Trout Brook Total Maximum Daily Load (TMDL)

Above Highland Avenue, July 2003

Above Boothby Avenue, September 2003

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September 2007
Report # DEPLW0714

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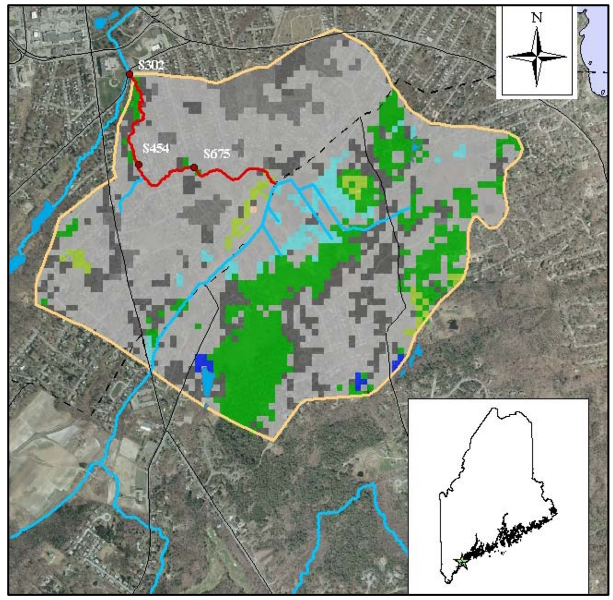
LIST OF ACRONYMS USED

BMP	Best Management Practice
CCC	Criteria Chronic Concentration (for toxic contaminants)
CMC	Criteria Maximum Concentration (for toxic contaminants)
CFUP	Compensation Fee Utilization Plan
CSO	Combined Sewer Overflow
CWP	Center for Watershed Protection
ENSR	ENSR Corporation
GIS	Geographic Information System
IC	Impervious Cover
LA	Load Allocation
MDEP	Maine Department of Environmental Protection
MRSA	Maine Revised Statutes Annotated
NPDES	National Pollutant Discharge Elimination System
MEPDES	Maine Pollutant Discharge Elimination System
NPS	Nonpoint source
PETE	Partnership for Environmental Technology Education
SI	Stressor Identification
SWAT	Surface Water Ambient Toxics
SWQC	(Maine's) Statewide Water Quality Criteria
TMDL	Total Maximum Daily Load
US EPA	U.S. Environmental Protection Agency
WLA	Waste Load Allocation

Trout Brook TMDL
Summary Fact Sheet



Why do a 'TMDL' on Trout Brook?

Trout Brook has multiple water quality problems (stormwater runoff, low dissolved oxygen, high metals concentrations and damaged aquatic life) that violate Maine's water quality standards and is considered impaired under the Clean Water Act. Streams, such as Trout, that do not meet minimum standards, are placed on a list (303d) that legally requires the Maine Department of Environmental Protection to conduct a TMDL assessment. The TMDL describes the impairments, pollutant sources and identifies the measures needed to restore the water. The goal of the Clean Water Act, and the TMDL, is for all waterbodies to comply with the state's water quality standards.

Description of the Watershed-

Under Maine's water quality statutes Trout Brook, is designated as Class B in Cape Elizabeth and class C in the South Portland segment. Trout originates in a wooded area west of Spurwink Avenue and then flows northward through mostly residential development with some agriculture and commercial development before entering Mill Cove, Portland Harbor, and Casco Bay. The portion of the stream subject to TMDL assessment is 2.9 miles in length with a watershed of ~970 acres in Cape Elizabeth, ~730 acres in South Portland.

Sampling Results & Stressor Identification-

The Trout Brook TMDL is based on sampling data collected from 1997 through 2004 which includes monitoring of the aquatic insect (macroinvertebrate) communities, physical habitat measurements and water chemistry. Sampling results and other existing data were compiled into a comprehensive report on Trout Brook entitled *'Urban Streams Nonpoint Source Assessments in Maine'*. Results were compared to Maine's Class C water quality standards to determine attainment in the impaired South Portland segment.

Sampling Results

Parameter	Years	Sampling	Results
Macroinvertebrates	1997-2004	8 events	Met Class C in 1999, 7 samples were non-attainment
Dissolved Oxygen	2003	~10 days	>50% of samples did not meet 5mg/l standard
5 Different Metals	2003	5 events	Exceeded Metals Criteria, likely as a result of the Combined Sewer Overflow (CSO)
Habitat Assessment	2003	Survey	Geomorphology identified problems with riparian buffer, entrenchment, channelization and bank stability (erosion).

Low flow above Boothby Avenue

These results describe the impairments but do not necessarily indicate the source or reason for the problems. MDEP undertook the Stressor Identification (SI) process determine the cause of the observed problems and guide the TMDL model selection. The SI was a collaborative effort of many water quality professionals in which urban stormwater emerged as the underlying cause of impairment. As summarized below, increased flow off of impervious surfaces; carries toxics and nutrients, destabilizes the stream channel, alters habitat suitability and elevates water temperatures. Streams with greater than 10% impervious cover in the watersheds (Trout has ~15%) have documented biological impairments in Maine and throughout the country. These impacts are attributed to changes in the stream environment due to the increased flow volume associated with stormwater runoff.

Stressor Identification Results

Stressor	Rating	Stormwater Sources	Other Likely Sources
Presence of toxic contaminants	**High**	• Impervious Surfaces Runoff • Winter Road Sand/Road Dirt • Sewage Input from CSO	• Agriculture Runoff • Sewage System Leaks • Natural Sources
Impaired Stream Habitat, Riparian Cover, & Altered Hydrology	**Medium**	• Impervious Surfaces Runoff • Stormwater Drain Outfalls • Increased Stormwater Volume	• Reduced Riparian Buffer
Low Dissolved Oxygen	**Medium/ Low**	• Sewage Input from CSO • Channel Modifications • Nutrient Enrichment	• Low Channel Gradient • Perched Water Table

<u>TMDL Model Selection</u> –

The next step was finding an appropriate model to connect water quality parameters to impervious cover. The % Impervious Cover Method was selected because it: connects stormwater runoff to instream effects, links TMDL targets to instream reductions, uses relatively easy calculation methods, and ties to engineered BMP solutions. Trout also receives stormwater input from a Combined Sewer Overflow (CSO) that was scheduled for removal during the time this TMDL was being developed, so it was not included in the TMDL model selection or calculations.

<u>Required TMDL Elements & Impervious Cover Modeling Results</u> –

The % Impervious model sets up targets and reductions for the runoff from existing impervious surfaces. The TMDL reports contains elements required by the Clean Water Act, which are summarized in the next table along with the model results. The target will be achieved, not through removal of pavement, but through the application of BMP's to create runoff conditions that resemble the characteristics of an 11% impervious area. Regardless of the target, the ultimate goal is attainment of water quality standards, and the target provides technical guidance to initiate a strategy for BMP implementation. BMP implementation will be directed by a


Stormwater above Boothby Avenue

Watershed Management Plan that is developed by watershed stakeholders. The TMDL goal will be met once the existing stormwater pollution has been adequately addressed and the biological community is restored.

Required TMDL Elements & Impervious Cover Modeling Results

TMDL Element	Clean Water Act Definitions	Trout Brook Findings
Goal	Achieve water quality consistent with Maine's Class C standards	A biological community consistent with Maine's Class C standards, attainment of the goal takes precedence over the target
Target	Loading capacity of pollutants that cause observed impairments or a means predicted to attain the goal	A watershed that resembles the stormwater runoff characteristics of a watershed with 11% Impervious Cover (%IC)
Margin of Safety (MOS)	Water quality targets are variable and the MOS adds a safety factor to increase the likelihood of attainment	Analysis of Maine's Biomonitoring data indicate that 11% IC would achieve the goal, therefore a 2% reduction was added to insure a MOS
Pollutant Loads	Estimate of the existing pollutant loads	9% IC (conservative estimate) and the associated components of stormwater runoff such as volume and nutrients
Load Allocation & Waste Load Allocations	Reductions in the pollutant loads that are required to achieve the water quality target	18% reduction in volume and stormwater constituents are needed to achieve the target
Implementation	Actions or engineered BMP solutions that will achieve the reductions and ultimately restore the Stream	Reductions will be guided by a Watershed Management Plan developed by community stakeholders to determine the relative contributions of each subwatershed and the best approach to solutions

Definitions-

- **TMDL** *is an acronym for* ***Total Maximum Daily Load****, representing the total amount of a pollutant that a waterbody can receive annually and still meet water quality standards.*
- **Stressor** *refers to pollutants or altered habitat conditions responsible for a stressful or negative response in the resident biological community.*
- **Stressor Identification** *is a systematic review of accumulated data and knowledge, which then rate biological stressors to identify the cause of significant problems.*
- **Impervious Cover** *refers to landscape surfaces covered by pavement or buildings that no longer absorb rain and may direct large volumes of runoff into the stream.*
- **BMPs or Best Management Practices** *are engineered solutions or techniques designed to reduce the impacts of pollutants and the altered flow associated with stormwater runoff.*

PART I: WATERBODY DESCRIPTON, IMPAIRMENTS, TMDL TARGET, AND BMP IMPLEMENTATION RECOMMENDATIONS

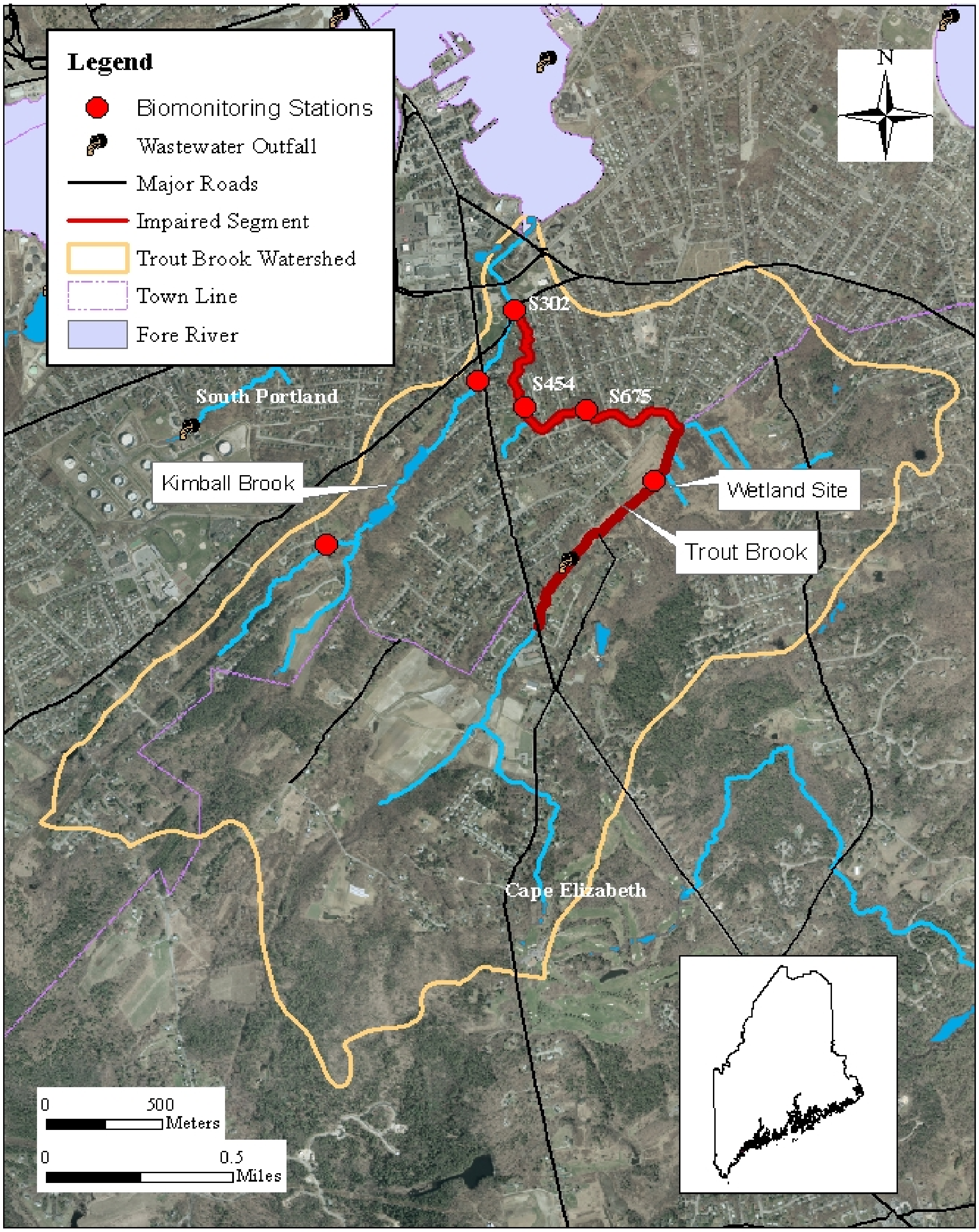
1. DESCRIPTION OF WATERBODY

Description of Waterbody and Watershed

Trout Brook (Fig. 1) is located in Cape Elizabeth and South Portland (southern Maine, 43°37'N, 70°15' W, HUC ME0106000105), and is of moderate length (~2.9 miles) and watershed size (~970 acres in Cape Elizabeth, ~730 acres in South Portland). The stream consists of a mainstem with headwaters located in a woodland west of Spurwink Avenue near Valley Road. From there, Trout Brook flows northward through mostly urban development with some agriculture and commercial development into Mill Cove, Portland Harbor, and Casco Bay. There are three tributaries to Trout Brook: the most upstream one enters the stream near the headwaters, the middle one enters it just upstream of Mayberry Street, and the most downstream one, Kimball Brook, enters Trout Brook immediately below the Highland Avenue bridge (Fig. 1). The entire watershed is classified as a "regulated area" under the NPDES Phase II Stormwater Program. Appendix A contains a set of photos of the stream.

