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

February 19, 2009

Laura Pelosi, Commissioner
Vermont Department of Environmental Conservation
103 South Main Street
Waterbury VT 05671-0408

SUBJECT: **Approval of Moon, Stevens, and Rugg Brook TMDLs**

Dear Commissioner Pelosi:

Thank you for your submittal of the Total Maximum Daily Load (TMDL) documents that address biological impairments in Moon, Stevens, and Rugg Brooks. These waterbodies are included on Vermont's 2008 303(d) list and were prioritized for TMDL development. The purpose of these TMDLs is to address aquatic life use impairments caused by stormwater runoff.

The U.S. Environmental Protection Agency (EPA) hereby approves Vermont's October, 2008 versions of the three TMDLs (for Moon, Stevens, and Rugg Brooks) submitted with a cover letter dated October 2, 2008. EPA has determined that these TMDLs meet the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

Thank you again for your submittal. My staff and I look forward to continued cooperation with VTDEC in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

Sincerely,

/s/

Ken Moraff, Acting Director
Office of Ecosystem Protection

Enclosure

cc: Tim Clear, VT DEC

EPA NEW ENGLAND'S TMDL REVIEW

TMDLs: Moon, Stevens and Rugg Brooks, Vermont

STATUS: Final

DATE: February 19th, 2009

IMPAIRMENT/POLLUTANT: Biological impairment (aquatic life support) caused by stormwater-related stressors: the TMDLs are proposed for stormwater runoff volume as a surrogate for the pollutant sediment and a variety of other stressors associated with stormwater.

BACKGROUND: The Vermont Department of Environmental Conservation (VTDEC) submitted drafts of the TMDLs on July 11, 2008. A public comment period was held from July 11, 2008 to September 5, 2008. The state submitted the final TMDLs with a letter dated October 2, 2008. In addition to the TMDLs themselves, the submittal included, either directly or by reference, the following additional documents:

- Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams, US EPA and VT DEC, September 2006.

- Stormwater Modeling for Flow Duration Curve Development in Vermont, TetraTech, 2005.

- Final Report – Investigation into Developing Cleanup Plans for Stormwater Impaired Waters, Vermont Water Resources Board, 2004.

- University of Vermont Stormwater Project – Statistical Analysis of Watershed Variables, prepared for VT ANR by the University of Vermont, October 2005

REVIEWER: Eric Perkins (617) 918-1602.

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 chlorophyl <u>a</u> and phosphorus loadings for excess algae and reduced clarity in the water column.

A. Description of Waterbodies and Background Information

The TMDL documents provide a description of each brook (Moon, Stevens and Rugg) including location, drainage area, and tributary information. They also provide background information on the development of the TMDLs, explaining that the roots of the TMDL approach go back to the Investigative Docket conducted by the Vermont Water Resources Board in 2004.

B. Pollutant of Concern

The primary pollutant of concern for these TMDLs is sediment. However, as the TMDL documents explain, the aquatic life impairments in these streams are believed to be caused by the mix of pollutants found in stormwater runoff. The TMDLs use the surrogate of stormwater runoff volume to address needed reductions in sediment and other pollutants. This surrogate is appropriate because the amount of pollutant load discharged from a watershed is a function of the amount of stormwater runoff generated from a watershed for a given set of conditions. This relationship is especially strong for sediment and sediment-associated pollutants, as described in the "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams" (EPA and VT DEC, 2006). There are no known wastewater or non-stormwater related discharges contributing to the impairments, so the stormwater runoff surrogate effectively represents the pollutants of concern.

Use of this surrogate has the secondary benefit of addressing the physical impacts to the stream channels (such as scour and channel over-widening) caused by stormwater runoff. These physical alterations to the stream are additional contributors to the aquatic life impairment. Also, reductions in stormwater runoff volume will help restore diminished base flow (another aquatic life stressor) by increasing infiltration and groundwater recharge. Because of the difficulty of sorting out the impacts of all the different stressors, both hydrologic and pollutant-related, VT DEC listed these streams on the 2008 Vermont §303(d) list as impaired by "stormwater".

C. Pollutant Sources

The documents explain that the source of the pollutant loads is stormwater runoff from the Moon, Stevens, and Rugg Brook watersheds. In addition to carrying pollutants from the watersheds, increased stormwater volume is destabilizing the stream channels, releasing sediment from the stream banks, degrading stream habitat and washing out biota, as discussed above.

D. Priority Ranking

The 2008 §303(d) list indicates that Moon, Stevens and Rugg Brooks are in the high priority category, meaning that they are scheduled for TMDL completion by 2010.

Assessment: EPA concludes that the TMDL documents meet the requirements for describing the waterbodies, pollutant of concern, pollutant sources, and priority ranking.

Some comments on the draft TMDL suggested that the Moon Brook impairment is caused more by increased temperature than stormwater-related causes. In its response to public comments and in subsequent communications with EPA, VTDEC noted that while an upper portion of the brook may be affected by elevated temperatures, it is VTDEC's firm opinion that the controlling lower reach of the brook (where the State monitors compliance) is impaired due to stormwater-related impacts. EPA believes VTDEC's explanation in the response to public comments is reasonable, and that the focus of the TMDL on stormwater is appropriate and consistent with the Moon Brook impairment information in Vermont's 2008 §303(d) list.

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 documents describe the applicable water quality standards on pages 8-10 of each document. The brooks are listed as impaired based on narrative criteria relating to aquatic biota. The impact of excessive stormwater runoff flows into the brooks has resulted in violation of the VTWQS §3-04(B)(4) which states that there shall be:

> *"No change from the reference condition that would prevent the full support of aquatic biota, wildlife, or aquatic habitat uses. Biological integrity is maintained and all expected functional groups are present in a high quality habitat. All life-cycle functions, including overwintering and reproductive requirements are maintained and protected."*

In Vermont, numeric biological indices are used to determine the condition of fish and aquatic life uses. Vermont's Water Quality Standards at 3-01(D)(1) and (2) provide the following regulatory basis for these numeric biological indices:

> *"(1) In addition to other applicable provisions of these rules and other appropriate methods of evaluation, the Secretary may establish and apply numeric biological indices to determine whether there is full support of aquatic biota and aquatic habitat uses. These numeric biological indices shall be derived from measures of the biological integrity of the reference condition for different water body types. In establishing numeric biological indices, the Secretary shall establish procedures that employ standard sampling and analytical methods to characterize the biological integrity of the appropriate reference condition. Characteristic measures of biological integrity include but are not limited to community level measurements such as: species richness, diversity, relative abundance of tolerant and intolerant species, density, and functional composition.*
>
> *(2) In addition, the Secretary may determine whether there is full support of aquatic biota and aquatic habitat uses through other appropriate methods of evaluation, including habitat assessments."*

Pursuant to the above provisions in its water quality standards, VT DEC developed numeric biological indices to aid in the determination of whether aquatic biota and habitat uses are supported. These indices are described in the document: "Biocriteria for Fish and Macroinvertebrate Assemblages in Vermont Wadeable Streams and Rivers" published by VT DEC in February 2004. Biological data collected from Moon, Stevens and Rugg Brooks were evaluated in accordance with the procedures laid out in this guidance document (or prior versions for data evaluated prior to 2004). Macroinvertebrates were assessed as in the poor range for a majority of the samples, and fish were assessed as either fair or poor for most samples. The TMDL documents explain that in most cases, including these, biological condition ratings of fair or poor indicate impaired status for Class B waters.

Establishment of the water quality targets

Because the impairments are based on biological indices, there are no numeric pollutant criteria to use as TMDL targets. Instead, the instream targets are expressed as measures of the hydrologic conditions believed necessary to achieve the Vermont water quality criteria for aquatic life. As described in more detail below, a target expressed as a percent flow reduction in relation to the 0.3% flow (the flow that is equaled or exceeded 0.3% of the time) was established for each brook, based on the hydrologic conditions of a reference (attainment) watershed where the aquatic life criteria are met. The flow reduction targets are 10.9% for Moon Brook, 25.5% for Stevens Brook, and 22% for Rugg Brook (see Table 3 of each TMDL document). These hydrologic targets serve as indicators 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 hydrologic conditions represent the conditions in which all these stressors are reduced to levels compatible with attainment of the aquatic life criteria. The TMDL documents explain which attainment watersheds were selected for each impaired stream, and the statistical and scientific basis for the selection.

The TMDL documents note that the VT Water Resources Board's 2004 report identifies flow duration curves (FDCs) as the best method for defining hydrologic targets. The following text from the TMDL documents (pages 10-12 of each TMDL) summarizes the benefits of the FDC approach:

"FDCs are very useful for describing the hydrologic condition of a stream/watershed because the curves incorporate the full spectrum of flow conditions (very low to very high, including critical conditions) that occur in the stream system over a long period of time. The FDCs also incorporate any flow variability due to seasonal variations. A comparison of the FDCs for an impaired and appropriate attainment stream/watershed can reveal obvious patterns. For example, a FDC for a stormwater-impaired stream/watershed will typically show significantly higher flow rates per unit area for high flow events and significantly lower flow rates per unit area for low-base flow conditions than the FDC for the attainment watersheds. The increased predominance of high flow events in the impaired watershed creates the potential for increased watershed stormwater pollutant loadings, increased scouring and stream bank erosion events, and the possible displacement of biota from within the system. Also the reduction in stream base flow revealed by the FDC can create a potential loss of habitat for low flow conditions."

For the above reasons, the TMDLs used FDCs to establish the hydrologic targets for each of the three brooks. For each brook, a high flow value (0.3%) and a low flow value (95%) were selected as points along the continuum of the FDCs useful for setting specific hydrologic targets. The 0.3% exceedance flow closely matches the one year return flow (the flow level that occurs on average once a year) and the 95% exceedance flow represents a low flow condition comparable to the 7Q10. The 0.3% flow was selected for the high flow targets because: 1) the one year flow level is generally considered the channel forming flow for small streams, and by targeting the channel forming flow one can directly reduce key channel altering events that damage biota and produce large amounts of sediment from within the stream system; 2) the 0.3% flow is close to the upper end of the high flow portion of the flow duration curve – selecting a target close to the upper end of the curve helps ensure that the implementation measures chosen to meet the target will also reduce the impact of the full range of storms that drive the shape of the rest of the flow duration curve; and 3) the design specifications for stormwater management measures in Vermont's stormwater manual are largely based on controlling the one year storm events -- the task of determining and implementing the mix of controls necessary to achieve the in-stream target can be accomplished most efficiently if reductions are measured with respect to one year flows.

Since there are limited hydrologic data for either impaired or attainment streams, the Water Resources Board's 2004 report recommended developing synthetic FDCs by employing a calibrated rainfall-runoff model based on land use and cover. Accordingly, FDCs were developed for both impaired and attainment streams and the relative difference between the two was used to establish the flows needed to restore a stream's hydrology. In the TMDLs, the hydrologic targets are expressed as percentage reductions or increases relative to the attainment watersheds' FDCs at the representative high and low flow values. Only the high flow targets are actually used for the load and wasteload allocations, but the low flow targets are included for informational purposes and to help communicate the overall aim and expected result of the TMDLs: to match all attainment stream FDC points (both on the high and low ends of the curve).

The TMDL documents explain that, based on available data and the model outputs necessary to develop the FDCs, the P8-Urban Catchment Model (P8-UCM) was selected to simulate the hydrology of impaired and attainment watersheds. Inputs to P8-UCM include climatological data, percent watershed imperviousness, pervious curve number, and times of concentration for ground water base flow and surface runoff. After initial calibration and review, additional changes were made to improve the low flow prediction capability of the model and refine the estimated surface runoff time of concentration. Upon final review and model verification, the calibrated model was used to develop FDCs for all impaired and attainment streams. A complete discussion of the model setup, calibration, adjustments and results can be found in the report entitled "Stormwater Modeling for Flow Duration Curve Development in Vermont" (Tetra Tech, 2005).

Assessment: EPA concludes that VTDEC has properly described its water quality standards, the relevant criteria and uses, and the water quality targets.

The use of surrogate hydrologic targets in place of numeric aquatic biota or pollutant targets is appropriate for these TMDLs because the hydrologic targets serve as indicators for conditions under which the water quality criteria for aquatic life can be attained. 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). This flexibility in the expression of TMDLs supports reliance on a surrogate where, as in this case, there is a reasonable rationale and the TMDL is designed to ensure attainment with water quality standards.

As noted in the "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for

TMDL Development in Vermont's Stormwater Impaired Streams," (US EPA and VT DEC, 2006), this surrogate approach is consistent with the recommendations of the "Report of the Federal Advisory Committee on the Total Maximum Daily Load Program" (National Advisory Council for Environmental Policy and Technology, 1998). The report recommends that: "When the impairment is tied to a pollutant for which a numeric criterion is not possible, or where the impairment is identified but cannot be attributed to a single traditional 'pollutant', the state should try to identify another (surrogate) environmental indicator that can be used to develop a quantified TMDL, using numeric analytical techniques where they are available, and best professional judgment where they are not….If they are used, surrogate environmental indicators should be clearly related to the water quality standard that the TMDL is designed to achieve."

For these TMDLs, the relationship between the surrogate indicator and the water quality criteria is carefully laid out in the Expanded Technical Analysis report referenced above. This expanded analysis further describes the link between the aquatic biota impairment and sediment (the key pollutant), and then how watershed hydrology is driving sediment levels in these streams. Based on these clear linkages to Vermont's water quality standards, EPA concludes that the surrogate approach has been used appropriately in these TMDLs, and that the surrogates for the water quality targets have been appropriately selected. EPA has also reviewed the supplemental report entitled "University of Vermont Stormwater Project: Statistical Analysis of Watershed Variables" (2005), and concluded that the target setting process and the establishment of the surrogate water quality targets has been well documented and completed with admirable scientific rigor.

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 stormwater runoff volume as a surrogate for sediment and other pollutants

Just as an instream flow target is used as the surrogate for the instream water quality target, stormwater runoff volume is used as the surrogate for the loading capacity (i.e. the maximum amount of pollutant inputs from the watershed that still allows attainment of Vermont's water quality standards).

As discussed in the TMDL reports, 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 these brooks. 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 stormwater flows, for the reasons explained in the TMDLs and supporting documentation. Therefore the TMDLs use the surrogate measure of stormwater runoff volume to represent the combination of pollutants that contribute to the impairment of these streams.

