Reconsideration of EPA's Approval of Vermont's 2002 Lake Champlain Phosphorus Total Maximum Daily Load ("TMDL") and Determination to Disapprove the TMDL

January 24, 2011

A. Statutory and Regulatory Background

Section 303(d) of the Clean Water Act ("Act") requires states to identify waters that do not or are not expected to meet applicable water quality standards after imposition of technology-based controls alone. In that event, the waters are considered "impaired," and must be identified or "listed" under Section 303(d) of the Act. Once such waters are identified, states are to develop TMDLs for any pollutant that is causing the impairment, at a level necessary to attain and maintain the applicable state water quality standards with seasonal variations and a margin of safety that accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality. The "total maximum daily load" that applies to a water segment is the sum of the "load allocations" ("LA") of pollutants from nonpoint sources, the "wasteload allocations" ("WLA") of pollutants from point sources, and a margin of safety.[1] *See* 40 C.F.R. §§ 130.2(g)-(i), 130.2(c)(1). Once the public has had the opportunity to review and comment on such TMDLs, states are required to submit the TMDLs to EPA for review and approval. If EPA disapproves a TMDL, it must then establish the TMDL at the level necessary to implement the applicable water quality standards and the state must incorporate the TMDL into its continuing planning process.

EPA's Water Quality Planning and Management Regulations at 40 C.F.R. Part 130 implement the requirements of Section 303(d) of the Act. Section 130.7 describes the TMDL process and the states' responsibility for identifying waters requiring TMDLs, developing TMDLs, and submitting the TMDLs to EPA for approval.

B. Vermont's 2002 Lake Champlain TMDL Submittal and EPA's 2002 Decision

Lake Champlain is bordered by the States of Vermont and New York and the Province of Quebec, Canada. The Lake is 120 miles long, with a surface area of 435 square miles and a maximum depth of 400 feet. The watershed is roughly 8,234 square miles and drains nearly half the land area of Vermont. The Lake is impaired due to excess phosphorus loadings, which have resulted in severe eutrophication in many lake segments.

The Vermont Department of Environmental Conservation ("VTDEC") began preparing the Lake Champlain phosphorus TMDL in the late 1990s, following the development and approval by Vermont, New York, and EPA of the Lake Champlain Management Conference plan entitled "Opportunities for Action" in 1996, and the completion of a multi-year Lake Champlain

[1] Load allocations also are attributed to natural background levels of the pollutant and to point sources not subject to regulation by the National Pollutant Discharge Elimination System ("NPDES") permitting program. Wasteload allocations are attributed to point sources that are subject to regulation by the NPDES permit program.

diagnostic-feasibility study in 1997. Drafts of the TMDL document were circulated for public comment in 2001 and 2002, and provided to EPA for comment as well.[2]

VTDEC submitted the final Lake Champlain Phosphorus TMDL to the Region for review and approval under Section 303(d) of the Act on September 25, 2002. The submittal addressed the nine segments of Lake Champlain identified on Vermont's Section 303(d) list of impaired waters. Following a review of the final TMDL package, including VTDEC's response to public comments, the Region approved Vermont's TMDL on November 4, 2002.

C. The Conservation Law Foundation ("CLF") Litigation

On October 28, 2008, CLF filed suit in federal district court against EPA seeking to set aside the Region's November 4, 2002 approval of Vermont's Lake Champlain Phosphorus TMDL and seeking establishment by EPA of a new TMDL.[3] The complaint alleged that EPA's approval was arbitrary, capricious, and not in accordance with law under the Clean Water Act and the Administrative Procedure Act, 5 U.S.C. § 706(2). Specifically, the complaint asserted that the 2002 TMDL contained a variety of flaws, including insufficiently stringent wasteload allocations coupled with a lack of reasonable assurances that nonpoint source reductions would occur; an inadequate margin of safety; inadequate specificity of the stormwater component of the wasteload allocations; and failure to consider water resources effects associated with documented and predicted climate change. The State of Vermont intervened in the case.

In April 2010, CLF and EPA signed a settlement agreement, and EPA filed a motion with the court seeking a voluntary remand to allow the Region to reconsider its 2002 TMDL approval decision and a stay of the litigation. The State objected to EPA's motion and moved the court to deny the request for remand and dismiss the case. On August 25, 2010, the court granted EPA's motion for voluntary remand and stayed the case for 180 days. In the settlement agreement with CLF, EPA agreed to complete its reconsideration of the 2002 TMDL no later than 120 days from the court's order granting the remand. That date was December 24, 2010. On December 14, 2010, EPA received a 30-day extension from CLF of the date by which EPA must issue its decision, i.e., no later than January 23, 2011.