The impaired section of the stream runs from Ocean Avenue, at the South Portland – Cape Elizabeth town line, to the Highland Avenue bridge in the lower part of the watershed (immediately downstream of biomonitoring station S302; Fig. 1). The lower portion of the impaired stream (below Sawyer Avenue) flows through dense residential development. This second-order portion of the stream largely has a wetted width of 2-3.5 m during summer baseflow conditions and a bankfull width of 4-6 m. Water depth in the summer is mostly 5-8 cm with some deeper areas. Parts of the stream were channelized in the past, resulting in an overwidened channel with little sinuosity. The stream bed is composed predominantly of rubble (40-45 %) with some gravel (20-25 %) and sand (20-35), and a few boulders (5-10 %). The morphology of this low-gradient stream is a riffle-run system with some pools. The riparian buffer consists largely of narrow (~10 m) wooded areas with an understory of herbaceous plants and ferns but lawn and the invasive Japanese Knotweed (*Polygonum cuspidatum*) have replaced the natural buffer in several areas. In the upper half of the watershed, above Sawyer Street, the riparian buffer consists of grassland, some wooded areas, and agricultural fields.

Fig. 1. Trout Brook watershed, impaired segment, and location of biomonitoring stations.



Impaired Stream Segment

The Class C portion of Trout Brook was included in Maine's 2002 and 2004 303 (d) lists (MDEP 2002b, 2004b) of waters that do not meet State Water Quality Criteria (SWQC). The original 303 (d) listing was based on a preliminary stream assessment and sampling results from the MDEP's Biological Monitoring Program (see Description of Impairments, below). Although the most currently approved 303(d) list for 2006 indicates the full 2.93 mile length of Trout Brook as impaired, the actual impaired length of the stream is limited to the segment from the Highland Avenue Bridge to Ocean Avenue (1.8 miles in length) (see Fig. 1). This impaired segment is Class C because it is a minor drainage in South Portland, and minor drainages in South Portland are specifically listed as Class C [38 MRSA §468 (1)(D)].

This TMDL does not apply to the following two portions of Trout Brook. First, the lowest reach of Trout Brook is excluded from the TMDL because additional data collected in 2003 indicated that the stream reach below the Highland Avenue bridge experiences saltwater intrusions from Mill Cove in Portland Harbor (PETE/MDEP 2005), and Maine's macroinvertebrate-based biological determination of classification attainment. Second, the TMDL does not apply to the upper-most portion of Trout Brook, a Class B segment located in Cape Elizabeth. MDEP has no data to indicate impairment, and the presumption of attainment in the upper watershed is supported by the presence of Brook trout (found during the urban stream project sampling), healthy wetland indicators, and a land-use mix of residential and undeveloped woods.

2. DESCRIPTION OF THE APPLICABLE WATER QUALITY STANDARDS

Maine State Water Quality Standards

Water quality classification and water quality standards of all surface waters of the State of Maine have been established by the Maine Legislature (Title 38 MRSA 464-468). According to Maine's Water Classification Program, the impaired segment of Trout Brook is classified as Class C (see Part I, section 1), and the applicable water quality standards are shown in Table 1. In order for a waterbody to attain its classification, all criteria must be met. The Maine Legislature also defined designated uses for all classified waters, which state that "Class C waters shall be of such quality that they are suitable for the designated uses of drinking water supply after treatment; fishing; recreation in and on the water; industrial process and cooling water supply; hydroelectric power generation, except as prohibited under Title 12, section 403; and navigation; and as habitat for fish and other aquatic life."

Table 1. Maine water quality criteria for classification of Class C streams (38 MRSA § 465).

Numeric Criterion	Narrative Criteria	
Dissolved Oxygen	**Habitat**	**Aquatic Life (Biological)**
5 ppm; 60% saturation	Habitat for fish and other aquatic life	Discharges may cause some changes to aquatic life, provided that the receiving waters shall be of sufficient quality to support all species of fish indigenous to the receiving waters and maintain the structure and function of the resident biological community.

Antidegradation Policy

Maine's anti-degradation policy requires that "existing in-stream water uses and the level of water quality necessary to sustain those uses, must be maintained and protected." (For designated uses of a Class C stream see previous section.) Additionally, MDEP must consider aquatic life, wildlife, recreational use, and social significance when determining "existing uses".

3. IMPAIRMENTS AND STRESSORS OF CONCERN

Detection of Impairments

Maine has an ongoing biological monitoring program within the MDEP, as well as biological criteria for the different classes of rivers and streams in Maine (38 MRSA § 465). The biomonitoring program uses a tiered approach to protecting aquatic life uses, and assesses the health of rivers and streams by evaluating the composition of resident biological communities (mainly benthic macroinvertebrates), rather than (or sometimes in conjunction with) directly measuring the chemical or physical qualities of the water (such as dissolved oxygen levels or concentrations of toxic contaminants)[1]. This biological assessment approach is extremely useful, especially for small streams impaired by stormwater runoff and the mix of associated pollutants, because benthic organisms integrate the full range of environmental influences and thus act as continuous monitors of environmental quality.

Description of Impairments

Maine's 2002 and 2004 303 (d) lists (MDEP 2002b, 2004b) note "Aquatic life"[1] as the impaired use for Trout Brook with "Urban NPS" as the potential source for the impairment. This assessment was based on data collected by the MDEP Biomonitoring unit on macroinvertebrate communities in the South Portland (i.e., Class C) portion of the watershed in four different years (Table 2). In five out of the six sampling events, the aquatic life criteria for a Class C stream were not attained. In addition, in 2004, samples collected at two stations did not attain Class C criteria (Table 2). Monitoring results were documented in the MDEP's SWAT (Surface Water

[1] Note that all of Maine's water quality standards have to be met for a waterbody to attain its classification.

Ambient Toxics) Program Reports (MDEP 2000, 2001a, 2002a, 2004a) as well as in the Urban Streams Project Report (PETE/MDEP 2005).

Table 2. Sampling results from MDEP's Biological Monitoring Program (upstream to downstream).

Station #	Location	Sampling Result	Years Sampled
S675	~100 m above Boothby Avenue (upstream)	NA*	2003, 2004
S454	~80 m from end of Mayberry Street (middle)	NA*	2000
S302	~20 m above Highland Avenue (downstream)	NA*	1997, 2000, 2003, 2004
		Class C	1999

* NA, Non-Attainment, i.e., the minimum requirements of Class C were not attained.

Stressors of Concern and Their Sources

To better understand urban impairments and their specific stressors, in 2003 MDEP launched a special project to collect a large amount of biological, chemical, and physical data throughout four urban watersheds, including the Trout Brook watershed. The data collected under the "Urban Streams Nonpoint Source Assessments in Maine" project, or Urban Streams Project (PETE/MDEP 2005), were analyzed during a series of Stressor Identification (SI) workshops held in May and June 2004. For Trout Brook, the SI analysis confirmed overall urban development as the primary factor responsible for stressors directly or indirectly linked to aquatic life impairments.

No discreet non-stormwater point source of pollution was identified in the Trout Brook watershed although there are four stormwater outfalls that discharge into the stream, and a single combined sewer overflow (CSO) in the middle part of the watershed that was removed in 2005 (D. Pineo, City of South Portland, pers. comm.). Following is a list of the five stressors that were identified in the stressor identification analysis as major factors causing the impairment at one or both stations, and the data this determination was based on. Sampling results are extensively documented in the Urban Streams Report (PETE/MDEP 2005); sampling methods and information on the SI analysis are provided in Chapter 2 of the report.

Stressor 1: Presence of toxic contaminants

During stormflow conditions, aluminum, copper, and zinc exceeded the SWQC CMC (Criteria Maximum Concentration). The role of toxicants as a stressor was also indicated by high conductivity levels in the stream and signals from the macroinvertebrate community. One "toxic contaminant" that was monitored indirectly (by way of continuous conductivity measurements) is saltwater that entered the stream at the downstream station in saltwater intrusions during high tide events in Portland Harbor. A maximum conductivity of 35,000 µS/cm was recorded, corresponding to a salinity of ~27 ppt (ocean salinity is ~32-35 ppt). This is a natural phenomenon at the downstream location on Trout Brook and cannot be remedied.

Stressor 2: Impaired instream habitat (upstream station only)

A geomorphological survey found low sinuosity and channel overwidening as a result of extensive channelization (60 % of total stream length; Field 2003). High flow volumes and their effects were observed near this station after storm events (Appendix F, Fig. 7).

Stressor 3: Impaired riparian habitat (downstream station only)

No qualitative data exist for this stressor but an absence or reduction in width of the riparian buffer was observed in places near the downstream station (Appendix F, Fig. 12).

Stressor 4: Altered hydrology (both stations)

Land use analysis showed that ~15 % of the impaired watershed consists of impervious areas (see Part II, section 3) which may lead to numerous changes in watershed hydrology. A geomorphological survey (Field 2003) found evidence of channelization which can affect natural flow patterns (Appendix F, Fig. 9).

Stressor 5: Low dissolved oxygen (upstream station only)

Instantaneous and continuous data of DO concentrations collected in the summer of 2003 were below the required level of 5 mg/L on several occasions (see Fig. 2 for diurnal DO data). Discussions with a MDEP geologist and a DO profile collected above this station suggest that the decreased concentrations at this station are caused by an input of (perched) groundwater and can be considered to be partly natural. However, channel modifications and sewage input from a CSO probably also contributed to reduced DO concentrations.

Table 3 lists the likely and possible sources responsible for the stressors identified during the stressor identification analysis. Some identified sources (italicized in Table 3) represent natural conditions, while several sources (highlighted in Table 3) are related to watershed imperviousness. For example, for the stressor 'Presence of toxic contaminants', the following sources are all linked to impervious surfaces present in the watershed: runoff from local roads and parking lots; winter road sand and road dirt; documented spills; sewage input from CSO; and sewage leaks. These sources and the resulting stressor are generally absent, or of minor importance, in non-urbanized watersheds. Recent studies (as summarized in CWP 2003) have shown that the percentage of impervious cover (IC) in a watershed strongly effects the health of aquatic systems because land surfaces that block infiltration of rainwater cause increased amounts of stormwater to run off into gutters, untreated storm sewers or directly to streams. In general, stream quality declines as imperviousness exceeds 10 % of watershed area, and may be severely compromised at greater than 25 % (Schueler 1994, CWP 2003). In Maine, existing local data indicate that an impervious cover of 10-15 % is adequate for attainment of Class C aquatic life criteria (MDEP 2005).