The supplemental document titled: "Expanded Technical Analysis: Utilizing Hydrologic Targets as Surrogates for TMDL Development in Vermont's Stormwater Impaired Streams" provides a detailed explanation of all stressors potentially contributing to the biological impairment in these streams (using the similar Potash Brook as an example), and how these stressors are linked to stormwater runoff. The relative importance of each stressor is also described in Table 3-1 of this document. Given that increased sedimentation is believed to be the most important pollutant stressor, the document includes, among other things, substantial detail on the relationship between sediment and streamflow. Figure 5-16 shows, for example, that based on sediment and flow data from similar streams, a 25% decrease in the 1-year (0.3%) flow can result in a 70% reduction in annual sediment load. This means that a relatively modest reduction in stormwater runoff volume can be expected to substantially reduce sedimentation. The document also lays out similar stormwater runoff linkages to all other identified stressors. While the exact levels of sediment needed to be achieved in Moon, Stevens and Rugg brooks are not defined, the use of the reference watershed approach ensures that the necessary sediment levels will be achieved. This is because by achieving the reduced stormwater runoff volumes occurring in the attainment watersheds, the corresponding sediment reductions necessary to meet water quality standards are expected to be achieved as well.

The TMDL documents and the expanded technical analysis describe how each stressor contributing to the biological impairment is related either directly or indirectly to stormwater runoff volumes. The stressors include: increased watershed pollutant load (e.g. sediment), increased pollutant load from in-stream sources (e.g., bank erosion), habitat degradation (e.g. siltation, scour, over-widening of stream channel), washout of biota, and loss of habitat due to reductions in stream base flow. The stressors associated with stormwater runoff are acting individually or cumulatively to degrade the overall biological community to a point where aquatic life uses are not fully supported and the streams do not attain the VTWQS.

Establishment of stormwater runoff volume 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 these TMDLs, because the "pollutant of concern" is represented by the surrogate measure of stormwater runoff volume, the loading capacity is the greatest volume of stormwater runoff each stream can receive without violating the aquatic life criteria. The challenge is to determine what this maximum stormwater runoff volume is for each brook.

As explained above (in Section 2), the TMDLs use a reference watershed approach in which hydrologic targets are developed by using similar "attainment" watersheds as a guide. The streams within the attainment watersheds meet or exceed the Vermont water quality standards criteria for aquatic life. Based on the comparison of the 0.3% flow point (approximately the one-year flow event) on the flow duration curve (FDC) for each impaired stream with the mean value of the 0.3% points on the FDCs for the appropriate attainment stream, the TMDLs establish stream flow reduction targets of 10.9% for Moon Brook, 25.5% for Stevens Brook, and 22% for Rugg Brook during these high flow events. Because stream flow during the high flow events in these small streams is nearly entirely a result of stormwater runoff, the percent reduction targets are used not only as the in-stream surrogate water quality targets, but also as the stormwater runoff volume reduction targets.

The use of the FDC to establish reduction targets also ensures that critical conditions are accounted for in these TMDLs. The impacts to aquatic biota generally occur throughout the year on a cumulative basis – i.e., it is the cumulative effect of the stressors throughout the course of a year (or years) that ultimately degrade conditions and result in an aquatic life impairment. By targeting the conditions under which the key stressors are introduced (high flow conditions), the TMDLs address critical conditions and the cumulative effects caused by these conditions throughout the year. In addition, any one-time impacts (such as the washout of biota due to channel scour) will also be addressed by these TMDLs through the reductions of the runoff volume from storm events that cause this damage.

Assessment:
EPA concludes that Vermont selected a reasonable surrogate for the loading capacity, adequately documented the assumptions and strengths and weaknesses in the modeling approach used to support the establishment of the loading capacity, and properly accounted for critical conditions. The basis for each of these conclusions is explained below.

Vermont'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. And as noted above (under Section 2) 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 stream hydrology as a surrogate water quality target,

EPA concludes that the use of stormwater runoff volume 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 Moon, Stevens, and Rugg brooks, where the impairment is for aquatic life, where stormwater is the cause of the impairment, and where no specific pollutant criterion is being violated.

The modeling assumptions and strengths and weaknesses are adequately documented
The assumptions and strengths and weaknesses of the modeling approach used to support the establishment of the loading capacity are discussed in the supplemental TMDL report entitled: "Stormwater Modeling for Flow Duration Curve Development in Vermont". Strengths and weaknesses associated with use of the P8 model are discussed on pages 14 and 17, and assumptions pertaining to each step in the modeling process are presented throughout the report. The results of the modeling work are thoroughly presented in this report. In addition, strengths and weaknesses and assumptions related to the use of statistical analyses of the modeling results to select an appropriate attainment watershed for Moon, Stevens and Rugg Brooks are presented in a second supplemental report entitled: "University of Vermont Stormwater Project: Statistical Analysis of Watershed Variables" (2005). EPA concludes that the assumptions and results of both the modeling and statistical analysis steps are adequately documented in these reports.

Critical conditions have been accounted for
The critical conditions for the three brooks are associated with storm events which, in addition to potential immediate damage to aquatic biota, produce cumulative impacts to the biota over time. Because the TMDL reduction targets directly address these high flow conditions, EPA concludes that critical conditions are adequately accounted for.

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. This guidance also acknowledges that the decision of the U.S. Court of Appeals for the Second Circuit, *NRDC v. Muszynski*, 268 F.3d 91 (2nd Cir. 2001), established the controlling legal precedent for cases brought in the Second Circuit, which includes Vermont. In this decision, the Court required a reasoned explanation for the choice of any particular non-daily load. For the reasons discussed below, the Region believes that Vermont has provided a reasonable basis for not including daily loads in these three TMDLs.

Even though the TMDL targets are expected to achieve reductions during all storms large enough to generate runoff throughout the year, the TMDLs do not express the loading capacity in terms of specific loadings (or runoff volume amounts) for each day. The rationale for this decision is two-fold:
1) The biological impairment in these brooks resulted from the cumulative effects of a range of stormwater runoff events throughout the year over a multiple year period. It is not the magnitude

of loadings on any particular day that drives attainment of the biological criteria; instead, attainment will result from a long-term overall reduction in the amount of stormwater runoff. The flow duration curve approach provides for identification of this overall reduction target.
2) Stormwater runoff will vary dramatically from one day to the next depending on rainfall amounts. There will be no runoff on some days, while storms may generate large runoff events on others. Because of this variability, it is neither feasible nor logical to establish specific daily loads linked to attainment of the biological criteria. In the face of such variability, the approach taken in these TMDLs, based on percent reductions tied to the flow duration curves, is both a practical and effective way to establish reduction targets. Rather than imposing particular daily limits, this approach establishes percent reduction targets for stormwater runoff volume that effectively apply to all storm events whenever they occur (i.e., on any given day) throughout the year.

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 load allocations for each brook are presented in Table 7 of each TMDL document. The stormwater runoff volume reductions for each stream were divided into WLA and LA portions, based on major land use categories in the watershed. The three major land use categories in these watersheds are urban/developed, agriculture/open, and forest/wetland. For all three of the TMDLs, the forest/wetland category received a load allocation of zero percent reduction, or no expected change in stormwater runoff, since the runoff characteristics from these areas are considered near optimal with regard to overall watershed hydrology. To assign allocations to the remaining two land use categories, a runoff coefficient was used to determine the relative influence of each land use category on runoff characteristics, and thus the FDC. The following paragraphs from the Moon Brook TMDL document (page 18) explain how this was done for all three of the TMDLs:

“A runoff coefficient (R_v) is an expression of the percentage of precipitation that appears as runoff. The value of the coefficient is determined on the basis of climatic conditions and physiographic characteristics of the drainage area and is expressed as a constant between zero and one. By determining the relative contribution to stormwater runoff from each land use category using the R_v, the allocation between WLA and LA can be made accordingly.

The primary influence on R_v is the degree of watershed imperviousness. This is shown through data collected from numerous watersheds during the National Urban Runoff Program Study from which an equation was developed to define the R_v. as shown below (Schueler 1987):

$R_v = 0.05 + 0.9(I_a)$

Where: I_a = Impervious fraction

Percent imperviousness was estimated using a previously developed relationship…for the Vermont Center for Geographic Information land use data layer."

Using the runoff coefficients and the area of each land use category, VT DEC determined the weighted influence on runoff in the Rugg Brook watersheds to be 69% for urban/developed land and 31% for the agriculture/open category. For the Stevens Brook watershed, which contains less land in the agriculture/open category, the weighted influence on runoff was found to be 89% for urban/developed land and only 11% for agriculture/open land. For the Moon Brook watershed, which has almost no land in the agriculture/open category, the relative influence on runoff was found to be 99% for the urban/developed land and 1% for agriculture/open land.

Given that all stormwater discharges from the urban/developed land category are included in the wasteload allocation portions of the TMDLs (for reasons explained below in the WLA section), the load allocations include only discharges from the agriculture/open land category. There are no CAFOs in these watersheds, and the agricultural/open land is outside of the MS4 portions of the watersheds, so the TMDLs assign all runoff from the agricultural/open category into the load allocation portion. Based on the weighting factors, the load allocations work out to a 0.1% reduction in stormwater runoff for Moon Brook, a 2.9% reduction for Munroe Brook, and a 6.6% reduction for Rugg Brook, as indicated in Table 7 of each TMDL document.

Assessment: The State's approach to breaking out the load and wasteload allocations is reasonable because the forest/wetlands land use category corresponds to "natural background" conditions, and the urban/developed and agricultural/open space categories are reasonable surrogates for the relative contribution of point and nonpoint source runoff, respectively. The agriculture/open land category is a reasonable reflection of nonpoint source stormwater runoff because there are no regulated point source discharges within these portions of the watersheds. The State's use of a runoff coefficient to estimate the amount of runoff from the various land use categories (and to subsequently establish the load and wasteload allocations), is a logical approach to this task given the influence of watershed imperviousness on runoff volumes. EPA concludes that the load allocations are adequately specified in the TMDLs at a level sufficient (when combined with the wasteload allocations) 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.

The wasteload allocations are presented in Table 7 of each TMDL and are expressed as percent reductions in stormwater runoff volume at Q0.3%. The reductions are 11.9% for Moon Brook, 24.4% for Stevens Brook, and 16.0% for Munroe Brook. Sections 3 and 4, above, explain how overall allocations were established based on the flow duration curve targets, and how these overall allocations were then divided into load and wasteload components based on land use categories and the amount of runoff generated from each category.

All stormwater discharges from the urban/developed land category were included in the wasteload allocation portions of the TMDLs. This was done because EPA interprets 40 C.F.R. §130.2(h) to require that allocations for point source discharges subject to the requirement for an NPDES permit must be included in the wasteload allocation portion of the TMDL. The urban/developed portions of these watersheds include the following types of NPDES permitted stormwater discharges:

- Discharges subject to Phase 2 municipal separate storm sewer system (MS4) permits
- Discharges subject to Phase 1 and 2 construction site stormwater permits
- Discharges subject to permits for stormwater associated with industrial activities

There are also some areas within the urban/developed portions of these watersheds that generate nonpoint source runoff and point source runoff not subject to NPDES permits. Discharges from nonpoint sources and point sources not regulated by the NPDES program normally receive load allocations rather than wasteload allocations. In the case of stormwater, however, where it is often difficult to identify and distinguish between discharges subject to NPDES and those that are not, EPA has stated that it is permissible to include all stormwater discharges from a particular land use category in the wasteload allocation portion of the TMDL. For these watersheds, insufficient data are currently available to separate out the parcels that generate stormwater that is not subject to NPDES permits and calculate the runoff volumes from these parcels. Therefore, the wasteload allocations include runoff from the NPDES regulated stormwater point sources listed above, runoff from nonpoint sources, and runoff from non-NPDES regulated point sources such as commercial areas and small construction sites (under an acre).

The runoff from sources within the urban/developed land category was then lumped into an aggregate wasteload allocation for each TMDL. The rationale for this aggregate allocation is described below. As indicated above, 40 C.F.R. § 130.2(h) provides that point source discharges must be addressed by the wasteload allocation component of a TMDL. Discharges involving process wastewater, non-contact cooling water, and other non-stormwater discharges are assigned individual waste load allocations pursuant to this regulation. Stormwater discharges, however, are less amenable to individual wasteload allocations. In recognition of this fact, 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," provides that it is reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical or aggregate wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. EPA's guidance recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated storm water discharges on an outfall-specific basis.

In the case of these three watersheds, VTDEC has determined that because the stormwater discharges are highly variable in frequency and duration, and because insufficient data is available on each parcel (e.g. detailed soils information) it is not feasible to establish specific wasteload allocations for each stormwater outfall. Although the State is developing this capability (to support implementation of the TMDLs), it is currently impossible to determine with any precision or certainty runoff amounts for individual discharges or groups of discharges. Therefore, all the stormwater runoff from the urban/developed land use category is combined into the aggregate wasteload allocations presented in Table 7 of each TMDL. Because it was determined that the urban/developed portions of these watersheds contribute from 69% to 99% of the total runoff to these brooks (depending on the watershed), the vast majority of the needed reductions are in the wasteload allocations.

Future Growth

The wasteload allocations include allocations for future growth ranging from a 1.0% to a 1.8% reduction in stormwater flow (see Table 7 of each TMDL document). The future growth allocation is for runoff expected to result from the maximum projected 10-year growth of single family homes or other small development creating less than one acre of impervious cover. The projected additional runoff for each stream was added to the initial reduction targets identified for the streams in Table 3 of each TMDL. Because future growth is expected to be concentrated in the urban/developed portion of the watersheds, the future growth allocations are included as part of the wasteload allocations.

The TMDLs do not include an allocation for future growth that creates more than one acre of impervious cover because this category of development is required by state law to comply with Vermont's stormwater manual. VT DEC believes that the channel protection and groundwater recharge standards in the stormwater manual will prevent stream degradation from this category of growth.

Assessment:
Ideally, if data are available, separate wasteload allocations for each NPDES stormwater discharge would be established. Given the data limitations discussed above, however, it is acceptable to group all NPDES eligible stormwater discharges into one wasteload allocation for stormwater. In addition, given the difficulty of separating out regulated from unregulated stormwater discharges in these cases (as described above), it is also acceptable to include both discharges subject to NPDES as well as nonpoint source runoff in this aggregate wasteload category.

