UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
1 Congress Street, Suite 1100
BOSTON, MA 02114-2023

March 28, 2007

Betsey Wingfield, Chief
Bureau of Water Protection and Land Reuse
Connecticut Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

Dear Ms. Wingfield:

Thank you for the final **Total Maximum Daily Load Analysis for Eagleville Brook, Mansfield, CT**. This TMDL uses percent impervious cover (%IC) as a surrogate for the mix of pollutants in stormwater. Eagleville Brook_01 and Eagleville Brook_02 were included on Connecticut's 2004 303(d) List as priority waters for TMDL development for non-attainment of Class A aquatic life support. Eagleville Brook remains on the final 2006 303(d) list that is currently pending EPA approval. TMDL analyses for the two waterbody segments have been submitted to EPA for approval.

The U.S. Environmental Protection Agency (EPA) hereby approves Connecticut's TMDL dated February 8, 2007. EPA has determined that this TMDL meets the requirements of Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations (40 CFR Part 130). Attached is a copy of our approval documentation.

This TMDL analysis is based upon Connecticut's methodology entitled, *Percent Impervious Cover as a Surrogate Target for TMDL Analyses in Connecticut*, last revised on December 14, 20006 . The technical support document for this method is detailed in Appendix B of the TMDL analysis. This is the first application of this method in the State. This approach to calculating the TMDL does not alter CT's standing policy of assessing use support in accordance with *Connecticut Consolidated Assessment and Listing Methodology (CT-CALM).*

Connecticut continues to make progress in addressing the State's water quality impairments through adoption of this new approach for TMDLs in small watersheds impaired by stormwater and nonpoint source pollution. My staff and I look forward to continued cooperation with the CT DEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Mary Garren at (617) 918-1322. Thank you very much.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

attachment

cc with attachment:
Paul Stacey, CT DEP
Lee Dunbar, CT DEP
Traci Iott, CT DEP
Chris Bellucci, CT DEP
Steve Silva, EPA
Mary Garren, EPA

EPA NEW ENGLAND'S TMDL REVIEW

TMDL: **A Total Daily Maximum Load Analysis for Eagleville Brook, Mansfield, CT**

CT Waterbody Segments on the State of Connecticut 2004 List of Connecticut Water Bodies Not Meeting Water Quality Standards (303(d) of the Federal Clean Water Act):

Waterbody Name	**(Segment ID)**
Eagleville Brook_01	CT3100-19_01
Eagleville Brook_02	CT3100-19_02

STATUS: Final

IMPAIRMENT/POLLUTANT: Aquatic life use impairment measured by Class A aquatic life criteria for benthic invertebrates which inhabit lotic waters; primary sources are urban nonpoint sources; TMDLs are established in terms of percent impervious cover (%IC serving as a surrogate for the mix of pollutants in stormwater)

BACKGROUND: The Connecticut Department of Environmental Protection (CT DEP) submitted a draft TMDL to EPA on September 1, 2006. The draft TMDL was public noticed on September 1, 2006 in the Hartford Courant and Willimantic Chronicle. Comments were accepted until October 6, 2006. CT DEP prepared a response to public comment which was submitted along with the final TMDL to EPA. All comments from EPA and the public were taken into account in the Response to Comments and the final TMDL submission. In addition to the TMDL itself, the submittal included, either directly or by reference, the following additional documents:

- Stressor Identification Eagleville Brook, Appendix 1.
- Percent Impervious Cover as a Surrogate Target for TMDL analyses in Connecticut, Appendix 2.
- Response to Comment for a Total Maximum Daily Load Analysis for the Eagleville Brook, Mansfield, Connecticut, February 8, 2007.
- University of Connecticut Campus Sustainable Design Guidelines, JJR Smithgroup, 2004. http://www.masterplan.uconn.edu/images/SDG-web.pdf
- Connecticut Department of Environmental Protection. 2004. *Connecticut Stormwater Quality Manual.* 79 Elm Street, Hartford, CT 06106. http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325704&depNav_GID=1654#download
- Connecticut Department of Environmental Protection. 2002. *Connecticut Consolidated Assessment & Listing Methodology for 305 (b) and 303(d) Reporting.* 79 Elm Street, Hartford, CT 06106. http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325612&depNav_GID=1654

- Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* EPA/444/4-89-00. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

The following review explains how the TMDL submission meets the statutory and regulatory requirements of TMDLs in accordance with § 303(d) of the Clean Water Act and EPA's implementing regulations in 40 CFR Part 130.

REVIEWER: Mary Garren (617-918-1322) email: garren.mary@epa.gov

REVIEW ELEMENTS OF TMDLs

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. § 130 describe the statutory and regulatory requirements for approvable TMDLs. The following information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation.

1. Description of Waterbody, Pollutant of Concern, Pollutant Sources and Priority Ranking

The TMDL analytical document must identify the waterbody as it appears on the State/Tribe's 303(d) list, the pollutant of concern and the priority ranking of the waterbody. The TMDL submittal must include a description of the point and nonpoint sources of the pollutant of concern, including the magnitude and location of the sources. Where it is possible to separate natural background from nonpoint sources, a description of the natural background must be provided, including the magnitude and location of the source(s). Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the assumed distribution of land use in the watershed; (2) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (3) present and future growth trends, if taken into consideration in preparing the TMDL; and, (4) explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments, or chlorophyll a and phosphorus loadings for excess algae.

A. Description of Waterbody and Background Information

The TMDL document provides a description of Eagleville Brook, including location, drainage area, and tributary information. The Eagleville Brook watershed drains a portion of the University of Connecticut (UCONN) main campus. Two sections of the upper segment of the brook (totaling 2300 linear feet) are piped beneath the campus. The drainage basin (2.4 sq. mi.) is not located within a NPDES Phase II Stormwater urbanized area. CT DEP has the authority to require point sources of stormwater in the watershed to obtain CT stormwater discharge permits (page 11, main document). UCONN, a primary source of stormwater, has been willing to work cooperatively with CT DEP to implement stormwater management activities that would preclude the need for permitting at this time (page 8, response to comments).

