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MEMORANDUM

TO: Retrofit Inventory Project Team
FROM: Zach Henderson, WC and Doug Roncarati, City of Portland
DATE: February 22, 2010
RE: Capisic Brook Restoration and Management Rationale

Enclosures: Subwatershed Figures with targeted catchments, Excerpts from Capisic Brook Flood Control Reevaluation 1999 and Stormwater Management Glossary of Terms

The following memo provides background information and assumptions for the identification of structural and non-structural opportunities in the Capisic Brook watershed. The memo has been subdivided into three primary sections: Previous Recommendations, Existing Conditions and a Structural Retrofit Inventory Strategy.

The watershed is approximately 1400 acres and contains five subwatersheds: the North Tributary, East Tributary, West Tributary, Middle Tributary, and Lower Tributary. Additionally, the Maine Department of Environmental Protection (Maine DEP) has further subdivided the watershed into catchments. Catchments generally represent the land area that discharges stormwater runoff at a discrete location and in sufficient quantity to warrant consideration for further management. Each catchment has a unique identifier as described by the Maine DEP and is included as a label on the figures.

Previous Recommendations: The Capisic Brook watershed has been previously studied for flood control and greenway master planning, in addition to Maine DEP stream studies and other natural resource inventories. This information has been reviewed and compiled in *Section 1 – Introduction* of the Capisic Brook Watershed Management Plan (Plan) and is summarized below. Some of the following recommendations have been implemented. Specific information on the East and West Branch detention basins has been included in the additional materials distributed to the Retrofit Strategy Team.

Infrastructure Improvements

1. Continue separation of the City's CSO system in order to eliminate input of sanitary wastewater into the stream thus significantly reducing nutrient and bacterial loads;
2. Construct the West Branch and East Branch Detention Basins to provide flood control and, if possible, develop the area around the basin to be used for active recreation play fields, and walking and hiking trails.
3. Reduce NPS runoff by replacing impervious cover with pervious material and channeling runoff through treatment/infiltration systems; and
4. Implement the following structural improvements to control overbank flooding:
    a. Extension of the Capisic Pond Dam weir;
    b. Increase conveyance by executing channel improvements as outlined in the DeLuca-Hoffman Flood Control Study;
    c. Install a 4' x 8' box culvert at Capisic Street;

d. Install a 48” diameter culvert adjacent to the existing culvert at Lucas Street;
e. Install a second 3’ x 6’ concrete box culvert at Taft Avenue; and
f. Install a 3’ x 9’ box culvert at Holm Avenue.

Planning and Outreach

1. Implement non-structural strategies to provide long-term improvements, including implementation of Education Stations and other outreach and education, pollution prevention, water quality monitoring, and policy and planning initiatives to reduce the likelihood for pollutants to enter the stream;
2. Increase the dissolved oxygen concentration in the stream through a managed reduction of stream water temperatures and a reduction in the discharge of nutrients to the stream;
3. Physically enhance the riparian zone and area around detention basins, including the replanting of native trees and restoring the natural morphology of Capisic Brook;
4. Develop a periodic maintenance schedule for the Capisic Brook channel system, including review of the channel for erosion and sedimentation, identification of debris accumulation and removal;
5. Reduce sewer system and septic leaks by inspecting and maintaining systems;
6. Utilize a road sweeping program to reduce road sand in stormwater and snow melt runoff during winter months; and
7. Encourage responsible development: Smart Growth and Low Impact Development (LID).

Community and Ecological Value

1. Design and implement a greenway within the Capisic Brook watershed as described in the Greenway Master Plan;
2. Enhance aesthetic value through construction of small bridges over water control structures, interpretive signs, and plant material identification markers; and
3. Modify and dredge Capisic Pond to create an environment suitable for fish and other wildlife after upstream modifications have been carried out.

Existing Conditions: Currently *Section 2 – Existing Conditions* of the Plan is being developed. This section includes an evaluation of current conditions in the watershed, subwatershed and catchments. This evaluation provides a basis for development of the structural retrofit inventory strategy and targeted non-structural management opportunities. Please note: The following tables and text are taken from the current Section 2 and all table references occur in the plan.