The State's two-pronged approach to accounting for future growth is well thought out, and the allocations for small development projects are based on a reasonable calculation of projected stormwater runoff from this category of development.

EPA concludes that the wasteload allocations are adequately specified in the TMDLs at levels sufficient (when combined with the load allocations) to attain and maintain water quality standards, and that future growth is adequately addressed.

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 TMDL documents explain that the MOS in these TMDLs is implicit, and is incorporated through conservative assumptions in the target setting approach.

For the other VT TMDLs previously developed and approved using this approach, the mean flows of the attainment streams were selected as the target flow conditions to provide an implicit margin of safety that the selected targets would result in the attainment of the Vermont Water Quality Standards. The flows for the attainment streams represent flows under which the biologic criteria are currently being met. This can be thought of as a range of flows in streams most similar to the impaired streams that are capable of sustaining appropriate aquatic life standards as defined by the VTWQS. It is reasonable to assume that attainment of flows at the high end of this range would allow the matched impaired stream to comply with the VTWQS, however, by lowering the targets to the attainment stream mean, a margin of safety is incorporated.

In the case of Moon, Stevens and Rugg Brooks, only one attainment stream (Tenney Brook) was found to be statistically appropriate for grouping with the impaired streams, so there was no range of flows from which to calculate a mean value. Therefore, a modified approach was used to simulate an attainment range and develop a more conservative target. The other attainment ranges developed for the lowland stormwater-impaired streams in Vermont were analyzed to determine the difference between the high flow end of the attainment range and the mean of the range. This analysis showed an average difference of 5% between the highest flow in the attainment range and the attainment mean. VTDEC then assumed that the modeled flows from Tenney Brook represented the highest flows of a hypothetical attainment range for each impaired stream. The flow at the 0.3% exceedence interval was then reduced by 5% to represent the mean of the attainment range and thus the new calculated high flow target for each impaired stream.

Assessment: EPA-New England concludes that the documentation for these three TMDLs provides an adequate MOS. The MOS provided by using the mean of a simulated range of attainment stream targets rather than the higher of the attainment stream targets is reasonable for these TMDLs, given the scientific rigor of the attainment stream selection and target setting process.

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)).

The Clean Water Act and implementing regulations require that a TMDL be established with consideration of seasonal variations. The VT Water Resources Board's 2004 report identifies flow duration curves (FDCs) as the best surrogate for defining hydrologic targets. The FDCs developed for these TMDLs are very useful for describing the hydrologic condition of a stream/watershed because the curves incorporate the full spectrum of flow conditions (very low to very high) that occur in the stream system over a long period of time. The FDCs also incorporate any flow variability due to seasonal variations.

As noted above in Section 3, while the high flow targets in these TMDLs are established for a particular storm size or flow event (the flow that is equaled or exceeded 0.3 percent of the year) the reductions called for in the TMDLs actually apply on a daily basis throughout the year. This is because the ultimate goal of the TMDLs is to match the full length of the flow duration curves (which include targets for all storm sizes) derived from the attainment watershed. The 0.3% flow point was selected as a representative point to use as a target. Because the stormwater controls to be implemented to meet the 0.3% target will also control the full spectrum of smaller storms (those that produce 99.7% of the flows) throughout the year, it is reasonable to expect that TMDL implementation will result in most other points on the curves coming into alignment with the corresponding points on the attainment curves.

Assessment: Given that the controls necessary to achieve the reduction targets for large storms will be effective throughout the year and will also control the full range of smaller storms, EPA concludes that seasonal variation has been adequately accounted for in the TMDLs.

8. Monitoring Plan for TMDLs Developed Under the Phased Approach

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.

These three TMDLs are not phased TMDLs, but the documents include descriptions of monitoring plans designed to measure progress toward TMDL implementation and attainment of water quality standards. While the monitoring plans will not be finalized until the State issues watershed permits for stormwater in each watershed, the TMDL documents indicate that the monitoring will include three main components, as recommended by the VT Water Resources Board's 2004 report. The three components are: 1) tracking stormwater treatment and control practices implemented; 2) monitoring of the primary stressors in the watershed; and 3) monitoring of in-stream habitat and biological and geomorphic condition.

The first component involves tracking progress towards implementing the requirements in the watershed permits. In addition to tracking BMP implementation, VT DEC also expects to track the percentage of stormwater controlled and the percent of land area retrofitted with BMPs in each watershed.

The monitoring of primary stressors will include continuous flow monitoring in each brook (already underway) and the accurate tracking of impervious cover changes within the watersheds.

Last but by no means least, monitoring of biological and geomorphic conditions will be key to measuring progress towards attaining water quality standards. Baseline biological and geomorphic assessments have already been completed; regular assessments will be continued as implementation proceeds.

Assessment: Because the monitoring plans will include, at a minimum, both continuous flow monitoring to measure progress towards TMDL targets and on-going biological monitoring to measure progress towards achieving water quality standards, EPA concludes that the proposed monitoring by VTDEC will be sufficient to evaluate the effects of TMDL implementation.

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.*

Although implementation plans are not a required element of a TMDL, and EPA does not approve implementation plans, VT DEC has included an implementation plan in each TMDL document.

The State's implementation strategy for these TMDLs includes two central permitting components. Vermont is authorized to implement both a federally-authorized NPDES permit program for all Clean Water Act-regulated stormwater discharges (such as stormwater associated with construction and other industrial activities and municipal discharges under the MS4 program) and a state-authorized permitting program for stormwater discharges from impervious surfaces equal to or greater than one acre. This dual permitting authority provides Vermont with powerful tools for requiring the implementation of stormwater treatment and control practices necessary to meet the stormwater runoff reduction targets in these TMDLs.

The State anticipates that it will utilize an iterative, adaptive management approach to implementing these TMDLs. The first prong of implementation will involve the issuance of watershed-wide general permits pursuant to Vermont's state stormwater law. Stormwater treatment and control measures will be required in the first-round watershed-wide general permits, including the construction and/or upgrade of stormwater treatment and control systems by specifically identified dischargers of stormwater runoff. The mix of stormwater control practices required by the permits will be calculated to achieve the TMDL stormwater runoff reduction targets for each watershed. The first-round general permits will include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the general permits provide for the attainment of the VTWQS and to determine the appropriate conditions or limitations for subsequent permits. Such a monitoring program may include ambient monitoring, receiving water assessment, discharge monitoring (as needed), or a combination of monitoring procedures designed to gather the necessary information. Based on this information, the permits will be amended, as needed, through the implementation of more widespread and/or more stringent treatment and controls or other best management practices as necessary to meet water quality standards in the stream. This adaptive management approach is a cyclical process in which a TMDL implementation plan is periodically assessed for its achievement of water quality standards and adjustments to the plan are made as necessary.

The second prong of the implementation plans includes NPDES permits issued by the Agency for stormwater discharges subject to the federal Clean Water Act and corresponding state authority (as described above). These permits contain conditions for implementation of appropriate best management practices to provide for attainment of the VTWQS.

In addition, the State plans to aggressively implement a variety of nonpoint source control measures specified in Vermont's Clean and Clear Action Plan. These measures are described in more detail in the reasonable assurances section, below.

Assessment: EPA is taking no action on the implementation plans but notes that the State appears to have a strong implementation strategy in place to achieve the goals of the TMDLs.

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."

Given that at least slightly less stringent wasteload allocations are included in these three TMDLs based on the assumption that nonpoint source reductions will occur, EPA's guidance interpreting the regulations requires that there be reasonable assurance that these nonpoint source reductions will be achieved in these cases.

The load allocation applies to discharges from the agriculture/open land use category and ranges from a 0.2% reduction in stormwater runoff volume for Moon Brook to a 6.6% reduction for Rugg Brook. The vast majority of the runoff reduction for these TMDLs is assigned to the wasteload allocations. VTDEC believes that nonpoint source control measures being implemented through Vermont's Clean and Clear Action Plan will achieve the modest load reductions set forth in the TMDLs. Although the Clean and Clear Action Plan is primarily a phosphorus reduction plan, action items in that Plan will also reduce sediment loadings and otherwise benefit Moon, Stevens, Rugg, and the other stormwater-impaired streams in the Champlain Basin. As presented in the TMDL, the State plans to:

- Expand the Conservation Reserve Enhancement Program statewide to create conservation easements on farms along streams for buffer implementation.
- Provide technical assistance by Agricultural Resource Specialists to help farmers statewide with best management practices, riparian buffer conservation, nutrient management, compliance with Accepted Agricultural Practices, basin planning, and other technical needs.
- Support agricultural participation in the basin planning process.

- Hire Watershed Coordinators for Lake Champlain Basin watersheds to help develop and implement river basin plans.
- Expand the Department's River Management Program to promote stream stability and reduce phosphorus loading from stream bank and stream channel erosion in the Lake Champlain Basin through a comprehensive program of assessment, protection, management, restoration, and education, with additional federal funding being sought from the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and other agencies.
- Enhance the Vermont Better Backroads Program throughout the Lake Champlain Basin with staffing for technical assistance and increased funding for erosion control grants to towns.
- Offer technical assistance to towns in the Lake Champlain Basin seeking to provide better water quality protection through local ordinances and other municipal actions. This may lead, for example, to improved protection of riparian areas in agricultural and open space areas.
- Protect and/or restore riparian wetlands.

Based on communications with VTDEC, EPA is aware that good progress has already been made on a number of the actions, including the following: 1) the State Department of Forests, Parks and Recreation recently established a Wetland Restoration and Protection Program that provides funding for the protection or restoration of wetland areas in the Lake Champlain Basin, and some potential wetland restoration sites have been identified in these watersheds, 2) an agricultural basin planner has been hired by the Otter Creek Natural Resources Conservation District, and this planner is facilitating input on agricultural components of the basin plans that include these watersheds; 3) both phase 1 and 2 geomorphic assessments of all four brooks have now been completed (following the VT ANR stream geomorphic assessment protocols), and specific recommendations for next steps are laid out; 4) an Agricultural Resource Specialist has been assigned to the region including these watersheds, and will be conducting a needs survey to determine opportunities for technical assistance on riparian buffer conservation, the Accepted Agricultural Practices, and other technical assistance needs; and 5) the Vermont League of Cities and Towns recently hired a staff person under the Clean and Clear Action Plan to assist municipalities with improvements to conservation oriented ordinances, and this person has or will be offering assistance to the municipalities in these watersheds. In addition, VT ANR is currently revising the Clean and Clear Action Plan to ensure that its strategies are up-to-date, effective, and more specific.

The TMDL documents indicate that, taken together, these components of the Clean and Clear Initiative (many of which are already underway) provide reasonable assurance that the modest nonpoint source reductions in the TMDLs will be achieved.

Assessment: EPA concurs that the TMDLs provide reasonable assurance that the nonpoint source load reductions will be achieved.

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.

A summary of the public participation process is included in each TMDL document. VTDEC provided an opportunity for public comment on the three TMDLs, beginning on July 11, 2008 and closing on September 5, 2008. Notice of the comment period was posted on the State's website and announced via newspaper. Informational public meetings were conducted in Rutland on August 27th and St. Albans on August 28th, 2008 to present the TMDL and answer any questions. Additionally, notification of the public meetings was posted on the Vermont Department of Libraries website. At the close of the public comment period, VTDEC received comments from three parties. A summary of these comments, along with responses from VTDEC, is included in each of the final TMDL documents.

Assessment: EPA concludes that VTDEC adequately involved the public during the development of the TMDLs, and provided reasonable and thorough 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: VT DEC's letter of October 2, 2008 states that the TMDLs are being formally submitted for EPA approval.

References

This document cites the following references in addition to those listed as part of the TMDL submittal package on page 1:

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Total Maximum Daily Load

To Address Biological Impairment in

Rugg Brook (VT05-07)

Franklin County, Vermont

October 2008

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Appendix A: Summary of Responses to Public Comments

Introduction

Section 303(d) of the Federal Clean Water Act requires each state to identify waters not attaining water quality standards, and to establish total maximum daily loads (TMDLs) for such waters for the pollutant of concern. The TMDL establishes the allowable pollutant loading from all contributing sources at a level necessary to attain the applicable water quality standards. TMDLs must account for seasonal variability and include a margin of safety that accounts for uncertainty of how pollutant loadings may impact the receiving water's quality. Once the public has had an opportunity to review and comment on the TMDL, it is submitted to the U.S. Environmental Protection Agency (USEPA) for approval. Upon approval, the TMDL is incorporated into the state's water quality management plan.

This TMDL establishes a scientifically based water quality target for Rugg Brook that, when attained, will allow the stream to meet or exceed the established Vermont Water Quality Standards (VTWQS) for which it is impaired. This TMDL has been established in accordance with Section 303(d) of the Federal Clean Water Act, implementing regulations (40 CFR §130) regarding TMDL development, and other relevant USEPA guidance documents.

The basis for this TMDL was initially explained in the final report produced by the Vermont Water Resources Board Investigative Docket (Vermont Water Resources Board, 2004). More specifically, Appendix A of that document ("*A Scientifically Based Assessment and Adaptive Management Approach to Stormwater Management (Stormwater Cleanup Plan Framework)*") outlined the necessary steps to develop a scientifically sound approach in creating TMDLs for stormwater-impaired waters. Henceforth, this approach is referred to as the "Framework". The Vermont Department of Environmental Conservation (VTDEC) adhered to the Framework's approach for developing cleanup targets in this TMDL.

Several investigations have been conducted by multiple parties to derive the necessary information called for in the Framework. Significant results and findings of those investigations are summarized in this TMDL. Additionally, frequent interaction between VTDEC and the VTDEC-convened Stormwater Advisory Group (SWAG) yielded useful guidance for the development of this TMDL.

Description of Waterbody

The majority of the stormwater impaired portion of the Rugg Brook watershed is located in the Town of St Albans with extent portions located in the City of St. Albans to the north, and southern portions in the Towns of Fairfield and Georgia in Franklin County. The stormwater impaired reach extends from river mile 3.1 and extends upriver approximately 1.6 miles. The headwaters portions of the watershed to the east and south originate in primarily forested areas but the streams quicky emerge into low density and agricultural areas. In the middle and lower portions of the stormwater impaired watershed, Rugg Brook travels through more highly developed residential and industrial land uses.