B. Pollutant of Concern

Eagleville Brook in Mansfield, CT is currently included on Connecticut's 2004 §303(d) list for non-attainment of the Class A aquatic life criteria of the Connecticut 2002 Water Quality Standards (WQS). It remains on the final 2006 303(d) list that is currently pending EPA approval. Exceedances of aquatic life criteria are determined based on biological monitoring of benthic invertebrates. The two waterbody segments (CT3100-19_01 and CT3100-19_02) that drain the 2.4 square mile watershed of Eagleville Brook were identified on the 2004 303(d) list as waters biologically impaired and with no pollutant cause identified.

A Stressor Identification (SI) analysis subsequently identified the most probable cause of the impairment as a complex array of pollutants transported by stormwater (page 6, main document). The physical impacts of stormwater flows were also identified as an impairment cause (page 12, Appendix 1). This TMDL analysis was developed using Impervious Cover (IC) as a surrogate for the mixture of pollutants conveyed by

stormwater to Eagleville Brook. There is insufficient information available on natural background levels of pollutants in the watershed, so it was not possible to separate natural background load from the total nonpoint source load.

Connecticut's stressor identification process yielded the conclusion that biological impairments were due primarily to a combination of pollutants and other stressors related to stormwater runoff from developed areas (Appendix 1). The major sources are stormwater from the impervious surfaces within the watershed, e.g. in the Town of Mansfield and at UCONN. Stormwater flows impact the brook through the high variability in stormwater volumes, embedded substrate caused by sediment runoff, and the transport of contaminants via stormwater. There are no NPDES-regulated point sources in the watershed other than, potentially, stormwater associated with construction activities disturbing more than one acre of land. Non-NPDES regulated point and nonpoint sources are the primary vehicles by which stormwater is transported into Eagleville Brook.

Given the importance of stormwater runoff to the Eagleville Brook TMDL, CT DEP has used the total **extent of impervious cover (%IC)** in the watershed as a **surrogate** for the complex mixture of pollutant and non-pollutant aquatic life stressors which are attributable to stormwater runoff from developed areas (page 6, main document and page 2, Appendix 2). A number of urban stressors and their sources can be addressed simultaneously by reducing % IC or its effects, and DEP refers to a list of remediation options in the "Implementation Plan" section of the TMDL report. Referenced in this section is the *University of Connecticut Campus Sustainable Design Guidelines*, among other relevant documents. The design guidelines provide extensive detail on actual plans for implementing % IC and stormwater runoff reduction on campus.

CT DEP provides an explanation and analytical basis for assessing the TMDL for aquatic life impairment through the use of surrogate measures (pages 6-7, main document and Appendix 2). Appendix 2, *Percent Impervious Cover as a Surrogate Target for TMDL Analyses in Connecticut*, goes into detail on the basis for the impervious cover TMDL approach and selection of the %IC target.

C. Pollutant Sources

The document explains that the source of pollutant loads is stormwater runoff from the Eagleville Brook watershed. In addition to carrying pollutants from the watershed, increased stormwater volume is destabilizing the Eagleville Brook channel, releasing sediment from stream banks, degrading stream habitat and washing out biota.

CT DEP identifies the magnitude and location of point sources and nonpoint sources (in terms of land use distribution in the watershed). Analysis shows that land uses in the watershed are 74% forested, 12% urban/developed, 10% open space, 2% water/wetland, and 2% agriculture (page 1, Appendix 1).

Priority Ranking

The brook was listed as a priority "T" meaning the waterbody was under study and a TMDL was planned for development.

Assessment: EPA Region 1 concludes that the TMDL document meets the requirements for describing the TMDL waterbody segment, pollutants of concern, identifying and characterizing sources of impairment, and priority ranking.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribe water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation. A numeric water quality target for the TMDL (a quantitative value used to measure whether or not the applicable water quality standard is attained) must be identified. If the TMDL is based on a target other than a numeric water quality criterion, then a numeric expression, usually site specific, must be developed from a narrative criterion and a description of the process used to derive the target must be included in the submittal.

The TMDL report defines the appropriate water quality criteria for aquatic life protection, designated uses (including habitat for fish and aquatic life) (page 7, main document), and anti-degradation policy (page 12, main document). Water quality classification and water quality standards of all surface waters of the State of Connecticut have been written in accordance with Connecticut's Clean Water Act, Chapter 446K of the Connecticut General Statutes. According to Connecticut's water classification, Eagleville Brook is classified as Class B/A. It is a Class A waterbody, not meeting Class A water quality criteria and designated uses. In order for a waterbody to attain its optimal classification, all applicable surface water quality standards must be met (page 7, main document).

The impact of excessive stormwater runoff into Eagleville Brook has resulted in a violation of the CT water quality standards (WQS), specifically the applicable aquatic life criteria for benthic invertebrates which inhabit lotic waters. The Eagleville Brook % IC TMDL is tied to achieving Connecticut's Class A water quality criteria and the attainment of Class A designated uses. Connecticut's narrative water quality standards applicable to Class A waters include the following aquatic life criterion:

> *<u>Benthic Invertebrates which inhabit lotic waters</u>*
> *A wide variety of macroinvertebrate taxa should normally be present and all functional feeding groups should normally be well represented. Presence and productivity of aquatic species is not limited except by natural conditions, permitted flow regulation or irreversible cultural impacts. Water quality shall be sufficient to sustain a diverse macroinvertebrate community of indigenous species. Taxa within the Orders Plecoptera (stoneflies), Ephemeroptera (mayflies), Coleoptera (beetles), and Trichoptera (caddisflies) should be well represented.*

It has been determined through biological monitoring that aquatic life use goals are not being met in Eagleville Brook. Connecticut's *Consolidated Assessment and Listing Methodology* presents the aquatic life support categories and contributing decision criteria for wadeable streams. Impaired sites are identified through fish population surveys and benthic invertebrate assessment. Eagleville Brook has observed low fish densities (Table 1, main document) and large areas almost devoid of fish. An extensive benthic invertebrate assessment was conducted using EPA's Rapid Bioassessment Protocol (RBP) III Benthic Community Score. Both the taxa richness (total number of taxa) and sensitive taxa (taxa which decrease in abundance in response to stress) were lower than found in healthy streams meeting aquatic life criteria. CT DEP assesses compliance with water quality standards for aquatic life criteria using RPB % of reference score as described in Connecticut's *Consolidated Assessment and Listing Methodology*. All sites in Eagleville Brook were determined to have an RBP score <54% of the reference which Connecticut has defined as their impairment threshold based on comparison of balanced indigenous aquatic communities of healthy reference streams to stressed communities of impaired streams.