D. EPA's Reconsideration on Remand

Following the judge's order, the Region reviewed the 2002 Lake Champlain TMDL and its

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[2] New York's Department of Environmental Conservation also began work on a Lake Champlain TMDL, and eventually the two states combined their efforts to produce a single TMDL document which covered all thirteen segments of the Lake. Vermont's portion of the TMDL addresses nine of these segments. Vermont developed the 2001 draft TMDL, and Vermont and New York jointly developed the 2002 draft TMDL.

[3] EPA Region 2 approved New York's portion of the Lake Champlain TMDL on September 30, 2002. CLF's lawsuit did not challenge that approval, and the statute of limitations has run on any ability to challenge Region 2's approval decision.

administrative record in light of applicable statutory and regulatory provisions and EPA guidance available at the time of the original approval. The Region's task was to determine, after a fresh look at these materials and consideration of the allegations in CLF's complaint, whether the TMDL submittal was consistent with Section 303(d) of the Act and its implementing regulations.

There were many components of the 2002 TMDL which were not challenged by CLF, and during the reevaluation the Region saw no information that called into question the Region's original analysis as to those components. Therefore, this decision document incorporates by reference the Region's evaluation of the sufficiency of the 2002 TMDL submittal, as set forth in the November 4, 2002 approval document, with respect to the following sections: 1) Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking; 2) Description of the Applicable Water Quality Standards and Numeric Water Quality Target; 3) Load Allocations; 4) Seasonal Variation; 5) Monitoring Plan to Track TMDL Effectiveness; 6) Implementation; 7) Public Participation; and 8) Submittal Letter.

The Region focused its reevaluation on the four major contested areas of the TMDL: margin of safety, stringency of WLAs in light of reasonable assurance that sufficient load reductions would occur, aggregation of stormwater WLAs, and climate change considerations associated with the loading capacity and hydrologic base year. The Region's analysis of each of the contested areas is discussed below.

1. Margin of Safety

The statute and regulations require that a TMDL include a margin of safety ("MOS") to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C); 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance *(USEPA, 1991)* explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

The 2002 Lake Champlain TMDL relies on an implicit MOS based on what it characterizes as two conservative assumptions in the lake model. The first conservative assumption cited is that changes to the ratio of particulate to dissolved phosphorus following TMDL implementation would not affect the internal phosphorus sedimentation balance. This is considered to be a conservative assumption because dissolved phosphorus contributes to total phosphorus levels in the lake more than does particulate phosphorus, and the lake model was calibrated at a time when phosphorus loads from waste water treatment plants ("WWTPs"), which are primarily in the form of dissolved phosphorus, made up a significantly greater percentage of the total load than would be the case following TMDL implementation. The TMDL document explains that once the TMDL load and wasteload allocations are achieved, the ratio of particulate to dissolved phosphorus would shift from approximately 2:1 (during the calibration period) to 3:1. The TMDL document indicates that this new 3:1 ratio would produce a higher rate of internal sedimentation (movement of phosphorus from the water column into the lake bottom sediment layer) than existed when the model was calibrated, resulting in more phosphorus being removed from the system than was calculated by the model.

The second conservative assumption cited is that the model's mean predicted phosphorus concentrations are below the applicable phosphorus criteria (for 6 of the 9 segments covered by the Vermont TMDL document). The TMDL document indicates that the difference between the criteria and the mean predicted levels averages 0.0028 mg/l (nearly 3 ug/l), which serves as an additional margin of safety.

EPA analysis of the MOS provision:

One of the concerns the Region identified during its review of the March 2002 draft Lake Champlain TMDL was that the document did not include an adequate margin of safety. In an effort to assist the State, the Region suggested two potential conservative assumptions, which the State then incorporated into the final submittal. While, at the time, the Region believed these assumptions provided sufficient MOS, upon closer scrutiny the Region has determined that in fact they do not provide sufficient MOS for all lake segments for the reasons discussed below.

The first component of the MOS does indeed appear to offer some margin of safety for those segments where the ratio of particulate to dissolved phosphorus would actually change as described. The scientific literature (*National Research Council, 2000*) supports the premise in the TMDL that phosphorus in nonpoint source loads is mostly in the particulate form and phosphorus in treatment plant effluent is primarily in the dissolved form. The literature further supports the assumption that phosphorus in the particulate form will disproportionately settle out through sedimentation (*Chapra, 1997*). However, a segment by segment analysis reveals that the ratio of particulate to dissolved phosphorus would not, in fact, change as anticipated for four segments: Northeast Arm, South Lake A, St. Alban's Bay, and Missisquoi Bay.