One unique feature in the Rugg Brook watershed is the stormwater diversion structure built to divert high water flows from adjacent Stevens Brook into Rugg Brook to avoid flooding in the most populated areas of the City of St. Albans. The diversion structure is an open channel that connects Stevens Brook to the lower reaches of the stormwater impaired portion of Rugg Brook.

The entire stream portion and its tributaries within the impaired reach are Class B waters designated as cold water fish habitat pursuant to the Vermont Water Quality Standards. The total watershed area of the stormwater impaired section is approximately 1,831 acres. The land use breakdown of the watershed draining to the stormwater impaired reach is 20% developed lands, 37% agricultural or open lands and 43% forested or wetlands.

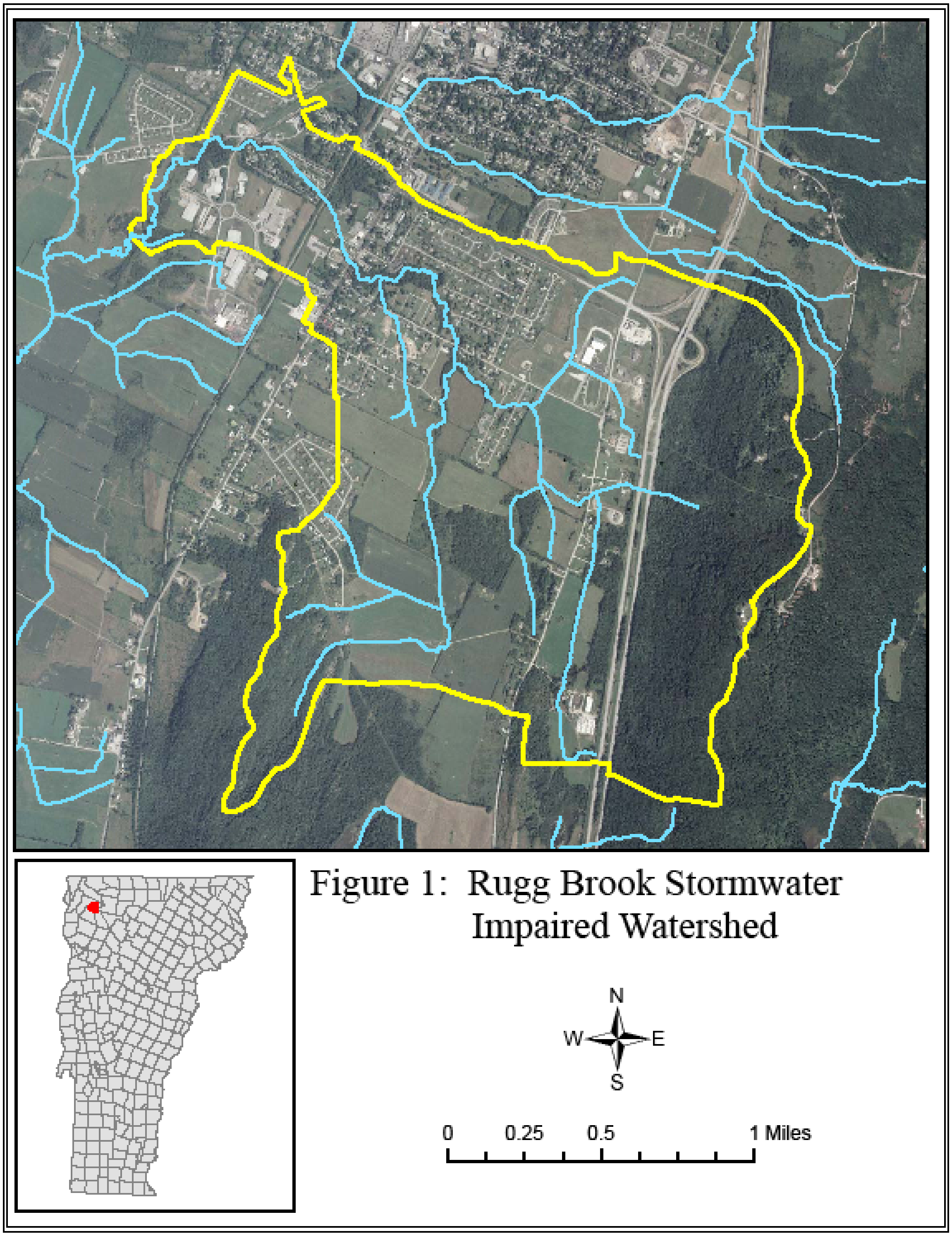


Figure 1: Rugg Brook Stormwater Impaired Watershed

Priority Ranking/303d List of Impaired Waters

Rugg Brook is designated as impaired on the 2006 Vermont 303(d) List from river mile 3.1 upstream for a distance of 1.6 miles 9.8 due to non-support of aquatic life designated uses. Since all tributaries and the upstream main stem drain to the impaired lower portion of the stream, the entire Rugg Brook watershed upstream from river mile 3.1 is considered to contribute to its impairment. The source of the impairment is multiple impacts associated with excess stormwater runoff.

According to the 2006 Vermont 303(d) List, TMDL development priority for Rugg Brook is high and scheduled for completion within 1-3 years from the 2006 listing cycle. In the 2006-2007 Legislative session, the Vermont Legislature amended the Vermont stormwater statute, 10 VSA §§1264 and 1264a, to require the issuance of a general or individual permit implementing a TMDL approved by EPA by January 15, 2010 for Vermont's stormwater impaired streams. VTDEC agrees with the Legislature that TMDL development and the issuance of general or individual permits to implement TMDLs for these streams is a high priority and is an integral component of the remediation process.

Description of Impairment

Biological Monitoring

In all the stormwater-impaired streams in Vermont, aquatic life use support (ALS) impairments are detected through the use of biological monitoring of fish and/or macroinvertebrate communities. The biological monitoring program relies on data from reference sites to define biological community goals for a given stream type. This approach is provided for in the VTWQS and specific numeric biological criteria have been established for several stream types to indicate compliance with the VTWQS.

The monitoring is extremely useful in that it directly measures the health of the aquatic life community and is reflective of environmental conditions that occur in the stream over an extended period of time (i.e. months) including the effects of intermittent discharges such as stormwater. However, biological monitoring is limited when trying to identify the specific pollutant stressor(s) and the extent to which they might contribute to the impairment.

The biological assessment information used to determine the stormwater impairment reach on Rugg Brook has been collected from sample points at river miles 4.3 and 4.4 (Table 1).

Table 1. Biomonitoring site locations and Aquatic Life Use Support (ALS) assessment for the fish and/or macroinvertebrate community, by site and year, on Rugg Brook.

Site (River Mile)	Date	Fish Assessment	Macroinvertebrates Assessment
4.3	1999	Poor	-
	2000	Poor	-
	2004	Poor	-
4.4	2002	-	Poor
	2004	-	Fair

Pollutants of Concern and Other Stressors

In streams draining developed watersheds, biological communities are subjected to many stressors associated with stormwater runoff. These stressors are related either directly or indirectly to stormwater runoff volumes and include increased watershed pollutant load (e.g. sediment), increased pollutant load from in-stream sources (e.g., bank erosion), habitat degradation (e.g. siltation, scour, over-widening of stream channel), washout of biota, and loss of habitat due to reductions in stream base flow. The stressors associated with stormwater runoff may act individually or cumulatively to degrade the overall biological community in a stream to a point, as in Rugg Brook, where aquatic life uses are not fully supported and the stream does not attain the VTWQS.

Surrogate Measure for Multiple Stressors

This TMDL utilizes the surrogate of stormwater runoff volume in place of the traditional "pollutant of concern" approach. The combination of stressors is represented by the surrogate of stormwater runoff volume. First, the use of this surrogate has the primary benefit of addressing the physical impacts to the stream channel caused by stormwater runoff such as sediment release from channel erosion and scour from increased flows. These physical alterations to the stream are substantial contributors to the aquatic life impairment. Also, reductions in stormwater runoff volume will help restore diminished base flow (increased groundwater recharge), another aquatic life stressor. This surrogate is also appropriate because the amount of sediment and other pollutants discharged from out of channel sources is a function of the amount of stormwater runoff generated from a watershed.

Fluvial Geomorphic Considerations

Where biological impairment of a stream is principally the result of physical stressors, such as in Rugg Brook, the natural and anthropogenic factors controlling physical form and process may be quantified, and the strategies for restoring modified fluvial processes may be devised.

According to McCrae (1991), channel morphology and fluvial processes are primarily controlled by a) watershed inputs from the production zone of the watershed; b) the valley morphology of the stream reach; and c) the boundary material characteristics of the channel (Figure 2).

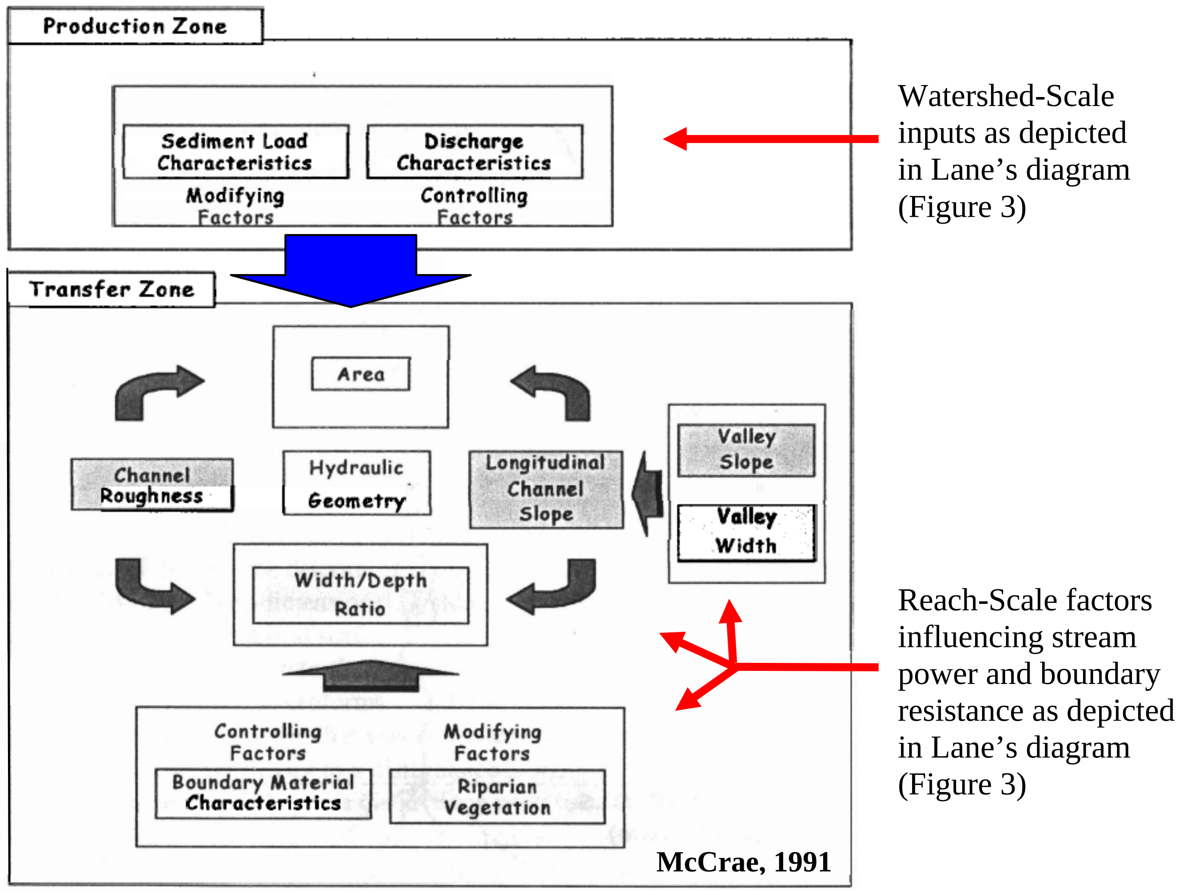


Figure 2. Diagram explaining the watershed and reach-scale controlling and modifying factors affecting the hydraulic geometry and fluvial processes of a stream.

In turn, channel and floodplain modifications and changes to the controlling factors of discharge and boundary materials, brought about by watershed and riparian land use modifications, place stress on biological communities by altering key physical habitat features of the stream network, including: hydrology; longitudinal and lateral connectivity; temperature; and the transport and retention of sediment, large wood, and organics.

Where the overall goal in the stormwater-impaired watersheds is to reduce physical stressors on key habitat features, the primary objective is to cost effectively manage toward the "reference" hydraulic geometry conditions of the stream channel where the energy grade or stream power, ***as influenced by stream flow (discharge characteristics)***, is in balance with the resistance of the natural boundary materials (Figure 3).

