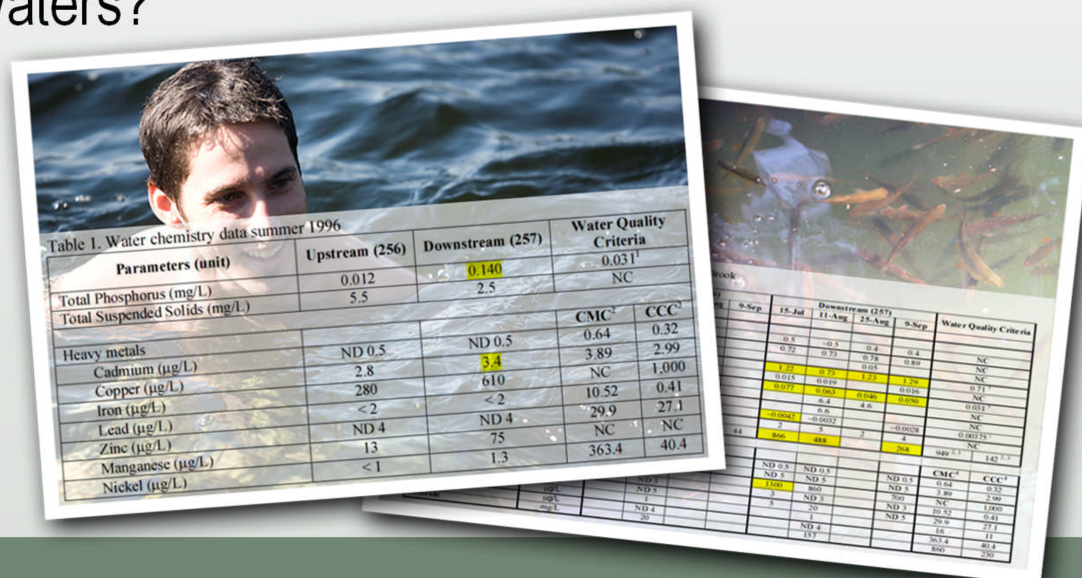


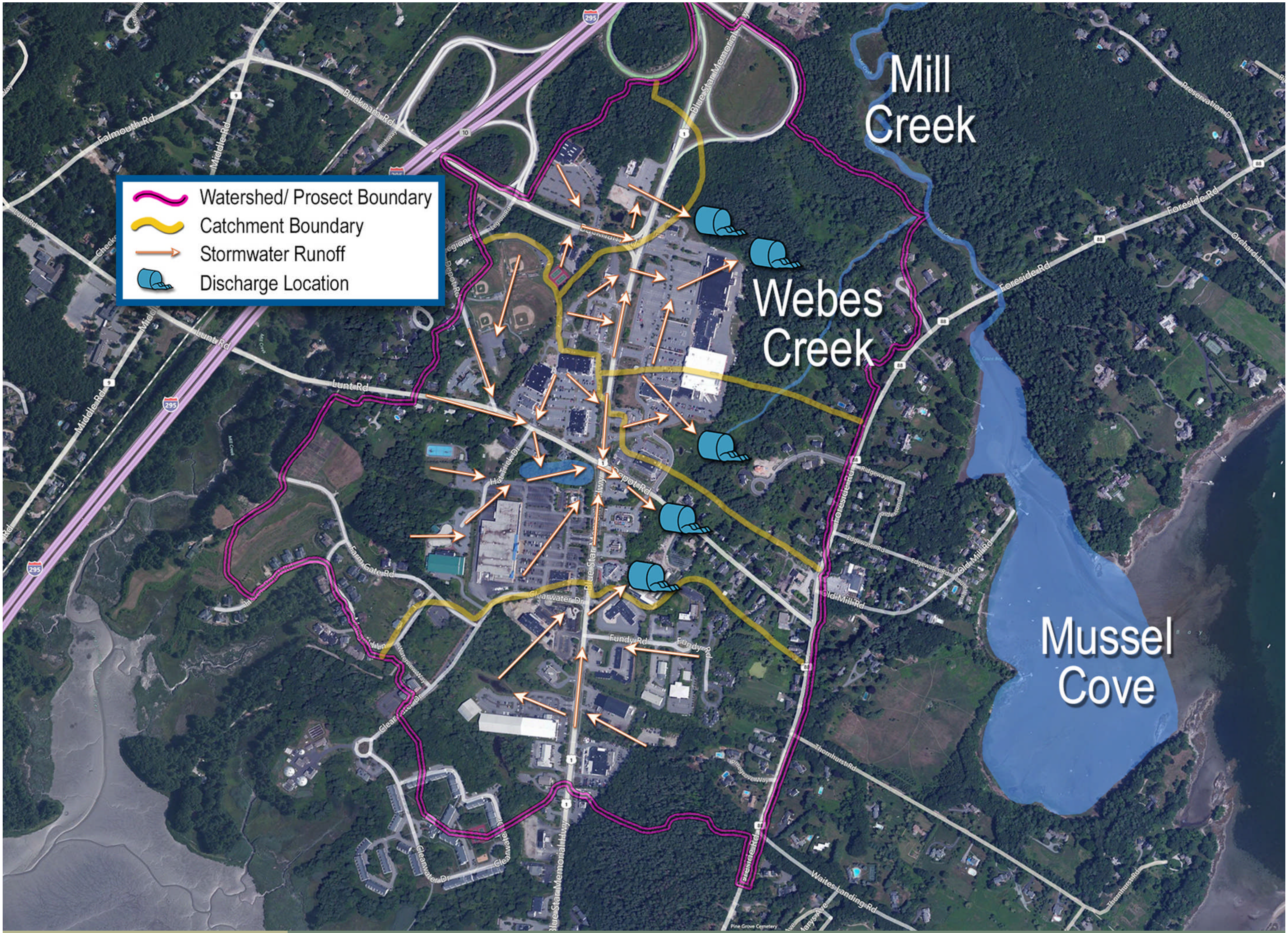
Table 1. Water chemistry data summer 1996

Parameters (unit)	Upstream (256)	Downstream (257)	Water Quality Criteria	
Total Phosphorus (mg/L)	0.012	0.140	0.031[1]	
Total Suspended Solids (mg/L)	5.5	2.5	NC	
			CMC[2]	CCC[2]
Heavy metals				
Cadmium (µg/L)	ND 0.5	ND 0.5	0.64	0.32
Copper (µg/L)	2.8	3.4	3.89	2.99
Iron (µg/L)	280	610	NC	1,000
Lead (µg/L)	< 2	< 2	10.52	0.41
Zinc (µg/L)	ND 4	ND 4	29.9	27.1
Manganese (µg/L)	13	75	NC	NC
Nickel (µg/L)	< 1	1.3	363.4	40.4

That Storm Drain does NOT lead to the Sewer

Water from your toilet and sink
sewer and on to the treatme

Polluted stormwater enters the
through the storm drains, which
vers and streams. Stormwater is



Watershed/ Prosect Boundary
Catchment Boundary
Stormwater Runoff
Discharge Location
Mill Creek
Webes Creek
Mussel Cove

How is Stormwater Regulated?