Table 3. Identified stressors and their sources in the Trout Brook watershed[*]. Sources representing natural conditions are italicized, those that are related to impervious surfaces are highlighted.

Stressor	Importance		Sources	
	Down-stream	Up-stream	Likely	Possible
1) Presence of toxic contaminants	High	High	Runoff from local roads and parking lots	Winter road sand and road dirt
			Saltwater intrusions	*Natural sources*
				Agricultural runoff
				Atmospheric deposition
				Documented spills
				Sewage input from CSO
				Sewage leaks
2) Impaired instream habitat	-	Medium	Channelization	
			Low gradient	
			Increased storm flow volume	
3) Impaired riparian habitat	Medium	-	Reduced riparian tree cover	
4) Altered hydrology	Low	Medium/ low	High percentage of impervious surfaces	Increased consumptive uses
			Stormwater outfalls	
			Channelization	
5) Low dissolved oxygen	-	Medium/ low	*Perched groundwater*	*Low channel gradient*
				Channel modifications
				Sewage input from CSO

[*] Note that the SI process analyzed the role of stressors and their sources within the entire watershed, not only the impaired watershed.

4. PRIORITY RANKING, LISTING HISTORY, AND ATMOSPHERIC AND BACKGROUND LOADING

Priority Ranking and Listing History

The large number of streams listed on the 303 (d) list requires Maine to set priority rankings based on a variety of factors. Factors include the severity of degradation, the time duration of the impairment, and opportunities for remediation. Maine has set priority rankings for 303 (d) listed streams by TMDL report completion date, and has designated Trout Brook for completion by 2005. Trout Brook‘s priority ranking was raised on the 2004 303 (d) list (MDEP 2004b) when the stream was included in the Urban Streams NPS Assessment Project (PETE/MDEP 2005).

Atmospheric Deposition

Atmospheric deposition of pollutants that occurs within a watershed will reach a stream through runoff containing material deposited on land, direct contact of the stream with rain, and the settling of dry, airborne material on the stream surface. As for contaminated runoff, it is assumed that in watersheds with a relatively low percent imperviousness enough soil remains that most atmospherically deposited metals are buffered and adsorbed before they can reach the stream (except in watersheds sensitive to acidification). Where imperviousness is elevated, as in the urbanized Trout Brook watershed draining into the impaired segment (15 %), it is unknown whether (or how much) material deposited from the atmosphere reaches a stream with runoff. A reduction in the % impervious cover (IC) in the watershed would help in reducing any negative effects from pollutants derived from the atmosphere. Other potential sources (i.e., direct contact with rain, and deposition in the stream of airborne material) are considered to convey minimal loads to Trout Brook because of the small surface area of the stream channel itself. On a larger scale, i.e., for Casco Bay, research has shown that atmospheric deposition accounts for a significant percentage of the inorganic nitrogen and mercury loading to the Bay (Ryan, et al. 2003).

Natural Background Levels

Although the headwaters of Trout Brook are in what could be called a "largely natural setting", even this section is influenced by urban development (logging, some residential development; see Fig. 1). As a result, no information on natural background levels of pollutants in this watershed is available.

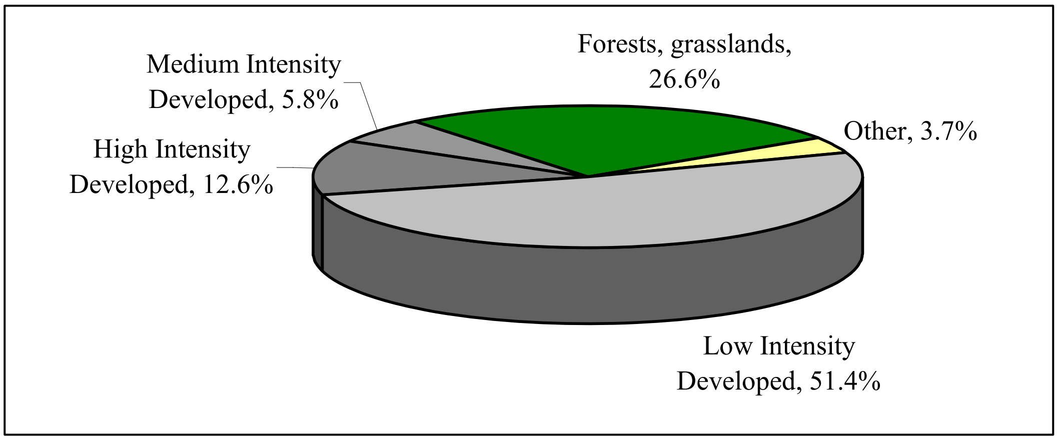
5. IMPERVIOUS COVER AND LANDUSE INFORMATION

Urban development primarily affects aquatic systems due to the high percentage of impervious cover (IC) present in urban areas. Effects include impairments in water quality, stream morphology, hydrology (Appendix F, Figs. 6-11), and aquatic communities (CWP 2003). For Trout Brook, the relationship between IC and the stressors identified for this waterbody is shown in Table 3. Stormwater runoff is water that does not soak into the ground during a rain storm but flows over the surface of the ground until it reaches a nearby waterbody. Stormwater runoff often picks up pollutants such as soil, fertilizers, pesticides, animal waste, and petroleum products. These pollutants may originate from driveways, roads, golf courses, and lawns located within a watershed[1]. The negative effects of urban stressors on overall stream quality can be reduced by disconnecting impervious surfaces from the stream so that runoff does not reach a waterbody untreated, or by converting impervious surfaces to pervious surfaces. Implementation of other measures that address habitat restoration, riparian recovery, and flood plain recovery can be an effective and less costly first step in abatement. More information on these Best Management Practice (BMP) options is provided in section 7, Implementation Recommendations.

[1] For more information on stormwater issues visit the MDEP Nonpoint Source Pollution website at www.maine.gov/dep/blwq/doceducation/nps/background.htm

The % impervious cover in the Trout Brook urbanized watershed draining into the impaired segment (Part II, Fig. 1) was determined from landuse data and a conversion of landuse to % IC. Details regarding this procedure are given in Part II, section 1. Landuse is dominated by low, medium, and high intensity development, which accounts for 70 % of all landuse types (Fig. 2; see also Part II, Table 2 & Fig. 1). Forests and grasslands account for another 27 % while other smaller landuses account for ~4 %. Converting landuse to % IC, imperviousness in the relevant watershed was estimated to be 15 %. This percentage reflects the total amount of impervious cover in this watershed.

Fig. 2. Distribution of landuse types, with percentages, in the Trout Brook watershed.



6. TOTAL MAXIMUM DAILY LOAD (TMDL) TARGET

Details regarding the determination of the TMDL target set for Trout Brook are given in Part II of this document, and a brief summary is provided here. For further details please consult Part II.

The Stressor Identification (SI) analysis indicated that urban stressors have caused the impairment in the macroinvertebrate community and Trout Brook's failure to attain aquatic life criteria. "Urban stressors" is a catch-all term encompassing a wide variety of effects caused by urbanization, with the majority of the effects being related, directly or indirectly, to stormwater runoff from impervious surfaces. Because of the major effect stormwater runoff has on aquatic systems (CWP 2003), the "Impervious Cover Method" (IC) method is used here to estimate current and target annual runoff volumes and annual pollutant loads for Trout Brook based on a target % IC of 11 %. The target % IC was determined in accordance with MDEP guidance (MDEP 2005) using MDEP data, information from the literature, and local conditions.

7. IMPLEMENTATION RECOMMENDATIONS

Watershed Implementation Update, September 2007

The South Portland Land Trust has protected 1,600 acres in the Trout Brook Watershed. In conjunction with this endeavor, the Land Trust has asked the City of South Portland to establish a task force to protect and preserve the Trout Brook Watershed and reduce the runoff of contaminants (South Portland Land Trust 2007). Additionally, the town of Cape Elizabeth has initiated the development of a Compensation Fee Utilization Plan (CFUP) through Maine's Stormwater Program (pers. comm. between MDEP & Maureen O'Meara, Cape Elizabeth, 2007). The CFUP would apply to Trout Brook Watershed and develop watershed and stream restoration projects with the goal of improving water quality in Trout Brook.

The goal of this TMDL is to have Trout Brook meet all applicable water quality criteria, including having the macroinvertebrate community attain Class C standards. Impairments observed in the aquatic communities in Trout Brook have been attributed to urban stressors, including additional stormwater runoff from impervious surfaces. Implementation is best addressed through a watershed management plan designed by stakeholders, which designates a low impact development strategy and accounts for future growth. Stormwater effects can be lessened, water quality improved, and impairments curtailed by implementing best management practices (BMPs) and remedial actions in a cost-effective manner using the following adaptive management approach:

- Implement BMPs strategically through a phased program which focuses on getting the most reductions, for least cost, in sensitive areas first (for example, begin with habitat restoration, flood plain recovery, and treatment of smaller, more frequent storms);
- Monitor ambient water quality to assess stream improvement;
- Compare monitoring results to water quality standards (aquatic life criteria);
- Continue BMP implementation in a phased manner until water quality standards are attained.

Generally speaking, these abatement measures can take one of three forms: they can consist of general stream restoration techniques (including flood plain and habitat restoration), they can disconnect impervious surfaces from the stream, or they can convert impervious surfaces to pervious surfaces. In general, practices that achieve multiple goals are preferred over those that achieve only one goal (ENSR 2006). For example, installing a detention basin along with runoff treatment systems provides more effective abatement of stormwater pollution than installing detention BMPs alone. Because of the effort and cost involved in implementing BMPs, a long-term strategy can be used to achieve water quality standards. For example, lower cost general stream restoration techniques that lessen stormwater effects immediately can be implemented in the short-term to initiate stream recovery.

This TMDL sets a target of 11 % impervious cover (IC). This target, and the current extent of IC of 15 %, reflects the total amount of impervious cover in the Trout Brook watershed. For practical purposes, the IC calculations in this TMDL do not distinguish between directly connected and disconnected surfaces. In any watershed, the runoff from impervious cover reaches the stream through both direct and indirect conduits that represent varying levels of stormwater treatment. A comprehensive sub-watershed survey of outlet structures and storm drainages would be needed to completely evaluate the amount of 'effective'[1] versus 'total' IC. Municipalities and entities that own extensive impervious surfaces are encouraged to conduct such surveys. Because effective IC presents the greatest pollution risk, efforts to disconnect or convert impervious surfaces should be directed primarily at these areas to ensure maximum benefit. This approach is likely to accelerate stream recovery and reaching the goal of this TMDL, i.e., attainment of water quality criteria. If criteria are attained before the target % IC is reached, the need for further reductions in impervious cover would be reduced (or possibly eliminated). It should be noted, however, that while a sub-watershed survey would be ideal for comprehensive planning towards stream restoration, immediate stormwater remediation may be more beneficial in the short run. Disconnecting 'hot spots' and installing bioretention structures may move the stream closer to the water quality target than documenting the current extent of effective IC.

The following three sections list the options available for BMPs aimed at stream restoration techniques, and disconnection and conversion of impervious surfaces. Because many factors must be considered when choosing specific structural BMPs (e.g., target pollutants, watershed size, soil type, cost, runoff amount, space considerations, depth of water table, traffic patterns, etc.), the sections below only suggest categories of BMPs, not particular types for particular situations. Implementation of any BMPs will require site-specific assessments and coordination among local authorities, industry and businesses, and the public. Advice on the selection, design, and implementation of any remedial measures can be obtained from the MDEP (Bureau of Land and Water Quality, Division of Watershed Management), the Cumberland County Soil and Water Conservation District, or web-based resources (see Appendix C & D for suggestions).