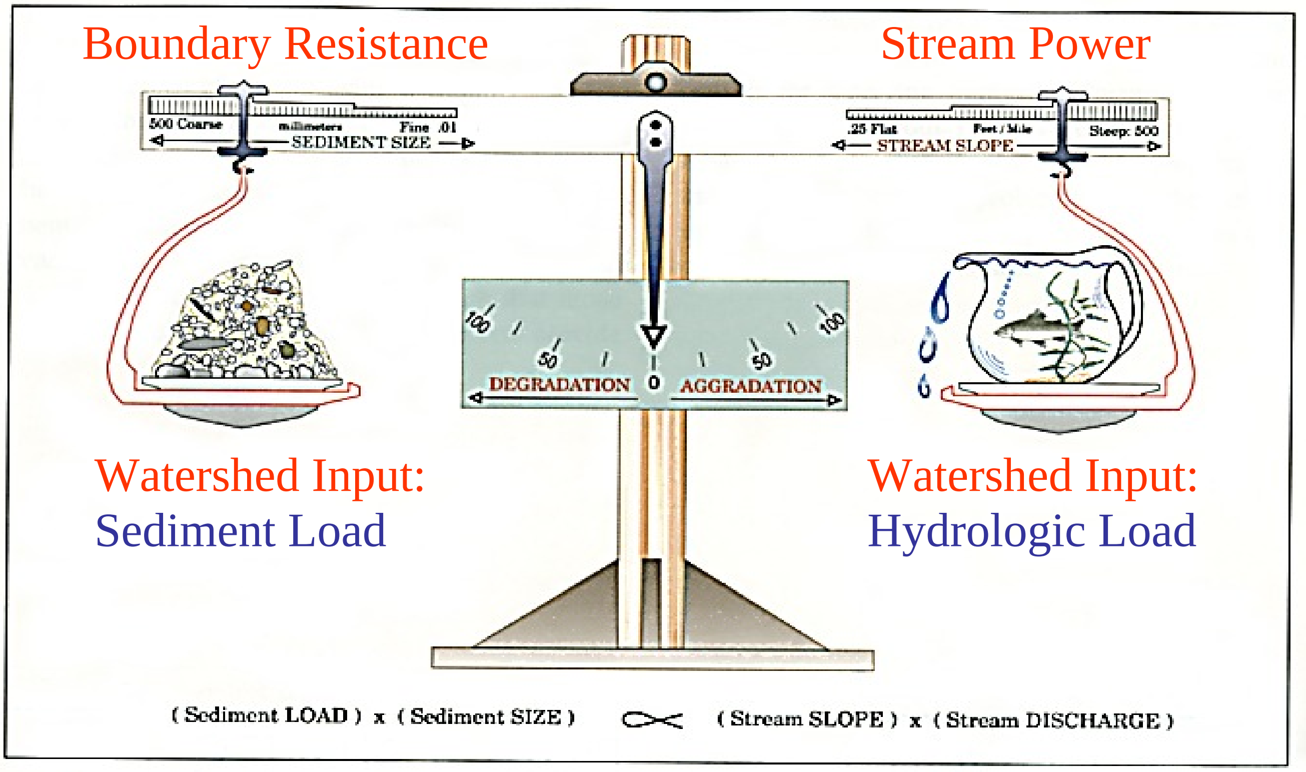


Figure 3: Lane's Diagram (1955) from Rosgen 1996 explaining the balance of stream energy grade with boundary resistance as controlled by hydrologic and sediment load.

The first priority in managing energy grade is to look at stream flow characteristics (Figure 2. production zone input) as the primary controlling factor influencing hydraulic geometry and stream power. To meet the stated goal, alterations to watershed inputs (i.e., stormwater) must be addressed before attempts to remediate other reach-scale (transfer zone) factors affecting hydraulic geometry are undertaken (e.g., dealing with river corridor encroachments to change artificial valley constraints affecting channel plan form and slope and/or restoring floodplain connection to reduce flood depths).

Additionally, sediment load from the production zone may also be a controlling factor to channel hydraulic geometry (Figure 2). In the case of stormwater-impaired streams in Vermont, production zone contributions (colluvial and runoff generated) are far outweighed by the sediment contributions at the transfer zone or reach scale (channel bed and banks), due to channel degradation and widening initiated by stormwater increases.

Stream geomorphic assessment data specific to the stormwater impaired reaches of Rugg Brook confirm the significance of the instream sediment generation, as opposed to production zone sediment inputs, and its resultant negative impact on aquatic biota habitat. Results from a 2005 geomorphic assessment in Rugg Brook indicate that the stream channel is highly unstable and that the potential for more degradation is high (Lake Champlain Committee, 2006). Of 7 reaches assessed in the stormwater impaired portion of the Rugg Brook watershed, all were rated as being in "fair" geomorphic condition. In the same 7 reaches, sensitivity to further channel instability was rated as "extreme" in 4 of the reaches, and either "very high" or "high" in the remaining 3. These conditions in turn reflect a generally degraded aquatic habitat whereby all but 1 of the 7 reaches were rated as having "fair" habitat conditions.

The goal of this TMDL is to address the controlling factor of instream sediment production by determining the departure of existing discharge characteristics in Rugg Brook from attainment stream discharge characteristics and setting flow reduction targets to allow for the reestablishment of good habitat conditions throughout the stream in order to meet VTWQS.

Reduced Base Flow

Increased impervious cover and the resulting increase in surface runoff reduces the amount of rainfall that infiltrates pervious (e.g., vegetated) areas to recharge groundwater. For many streams, groundwater recharge is the predominant source of stream base flow. Diminished base flow can further stress aquatic life and cause or contribute to aquatic life impairments through loss of aquatic habitat (shrinking wetted perimeter) and increased susceptibility to pollutants.

The loss in base flow is directly proportional to the increase in stormwater runoff volume. It is possible to reasonably estimate stormwater runoff and the amount being recharged. It can be far more complicated to estimate the relationship between groundwater recharge and stream base flow. However, simpler methods involving hydrologic models have been used to successfully predict stream base flow as a function of groundwater recharge. More difficult, however, is understanding and quantifying the net effect of diminished base flow on aquatic life for a given stream.

Water Quality Standards

Rugg Brook is listed as impaired based on narrative criteria relating to aquatic biota. The impact of excessive stormwater flows into Rugg Brook has resulted in a violation of the VTWQS §3-04(B)(4) which states that there shall be:

> *"No change from the reference condition that would prevent the full support of aquatic biota, wildlife, or aquatic habitat uses. Biological integrity is maintained and all expected functional groups are present in a high quality habitat. All life-cycle functions, including overwintering and reproductive requirements are maintained and protected."*

In Vermont, numeric biological indices are used to determine the condition of fish and aquatic life uses. Vermont's Water Quality Standards at 3-01(D)(1) and (2) provide the following regulatory basis for these numeric biological indices:

> *"(1) In addition to other applicable provisions of these rules and other appropriate methods of evaluation, the Secretary may establish and apply numeric biological indices to determine whether there is full support of aquatic biota and aquatic habitat uses. These numeric biological indices shall be derived*

from measures of the biological integrity of the reference condition for different water body types. In establishing numeric biological indices, the Secretary shall establish procedures that employ standard sampling and analytical methods to characterize the biological integrity of the appropriate reference condition. Characteristic measures of biological integrity include but are not limited to community level measurements such as: species richness, diversity, relative abundance of tolerant and intolerant species, density, and functional composition.

(2) In addition, the Secretary may determine whether there is full support of aquatic biota and aquatic habitat uses through other appropriate methods of evaluation, including habitat assessments."

Designated Uses

Rugg Brook is a Class B waterbody. Section 3-04(A) of the VTWQS states:

Class B waters shall be managed to achieve and maintain a high level of quality that is compatible with the following beneficial values and uses: . . .

§3-04(A)(1):

aquatic biota and wildlife sustained by a high quality aquatic habitat with additional protection in those waters where these uses are sustainable at a higher level based on Water Management Type designation.

Since biomonitoring data does not meet the criteria for Class B standards, Rugg Brook does not support the designated uses for Class B waters.

Antidegradation Policy

In addition to the above standards, the VTWQS contain the following General Antidegradation Policy in §1-03(B):

All waters shall be managed in accordance with these rules to protect, maintain, and improve water quality.

Numeric Water Quality Target

In a pollutant-specific TMDL, a stream's water quality target, or 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 stormwater runoff volume, the loading capacity is the greatest volume of stormwater runoff Rugg Brook can receive without violating the stream's aquatic life criteria. The challenge is to determine the maximum stormwater runoff target volume for the stormwater-impaired streams.

Target Setting Approach

The Framework identifies a reference watershed approach whereby hydrologic targets are developed by using similar "attainment" watersheds as a guide. The term "attainment" is used here rather than "reference" because reference tends to imply that the ultimate goal for the impaired stream approaches pristine. Instead, the attainment watershed(s), while meeting or exceeding the Vermont water quality standards criteria for aquatic life, should contain some level of development in order to better approximate the true ecological potential of the impaired stream. This TMDL uses the attainment watershed approach for target setting and identifies hydrologic targets for Rugg Brook based on the hydrologic characteristics of similar watersheds where the VTWQS aquatic life criteria are currently met.

The first step in using the attainment watershed approach is to select appropriate attainment streams, which, ideally, are as similar to the impaired watershed as possible in physical makeup, such as slope, soils, climatic patterns, channel type, and land use/cover, etc. Since all of the lowland stormwater-impaired streams are located in the Lake Champlain Valley, a collection of similarly located streams was identified from which the most representative attainment watersheds could be selected for each stormwater-impaired watershed.

The Framework identifies flow duration curves (FDCs) as the best surrogate for defining hydrologic targets. FDCs are very useful at describing the hydrologic condition of a stream/watershed because the curves incorporate the full spectrum of flow conditions (very low to very high) that occur in the stream system over a long period of time. The FDCs also incorporate any flow variability due to seasonal variations. A comparison of FDC between an impaired and appropriate attainment stream/watershed can reveal obvious patterns. For example, a FDC for a stormwater-impaired stream/watershed will typically show significantly higher flow rates per unit area for high flow events and significantly lower flow rates per unit area for low-base flow conditions than the FDC for the attainment watersheds. The increased predominance of high flow events in the impaired watershed creates the potential for increased watershed stormwater pollutant loadings, increased scouring and stream bank erosion events, and the possible displacement of biota from within the system. Also the reduction in stream base flow revealed by the FDC can create a potential loss of habitat for low flow conditions.

A high flow value (0.3%) and a low flow value (95%) were selected as points along the continuum of the FDCs useful for setting specific hydrologic targets. The 0.3% exceedance flow closely matches the one year return flow and the 95% exceedance flow represents a low flow condition comparable to the 7Q10.

Since there is limited hydrologic data for either impaired or attainment streams, the Framework recommends developing synthetic FDCs by employing a calibrated rainfall-runoff model based on land use and cover. FDCs can then be developed for both impaired and attainment streams and the relative difference between the two is used to establish the flows needed to restore the stream's hydrology. In this TMDL, the hydrologic targets are expressed as percentage reductions or increases relative to the attainment watersheds' FDCs at the representative high and low flow values.

Flow Duration Curve Development

Based on available data and the model outputs necessary to develop the FDCs, the P8-Urban Catchment Model (P8-UCM) was selected (Walker, 1990) to develop the synthetic FDC for both the stormwater impaired and attainment streams. Inputs to P8-UCM for hydrologic simulation include climatological data, percent watershed imperviousness, pervious curve number, and times of concentration for ground water base flow and surface runoff.

After initial calibration and review, additional changes were made to improve the low flow prediction capability of the model and refine the estimated surface runoff time of concentration. Upon final review and model verification, the calibrated model was used to develop FDCs for all impaired and attainment streams in the lowland areas. A complete discussion of the model setup, calibration, adjustments and results can be found in the report entitled *"Stormwater Modeling for Flow Duration Curve Development in Vermont"* (Tetra Tech, 2005). The complete FDC for Rugg Brook along with expanded views of the high and low flow portions of the curve are given below in Figures 4 through 6.

Target Setting

With the FDCs for all attainment and impaired streams in hand, a process was developed to determine which attainment streams to use for setting appropriate hydrologic targets. A statistical approach was developed cooperatively by researchers at the University of Vermont and the VTDEC that allowed for the selection of the most appropriate attainment streams for each stormwater-impaired stream. A summary of this methodology is given below; however, the complete methodology and results can be found in a report under separate cover (Foley, 2005).

The first step in this target setting approach was a statistical analysis of the P8 input variables for each watershed to establish what are the most influential factors determining impairment/attainment in the sample of Lake Champlain Valley streams. The second step grouped impaired streams with the most similar attainment streams based on watershed features that were least likely to determine impairment based on step one. By doing this, watersheds were grouped based on intrinsic similarities that effect flow, resulting in attainment streams being grouped with the most similar stormwater-impaired streams. Within each group, the attainment stream FDCs represent a hydrologic regime that will most likely support healthy aquatic life and thus the attainment of the VTWQS for each stormwater-impaired stream.

Due to the relatively small sample size of attainment streams (15) relative to the number of lowland stormwater-impaired streams (12), the concept of a range of appropriate FDC values is useful to alleviate some uncertainty associated with selecting the single best matching watershed. While the entire range of flows within each attainment group represents flow regimes associated with attainment conditions (i.e. supporting VTWQS criteria for aquatic life), the selection of the mean value provides an intrinsic margin of safety that the selected target represents an attainment condition.

In the case of Rugg Brook, there was only a single attainment stream, Tenney Brook, grouped with it so there was no range of flows from which to calculate a mean value. Because only the single attainment stream was matched with Rugg Brook, a modified approach was applied to simulate an attainment range and develop a more conservative target than simply using the flow of the single attainment stream as the target. To do this, the other attainment ranges developed for the lowland stormwater impaired streams were analyzed to determine the relationship between the high flow end of the attainment range to the mean of the range. This analysis showed an average difference of 5% between the highest flow in the attainment range and the attainment mean. The range of percent differences was from 1% to 10%. The next step assumed that the modeled flows from Tenney Brook represented the highest flows of an assumed attainment range for Rugg Brook. The flow at the 0.3% exceedance interval was reduced then by 5% to represent the mean of the attainment range and thus the new calculated high flow target for Rugg Brook. The same approach was applied to the low flow target to develop a calculated target.

The attainment stream best matched with Rugg Brook is given in Table 2 with FDC flows at the high and low flow intervals. Also, the calculated target flow is given based on the above described approach. Figures 4 through 6 graphically represent the FDCs for Rugg Brook and associated attainment streams (complete FDC, high flow and low flow respectively).

Table 2. Attainment streams matched with Rugg Brook and corresponding flows.

	Status	Q 0.3% (cfs/mi^2)	Q 95% (cfs/mi^2)
Rugg	Impaired	11.3195	0.2027
Tenney	Attainment	9.3369	0.2399
Calculated target flows		8.8700	0.2519
Difference between Rugg Bk. and target flows		2.4495	0.0492

Figure 4. Flow duration curves for Rugg Brook and attainment stream.