Clean Water Act

- **Maine Pollution Discharge Elimination System (MEPDES)**
  - Maine is a delegated state and issues permits
  - Establishes required discharge limits and testing requirements.
- **Municipal Separate Storm Sewer System Discharges**
  - Five year general permit – 6 management measures
  - Progress required to clean up urban impaired streams
- **Residual Designation Authority (Long Creek)**

Maine Law

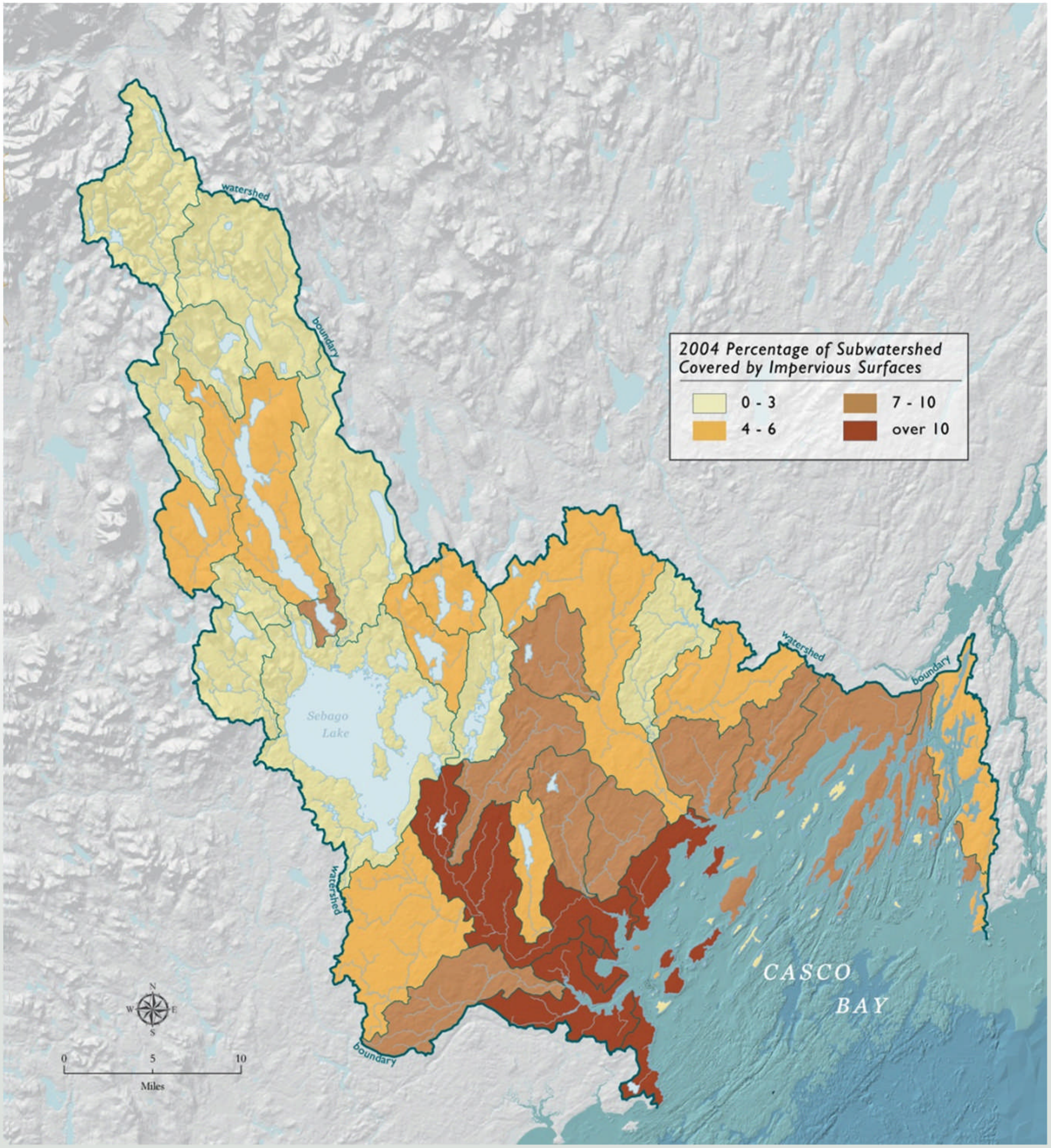
- State Stormwater Management Law (Chapter 500)
- Urban Impaired Streams
- Provision for waiver where local program addresses stormwater

Components of Maine Law

- Basic Standards – Erosion and Sediment Control
- General Standards – Storing and treating the first inch of runoff
- Flooding Standards – Storing and slowly releasing the runoff associated with the 2, 10 and 25 year events
- Urban Impaired Waters

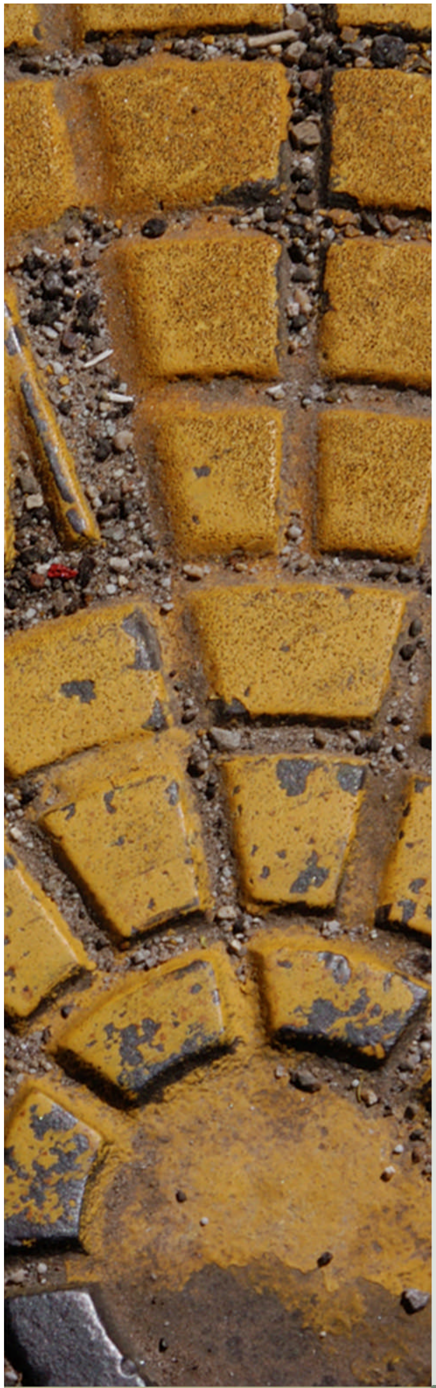
Casco Bay Impaired Waters Are Suburban

A close relationship between impaired waters and stormwater derived from roads and rooftops


2004 Percentage of Subwatershed Covered by Impervious Surfaces
0 - 3
4 - 6
7 - 10
over 10
watershed
boundary
watershed
boundary
watershed
boundary
Sebago Lake
CASCO BAY
N
S
E
W
0
5
10
Miles

Our cities and towns can be hard on Casco Bay

- Developed land pollutants degrade coastal water quality
  - High bacteria counts can close clam flats, swimming beaches
  - Nutrients in runoff affect coastal water quality
    - algae blooms
    - low DO
    - potential fish kills
  - Toxic chemicals accumulate in sediments and marine organisms, especially top predators like Osprey
- (Sub) urbanization triggers loss and reduction in quality of habitat



Status of Casco Bay Clam Flats

- DMR has mapped nearly 11,000 acres of softshell clam habitat and close to 1,300 acres of quahog habitat in Casco Bay
- Slightly less than 2/3 of Casco Bay Flats are usually open for harvest
- Nearly ¼ are permanently closed to harvest

Status of Mussel Cove

- DMR divides Mussel Cove into Inner and Outer portions, managed differently
- Harvesting clams is prohibited in Inner Mussel Cove
  - No single source of bacteria has been identified but the site has a history of high levels
  - Water samples from near Route 1 have shown high bacteria levels
- Outer Mussel Cove is closed seasonally

Project Tasks

- Identification of opportunities for shared runoff management and cost savings.
  - Mapping
  - Evaluation of private and public stormwater management

Project Tasks

- Integration with Route 1 Infrastructure Study
  - Build out Analysis
  - Zoning modifications

Project Tasks

- Enhanced capacity for future commercial growth.
  - Stormwater management on cooperative basis, particularly for flooding criteria.
  - Ordinance and Rule Changes

Project Tasks

- A Roadmap to better water quality in Mill Creek, Mussel Cove and Casco Bay.
  - MDOT Demonstration project