In summary, implementation of remedial measures will occur under an adaptive management approach in which certain measures are implemented, their outcome and effectiveness evaluated, and future measures selected so as to achieve maximum benefit based on new insights gained. This process may be repeated several times, starting with the most appropriate measures for the area. The order in which measures are implemented should be determined with input from all concerned parties (e.g., city, businesses, industry, residents, regulatory agencies, watershed protection groups). It is suggested that the City develops implementation recommendations by the end of 2009. Further details on the measures suggested below are provided in Chapter 4 of the Urban Streams Report (PETE/MDEP 2005). In addition, Appendix C lists BMPs in a matrix format in which traditional and newly developed ("Low Impact Development") BMP types are rated according to their ability to mitigate for impacts of impervious cover and applicability to certain urban situations. The matrix was developed by ENSR as a multi-use tool and thus contains some BMPs and IC impacts not directly applicable to Trout Brook.

[1] 'Effective' IC is impervious cover that that is directly connected to the stream via hard surfaces or in close proximity, and from which runoff enters a waterbody untreated.

General Stream Restoration Techniques

Following is a list of general BMPs and stream restoration techniques and how they can alleviate stressors and improve stream health. Short-term implementation of these measures will complement the long-term strategy of disconnecting or removing impervious surfaces suggested above. Web-based information resources that can aid with planning and implementing these measures are given in Appendix D.

- Maintaining the riparian buffer where it is adequate, i.e., has a width of at least 23 m (75 feet), wherever possible, and is composed of native plants, including mature trees. Enhancing or replanting the riparian buffer where it is inadequate. An adequate buffer will filter runoff from commercial and residential lots, improves shading (which helps to keep water temperature low), and increases large woody debris availability, and food input. It will also provide terrestrial and aquatic habitat for insects with aquatic life stages, thus enhancing recolonization potential of the macroinvertebrate community.
- Reclamation of flood plains by returning these areas to a natural state will naturally moderate floods; reduce stress on the stream channel; provide habitat for fish, wildlife, and plant resources; promote groundwater recharge; and help maintain water quality. Protection of intact flood plains should be a high priority.
- Improving channel morphology (restoring sinuosity, pool availability and diversity, and flow diversity) by installing double wing deflectors and low crib walls in the stream (see PETE/MDEP 2005, Chapter 4, Fig. 24) will improve flow conditions and habitat for macroinvertebrates. Because of the complex nature of channel restoration, any improvement activity requires the extensive involvement of a trained professional.
- Reducing the incidence of spills (accidental and deliberate) for example by improving education and training will reduce toxic contaminant input.
- Reducing the input of winter road sand and road dirt by sweeping roads, parking areas or driveways will reduce excess sedimentation.
- Minimizing waste input from pets by picking up waste will reduce bacteria and nutrient input.
- Minimizing lawn/landscaping runoff by minimizing fertilizer/pesticide use and using more efficient application methods will reduce nutrient and toxic contaminant input.
- Eliminating the potential for sewer/septic system leaks by regularly inspecting and maintaining sewer/septic systems will reduce toxic contaminant and nutrient input.
- Eliminating illicit discharges by detecting and eliminating discharges will reduce toxic contaminant and nutrient input.
- Reducing erosion from land use activities with mulches, grass covers, geotextiles or riprap will reduce the potential for sedimentation problems. In streambank stabilization projects, use of woody vegetation is preferred over riprap in most cases.
- Investing in education and outreach efforts will raise public awareness for the connections between urbanization, impervious cover, stormwater runoff, and overall stream health.
- Encouraging responsible development by promoting Smart Growth or Low-Impact Development guidelines and the use of pervious pavement techniques will minimize overall effects of urbanization.

- Reducing new impervious cover by promoting shared parking areas between homes or between facilities that require parking at different times will reduce impacts related to impervious surfaces. Lowering minimum parking requirements for businesses and critically assessing the need for new impervious surfaces will have the same effect.
- Reducing the temperature of water discharged from (future) detention structures by including outlet mechanisms (e.g., underdrains) that cool the discharge will reduce the potential for negative temperature effects on the stream.
- Eliminating the few septic systems in the watershed by expanding the municipal sewer system will reduce toxic contaminant and nutrient input. Given low potential for problems arising from septic systems and the high cost required for abatement, this is not considered a high-priority item.
- Eliminating sewage input from the CSO will reduce toxic contaminant and nutrient input. (The single CSO in the watershed was disconnected in spring 2005; D. Pineo, City of South Portland, pers. comm.)

Disconnection of Impervious Surfaces

The purpose here is to prevent stormwater runoff from reaching the stream directly (via the storm drain system). There are various options for achieving this goal:

- Channel runoff from large parking lots, roads or highways into
  - detention/retention BMPs (e.g., dry/wet pond, extended detention pond, created wetland), preferably one equipped with a treatment system (e.g., underdrains);
  - vegetative BMPs (e.g., vegetated buffers or swales);
  - infiltration BMPs (e.g., dry wells, infiltration trenches/basins, bio-islands/cells);
  - underdrained soil filters (e.g., bioretention cells, dry swales).
- Redesign and retrofit existing detention to provide extended detention for 6 month and 1 year storms.
- Guide runoff from paved driveways and roofs towards pervious areas (grass, driveway drainage strip, decorative planters, rain gardens).
- Remove curbs on roads or parking lots.
- Collect roof runoff in rain barrels and discharge into pervious areas.

All of these options for disconnection of impervious surfaces provide for a virtual elimination of runoff during light rains (which account for the majority of runoff events but not the majority of pollutant or stormwater input), reduction in peak discharge rate and volume during heavy rains, sedimentation or filtration of some pollutants, and improvement in groundwater recharge. Disconnection of impervious surfaces can often be achieved at reasonable cost and, unlike the removal of impervious surfaces (below), does not generally create material for disposal. These BMPs cover most sizes of impervious surfaces (private driveways and small building roofs to large parking lots and highways), and many have been widely used in cold climates.

Conversion of Impervious Surfaces

This is achieved by replacing impervious surfaces with pervious surfaces, for example by using the following BMPs:

- Replace asphalt on little-used parking lots, driveways or other areas with light vehicular traffic with porous pavement blocks or grass/gravel pave.
- Replace small areas of asphalt on large parking lots with bioretention structures (bio-islands/cells).
- Replace existing parking lot expanses with more space-efficient multistory parking garages (i.e., go vertical).
- Replace conventional roofs with green roofs.

These options for conversion of impervious surfaces also provide for a virtual elimination of runoff during light rains (which account for the majority of runoff events), reduction in peak discharge rate and volume during heavy rains, filtration of some pollutants, and improvement in groundwater recharge. However, a number of problems exist with these options (e.g., removed asphalt or roofing shingles must be landfilled or recycled), and removal of existing impervious surfaces may be operationally unfeasible. Some of these BMPs are still in the experimental stage for cold climates and may not prove suitable for widespread implementation. Use of these BMPs may therefore be limited to relatively few instances. As far as possible, construction or building projects should, however, consider these and other possibilities for reducing new impervious cover during the planning stages.

8. MONITORING PLAN

Maine DEP will evaluate the progress towards attainment of Maine's water quality standards by monitoring the macroinvertebrate community in Trout Brook. Under the Biomonitoring Unit's existing rotating basin sampling schedule, Trout Brook will be sampled again in 2010. Adaptive implementation of the remedial measures listed above should be pursued until aquatic life criteria are met. Once water quality standards have been met in at least two sampling events with normal summer conditions (as defined by MDEP Biomonitoring Protocols) within a 10-year period (i.e., by 2015), no further remedial measures are required. If water quality standards continue to be violated once BMPs and restoration techniques have been implemented this TMDL will enter a secondary phase in which the approach proposed in this document will be reassessed.

PART II: TMDL PLAN

1. TMDL TARGET: LOADING CAPACITY AND IMPERVIOUS COVER

Loading Capacity

Loading capacity is the mass of pollutants that a waterbody can receive over time and still meet numerical or narrative water quality targets. Trout Brook currently does not meet Maine's aquatic life criteria for a Class C stream (Part I). For streams in urbanized areas, additional stressors affecting aquatic life exist in the form of non-pollutant impacts such as alterations in channel morphology and the flow regime, or degradation of the riparian buffer. In this TMDL, the extent of impervious cover (% IC) in the watershed is used as a surrogate for the complex mixture of pollutant and non-pollutant stressors attributable to stormwater runoff from developed areas. By reducing the % IC using the options listed above in Part I, section 7, Implementation Recommendations, a number of urban stressors and their sources can be addressed simultaneously (e.g., toxic load from runoff and road sand; habitat impairment due to storm flows; sedimentation problems from road sand and exposed soil; low flows related to high imperviousness).

The loading capacity of Trout Brook is set at 11% IC, which includes a 2% margin of safety. The target % IC for Trout Brook was selected by considering local conditions within the framework of the appropriate target range of 10-15 % IC established by MDEP for Class C waterbodies (MDEP 2005, attached in Appendix E). Given the local conditions (i.e., the presence of a substantial length of riparian buffer which serves to offset the impact of other factors listed in Table 1), a target %IC of 11% was set for Trout Brook.

Table 1. Conditions considered in selection of target % impervious cover for Trout Brook.

Ameliorating conditions	Exacerbating conditions
Presence of a riparian buffer >10 m in width along 44 % of the stream (PETE/MDEP 2005)	Absence of riparian buffer along 39 % of the stream (PETE/MDEP 2005)
Documented cold water input (PETE/MDEP 2005)	Wetland likely contributing to elevated water temperature and lowered dissolved oxygen (DO) concentration
	Naturally low DO concentration in part of stream (PETE/MDEP 2005)
	Impermeable soils (clays and silts of glacial-marine origin) reducing infiltration potential
Natural flood plain along ~44 % of stream within relevant watershed*	Compromised flood plain along ~56 % of stream within relevant watershed [1]

* Estimated from Fig. 1.

Impervious Cover (IC) Method

The IC Method was developed by the Center for Watershed Protection (CWP) to assess the impacts of urbanization on small streams and receiving waters, and to document the linkage between the % impervious cover in watersheds and instream water quality. The IC Method was used by ENSR in a pilot project to develop TMDLs for streams potentially impaired by urban nonpoint source pollution (ENSR 2005). ENSR selected the IC Method for their pilot project "primarily because it provides a strong and straightforward link between water quality impairment and causal factors" (ENSR 2005).

Impervious Cover and Landuse Information

As a first step for calculating the % impervious cover in the Trout Brook watershed, the watershed boundary (Part I, Fig. 1) was determined. In addition to the watershed directly draining into the impaired segment, areas draining into the middle third of the stream were included because of the proximity to the impaired segment and the amount of urbanization present. The upper third of the watershed was excluded here because of its overall rural character. The watershed boundary was determined based on a drainage map obtained from the City of South Portland and actual stormwater drainage systems in South Portland. Watershed imperviousness was estimated from landuse data and a conversion of landuse to % IC. Landuse data were derived from "Maine_Combo_Landcover", a GIS map layer developed by MDEP staff that combines data from Maine Gap Analysis Program (GAP) and USGS Multi Resolution Landcover Characterization (MRLC) coverages[1]. Both GAP and MRLC are based on 1992 Land-Sat TM satellite imagery. Metadata for Maine_Combo_Landcover are maintained by MDEP's GIS unit. Within the relevant watershed, land use is dominated by low, medium, and high intensity development, which accounts for 70 % of all landuses (Table 2, Fig. 1). Forests, and grasslands account for 27 % while other smaller landuses account for ~4 %.

Table 2. Extent of various landuse types in the Trout Brook watershed. Letters b-e shown in the first column refer to the land cover types listed in Table 3. (Note: different terms are used here than in Table 3 for landuse types b-e to more accurately reflect actual landuse; also see footnote to Table 3.)

Landuse Type		Acres	%
e	Low Intensity Developed	363	51.4
-	Forests, Grasslands	188	26.6
b, c	High Intensity Developed	89	12.6
d	Medium Intensity Developed	41	5.8
-	Other*	27	3.7
-	Total watershed area	708	100.0

* "Other" landuse categories are [in order of decreasing area (<22 acres) or percentage (≤3.1 %)] Wetlands, Water, and Nonvegetated.

[1] To minimize uncertainties in precise landuse type (e.g., different types of urban developments, forests or wetlands), the original 19 "Maine_Combo_Landcover" types present in the Trout Brook watershed were grouped into the eight generalized types shown in Fig. 1.