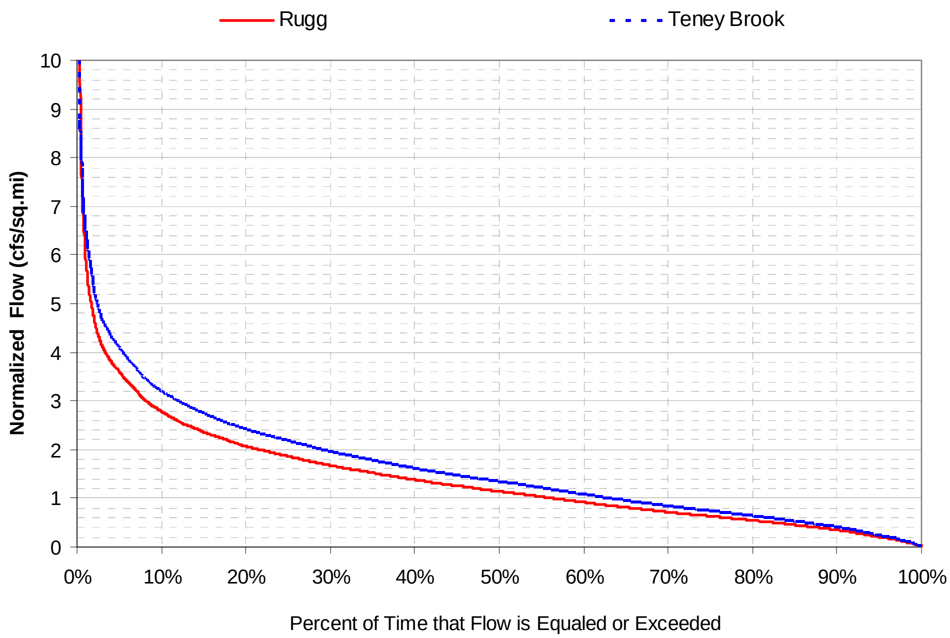


Figure 5. High flow portion of the flow duration curves for Rugg Brook and attainment stream.

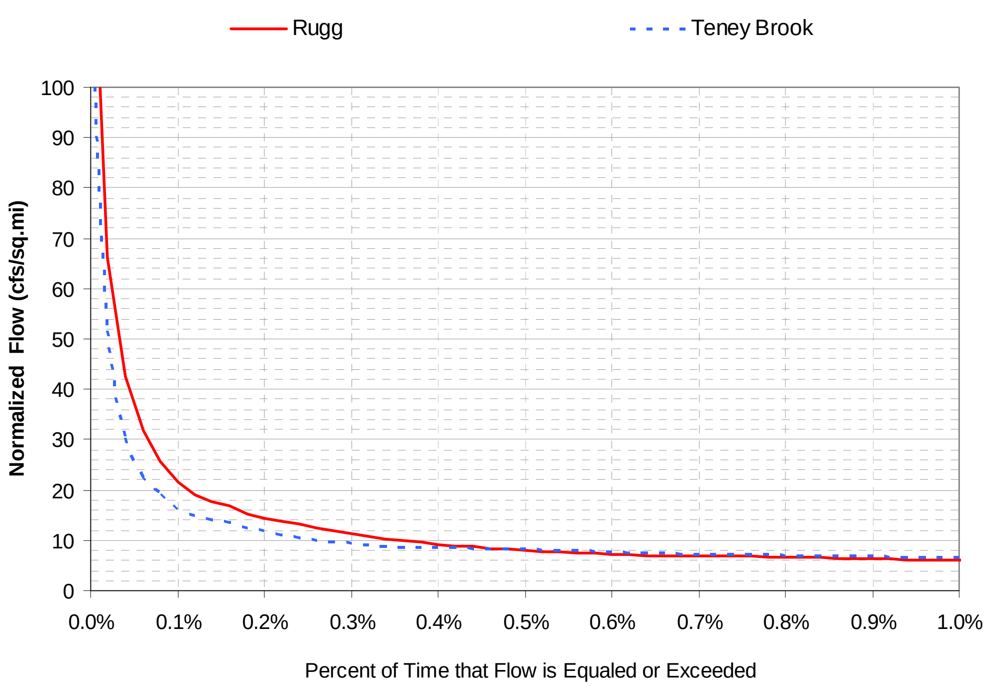
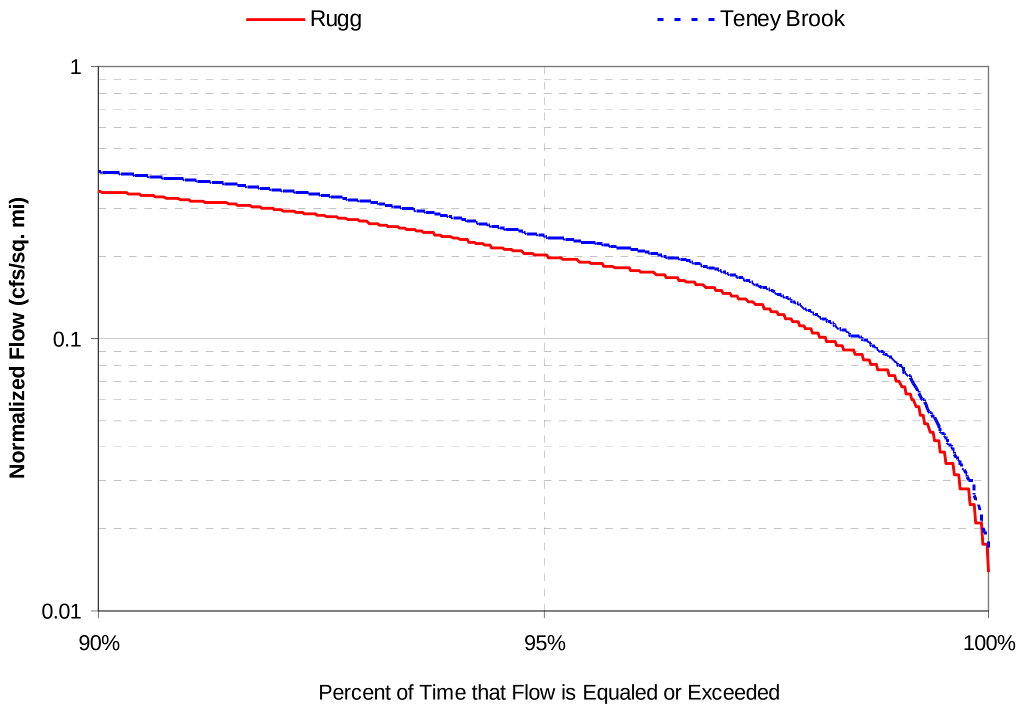


Figure 6. Low flow portion of the flow duration curves for Rugg Brook and attainment stream.



The actual TMDL target flows for Rugg Brook are the percentage differences between the Rugg Brook flows and the mean of the attainment streams at both Q0.3% and Q95% (Table 3). This accounts for any lack of accuracy in the FDCs developed with the P8-UCM. Considering the relative simplicity of the model, there may be some inaccuracy with the final modeled flow values compared to actual flows. However, since similar data sources and calibrated model were used across all watersheds, both impaired and attained, inaccuracies are expected to be relative across all watersheds. Therefore, the relative difference between impaired and target flows are best described as a percentage rather than actual flow rates.

Table 3. Watershed flow targets for Rugg Brook given as percentage increase/decrease from current conditions.

Target decrease in flow at Q 0.3%	Target increase in flow at Q 95%
22%	24%

Margin of Safety

The Clean Water Act and implementing regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between the TMDL allocations and water quality. EPA guidance explains that the MOS may be either implicit (i.e. incorporated into the TMDL through conservative assumptions in the analysis) or explicit (i.e. expressed as a separate allocation). The MOS in this TMDL is implicit and is incorporated through conservative assumptions in the target setting approach.

As described above, the mean flow of the attainment streams was selected as the target flow condition in the Rugg Brook TMDL to provide an intrinsic margin of safety that the selected targets would provide for the attainment of the VTWQS. Due to the rigorous application of the attainment stream selection approach in the Rugg Brook TMDL, the targets are believed to be particularly accurate thus reducing the need for an overly conservative or arbitrary margin of safety.

The use of the attainment stream approach is a particularly good approach to identify flow targets because it relates appropriate flow conditions in streams that comply with the VTWQS (attainment streams) back to Rugg Brook. However, haphazard matching of attainment streams, and thus flow targets, to Rugg Brook could lead to targets with a high degree of uncertainty as to whether standards would be met. To provide a more rigorous target setting approach, attainment streams for Rugg Brook were selected using an analysis described in “Statistical Analysis of Watershed Variables” (Foley, J. and Bowden, 2005). VTDEC believes that by utilizing this approach, Rugg Brook was paired with the “most similar” attainment streams available in the Lake Champlain Basin. By identifying the “most similar” attainment streams through standard statistical approaches, a significant amount of uncertainty is eliminated regarding what are the best target values.

Additionally, it is likely that the flows represented by the attainment stream are not at the “threshold” of attainment. That is, the modeled flows in the streams currently meeting standards likely represent flows somewhat below that which impairment would occur, thus adding an additional level of safety.

VTDEC affirms the attainment stream approach outlined in the Docket report and has taken steps to reduce a significant level of target setting uncertainty by incorporating a solid statistical approach. The fact that the stormwater runoff volume target approach has not routinely been utilized in the development of TMDLs should not detract from its firm basis in sound science and logical experimental design.

Further, the Docket strongly urges the concept of adaptive management when implementing controls in the stormwater-impaired streams and VTDEC is firmly committed to this idea. Various types of watershed monitoring, many of which have already been initiated, will provide the necessary data to either adjust the targets or implementation measures to ensure ultimate compliance with VTWQS in Rugg Brook. While VTDEC believes there is an adequately conservative margin of safety associated with these targets, post-implementation adaptive management provides yet another layer of “safety” that the VTWQS will be met.

Seasonal Variation

The Clean Water Act and implementing regulations require that a TMDL be established with consideration of seasonable variations. The FDCs, and subsequent hydrologic targets, developed for this TMDL are very useful for incorporating any seasonal variation in the stream system because they describe the full spectrum of flow conditions (very low to very high) that occur. By using a 10 year simulation period utilizing actual precipitation data to develop the FDCs, any flow variability due to seasonal variations has been incorporated into the hydrologic targets and the required flow decreases/increases in Rugg Brook to meet those targets.

Allocations

In addition to the overall watershed target, TMDLs must also provide for an allocation of that target between point sources and nonpoint sources, or, the Wasteload Allocation (WLA) and the Load Allocation (LA) respectively. USEPA guidance allows for a gross allocation between these two stormwater source types rather than accounting for every discrete stormwater conveyance and the areas draining to them (USEPA 2002). The USEPA guidance also allows for dividing the allocation by using a land use analysis to simplify the process. By making the assumption that more developed areas typically convey stormwater via discrete means such as pipes or swales and lesser developed areas mostly convey stormwater via surface sheetflow, the allocation process can be developed with land use analysis whereby developed areas fall into the WLA and the lesser developed areas into the LA.

This TMDL uses the land use based allocation approach to distribute the overall percentage targets for the watershed. To do this, the Rugg Brook watershed was divided into three broad categories including Urban/Developed, Agriculture/Open, and Forest/Wetland. Table 4 below illustrates how the land use categories were divided into these three broader categories and the associated land areas within the Rugg Brook watershed.

Table 4. Categorization of Land Uses into broader classes.

Major Land Use Categories	Land Use Name
Urban/Developed	Residential
	Commercial
	Industrial
	Transportation
	Other Urban
Agriculture/Open	Agriculture/Mixed Open
	Row Crops
	Hay/Pasture
	Barren Land
Forest/Wetland	Deciduous Forest
	Coniferous Forest
	Mixed Forest
	Brush/Transitional
	Wetland
	Water

The overall percent reduction/increase in flows was then distributed among these three categories to meet watershed targets. It was determined that there would be a zero allocation, or no expected change in flow levels emanating from the Forest/Wetland category since the runoff characteristics from these areas are likely optimal with regard to overall watershed hydrology. This left the allocation to be distributed between the Urban/Developed (WLA) and Agriculture/Open (LA) categories. The next step was to determine the relative amount of influence each category had on runoff characteristics, and thus the FDC, and divide the allocation accordingly. To accomplish this, the concept of a runoff coefficient was utilized.

A runoff coefficient (R_v) is an expression of the percentage of precipitation that appears as runoff. The value of the coefficient is determined on the basis of climatic conditions and physiographic characteristics of the drainage area and is expressed as a constant between zero and one. By determining the relative contribution to stormwater runoff from each land use category using the R_v, the allocation between WLA and LA can be made accordingly.

The primary influence on R_v is the degree of watershed imperviousness. This is shown through data collected from numerous watersheds during the National Urban Runoff Program Study from which an equation was developed to define the R_v. as shown below (Schueler 1987):

$$R_v = 0.05 + 0.9(I_a)$$

Where: I_a = Impervious fraction

Percent imperviousness was estimated using a previously developed relationship (CWP et al., 1999) for the Vermont Center for Geographic Information (VCGI) land use data layer. Table 5 presents the estimated values for various land use categories.

Table 5. Relationship between VCGI Land Use and percent imperviousness.

VCGI Land Use Code	Land Use Name	Percent Impervious Cover
3	Brush/Transitional	0%
5	Water	0%
7	Barren Land	0%
11	Residential	14%
12	Commercial	80%
13	Industrial	60%
14	Transportation	41%
17	Other Urban	60%
24	Agriculture/Mixed Open	2%
41	Deciduous Forest	0%
42	Coniferous Forest	0%
43	Mixed Forest	0%
61,62	Wetland	0%
211	Row Crops	2%
212	Hay/Pasture	2%

By calculating the R_v for each broad land use group, and then weighting that coefficient's influence on runoff based on the amount of land area within each group, the relative influence of each group on runoff (and conversely groundwater recharge) can be used to allocate the watershed targets across the entire watershed. The results for Rugg Brook are given below in Table 6.

Table 6. The relative influence of each land use category on stormwater runoff in Rugg Brook based on the calculation of the R_v.

	R_v	Area (acres)	Weighted influence on runoff
Urban/Developed	0.29	366	69%
Agriculture/Open	0.07	677	31%

USEPA interprets 40 CFR 130.2 to require that allocations for NPDES-regulated discharges of stormwater runoff be included within the wasteload allocation component of the TMDL (USEPA, 2002). USEPA also states that in instances where there is insufficient data to calculate loads on an outfall by outfall basis, the stormwater wasteload may be expressed as an aggregate or categorical allocation. USEPA acknowledges that in cases where it is difficult to separate NPDES-regulated from non NPDES-regulated stormwater discharges, it is acceptable to include both NPDES-regulated stormwater discharges and non NPDES-regulated discharges (which would typically be included in the load allocation portion of the TMDL) in this aggregated wasteload category.