Questions
&
Discussion

TOWN OF FALMOUTH
INCORPORATED 1718
MAINE

WOODARD & CURRAN

Maine Coastal Program

Route 1 Falmouth Commercial District

Stormwater Planning for Long-Term Sustainable Growth

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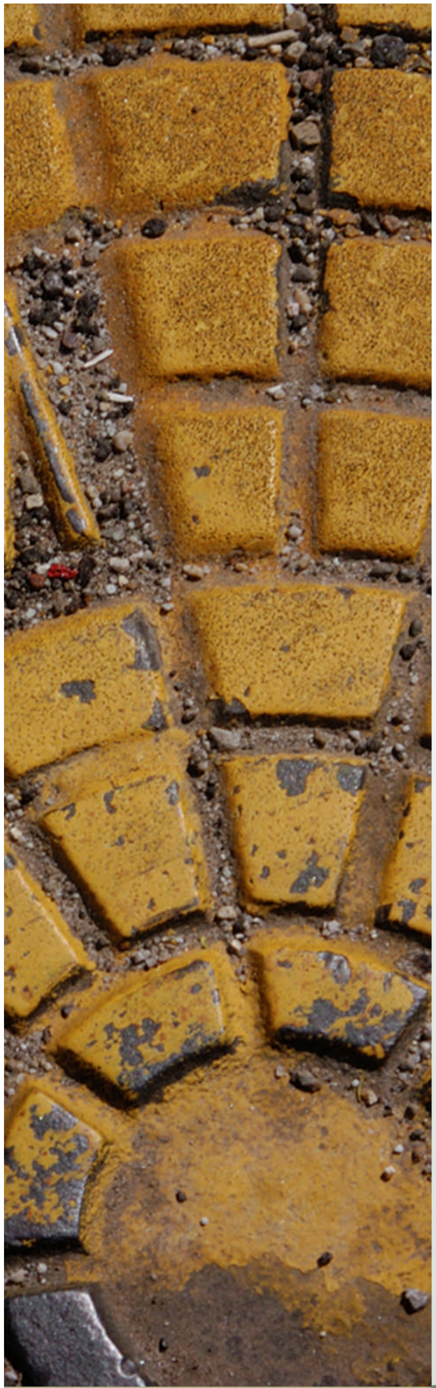

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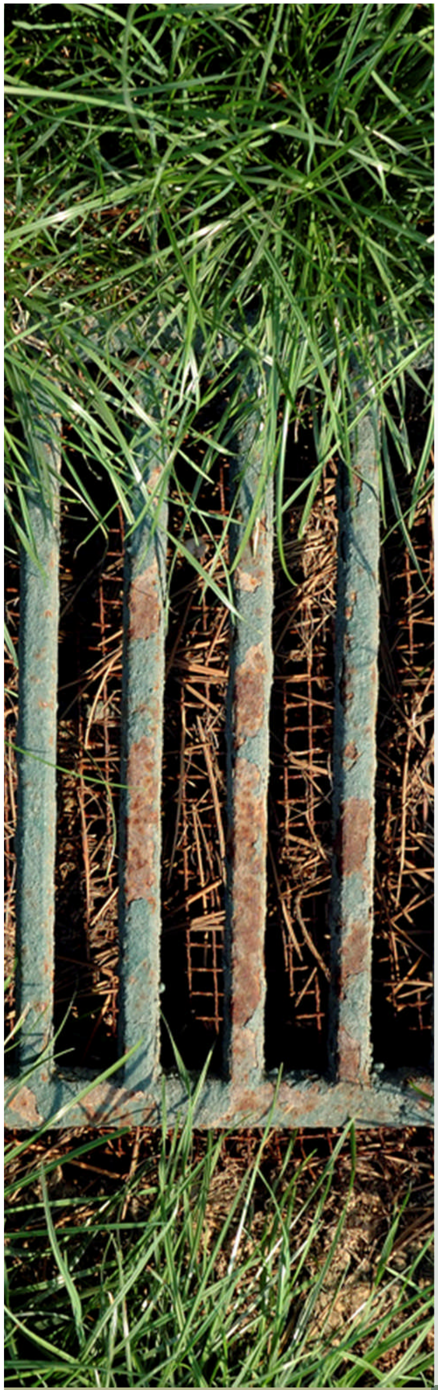

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beneath roadways	→	heaving

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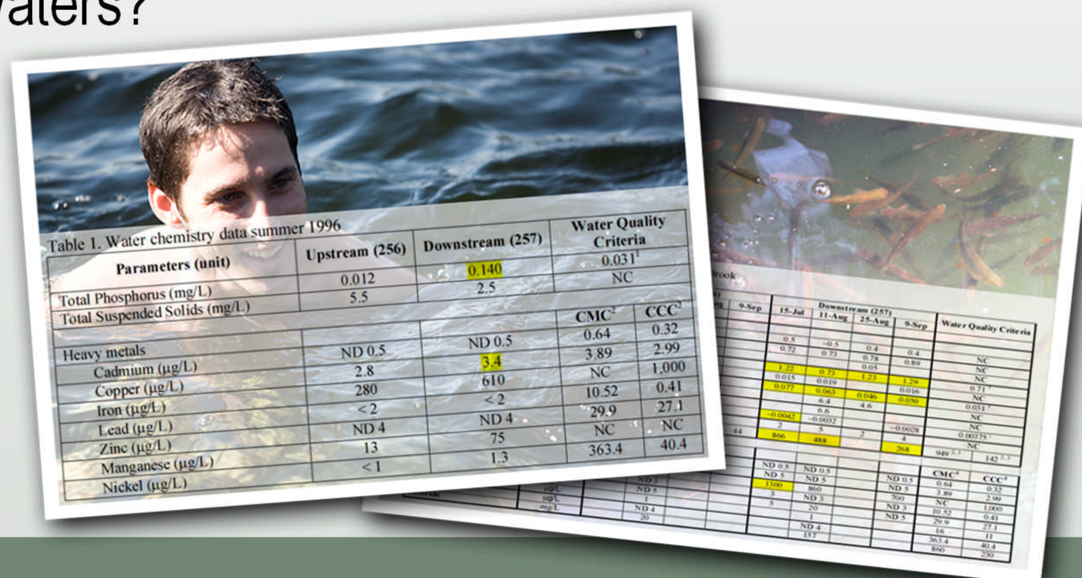

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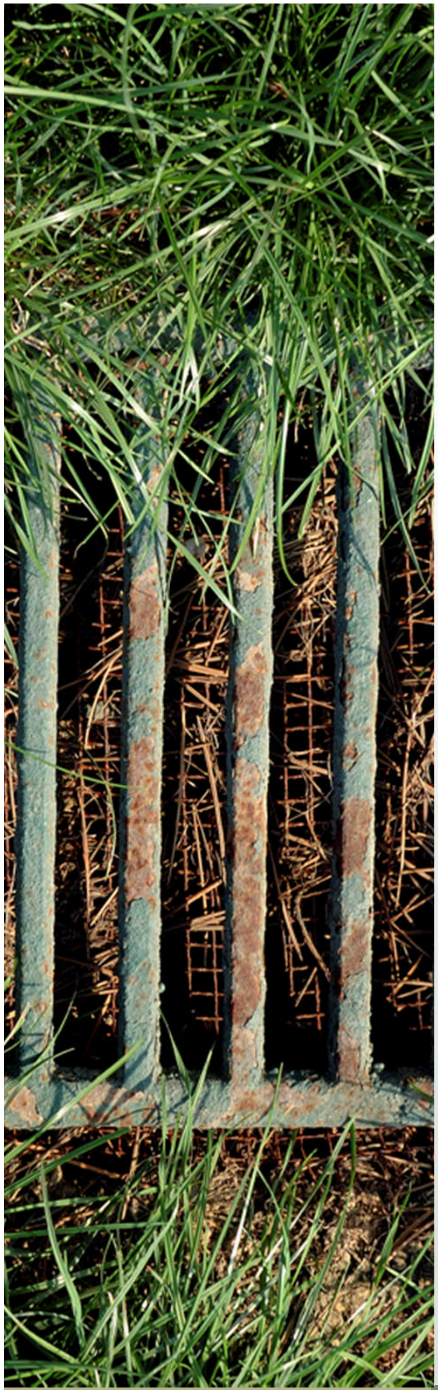

That Storm Drain does **NOT** lead to the Sewer

Water from your toilet and sink flows to the sanitary sewer and on to the treatment plant.

Polluted stormwater enters the drainage system through the storm drains, which drain directly to nearby ponds, rivers and streams. Stormwater is not treated.