For the Northeast Arm the reason is simple: there were (and are) no WWTP discharges to this segment and the reductions are all targeted to nonpoint sources. This means that the ratio of particulate to dissolved phosphorus fractions being input to the lake is determined entirely by the nonpoint source loads, and there is no opportunity to change the ratio through WWTP reductions.

For South Lake A and Missisquoi Bay, the reason this basis for an MOS does not apply is that the phosphorus reductions from WWTP discharges called for by the TMDL represent a smaller percent reduction than the percent reductions required from non-WWTP discharges, so the ratio of particulate to dissolved phosphorus would actually decrease in these segments (see Table 1). For South Lake A, which receives phosphorus loads from both Vermont and New York, there is no margin of safety based on this assumption, whether one considers the combined New York and Vermont allocations or just the Vermont allocations. While the Missisquoi Bay segment receives phosphorus from both Vermont and Quebec, EPA's reconsideration of the MOS focused only on the Vermont allocations. This is because the TMDL only includes load and wasteload allocation break-downs for Vermont. While Quebec agreed to an overall allocation

Table 1. Margin of Safety by Lake Segment: Ratio of Particulate to Dissolved Phosphorus in 1991 in Comparison to the Ratio after TMDL Allocations are Achieved.

Lake Segment	1991 WWTF Load (mt/yr)	1991 NPS* Load (mt/yr)	1991 Ratio of NPS:Point Loads (Part./Dissolved)	TMDL WWTF Allocation (mt/yr)	TMDL NPS Allocation* (mt/yr)	TMDL Ratio of NPS:Point Loads (Part./Dissolved)	MOS?
South Lake B (VT)	3.2	24.8	7.7 : 1	1.62	19.2	11.8 : 1	Yes
South Lake B (VT & NY)	7.1	49.1	7.0 : 1	3.56	41.2	11.6 : 1	Yes
South Lake A (VT)	0.1	2.4	24.0 : 1	0.2	0.4	2.0 : 1	No
South Lake A (VT & NY)	9.7	5.9	0.6 : 1	8.1	3.7	0.5 : 1	No
Port Henry (VT)	0.0	0.4	0.4 : 0	0.0	0.1	0.1 : 0	No
Otter Creek (VT)	62.8	58.9	0.9 : 1	12.0	44.1	3.7 : 1	Yes
Port Henry/Otter Creek (combined) VT and NY	64.6	62.0	1 : 1	12.9	46.7	3.6 : 1	Yes
Main Lake (VT)	27.7	60.3	2.2 : 1	25.3	51.3	2.0 : 1	No
Main Lake (VT & NY)	34.8	92.1	2.6 : 1	29.5	80.8	2.7 : 1	Yes
Shelburne Bay	5.3	11.1	2.1 : 1	2.0	10.0	5 : 1	Yes
Northeast Arm	0.0	3.2	3.2 : 0	0.0	1.2	1.2 : 0	No
St. Albans Bay	0.8	7.2	9.0 : 1	2.8	5.2	1.9 : 1	No
Missisquoi Bay (VT)	6.9	94.2	13.6 : 1	4.2	54.1	12.9 : 1	No

* NPS (nonpoint source) in this case refers to all non-WWTF (waste water treatment facility) loads/allocations.

(40% of the total load to the bay) in a 2002 agreement between Vermont and Quebec (referenced on page 18 of the TMDL document), the agreement did not break that 40% (38.9 mt/yr) into load and wasteload allocations, and there is no available information in the administrative record from which we could conclude that the reductions would result in a greater particulate to dissolved ratio. Therefore, any potential MOS afforded to Missisquoi Bay by this conservative assumption would have to be based on the Vermont allocations alone. A comparison of the Vermont 1991 loads with the TMDL allocations (as shown in Table 1) for the Bay reveals that in fact there will be a smaller particulate to dissolved ratio following TMDL implementation. Therefore, this component of the MOS is not available for this segment.