Establishment of the water quality target

Because the impairment is based on biological indices, there is no numeric pollutant criterion to use as the TMDL target. Instead, the instream target is expressed as a measure of the watershed impervious cover condition believed necessary to achieve the Connecticut water quality criteria for aquatic life. As described in more detail below, a TMDL target of 12% impervious cover (with wasteload and load allocations of 11% after a 1% margin of safety) was established for Eagleville Brook, based on the impervious cover conditions of many reference watersheds both in Connecticut and across the country where watershed impervious cover and attainment of aquatic life criteria have been compared. This impervious cover target serves as an indicator for sediment and sediment-associated pollutants, along with the other stressors to aquatic life such as channel scour and loss of pool/riffle habitat. Based on the comparison with the attainment watersheds, the target impervious cover condition represents the condition in which all these stressors are reduced to levels compatible with attainment of the aquatic life criteria. The TMDL document explains which watersheds were selected for impervious cover target threshold development, and the statistical and scientific basis for the selection.

Assessment: EPA Region 1 concludes that CT DEP has properly presented its water quality standards, and has made a reasonable interpretation of its water quality standards for the designated uses of Eagleville Brook. CT DEP considers waters with an RBP score of <54% to be impaired for aquatic life uses, and Eagleville Brook's scores ranged from 20% to 50%, clearly a condition of impairment. As explained in Appendix 2, achieving the % IC target of 12% is expected to result in an RBP score of at least 54%, which corresponds to the lower end of the range of the "slightly impaired" biological condition category in EPA's Rapid Bioassessment Protocol. The reference streams CT used to develop their RPB protocol are high quality so that a stream with an RPB score of 54% still has adequate biodiversity to meet CT's narrative aquatic life criterion. CT DEP will use site specific biomonitoring in accordance with the "fully supporting" criteria of

Connecticut's *Consolidated Assessment and Listing Methodology* in making a decision on when water quality standards have ultimately been achieved. The Region believes that Connecticut has taken a reasonable approach in establishing the surrogate % IC that is expected to result in the Brook attaining water quality standards.

The use of a surrogate impervious cover target in place of a numeric pollutant target is appropriate in this case because the impervious cover target serves as an indicator for conditions under which the water quality criteria for aquatic life can be attained. Appendix 2 of the TMDL submission provides a reasonable basis for linking % IC to attainment of aquatic life criteria and uses.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a water can receive without violating water quality standards (40 C.F.R. § 130.2(f)). The loadings are required to be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. § 130.2(i)). The TMDL submittal must identify the waterbody's loading capacity for the applicable pollutant and describe the rationale for the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In most instances, this method will be a water quality model. Supporting documentation for the TMDL analysis must also be contained in the submittal, including the basis for assumptions, strengths and weaknesses in the analytical process, results from water quality modeling, etc. Such information is necessary for EPA's review of the load and wasteload allocations which are required by regulation.

In many circumstances, a critical condition must be described and related to physical conditions in the waterbody as part of the analysis of loading capacity (40 C.F.R. §130.7(c)(1)). The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence. Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards.

Use of impervious cover as a surrogate for sediment and other pollutants
Impervious cover is used as the surrogate for the instream water quality target (attainment of aquatic life criteria), and for the loading capacity (i.e., the maximum amount of pollutant inputs from the watershed that still allows attainment of Connecticut's water quality standards).

As discussed in the TMDL documentation, a combination of pollutants found in stormwater, including sediment (from wash-off and instream sources) and associated pollutants such as metals, is contributing to the aquatic life impairment in Eagleville Brook. However, there is no information that indicates that any pollutant is causing or contributing to an exceedence of any pollutant specific water quality criterion. Nor is there sufficient information available to identify specific pollutant loadings which, in combination, are contributing to the aquatic life impairment, particularly given the variability in types and amounts of pollutants depending on a range of storm events. On the other hand, there is a strong correlation between pollutant loads and impervious

cover, for the reasons explained in the TMDL and supporting documentation. Therefore the TMDL uses the surrogate measure of impervious cover to represent the combination of pollutants and other stressors that contribute to the impairment of Eagleville Brook.

Establishment of TMDL Percent Impervious Cover (% IC) targets
In a pollutant-specific TMDL, a stream's loading capacity is the greatest amount of pollutant loading the water can receive without violating water quality standards. In this TMDL, because the "pollutant of concern" is represented by the surrogate measure of impervious cover, the loading capacity is the greatest amount of impervious cover the Eagleville Brook watershed can support without violating the stream's aquatic life criteria.

The impervious cover method for illustrating the connection between land development and water quality was developed by the Center for Watershed Protection (CWP, March 2003[1]). The research monograph, *Impacts of Impervious Cover on Aquatic Systems*, establishes the linkage between the level of IC in the watershed (causal variable), and water quality as measured by aquatic life criteria (response variable). (1, page 2) CWP's IC model is based on estimates of total % IC. Use of the impervious cover method (ICM) for TMDL development was suggested and piloted by ENSR in EPA Region 1 in 2004-5[2], and involves:

- Watershed delineation;
- Mapping or estimation of total impervious cover;
- Establishment of %IC target for unimpaired conditions based on State, Region and National information;
- Comparison of estimated % IC to the % IC target for un-impaired conditions; and
- Calculation of % IC reduction from current conditions (TMDL implementation objective) needed to attain water quality.