Table 2-1: Impervious Area within the Watershed

Impervious Area	Acres	Percentage of Total Impervious Area by Type
Parking	137	31%
Buildings	119	27%
Roads	114	26%
Driveways	47	11%
Sidewalks	15	3%
Cemetery	10	2%
Other	2.2	<1%

In the Capisic Brook watershed, impervious cover is primarily located within residential and commercial areas. These areas comprise the majority of the watershed, with residential and commercial land uses making up 35% and 11% of the watershed, respectively. Other significant land uses include the Evergreen Cemetery and vacant land, which comprise 15% and 12% of the total watershed, respectively. The latter land uses consist of far less impervious area, and are less likely to contribute stormwater runoff during smaller storm events. These less developed lands are also likely to be maintaining the ecological integrity in the upper reaches of the Capisic Brook.

Impervious cover types are often uniquely distributed by land use. Commercial areas in the watershed contain over 66% of all parking areas but only 32% of the rooftop area. Conversely, over 50% of the rooftop area in the watershed is in residential areas. Roadways and driveways are also significant components of the impervious cover in residential areas. Rooftop, roadway, and parking impervious cover can have significantly different stormwater pollutant characteristics and should be considered differently under pollution prevention and management scenarios.

Impervious cover has been evaluated by subwatershed. The breakdown of impervious cover by subwatershed is included in Table 2-2 and is helpful to prioritize watershed improvement activity. The land use within the West Tributary subwatershed is largely commercial and the watershed area is 46% impervious area, with significant parking, roadway and building areas. The North Tributary subwatershed is primarily residential, but has a significant commercial district along Warren Avenue. Nearly half of the land in the Lower Tributary subwatershed is residential and most of the impervious area is roadway and buildings.

Table 2-2: Impervious Area by Subwatershed

Subwatershed	Subwatershed Area (Acres)	Impervious Surfaces (Acres)	Percent of Subwatershed Area covered by Impervious Surfaces	Percent of Subwatershed covered by Parking	Percent of Subwatershed covered by Roadway	Percent of Subwatershed covered by Buildings
West Tributary	339	155.5	46%	21%	11%	11%
North Tributary	370	99.8	27%	8%	6%	7%
East Tributary	220	47.5	22%	12%	3%	4%
Middle	80	17.8	22%	4%	6%	8%
Lower	413	123.5	30%	1%	10%	10%

The MaineDEP has divided the subwatersheds into individual catchments of 135 acres or less. Catchments are a discrete hydrologic unit. The precipitation that falls in a catchment eventually makes its way to a single outfall location. The outfalls may be a pipe or open channel. Catchments are an appropriate scale for recommendations for structural stormwater management.

Each catchment has been evaluated, as a component of this project, to assist in the identification of priority areas for further field evaluation. The percentage of each catchment covered by roadways and parking lots was determined. In catchments where roadways made up greater than 5% and parking greater than 10% of the drainage area were identified to guide further structural field evaluation and are listed in Table 2-3.

Table 2-3: Catchments Identified to Guide Field Evaluation for Structural Stormwater Management Considerations

Catchment ID	Catchment Area (acres)	Roadway Impervious Cover (% of Catchment Area)	Parking Impervious Cover (% of Catchment Area)	Subwatershed Location
M27	40.8	13.6	31.2	East
N1a	2.1	13.8	22.1	North
N3	9.2	15.5	36.0	North
N4	4.3	23.8	54.2	North
N6	4.0	20.8	37.9	North
N7	2.7	29.7	39.5	North
W7	42.3	14.4	10.8	West
W9	82.0	7.6	46.2	West
W10	2.1	17.8	53.2	West

Table 2-7 lists the inventory of roadways within the watershed and whether they are owned by the City, State, private, and the Maine Turnpike Authority (MTA).

Roadways	Linear Feet	Acres
Townway	97,162	80.6
Private	61	N/A
State	25,108	18.8
MTA	15,963	14.9

Structural Retrofit Inventory Strategy:

The objectives of this section of the memo are to define the;

- Structural retrofit inventory process,
- Specific stormwater quality and quantity BMPs that will be considered during the field evaluation, and
- Key assumptions.

