State of Vermont
WATER RESOURCES BOARD

RE: Investigation into Developing Cleanup Plans for Stormwater Impaired Waters - Docket No. INV-03-01

Order Closing Docket and Issuance of Final Report for Comment

I INTRODUCTION AND OVERVIEW

Pursuant to WRB Rule 7, the Water Resources Board (Board) opened this Docket to investigate the technical issues related to developing cleanup plans for waters of the state impaired by stormwater. The Docket was opened following by the Board's denial of Watershed Improvement Permits (WIPs) issued by the Agency of Natural Resources (ANR) for new and existing discharges to certain stormwater impaired waters.[1] See Re: Morehouse Brook No. WQ-02-04, Findings of Fact and Conclusions of Law, and Order (June 2, 2003).

The Board's decision in Morehouse Brook (WIP Decision) raised issues regarding the technical feasibility of designing cleanup plans for stormwater impaired waters and the degree of certainty that WIPs and other cleanup plans can provide as to when and if stormwater impaired waters will be restored to compliance with the Vermont Water Quality Standards (VWQS). The Board opened the Docket in order to facilitate an open and balanced discussion of these issues outside the confines of any particular contested case and to move forward with designing and implementing effective cleanup plans for Vermont's stormwater impaired waters.

The Board issued a Notice of Investigative Docket (Notice) in accordance with WRB Rule 7, with the intent of attracting a wide range of stakeholders (including individuals, public and private organizations and regulatory agencies) to participate in a dialogue addressing the problem of stormwater pollution in Vermont. The Board was pleased that in response to the Notice nineteen (19) groups filed requests to participate in the Docket. The groups represented such diverse interests as local, state and federal governmental agencies, statewide and regional businesses groups, environmental advocates, professional engineers, Vermont's academic community and organizations representing the interests of the agricultural community.

To facilitate the dialogue, the Board requested, and the United States Environmental Protection Agency (EPA) agreed to provide, professional facilitation services for the Docket. The EPA facilitators were present at every official Docket meeting and were instrumental in ensuring that the dialogue occurred in a manner that enabled the participants to reach as much consensus as possible.

[1] The WIPs were general permits issued to cover new and existing discharges to four streams in Chittenden County impaired by stormwater. The WIPs served as cleanup plans for these waterbodies.

In its Notice, the Board identified seven technical questions that it would investigate as part of the Docket. **The Board also indicated in the Notice its intention to generate a report at the conclusion of the investigation that would summarizethe technical information developed as part of the investigation and, if possible, provide recommendations for developing cleanup plans for Vermont's stormwater impaired waters.** At the first meeting of the Docket, the Board committed to submitting the draft report for comment by the Docket participants prior to issuing its final report. As noted in this Order, Docket participants will have one week to submit comments on the report. The Board will prepare a responsiveness summary that will be available as an addendum to the report. Both the report and the responsiveness summary, when it is completed, will be accessible through the Board's website.

After nearly five months of meetings, a technical workgroup comprised of scientists, engineers, municipal officers, consultants and government regulators (established by the Board at the request of the Docket participants) submitted two documents to the Board to address the matters investigated in this Docket. The first is a technical report titled "*A Scientifically Based Assessment and Adaptive Management Approach to Stormwater Management*" (Stormwater Cleanup Plan Framework, attached as Appendix A) that proposes a framework for developing cleanup plans for Vermont's stormwater impaired waters.

The *Stormwater Cleanup Plan Framework* identifies specific elements that cleanup plans for Vermont's stormwater waters should include and sets out a detailed approach for developing stormwater cleanup plans. The *Stormwater Cleanup Plan Framework* is a major achievement. It represents the general consensus reached among the diverse stakeholders that a technically feasible stormwater cleanup plan can be developed, and it meets the goal that the Board set out in the Order opening this Docket of providing recommendations for developing cleanup plans for Vermont's stormwater impaired waters.

The *Stormwater Cleanup Plan Framework* does **NOT** address the legal and policy choices that must be made in order to implement technically feasible and legally sufficient stormwater management plans for impaired waters. As described in this report, the *Stormwater Cleanup Plan Framework* is a technical document developed by scientists and engineers, not lawyers or advocates. It lays out the scientific foundation for implementing an effective regulatory program for stormwater impaired waters in Vermont. The next step is the implementation of this framework by ANR.

The second document provides answers to the seven questions posed by the Board in its Notice. Entitled the *"Scientific Underpinnings of the Water Resources Board's Seven Questions,"* (attached as Appendix B) it provides consensus answers to crucial areas of technical disagreement or uncertainty that existed when the Docket was opened.

Taken together, these documents represent the substantial consensus that was reached among the Docket participants. While complete agreement was not reached on either, the Docket participants reached what the Board would characterize as 95% consensus on both the *Stormwater Cleanup Plan Framework* and the *Scientific Underpinnings of the Water Resources Board's Seven Questions*, **with most of the contentious issues that were previously in dispute being agreed upon by all of the Docket participants.** Key issues upon which the Docket participants reached consensus include:

- Agreement on technically feasible ways to design stormwater clean up plans which include a methodology to predict and measure success towards restoring impaired waters to meet the VWQS based on actions taken to reduce stormwater pollution. This was a major breakthrough in that prior to the Docket there was no consensus on how to (and whether ANR could) predict and measure progress toward achieving the VWQS because of the lack of demonstrable correlation between actions to control stormwater and the response of the aquatic biota (fish, macroinvertebrates (bugs) and other life) in the receiving water, which is how VWQS compliance is ultimately determined in Vermont.

- The Docket participants agreed that for most stormwater impaired waters, it is unlikely that the VWQS can be achieved in five years following implementation of the cleanup plan. However, the Docket participants concluded that a specific stormwater cleanup plan could be developed using hydrology and sediment as surrogates[2] for how aquatic biota (fish and macroinvertebrates (bugs)) will respond to actions to reduce stormwater pollution, and that using these surrogates will allow ANR to provide reasonable assurance that a particular stormwater cleanup plan will result in compliance with the VWQS, even though more than five years will be necessary to achieve compliance in most instances.

- The Docket participants agreed that *monitoring* is a key component of any stormwater cleanup plan and that the plan should be adjusted periodically based on the monitoring results. This is the heart of the concept of "adaptive management" (learn as you implement the plan and adjust accordingly), which all Docket participants agreed must be part of an effective stormwater cleanup plan framework.

- The Docket participants agreed on at least one method that could be used to connect the hydrologic and sediment targets with a determination of the specific actions that are needed to implement the plan. This method, which is explained in

[2] As discussed in detail herein (See *Section III*, Appendix A and B), while it is not known how aquatic biota will respond to reductions in stormwater pollution, it is possible to set targets for reduction in sediment and hydrology (volume of water) by reference to sediment and hydrologic conditions in streams where the VWQS are being met. The assumption is that if the sediment and hydrologic targets are met, the aquatic biota will recover over time to a point where compliance with VWQS is achieved.

the *Stormwater Cleanup Plan Framework,* involves the use of what the Docket participants have called *Stormwater Impact Areas* (SIA).

? The Docket participants agreed that designing a plan using hydrology and sediment as surrogates for how the aquatic biota in impaired waters will respond makes it feasible for ANR to develop and implement Total Maximum Daily Loads (TMDLs) for stormwater impaired waters. Under federal law, waters that are designated by states as impaired - not meeting state Water Quality Standards (WQS) - must be placed on what is known as the impaired waters list. See Section 303(d) of the federal Clean Water Act (CWA), 33 U.S.C.A. §1313(d). Pursuant to the CWA, states are required to prepare cleanup plans for waters on the impaired waters list. Id. These cleanup plans are called TMDLs. TMDLs involve evaluating the assimilative capacity of a waterbody (how much of particular pollutant can a water body absorb and meet WQS), and estimating the amount of the pollutant (the pollutant load) that must be reduced to bring the water body back into compliance with the WQS. Prior to the Docket, there was no consensus that is feasible to develop and implement a TMDL for stormwater impaired waters.

Having received and considered these two documents, the Board concludes that it has completed the investigation into the matters identified in the Notice. Accordingly the Board is issuing an Order closing the Docket and issuing a Final Report.

Initial drafts of the two documents were circulated to the Docket participants in early February. At the final Docket meeting on February 20, 2004, the Chair requested that Professor Watzin of the University of Vermont revise both of the documents in response to the comments made at the meeting.[3] The Chair established February 27, 2004 as the deadline for Docket participants to submit comments on final revisions to the drafts made by Professor Watzin following the February 20, 2004 meeting. To the extent that this report includes comments from participants received by February 27, 2004 on the revised drafts, those comments are adopted by the Board. To the extent such comments are not included in this report, they are not adopted by the Board. **The Board believes that the comments not incorporated in its Final Report represent relatively minor deviations from the substantial consensus reached by the Docket participants on both the *Stormwater Cleanup Plan Framework* and *Scientific Underpinnings of the Water Resources Board's Seven Questions*.**[4]

It is important to note that the intent of the Board in opening the Docket was to gather technical information on how to establish long term regulatory program for restoring Vermont's stormwater impaired waters. The Board's intent was not to focus on the legal and policy issues related to implementing that program. In fact, the Board

[3] Professor Watzin was the primary coordinator and author of both the *Stormwater Cleanup Plan Framework* and *Scientific Underpinnings of the Water Resources Board's Seven Questions*.
[4] The comments not incorporated into this report can be found in the Board's official file on the Docket.

explicitly discouraged a discussion of policy issues in the Docket in an effort to move the discussion beyond specific legal disputes over stormwater pollution and to concentrate instead on developing a solution to the Vermont's stormwater pollution problem.

The Board was favorably impressed by the ability of the Docket participants to set aside their legal disagreements and engage openly and in good faith in the Docket. The Board was also impressed by the tremendous effort made by all of the Docket participants toward reaching consensus on an effective regulatory framework. The Board commends all of the participants for their work.

However, the Board recognizes that there are still disagreements regarding some of the legal and policy issues associated with implementing the *Stormwater Cleanup Plan Framework*. After careful consideration, the Board concludes that even though the Docket did not focus on policy and legal issues, it is appropriate to address implementation issues that are related to and within the scope of technical investigation that occurred in this Docket, as part of the final Docket report. Accordingly, a brief section on policy and implementation is included in this report to address those issues which the Board finds to be within the scope of the Docket.

The Board strongly believes that the recommendations in this report represent Vermont's best opportunity for restoring the State's stormwater impaired waters and, in doing so, for creating regulatory certainty for all concerned, and particularly for land owners seeking stormwater discharge permits. The Board urges the stakeholders to work in the collaborative spirit of the Docket to address the remaining legal and policy issues in order to implement the recommendations in this report as soon as possible.