Our cities and towns can be hard on Casco Bay

- Developed land pollutants degrade coastal water quality
  - High bacteria counts can close clam flats, swimming beaches
  - Nutrients in runoff affect coastal water quality
    - algae blooms
    - low DO
    - potential fish kills
  - Toxic chemicals accumulate in sediments and marine organisms, especially top predators like Osprey
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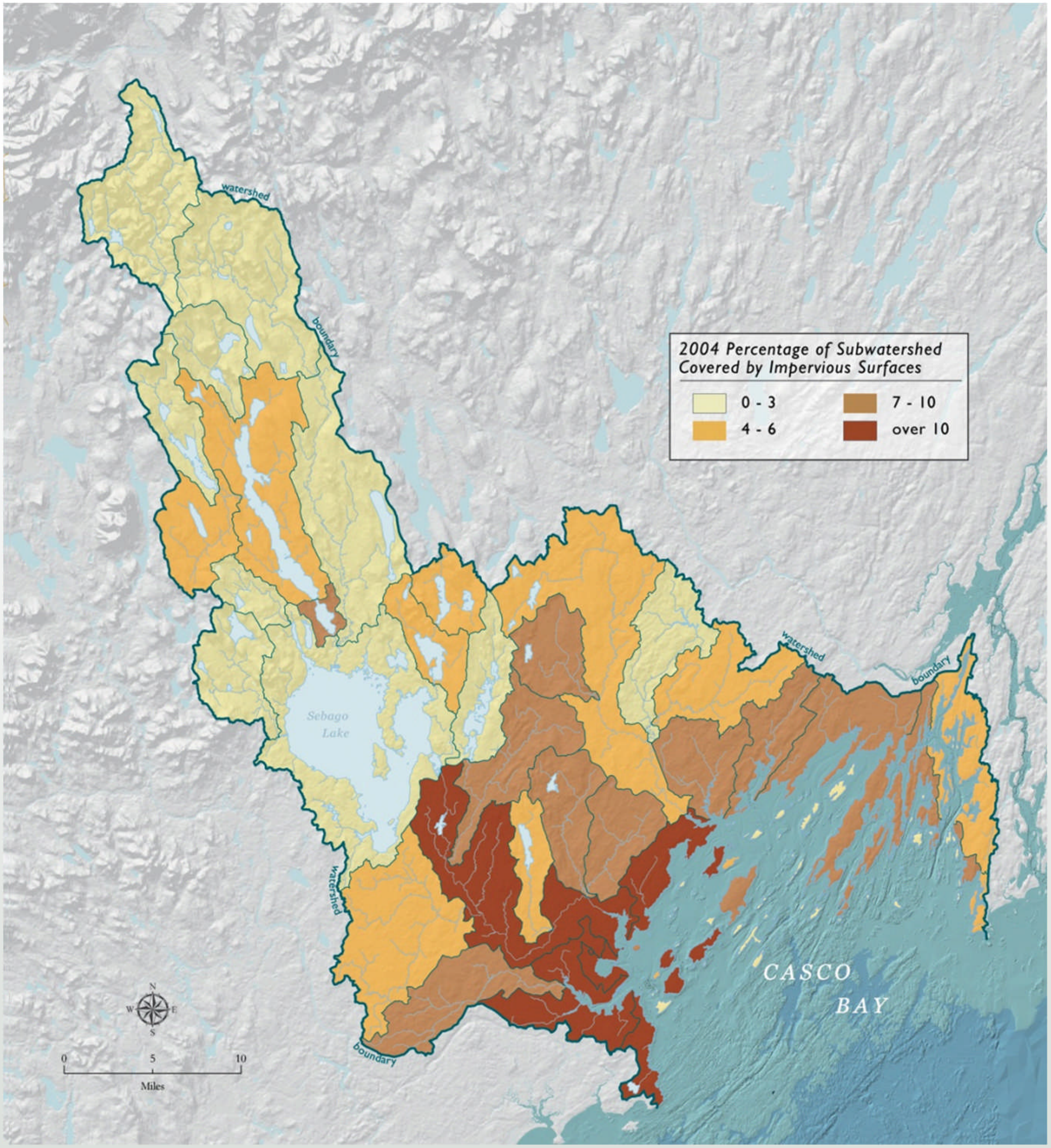
Casco Bay Impaired Waters Are Suburban

A close relationship between impaired waters and stormwater derived from roads, parking areas and rooftops


2004 Percentage of Subwatershed Covered by Impervious Surfaces
0 - 3
4 - 6
7 - 10
over 10
watershed
boundary
watershed
boundary
watershed
boundary
Sebago Lake
CASCO BAY
N
S
E
W
0
5
10
Miles

Project Tasks

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  - Mapping
  - Evaluation of private and public stormwater management
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  - Zoning modifications
- Enhanced capacity for future commercial growth.
  - Build-Out analysis
  - Stormwater management opportunities
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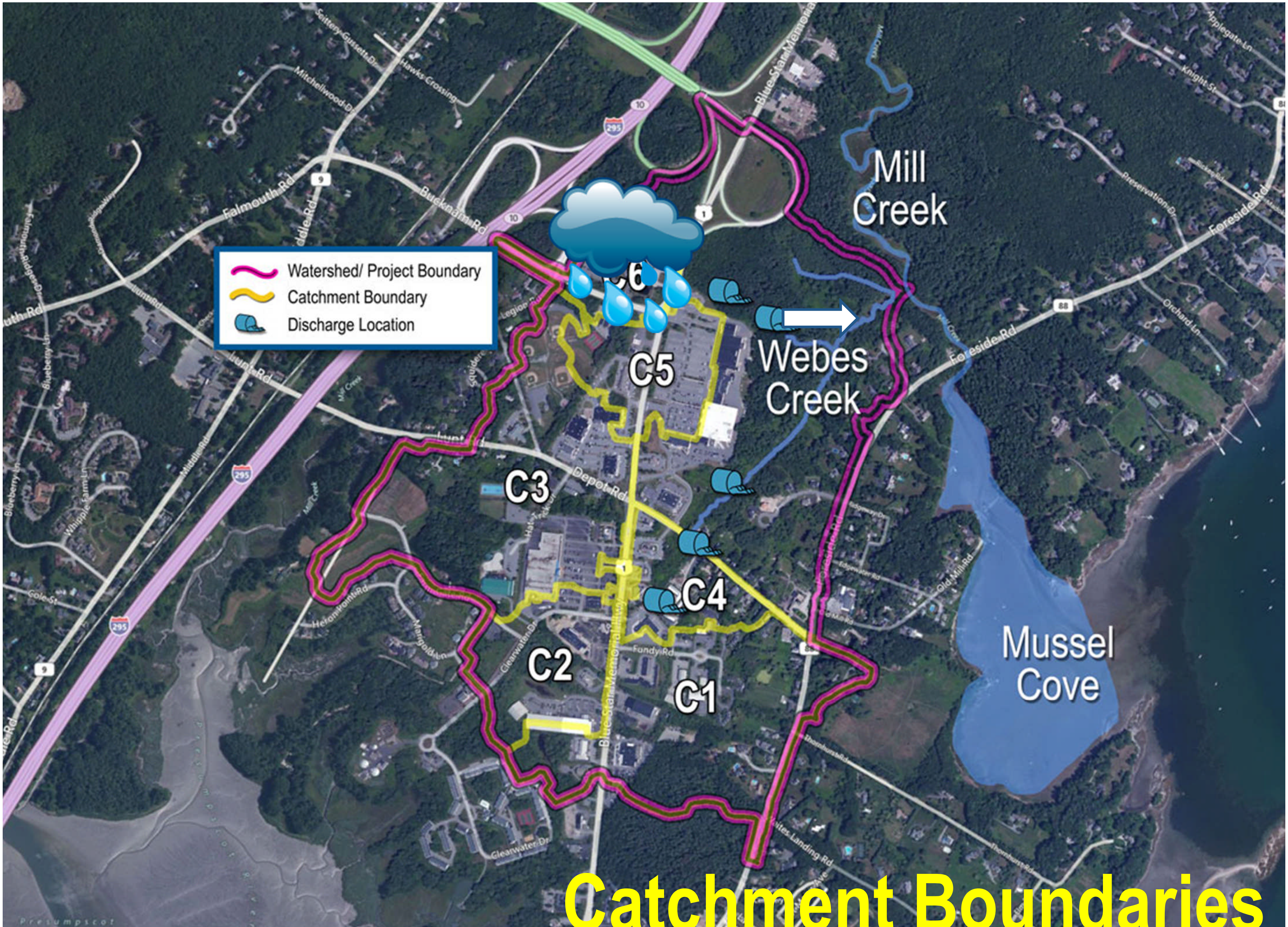
  - MDOT- Town Demonstration project