Connecticut DEP developed the support document for using this method in Connecticut (Appendix 2) entitled, *Percent Impervious Cover as a Surrogate Target for TMDL Analyses in Connecticut*, after extensive peer review within and outside the government agencies. A total of 125 sites met the criteria as outlined in the section on "Applicable Streams" in Appendix 2 and were considered in this analysis. Sites were evaluated 1) graphically using scatter plots and box plots and 2) using summary statistics. Since IC estimates were available for four years - 1985, 1990, 1995, and 2002 - the IC dataset from the closest year preceding the monitoring date was used in all cases.

Scatter plots from the Applicable Streams in Connecticut showed that taxa richness (total number of taxa) and EPT taxa (taxa in the orders Ephemeroptera, Plecoptera, and Trichoptera) generally decreased with increasing IC (Figure 2, Appendix 2). As a group, EPT taxa can be characterized as sensitive taxa and often occur in decreased abundance in response to environmental stress.

Applicable Streams were further separated in two groups - 1) those that met Connecticut aquatic life criteria as assessed using RBP % of reference score and 2) those that did not meet Connecticut's aquatic life criteria. The general trend observed in these data was that

the % IC was lower for streams that met Connecticut's aquatic life criteria than sites that did not meet Connecticut's aquatic life criteria, although there was some overlap in the upper quartile of the "meet" group with the lower quartile of the "do not meet" group (Figure 3, Appendix 2).

Figure 4 (Appendix 2) demonstrates a "threshold" effect in that as the % IC increases to approximately 12%, no Applicable Streams met Connecticut's aquatic life criteria (i.e., >54% reference community). Based on this analysis, the CTDEP believes that 12% IC is a good threshold for aquatic life impairments. It is recognized that IC may not be the direct factor causing the impairment, but that there is a strong enough relationship to use IC as a surrogate measure in situations when a Stressor Identification analysis has determined that stormwater is the primary candidate cause of the aquatic life impairment. For impaired streams with less than 12 % IC upstream, factors other than stormwater will be investigated using the Stressor Identification Procedures employed by DEP.

The TMDL submission explains the use of the impervious cover model to establish the link between water quality (attainment of aquatic life and other criteria) and the mix of pollutants in stormwater runoff. It also describes the benefits of using IC as a surrogate for aquatic life impairments caused by stormwater, including the quantifiable relationship linking IC and aquatic life use support; the cause of impairment being the mixture of pollutants transported by stormwater; consistency with the DEP strategy to address stormwater impacts; the ease of comprehension by the public; and use of readily available information for TMDL development (page 6, Appendix 2). The report provides a discussion of and recommendations for TMDL implementation (page 11, main document). Referenced documents provide extensive detail on implementation of stormwater reduction in the watershed.

In addition to the work done in Connecticut to support use of this method, Table 1 in Appendix 2 presents the very large number of studies conducted that scientifically support the method. The strength of evidence provided by these studies in support of the impervious cover approach to the Eagleville Brook TMDL is robust.

Eagleville Brook meets the criteria (Appendix 2) for application of the Connecticut IC method. The brook has benthic monitoring locations with RPB III level of effort, an upstream drainage area <50 square miles (2.4 square miles), and stressor identification analysis that indicates the complex array of pollutants and hydrologic stress associated with stormwater is the cause of impairment (page 6, main document). CT DEP explains the assumptions, strengths and weaknesses of the analytical process which is appropriate for the TMDL assessment of small stormwater-impaired streams.

The loading capacity or TMDL target for Eagleville Brook is set at 12% IC (page 7, main document), which is the threshold observed for Applicable Streams below which the streams are capable of supporting a macroinvertebrate community that meets aquatic life use goals in Connecticut’s Water Quality Standards. A summary of the TMDL analysis for Eagleville Brook is presented in Table 4 below. The TMDL target, wasteload allocation (WLA) and load allocation (LA), margin of safety (MOS), current conditions and TMDL implementation objectives are identified for both segments of Eagleville

Brook. As shown in Table 4, two separate TMDL implementation objectives are calculated for segment, CT 3100-19_02 based on current IC data from two locations within Eagleville Brook_02.

Table 4 - Summary of TMDL analysis for Eagleville Brook. (from page 9, main document)

Waterbody Name and Segment ID	Map ID	Waterbody Segment Description	Percent Impervious Cover				TMDL Implementation Objective
			TMDL Target	WLA and LA	MOS	Current Condition	
Eagleville Brook_01 CT 3100-19_01	1	From the mouth at Eagleville Pond upstream to confluence with Kings Brook, Mansfield.	12 %	11%	1%	5 %	Anti-degradation
Eagleville Brook_02 CT 3100-19_02 (Map ID 2)	2	From confluence with Kings Brook to headwaters near UCONN campus.	12 %	11%	1%	14 %	21 % Reduction in % IC accomplished by improved stormwater management
Eagleville Brook_02 CT 3100-19_02 (Map ID 3)	3	Unnamed Pond on UCONN Campus (contained within CT 3100-19_02)	12 %	11%	1%	27%	59 % Reduction in % IC accomplished by improved stormwater management

The % IC TMDL and WLA/LA targets apply at all times (instantaneous, daily, monthly, seasonal, annual) and will therefore achieve reductions in stormwater runoff volume in all storm
events whenever they occur (e.g., on any given day) throughout the year (page 9, main document).

Critical conditions

The % IC loading capacity for Eagleville Brook is set to protect water quality and support uses during *critical conditions*. Since stormwater occurs throughout the year, with different environmental effects, at both low and high flows, critical conditions for aquatic life protection are not limited to particular flow conditions or time of year. Benefits realized from IC reductions will occur in all seasons because stormwater controls to be implemented to meet the IC targets will reduce adverse impacts (pollutant loading and damaging flows) for the full spectrum of storms throughout the year (page 10 main document).

Assessment: EPA Region 1 concludes that Connecticut selected a reasonable surrogate (percent impervious cover (% IC)) for the complex mixture of pollutant and non-pollutant stressors causing water quality impairment, and that the targets have all been appropriately set at levels necessary attain and maintain applicable water quality standards in Connecticut. The loading capacity is based on a reasonable approach for establishing the relationship between pollutant loading in stormwater runoff and water quality in stormwater-impaired streams. Furthermore, the % IC TMDL is based on an analysis of Connecticut-specific biological monitoring data (pages 3-5, main document and Appendix 2). EPA also concludes that Connecticut adequately documented the assumptions and strengths and weaknesses in the modeling approach used to support the establishment of the % IC loading capacity, and properly accounted for critical conditions for all the TMDLs established. The bases for these conclusions are explained below.