II PROCEDURAL HISTORY

A. Opening the Docket – The Original Seven Questions

On September 5, 2003 the Board, pursuant to WRB Rule 7, on its own motion, issued an Order opening this Docket. The Order provided the following non-exclusive list of questions related to developing clean up plans for stormwater impaired waters:

1. Is it scientifically feasible to develop and implement a WIP or other cleanup plan that is based primarily on source controls for Vermont's water bodies that are impaired as a result of stormwater and that provides reasonable assurance that the receiving waters will comply with the VWQS within five years or within any definitive period of time? If so what are the elements of such a plan?

2. What tools are available to predict how aquatic biota in impaired waters will respond to implementation of treatment and control measures for stormwater discharges? In the absence of such tools, how can a cleanup plan for stormwater impaired waters be developed to provide reasonable assurance of compliance with the VWQS?

3. What are the appropriate physical, chemical, and biological targets to be used to demonstrate attainment of VWQS? Should or can meaningful interim targets be used as milestones? If so which tools are appropriate and in what circumstances to demonstrate progress toward meeting the final targets?

4. How should cleanup plans address the impacts to stormwater impaired waters from both natural and manmade conditions such as eroding banks, rechannelization, riparian zone encroachment, on-stream ponds, and other factors that are the result of geomorphic instability in these waters that will continue to occur and adversely effect aquatic biota regardless of reductions in stormwater discharges?

5. Is it scientifically feasible to develop a Total Maximum Daily Load (TMDL) for Vermont's water bodies that are impaired as a result of stormwater? If not, why not? If it is scientifically feasible to develop a TMDL for such waters, is the TMDL the most effective approach to cleaning up Vermont's stormwater impaired waters? If it is not scientifically feasible, what alternatives are there?

6. If it is not scientifically possible to provide reasonable assurance that impaired waters will be restored to compliance with VWQS, what should the policy of the state of Vermont be with regard to developing cleanup plans for stormwater impaired waters? At what point, if ever, should Vermont lower the designated uses, classifications and/or water quality criteria for the water bodies if there is no reasonable assurance that these waters can be managed to meet the existing VWQS?

7. What are the scientific and technical opportunities and difficulties in developing and utilizing offsets to address stormwater impaired waters?

See Board's Order in *Re: Investigation into Developing Cleanup Plans for Stormwater Impaired Waters*, Docket No. INV-03-01 (September 5, 2003)

The Order stated that the Board's Chair would preside over the investigation and that the Docket would be facilitated by a U.S. Environmental Protection Agency (EPA) employee or employees affiliated with the Regional Alternative Dispute Resolution (ADR) program. The Order also noted that the Board reserved the right to appoint less than a quorum of the Board and/or staff to convene meetings related to the Docket. The Order stated that the Docket may consist of several meetings and that the Docket would be closed on or before November 27, 2003 unless the Board extended the Docket.

B. Public Notice and Participation

Pursuant to the Order, Public Notice of the Docket was provided by publication of the Notice in newspapers throughout the State of Vermont. The Board set September 16, 2003 as the deadline for individuals or entities who wished to actively participate in

the Docket to notify the Board. The Order provided that "actively participate" meant participation in the facilitated discussion by providing technical experts qualified to address the matters to be investigated in the Docket. In addition, the Board provided actual notice of the Docket to certain entities that were invited to petition to be active participants.[5]

On or before September 16, 2003 the following entities filed requests to actively participate in the Docket: EPA, the Vermont Farm Bureau, the Village of Essex Junction, the Vermont League of Cities and Towns (VLCT), the Conservation Law Foundation (CLF), the City of South Burlington, a collection of Chittenden County municipalities and the University of Vermont (UVM) that identifies itself as the "Joint MS4s[6], the Vermont Natural Resources Council (VNRC), the Home Builders and Remodelers Association of Northern Vermont, the Vermont Chamber of Commerce, the Vermont Ski Areas Association, Dubois & King,Inc., the Vermont Agency of Transportation (VTRANS), EPA, the Lake Champlain Committee (LCC), the City of Burlington, Associated Industries of Vermont (AIV), and the Lake Champlain Regional Chamber of Commerce (LCRCC).[7]

On September 24, 2003, the Board convened the initial meeting in the Docket at the Burlington Boathouse in Burlington, Vermont. At the initial meeting the Board announced that it had voted[8] to grant active participant status to all parties who had requested to participate in the Docket except for VLCT and the Vermont Farm Bureau. The Board found that because VLCT and the Vermont Farm Bureau had not identified technical experts to participate in the Docket, it did not meet the requirements for designation as an active participant set forth in the Order. However, the Board stated that if VLCT and/or the Vermont Farm Bureau identified technical experts at a later date, the Board would allow those organizations to enter the Docket as active participants at

[5] The following organizations were invited by the Board to actively participate in the Docket: ANR, EPA, the Vermont Farm Bureau, the Vermont Agency of Agriculture, Farms and Markets, the Greater Burlington Industrial Corporation (GBIC), the Vermont Natural Resources Council (VNRC), the Conservation Law Foundation (CLF), the City of South Burlington, the City of Burlington, the Town of Colchester, the Town of Essex, the Village of Essex Junction, the Town of Williston, the Vermont League of Cities and Towns (VLCT), the U.S. Fish and Wildlife Service, the University of Vermont (UVM), the National Resource Conservation Service (NRCS), the Lake Champlain Committee (LCC) and the National Wildlife Federation (NWF).

[6] The City of South Burlington, the Town of Colchester, the Town of Williston, the Village of Essex Junction, the Town of Essex and UVM make up the Joint MS4s. The Joint MS4s represent entities that are subject to the Small Separate Storm Sewer System (MS4) general stormwater permit issued by ANR. The MS4 permit has been appealed to the Board and the appeal is pending before the Board. Some of the entities that comprise Joint MS4 group also requested separate active participant status in the Docket as separate entities.

[7] John McClaughry, President of the Ethan Allen Institute submitted a comment to the Board regarding the scope of the Docket. However, Mr. McClaughry did not request that the Ethan Allen Institute be granted status as active participants in the Docket.

[8] Board Chair David J. Blythe presided over the Docket meeting with Board Members John D.E. Roberts, Vice-Chair, Jane Potvin, Lawrence H. Bruce, Jr. and Michael J. Hebert in attendance. On a motion by Roberts, seconded by Hebert, the Board unanimously voted to allow all petitioners other than VLCT and the Vermont Farm Bureau status as active participants for the reasons stated above.

that time. The Chair also noted that all of the Docket meetings were open to the public and that VLCT and the Vermont Farm Bureau could request to receive notice of and attend subsequent Docket meetings.

Robert Wernecke from the American Council of Engineers (ACE) indicated at the meeting that ACE was seeking status as active participants in the Docket, and that ACE would provide professional engineers as technical experts to represent its interests in the Docket. Based on this representation, the Board granted ACE status as active participants.

C. Docket Meetings

The Board held a total of 6 formal Docket meetings between September 24, 2003 and February 20, 2004. In addition, technical subgroups of the Docket met a total of 7 times between October 2, 2003 and January 23, 2004. Board Chair Blythe presided over all of the Docket meetings and all of the formal Docket meetings were professionally facilitated by EPA employees affiliated with the Regional ADR program.[9] At the September 24, 2003 meetings, the active participants agreed that e-mail would be the most productive method of exchanging information among Docket participants. Accordingly, from the September 24, 2003 meeting forward all meeting agendas, summaries, draft documents and comments by active participants were circulated via e-mail. An extensive e-mail list of active participants and other interested persons was established and maintained by the Board. In addition, all meeting agendas and substantive exchanges of information were posted on the Board's website.

The Board's official file on the Docket will include copies of all meeting agendas, meeting summaries, the Final Report with the appended *Stormwater Cleanup Plan Framework* and *the Scientific Underpinnings of the Water Resources Board's Seven Questions* and a responsive summary to comments submitted on the Final Report by Docket participants.

The following is a brief description of the formal Docket and technical subgroup meetings held throughout the course of the Docket:

September 24, 2003 (Formal Docket Meeting) – Initial Docket meeting where active participants were established and the Board engaged the participants in a discussion of the best way to structure the Docket meetings to address the questions posed by the Board in its Notice. Because this represented the first time that the Board exercised its authority to open an investigative Docket, there were many open questions regarding how the Docket would be conducted. The Board made it clear from the outset that it wanted the participants to have a say in how the Docket would proceed. The Docket

[9] The Board members did not attend any of the technical subgroup meetings, although at least one Board staff member was present at all the subgroup meetings. In addition, the professional facilitators did not attend the subgroup meetings.

participants agreed that it would be useful to establish a shared understanding of the background science to focus the discussion to follow and to address any differing baseline assumptions at the earliest opportunity. It was felt that a collaboratively prepared review of the relevant science drawn from the Docket participants' own expertise would lay this foundation from which the group could work together to develop a cleanup plan. Subgroups were formed to develop presentations on the background science necessary to move the process forward. All Board members attended this meeting.

October 2, 2003 (Docket Subgroup Meeting) – Professors Mary Watzin and Breck Bowden from UVM host and facilitate a meeting on background information on the state of the science of stormwater. Assignments are made to Docket participants to present background information at the next formal Docket meeting. These presentations can be viewed via the Board's website.

October 3, 2003 (Docket Subgroup Meeting) – Juli Beth Hoover, Planner for the City of South Burlington, hosts and facilitates a meeting on question #4 in the Board's Docket Order, which the Docket participants agreed was tied directly to the background science of stormwater.[10] Assignments are made to participants to make presentations on question #4 at the next formal Docket meeting. These presentations can be viewed via the Board's website.

October 15, 2003 (Formal Docket Meeting) – The Board convenes the second formal Docket meeting. Background information is exchanged. The exchange reveals that there is significant consensus among the Docket participants on the state of the science of stormwater. However, the Docket participants also realize that the group must get beyond the background science issues and begin to address the difficult questions of how to develop a practical stormwater cleanup plan in order to move the process forward. Following the meeting, participants are invited to advise the Board on how to proceed with the Docket. Based on the responses the Board determined that the focus of the Docket should be on answering the "ultimate questions" posed by the Board in its notice, which were identified by the Board as questions #1 and #5. Question #1 addresses whether a WIP could be designed to provide reasonable assurance that VWQS will be met in five years and question #5 addresses whether a TMDL can and should be developed for Vermont's stormwater impaired waters. All Board members attended this meeting.

November 13, 2003 (Formal Docket Meeting) – The Board convenes the third formal Docket meeting with the focus on addressing question #1. This was a significant meeting in that the Docket participants agreed that the Docket was making sufficient progress that the November 27th deadline for closing the Docket set forth in the Board's

[10] See question #4 as set forth in the Docket Order, which addresses issues related to the fact that streams continue to adjust and adversely affect stream biology after stormwater controls are placed on particular sites. This results in on-going impacts to water quality even after remedial measures are taken that must be factored into stormwater cleanup plans.