Because of data limitations and the wide variability of stormwater discharges, it is not possible to separate the stormwater discharges subject to the NPDES program (e.g. stormwater discharges from construction activity, MS4 discharges and multi-sector industries) from stormwater discharges that are not subject to NPDES permitting (e.g. stormwater discharges from impervious surfaces regulated under Vermont's stormwater program). Therefore, all stormwater discharges from the urban/developed land category are included in the wasteload allocation portion of this TMDL. This category includes the NPDES-regulated stormwater discharges as well as other sources of stormwater runoff not regulated as NPDES discharges.

In other words, the weighted proportion of runoff from the more developed areas, where the vast majority of the NPDES regulated and non-NPDES regulated stormwater was generated, established the limit of the WLA. Therefore, the "regulated" areas, including all the NPDES regulated and non-NPDES regulated sources in the WLA, are responsible for reducing and maintaining a 93% decrease in the high flow target. The same is true for the LA whereby the "nonregulated" areas are responsible for reducing and maintaining a 7% decrease in the high flow target.

By aggregating NPDES-regulated and non NPDES-regulated stormwater discharges in the wasteload allocation, the public is provided with a clearer understanding of how Vermont proposes to achieve water quality standards and meet the cleanup target established in the TMDL. However, the inclusion of stormwater discharges outside the scope of the NPDES permit program in the wasteload allocation does not mean that these discharges are legally required to obtain a NPDES stormwater permit currently or that they will be legally required to obtain a NPDES permit to implement the TMDL.

Future Growth

The Agency has applied a two step analysis in allocating for future growth in this TMDL. First, as to "jurisdictional" new growth that is subject to the VTDEC's permit program for impervious surfaces under 10 V.S.A. Section 1264 (i.e. new impervious surfaces greater than one acre), the Agency assumes that the channel protection requirements in the Vermont Stormwater Management Manual requiring 12-hour detention of the 1-year storm, or 24-hour detention if discharging to a warm-water fishery, are sufficient to protect against future stream degradation. The manual requires sites to meet channel protection (CPv) as well as groundwater recharge treatment standards. The premise of the channel protection standard is that runoff would be stored and released in such a gradual manner that critical erosive velocities would seldom be exceeded in downstream channels. MacRae (1991) found that the traditionally used 2-year control approach failed to protect channels worn into more sensitive boundary materials and actually aggravated erosion hazard in very sensitive channels. Therefore, MacRae (1991) developed the distributed runoff control (DRC) as a method to vary the degree of control from the 2-year control to the 80% over control based on the strength of boundary material. A study done in Maryland (Cappuccitti, 2000) showed that "the CPv and DRC methods provide a comparable level of management." Additionally, the Center for Watershed Protection (CWP) recommends the use of the channel protection criteria stating that "the criterion balances the need to use a scientifically valid approach with a methodology that is relatively easy to implement in the context of a statewide program." (CWP, 2000) VTDEC believes that if future growth complies with the channel protection standard as well as the groundwater recharge treatment standard, Rugg Brook will be able to meet both the high and low flow targets of the TMDL.

For "jurisdictional" new growth relative to the low flow targets, the Vermont Stormwater Management Manual groundwater recharge treatment standard requires that predevelopment recharge volumes be maintained, thus providing adequate protection.

As to "non-jurisdiction" new growth (i.e. new impervious surfaces less than one acre), runoff from which could contribute to stream degradation, the Agency has allocated additional stream flow reductions from current conditions to account for these potential impacts. This allocation is based on future growth estimates of "non-jurisdiction" impervious surfaces within the Rugg Brook watershed. Based on current development patterns and potential for future growth, 15 acres was estimated to be an appropriate future growth target. By requiring reductions from currently developed areas that are equal to the future impacts of the additional 15 acres, this type of future development should have no effect on the overall watershed stream flow targets. The same approach has been applied to the low flow targets.

Based on a subsequent P8-UCM model run, the projected 15 acres of impervious surfaces increased the flow at the 0.3% high flow point on the FDC from 11.3195 to 11.4313 cfs/mi^2. The flow at the 95% low flow point on the FDC remained unchanged at 0.2027 cfs/mi^2.

Overall Allocation

In the broadest sense, the primary function of a TMDL is to determine and allocate among sources the maximum pollutant loading a waterbody can receive to maintain compliance with the appropriate water quality standard. For the Rugg Brook TMDL, it's the stormwater runoff volume that is being limited overall and allocated among sources. This approach works well within the TMDL framework for the high flow target whereby an overall reduction of stormwater runoff is required. However, this approach does not fit particularly well for the low flow target where an increase in non-stormwater instream flow is necessary and loading of stormwater runoff volume is not directly being allocated. The restoration of low flows in Rugg Brook is actually a secondary result of controlling stormwater runoff (high flows) to increase groundwater recharge. As stormwater runoff volumes are controlled (high flow reductions), the water that eventually reaches the stream (low flow increases) is no longer considered stormwater runoff because it is generally routed through the groundwater and does not reach the stream for a significant amount of time following the precipitation event.

Also, the benefit of decreased pollutant loading (sediment, nutrients, etc.) due to reduced stormwater runoff at high flows provides a good fit, although indirectly, within the TMDL framework. The same cannot be said of the low flow targets. The low flow targets represent conditions where pollutants are already substantially removed from water the stream receives from groundwater and thus there are no problematic "pollutants" to allocate.

For these reasons, EPA does not consider the low flow targets applicable to an allocation scenario and thus they will not be presented as such in this TMDL. Therefore, Table 7 gives the overall Rugg Brook TMDL allocation for the high flows and Table 8 presents the overall Rugg Brook targets for the low flow condition.

It should be emphasized here that even though the low flow targets are not part of the formal TMDL allocation, VTDEC remains committed to including these low flow targets within the remediation plan for the watershed.

Table 7. Rugg Brook TMDL high flow allocation at Q0.3%.

Wasteload Allocation	Stormwater reduction from current Urban/Developed areas	15.0%	16.0%
	Additional stormwater flow reduction from Urban/Developed areas to account for future growth	1.0%	
Load Allocation	Stormwater reduction from Agriculture/Open areas		6.6%
Total Rugg Brook watershed stormwater flow reduction allocation at Q0.3%			22.6%

Table 8. Rugg Brook low flow targets at Q95%.

<table>
<tr><td rowspan="2">Wasteload Allocation</td><td>Base flow increase from current Urban/Developed areas</td><td>16.8%</td><td rowspan="2">16.8%</td></tr>
<tr><td>Additional base flow increase from Urban/Developed areas to account for future growth</td><td>0.0%</td></tr>
<tr><td>Load Allocation</td><td colspan="2">Base flow increase from Agriculture/Open areas</td><td>7.4%</td></tr>
<tr><td colspan="3">Total Rugg Brook watershed base flow increase target at Q95%</td><td>24.2%</td></tr>
</table>

Reasonable Assurances

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the wasteload allocation is based on an assumption that nonpoint source load reductions will occur, EPA's TMDL guidance provides that a TMDL must provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. In order to allocate loads among both nonpoint and point sources, there must be reasonable assurances that nonpoint source reduction will in fact be achieved. Where there are not reasonable assurances, under the Clean Water Act, the entire load reduction must be assigned to point sources.

As discussed earlier, this TMDL has been structured with an aggregate wasteload allocation category that includes both NPDES-regulated stormwater discharges and non NPDES-regulated stormwater discharges. Under the Clean Water Act, the only federally enforceable controls are those for point sources through the NPDES permitting process. However, VTDEC implements both a federally-authorized NPDES permit program for stormwater discharges from construction activities, industrial activities and municipal discharges under the MS4 program and a state-authorized permitting program for stormwater discharges from impervious surfaces equal to or greater than one acre. VTDEC is, therefore, well positioned to require implementation of stormwater treatment and control measures through NPDES permit conditions and state stormwater permit conditions for discharges in the urban/developed land category. This wasteload allocation category constitutes a 69% weighted influence on stormwater runoff.

The load allocation is comprised of the agriculture/open land use category that constitutes a 31% weighted influence on stormwater runoff. VTDEC believes that nonpoint source control measures that will be implemented through Vermont's Clean and Clear Action Plan will achieve the minimal load reductions set forth in this TMDL. Although the Clean and Clear Action Plan is primarily a phosphorus reduction plan, action items in that Plan will also benefit the stormwater-impaired streams in the Champlain Basin. These action items include:

- Expand the Conservation Reserve Enhancement Program statewide to create conservation easements on farms along streams for buffer implementation.
- Provide technical assistance by Agricultural Resource Specialists to help farmers statewide with best management practices, riparian buffer conservation, nutrient

management, compliance with Accepted Agricultural Practices, basin planning, and other technical needs.

- Support agricultural participation in the basin planning process.
- Hire Watershed Coordinators for Lake Champlain Basin watersheds to help develop and implement river basin plans.
- Expand the Department's River Management Program to promote stream stability and reduce phosphorus loading from stream bank and stream channel erosion in the Lake Champlain Basin through a comprehensive program of assessment, protection, management, restoration, and education, with additional federal funding being sought from the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, and other agencies.
- Enhance the Vermont Better Backroads Program throughout the Lake Champlain Basin with staffing for technical assistance and increased funding for erosion control grants to towns.
- Offer technical assistance to towns in the Lake Champlain Basin seeking to provide better water quality protection through local ordinances and other municipal actions.
- Protect and/or restore riparian wetlands.

The nonpoint source phosphorus reduction activities listed in the Lake Champlain Phosphorus TMDL implementation plan will be actively pursued, contingent on the availability of state and federal funding and the provision of other necessary authority to the Department to carry out these implementation activities. Vermont Governor Douglas announced his "Clean and Clear Action Plan" on September 30, 2003. A major focus of this plan is implementation of the Lake Champlain Phosphorus TMDL.

A total of $5.2 million in state funds was approved by the Vermont General Assembly for state fiscal year 2008 for the Clean and Clear Action Plan. This follows the $8.1 million and $9.5 million state appropriation in FY2006 and FY2007 respectively. These funds are being used to support the above mentioned activities, and others, by the Agency of Natural Resources, the Agency of Agriculture Food and Markets, and many partners.

Implementation Plan

EPA is not required to and does not approve TMDL implementation plans. Moreover, TMDLs are not legally required to include implementation plans. Despite this, the Agency has provided below a brief description of the general framework that it anticipates using to implement this TMDL. The Agency is providing this general description to aid the public in understanding the myriad of tools that the Agency possesses to effectively implement this TMDL. This framework may change over time based on new information gathered by VTDEC and as necessary to meet the requirements of this TMDL.

As a starting point, the Agency has been undertaking various projects to collect information to aid in the development of the implementation plan and in monitoring to assess the success of the plan as it is implemented and make necessary adjustments to the implementation plan. These projects include stream geomorphic assessment, subwatershed mapping, flow gaging and precipitation monitoring, impervious surface mapping and engineering feasibility assessment

Stream Geomorphic Assessment

In order to support the monitoring phase of stream remediation efforts, ANR has contracted with UVM and various consultants to develop a consistent baseline of stream geomorphic assessments (SGAs) for the stormwater-impaired streams, including Rugg Brook. These SGAs can be used as a point of comparison for future assessments to document improvements or degradation of these streams on a set of reaches from stormwater-impaired streams.

Subwatershed Mapping

The objective of this project is to identify discharge points within the stormwater-impaired watersheds and delineate the associated watersheds for those discharge points. The previously available subwatershed data is of varying quality. In some cases, there was data on stormwater collection systems and discharge points. However, all of the watersheds took a substantial amount of work to get an accurate subwatershed delineation. The delineation of these sub-watersheds will help to focus stormwater treatment and control measures on higher risk areas within each stormwater-impaired watershed.

Flow Gaging and Precipitation Monitoring

Altered hydrology within the stormwater-impaired watersheds is the dominant factor in causing the impairments. To support the monitoring phase of stream remediation, ANR, through a contract, established and operates stream flow and precipitation recording stations within each of the stormwater-impaired waters. This data will form an essential part of the adaptive management approach (discussed below) as stream flow is anticipated to reflect the initial response of Rugg Brook to stormwater treatment and control measures that are implemented in accordance with this TMDL.

Impervious Surface Mapping

ANR is mapping the impervious surface area of each stormwater-impaired watershed using QuickBird satellite data. The QuickBird satellite acquires high-quality satellite imagery for map creation, detection of change over time, and image analysis. This project is being undertaken in conjunction with the School of Natural Resources at the University of Vermont.

ANR has performed the digital analysis of the data for the Rugg Brook watershed. UVM will apply advanced object oriented eCognition classification techniques to potentially improve the mapping accuracy for the previously analyzed data using the QuickBird satellite data. This data will be used in developing the implementation plan for this TMDL.

Engineering Feasibility Assessment

To help develop the implementation plan for this TMDL, ANR is currently collecting technical data for all significant stormwater treatment practices (including ponds, infiltration basins, constructed wetlands, etc.) in the Rugg Brook watershed. Technical information including pond volume, drainage area and detention time is being collected through permit review and site modeling using HydroCAD software. Once information is collected, site visits are conducted to ensure the accuracy of data. In addition to data collection, ANR is also conducting a limited engineering feasibility analysis at each site to determine what can reasonably be achieved at each site with regard to stormwater detention and infiltration.

Vermont BMP Decision Support System

In order to implement appropriate restoration efforts, it is important to identify and size the appropriate best management practices (BMP) to achieve the watershed target. Because there are a plethora of BMP type, size, and location combinations, this type of analysis is typically extremely time-consuming. It may require numerous computer model iterations and a significant data pre- and post-processing effort. The urban nature of the stormwater impaired Vermont watersheds and their inherent spatial limitations make them particularly difficult and time-consuming to evaluate. Restoration may require implementing a large number of small-scale BMPs. To increase the efficiency in evaluating these watersheds, a BMP modeling tool that considers type, sizing, and placement and produces results that can be compared to the TMDL targets is being developed. This modeling tool is the Vermont BMP Decision Support System (VT BMP DSS). The VT BMP DSS will help to evaluate where the implementation of stormwater treatment and control will result in the greatest improvements on the flow regime, and ultimately the water quality in the watershed.