The method used to convert landuse to % IC was developed by MDEP staff (MDEP 2001b) by applying a % imperviousness formula to the "Maine_Combo_Landcover" GIS layer. The resulting values for imperviousness of certain land cover types in Maine are presented in Table 3. Calibration (i.e., groundtruthing) of the method led to the addition of a multiplier to give a final formula for watershed % IC of:

$$\text{Watershed \% IC} = 0.85 \; * \left(\frac{\sum_{a}^{f} (\text{Acres of landuse type} * \text{Estimated \% IC})}{\text{Total watershed area}} \right)$$

Where Acres of landuse type a-f[1] = see Table 2
Estimated % IC for land cover type a-f[5] in Maine = see Table 3
Total watershed area = see Table 2

Using this formula, % IC for the Trout Brook watershed was estimated to be 14.7%.

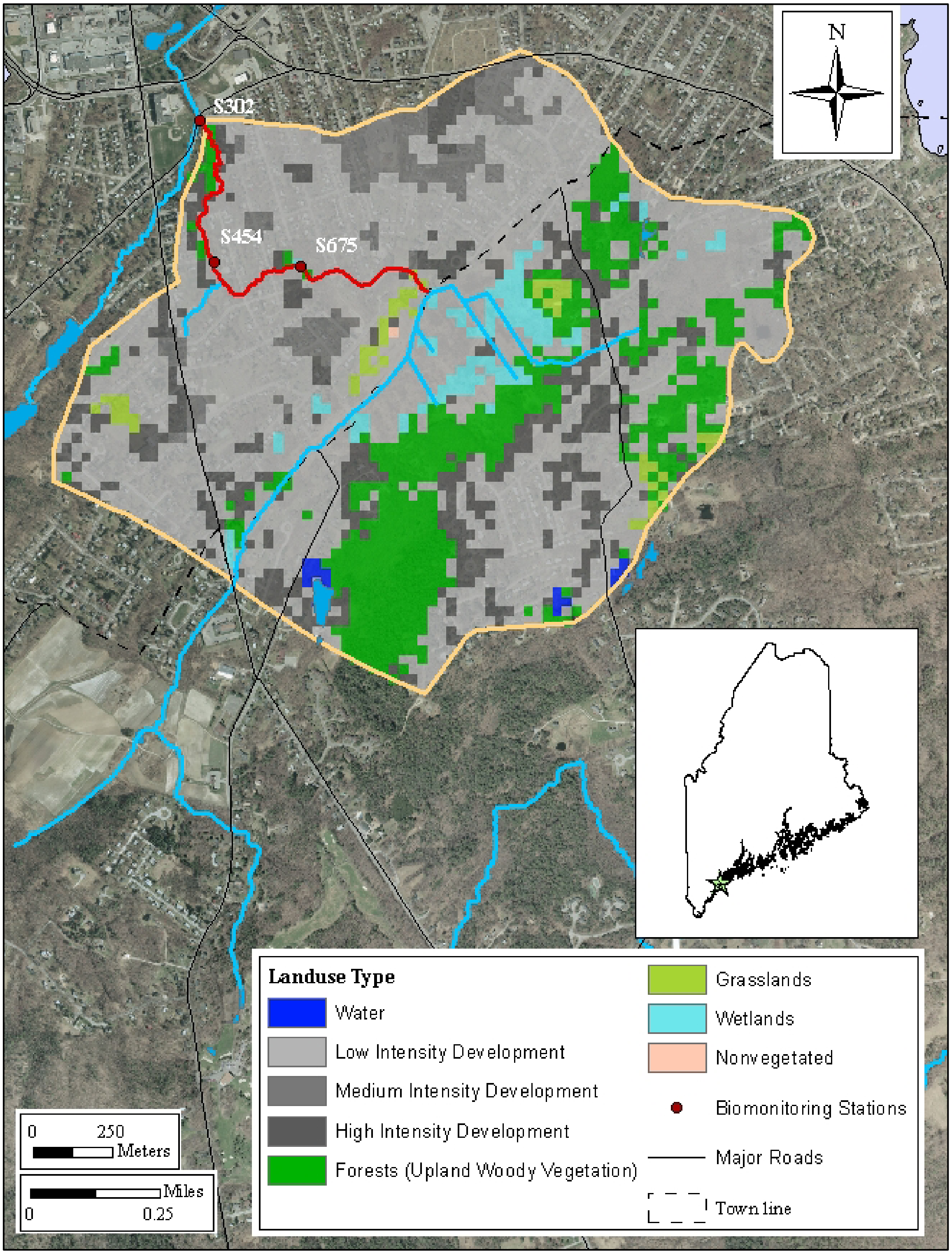
Table 3. Estimated % impervious cover (IC) for urban land cover* types in the "Maine_ Combo_Landcover" GIS map layer (MDEP 2001b). Letters a-f shown in the first column refer to the landuse types listed in Table 2.

Land Cover Type		Estimated % IC
a	Urban Industrial	90.20
b	Dense Residential Developed	56.50
c	Commercial-Industrial-Transportation	54.04
d	High Intensity Residential	27.11
e	Low Intensity Residential	17.26
f	Sparse Residential Developed	11.98

* Because of the way land cover types were derived from two GIS datasets, terms used here do not necessarily reflect the actual landuse (e.g., residential). Land cover types do, however, accurately reflect the extent of imperviousness due to development associated with each category.

1 Landuse types 'a' and 'f' do not occur in this watershed.

Fig. 1. Landuse in the Trout Brook watershed



Note: some land along Trout Brook upstream of the impaired segment was incorrectly identified as "Low Intensity Development". This misidentification was changed manually to "Grasslands" before landuse extent and % IC were calculated.

Daily Pollutant Loads

Percent impervious cover (% IC) serves as a surrogate measure of the complex mixture of pollutants transported by stormwater. Maine's SWQC includes biological standards that respond not only to pollutant loads contributed by stormwater, but integrate additional environmental stressors such as flow and habitat alterations. Expression of the TMDL target in terms of % IC is especially useful for stormwater-impaired waters because the target is applicable at all times, whether the time step is instantaneous, hourly, daily, weekly, monthly, seasonal, or annual.

This TMDL also presents daily pollutant loads for two specific pollutants which serve as surrogates for the complex mix of pollutants commonly found in stormwater. Calculations of the total maximum daily loads for lead (Pb) and zinc (Zn) are presented in Appendix B. Pb and Zn are chosen as surrogate pollutants for the complex mixture of metals in stormwater because there are extensive data documenting their presence in stormwater. The CWP cites over 2,000 data points for each metal, and Pb and Zn are two metals most commonly detected at the highest concentrations in stormwater (CWP 2003).

SWQC require water quality criteria be met for all streamflows of 7Q10 and above. Given the dynamic nature of stormwater run-off volume and resulting streamflows, the presentation of the daily loads in tabular and/or graphic form is used to express the daily maximum pollutant load which changes as daily streamflow varies.

The maximum daily load for NPDES-permitted sources (i.e., the wasteload allocation), the load for all other sources (i.e., the load allocation, which includes natural background and nonpoint sources), and a margin of safety are included in the TMDLs. The load allocation is included in the wasteload allocation because it is not possible to separate out the NPDES-permitted sources from all other sources, given the large number of regulated and unregulated sources and the variability of stormwater. A 5% explicit margin of safety was included by decreasing the applicable water criterion by 5% before calculating the allowable daily wasteload (which is also shown in Appendix B).

MDEP recommends the use of the imperious cover target to establish the implementation goals rather that the over pollutants specific TMDL loads because the % IC target will more effectively guide BMP's implementation to reduce stormwater impacts. Ultimate compliance with water quality standards for the TMDL will be determined by measuring instream water quality to determine when standards are attained.

Limitations of the Impervious Cover Method

The impervious cover (IC) method can be used to efficiently characterize water quality impairment and establish surrogate TMDL targets for % IC, or stormwater runoff volume, or pollutant reduction targets for watersheds that are impaired by stormwater (ENSR 2005). There are four limitations that affect the use of the method in Trout Brook as follows:

1. Limitation: The IC model applies to 1st through 3rd order streams.
   Effect: Trout Brook is a 1st to 2nd order stream, i.e., use of the model is appropriate.

2. Limitation: This method does not account for non-stormwater source pollutant loadings.
   Effect: There are no non-stormwater point sources of pollution in the watershed, and violation of aquatic life criteria in this watershed is believed to be caused by stormwater (including CSOs) and/or nonpoint source pollution, exacerbated by instream and riparian habitat disturbances. The single CSO in the watershed was disconnected in the spring of 2005 (D. Pineo, City of South Portland, pers. comm.).

3. Limitation: This method does not account for dynamic internal stream processes that effect water quality.
   Effect: Generally, TMDL methods do not account for in-stream physical processes that directly affect habitat and biological organisms. Internal movement and shifting of the sediment has a direct effect on habitat suitability, but is not easy to quantify or included in TMDL analysis.

4. Limitation: Additional site specific information is required for identification and specification of Best Management Practices (BMPs) to achieve TMDL goals.
   Effect: Suggestions for BMPs, remedial actions, and restoration techniques aimed at removing identified stressors, or mitigating their effects, are made in Part I, section 7. Implementation of these BMPs will aid substantially in reducing the % IC and its effects. However, the substantive reductions recommended will likely require site specific information for optimal implementation of BMPs.

2. LOAD ALLOCATIONS

All Load Allocations (LAs) are given the same 9 % IC allocation as the Waste Load Allocations (WLAs) (see next section). This approach was chosen because LAs must be accounted for but it was not feasible to separate the loading contributions from nonpoint sources, background, and stormwater. Including a margin of safety of 2 % in the 11 % Load Allocation yields the Load Allocation of 9 % IC (see Table 4).

3. WASTE LOAD ALLOCATIONS

The entire Trout Brook watershed is classified as a “regulated area” under the NPDES Phase II Stormwater Program. Under the stormwater program, municipal separate storm sewer system (MS4), construction, and industrial stormwater discharges are considered as point sources and are allocated as waste loads. In this TMDL, the total extent of impervious cover (% IC) in the watershed is used as a surrogate for the complex mixture of pollutant and non-pollutant stressors attributable to stormwater runoff from developed areas. The total loading capacity is set at 11 % IC. The ‘WLAs’ and ‘LAs’ are established at a % IC of 9 %, which allows for a margin of safety of 2 % IC, as shown in Table 4.

The CSO, which is permitted under the MEPDES Program and is thus allocated a waste load, is included in Table 4 with a "0" allocation because it was removed in the spring of 2005 (D. Pineo, City of South Portland, pers. comm.).

Table 4. Estimated target annual load and waste load allocations for Trout Brook

	Allocations (% IC)
Combined Sewer Overflow (WLA)	0*
Waste Load Allocations, Load Allocations	9
Margin of Safety	2
Total Allocation (TMDL)	11

* The WLA for CSO (a combined discharge of wastewater and stormwater) is set at zero because the CSO has been removed.

The necessary reduction in % IC discussed in the TMDL reflects reduction from current conditions. Future development activities have the potential to increase effective impervious cover and resulting stormwater runoff and associated pollutants, and these future activities will need to be addressed in a Watershed Management Plan (prepared by watershed stakeholders with support from MDEP). To ensure that the TMDL targets are attained, future development either will need to be constructed and operated in such a way that there is no net increase in stormwater runoff, or additional reduction in effective IC will need to occur at existing sites that contribute stormwater runoff.

4. MARGIN OF SAFETY

The Trout Brook TMDLs provide explicit margins of safety (MOS). The % IC TMDL includes an explicit margin of safety of 2 % impervious cover which is reserved from the total loading capacity of 11%. (See guidance page 37, Appendix E.) This implicit MOS is sufficient to accounts for the uncertainty in the selection of a numeric water quality target of 11 % IC (within the range of 10-15% IC suitable for Class C streams) primarily because of the mitigating presence of a riparian buffer along a substantial portion of Trout Brook. Furthermore, the 2% IC translates to an actual 18% MOS when 2% IC is compared to the 11% TMDL [(2% IC / 11% IC) x 100 = 18.2 %].