Order should be extended. In addition, at this meeting the participants agreed that a technical subgroup should be established to address technical questions that underlie the answer to questions #1 and #5.[11] This group was called the Assessment Workgroup (Workgroup). Members of the Workgroup were UVM Professors Mary Watzin and Breck Bowden (Co-Chairs), Jeff Nelson (City of South Burlington, GBIC and the LCRCC), Kim Kendall (VNRC), Lori Barg (VNRC and LCC) Mike Tuttle and Bill Ahearn (VTRANS) Mike Winslow (LCC), Robert Moore (CLF) and several representatives from EPA and ANR. As noted below, the creation of the Assessment Workgroup and dedication of its members allowed the Board to successfully conclude the Docket in a relatively short period of time. Board members Blythe, Bruce, Hebert and Potvin attended the meeting.

December 5, 2003 (Docket Subgroup Meeting) – The first meeting of the Assessment Workgroup is held. Significant progress is made and the Workgroup requests permission to use the December 10, 2003 scheduled formal Docket meeting to continue its progress. Chair Blythe grants the workgroup permission to meet on December 10th in lieu of a formal Docket Meeting.

December 10, 2003 (Docket Subgroup Meeting) – The second meeting of the Assessment Workgroup is held. At this meeting the outline of what would ultimately become the *Stormwater Cleanup Plan Framework* is established. The Workgroup receives significant assistance from a Bruce Cleland, a national expert on developing stormwater cleanup plans provided by EPA. Mr. Cleland demonstrates how hydrology and sediment can be used as surrogate for the impact of stormwater on aquatic biota.

December 11, 2003 (Formal Docket Meeting) – The Board convenes its fourth formal Docket meeting. The highlight of this meeting is the report from the Assessment Workgroup. The Board and participants agree that if the Assessment Workgroup is allowed to continue its work, it may be able to present a consensus technical report on developing stormwater cleanup plans to the Board. Recognizing the progress and consensus building occurring in the Workgroup, the Board authorizes the Assessment Workgroup to meet on January 6, 2004 to continue its work. The next formal Docket meeting is scheduled for January 13, 2004. Board members Blythe and Hebert are present at the meeting.

January 6, 2004 (Docket Subgroup Meeting) – The third meeting of the Assessment Workgroup is held. Further progress is made toward reaching consensus on a recommended framework for developing stormwater cleanup plans. The Workgroup requests permission to utilize the scheduled January 13, 2004 formal Docket meeting to continue its work. Chair Blythe grants the request.

January 13, 2004 (Docket Subgroup Meeting) – The Assessment Workgroup reaches substantial consensus on the technical framework for a stormwater cleanup plan. It is

[11] All Board members present at the November 13, 2003 meeting unanimously agreed to the extend the Docket meetings beyond the proposal to close the Docket by November 27, 2003 set forth in the Order.

agreed that the Workgroup should report its progress to the Board at a formal Docket meeting.

January 28, 2004 (Formal Docket Meeting) – The Board convenes its fifth formal Docket meeting. Professor Mary Watzin presents the significant consensus that the Assessment Workgroup has reached on a framework for a stormwater cleanup plan to the Board. Jeff Nelson indicates that he agrees with a majority of the proposal but has several significant concerns that must be addressed before he could agree to the plan. Because the rest of the Docket participants appear to be in general agreement with the proposal, Chair Blythe requests that Professor Watzin and Jeff Nelson meet in effort to resolve their disagreements and present a revised proposal for the Docket participants to comment on. Board members Blythe and Hebert attend the meeting.

February 20, 2004 (Formal Docket Meeting) – The Board holds its sixth and final Docket meeting. Mary Watzin and Jeff Nelson reached agreement on the revisions to the *Stormwater Cleanup Plan Framework* and a revised draft was submitted to the Docket participants prior to the meeting. There were several minor comments on the revised draft. Robert Moore of CLF presented detailed and significant comments on Phase III (the monitoring and adaptive management section) of the proposed *Stormwater Cleanup Plan Framework*. All Docket participants indicated that they agreed with the *Stormwater Cleanup Plan Framework* presented contingent upon changes to the proposal consistent with comments made at the meeting. CLF indicated it agreed with the proposal with the exception of concerns it raised on Phase III. Professor Watzin agreed to circulate revised versions of the *Stormwater Cleanup Plan Framework* and the *Scientific Underpinnings of the Water Resources Board's Seven Questions*, which was originally drafted by Professor Watzin prior to the January 28th meeting, to the group. The Board established February 27, 2004 as the deadline for Docket participants to comment on these revised documents. The Board indicated that it intended to issue an Order Closing the Docket and a proposed Final Report for comment by the Docket participants following receipt of the comments on the documents revised by Professor Watzin. In addition, several issues related to policy and implementation of the *Stormwater Cleanup Plan Framework* were raised at this meeting. The Board indicated that it had fulfilled its goal of reaching consensus on the technical issues it identified in the Docket Order and it was beyond the scope of the Docket to begin a facilitated discussion of policy and implementation issues under the Board's auspices. Several Docket participants suggested that a collaborative process authorized by an entity other than the Board be established to address implementation issues related to creating the general permit to implement the *Stormwater Cleanup Plan Framework*. ANR indicated it might be open to establishing such an effort under its auspices. Board members Blythe and Hebert attended the meeting.

III CONCLUSIONS

A. Development of Stormwater Cleanup Plan Framework

At the center of the recent controversy about how to cleanup Vermont's stormwater polluted waters has been the issue of uncertainty. In Vermont, compliance with the VWQS is determined by the health of the aquatic biota (the health of fish and macroinvertebrates (bugs) measured by biotic criteria) in the state's rivers, streams, lakes and ponds. Uncertainty exists with regard to when the aquatic biota in these water bodies will recover after actions to reduce stormwater pollution that have impaired the biota are taken. Similarly, uncertainty exists with regard to exactly what actions to reduce stormwater pollution are necessary to trigger the recovery of the aquatic biota in Vermont's waters. There is no question or disagreement that reducing stormwater will improve water quality. However, this begs the question how much stormwater reduction from which areas is necessary to restore polluted waters to compliance with VWQS, and how to do you make predictions about when VWQS will be achieved in these waters?

Following the Board's WIP Decision, disagreement about how to address the uncertainty described above resulted in deadlock on the stormwater issue in Vermont. The WIP Decision provides that under state law stormwater cleanup plans must either include schedules of compliance reasonably designed to assure compliance with VWQS in five years (if a WIP is used) or be based on a TMDL, which involves estimating how much stormwater reduction is necessary to achieve compliance with the VWQS.

The WIP Decision set off a scientific debate about what degree of predictability in terms of assuring VWQS compliance can be built into stormwater cleanup plans, given the inherent scientific uncertainties surrounding the issue. The conundrum framed by the WIP Decision is how either a WIP or a TMDL can be used to address stormwater impaired waters if no reliable tools exist to predict when the biota in stormwater impaired waters will recover or how much stormwater pollution is required to attain the recovery? This question represents the core issue that the Board sought to address in opening this Docket.

The Board is pleased to report that the document titled *A Scientifically Based Assessment and Adaptive Management Approach to Stormwater Management*" (*Stormwater Cleanup Plan Framework*), which is attached as Appendix A, directly answers the question of how to develop a stormwater cleanup plan in light of the existing scientific uncertainties. The *Stormwater Cleanup Plan Framework* provides in detail practical tools that can be used to deal with the uncertainty surrounding the response of aquatic biota to stormwater management actions.

The *Stormwater Cleanup Plan Framework* recommends a three phased approach to developing stormwater cleanup plans. The three Phases are summarized below. The summary is intended to amplify the specific recommendations contained in the *Stormwater Cleanup Plan Framework.*

Phase I - Verification

Phase I involves verifying that the water body is impaired due to stormwater to ensure that the state's cleanup efforts are properly tailored to the problem. In other words, make sure that problem is stormwater before subjecting the waterbody to a stormwater cleanup plan.

Phase II – Data Gathering to Develop Stormwater Management Plan

Phase II of the *Stormwater Cleanup Plan Framework* provides one of the major strategies for dealing with the uncertainty of when aquatic biota will respond to stormwater reductions. The main strategy uses hydrology (water volume/flow) and sediment as surrogates for, or indicators of, how the aquatic biota in impaired waters will ultimately respond to reductions in stormwater.

The Docket participants unanimously agreed that the biotic criteria are not met in stormwater impaired waters because stormwater runoff has caused an imbalance in the water and sediment dynamics of the waterbody. The *Stormwater Cleanup Plan Framework* concludes that a stormwater management plan can be developed based upon targets established using water flow and sediment as surrogates for most of the pollutants that are transported by stormwater to the receiving water. The theory is if water flow and sediment are controlled, it is reasonable to assume that the vast majority of the adverse impacts of stormwater on a waterbody are being addressed. Accordingly, while it is not possible to accurately predict how the aquatic biota will respond to efforts to control stormwater, it is reasonable to assume that if hydrologic and sediment conditions of representative waterbodies that meet VWQS are achieved, the biota can be expected to recover as well.

As part of Phase II, the *Stormwater Cleanup Plan Framework* also identifies the SIA approach referenced in *Section I* of this report, as a tool for determining where stormwater reductions should be sought to achieve the hydrologic and sediment targets, and ultimately result in compliance with the VWQS. The SIA approach involves examining and identifying areas that represent the greatest contribution to existing stormwater impairments, and targeting these areas for more aggressive pollution reductions. The use of the SIA method provides a basis for the actions that the state will require landowners to take to reduce stormwater.

Phase III – Implementation/Monitoring

Phase III of the *Stormwater Cleanup Plan Framework* recognizes the universal agreement among the Docket participants that the accuracy of the targets established in Phase II must be verified through a comprehensive monitoring program. EPA technical staff, whose participation was vital to the success of the Docket, clearly conveyed that in developing the *Stormwater Cleanup Plan Framework*, Vermont is on the cutting edge of

creating predictable, defensible stormwater cleanup plans. **In fact, there is reason to believe that the *Stormwater Cleanup Plan Framework* may be used by other states across the country as a model for designing their own stormwater cleanup plans**.

While EPA supported the use of hydrologic and sediment targets as set forth in *Stormwater Cleanup Plan Framework*, EPA and all the other Docket participants agreed that the correlations being drawn between hydrologic and sediment targets and the response of aquatic biota must be evaluated and adjusted over time. Accordingly, Phase III recommends that monitoring data be gathered and used to revise both the targets and the actions designed to achieve stormwater reductions. This is the crucial adaptive management component of the plan that addresses unknowns and uncertainties of the state of the science of stormwater by allowing ANR to gain scientific knowledge by implementing the plan and making appropriate adjustments to the plan as more about the response of impaired waters to stormwater reductions is learned.

In sum, the *Stormwater Cleanup Plan Framework* represents a technically sound foundation for developing a stormwater cleanup plans that deals practically and responsibly with the existing scientific uncertainties inherent in stormwater pollution control. The Board recommends that ANR implement the approach to developing stormwater management plans set forth in Appendix A through a general permit program.