Stormwater Diversion Structure

An important aspect in Rugg and Stevens Brooks is the presence of the stormwater diversion structure built and functioning to divert high water flows from Stevens to Rugg Brook to avoid downstream flooding in the City of St Albans. Since this structure has a direct and potentially significant impact on the types of flows this TMDL looks to control, a full understanding of its impact on the modeled flow duration curves will need to be developed and its effects accounted for in the development of any implementation plan for these watersheds.

Watershed-Wide General Permits and NPDES Permits

As discussed above, Vermont is authorized to implement both a federally-authorized NPDES permit program for stormwater discharges from construction activities, industrial activities and municipal discharges under the MS4 program and a state-authorized permitting program for stormwater discharges from impervious surfaces equal to or greater than one acre. This dual permitting authority provides Vermont with powerful tools for requiring stormwater treatment and control practices and monitoring necessary to implement this TMDL.

The Agency currently anticipates that TMDL implementation will be phased and that the Agency will utilize an iterative, adaptive management approach to implementation The first phase of implementation may involve the issuance of a watershed-wide general permit pursuant to state law and may involve requiring controls through Vermont's federally-authorized NDPES stormwater permit program for municipal discharges, discharges associated with industrial activities and construction discharges. Stormwater treatment and control measures required in the first-round watershed-wide general permit may include the construction and/or upgrade of stormwater treatment and control systems by specifically identified dischargers of stormwater runoff.

The first-phase permit(s) will include a coordinated and cost-effective monitoring program to gather necessary information on progress toward the TMDL target and water quality standards and to determine the appropriate conditions or limitations for subsequent permits. Such a monitoring program may include BMP evaluation, ambient monitoring, receiving water assessment, or a combination of monitoring procedures designed to gather the necessary information. Based on this information, the permit(s) would be amended, as appropriate, to require implementation of more widespread and/or more stringent treatment and controls or other best management practices as necessary to meet the TMDL targets. This adaptive management approach is a cyclical process in which a permit(s) is periodically assessed and adjustments to the permit(s) are made as necessary.

Monitoring Plan

USEPA recommends a monitoring plan to track the effectiveness of a TMDL. The Framework supports the concept of adaptive management which necessitates a substantial monitoring plan at several levels. The Framework identifies three levels of monitoring that are necessary for an adaptive management process to proceed most effectively. These include monitoring: 1) BMP implementation, 2) the primary stressors in the watershed, and 3) the instream habitat and biological condition. VTDEC intends to institute a comprehensive monitoring plan that addresses all the aspects identified in the Framework. At this point, certain parts of the monitoring plan have already been initiated while it is premature for others to begin. Several of the initiated monitoring programs have been summarized in the previous "Implementation Plan" section.

Since the watershed general permit that will require the implementation of stormwater treatment and control measures necessary to meet the TMDL target for Rugg Brook has yet to be developed, there is currently no specific monitoring plan for Rugg Brook. However, VTDEC will include requirements for the monitoring components listed in the Framework which might include tracking BMPs implemented, percentage of stormwater treated, percent of land area treated, etc. in the general permit. This should be accomplished relatively easily through database tracking of permits.

Monitoring of the primary stressors in Rugg Brook is necessary to reveal if the implementation measures are having the desired impact. To date, some background monitoring has occurred to provide baseline information against which to measure future change. Continuous streamflow monitoring has been initiated in Rugg Brook. Also, VTDEC has developed the in-house capability to accurately measure imperviousness within the watershed based on satellite imagery.

Monitoring of habitat condition and biological condition in Rugg Brook has also been initiated. A stream geomorphic assessment has been completed which includes an assessment of aquatic life habitat. This data will provide a baseline against which to compare future assessments. Recent biological monitoring has also been conducted to verify the stormwater impairment listing of Rugg Brook. Similarly, this will be used as background data to track future improvements and ultimate meeting of the VTWQS.

Public Participation

A public comment period was established and noticed in both the Rutland Herald and the St Albans Messenger upon the release of the draft Rugg Brook TMDL. The comment period ran from July 11 through September 5, 2008. In conjunction with the release of the draft TMDL, two informational public meetings were conducted, one in Rutland on August 27, 2008 and another in St Albans on August 28, 2008 to present the TMDL and to answer any questions. Additionally, notification of the public informational meeting was posted to the Vermont Department of Libraries website.

At the close of the public comment period, VTDEC had received comments from three parties. A response summary is given in Appendix A.

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Appendix A

Summary of Responses to Public Comments

Comments received

Submitted by:	Signed by:	ID
Northwest Regional Planning Commission	Catherine Dimitruk	NWRPC
City of Rutland - DPW	Alan Shelvey	Rutland
Ken Minck	Ken Minck	Minck

Response summary

Some comments have been edited or paraphrased for brevity but every effort was made to preserve the original meaning and context.

1. I am disappointed that this TMDL is only addressing storm water. I was under the impression a "watershed" approach was being taken regarding TMDLs. Rugg brook also has problems starting at the mouth, please see 303d. It's hard for me to understand why just 1 reach of the 303d issue would be dealt with in isolation. Are other TMDLs in the works for the downstream issues? [Minck]

   <u>Response:</u> By their very nature, TMDLs are developed on specific stream reach/pollutant combinations. In the case of Rugg Brook, this stormwater TMDL deals specifically with the stormwater impairment of the upper reaches of the watershed. The lower portion of the watershed is identified as impaired due to E. coli and undefined pollutants associated with agricultural runoff. While there are currently no TMDLs under development for this reach of Rugg Brook, significant assessment, planning and restoration activities continue including the completion of phase 1 and 2 geomorphic assessments and a significant floodplain restoration project aimed to reduce downstream sedimentation and phosphorus loading to St. Albans Bay.

2. Page 3. We note that the map of the Moon Brook watershed is different from and encompasses a larger area than on any map previously presented by the Agency. The new map shows a significant area in the vicinity of Park Street is now in the watershed. There are multiple low lying areas within the new watershed boundary that do not have a visible outlet. [Rutland]

   <u>Response:</u> The watershed boundary presented in the TMDL is the latest and most detailed information VTDEC has on the Moon Brook watershed. These data were developed through an extensive investigation into the watershed boundaries of all the stormwater impaired watersheds in Vermont. Information developed from this investigation is presented in the report entitled *Stormwater Impaired Watershed Mapping Report* dated 2/24/06. This current mapped version of the Moon Brook watershed has been posted to the Water Quality Division's web site for approximately the last two years.

3. Page 4. The impairment is noted as extending from the confluence with Otter Creek up stream to mile point 2.3 (the discharge of Combination Pond). This is consistent with the evidence that implicates temperature rise in the pond as a primary cause of impairment. Stormwater as the pollutant is a surrogate for sediment. The fact that the impairment begins where in-stream sediment is minimal or non-existent, immediately downstream of a huge and very effective sediment trap (Combination Pond) further boosts that argument. [Rutland]

   Response: VTDEC contends, and as has been communicated to the City of Rutland in writing, that it is at the lowest biomonitoring sample site on Moon Brook (0.3 miles from the mouth) by which Water Quality Standards compliance is measured regarding the stormwater impairment. VTDEC does not dispute that while increased water temperature is indeed a stressor of the biotic community in Moon Brook, particularly trout in the upper watershed below the ponds, there are indicators that stormwater runoff is the primary stressor across the watershed, especially as indicated at sampling results at the lowest monitoring point.

4. Page 14. The coincident of the graphs in Figure 5 does not seem to support a significant expenditure of resources to reduce stormwater related flows in Moon Brook. [Rutland]

   Response: As noted in the TMDL, the high flow reduction target from current modeled conditions is 12%. Across the spectrum of the stormwater impaired streams for which TMDLs have been developed, this percent flow reduction is relatively modest. However, at this time watershed-specific implementation planning and cost estimates have not been developed to estimate the resources required to achieve this target.

5. The computer modeling exercise has determined that an appropriate 0.3% flow for Moon Brook is 8.87 cfs/sq. mi. Thus, with an area of 5,545 acres (8.66 sq. mi.) the 0.3% stream flow consistent with attainment is 76.81 cfs. There is no mention of an adjustment for the runoff collected in the combined sewer system. When one deducts the runoff from the heavily developed area served by that system one may find that the calculated flow is below that figure. [Rutland]

   Response: Adjustments to account for the area of the watershed that drains to the combined sewer will be addressed in the watershed modeling phase of the implementation planning process.

6. We question whether it is appropriate to develop a TMDL for a non-MS4 community. [Rutland]

   Response: As provided in the Federal Clean Water Act, implementing regulations and USEPA guidance, there are no provisions that prohibit TMDL development for a non-MS4 regulated community. On the contrary, TMDLs are required for each pollutant/waterbody combination identified on Vermont's 303(d) List of Impaired Waters.

7. A significant amount of land area within the Stevens Brook impaired watershed is drained to areas outside of the impaired boundary either to a location further downstream or to the City wastewater treatment plant. The NRPC is working closely with the City of St Albans to map these areas and will provide this data to DEC in the coming year. The TMDL should address how these areas will be handled, given that they are not currently impacting the impaired portions of the stream. [NWRPC]

   Response: VTDEC is aware of the potential that several areas within the current presumed watershed boundary may drain to areas outside the impaired watershed or to the wastewater treatment facility. However, at this time VTDEC is not aware of any finished mapping product that delineates these areas. Upon its completion, VTDEC will look to incorporate this information in the development of an implementation plan. VTDEC appreciates the efforts of the NWPC and the City of St Albans to further develop this critical information.

8. The diversion structure that links Stevens and Rugg Brooks is perhaps the most unique feature of this watershed. While the TMDL notes the need for more information regarding the impact of the diversion structure, it does not assign specific responsibility for the task. Without this information, there is no way to accurately access the watershed area affecting the brooks below the diversion structure. Furthermore, in high rain events, there is no way to distinguish the contribution of stormwater runoff from the contribution of the diversion structure in the lower section of Rugg Brook. Given that DEC's stream gages are below the diversion structure, it will be critical to better understand how it functions if we are to accurately access our progress toward meeting the established targets. [NWRPC]

   Response: Incorporation of the diversion's effects on watershed hydrology, and thus the TMDL targets, will be addressed to the fullest extent possible in the development of the watershed-specific implementation plans. VTDEC agrees that more detailed information will be necessary to fully understand the impact of the diversion on the hydrologic regime of these two streams. As implementation planning moves forward, VTDEC is interested in developing or partnering to develop these data. However, resources are not currently available for VTDEC to commit to this project.

9. The TMDL should include the land use maps and the impervious cover maps that have been developed by DEC, as these provided data that was used in the development of the TMDL. [NWRPC]

Response: Information related to the land use and impervious cover data are presented in the document referenced in the TMDL as *"Stormwater Modeling for Flow Duration Curve Development in Vermont"* (Tetra Tech, 2005).

10. According to the TMDL there is very little biological data for Stevens and Rugg Brooks. Given that this is the basis for the impaired designation, the TMDL should provide a clear indication of how often biological data will be monitored in the future and what will be considered acceptable. DEC should also consider that the other factors, such as toxics and poor habitat due to channel modifications, may also have significant impacts on biota. [NWRPC]

    Response: Recommendations for the frequency of biological monitoring are currently in development. In evaluating the biological condition of the stormwater impaired streams, the VTDEC takes a holistic approach and aims to integrate all available information to formulate a stream-specific evaluation of contributing stressors.

11. The TMDL assumes that decreasing high flows will adequately address the issues of low flows. In order for this to be true, we need to prioritize practices that infiltrate stormwater and recharge the groundwater. However, DEC has recently waivered in their support of small-scale infiltration practices and propose to resolve any contradictions with the Underground Injection Control permit. [NWRPC]

    Response: VTDEC does more than assume that controlling high flows will adequately address the low flow targets. VTDEC has developed a comprehensive predictive modeling tool that can indicate whether or not the low flow targets can be met with any given implementation scenario.

    Infiltration practices, including small-scale practices, are allowable for regulated projects under the Vermont Stormwater Management Manual. Currently, some infiltration practices on projects without a Stormwater Discharge Permit may require a permit under the Underground Injection Control (UIC) Rule. The Department is currently in the process of re-drafting the UIC rule to remove any unnecessary regulatory requirements for smaller, benign, infiltration practices.

12. In considering the land that might be available for stormwater projects within the impaired watersheds, DEC should consider the potential brownfields and contaminated sites where infiltration practices are not appropriate. [NWRPC]

    Response: The VTDEC Stormwater Manual specifically excludes certain "hot spots" from consideration as sites for infiltration.

13. The TMDL proposes to use a regulatory permitting process to meet targets in developed areas, while relying on voluntary, incentive-based practices in agricultural areas. Some consideration should be given to the fairness of this proposal. The TMDL implementation plan should also address if and how projects in the developed areas might be linked to projects in agricultural areas, such as an offset or mitigation program. [NWRPC]

    Response: VTDEC will consider this information during the development of watershed-specific implementation plans.

14. There is little justification for why DEC is expecting 15 acres of new non-jurisdictional development in both the Stevens and Rugg watersheds. [NWRPC]

    Response: VTDEC analyzed existing building patterns, land use/cover, and parcel information within the impaired watershed boundaries for Stevens and Rugg Brooks to develop the 15 acre estimate of new non-jurisdictional (<1 acre) impervious surfaces. Admittedly, this can be a rather subjective estimate but VTDEC believes this figure is sufficient for the protection of the streams to move forward with the implementation planning process.

15. The proposed monitoring plan includes using a database to track permits in order to assess progress. This method will only yield valid results if stormwater facilities are modeled and designed correctly and are constructed and maintained as designed. The TMDL should include a plan to inspect and monitor projects to ensure they perform in accordance with their permit. [NWRPC]

    Response: VTDEC wholeheartedly agrees that permit compliance is vital to the tracking of stormwater treatment improvements within the stormwater impaired watersheds; however, the specifics of compliance monitoring are best addressed within the framework of the watershed-specific implementation plan that will be established to meet the hydrologic targets of each respective TMDL.

<table>
<tr><td colspan="8">Data for entry in EPA’s National TMDL Tracking System</td></tr>
<tr><td colspan="3">TMDL (Water body) Name *</td><td colspan="5">Rugg Brook</td></tr>
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