The pollutant-specific TMDLs for Pb and Zn provide an explicit MOS which is applied to the appropriate SWQC before calculating the allowable daily wasteload allocations.

5. SEASONAL VARIATION

The TMDL was established to protect the stream during critical conditions throughout the year. The IC target will result in reductions in the effects of IC which will improve water quality for all flows and seasonal conditions (ranging from summer low flows, to high spring flows during snowmelt). The daily loads for Pb and Zn are expressed as a function of flow to assure SWQC are attained for all flows and seasonal conditions.

Critical conditions can occur for aquatic life and habitat in stormwater-impaired streams at both low and high flows. Frequent small storms can contribute large volumes of runoff and a mix of pollutants. High flows can cause channel alterations, increased pollutant loads from scouring and bank erosion, wash-out of biota, and high volume pollutant loading. Increased % impervious cover and the resulting increase in surface runoff reduces the amount of infiltrating rainfall that recharges groundwater. This diminished baseflow can further stress aquatic life and cause or contribute to aquatic life impairments through loss of aquatic habitat and increased susceptibility of pollutants at low flow. Furthermore, specific BMPs implemented will be designed to address loadings during all seasons.

6. PUBLIC PARTICIPATION

Public participation in the Trout Brook TMDL development was ensured through several avenues. A preliminary review draft TMDL, which had been reviewed by MDEP staff (M. Evers, L. Tsomides, J. Varricchione, Bureau of Land and Water Quality), was distributed to the following watershed stakeholder organizations and outside reviewers:

- Pat Cloutier and David Pineo, City of South Portland
- Bob Malley and Maureen O'Meara, Town of Cape Elizabeth
- Karen Young, Casco Bay Estuary Project, Portland
- Mike Doan and Joe Payne, Friends of Casco Bay, South Portland
- Betty McInnes, Cumberland County Soil and Water Conservation District
- Mac Sexton, South Portland Land Trust
- Ken Hickey, ENSR Corporation, Westford, MA
- Tom Schueler, Center for Watershed Protection, Ellicott City, MD

Paper and electronic forms of the *Trout Brook TMDL, Draft Report* were made available for public review in three ways: the report was available for viewing at the Augusta office of the MDEP; it was posted on the MDEP Internet Web site; and a notice was placed in the 'legal' advertising of a local newspaper. The following ad was printed in the Sunday editions of the Portland Press Herald on August 21 and 28. The U.S. Environmental Protection Agency (Region I) and interested public were provided a 30 day period (from August 19 to September 19, 2005) to respond with draft comments.

PUBLIC NOTICE FOR TROUT BROOK - In accordance with Section 303(d) of the Clean Water Act, and implementation regulations in 40 CFR Part 130, the Maine Department of Environmental Protection has prepared a Total Maximum Daily Load (TMDL) report (DEPLW0714) for Trout Brook in South Portland and Cape Elizabeth, Cumberland County. This TMDL report estimates the current extent of impervious cover, and the reductions in impervious cover and application of general stream restoration techniques required to enable the stream to meet Maine's Water Quality Criteria.

A Public Review draft of the report may be viewed at the Maine DEP Offices in Augusta (Ray Building, Hospital St., Rt. 9) or on-line at: http://www.maine.gov/dep/blwq/comment.htm.

Send all written comments by September 19, 2005 to Melissa Evers, Maine DEP, State House Station #17, Augusta, ME 04333, or email: Melissa.Evers@maine.gov

Comments- Comments received are summarized in Appendix A along with a response to those comments.

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PUBLIC REVIEW PROCESS

The Trout Brook TMDL report was open for public review from August, 19 to September 19, 2005. The following are the summarized comments submitted by citizens during this period. Editorial and formatting suggestions are withheld from this section, but were taken into consideration and incorporated into the final draft of the report.

From: Evers, Melissa
Sent: Tuesday, August 30, 2005 6:02 PM
To: 'Maureen O'Meara'; Evers, Melissa
Cc: Bob Malley; Michael McGovern; Meidel, Susanne K
Subject: RE: Trout Brook

Maureen,

Thanks for your interest in the Trout Brook TMDL, in response to your comments-

1. The implementation plan cited in the TMDL will be initiated by towns and community organizations in the Trout Brook watershed and I anticipate that Cape Elizabeth will be involved in any plan that goes forward from the TMDL. Plan responsibilities will be clearly distinguished between Cape Elizabeth and South Portland, but it is unlikely that runoff and activities that influence downstream portions of Trout Brook will be delineated along town boundaries. Active participation in the BMP planning process will include opportunities to negotiate how to best restore the stream and identify the most appropriate funding mechanisms.

2. I commend Cape Elizabeth's conservation efforts and acknowledge the need to balance stream restoration with preserving traditional farm uses. Farming does keep a large portion of landuse in pervious coverage that stabilizes stormwater runoff and can accommodate beneficial BMP's. A good restoration plan can identify agricultural BMP's that are compatible with farm operations and will accomplish the goal of re-establishing Maine's water quality standards in Trout Brook.

Hopefully the TMDL provides the guidance needed to initiate a meaningful watershed planning process that will educate the community and result in measurable water quality improvements in Trout Brook.

Sincerely,
Melissa Evers
MDEP
SHS # 17
Augusta, ME 04333
207-287-2838

-----Original Message-----
From: Maureen O'Meara [mailto:ceplan@maine.rr.com]
Sent: Tuesday, August 30, 2005 4:27 PM
To: Melissa.Evers@maine.gov
Cc: Bob Malley; Michael McGovern
Subject: Trout Brook

Melissa,

Thanks for speaking with me this morning.

The two comments I wanted to offer regarding the Trout Brook TMDL Draft report are as follows:

1. It is my understanding that this report will likely be followed by an implementation plan. When that plan is prepared, it would be helpful if the plan distinguishes between recommendations located on the Cape Elizabeth or South Portland side of the brook. In this draft report, it is a little difficult to determine which recommendations would impact which community.

2. The draft report references impacts from abutting agricultural uses. I assume this is the Maxwell Farm located in Cape Elizabeth. The Town would like to be very involved in the nature of implementation recommendations that are located in Cape Elizabeth and especially the farm. The Town has a history of strong support for shoreland protection. Many of the town's environmental and other goals are advanced by the preservation of existing farms. It is very important that any implementation recommendations accommodate both the need for stream protection and the preservation of agricultural uses.

I understand this report could increase the availability of grant funding to improve Trout Brook. Good luck with your efforts.

Maureen O'Meara
Town Planner

October 12, 2007

Charles Sexton
South Portland, Maine

RE: TROUT BROOK TOTAL MAXIMUM DAILY LOAD (TMDL) REPORT COMMENTS

Dear Mr. Sexton,

Thank you for providing comments that contribute towards the final draft of the Trout Brook TMDL. I will address each comment according to the number assigned in your original submittal and will include both the comments and the response in an Appendix in the TMDL.

1.. The brook description on p.5.states that it is of moderate length (~2.5 miles), whereas the description on p.7 under the Impaired Stream Segment states it is 2.9 miles.

This discrepancy has been addressed.

2.. Shouldn't bacterial violations be mentioned somewhere, since they were found on most sampling dates in summer 2003 both upstream and downstream? Did the removal of the one remaining CSO this year take care of that problem?

There is overlap in the sources of bacterial contamination and the cause of aquatic life violations, but defining the problems and the solutions for each problem requires distinct TMDL approaches. This TMDL is designed to address aquatic life violations that results from stormwater runoff and resolving stormwater sources will likely address the bacteria sources, such as removal of the CSO. While this is true, a TMDL designed to address bacterial contamination will not address the instream habitat degradation connected to aquatic life violations. This TMDL also advances an adaptive approach towards stream restoration, which means that water quality will be reassessed to evaluate the effectiveness of implementation of best management practices (BMP).

3.. Regarding Implementation Recommendations, p. 13 et seq, why do these recommendations keep getting strung out, i.e. why give the City another year plus to develop implementation recommendations? Why doesn't DEP spell out exactly what should be done, when, and by whom? I think you guys could do that more readily than anyone in the City. Clearly, I do not understand the process.

The TMDL sets water quality goals, describes the problems and defines the reductions needed to attain water quality standards. This is the first phase in the complex process of restoring a degraded waterbody. The next step requires the collective process involved in developing a comprehensive Watershed Management Plan (WMP). The WMP will involve many stakeholders and define the site specific sources of stormwater and develop a set of concrete recommendations for implementation. The City has critical local knowledge and the community needs to take ownership of this process to sustain long term restoration goals.

4.. What is a green roof (ref. p.17)? Does that mean sod? Or is it something else that the City could require in our building code?

A green roof is a low impact development technique that refers to a roof that is planted with some vegetation. It is a BMP that reduces the runoff from impervious surface of roof and is a technique that has specific requirements and should considered in the context of site specific applications. It is listed in the TMDL as potential tool and the City does not need to specify this technique in the building codes.

5.. I would enjoy more data in the Priority Ranking and Listing History paragraph on p.18. What is the ranking of Trout Brook? How does it compare with other streams in Maine?

The Priority Ranking and Listing History are reflected in the history of the 303 d list that is periodically revised. Maine does not use a numerical score for the priority ranking; it is based on the factors listed in the TMDL (community interest, opportunity for restoration and time of original listing) and the TMDL due date is the ranking. Trout Brook was scheduled for a TMDL in 2012 on the 2002 303d list, this changed to 2006 on the 2004 list due to the interests of the Urban Stream Project. There are approximately 75 streams listed on Maine's

303 d list and the TMDL's are scheduled through 2015, depending on when DEP can realistically do the TMDL.

6.. I would enjoy in regard to the Atmospheric Deposition paragraph on p.18 something other than the cop out that national action is required, which of course is true. Why can't South Portland do something to assert our disdain for contaminants from afar? Do you know of any local ordinances or even resolutions which would be apt?

The section on Atmospheric Deposition has been revised as follows:

Atmospheric Deposition

'Atmospheric deposition of pollutants that occurs within a watershed will reach a stream through runoff containing material deposited on land, direct contact of the stream with rain, and the settling of dry, airborne material on the stream surface. As for contaminated runoff, it is assumed that in watersheds with a relatively low percent imperviousness enough soil remains that most atmospherically deposited metals are buffered and adsorbed before they can reach the stream (except in watersheds sensitive to acidification). Where imperviousness is elevated, as in the urbanized Trout Brook watershed draining into the impaired segment (15 %), it is unknown whether (or how much) material deposited from the atmosphere reaches a stream with runoff. A reduction in the % impervious cover (IC) in the watershed would help in reducing any negative effects from pollutants derived from the atmosphere. Other potential sources (i.e., direct contact with rain, and deposition in the stream of airborne material) are considered to convey minimal loads to Trout Brook because of the small surface area of the stream channel itself. On a larger scale, i.e., for Casco Bay, research has shown that atmospheric deposition accounts for a significant percentage of the inorganic nitrogen and mercury loading to the Bay (Ryan, et al. 2003).'

The reference to national action has been deleted and the impact from atmospheric contaminants is not considered significant for Trout Brook. Your questions on how to use local action to influence national air policy and pollution laws is beyond the scope of this TMDL. Air pollution from other parts of the United States continues to be a concern for residents of the state of Maine and I encourage you to contact an organization focused on this air related issues.

7.. On p.21 it is not clear to me whether the 14.7% IC means the entire Trout Brook watershed, or just some constrained drainage proximate to the impaired section of Trout Brook.

The 14.7% IC refers to a '…constrained drainage proximate to the impaired section of Trout Brook.' The boundaries of the area are outlined on the map in Figure 1 of Section II.

8.. Table 3 on p.23 shows that estimated IC for residential uses varies from 11.98 to 56.50, and there are only 4 categories to encompass that huge variation! Seems pretty broad brush and susceptible to fuzzy IC estimations.

Your observation that the IC estimate is 'fuzzy' is a reasonable characterization. IC is determined from landuse maps that were developed from satellite photo interpretation, so it is an estimate using the best available tools. A more accurate estimate of IC could be made, but it would not appreciably change the final recommendations or the process of BMP implementation to restore the stream.