Connecticut's use of a surrogate is reasonable and appropriate

While TMDLs are intended to address impairments resulting from pollutants, there is nothing in EPA's regulations that forbids expression of a TMDL in terms of a surrogate for pollutant-related impairments. EPA's regulations state that TMDLs can be expressed in several ways, including in terms of toxicity, which is a characteristic of one or more pollutants, or by some "other appropriate measure." 40 C.F.R. § 130.2(i). They also state that TMDLs may be established using a biomonitoring approach as an alternative to the pollutant-by-pollutant approach. 40 C.F.R. § 130.7(c)(1). For the same reasons described above relating to the appropriateness of using impervious cover as a surrogate water quality target, EPA concludes that the use of impervious cover as a surrogate for the loading capacity is also reasonable and appropriate. EPA believes this surrogate approach is suitable for small stream systems such as Eagleville Brook, where the impairment is for aquatic life, where stormwater is the cause of the impairment, and where no specific pollutant criterion is being violated.

TMDL for Percent Impervious Cover (% IC)

EPA Region 1 concurs with expressing the TMDL surrogate for stormwater pollutants and impacts as a % IC TMDL, based on the reasons provided by CT DEP in the TMDL and as discussed below. Strong evidence exists for the direct relationship between total watershed IC and increased stormwater runoff volume and peak discharge [(1, page 37)] and lower baseflows. IC increases the volume of stormwater runoff and therefore, the total pollutant load [(1, page 91)].

The scientific record documenting the impact of watershed urbanization on surface water quality and the integrity and diversity of aquatic communities is quite strong. Research from the mid-1990's pointed to the emergence of impervious surface coverage as a key environmental indicator [(5, pages 243-258)]. Scientific literature summarized in 2003 generally shows that aquatic insect and freshwater fish diversity declines at fairly low levels of impervious cover (10-15% IC), and urban land use of 33% [(1, page 116)]. In general, the data summaries from CWP document that stream habitat diminishes at about 10% watershed IC, and becomes severely degraded beyond 25% watershed IC [(1, page 54)]. Earlier research has shown that the variety of fish species drops as well [(4, pages 28-31)].

The regional scientific record documenting the linkage between % IC and the integrity and diversity of aquatic communities is also strong, and growing. Recent study results from USGS in the New Hampshire seacoast region confirm that the percent impervious surface in a watershed can be used as an indicator of stream quality: the biological condition score was negatively correlated with the percent impervious surface [(7)]. The study of benthic monitoring sites sampled by CTDEP from 1996 to 2001 (and more recently, a group of sites selected based on a probabilistic sampling design) demonstrated a threshold effect in Connecticut small streams: as the % IC increases to approximately 12%, no streams met Connecticut's aquatic life criteria (Appendix 2).

Various studies have reported changes in fish assemblage composition and feeding ecology, with altered assemblages often occurring at relatively low levels of urbanization (e.g., 10-15% imperviousness). [(10, page 657)]

The CWP states that the IC model and 10% IC threshold applies to small streams (1st – 3rd order) in the East Coast and Midwest [(1, page 116)]. Earlier research from the CWP shows the influence of impervious cover on watersheds to be *very strong* at the catchment level (0.05 to 0.50 sq. mi.), *strong* at the subwatershed level (1 to10 sq. mi.), and *moderate* at the watershed level (10-100 sq. mi.) [(6 page 135)]. This makes sense because in smaller watersheds, the IC is more likely to be located in proximity of the monitoring location, whereas high IC clusters in a large watershed may be located far upstream of the monitoring site, and may have no effect on the macroinvertebrates at the monitoring location. For this reason, CT DEP limited its analysis of CT benthic monitoring sites to those located with upstream drainage areas of <50 square miles (page 3, Appendix 2). With a watershed size of 2.4 square miles (1572 acres), Eagleville Brook watershed in Connecticut falls within the category of strongly influenced by impervious cover.

EPA concurs with Connecticut's assessment of the strengths and limitations of the ICM as applied to Eagleville Brook. The IC model is appropriate for Eagleville Brook for several reasons. First, the State is located in the East Coast range of applicability identified by the CWP. Second, Eagleville Brook meets the criteria established by CT DEP for developing the IC target and use of this method (page 6, main document). Furthermore, there are no known significant non-stormwater sources in the Eagleville Brook watershed (page 26 TMDL report). For the reasons explained above, EPA believes the % IC surrogate approach is suitable for Eagleville Brook, where the impairment is for aquatic life, and where stormwater, with its associated pollutant and other stressors, is the cause of the impairment. Additionally, use of an impervious cover target offers an implementation advantage because it relates directly to both the source of impairment and BMP measures needed to restore water quality.

Critical Conditions

The critical conditions for Eagleville Brook are associated with storm events from developed areas which, in addition to potential immediate damage to aquatic biota, produce cumulative impacts to the biota over time. These urban/suburban storm events dramatically change watershed hydrology by affecting the quantity and quality of runoff. Urban development results in increases in stormwater runoff peaks and volumes [(8)], and

increased frequency of runoff from smaller storms. As the amount of impervious cover in watersheds increases, greater quantities of stormwater runoff wreak havoc with the physical structure and stability of streams and the habitat for aquatic life, while increased runoff of pollutants create water quality problems, and less base flow is available to aquatic life in streams during low flow periods. (9, page 1-1)

These higher peak volumes scour macroinvertebrates along with other stream bed materials. Lower base flows reduce the amount and extent of wetted aquatic habitat, and increase aquatic temperatures and stress on aquatic life. More frequent post-development runoff from smaller storms (that used to infiltrate or soak into pervious ground and surfaces) subject aquatic life to more frequent exposure to pollutants, and increased destabilization of stream morphology and aquatic habitat.