Background

In general, the intent of a structural retrofit inventory is to identify specific locations within the study drainage areas that may allow the implementation of stormwater BMPs that have the potential to reduce stormwater volume discharges (i.e. infiltration, evapotranspiration) and/or reduce pollutant loading.

The basic process of the retrofit inventory is to select appropriate structural stormwater management BMPs that minimize impact on existing infrastructure and provide the most efficient use of available space and financial resources.

The structural stormwater retrofit inventory generally follows the guidance of the Center for Watershed Protection's "Eight Step Approach to Stormwater Retrofitting". For the purposes of this project, the term retrofit is used to describe any engineered modification to existing infrastructure or land area(s) in order to improve stormwater quality or quantity runoff from impervious and developed land surfaces.

Retrofit Inventory Strategy

The retrofits identified through this evaluation are intended to provide a planning level evaluation of the likely cost and benefit of "disconnection" of impervious surfaces within the identified drainage areas. Detailed site survey, soil borings/test pits and engineering design will be required for the design, final sizing and installation of any stormwater retrofit.

The following outlines the proposed structural retrofit system types that will be considered during the field inventory. The names of stormwater BMPs vary regionally and the following systems as described are in reference to this study only. Design criteria may vary in other applications in other areas.

The systems identified below represent BMPs that can be utilized in a variety of conditions (e.g. well-drained soils, poorly drained soils, narrow right-of-way, existing landscaped areas, limited hydraulic head, etc.) and that have the potential to provide water quality and quantity benefits.

Soil Filter: Soil filter systems are vertical flow media filters that are typically vegetated with grass and/or landscape plantings. Often these systems are underdrained in poorly draining subsoils but can provide some volumetric losses 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 successful for general pollutant load reduction.

Gravel Wetland: Gravel wetland systems are horizontal flow retention and filter systems. The gravel wetland utilizes temporary storage and settling and soil media filtration as the primary mechanism for pollutant removal. These systems are especially well-suited on poorly draining soils or in locations with limited hydraulic head. This is one of the UNH Stormwater Center's most successful systems for overall pollutant removal. These systems can also provide peak flow attenuation and minor volumetric reductions through evapotranspiration.

Raingarden: Raingarden systems are simple soil-modified depressions that provide settling and infiltration during small precipitation events and for small drainage areas. These systems as described in this study are not underdrained due to site constraints such as limited hydraulic head. These systems are particularly well-suited to residential locations where rooftop runoff discharges via drip edges, roof scuppers, or downspouts to an adjacent vegetated or lawn area. Raingardens would likely provide minor peak flow attenuation and pollutant removal for small storm events with the appropriate design.

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Roof Runoff Storage: Roof runoff storage systems are above-grade cisterns that have the potential for beneficial reuse. In New England climates these systems are only appropriate during the non-winter months. These systems will be selected for sites where rooftop discharge locations are concentrated via exterior downspouts and if there is potential for exterior beneficial reuse of the stored runoff (i.e. adjacent landscaping). Roof runoff storage would likely provide peak flow attenuation and volumetric reductions for small storm events with the appropriate design.

Below-Grade Treatment Train: Proprietary below grade treatment trains are diverse but typically include a physical settling and filtration component. These systems are well suited to stormwater treatment on parcels with limited available surface area. The system considered for this project are the Contech® Hydrodynamic Separation and Filtration. The below grade treatment train is typically an off-line, flow through system and has a defined maximum flow through rate based on filter limitations. The below grade treatment train can provide modest pollutant removals but does not provide peak flow attenuation or overall volume reductions unless designed with upstream storage. For this exercise, this system type will only provide filtration.

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 if stormwater is already routed via below-grade drainage infrastructure. The system considered for this study is a Stormtech™ chamber storage and "isolator row" filtration system. These systems have the potential to attenuate peak flows, provide pollutant removal and can provide volume reductions via infiltration in appropriate locations.