B. Scientific Underpinnings of the Water Resources Board's Seven Questions

The seven questions posed in the Order for this Docket represent the major points of technical disagreement that existed when the Docket was opened in September. For example, as noted in *Section I* of this report, the questions address whether stormwater cleanup plans can reasonably assure compliance with VWQS in five years and whether it is feasible to develop and implement a TMDL for Vermont's stormwater impaired waters. The Board recognized at the outset of the Docket that it was essential to resolve these threshold questions in order to achieve any degree of consensus on the framework for a practical, effective stormwater cleanup plan.

Attached as Appendix B is a document titled *"Scientific Underpinnings of the Water Resources Board's Seven Questions"* that was developed by the Docket participants. Rather than reiterating or attempting to characterize the answers provided by the Docket participants, the Board adopts the answers to the questions as provided in Appendix B.

Ironically, at the end of the day, the answers to these threshold questions that were the subject of so much dispute are somewhat overshadowed in this report by the positive recommendations for how Vermont should proceed in developing stormwater cleanup plans set forth in the *Stormwater Cleanup Plan Framework.* However, it was in attempting to answer the seven questions that led the Docket participants to develop the creative solutions that are now embodied in the *Stormwater Cleanup Plan Framework*

and that can form the basis for a stormwater management plan to cleanup Vermont's waters.

IV POLICY AND IMPLEMENTATION

As discussed in *Section I*, the focus of the Docket was on the technical issues related to developing cleanup plans for stormwater impaired waters, not legal and policy issues relating to implementation of the plan. However, the Board is aware that the next phase of the process involves addressing issues related to implementation of the Stormwater Cleanup Plan Framework. Accordingly, the Board takes this opportunity to offer comments on the following policy and implementation issues that it believes are within the scope of the matters investigated in the Docket:

A. Continue Collaborative Process

ANR offered at the final Docket meeting to consult with participants in the Board Docket on developing a permit program to implement the Stormwater Cleanup Plan Framework. By developing a permit program, the Board refers to making decisions about practical issues such as what specific stormwater management actions will landowners be required to take? Under what circumstances will landowners be allowed or required to use pollution offsets? How would such an offset program be administered? What role will municipalities play in administering the program, if any? This is a short list of the many implementation issues that lie ahead as ANR begins to develop its permit program. At the final Docket meeting, EPA indicated that its regional ADR Program is willing to assist ANR and the Docket participants in identifying and, to the extent possible, funding the services of a neutral facilitator who would be acceptable to the group for the purposes facilitating future discussions on implementation issues if ANR is interested in pursuing a collaborative process.[12] The Board encourages ANR and the Docket participants to continue to take a collaborative approach to implementing its permit program and to pursue EPA's offer of assistance. A significant amount of trust and good faith was developed among the stakeholders within the Board's Docket that can and should be carried over into addressing the implementation issues and to help assure the success of Vermont's stormwater management program.

B. Interim Actions

It is not known at this time how long it will take ANR to implement the Stormwater Cleanup Plan Framework. However, the *Stormwater Cleanup Plan Framework* will necessarily take some time to develop and implement, and this will have an effect on stormwater permitting during this interim period. Because the focus of the Docket was on developing cleanup plans for stormwater impaired waters, and not on what should be

[12] The Board does not feel that it would be appropriate it for it to address the development of the stormwater permit program as part of its Docket, as it still hears appeals of ANR permits and many of the issues related to implementing the permit program could ultimately be appealable to the Board.

done while the plan is being developed, the Board does not comment on specific proposals to address permitting while the Stormwater Cleanup Plan Framework is being implemented. However, the Board notes that currently ANR has the authority to issue individual stormwater permits for stormwater impaired waters as long as ANR complies with current standard of no new or increased discharge of pollutants of concern set forth in Vermont law. See In re Hannaford Bros. Co., No. WQ-01-01, Memo. of Decision at 15-19 (Vt. Water Res. Bd. June 29, 2001); In re Hannaford Bros. Co., No. WQ-01-01, Mem. of Decision at 5-8 (Vt. Water Res. Bd. Aug. 29, 2001); and In re Hannaford Bros. Co., No. WQ-01-01, Findings of Fact, Conclusions of Law, and Order at 10-14 (Vt. Water Res. Bd. Jan. 18, 2002), aff'd, No. 280-02 CnCv (Chittenden Co. Super. Ct. Apr. 30, 2003). The Board believes that any interim approach must be consistent with this standard in order to ensure compliance with state and federal law.

C. Legislative Action

The Board is aware that discussions are on-going with regard to whether changes to Vermont's stormwater laws are necessary to enable ANR to implement the Stormwater Cleanup Plan Framework. While the Board is not taking an official position on ANR's recently proposed legislation, the Board offers the following recommendations regarding legislative changes that it believes are appropriate in order to facilitate implementation of the *Stormwater Cleanup Plan Framework.*

1. Summary of Legislative Recommendation

The Board recommends that Vermont's existing stormwater law be amended to recognize that it is unlikely that most of Vermont's stormwater impaired waters will be restored to meet VWQS in five years and to provide a clear regulatory tool that is an alternative to the WIP, which would not be subject to the five year limitation in current state law.

2. Rationale for Legislative Recommendation

The Board has previously held that in the absence of a TMDL, "Vermont law does not allow a new or increased discharge of measurable and detectable pollutants of concern into impaired waters." In re Hannaford Bros. Co., No. WQ-01-01, Mem. of Decision at 15-19 (Vt. Water Res. Bd. June 29, 2001); In re Hannaford Bros. Co., No. WQ-01-01, Mem. of Decision at 5-8 (Vt. Water Res. Bd. Aug. 29, 2001); and In re Hannaford Bros. Co., No. WQ-01-01, Findings of Fact, Conclusions of Law, and Order at 10-14 (Vt. Water Res. Bd. Jan. 18, 2002), aff'd, No. 280-02 CnCv (Chittenden Co. Super. Ct. Apr. 30, 2003).

The Hannaford decision led to the enactment of Act 109 and the authorization of the WIP as an alternative to a TMDL for stormwater impaired waters. In the recent WIP decision, the Board held that "Vermont law now specifically recognizes that a source-control plan, such as WIP, may be used as an alternative to a TMDL under specified

conditions." See Re: Morehouse Brook No. WQ-02-04, Findings of Fact and Conclusions of Law, and Order (June 2, 2003). As noted above the specified conditions that apply to a WIP are that a WIP must include "a schedule of compliance of no longer than five years reasonably designed to assure attainment of the VWQS." See 10 V.S.A. § 1264(f)(1). The Board also held in the WIP decision that "if ANR cannot design a WIP that will satisfy that requirement, then a WIP cannot be issued, and ANR must establish and implement a TMDL for the receiving waters." Id.

If a TMDL is developed, there is no specific time frame in federal law for when impaired waters that are the subject of a TMDL must meet state Water Quality Standards. The rationale for not including a set timeframe for TMDL's to result in compliance with state WQS is that TMDLs are based on an analysis of assimilative capacity and an accompanying load allocation. The assimilative capacity and loading analysis creates reasonable assurance that if the measures set forth in the TMDL are implemented VWQS will be met.[13] Accordingly, a static drop dead for WQS compliance based on TMDLs is not required. In addition, because the assimilative capacity and pollutant loads in each waterbody are different, it is not rationale to establish a policy that all TMDLs must achieve WQS within the same fixed time frame. Implied in the Board's WIP Decision is that WIPs must comply with the five year limitation and cleanup plans that implement TMDLs are not subject to the limitation.

Both the *Stormwater Cleanup Plan Framework* and the *Scientific Underpinnings of the Water Resources Board's Seven Questions* acknowledge that most of Vermont's stormwater impaired waters will not meet the VWQS based on Vermont's biocriteria in five years. However, both documents describe an approach to developing a stormwater management plan that can be used to develop a TMDL. As outlined in the *Stormwater Cleanup Plan Framework,* hydrologic and sediment targets can be used to create estimates of assimilative capacity in impaired waters and to develop gross estimates of the loads of stormwater pollutants that must be reduced to meet the targets, which can be used as the basis for a TMDL. Accordingly, one option available to ANR is to develop and implement TMDLs using the *Stormwater Cleanup Plan Framework* that, for the rationale stated above, are not subject to the five year time frame under federal law.

The issue that the Board has identified is that state law could be interpreted as imposing a five year time frame for VWQS compliance for stormwater cleanup plans based on TMDLs. 10 V.S.A. § 1264(f) does not distinguish between WIPs and stormwater clean up plans based on TMDLs in terms of complying with five year provision of state law. Accordingly, an argument could be made that Vermont law requires that TMDLs be developed and implemented through a WIP permit program that is reasonably designed to attain compliance with VWQS in five years. The Board believes that interpretation would be inconsistent with science, the Clean Water Act and this report.

[13] TMDLs also include the use of the adaptive management concept this report endorses as a key component of the cleanup plan framework. Built into the TMDL is the idea that you adjust the plan over time based on monitoring.

10 V.S.A. § 1264(f) provides:

> *Where the secretary determines the water quality standards are not met in receiving waters due, in whole or in part, to pollutants contained in or impacts caused by discharges of collected stormwater runoff, the secretary may issue a general permit specific to the watershed (watershed improvement permit), a permit for an individual project, or a statewide general permit for discharges other than existing stormwater discharges.* The secretary may utilize watershed improvement permits as a means of ensuring the water quality standards are achieved and maintained in these impaired waters. An authorization to discharge collected stormwater runoff pursuant to a permit issued under this subsection shall be valid for a time period not to exceed five years. A person seeking to discharge collected stormwater runoff after the expiration of that period shall obtain an individual permit or coverage under a general permit, whichever is applicable, in accordance with subsection 1263(e) of this title *(emphasis added).*

The italicized language indicates that ANR may only issue a generic statewide general permit for new discharges of stormwater in stormwater impaired waters. According to 10 V.S.A. § 1264(f), if ANR wishes to issue a general permit for both new and existing discharges to stormwater impaired waters, the only tool available to ANR is the WIP.

3. Proposed Legislative Amendment

The Board recommends that the Legislature address this issue by adding the following underlined language to10 V.S.A. § 1264(f):

> Where the secretary determines the water quality standards are not met in receiving waters due, in whole or in part, to pollutants contained in or impacts caused by discharges of collected stormwater runoff, the secretary may issue a general permit specific to the watershed (watershed improvement permit), a permit for an individual project, or a statewide general permit for discharges other than existing stormwater discharges. The secretary may utilize watershed improvement permits (WIP), as an alternative to a TMDL, as a means of ensuring the water quality standards are achieved and maintained in these impaired waters, if the conditions set forth in to10 V.S.A. § 1264(f)(1) are met. An authorization to discharge collected stormwater runoff pursuant to a permit issued under this subsection shall be valid for a time period not to exceed five years. A person seeking to discharge collected stormwater runoff after the expiration of that period shall obtain an individual permit or coverage under a general permit, whichever is applicable, in accordance with subsection 1263(e) of this title.