EPA concludes that critical conditions are adequately accounted for because the TDML reduction targets directly address the effect of % IC on stormwater runoff in the watershed, and thus the range of the stormwater impacts under varying critical conditions at different flows.

TMDL Time Increment / Daily Loading

EPA's November 15, 2006 guidance entitled "Establishing TMDL 'Daily' Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No.05-5015, (April 25, 2006) and Implications for NPDES Permits," recommends that TMDL submittals express allocations in terms of daily time increments. In this case, the TMDL's % IC targets are not explicitly expressed in terms of a daily increment. However, they are, in effect, daily targets because they will achieve reductions in stormwater runoff volume in all storm events whenever they occur (e.g., on any given day) throughout the year (page 9, main document).

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity allocated to existing and future nonpoint sources and to natural background (40 C.F.R. § 130.2(g)). Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. § 130.2(g)). Where it is possible to separate natural background from nonpoint sources, load allocations should be described separately for background and for nonpoint sources.

If the TMDL concludes that there are no nonpoint sources and/or natural background, or the TMDL recommends a zero load allocation, the LA must be expressed as zero. If the TMDL recommends a zero LA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero LA implies an allocation only to point sources will result in attainment of the applicable water quality standard, and all nonpoint and background sources will be removed.

The TMDL loading capacity of 12% IC was adjusted by 1% for a margin of safety (discussed further below), yielding an overall allocation target of 11% IC. The TMDL applies the 11% IC target to all stormwater drainage areas and affects all sources subject to load allocations (LA) and wasteload allocations (WLA) in the watershed (**WLA=LA=11% IC**). The % impervious cover reductions required to achieve the WLA and LA target are calculated by:

Percent IC Reduction = ((IC Current Condition – IC Target)/IC Current Condition) x 100
where the IC Target = 11%

See page 9, Table 4 above for the expected reductions for each segment of the Brook.

The TMDL target is based on achieving an impervious cover goal across the whole watershed. It is not feasible to separate into separate allocation categories the impervious cover associated with stormwater contributions from nonpoint sources, regulated point sources, and unregulated point sources. Therefore, the impervious cover target applies to all impervious cover in the watershed as a common WLA/LA TMDL target.

Assessment: The impervious cover target applies irrespective of the type of stormwater (nonpoint source or point source) that is generated from any given parcel. Because insufficient data are available for each parcel in the watershed, it is not feasible to establish specific % IC allocations for each area that generates stormwater, nor is it feasible to draw a clear distinction between stormwater from nonpoint sources, non-NPDES regulated point sources, and NPDES-regulated point sources (which would require a wasteload allocation – see next section). Therefore, EPA agrees that it is reasonable to allocate the % IC with a common WLA/LA target. Furthermore, the control measures necessary to achieve reductions in the level of effective impervious cover (including abatement of point and nonpoint sources of stormwater) are not affected by this practice. EPA Region 1 concludes that the load allocation is adequately specified in the TMDL at a level necessary to attain and maintain water quality standards.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to existing and future point sources (40 C.F.R. § 130.2(h)). If no point sources are present or if the TMDL recommends a zero WLA for point sources, the WLA must be expressed as zero. If the TMDL recommends a zero WLA after considering all pollutant sources, there must be a discussion of the reasoning behind this decision, since a zero WLA implies an allocation only to nonpoint sources and background will result in attainment of the applicable water quality standard, and all point sources will be removed.

In preparing the wasteload allocations, it is not necessary that each individual point source be assigned a portion of the allocation of pollutant loading capacity. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, an aggregated WLA can be assigned to the group of facilities. But it is necessary to allocate the loading capacity among individual point sources as necessary to meet the water quality standard.

The TMDL submittal should also discuss whether a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions will occur. In such cases, the State/Tribe will need to demonstrate reasonable assurance that the nonpoint source reductions will occur within a reasonable time.

As noted above, the TMDL establishes the WLA at the same 11% IC that it establishes for the LA. (see page 8, main document and the discussion in Section 4 above). The wasteload allocation was established as a common watershed allocation at a maximum of

11% IC because it was not possible to establish WLAs for individual parcels or stormwater sources.

DEP notes that 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. 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. This approach is consistent with the *2004 Connecticut Stormwater Quality Manual* [11] (e.g. see pages 3-2 and 4-2), the *2004 University of Connecticut Campus Sustainable Design Guidelines* [12] (e.g. see page 11, Goal 1) and the 2006 *Stormwater TMDL Implementation Support Manual* [9] (e.g. see page 4-1). CT DEP is working with UCONN and the Town of Mansfield to improve stormwater management in the watershed (page 11, main document).

The % IC WLA and LA target will be used to guide TMDL implementation, through adaptive management. Stormwater impacts can be reduced most effectively by reducing the volume of stormwater discharge and the effect of impervious cover in the contributing watershed (as well as using stream restoration techniques). DEP also explains that ultimate compliance with the TMDL and Connecticut's WQS will be when monitoring data confirms that aquatic life uses are fully supported (page 12, main document).

Assessment: WLAs are required for NPDES regulated point sources of pollutants. In this case, where the allocations are tied to the surrogate % IC, WLAs would be needed for areas from which there are NPDES (or, in Connecticut, CTPDES) regulated stormwater discharges. At present, there are few, if any, such sources in the watershed. The Eagleville Brook watershed area is not currently subject to the Municipal Separate Storm Sewer System (MS4) stormwater permit program. Stormwater associated with construction site activities affecting over one acre would be subject to the CTPDES stormwater permit program.

EPA's TMDL guidance suggests that it is acceptable in cases where data is unavailable to allocate stormwater by gross allotments. See EPA's November 22, 2002 guidance entitled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Stormwater Sources and NPDES Permit Requirements Based on Those WLAs." Given the data limitations mentioned above, it is acceptable to group all NPDES eligible stormwater discharges into a common wasteload allocation target for % IC. In addition, given the difficulty of separating out % IC associated with different stormwater sources (point and nonpoint, regulated and nonregulated) in this case, it is acceptable to include all sources in this one aggregate allocation (WLA=LA=11% IC). Although Eagleville Brook is not located in an urban area currently regulated under Connecticut's Municipal Separate Storm Sewer (MS4) permit, future construction projects in the watershed may be subject to the Connecticut stormwater permitting

program and as discussed above will require control of stormwater on site or potential further IC reduction by existing sources.