Webes Creek Watershed



Catchment Boundaries

Existing SW Management

Rite Aid Wetpond

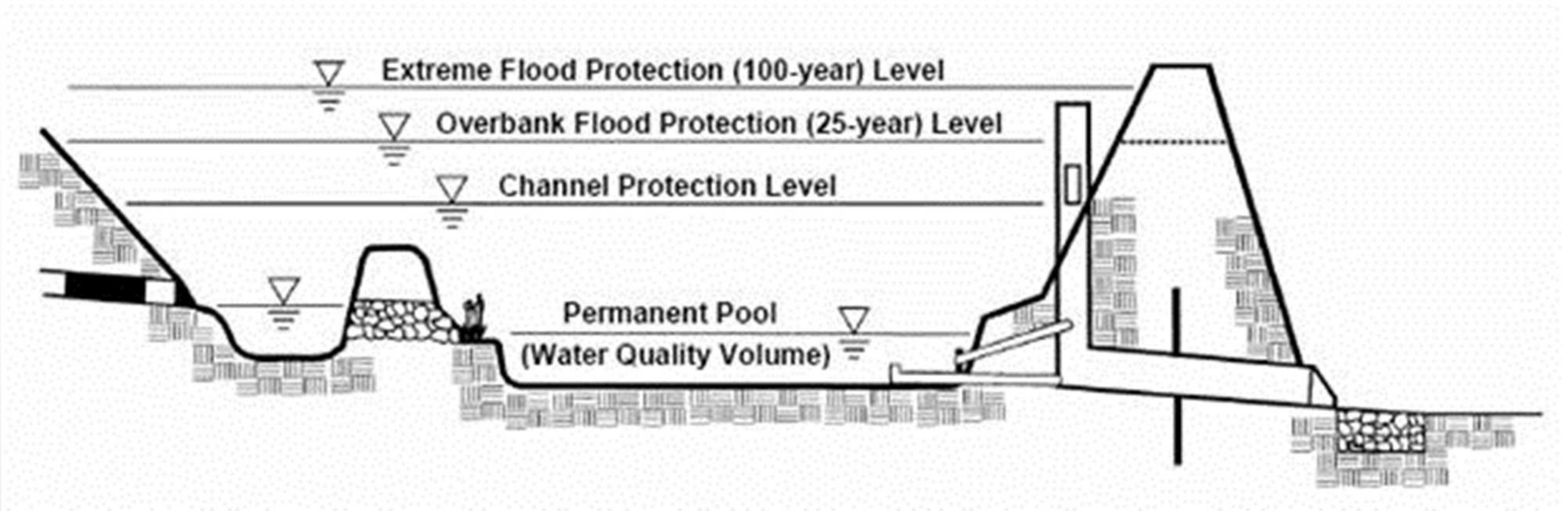
Key Bank Soil Filter

Maine Med Detention Basin

Falmouth Shopping Center Detention Basin

Norway Savings Below-Grade Stormwater Management Facility

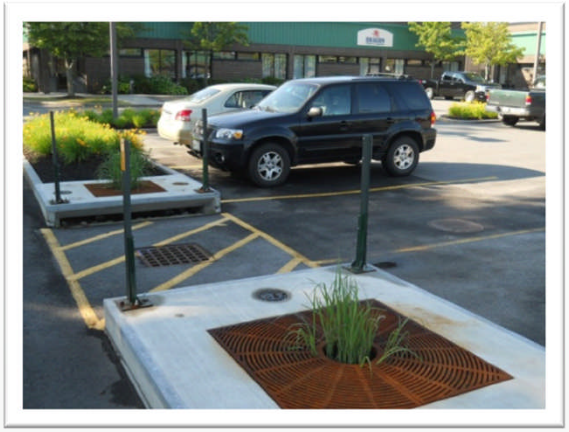
What Do These Systems Do?



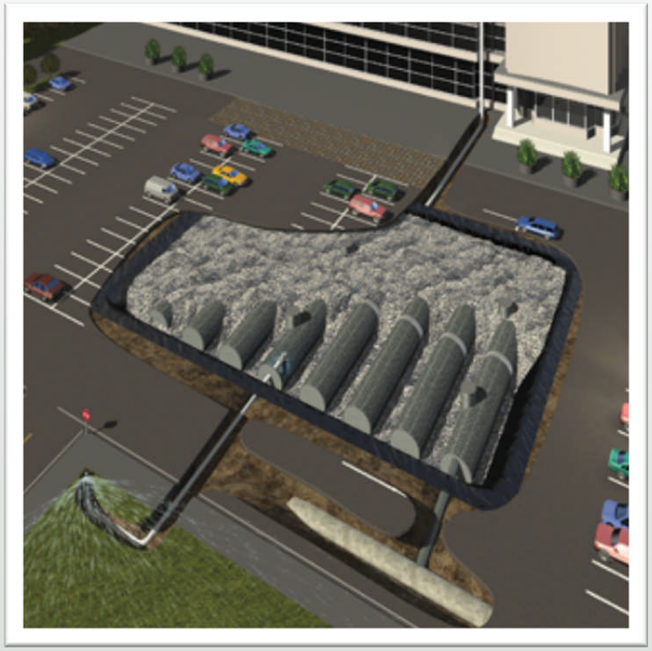
- Water Quality Volume = 1” Rainfall x Area Producing Runoff
- Channel Protection Volume = 2.5” in 24 hrs
- Flooding Protection = 5.5”- 6.7” in 24 hrs