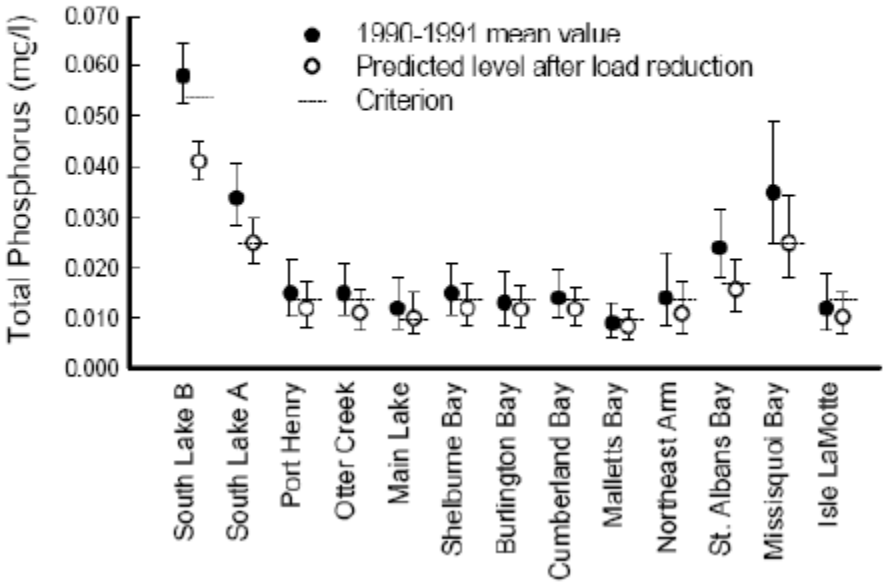
In the case of the St. Albans Bay segment, not only does this basis for the MOS not apply, but the ratio of particulate to dissolved phosphorus actually shifts substantially in the opposite direction. The 1991 ratio of 9:1 particulate to dissolved would shift to approximately 2:1 particulate to dissolved when TMDL allocations are achieved, because the TMDL specifies increased WWTP loads and decreased nonpoint source loads relative to 1991 loads.

Table 1 also indicates no MOS for certain segments shared between Vermont and New York, but this is the case only if one calculates the ratios based solely on the Vermont inputs. Once loadings from both states are factored into the calculations, these segments (Port Henry and the Main Lake) do have an MOS based on this conservative assumption. The calculation for the Port Henry segment is complicated by the fact that the New York TMDL treats Port Henry and Otter Creek as one segment and assigns one overall loading allocation to this larger segment. Therefore, the only way to accurately assess whether an MOS is provided for Port Henry and Otter Creek, taking into account New York inputs, is to combine the two segments. Table 1 demonstrates that a substantial MOS is indeed available when both New York and Vermont loadings are taken into account for this combined segment.

In conclusion, while the first conservative assumption provides an MOS on a lake-wide basis (if all loads throughout the basin are considered in aggregate), a segment by segment analysis reveals that it does not provide an MOS for four of the nine segments addressed by the Vermont portion of the TMDL. The segment-specific analysis is particularly important because some segments such as St. Albans Bay and Missisquoi Bay, while connected to the rest of the lake, are influenced much more by local phosphorus loads (inputs directly to each segment) than by phosphorus exchanges from other parts of the lake.

The second conservative assumption stems from the fact that the lake model was programmed to ensure that there be at least a 50% probability that mean phosphorus criteria in all lake segments would be met. As described in the TMDL document, for 6 of the 9 Vermont TMDL segments, the average phosphorus levels following TMDL implementation are predicted to be somewhat below criteria, providing an MOS for these segments. However, there are two concerns with this basis for an MOS. First, there are three segments, South Lake A, Main Lake, and Missisquoi Bay, that the TMDL acknowledges are not afforded an MOS on this basis. Second, Figure 4 of the TMDL document (reproduced below as Figure 1) makes it clear that even in cases where the mean predicted value is below criteria, the 95% confidence interval extends well above the criteria in all cases other than South Lake B. This means that the only segment where the model predicts at least a 95% probability of meeting criteria is South Lake B. For South Lake B, there

Figure 1. Predicted Phosphorus Concentrations Following Load Reductions (Reproduced from the Lake Champlain Phosphorus TMDL, p. 17)



Predicted phosphorus concentrations in Lake Champlain segments following targeted load reductions, compared with 1991 measured mean levels and in-lake criteria values (from Table 2). Error bars show 95% confidence intervals for the existing mean and predicted phosphorus concentrations. The predicted concentrations and criteria values are listed below. (Figure modified from Vermont DEC and New York State DEC 1997.)

Lake Segment	Predicted Phosphorus Conc. (mg/l)	Criterion (mg/l)
South Lake B	0.040	0.054
South Lake A	0.025	0.025
Port Henry	0.012	0.014
Otter Creek	0.011	0.014
Main Lake	0.010	0.010
Shelburne Bay	0.012	0.014
Burlington Bay	0.012	0.014
Cumberland Bay	0.012	0.014
Malletts Bay	0.008	0.010
Northeast Arm	0.011	0.014
St. Albans Bay	0.015	0.017
Missisquoi Bay	0.025	0.025
Isle LaMotte	0.010	0.014

is a substantial margin between the upper 95% confidence interval (about 46 mg/l) and the South Lake B criterion (54 mg/l), and this margin could reasonably be considered an MOS for this segment. But for all the other segments, where the model predicts there is significantly less than a 95% chance of meeting criteria, the Region believes it is not justifiable to ascribe an MOS on this basis. In summary, based on this re-evaluation, the Region concludes that this conservative assumption not only provides no MOS to the three segments acknowledged in the TMDL document (South Lake A, Main Lake, and Missisquoi Bay) but it also provides no MOS to 5 of the 6 remaining segments. This assumption only provides an MOS for South Lake B.