(1) Any WIP permit issued for existing discharges pursuant to this subsection shall include a schedule of compliance of no longer than five years reasonably designed to assure attainment of the VWQS. General permits may be issued for new and existing discharges to stormwater impaired waters if the general permit is implementing a TMDL or other cleanup plan approved by EPA that is consistent with federal law. Such general permits shall include a schedule of compliance reasonably designed to assure attainment of the VWQS.

This legislative change would make it clear that if a TMDL is in place, and the general permit is implementing a stormwater cleanup plan based on the TMDL, the five year limitation associated with the WIP provision does not apply. The proposed statutory change makes reference to an "other cleanup plan approved by EPA that is consistent with federal law," to be consistent with EPA guidance on developing TMDLs.

4. The WIP Option

If the above legislative change is made, the Legislature may still want to leave the WIP option in the law. As discussed in the WIP Decision, it makes sense to allow ANR to opt out of the analysis associated with a comprehensive TMDL if it can identify waters where the cause of the impairment is obvious and reasonable assurance of compliance with VWQS in five years can be provided. The conclusion of the Docket participants is that some (albeit very few) stormwater impaired waters may be able to be restored to VWQS in five years. Accordingly, the Board believes that the WIP option should remain in the law as a regulatory tool to address impairments to these waters.

5. Other Legislative Issues

The Board's silence on other legislative changes that have been or may be proposed as necessary to implement the Stormwater Cleanup Plan Framework should not be construed as either support for or opposition to any given proposal. The Board believes that the only statutory revision issue within the scope of the Docket is the matter of the five year time frame because the feasibility of restoring waters to compliance with the VWQS within five years was a major focus of the investigation. Accordingly, it is the only Legislative issue that the Board addresses.

V ORDER

Accordingly it is hereby Ordered:

1 Active Participants have until Tuesday, March 16, 2004 to submit comments on the Final Report. Comments shall be mailed to the Board's Office and to the list of Active Participants set forth on the attached certificate of service.

2 Upon receipt of comments on the Final Report by the deadline established in this Order, this Docket shall be closed.

Dated at Montpelier, Vermont on this 9th day of March, 2004.

On behalf of the Vermont Water Resources Board by

David J. Blythe, Former Chair

John F. Nicholls, Chair

A Scientifically Based Assessment and Adaptive Management Approach to Stormwater Management (Stormwater Cleanup Plan Framework)

Phase 1 – The purpose of this phase is to verify that a water listed as "impaired" on 303(d) Impaired Waters List still deserves to be there.

The Vermont Agency of Natural Resources uses an established protocol for listing waters on the "Impaired Waters List" in its Biennial Report on Water Quality. This protocol has recently been updated and formalized and will soon be released for public comment.

Phase 1 will be based on the data gathered by the ANR in the listing process, supplemented by any additional scientifically-based information that might be available. This phase of the procedure is meant to be a rapid and relatively simple assessment validating the need for the development of a stormwater management plan based on the targeted implementation of best management practices (BMPs) to control and treat stormwater runoff within the impaired watershed.

If the waterbody still does not attain the Vermont Water Quality Standards (VWQS) and the most likely cause of non-attainment is still judged to be stormwater runoff, then Phase 2 of the assessment process would begin. If new data suggest that the waterbody meets applicable VWQS criteria, the procedure for delisting would be initiated.

Phase 2 – The purpose of this phase of the assessment is to gather the data needed to develop a stormwater management plan.

Waters on the impaired waters list because of stormwater discharges share common features. Water flow and sediment dynamics in these streams are out of balance, therefore, the physical habitat in the channel no longer supports healthy biotic communities, as measured by biological criteria developed by ANR pursuant to the VWQS. Best professional judgment suggests that a stormwater management plan targeted toward restoring an appropriate balance of water flow and sediment loading has the greatest potential for success. Although stormwater runoff is a complex mixture of pollutants, these pollutants move either with the water flow or attached to sediment particles in the water. Therefore, targeted changes in water flow and sediment loading would be expected to help control the other pollutants in stormwater runoff as well.

In Phase 2, essential data must be gathered in order to estimate how much change in water flow (hydrology), and reduction in sediment load is needed to restore the in-stream habitat and attain the water quality standards. A "guide" to a more balanced hydrology and sediment regime can be developed by examining one or more appropriate watersheds that have similar landscape characteristics to the impaired watersheds and that **are** in compliance with the VWQS. By using more than one such "attainment" watershed, targets which reflect a range of acceptable conditions could be developed.

Step 1. Using this approach, the first step in Phase 2 is to select appropriate attainment watersheds for use in developing stormwater management targets for the impaired watershed(s).

An appropriate attainment watershed should be in compliance with applicable VWQS criteria and be similar to the impaired watershed in the following characteristics:

- Watershed size
- Elevation
- Channel slope
- Surficial geology and soil type
- Natural land cover (for example, the percent wetland and forested area)

The attainment watersheds must also be in good geomorphic condition – meaning that the watershed is not experiencing severe or widespread erosion, deposition, or channel change.

The attainment watersheds are not envisioned as pristine, but rather they will contain some development and stormwater infrastructure, but also be in a healthy condition. The idea is to select watersheds for comparison that could represent the ecological potential of the impaired watershed. Final selection of appropriate attainment watersheds will rely on available biological data and best professional judgment.

Once appropriate attainment watersheds are selected, a set of initial targets for the impaired watershed will be established through a series of comparisons of the impaired watershed to the attainment watershed. These comparisons will include the hydrology and sediment load of each watershed.

Flow duration curves will be used as a surrogate for defining hydrological targets. Representative targets will be established for high, median, and low flow conditions. These could be defined as the 5^{th}, median, and 95^{th} percentiles on the curve. Because long-term water flow records are lacking for most Vermont watersheds, simple modeling approaches will be used to develop these curves. Candidates include GWLF, SWMM, P8, SLAMM and other rainfall runoff models based on land cover/land use. To the extent possible, the models will be calibrated with existing long term data. The same models would be run in the impaired watershed and the attainment watersheds, and the relative difference between the two conditions would be used to establish the flows needed to restore the stream's hydrology. Hydrologic targets could be expressed as percentage reductions in distribution of runoff volumes over time within the impaired watershed. Alternatively, ratios of the instantaneous one day peaks to daily mean flow on the same day could be used. Attention to low flow conditions can provide a focus for efforts to restore groundwater recharge and maintain adequate base flows.

Representative sediment targets could also be developed using modeling. By also using sediment as a surrogate, we acknowledge the dual role of water and sediment in achieving an equilibrium condition in a healthy stream. It also allows us to frame our targets within the context of a simple Total Maximum Daily Load (TMDL) analysis, should this be necessary. Such a TMDL could then be based on runoff volumes and sediment loading from various sources in the watershed.

The same model that is used to develop the hydrologic targets could also be used to develop a sediment wash-off target, but other approaches are possible as well. Targets could be developed

by comparing predicted wash-off in the attainment watersheds to the predicted wash-off in the impaired watershed. In this approach, the relative difference between the two conditions would be used to establish the wash-off sediment loadings reductions that are needed. Targets could again be expressed as percentage reductions in wash-off in the impaired watershed.

This approach to developing sediment targets focuses specifically on wash-off. Because sediment loading in the stream itself is increased by high flows, it is expected that sediments coming from bank erosion and channel erosion will be addressed by using the hydrologic targets. More specifically, sediment at high flow will be managed by reductions in water flow rates through discharge controls, with allowances for stream channel adjustment processes. As these stormwater volume controls are implemented, reductions in channel erosion and associated sediment movement should also occur. If sediment reductions do not occur as anticipated over time, specific actions focused on the sediment itself could be revisited. To manage sediment at lower flows (smaller storms) and in those streams that might be in relatively good geomorphic condition, the initial focus could rely more on management actions designed to control wash-off.

This approach is based on the assumption that there is a relationship between healthy in-stream habitats and stormwater management. Although the precise nature of this relationship is uncertain it is reasonable to expect that aquatic habitat conditions will improve as hydrology and sediment dynamics are restored. As habitat conditions improve with the restoration of hydrology and sediment dynamics, the macroinvertebrate and fish communities would also be expected to recover.

Step 2. The second step of Phase 2 is to develop a stormwater management plan that specifies the mix of management measures necessary to meet the water flow and sediment load reduction targets established. As implementation of this stormwater management plan begins, the first cycle of the iterative, adaptive management cycle is initiated and we proceed to Phase 3.

Both the hydrologic and sediment modeling in Step 1 rely upon data that represent watershed and site conditions. Although this analysis will help establish the overall goals of a stormwater management plan, additional assessment tools may be needed to determine what management actions are needed and how those actions should be prioritized. Specific spatial data sets which could be considered for use in these additional assessments include the following:

- Subwatershed boundaries
- Stormwater “polygons” or land areas within which runoff is collected
- Existing stormwater infrastructure (degree of treatment and control)
- Percent impervious cover
- Soils-erodibility
- Soils-hydrologic soil group
- Channel slope
- Road density
- Road locations (near the stream or not)
- Number of bridge/culvert crossings
- Type of surficial deposit
- Potential recharge areas

Generally, these data sets are either readily available, or are could be developed using existing GIS data layers. Through the overlay of some or all of these data sets, a risk assessment approach can be taken to define specific areas within an impaired watershed which may contribute disproportionately to existing water quality impairments. A scoring system could be developed to weight these factors and identify specific "stormwater impact areas" (SIAs). These scores could then be used to guide implementation of the stormwater management plan by identifying areas which should be the focus of the most intensive implementation efforts. Therefore, the SIA scoring method provides a means to connect the hydrologic and sediment targets with a determination of the specific actions that are needed to implement the plan.