Soil Filter - South Portland

Streetscape Esplanade Filter



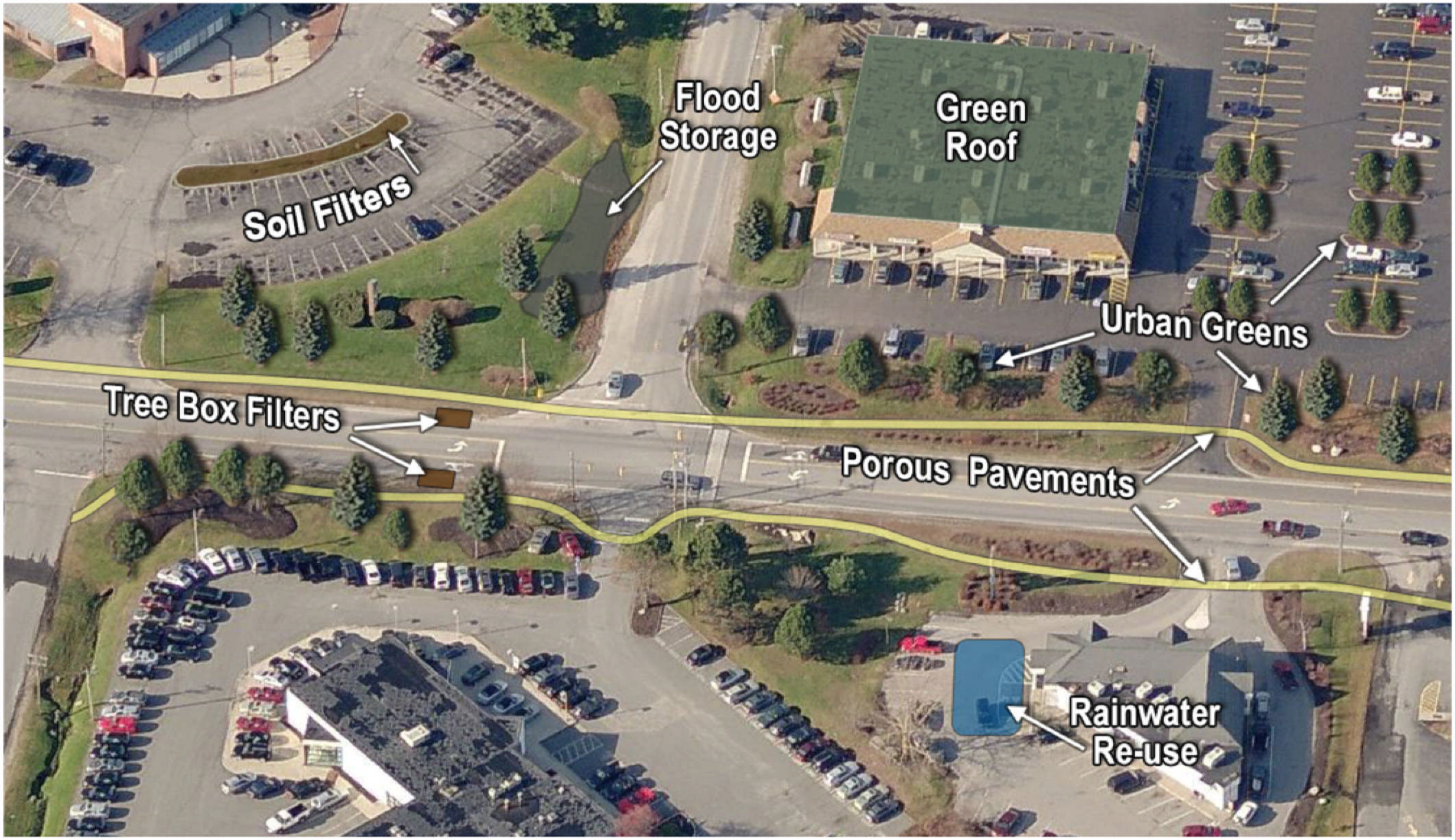
Tree Box Filter - South Portland



Rainwater Harvesting

Sidewalk Tree Filters - Portland

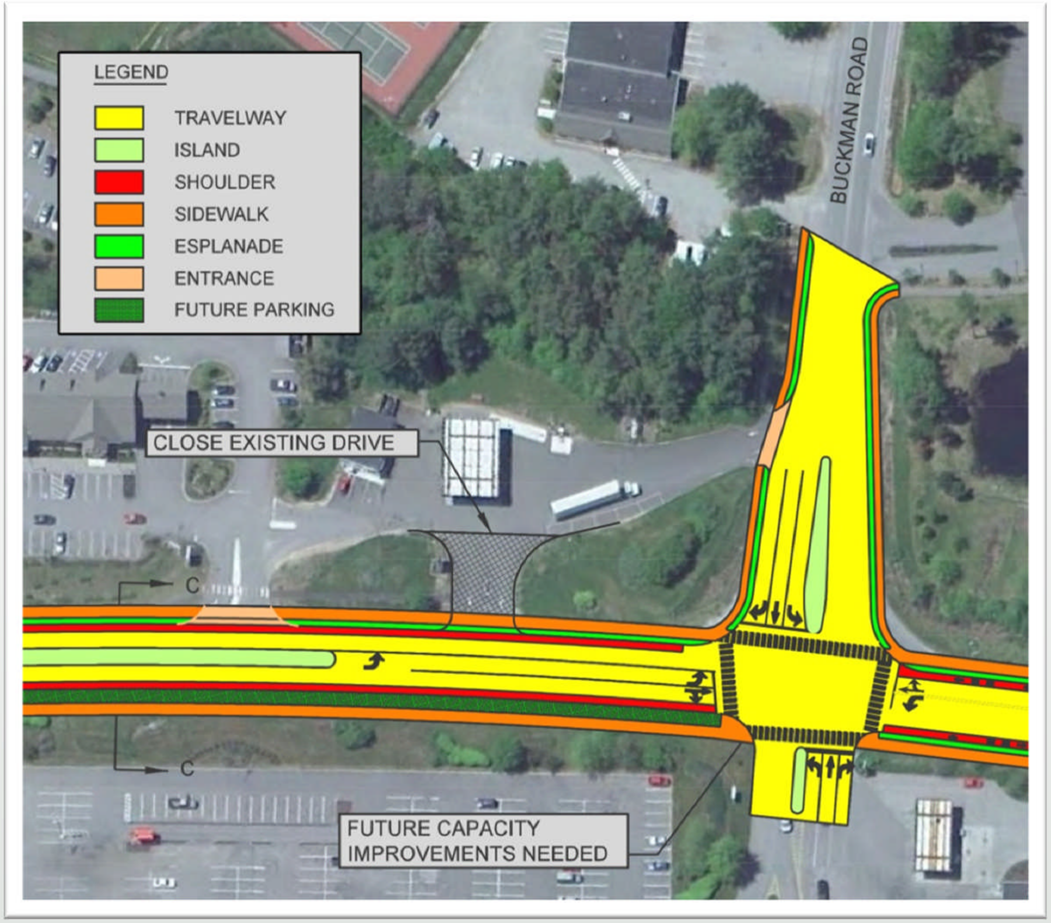
The Future of SW Management Infrastructure



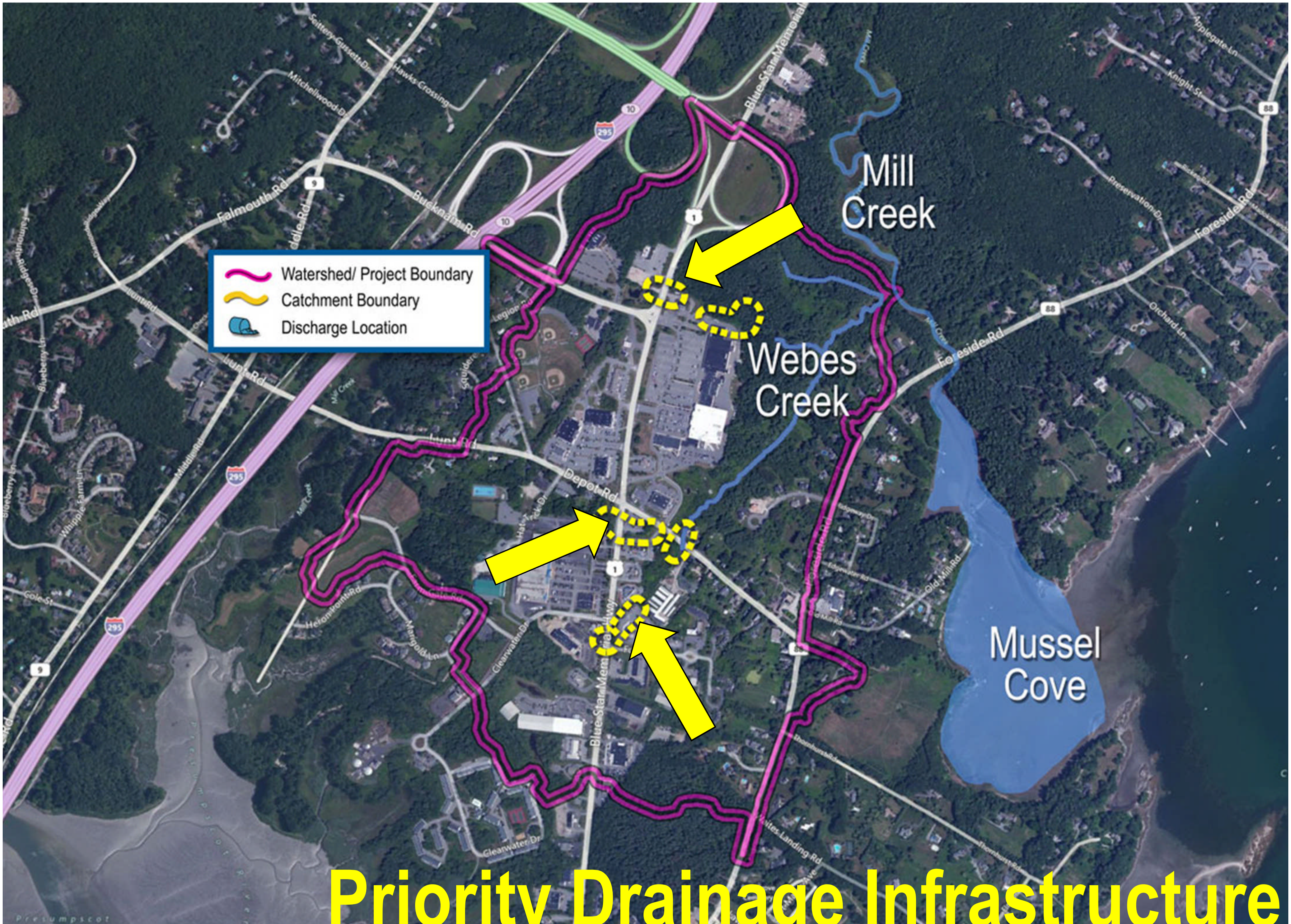
The Future is Expensive….