EPA Region 1 concurs that the WLA components of the TMDL is appropriately set to assure attainment of water quality standards.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)). EPA guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

The Eagleville Brook TMDL provides an explicit margin of safety (MOS) of **1% IC** in the contributing watershed, which is reserved from the total loading capacity of 12% (page 10, main document). This 1% IC represents an 8% MOS when compared to the total loading capacity of 12% IC [MOS = (1 ÷ 12) x 100 = 8.33].

Assessment: EPA Region 1 concludes that adequate margin of safety is provided by the explicit MOS.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The method chosen for including seasonal variations in the TMDL must be described (CWA § 303(d)(1)(C), 40 C.F.R. § 130.7(c)(1)).

CT DEP considered seasonal variations in conditions when developing the TMDL because stormwater volume and pollutant loads vary throughout the year, and because impairment to aquatic life and habitat in stormwater-impaired streams occurs at both low and high flows, with different environmental impacts (page 10, main document). The TMDL was established to protect aquatic life uses 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. In addition, specific BMPs implemented will be designed to address loadings during all seasons.

Assessment: EPA Region 1 concludes that seasonal variation has been adequately accounted for in the TMDL because the TMDL was developed to be protective year round. Seasonal fluctuations in flow, and varying contributions of nutrients and sediment from snow and rainfall runoff, are taken into account. There is no need to apply different targets on a seasonal basis because the stormwater controls to be implemented to meet the IC targets will reduce adverse impacts (pollutant loading and damaging flows) for the full spectrum of storms throughout the year (page 10, main document).

8. Monitoring Plan

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), and EPA's 2006 guidance, Clarification Regarding "Phased" Total Maximum Daily Loads, recommend a monitoring plan when a TMDL is developed using the phased approach. The guidance indicates that a State may use the phased approach for situations where TMDLs need to be developed despite significant data uncertainty and where the State expects that the loading capacity and allocation scheme will be revised in the near future. EPA's guidance provides that a TMDL developed under the phased approach should include, in addition to the other TMDL elements, a monitoring plan that describes the additional data to be collected and a scheduled timeframe for revision of the TMDL.

Eagleville Brook is not a phased TMDL, but the document includes a description of a monitoring plan designed to measure attainment of water quality standards. CT DEP explains that progress towards attainment of water quality standards will be evaluated by monitoring the macroinvertebrate community and assessing surface water chemistry according to an existing rotating basin sampling schedule (page 11, main document).

Assessment: EPA Region 1 concludes that the anticipated monitoring by and in cooperation with CT DEP is sufficient to evaluate the adequacy of the TMDL and attainment of water quality standards, although not a required element for TMDL approval.

9. Implementation Plans

On August 8, 1997, Bob Perciasepe (EPA Assistant Administrator for the Office of Water) issued a memorandum, "New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs)," that directs Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired solely or primarily by nonpoint sources. To this end, the memorandum asks that Regions assist States/Tribes in developing implementation plans that include reasonable assurances that the nonpoint source load allocations established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. The memorandum also includes a discussion of renewed focus on the public participation process and recognition of other relevant watershed management processes used in the TMDL process. Although implementation plans are not approved by EPA, they help establish the basis for EPA's approval of TMDLs.

CT DEP provides both specific and general implementation recommendations in the TMDL report (page 11, main document and pages 5-6, Appendix 2). The *University of Connecticut Campus Sustainable Design Guidelines*, referenced in the TMDL, provide extensive detail on actual plans for implementing % IC and stormwater runoff reduction on campus. The DEP recommends using an adaptive management approach toward lessening stormwater impacts and improving water quality.

Assessment: Addressed, though not required. EPA is taking no action on the implementation plan.

10. Reasonable Assurances

EPA guidance calls for reasonable assurances when TMDLs are developed for waters impaired by both point and nonpoint sources. In a water impaired by both point and nonpoint sources, where a point source is given a less stringent wasteload allocation based on an assumption that nonpoint source load reductions

will occur, reasonable assurance that the nonpoint source reductions will happen must be explained in order for the TMDL to be approvable. This information is necessary for EPA to determine that the load and wasteload allocations will achieve water quality standards.

In a water impaired solely by nonpoint sources, reasonable assurances that load reductions will be achieved are not required in order for a TMDL to be approvable. However, for such nonpoint source-only waters, States/Tribes are strongly encouraged to provide reasonable assurances regarding achievement of load allocations in the implementation plans described in section 9, above. As described in the August 8, 1997 Perciasepe memorandum, such reasonable assurances should be included in State/Tribe implementation plans and "may be non-regulatory, regulatory, or incentive-based, consistent with applicable laws and programs."

There are currently no regulated point sources in the watershed (other than, possibly, the occasional stormwater associated with construction activity) and consequently none was given a less stringent allocation based on the assumption that NPS load reductions will occur. In any case, the nature of the surrogate TMDL as expressed in terms of % IC is that all sources will be controlled to a point that reflects the effective % IC target. CT DEP addresses reasonable assurances through their work with the watershed partners, including the Town of Mansfield, UCONN, and conservation organizations to implement better stormwater management in the watershed (page 11, main document). Although the watershed area surrounding Eagleville Brook was below the threshold for inclusion in the initial list of the Connecticut's MS4 Permit Program, the Commissioner has the authority under definitions contained in Sections 22a-423 of the Connecticut General Statutes and Section 22a-430-3(a) of the Regulations of Connecticut State Agencies to include "those additional municipally-owned or municipally-operated Small MS4s located outside an Urbanized Area as may be designated by the Commissioner." This option could be pursued if future biological monitoring indicates continuing non-attainment of aquatic life goals in Eagleville Brook or there is lack of cooperation by watershed partners.