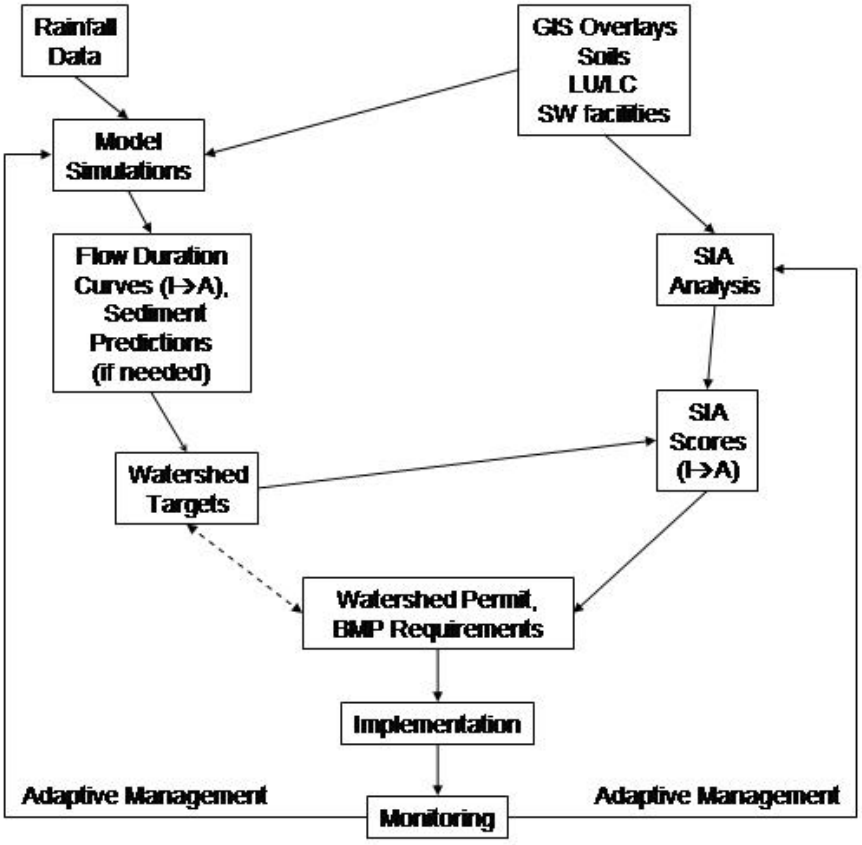
Although the SIA analysis in not the only way that stormwater management actions might be identified, when combined with the hydrologic modeling, it could be used relatively rapidly to prioritize activities with the watershed. The tasks involved in the modeling and the SIA analysis could proceed on a parallel track, merging prior to the development of the specific management actions, or BMPs, required in the clean-up plan. These tracks are illustrated in Figure 1. However, because of the considerable uncertainties involved in the development of these targets and natural variation, an adaptive management approach is also necessary to provide a means for refining the plan over time. As stormwater treatment and control strategies are implemented, additional data must be gathered and indicators tracked in order to judge progress and fine-tune the clean-up strategy.

The goal of step 2 is to identify objectively areas that may require greater intervention to achieve the established targets. The SIA scores for the subwatersheds within the impaired watershed could be used to define areas of greater risk to water quality resulting from existing stormwater discharges. Likewise, field assessment data such as Rapid Geomorphic Assessment (RGA) and Rapid Habitat Assessment (RHA) scores could also provide useful information to identify those areas with particular impairments. Using these approaches, the specific actions required of individual parcel owners and the required stormwater treatment and control performance standards could be linked to position in the watershed. A consistent and predictable approach to these requirements is necessary. Since it is anticipated that watershed permits would be written based on best management practices (BMP), then the water flow alteration or sediment wash-off reduction efficiency of each practice must be estimated. These changes would be assumed for each BMP that is correctly constructed and appropriately maintained. Permit compliance would likewise be judged on the basis of construction and maintenance in accordance with BMP specifications.

On some properties, the load reductions necessary may not be possible on site because of site constraints. An engineering feasibility analysis would be required to document those sites on which the assigned level of performance could not be achieved, as well as to provide a determination regarding the level of performance which could be achieved. Offsets could be required in these cases to ensure that the equivalent load reduction or hydrologic benefit would be achieved.

Figure 1. Sequence of tasks to develop a Stormwater Management Plan. The watershed targets would be developed based on the hydrologic modeling. The SIA analysis and scoring would then suggest specific actions that could be used to achieve these targets. The hydrologic changes expected from these BMPs would

be compared to the hydrologic targets as a final cross-check (dashed line) before any implementing permit was finalized.



Once an initial mix of management measures has been defined, the hydrologic models could be run to determine whether the flow alterations necessary to achieve the targets might be expected with implementation of these measures in the impaired watershed. Although both the water flow and sediment targets could be used to guide the development of the specific management measures, currently, there is a better general understanding of the hydrologic responses in streams than there is of the sediment dynamics in streams. Therefore, in most cases the hydrologic targets will be the primary ones driving the development of specific management strategies. An implementing permit would not be completed until this cross-check with the models indicated that the management measures specified could be expected to result in the necessary changes in watershed condition.

Because new development might be expected to have impacts on impaired streams, provisions for new development must also be made in any implementing permits. There are a variety of policy options that might be pursued to accomplish this, but in any case, an accommodation for new development must be made in the overall watershed load.

Because of the scientific uncertainties associated with predicting stream responses and the effectiveness of stormwater management, a margin of safety must also be incorporated into the stormwater management plan. This margin of safety could be accomplished by using conservative assumptions in the modeling used to select the loadings targets, by selecting conservative targets, by using uncertainty analysis to estimate appropriate ranges of response, or by a combination of these approaches. Ultimately, the margin of safety for each watershed will be based on site specific information and best professional judgment.

Finally, the larger watershed context for stormwater management must also be considered in Phase 2. Some goals that are difficult to accomplish within the constraints of stormwater permitting might be accomplished through improved coordination of other efforts. For example, municipal actions would be needed to provide riparian corridor protection and other conservation benefits. Additional benefits might also come from working with other stormwater permitting programs required under the federal Clean Water Act such as the Municipal Separate Storm Sewer System permit (MS4), the Multi-Sector General Permit (MSGP), and the construction site general permits, which regulates stormwater runoff from municipal, industrial and construction sites respectively. These efforts could also be used to establish a set of potential offset projects which could be funded by fees assessed for sites that are unable to meet designated performance requirements as determined through engineering feasibility analyses.

Although some flexibility in translating the hydrologic and sediment targets into management actions seems appropriate, the implementation plan must be specific enough to provide reasonable assurance that the expected water quality improvements based on these targets will be achieved. Because the water flow and sediment targets represent our best estimate of the improvements that are needed in the stream to attain the VWQS, the expected benefits of the implementation plan would be compared against these targets. However, attaining the VWQS, and not the targets, is the goal of the stormwater management plan. Compliance will ultimately be judged by attaining the VWQS.

Phase 3 – The purpose of this phase is to track implementation of the stormwater management actions, as well as the resulting changes in the streams and their biota in the impaired watersheds. The assessment data gathered will be used to evaluate progress and make decisions about the need to alter management actions in order to ultimately attain compliance with applicable VWQS criteria.

Adaptive management relies on the collection of data that are used in an iterative evaluation and decision-making process. A specified sequence of data collection and evaluation is followed with specified decision points about the need for revisions in the management plan.

Although macroinvertebrate and fish communities that meet criteria developed by ANR for compliance with the VWQS are the ultimate measures of success, these measures may be the last to respond to improvements in the impaired water. Other changes in the physical and chemical habitat conditions within the stream will indicate progress towards the VWQS.

Indicators should be selected that track (1) the implementation of the stormwater management actions, (2) the changes in the primary stressors in the impaired streams, and (3) the changes in the condition or state of the in-stream habitat and biotic community. Baseline measurements of all indictors must be made on a timetable that ensures that these data are roughly concurrent with the issuance of any implementing permit.

(1) Indicators of the implementation of the stormwater management actions might include:

- the number of BMPs implemented, by type
- the percentage of the total number BMPs expected under the permit that have been constructed or maintained
- the percentage of the water flow managed by the BMPs
- the percentage of the total acreage needing stormwater management that has been managed

After the first year, these data would be collected and compiled on an annual basis as a component of watershed permit administration.

(2) Indicators of the primary stressors in the impaired watershed might include:

- untreated impervious area (not total impervious area)
- streamflow (a flow duration curve must be developed based on continuous stage or stage/discharge data), and its relationship to the target
- predicted wash-off, and its relationship to the target
- TSS or some other field measurement of sediment concentration in the stream

Because the hydrologic and sediment targets are based on comparisons to the attainment watersheds, these data must also be collected in one or more of the attainment watersheds. To be most useful, water flow should be continuously monitored and TSS measurements should be collected on an event basis and the data compiled on an annual basis. Data onuntreated impervious area and predicted wash-off should also be calculated on a periodic basis. The specific monitoring elements for each watershed could be defined as a component of each implementing permit at the time such permits are issued.

(3) Indicators of state or condition of the in-stream habitat and biotic community might include:

- RGA and RHA scores
- channel profile measurements (for example, width to depth ratio),
- substrate measures (for example, embeddedness or pebble count)
- length or percent eroded bank
- length or percent mid-channel bars
- measures of the macroinvertebrate and fish communities

After baseline conditions are established, most of these indicators would only need to be measured on a biannual basis. Because of its extreme importance, and the potential for drought

or extreme high flow conditions to interfere with data collection in some years, the macroinvertebrate and fish communities should be monitored on an annual basis.

The adaptive management cycle and decision-making. The implementation indicators would be used to determine whether the stormwater management plan was being implemented as intended. The stressor and state indictors would be used to track the effectiveness of the management plan in the watershed. The stressor indictors relate directly to the implementation of management actions and the hydrologic, sediment and/or SIA score targets that have been established. As BMPs are implemented, the amount of untreated impervious area should decline, and the water flow and sediment characteristics in the impaired watershed should begin to adjust to these changes. As damaging water and sediment loads are reduced, the state indicators track the responses in the stream habitat and biota. Attaining the applicable VWQS is the goal of the stormwater management plan, and, ultimately, compliance will be judged by meeting these standards.

How the adaptive management cycle might work. The following scenario gives an example of how the adaptive management cycle might work. Additional discussion and refinement of the indicators and decision points will be needed if and when this approach in adopted.

Once a stormwater permit is issued, design and acquisition of other permits might be expected to take two to three years. In year three, we would expect construction or remedial maintenance to be occurring throughout the watershed. Increases in the number and percentage of actions would indicate positive progress. Although some changes in net impervious area and water flow might be discernable in year three, the first evaluation in the adaptive cycle would not typically occur until year five.

In year five, the first formal data review in the adaptive management cycle might occur. By this time, we should expect to see a relatively high percentage of the management actions in place. We should also expect to see some significant changes in the stressor indicators. Untreated impervious area should be declining. Some changes in both water flow and predicted wash-off should be apparent; however, because it will take time for the natural adjustment processes to occur in the stream channel, it is unrealistic to expect that all the flow alterations planned have been achieved. In significantly impaired waters, the channel adjustment processes may mean that some measures will actually get worse before they begin to improve.

Some of the state indicators should also show changes in year five. It may be reasonable to expect adjustments in the channel profile, and perhaps small improvements in the RGA and RHA scores. In less severely impaired waters, some improvements in the macroinvertebrate and fish communities might be apparent. If the weight of evidence suggests that the stream is responding in a positive direction, then the decision in year five would be to continue management as planned. In most streams, some movement towards the hydrologic and sediment targets would probably be sufficient to constitute good progress.

Data would continue to be compiled and reassessed on a biannual schedule. In most impaired streams, movement towards the hydrologic and sediment targets should be followed by adjustments in the channel profile, and then improvements in the RGA and RHA scores.