Stormwater Retrofit Opportunity Area	Possible Stormwater Management Retrofit	Total Construction Cost (+/-)
1. The Falmouth Shopping Center Dry Detention Basin Retrofit	Gravel Wetland Retrofit	**$135,000**
2. The Falmouth Shopping Center Plaza Quality Enhancements	Gravel Wetland/Below-Grade Filter System	**$795,000-$1,315,000**
3. Clearwater Drive Flow Control	Flow Control	**$30,000**
6. The Falmouth Inn Greenspace Retrofit	Gravel Wetland	**$220,000**
10. Bucknam Road Gateway Retrofit	Filtration Swale/Soil Filter	**$210,000-$260,000**
11. Route 1 Roadway Per Unit	Catch Basin Insert/Filter Box	**$35,000-$45,000**[1]
12. The Wal-Mart Plaza Quality Retrofits	Raingarden/ Below-Grade Filter System	**$90,000-$1,305,000**

Integration With Route 1 Study



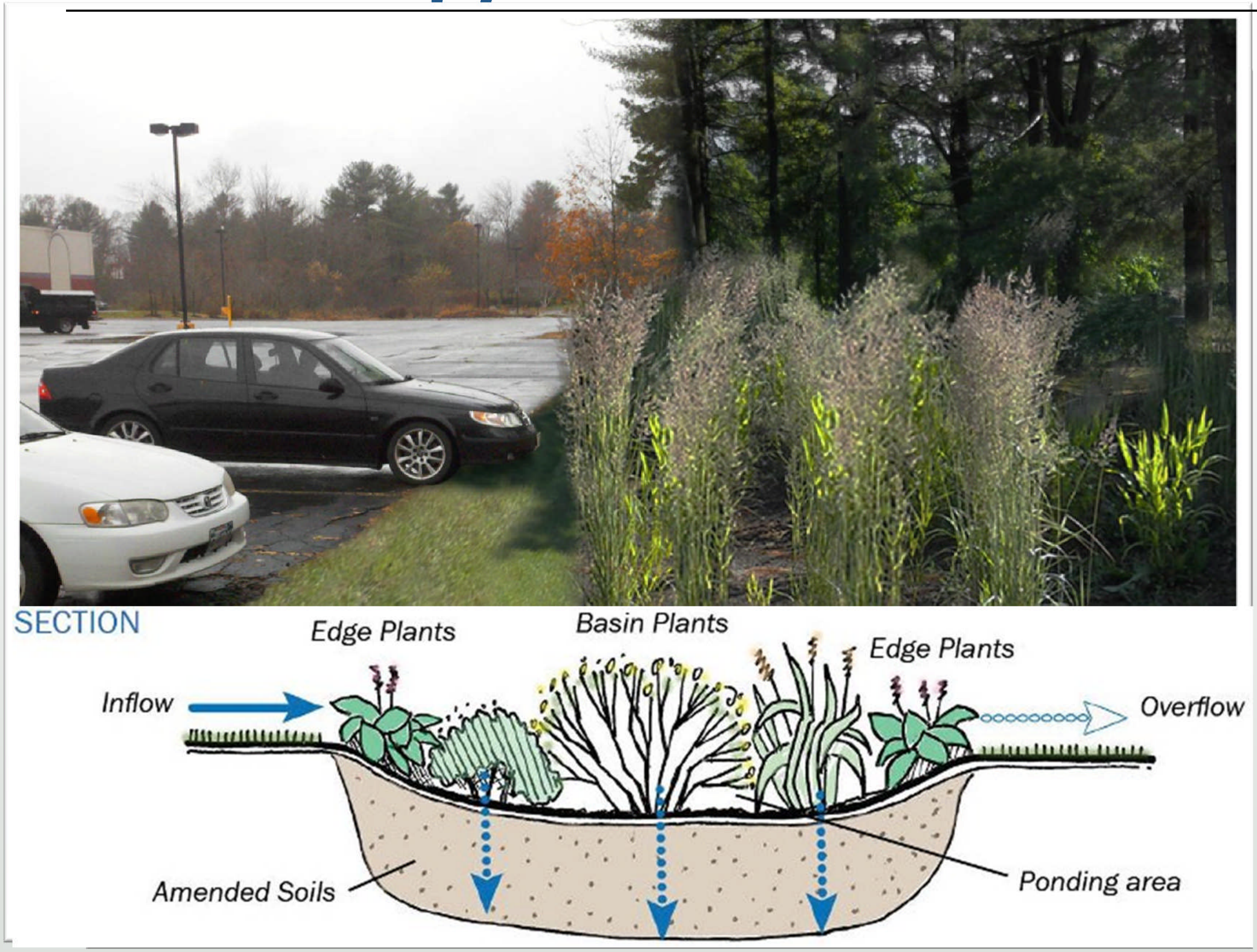
- Where is the priority drainage infrastructure?
- What are the possible impacts from Build-Out?



Priority Drainage Infrastructure

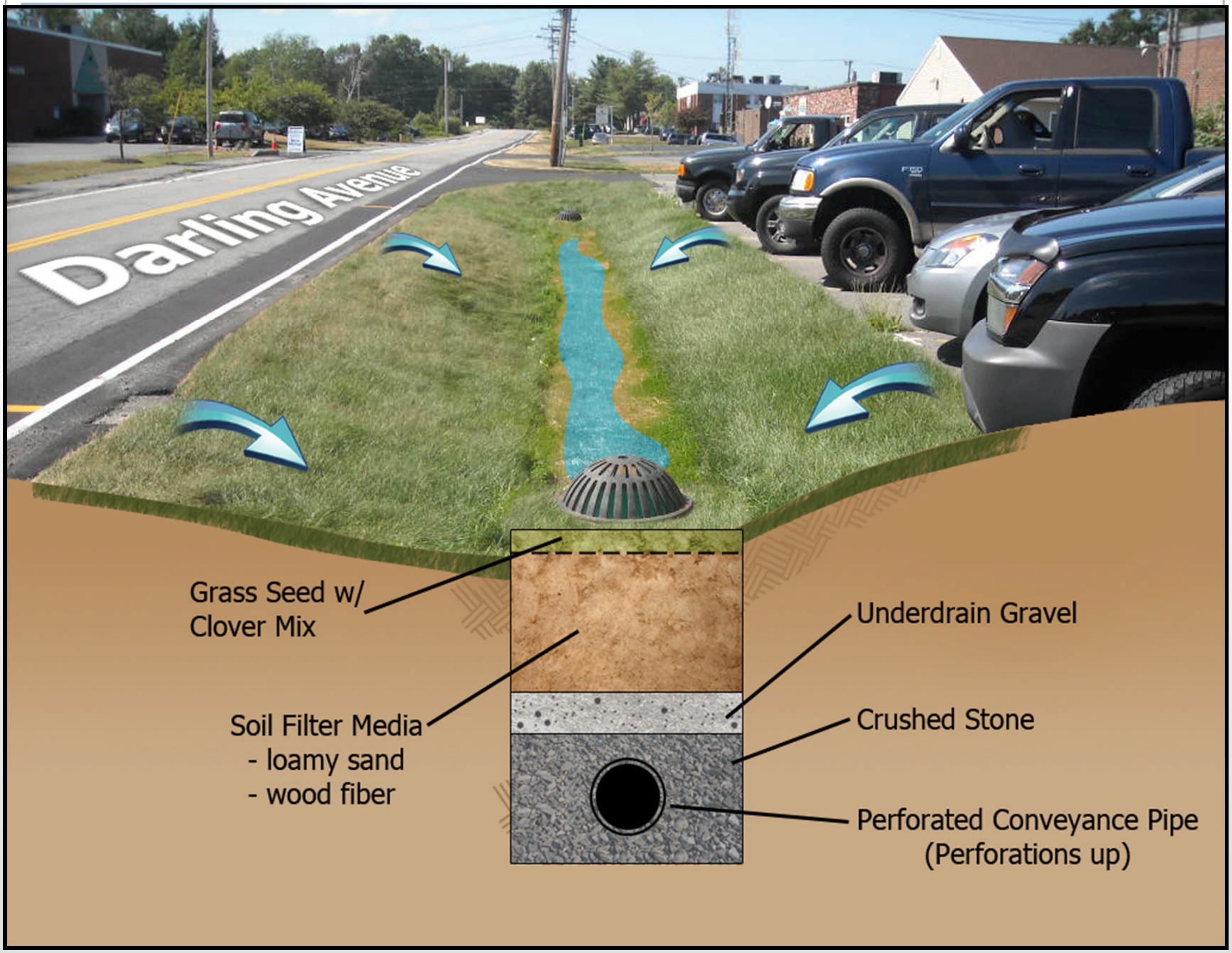
SW Mngt. & Treatment Opportunities

Retrofit Opportunities



Wal Mart Plaza Raingarden

Hat Trick Drive Flow Control



Bucknam Road Gateway

Ordinance Considerations

- Reduce Impediments to Low Impact Development Design and Construction
  - Use of Setbacks for Treatment Zones
  - Flexible Off-Street Parking Requirements
- Overlay District
- Reduced Individual Site Requirements Under A Managed Plan