Your participation in the process will also help to move stream restoration in a positive direction and improve the local environment for residents.

Sincerely,
Melissa Evers
Maine Department of Environmental Protection
SHS #17
Augusta, ME 04330

October 1, 2007

Steve Bushey
69 Adelbert Street
South Portland, Maine

RE: TROUT BROOK TOTAL MAXIMUM DAILY LOAD (TMDL) REPORT COMMENTS

Dear Mr. Bushey,

Thank you for providing comments that contribute towards the final draft of the Trout Brook TMDL. Please note that much of the stream specific information you provided is valuable for watershed planning and protection, but does not directly influence the technical aspects of the TMDL. I will address each comment according to the number assigned in your original submittal and will include both the comments and the response in an Appendix in the TMDL.

1. The watershed's location directly beneath the flight path of the jetport might result in excessive depostion of contaminant's, metals etc. originating from the jet exhaust. This might seem trivial, however, having lived in the area long enough one can recognize the particulate matter that settles on us from above. Hence I won't rule that out as a chronic source to the brook.

This is an interesting point that may warrant further investigation in the future if conventional stream and watershed restoration techniques prove unsuccessful. The impact of generic atmospheric deposition on contaminant levels in streams was addressed in the Goosefare Brook TMDL as follows:

‘Atmospheric deposition of metals that fall within a watershed will reach a stream through: runoff that contains wash off from land deposited material, direct contact with rain and dry airborne material that settles on the stream surface. It is assumed that the soil buffers and adsorbs most atmospherically deposited metals before they reach the stream through the runoff processes (except in watersheds sensitive to acidification). The other potential source is direct contact with rain and this is a nondetectable load, given the small surface area of the stream that directly receives rain. Regionally, our knowledge of trace metal deposition in flowing freshwaters is relatively limited.'

2. I wonder what, if any, impact might be attributable to the old City gravel pit on the west side of Sawyer Street. this long time open area of exposed soils is generally adjacent the stream and could likely contribute not only sediments but exposure to other issues.

Any gravel pit or source of sediment and contaminated runoff would generally be considered a watershed hot spot that would need to be addressed. Recommendations for specific sites and a strategy for implementation of Best Management Practices would be included in the Watershed Management Plan (WMP), and I assume this site will be identified as the process moves forward.

3. As you are aware, I have stated to Dave that the kids have in the past been successful in catching and releasing brook trout, specifically between Sawyer Road and Highland Avenue. Several areas hold the trout beneath the street culvert outlets and along undercut stream edges. The fish will literally perch up under the undercut (essentially beneath a grass layer) they have caught fish from 2" to 12" in size so it appears they are able to maintain a population. I am uncertain if these fish may derive from stockings that are done annually in the Hinkley Park ponds and they make their way down Kimball brook.

4. The Hinkley Park ponds maintain multiple fisheries including a heavy sunfish population, bass, pickerel. generally speaking the stocked trout either get caught by fisherman soon after stocking or they are eaten by the herons or comorants. The upper stream flowing into the upper pond also appears to have good enough conditions to support a small trout population. Both ponds and entering stream maintain a healthy snapping turtle population. The boys have observed countless turtles with size up to 18" across (the granddaddy of all snappers) The salamander population also appears strong around the park.

Both of these items provide great information for consideration in any future stream protection strategy. Fisheries enhancement is usually listed as a general goal of water quality restoration activities, but a focused fisheries restoration project is often not included. It may be appropriate on Trout Brook to include a 'Fisheries Management' section in the WMP that would include trout harvest guidelines and specific recommendations for trout habitat restoration. Protection specific to turtles and amphibians could also be incorporated into the WMP.

5. Several areas along the stream downstream of Sawyer street contain maintained residential yards. Unfortunately these landowners also have pets and are likely a source of pet waste into the brook. Perhaps a friendly discussion with landowners along the brook could help address this issue.

Good point, the combination of pet waste and lawns that border the stream is generally detrimental for stream health and habitat. I expect addressing this problem will be part of any WMP and proper disposal of pet waste is an issue many MS4 communities are addressing in their stormwater education efforts.

6. Hinkley park contains numerous trails that receive heavy use and are showing excessive signs of wear and tear and the resultant erosion of sediments into the ponds. A long Term management plan to restabilize ground within the park might go a long ways. A simple program of applying wood mulch to eroded area might benefit given the heavy mountain bike and foot traffic into the pond.

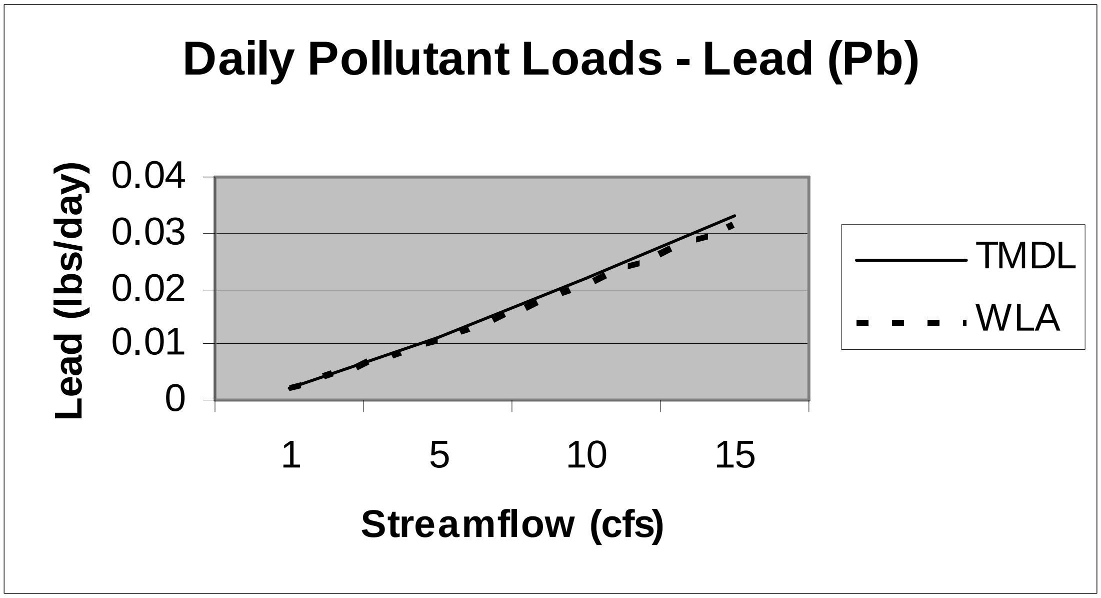
7. A long term consideration might involve rethinking of the outlet to the lower Hinckley Pond so that water is drawn from the bottom of the pond versus over the concrete spillway, hence water temperature might be cooled rather than taking the warm water off the top. Is there also a plan to maintenance dredge the ponds any time soon and if so the sediments should be tested for metals etc.

Hinckley Park and Pond are not covered in the impaired watershed identified in the Trout Brook TMDL. These ponds are part of Kimball Brook, another impaired water and will be covered in separate TMDL. When the Kimball Brook TMDL is ready for public review I send you copy and you may resubmit these comments. These comments identify pertinent restoration activities within the Kimball Brook watershed and should be included in a WMP. This also brings up an issue beyond the TMDL, -whether or not it would valuable to develop a WMP that covers both Trout and Kimball Brooks, given their proximity and downstream connection.

The technical requirements of the TMDL do not address many of your keen watershed observations, but they have been noted and will influence the direction of future watershed planning efforts. Your participation in the process will also help to move stream restoration in a positive direction and improve the local environment for residents.

Sincerely,
Melissa Evers
Maine Department of Environmental Protection
SHS #17
Augusta, ME 04330

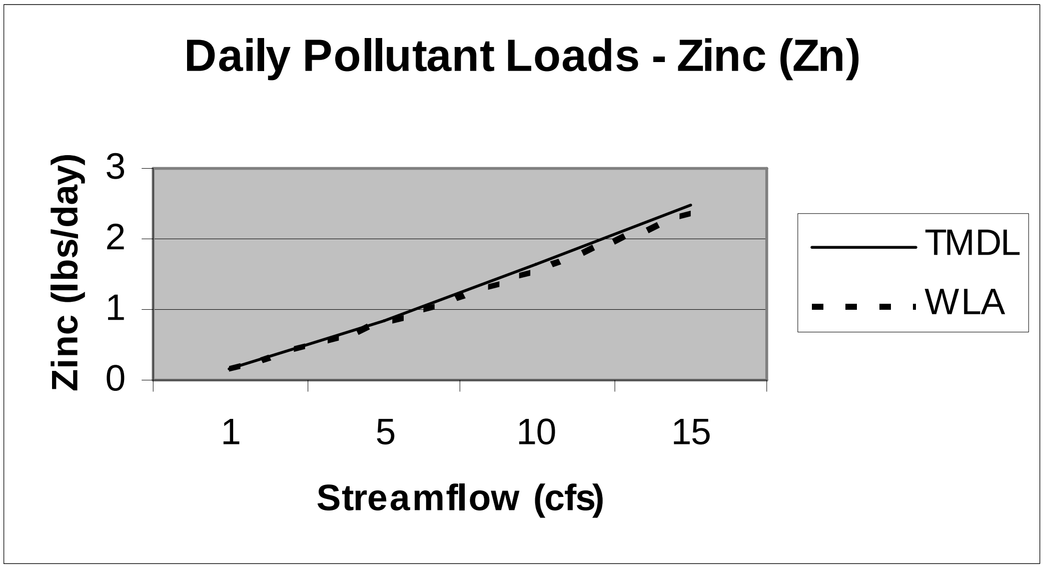
Calculated Daily Pollutant Loads for Trout Brook



Calculated Daily Pollutant Loads for Lead in Trout Brook displayed on graph.

Daily Lead (Pb) Pollutant Loads	Based on Maine SWQC @ 20 mg/l hardness Pb Criteria Chronic Concentration **CCC = 0.41 (ug/l)**	
Stream Flow[1] (cfs)	***TMDL[2] (lbs/day)***	***WLA (5%MOS)[3] (lbs/day)***
0.01	0.000022	0.000021
1	0.0022	0.0021
5	0.011	0.010
10	0.022	0.021
15	0.033	0.031

1. Stream Flow values based on the expected range of flows in Trout Brook
2. TMDL = Total Maximum Daily Load calculated using flow and SWQC CCC
3. WLA = Waste Load Allocation is 95% of the TMDL or a 5% Margin of Safety calculated for the CCC