Based on this re-evaluation, it is clear that while each of the two conservative assumptions described in the TMDL document provides some level of MOS for certain segments, neither component provides an MOS for all segments. The Region concludes that neither of the conservative assumptions relied upon in the 2002 TMDL provides an implicit MOS for four of the nine segments included in the TMDL (South Lake A, Missisquoi Bay, St. Albans Bay, and the Northeast Arm), and that only one segment, South Lake B, is provided an implicit MOS based on both the assumptions cited in the TMDL document. Therefore, the Region concludes upon reconsideration that the level of MOS provided is insufficient and inconsistent with EPA regulations.

2. Stringency of Wasteload Allocations and Reasonable Assurance

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to one of its existing or future point sources (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). According to 40 C.F.R. §130.2(i), "[i]f best management practices or other nonpoint source pollution controls make more stringent load allocations practicable, then wasteload allocations can be made less stringent." EPA's TMDL guidance further explains that when a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, the TMDL must provide "reasonable assurances" that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable (*USEPA, 1991; see also Perciasepe, 1997*). This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

The 2001 draft Lake Champlain TMDL identified several WLA/LA options involving varying degrees of stringency for the sixty Vermont wastewater treatment facilities in the Lake Champlain Basin, and requested public comment on which WLA/LA scenario was preferred. Ultimately the final TMDL included one of the less stringent WLA (treatment plant) scenarios and relied on greater nonpoint source reductions to make up the difference. Most of the WLAs for treatment plants in the final TMDL were based on the plants' design flows with effluent concentrations of 0.6 mg/l or 0.8 mg/l of phosphorus (depending on the type of facility), well above levels that would otherwise be required in the absence of nonpoint source load reductions, and also well above what was technologically feasible at the time.[4] Nineteen of the smallest

[4] Six facilities were held to their then-existing permitted loads, which were less than the annual load at a concentration of 0.6 mg/l.

facilities were given WLAs based on a much less stringent effluent concentration of 5.0 mg/l. Thus, in order to be consistent with the TMDL regulations, there must be sufficient reasonable assurance that the necessary LAs will be achieved in order to justify the less stringent WLAs for the wastewater treatment facilities.

The final TMDL (page 46) presents a number of factors intended to provide reasonable assurance that the nonpoint source controls would occur. These include:

1) A Lake Champlain Basin Program report found that implementation efforts by state and federal agencies generally met or exceeded the first five-year phosphorus reduction targets established by the Lake Champlain Management Conference. However, the TMDL document acknowledges that relying solely on existing reduction programs would not be sufficient to achieve the full 20-year reduction targets (including the TMDL load allocations).

2) A variety of new nonpoint source programs described in the Vermont implementation plan section of the TMDL are referenced, including Vermont's new (at the time) 2002 stormwater control program, the Watershed Improvement Permits, and the new (at the time) river management program.

3) The 2002 Farm Bill, which was expected to provide triple the annual funding through 2007 for conservation cost-share programs serving Vermont's farming community.

4) Vermont's 1999 "Upgrade for Enhanced Nonpoint Source Management Program" provides new five and fifteen-year phosphorus load reduction targets for Lake Champlain consistent with the TMDL.

5) The full suite of programs and approaches identified in the Vermont implementation plan (within the TMDL document) demonstrate the magnitude of commitment toward achieving the nonpoint source reductions.

EPA analysis of the Reasonable Assurance provision:

As was the case with the MOS section, during its review of the March 2002 draft TMDL, the Region was concerned that it did not contain enough reasonable assurance and requested that Vermont strengthen this section in the final version of the TMDL. The final version included additional components in the reasonable assurances section, including some suggested by the Region. While, at the time, the Region considered the expanded reasonable assurance section to be sufficient, upon closer examination the Region has determined that this element of the TMDL is inadequate for reasons discussed below.

In its re-evaluation of the reasonable assurance provision, the Region sought to determine whether the information in the TMDL document is sufficient to answer two questions: 1) Is there reasonable assurance that nonpoint source control actions will occur, and 2) If these actions occur, is there reasonable assurance that they would achieve enough phosphorus reduction to meet the load allocations specified in the TMDL.