Funding Considerations

- Special Assessment Districts (TIF)
- Grants and Loans
- General Fund Revenues
- User Fees

Future Opportunities

- Ahead of Regulatory Requirements
- Re-Visioning of Route 1
- Shared Opportunities Often Less Expensive than Site-by-Site
- Shared Private Property Management (Landscaping, Winter Operations, Sweeping)


Questions
&
Discussion

APPENDIX G: TOWN ORDINANCE REVIEW

Improvement Method	Development Friendly	Residential Commercial Universal	Level of Difficulty	Planned for in Route One Zoning for SB1
Zoning Bylaw and Site Plan Review Standards				
Dimensional Requirements				
Permit the location of bioretention areas, rain gardens, filter strips, swales, and constructed wetlands in required setback areas and in buffer strips.	X	u	1	x
Minimize setback distances in residential districts in order to increase flexibility with regard to house location.	X	r	1	na
Permit reduction in frontage (and corresponding road length/paved area) where appropriate, such as in open space residential developments, at the outside sideline of curved streets, and around cul-de-sacs.	X – in current Sec 3.13 could be easier	r	1	na
Establish limits on the extent of lawn area on residential lots, either area or percentage of lot.		r	1	na
Bylaw should establish regulatory controls over tree clearance and removal of mature trees/forest stands.		u	1	??
Open Space Developments				
Permit open space residential developments (cluster development or conservation subdivision design) as a "by right" form of development (no special permit required.) Permit flexible site design criteria such as reduced setbacks and smaller lot sizes.	3.13 already in place, need to adopt amendments as already drafted and allow smaller lots	r		na
Permit construction of LID stormwater management techniques (bioretention, swales, filter strips) on land held in common.	x	U	1	
Parking Requirements				
Permit use of permeable paving for parking stalls and spillover parking areas.	x	C	1	x
Do not require more than 3 off-street parking spaces per 1000 square feet of gross floor area in professional office buildings.	x	C	2	x
Do not require more than 4.5 off-street parking spaces per 1000 square feet gross floor area of shopping centers.	x	C	2	x
Do not require more than 2 off-street parking spaces per single family home.	x	C	2	x

Improvement Method	Development Friendly	Residential Commercial Universal	Level of Difficulty	Planned for in Route One Zoning for SB1
Establish parking maximums.	?	U		?
Establish formulas for the utilization of shared parking for uses with different peak demand periods (e.g., office peak demand period 9am – 5pm; housing peak demand period 6pm – 8am.) Allow reduction of parking requirements if shared parking is proposed. Provide model shared parking agreements that can be included as deed restrictions or permit requirements.	x	C	2	x
Permit stall width of 9 feet or less for a standard parking space.	current	U	1	x
Permit stall length of 18 feet or less for a standard parking space.	x	U	1	x
Recommend or require smaller stalls for compact cars, up to 30% of total number of parking spaces.	Current up to 50%	C	1	x
Establish landscaping requirements for parking areas that include vegetated islands with bioretention functions.		C		
Common Driveways				
Permit the use of common driveways to serve up to four houses, including lots that do not meet standard dimensional requirements.	x	R	1	na
Site Plan Requirements				
Allow bioretention areas, filter strips, swales, and constructed wetlands to count towards to fulfillment of site landscaping/open space requirements.	x	U	1	x
Require driveway width no more than 9 feet.	x	U	2	
Permit use of pervious material for single family driveways (porous pavers, paving stones, pervious asphalt or concrete), and/or use of 'two-track' design for residential driveways.	x	R	1	na
Allow discharge of uncontaminated rooftop runoff to lawn areas and buffers, with level spreader or other velocity reduction mechanism.	x	U	2	
Allow temporary (72-hour) ponding of stormwater prior to infiltration.	x	U	1	
Require development of a stormwater management and erosion control plan for construction activities.	existing	U	2	Need to design new standards
Subdivision Rules and Regulations/Roadway Design Standards				

Improvement Method	Development Friendly	Residential Commercial Universal	Level of Difficulty	Planned for in Route One Zoning for SB1
Street Location				
Considerations for street layout should include reducing street length and minimizing total paved area (including cul-de-sacs), with the goal of protecting site hydrology. Identify the need to reduce cut and fill, do not run streets across steep hillsides, route streets along ridgelines, protect important natural features.		R	2	na
Street Cross Sections				
Permit a minimum pavement width of 18-22 feet on low-traffic local streets in residential neighborhoods. Allow narrower pavement widths along sections of roadway where there are no houses, buildings, or intersections, and where on-street parking is not anticipated.	x	R	1	na
Permit the use of "open section" roadways with roadside swales. Do not require the use of conventional curbs for the full length of all streets in residential neighborhoods. Where curbs are deemed necessary to protect the roadway edge, allow the use of perforated curbs (that allow runoff to flow into swales) or "invisible curbs" (flush with the road surface.)	existing			
Establish criteria for the design of roadside swales to ensure adequate stormwater treatment and conveyance capacity.		R		na
Permit placement of utilities under the paved section of the right of way or immediately adjacent to the road edge (so that the land adjacent to the roadway can be used for swales.)	??	U	2	
Permit use of permeable paving for road shoulders/parking lanes in residential neighborhoods, with use of conventional paving for travel lanes only.		R	1	na
Permit the use of permeable paving for sidewalks.		U	1	??
Permit sidewalk placement on one side of the street only in low-density residential neighborhoods.				
Provide flexibility with sidewalk layout; e.g., alternative pedestrian circulation layout that uses common areas, rather than street rights of way.	x	R		

Improvement Method	Development Friendly	Residential Commercial Universal	Level of Difficulty	Planned for in Route One Zoning for SB1
Sidewalks should be designed so that the runoff is disconnected from the stormwater system. e.g, place a green strip			??	
Site Work				
Encourage developer to limit clearing within the right-of-way to the minimum necessary to construct roadway, drainage, sidewalk, and utilities, and to maintain site lines; do not require clearing and grubbing of entire right-of-way.	X	U	1	??
Require contractors to reestablish permeability of soils hat have been compacted by construction vehicles. For example, contractor can rototill lawn areas prior to seeding to re-establish void space (hence permeability and infiltration) of the soils.		U	1	??
Dead Ends				
Minimize the required radii for cul-de-sacs. A radius of 35 feet is optimal, depending on emergency vehicles.		U	2	??
Allow the creation of landscaped island (and bioretention cells) within cul-de-sacs.	x	U	1	
Permit use of one-way loop streets to eliminate turnarounds.	x	U	1	
Permit “hammerhead” turnarounds instead of cul-de-sacs.	x	U	1	
Wetlands Bylaw and Regulations				
Permit the use of low impact stormwater structures (such as bioretention areas, infiltration trenches, or grass swales) within the buffer zone of (state or local jurisdictional) wetland resource areas, provided the location of these structures is not in conflict with any other setback criteria required by NRPA.	??	U	1	
Department of Building Inspector				
Local plumbing codes should permit the use of harvested rainwater for interior non-potable uses such as toilet flushing.	x	U	2	???