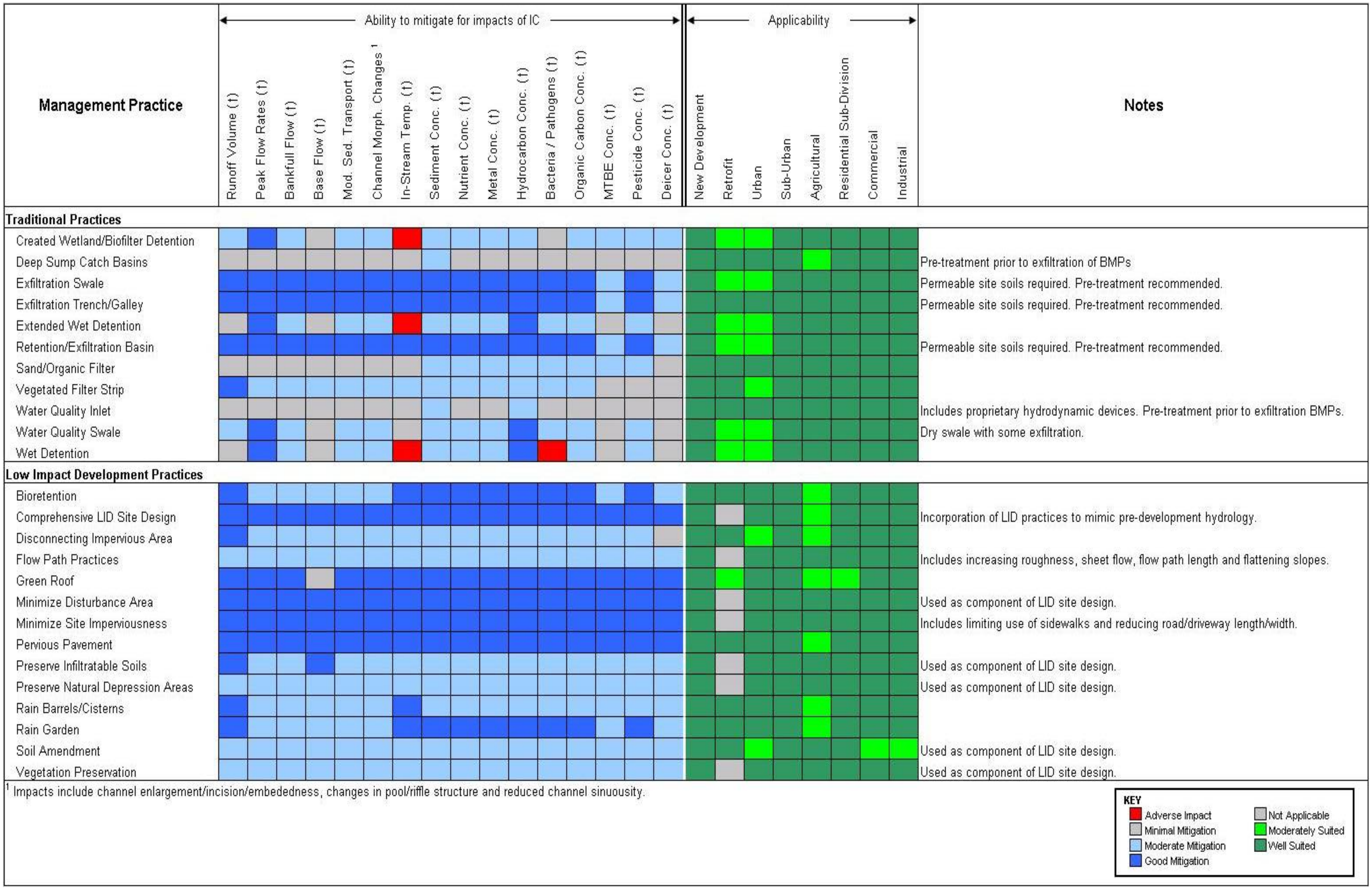
Calculated Daily Pollutant Loads for Zinc in Trout Brook displayed on graph.

Daily Zinc (Zn) Pollutant Loads	Based on Maine SWQC @ 20 mg/l hardness Zn Criteria Chronic Concentration **CCC = 30.6 (ug/l)**	
Stream Flow[1] (cfs)	***TMDL[2] (lbs/day)***	***WLA (5%MOS)[3] (lbs/day)***
0.01	0.0016	0.0016
1	0.16	0.16
5	0.82	0.78
10	1.65	1.57
15	2.47	2.35

4. Stream Flow values based on the expected range of flows in Trout Brook
5. TMDL = Total Maximum Daily Load calculated using flow and SWQC CCC
6. WLA = Waste Load Allocation is 95% of the TMDL or a 5% Margin of Safety calculated for the CCC

Best Management Practices for Mitigating Impacts of Impervious Cover

2005, ENSR Corporation, Westford, MA



WEB-BASED RESOURCES FOR INFORMATION ON STORMWATER ISSUES AND BEST MANAGEMENT PRACTICES

Note that this list is only a starting point and does not attempt to be comprehensive.

Center for Watershed Protection. Publications and Stormwater Management.
http://www.cwp.org/pubs_download.htm
http://www.cwp.org/stormwater_mgt.htm

City of Nashua, New Hampshire. 2003. Alternative Stormwater Management Methods. Part 2 – Designs and Specifications. City of Nashua, New Hampshire
http://ceiengineers.com/publications/nashuamanualpart2.pdf

Connecticut NEMO (Non-point Education for Municipal Officials). Reducing Runoff.
http://nemo.uconn.edu/reducing_runoff/index.htm

Connecticut River Joint Commissions (CRJC). 2000. Introduction to Riparian Buffers for the Connecticut River Watershed. CRJC, Charlestown, NH. 4 pp. www.crjc.org/buffers/Introduction.pdf

Cumberland County Soil and Water Conservation District. Technical Assistance.
http://www.cumberlandswcd.org/Technical%20Assistance.htm

Maine Department of Environmental Protection (MDEP). Stormwater Program, “think blue”, Nonpoint Source Pollution education, and riparian buffer information.
http://www.maine.gov/dep/blwq/docstand/stormwater/
http://www.thinkbluemaine.org/
http://www.maine.gov/dep/blwq/doceducation/nps/background.htm
http://www.maine.gov/dep/blwq/docstream/team/riparian.htm

2003a. Maine Erosion and Sediment Control BMPs. Maine Department of Environmental Protection, BLWQ, Augusta, ME; DEPLW 0588.
http://www.maine.gov/dep/blwq/docstand/escbmps/

Maine NEMO (Non-point Education for Municipal Officials). Fact sheets.
http://www.mainenemo.org/publication.htm

Maine State Planning Office (MSPO). Sprawl & Smart Growth Resources.
http://www.state.me.us/spo/landuse/resources/sprawl.php

The Stormwater Manager’s Resource Center.
http://www.stormwatercenter.net/

U.S. Department of Agriculture (US DA). US DA National Agroforestry Center, Visual Simulation for Resource Planning.
http://www.unl.edu/nac/simulation/

U.S. Environmental Protection Agency (US EPA). Stormwater Program, Low Impact Development (LID) page, and Encouraging Smart Growth.
http://cfpub.epa.gov/npdes/home.cfm?program_id=6
http://www.epa.gov/owow/nps/lid/
http://www.epa.gov/smartgrowth/

DRAFT
Maine Department of Environmental Protection

Percent Impervious Cover TMDL Guidance for Attainment of Tiered Aquatic Life Uses

This policy pertains to the innovative Impervious Cover Method (% IC) which was developed as one possible approach for Total Maximum Daily Load (TMDL) assessments in impaired rivers and streams (ENSR 2004). Many of these impaired waterbodies are located primarily in areas included in EPA's NPDES Phase 2 Stormwater Program maps for MS4s[1]. The guidelines in Table 1 apply biomonitoring data from the Maine Department of Environmental Protection (MDEP) to the % IC TMDL approach which links watershed impervious cover to stream quality. In a TMDL, the % IC method may be the sole method proposed to achieve the removal of impairments, or it may be supplemented by other abatement strategies designed to address distinct sources of stressors (such as effects of CSOs).

Table 1. Percent Impervious Cover (IC) Policy guidelines for expected attainment of Maine's designated aquatic life uses. TMDL (Loading Capacity), WLA, Waste Load Allocation; MOS, Margin of Safety.

Statutory Class	**Class attainment demonstrated in MDEP data at % IC**	**TMDL Target Values for % IC (TMDL = WLA + MOS)**		
		TMDL	**WLA[1]**	**MOS**
Class AA	~6 % [2]	Does not apply[3]		
Class A		<6 %	<5 % [4]	1 %
Class B	~8 %	7 - 10 % [4]	6 – 9 % [4]	1 %
Class C	~15 %	10 - 15 % [4]	8 – 13 % [4]	2 %

[1] Load allocation (LA) is included in the WLA because it is not feasible to calculate separately.
[2] For attainment determination, Classes AA and A are combined.
[3] Because of the high-priority, sensitive nature of Class AA streams, application of a generalized method such as the % IC method is not advised.
[4] Stream-specific targets will be chosen for each TMDL.

The goal of the TMDL is attainment of Maine's aquatic life criteria and the % IC target provides an engineering means to achieve that end. Target values represent the level of impervious cover that generally coexists with a biological community that meets aquatic life criteria as defined by Statutory Class. Achieving the % IC target requires the long-term implementation of Best Management Practices (BMPs) to effectively reduce stormwater quantity and improve quality. Each TMDL will suggest stream-specific (if possible) BMPs

[1] For maps, see www.maine.gov/dep/blwq/docstand/stormwater/maps/index.htm

and restoration techniques for short-term implementation to reduce urbanization impacts while long-term adaptive approaches are developed. No further reductions in % IC or implementation of BMPs will be required once aquatic life criteria are met (as determined by biological monitoring).

For each TMDL, MDEP staff will employ best professional judgment to set a single % IC value based on knowledge of site-specific conditions and aquatic life goals for the waterbody. These conditions can be either ameliorating or exacerbating, leading to a % IC recommendation near the upper or lower end of the range shown in Table 1 (column "TMDL"), respectively. Ameliorating conditions include existence of an adequate riparian buffer, demonstrated cold water input into the stream, an intact flood plain, or a highly permeable soil group. Exacerbating conditions include absence of an adequate riparian buffer, loss of the flood plain, an impermeable soil group, naturally stressful in-stream conditions (e.g., lower dissolved oxygen concentrations or elevated temperature due to an upstream wetland), a concentration of imperviousness in one reach of a stream, or a documented pollution legacy of the watershed (e.g., from long-established industrial site). Other ameliorating or exacerbating circumstances may be considered on a case by case basis.

The % IC guidelines in Table 1 are based on analysis of MDEP Biomonitoring Program data from 43 macroinvertebrate samples collected between 1994 and 2004 from 32 watersheds of first to third order in size[1] that were influenced by differing amounts of % IC (minimum 5 %) upstream of the sampled location (Appendix 1). Detectable changes in structural characteristics of aquatic assemblages (fish and benthic macroinvertebrates) are noted, in the scientific literature, to occur above ~10 % IC (Paul and Meyer 2001, CWP 2003). Analysis of Maine macroinvertebrate data supports this finding, with streams above 8 % IC rarely attaining Class B aquatic life numeric criteria (Code of Maine Rules 06-096, Chapter 579*: "Classification Attainment Evaluation Using Biological Criteria for Rivers and Streams").* Class B criteria are designed to support the narrative standard of "no detrimental change in the resident biological community" (Title 38 MRSA §465). Class C is the lowest condition allowed for Maine rivers and streams, and "discharges to Class C waters may cause some changes to aquatic life". Class C criteria are designed to support the narrative standard of "maintenance of structure and function of the resident biological community." The Maine data also indicate that impervious cover of 15 % is adequate, in most cases, for attainment of Class C numeric aquatic life criteria. The % IC guideline ranges specified in Table 1, column "TMDL", were selected to cover % IC values found adequate to support water quality Classes B and C in Maine, while also accounting for the % IC quoted in the literature (10 %, CWP 2003) as impacting aquatic systems.

Tiered designated uses in Maine's water quality standards are designed to provide four levels of protection for rivers and streams. Waterbodies are assigned to a designated use class that represents the highest attainable goal condition, taking into account current environmental conditions (e.g., attainment status for dissolved oxygen, bacteria, and aquatic life standards) as well as socioeconomic factors. As shown in Table 2,

Table 2. Percent of river and stream miles in Maine's designated use

Statutory Class	**% of total miles**
Class AA	6 %
Class A	45 %
Class B	47 %
Class C	2 %

[1] The % IC method for urban stream TMDLs is only appropriate for streams of 1st to 3rd order.

most river and stream miles in the state are managed for Class AA/A[1] or Class B conditions and thus would require application of the <6 % or 7-10 % IC guidelines, respectively.

It is expected that an adaptive management approach to implementing stream restoration techniques and BMPs, including a reduction in % IC, will lead to an improvement in macroinvertebrate communities. If aquatic life criteria are not met after a first phase of implementation, the initial TMDL approach will be re-evaluated and further recommendations be made based on new insights gained.

References

Center for Watershed Protection (CWP). 2003. Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph No. 1. CWP, Ellicott City, MD. 142 pp.

ENSR Corporation. 2004. Draft, Pilot TMDL Applications using the Impervious Cover Method. Document # 10598-001-002.

Paul M.J., Meyer J.L. 2001. Streams in the Urban Landscape. Ann Rev Ecol Sys 32: 333-365.

[1] Very few Class AA/A waterbodies are currently in urban areas so that the % IC policy will be applied only rarely to such streams. MDEP’s 2004 303(d) list includes no Class AA/A streams with “Urban NPS” as the potential source of aquatic life impairment.