The first component of reasonable assurance described in the final TMDL – that the first five-year reduction targets (established by the Lake Champlain Management Conference in 1996) were met or exceeded on schedule – does not provide assurance that the additional needed reductions would also be achieved. In addition, the only verified phosphorus reductions achieved during those five years resulted from wastewater treatment plant upgrades (driven by

permit requirements). The nonpoint source reductions assumed to have occurred during that period were based on unverified estimates of how much phosphorus may have been controlled as a result of implementing agricultural best management practices. Indeed, the Lake Champlain Basin Program report referenced in the TMDL acknowledges several potential sources of error associated with the estimates (*Lake Champlain Basin Program, 2000*). This element of the reasonable assurance section demonstrates that significant point source reductions occurred, but provides no confirmation of the amount of nonpoint source reductions achieved during the five-year period. More importantly, no assurance is provided that future agricultural reductions and other nonpoint source reductions would be achieved or that if anticipated future reductions did occur, such reductions would be sufficient to meet the TMDL load allocations.

The second component relies on several new DEC programs expected to address stormwater sources (i.e., nonpoint sources as well as non-NPDES regulated point sources). The Watershed Improvement Program established a new state permit program to achieve stormwater, sediment, and phosphorus reductions in 14 small sub-watersheds impaired by stormwater. While permits issued under this program were later overturned by the Vermont Water Resources Board, at the time of TMDL approval the program arguably provided reasonable assurance that some existing stormwater sources of phosphorus within affected watersheds would be controlled. The weakness of this element is that the 14 watersheds affected are very small, and the anticipated actions required by the permits were estimated to reduce a total of only 0.3 mt/yr of phosphorus (see page 61 of the TMDL document) – less than one percent of the 80.5 mt/yr reduction required to achieve the load allocations.

Another new program cited is Vermont's 2002 state stormwater permitting program. In 2002, Vermont substantially revised its stormwater permitting program to include improved standards for large new development projects (generally those generating over an acre of impervious surface). However, this program only applies to new sources of phosphorus associated with stormwater discharges from new development or redevelopment projects. It does nothing to address the existing stormwater loads targeted by the TMDL, nor does it even fully address the new sources. The implementation plan that accompanied the TMDL suggests that the 80% total suspended solids ("TSS") reduction standard specified in the Vermont Stormwater Manual would likely result in a comparable level of phosphorus control. However, most research available in 2002 suggested that this level of phosphorus reduction should be considered overly optimistic for the practices (such as wet ponds) commonly used to meet the standards in the 2002 Vermont Stormwater Manual. A more realistic reduction estimate based on performance data available at the time would have been in the 40% to 60% range (*Winer, 2000; Schueler, 1987*). But even if the 80% effectiveness level is assumed, this means that new development in compliance with the 2002 Manual would still be expected to generate new phosphorus loads, as would smaller new developments not subject to the program.

The second component also relies on Vermont's river management program. As described in the implementation plan, this innovative program focuses on increasing stream stability and includes assessment, protection, management, and restoration phases. The intent is to reduce streambank and channel erosion associated with stream instability, and thus reduce phosphorus inputs to the lake. However, each phase of this program, from assessment to restoration, is dependent upon adequate funding, and the protection and restoration steps are further dependent on willing land

owners and other partners to volunteer to participate in a project. So while this program, like many others referenced in the TMDL, was certainly poised to be able to contribute to phosphorus reductions, no assurance was provided that projects would actually go forward, or that projects would occur in sufficient numbers to adequately address the magnitude of the need.

The third component is the 2002 Farm Bill, which authorized a large increase in funding at the national level for agricultural best management practices ("BMP") cost share programs, and authorized these funding levels through 2007. But these funds are provided to projects only if 1) the U.S. Department of Agriculture's ("USDA") Vermont office successfully applies for the funds to the national USDA office, and 2) agricultural producers choose to apply, meet certain application criteria, and provide the matching funds required. There is further uncertainty regarding which BMPs would be funded, whether projects would address watersheds and farms that contribute significant phosphorus loads to the lake, and how much phosphorus reduction could be expected. The Farm Bill also only provided the funds for the first five years, whereas the TMDL implementation plan indicates such funding would be needed for at least 15 years. While it is true that the passage of the 2002 Farm Bill made it more likely that more BMP cost-share projects would be implemented than had been previously, the TMDL provides no assurance that this would happen, and no estimate of how much phosphorus would be controlled through this program.

The fourth element, Vermont's 1999 "Upgrade for Enhanced Nonpoint Source Management Program," was an amendment to a state-wide nonpoint source management plan. While it is commendable that the goals of this plan are consistent with the TMDL goals, the document makes no binding commitment to actions – it is a plan and nothing more.