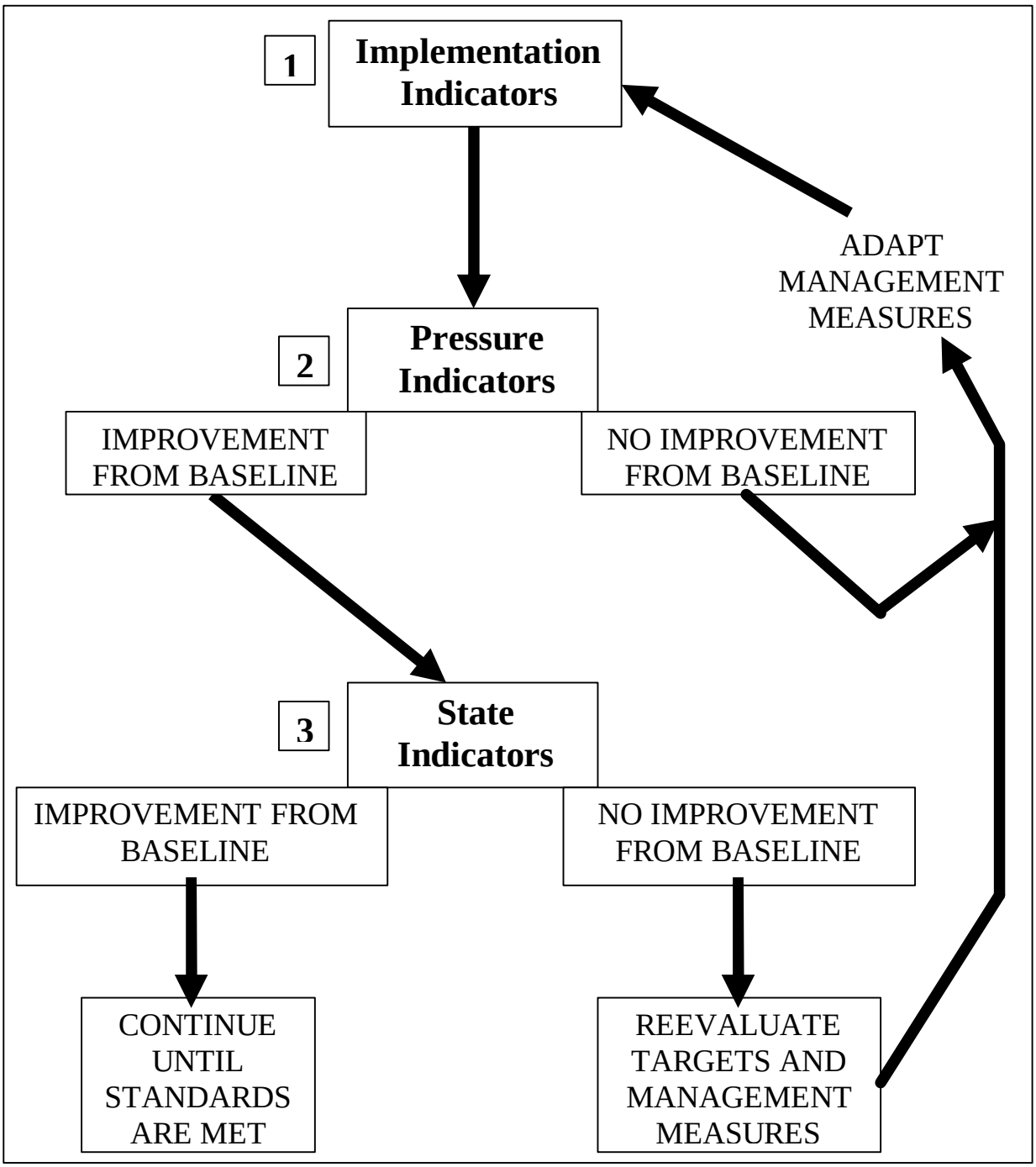
Improvements in the macroinvertebrate and fish communities would likely occur last, especially in severely impaired waters. If the hydrologic and sediment targets have been achieved and the biota have still not responded, then a broader look for other stressors like toxic pollutants should occur.

By year seven, it might be reasonable to expect that less severely impaired waters might be close to or even attaining the biotic criteria. In more severely impaired waters, continued progress towards the hydrologic and sediment targets might still constitute good progress. If biotic criteria are not achieved in less severely impaired waters, or significant movement towards the biotic criteria has not occurred in severely impaired waters by the third review in year nine, then additional management actions should again be considered. A general schematic outlining how the indicators would be used in the adaptive management cycle appears in Figure 2.

As this phased assessment continues to be developed, more specific milestones and decision points for use in the adaptive management cycle should be developed. It is likely that some flexibility and tailoring for the severity of the impairment in each watershed will be necessary. However, for each watershed, some *a priori* expectations about what degree of change from baseline conditions constitutes improvement should be developed.

The data collected in Phase 3 can also be used to improve the hydrologic modeling used in Phase 2 to develop the loadings targets. With this in mind, more data might be collected to support the implementation of the first few permits than might be necessary to support later permits.

Figure 2. A general framework for the adaptive management approach. [1] A management plan is developed or adapted and implemented. The actions taken are expected to lessen the pressures exerted on the streams in the watershed. [2] Following implementation and time for the streams to respond, changes in the pressures on the system are evaluated. If they have changed in a positive direction, improvements in the state of the system are expected over time. If they have not lessened, additional management steps may be warranted. [3] The state of the stream habitats and biota are evaluated. If the state of the system has improved, continue with the existing management plan. If the pressures have lessened but the state does not improve, reevaluate the management plan and adjust the targets and management measures.



Areas of Agreement about the Scientific Underpinnings of the Water Resources Board's Original Seven Questions

Question 1. *Is it scientifically feasible to develop and implement a WIP or other cleanup plan that is based primarily on source controls for Vermont's water bodies that are impaired as a result of stormwater and that provides reasonable assurance that the receiving waters will comply with the VWQS within five years or within any definitive period of time? If so what are the elements of such a plan?*

Although there are many scientific uncertainties associated with the process, it is scientifically feasible to develop and implement a watershed improvement or management plan based on controlling stormwater. However, it is not clear what level of stormwater control will be needed in every impaired watershed or how long it will take to achieve compliance with the Vermont Water Quality Standards (VWQS). For most stormwater impaired waters, it is unlikely that the VWQS will be attained within five years. Those waters that are furthest from compliance will take the longest to meet the VWQS.

Because of the large uncertainties associated with achieving compliance in complex and dynamic landscapes, an adaptive management approach represents the most prudent course of action. The critical elements of such an approach are outlined in the attached pages describing a scientifically based assessment and adaptive management approach.

Question 2. *What tools are available to predict how aquatic biota in impaired waters will respond to implementation of treatment and control measures for stormwater discharges? In the absence of such tools, how can a cleanup plan for stormwater impaired waters be developed to provide reasonable assurance of compliance with the VWQS?*

Although it is not possible to predict precisely how aquatic biota in impaired streams will respond to the implementation of stormwater treatment and control measures, we do know that both macroinvertebrates and fish are adversely affected by increasing urbanization in a watershed. A review of the available scientific data suggests that the strongest correlations occur between biotic measures and the area of untreated impervious surface in a watershed. On the positive side, there are also data that show improvements in biotic measures with aggressive stormwater management.

Because the precise nature of the relationship between biotic integrity and stormwater management is not known, an adaptive management approach is necessary. The attached assessment approach lays out a strategy for using monitoring information to judge progress towards achieving the VWQS as a stormwater management plan is implemented.

Question 3. *What are the appropriate physical, chemical, and biological targets to be used to demonstrate attainment of VWQS? Should or can meaningful interim targets be used as milestones? If so which tools are appropriate and in what circumstances to demonstrate progress toward meeting the final targets?*

The streams on Vermont's list of impaired waters (the 303(d) list) because of stormwater pollution currently violate the VWQS developed to protect aquatic life. Specifically, these streams do not meet the state's biotic integrity criteria which measure the health of both the macroinvertebrate and fish communities in streams. These biotic criteria are used to make judgments about either violation or attainment of the VWQS developed to protect aquatic life.

The biotic criteria are not met in stormwater impaired streams because stormwater runoff has caused an imbalance in the water and sediment dynamics in the stream. Therefore, a stormwater management plan can be developed based upon targets established by using water flow and sediment as surrogates for stormwater and most of the other pollutants of concern that could be transported by stormwater. Other data such as land cover, the stormwater infrastructure, and soils information, could also be used to help identify specific stormwater impact areas that might be used to inform the choice of specific management actions. As a stormwater management plan is implemented, measures of the physical characteristics of the stream could be used as indicators to help determine whether the improvements thought necessary to attain the VWQS are occurring.

The attached assessment strategy lays out an approach that uses a series of indicators to measure impairment, identify stormwater management goals, evaluate progress towards attaining the VWQS, and make decisions about the need for additional actions in the watershed.

Question 4. *How should cleanup plans address the impacts to stormwater impaired waters from both natural and manmade conditions such as eroding banks, rechannelization, riparian zone encroachment, on-stream ponds, and other factors that are the result of geomorphic instability in these waters that will continue to occur and adversely effect aquatic biota regardless of reductions in stormwater discharges?*

The stream channel instability in many stormwater impaired watersheds is caused by an imbalance in the water and sediment dynamics in the streams in the watershed. It reflects the stormwater inputs to the impaired watershed, as well as other potential human modifications, including dredging, filling, and bank and channel alterations. Once unbalanced, streams undergo predictable patterns as they seek to regain equilibrium and restore access to their flood plains. Although ultimately a variety of approaches to management might "help" the stream re-establish its equilibrium, until a more natural hydrology and sediment regime are reestablished through stormwater treatment and control, stream channel stabilization efforts by themselves will not be successful. After stream channel adjustment process have had time to "work," then other management efforts can assist the stream channel in reaching an equilibrium condition. Riparian zone encroachment will restrict the options available for stream channel adjustment.

Appropriate watersheds that meet the VWQS can be used as a "guide" to a more balanced hydrology and sediment regime. These 'attainment watersheds' would have similar landscape characteristics to the impaired watershed (including, but not limited to soils and geology, elevation, slope, entrainment, natural vegetation) and although they might be developed to some extent, they would be in compliance with the VWQS. The choice of attainment streams can help in handling differences in stream channel morphology from place to place. The attached

assessment approach outlines a way to use attainment watersheds to guide the development of an appropriate cleanup plan.

Question 5. *Is it scientifically feasible to develop a Total Maximum Daily Load (TMDL) for Vermont's water bodies that are impaired as a result of stormwater? If not, why not? If it is scientifically feasible to develop a TMDL for such waters, is the TMDL the most effective approach to cleaning up Vermont's stormwater impaired waters? If it is not scientifically feasible, what alternatives are there?*

Although there are considerable scientific uncertainties (especially where streams are highly unstable), it is possible to develop a TMDL for stormwater impaired streams using water (discharge) and sediment as surrogates for stormwater should this be necessary. In such an approach, the discharge and sediment characteristics of watersheds that are in compliance with the VWQS become the estimates of "assimilative capacity." Appropriate measures of flow and sediment loading become the stormwater management targets. Load allocation is based on runoff volumes and sediment loading from various sources in the watershed. As stormwater treatment and control strategies are implemented in keeping with these load allocations, an adaptive management approach must be used to judge progress and fine-tune the clean-up strategy.