Below Grade Storage with Above-Grade Filter: Below-grade storage with above-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 pervious areas where surface land use limits development of a surface storage system. The above grade filter is preferable to below grade filters for ease of maintenance, but is only applicable with sufficient hydraulic head and "daylighting" opportunity. The system considered for this study is a Stormtech™ Chamber storage and StormTreat™ filter system. This system has the potential to attenuate peak flows, provide pollutant removal and can provide volume reductions via infiltration in appropriate locations.

Esplanade 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 study and range in surface footprint from 24 sf to 91 sf 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 and are connected via underdrain piping. Overflows from the box filters are conveyed to existing drainage infrastructure.

Diversion to Buffer: Diversion to buffer systems are conveyance modifications for surface stormwater in order to promote the disconnection of impervious areas. Other names typically used are turnouts or curb breaks. The turnout to buffer is only identified in areas with sufficient buffer to provide water quality and quantity attenuation. This system is also identified in locations where manipulation of surface flows would be necessary to bring stormwater into an adjacent treatment system. Buffers have the potential to reduce pollutant load through settling and infiltration and reduce peak flows if sufficient soils, grades and depth of buffer is available.

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Assumptions

The following outlines key assumptions, given the objectives of the project and inherent uncertainties related to stormwater management retrofits.

- Structural stormwater BMPs that reduce peak flows and have the potential to provide overall volume reductions, via infiltration and/or evapotranspiration, will be identified as a priority over systems that do not. Each retrofit opportunity location will identify one BMP based on the best professional judgment of the field inventory team.
- Above-grade stormwater management systems are preferable to below-grade systems for ease of maintenance.
- Soil conditions within the study area are primarily Hydrologic Soil Group C and D, which are not ideal for infiltration systems, but infiltration may be possible for small precipitation events (<0.5 inches/24 hours) and in specific locations. This particular precipitation event is typically represented by 80% of all precipitation events.

- Some retrofit opportunities identified in the field will not be feasible due to unknown constraints such as below ground utilities or property owner issues.
- Some inconsistencies may exist between defined drainage area boundaries and actual hydrologic boundaries. All data generated during the GIS analysis will rely on pre-defined boundaries and therefore should be considered for planning level analysis only.
- Certain structural BMPs (i.e. raingardens and roof runoff storage systems) may be generically recommended for residential areas. Site specific evaluation of private residential properties for structural stormwater management is beyond the scope of this project.

Retrofit Inventory Process

Potential retrofit opportunity locations will be identified through preliminary analysis of high-resolution aerial photography and storm sewer infrastructure maps.

The field retrofit evaluation will focus on the identification of underutilized landscape areas adjacent to directly connected impervious areas within the study drainage areas. Retrofit locations identified in this assessment will typically involve the use of underdeveloped or landscaped areas in medians, parcel setbacks or transportation-related Right of Way. The retrofits selected during this evaluation will not typically require a significant adjustment to current land use.

Field evaluation of stormwater retrofit opportunities will be accomplished through the use of digital data collection forms within ArcPAD and Global Positioning System (GPS) Trimble GeoXH equipment. Retrofit locations are identified in the field based on available land area, elevations of adjacent impervious area surfaces and surface slopes and the potential hydraulic head (change in elevation) between surfaces to be treated and proposed outlet inverts. The preferred structural BMP type will be selected for the site and the available surface area for the treatment area will be noted.

Specific site assessment will also consider possible surface constraints, contributing area land use, construction and maintenance access opportunities and potential permitting issues among others.

As a part of data collection, the surface area draining to each retrofit location will be delineated based on 2' contour data and field verification of overland flow paths. Individual drainage areas will be analyzed for percentage of impervious and landscaped areas based on available GIS data.

For this study, ideal water quality volumes (cubic feet) to be retained and treated are considered to be 1" of rainfall depth times the impervious drainage area and 0.4 inches of rainfall times the landscaped area. Each retrofit will be evaluated based on its ability to manage the water quality volume (WQV) and will be attributed with a percentage of WQV managed given available treatment area. In proprietary "flow-through" systems WQV retention is not possible. Manufacturer specified treatment areas will be used as a basis for determining the percentage of flow through rate achievable in the system. An ideal flow rate during the design storm would be 100% of manufacturer specification.