Finally, the implementation plan that accompanies the TMDL contains descriptions of additional programs and a variety of recommended actions. Beyond the programs discussed above, the plan includes many recommendations for local government entities, and funding recommendations for programs ranging from wetlands protection to better roads management to forest management. The strength of this plan is that it provides a detailed discussion of a wide range of actions needed to help implement the TMDL. Its weakness (in the reasonable assurance context) is that nearly all of the recommendations are just that – recommendations. Nearly all elements of the plan depend on both additional funding and entities' willingness to participate or cooperate voluntarily with the intent of the program, whether it be the better backroads program or the development of local ordinances to establish riparian buffers and related measures. In short, the plan provides very little, if any, assurance that the recommended actions will occur, and provides no indication of the magnitude of phosphorus reductions expected from these actions.

In conclusion, the Region finds that the TMDL document identified only one program, the Watershed Improvement Permit program, which provides reasonable assurance that specified nonpoint source control measures would occur and would result in specific phosphorus reductions compared to baseline loads. However, as discussed above, the magnitude of reductions expected from this program was less than one percent of the reductions needed to meet the load allocations. Beyond this, the Region is unable to identify any programs or activities in existence at the time of the TMDL submittal that provide assurance that nonpoint

source reductions would occur, and that anticipated reductions would be sufficient to meet TMDL load allocations. The Region concludes upon reconsideration that the TMDL's level of assurance that necessary load reductions would occur is insufficient to support establishment of less stringent wasteload allocations for the wastewater treatment plants than would otherwise be required.

3. Wasteload Allocations for Stormwater

As noted above, a wasteload allocation is the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollutants (40 C.F.R. § 130.2(h)). EPA guidance clarifies that all point source discharges subject to the requirements of NPDES permits must be included in the wasteload allocation portion of the TMDL.[5] (*Wayland and Hanlon, 2002*). This includes stormwater discharges from certain municipal separate storm sewer systems (MS4), stormwater discharges associated with certain industrial activities, and stormwater discharges associated with construction site development, among others. EPA guidance further states that NPDES-regulated stormwater discharges may either be expressed as individual wasteload allocations (for each source or outfall, for example) or as a single categorical allocation for all NPDES-regulated stormwater discharges when data are insufficient to assign each source an individual wasteload allocation. (*Wayland and Hanlon, 2002*). The guidance also explains that stormwater discharges from sources not currently subject to NPDES regulations may also be included in the wasteload allocation portion of a TMDL (*Wayland and Hanlon, 2002*). While the final version of this guidance memorandum was published on November 22, 2002, just after the November 4, 2002 TMDL approval, the guidance was available in draft form and utilized by the Region's staff well before TMDL approval.

The Vermont Lake Champlain TMDL used a single categorical wasteload allocation for all NPDES-regulated stormwater discharges within each lake segment watershed, based on available estimates of phosphorus runoff from developed land portions of the basin. This aggregate wasteload allocation also included some stormwater (point source and nonpoint source) discharges not subject to any NPDES regulations.

EPA analysis of the Stormwater Wasteload Allocation provision:

The Region considered two main questions in its review of this portion of the TMDL: 1) Are stormwater discharges correctly placed in the wasteload allocation part of the TMDL equation, and 2) Are the wasteload allocations for stormwater discharges sufficiently specific.

As noted above, in the case of the Vermont Lake Champlain TMDL, all stormwater discharges subject to NPDES permits are included in a "developed land" category of the wasteload allocation. This is consistent with the EPA guidance and regulations described above. Regarding the specificity of the allocations, the developed land category is an aggregate WLA which lumps together all stormwater discharges subject to NPDES permits, along with some

[5] Point source discharges that are not regulated by the NPDES program may be included in either the WLA or the LA portion of the TMDL.

nonpoint source and non-NPDES regulated point source stormwater discharges. The TMDL document explains that the discharges were combined this way because insufficient information existed to accurately separate out and quantify stormwater discharges from NPDES regulated point sources.