Both the water flow and sediment targets can be used to guide the development of the stormwater management plan. However, currently there is less uncertainty about stream hydrology than there is about stream sediment dynamics. Therefore, in most cases the hydrologic targets will be the primary ones driving the load allocation and development of specific management strategies. Hydrology is also the major driver for stream channel erosion, so control of high water flows will also achieve reductions in channel sediment movement. If sediment does not respond as desired over time, sediment loading might be revisited. In some streams, where geomorphic condition is relatively good, sediment targets could be used initially to determine management actions designed to control wash-off from developed sites.

This strategy is based on the assumption that there is a relationship between healthy in-stream geomorphology/habitats and stormwater management. Although the precise nature of this relationship is uncertain, it is reasonable to expect that as hydrology and sediment dynamics are restored, habitats will improve, and the macroinvertebrate and fish community will recover. Although decisions about stormwater impairment are ultimately made based on the biotic criteria, positive changes in physical habitat conditions within the stream will indicate progress towards the VWQS within an adaptive management approach.

The most effective approach to cleaning up Vermont's stormwater impaired waters is one based on scientifically defined hydrologic and sediment loading targets. Whether a TMDL or a Water Quality Remediation Plan is used as the basis for a cleanup plan, the key is to start by defining water flow and sediment loading targets that can give reasonable assurance that they will meet the VWQS. As the water flow alterations and sediment load reductions are implemented in a stormwater management plan, monitoring data can be used in an adaptive management framework to cope with scientific uncertainties and make any adjustments in the cleanup plan that may be needed.

Question 6. *If it is not scientifically possible to provide reasonable assurance that impaired waters will be restored to compliance with VWQS, what should the policy of the state of Vermont be with regard to developing cleanup plans for stormwater impaired waters? At what point, if ever, should Vermont lower the designated uses, classifications and/or water quality criteria for the water bodies if there is no reasonable assurance that these waters can be managed to meet the existing VWQS?*

There is scientific evidence to suggest that stormwater management can result in improvements in aquatic biota in impaired streams. Although it is not possible to say with certainty whether full compliance with VWQS is possible or not in all the stormwater impaired streams in Vermont, best professional judgment suggests that cleanup plans based on the attached assessment and adaptive management approach have a reasonable probability of success.

The adaptive management approach is 'responsive' rather than 'prescriptive.' It provides a rational framework for responding to future unforeseeable conditions. At this time, we see no need for Vermont to consider lowering its designated uses, classifications, or water quality criteria for any water body.

Question 7. *What are the scientific and technical opportunities and difficulties in developing and utilizing offsets to address stormwater impaired waters?*

The realities of existing site constraints and the scientific uncertainties associated with predicting and managing stormwater suggest that offsets are needed and that they must include a margin of safety. Although further discussion of offsets would be worthwhile, a full exploration of this topic has not yet been undertaken.

Glossary

Assimilative capacity The maximum amount of a pollutant that a water body can receive without violating the Vermont Water Quality Standards. The assimilative capacity of a water body may be allocated among pollutant dischargers using a total maximum daily load (TMDL).

Best management practice (BMP) Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce water pollution. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Biological criteria Numeric indices or matrices generated by ANR for interpreting the narrative aquatic biota criteria in the Vermont Water Quality Standards.

Classification The water quality definition establishing the management goal or use for a particular body of water. Class A(1) waters are suitable for public water supply with disinfection when necessary and have uniformly excellent character; Class A(2) waters are high quality waters with significant ecological value; Class B waters are suitable for bathing and recreation and irrigation and agricultural uses and represent good fish habitat and good aesthetic value and are acceptable for public water supply with filtration and disinfection. Vermont is in the process of designating all Class B waters as Water Management Type 1, Type 2, or Type 3 to provide for the protection of Class B waters in a manner that more explicitly recognizes their attainable uses and the level of water quality protection already afforded.

Designated use A use or classification specified in water quality standards for a water body or segment whether or not the use is being attained. Examples of designated uses include public water supply, cold water fishery, and swimming.

Discharge In the regulatory sense, this term means the placing, depositing, or emission of any waste directly or indirectly into Vermont's waters. In the hydrological sense, this term means the volume of water flowing in a stream past a specific point in a given period of time. The term discharge in this sense refers to flow and may be expressed as cubic feet per second, gallons per minute, etc.

Entrainment The capture or mobilization of bed load or suspended sediment in water by fluvial processes.

Flood plain Areas adjacent to a stream or river that are subject to flooding or inundation during a storm event. Flood plains may be defined by frequency analysis, such as a 100-year flood.

Flow Hydrological discharge. Stream flow may be separated into different components, such as storm flow, which consists mostly of surface runoff, and base flow, which consists mostly of groundwater discharge.

Flow duration curve A graphic illustration of the percentage of time during which specified flows are equaled or exceeded at a particular stream station. Low flows are exceeded a majority of the time, whereas floods are exceeded infrequently. Flow duration curves typically use daily average discharge rates. Flow duration curves may assist with grouping water quality data according to flow conditions and targeting different management strategies to different stream flows.

Geographic information system (GIS) A computer system capable of capturing, storing, analyzing, and displaying geographically referenced information--that is, data identified according to location. Software tools can extract features from satellite images or aerial photographs for use in GIS systems. A GIS makes it possible to link, or integrate, information that is difficult to associate through any other means. Thus, a GIS can be used to determine the statistical or geographic relationship between different mapping layers, such as streams and roads or other impervious surfaces.

Geomorphology The study of the planar and cross sectional shape of streams over time. Fluvial geomorphology is a science that seeks to explain the physical interrelationships of flowing water and sediment in varying land forms.

Hydrologic soil group (HSG) A Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from A soils, with high permeability and little runoff production, to D soils, which have low permeability rates and produce much more runoff.

Hydrology The science of water. This term is also used to refer to the occurrence, distribution, movement, and chemistry of surface waters and encompasses the interrelationships of geologic materials and processes with water.

Impaired water A water segment that does not comply with the Vermont Water Quality Standards.

Impaired waters list A list of the impaired waters in Vermont that the Vermont Agency of Natural Resources submits to the United States Environmental Protection Agency biennially pursuant to the requirements of the federal Clean Water Act.

Impervious surface Those surfaces, including, but not limited to, paved and unpaved roads, parking areas, roofs, driveways, and walkways, from which precipitation runs off rather than infiltrates.

Load allocation Used as shorthand for a pollutant load allocation or total maximum daily load, which means a plan for the distribution of maximum allowable loads over a unit period of time to dischargers or categories of dischargers in a manner that reasonably ensures that the sum of these allocations will not exceed the assimilative capacity of a particular water body. Under federal law, this term refers to the component of a pollutant load allocation assigned to nonpoint sources of pollution.

Load The amount of a pollutant, usually expressed in mass.

Macroinvertebrate A bug. The assemblages of macroinvertebrates in streams can reflect the biological integrity of these streams and the extent to which they comply or fail to comply with the biological criteria of the Vermont Water Quality Standards.

Offset A reduction of pollutant loads from one site that compensates for the extent to which the load reduction requirements that apply to another site have not been achieved.

Performance standards Treatment and control requirements for discharges of pollutants.

Rapid Geomorphic Assessment (RGA) A technique set forth in ANR's Stream Geomorphic Assessment Handbook for conducting a physical assessment of a stream's channel condition.

Rapid Habitat Assessment (RHA) A technique set forth in ANR's Stream Geomorphic Assessment Handbook for conducting a physical assessment of a stream's biotic habitat.

Recharge The replenishment of groundwater, that is the addition of water to an aquifer, which occurs through infiltration.

Reduction efficiency The rate at which treatment systems reduce pollutant loads.

Riparian zone The land area adjacent to a lake or stream.

Runoff That portion of the precipitation on a drainage area that is discharged to stream channels.

Source Includes point sources and nonpoint sources of pollutants. A point source is a discernable, confined, and discrete conveyance, like a pipe or a ditch. A nonpoint source is diffuse and includes uncollected runoff and atmospheric deposition.

Source controls Treatment systems for discharges of pollutants. The term usually refers to structural controls for point sources such as stormwater treatment ponds as opposed to nonstructural controls for nonpoint sources, such as riparian forests or pet waste management.

Slope Rise divided by run. Thus, a stream channel that drops five feet vertically for every fifty feet of length has a slope of 1:10.

Stage The variable water surface or the water surface elevation above any chosen datum.

Stormwater Precipitation that does not infiltrate into the soil, including the material dissolved or suspended in it.

Stormwater impact area (SIA) A geographic area ranked for its potential to generate stormwater runoff.

Total suspended solids (TSS) The total amount of soils particulate matter that is suspended in the water column.

Total maximum daily load (TMDL) A plan for distributing the maximum allowable loads over a unit period of time to dischargers or categories of dischargers in a manner that reasonably ensures that the sum of these allocations will not exceed the assimilative capacity of a particular water body. Under federal law, a TMDL includes a wasteload allocation for point sources, and load allocation for nonpoint sources, and a margin of safety.

Toxic pollutant Pollutants listed as toxic under the Clean Water Act. Exposure to or assimilation of toxic pollutants, which include heavy metals, for example, may lead to death, disease, behavioral abnormalities, genetic mutations, physiological or reproductive malfunctions, or physical deformations in organisms or their offspring.

Vermont Water Quality Standards (VWQS) Designated uses, water quality criteria, and antidegradation requirements for Vermont's waters. Waters that do not comply with the VWQS are polluted.

Wash-off Pollutant loads carried into streams by stormwater runoff as opposed to pollutant loads created by hydrologic modification of the streams that causes unnaturally aggressive stream bank erosion and stream channel incision.

Water quality criteria Elements of the Vermont Water Quality Standards that will protect the designated uses of a water body. Criteria may be numeric or narrative.

Water quality remediation plan A plan other than a TMDL or pollutant load allocation designed to bring an impaired water body into compliance with the Vermont Water Quality Standards.

Watershed An area of land that discharges surface runoff to an outlet or mouth. A watershed may also be referred to as a drainage area, drainage basin, river basin, or catchment.

Watershed improvement permit (WIP) A general permit specific to an impaired watershed that is designed to apply management strategies to existing and new discharges in a manner that will reasonably ensure that the receiving waters will achieve and maintain compliance with the Vermont Water Quality Standards within five years.

LIST OF ACTIVE PARTICIPANTS IN DOCKET

The United States Environmental Protection Agency (EPA)
The Village of Essex Junction
The Conservation Law Foundation (CLF)
The City of South Burlington
Joint MS4s
The Vermont Natural Resources Council (VNRC),
The Home Builders and Remodelers Association of Northern Vermont
The Vermont Chamber of Commerce
The Vermont Ski Areas Association
Dubois & King, Inc.
The Association of Civil Engineers
The Vermont Agency of Transportation (VTRANS)
The Lake Champlain Committee (LCC)
The City of Burlington
Associated Industries of Vermont (AIV),
The Lake Champlain Regional Chamber of Commerce (LCRCC)
The National Resource Conservation Service
The University of Vermont
The Agency of Natural Resources