Assessment: Addressed on pages 11 and 12 of the main TMDL document and in comments from UCONN, Town of Mansfield and the Willimantic River Alliance (2/8/07, Response to Comments document), where the stakeholders express their support and commitment to TMDL implementation. Based on the fact that any new construction that may be regulated will be a small fraction of the watershed IC (and essentially is incorporated into the IC target as discussed
in Section 5 above) and the commitment of CT DEP and its watershed partners backed up by CT DEP's regulatory authority, EPA concludes that adequate reasonable assurance has been provided.

11. Public Participation

EPA policy is that there must be full and meaningful public participation in the TMDL development process. Each State/Tribe must, therefore, provide for public participation consistent with its own continuing planning process and public participation requirements (40 C.F.R. § 130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval must describe the State/Tribe's public participation process, including a summary of significant comments and the State/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. § 130.7(d)(2)).

Inadequate public participation could be a basis for disapproving a TMDL; however, where EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

The public participation process for the Eagleville Brook TMDL is described on page 12 of the main document. EPA worked with CT DEP by reviewing the draft TMDL during its preparation. Paper and electronic copies of the public review draft report were made available on August 30, 2006 and posted on the CT DEP Internet web site at: http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325604&depNav_GID=1654
A *Notice of Intent to Adopt a TMDL Analysis for Eagleville Brook* was also placed in the legal classified sections of the Hartford Courant and Willimantic Chronicle on August 30, 2006. The deadline for public comment was October 6, 2006. CT DEP fully addressed comments received during the public comment period in their February 8, 2007 Response to Comments for *A Total Maximum Daily Load Analysis for the Eagleville Brook, Mansfield, Connecticut*. The Response to Comments was submitted, along with the public notice and mailing list, along with the Final TMDL.

Assessment: EPA Region 1 concludes that CT DEP has done an adequate job of involving the public during the development of the TMDL, has provided adequate opportunities for the public to comment on the TMDL, and has provided reasonable responses to the public comments.

12. Submittal Letter

A submittal letter should be included with the TMDL analytical document, and should specify whether the TMDL is being submitted for a technical review or is a final submittal. Each final TMDL submitted to EPA must be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final submittal, should contain such information as the name and location of the waterbody, the pollutant(s) of concern, and the priority ranking of the waterbody.

Assessment: CT DEP's letter of February 15, 2007 states that the TMDL is being formally submitted for EPA approval.

References:

1. Center for Watershed Protection, 2003. Watershed Protection Research Monograph No.1, *Impacts of Impervious Cover on Aquatic Systems*, March 2003.

2. EPA/ENSR, 2005. *Pilot TMDL Applications using the Impervious Cover Method*, October 2005. http://www.epa.gov/region1/eco/tmdl/assets/pdfs/Stormwater-TMDL-Implementation-Support-Manual.pdf

3. Maine DEP, *Draft Percent Impervious Cover TMDL Guidance for Attainment of Tiered Aquatic Life Uses*, Draft 7, 2005.

4. Schueler, T.R., *Site Planning for Urban Stream Protection*, Metropolitan Washington Council of Government, December 1995.

5. Arnold, C.L. and C.J. Gibbons, *Impervious Surface Coverage: The Emergence of a Key Environmental Indicator*, *Journal of the American Planning Association*, vol. 62, no. 2, Spring 1996, pages 243-258.

6. Center for Watershed Protection, 1998. *Basic Concepts in Watershed Planning*, Chapter 1 from *The Rapid Watershed Planning Handbook*, October 1998, Table 1, page 135.

7. Deacon, J.R., S.A. Soule, and T.E. Smith, 2005. *Effects of Urbanization on Stream Quality at Selected Sites in the Seacoast Region in New Hampshire, 2001-03*, U.S. Geological Survey Scientific Investigations Report 2005-5103, November 15, 2005, Abstract online at http://pubs.usgs.gov/sir/2005/5103/

8. Leopold, L.B. 1968. *Hydrology for urban land planning – a guidebook on the hydrologic effects of urban land use*. Geological Survey Circular 554. US Dep. of the Interior. Washington, DC, pp. 1-18.

9. ENSR, 2006. *Stormwater TMDL Implementation Support Manual*, ENSR Corporation March 2006.

10. Roy, A.H. et al, 2005. *Investigating hydrologic alteration as a mechanism of fish assemblage shifts in urbanizing streams.* J.N. Am. Benthol. Soc., 2005, 24(3):656-678.

11. Connecticut Department of Environmental Protection. 2004. *Connecticut stormwater quality manual.* 79 Elm Street, Hartford, CT 06106. http://www.ct.gov/dep/cwp/view.asp?a=2721&q=325704&depNav_GID=1654#download

12. JJR Smithgroup, 2004. University of Connecticut Campus Sustainable Design Guidelines.
http://www.masterplan.uconn.edu/images/SDG-web.pdf

13. Connecticut Department of Environmental Protection. 2002. *Connecticut consolidated assessment & listing methodology for 305 (b) and 303(d) reporting.* 79 Elm Street, Hartford, CT 06106.
http://www.ct.gov/dep/cwp/view.asp?a=2719&q=325612&depNav_GID=1654

14. Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* EPA/444/4-89-00. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Data for entry in EPA's National TMDL Trackng System

TMDL Name*	**Eagleville Brook**
Number of TMDLs*	**2**
Lead State/Towns*	Connecticut/Mansfield, CT
TMDL Status	Final
Pollutant ID	705 pollutants in stormwater (% IC surrogate)
TMDL End Point	CT narrative aquatic life criteria for Class A waters (% IC surrogate for pollutants in stormwater)
TMDL Type	Nonpoint Sources
Point Sources & Permit #	N/A
List ID (from system)	CT
Impairment ID (from system)	94 Aquatic Life
Cycle (list date)	2004
Establishment Date (approval)*	March 28, 2007
EPA Developed	No

* Data also for EPA Region 1 TMDL web page.

TMDL Target 12%IC WLA=LA=11%

TMDL Implementation Objectives

CT 3100-19_01	anti-degradation
CT 3100-19_02 at location 2	21% reduction in current %IC
CT 3100-19_02 at location 3	59% reduction in current %IC