While EPA guidance encourages states to establish wasteload allocations as specifically as possible, the guidance clearly supports the type of aggregate allocation used in the Lake Champlain TMDL when available data preclude further specificity. At the time of TMDL approval, Vermont's MS4 systems had not yet been mapped, the stormwater discharges associated with the multi-sector and construction permits had not been quantified, and the MS4 and multi-sector permits themselves had not yet been issued. The available estimates of phosphorus discharges from developed land were crude estimates of discharges from each municipality based on basin-wide land use data (*Millette, 2001*). These estimates did not break out contributions from the various permitted source categories, nor did they break out contributions from the regulated and non-regulated (including point and nonpoint source) stormwater discharges. While estimates of phosphorus loading from a few specific sources (e.g., large commercial parking lots) within some municipalities were available (*Pease, 1997*), these estimates did not address NPDES-regulated discharges and did not provide a means to estimate loads from either individual or aggregate NPDES-regulated discharges. Based on a review of information available at the time of TMDL approval, the Region concludes that the level of specificity of the wasteload allocations was as refined as could reasonably be expected with available data. Therefore, upon reconsideration, the Region concludes that stormwater discharges addressed by the Vermont Lake Champlain TMDL are expressed in a manner consistent with EPA regulations and available guidance.

4. Loading Capacity, Hydrologic Base Year, and Climate Change Considerations

EPA regulations define loading capacity as the greatest amount of a pollutant that a waterbody can receive without violating water quality standards (40 C.F.R. §130.2(f)). A TMDL must identify the loading capacity of a waterbody for the applicable pollutant and should describe the rationale for the method (typically a water quality model) used to establish the relationship between the numeric pollutant target and the identified pollutant sources. Supporting documentation for the TMDL analysis should also be contained in the submittal, including the basis for assumptions, and strengths and weaknesses in the analytical process (*USEPA, 2002; USEPA, 1999a*).

The loading capacity for the Lake Champlain TMDL was calculated using a water quality model (the BATHTUB program) and monitoring data collected between 1990 and 1992. The model used an annual steady-state approach with spatial segmentation that accounted for the movement of water and phosphorus between 13 lake segments. The model was used to predict the load reductions required to attain the in-lake phosphorus criteria in each lake segment.

In order to represent long-term average conditions, a hydrologic base year was selected from within the 1990 to 1992 monitoring period. Tributary flows measured during this period were compared with the distribution of long-term annual mean values. It was found that mean flows from the full March 1990 to February 1992 monitoring period were consistently higher than the

long-term mean flows. This was the result of what were considered unusually high flows (compared to the long term record) in 1990. The mean flows corresponding to calendar year 1991, however, were similar to the long-term annual flows. Calendar year 1991 was therefore selected as a hydrologic base year, and used in the modeling process to establish the loading capacity and baseline loading conditions (*VTDEC and NYSDEC, 1997*). Subsequently, the loading capacity and baseline loading conditions were used to establish load and wasteload allocations and phosphorus reductions needed to achieve the allocations. The potential effects of climate change were not considered in this process.

EPA analysis of the loading capacity, hydrologic base year, and climate change considerations:

The Region's reconsideration of the loading capacity and the choice of the hydrologic base year focused on CLF's assertion in its complaint that the selection of the 1991 hydrologic base year improperly failed to consider the effects of "then-occurring and predicted" climate change on the loading capacity and other elements of the TMDL.

EPA's regulations and guidance provide little detail on the establishment of the loading capacity beyond suggesting that water quality models or other analytical tools be used, and that the assumptions and strengths and weaknesses should be documented. The selection of a hydrologic base year is not discussed in either the regulations or TMDL guidance documents. Climate change considerations are also not addressed by the regulations or guidance available at the time of TMDL approval. Given the lack of specificity on these topics in regulations and guidance, the Region's reconsideration focused on whether these aspects of the Lake Champlain TMDL were scientifically sound and adequately documented as directed by EPA regulations and guidance available at the time of TMDL approval.

Upon reconsideration, the Region continues to believe the procedure used to select the 1991 hydrologic base year was scientifically sound. The procedure was largely based on the approach used for phosphorus management purposes in the Great Lakes (*Thomas et al., 1980*). Given that tributary flows and loadings were known to vary from year to year as a result of natural variability (especially variability in precipitation), the selection of a hydrologic base year comparable to the long-term historical average was a reasonable way to establish baseline flows for use in calculating the loading capacity and establishing a baseline loading scenario. Essentially, the 1991 base year was selected because it represented a typical hydrologic year as of the time the lake modeling work was conducted.

Flow monitoring data collected after 1991 and prior to TMDL approval in late 2002 revealed flows higher than 1991 flows for much of the decade, but no consistent trend was apparent. Total flows into the lake generally increased between 1991 and 1997/1998, and then decreased between 1997/1998 and 2001/2002 to the extent that the 2001-2002 flows were actually slightly lower than the 1991 flows. Given this fluctuation, and the relatively short period of monitoring in comparison to the long-term trends,[6] it was reasonable in 2002 to conclude that the 1991 base

[6] EPA understands long-term trends in this case to refer to a period of at least 60 years, based on the longevity of USGS gages on major tributaries to Lake Champlain, as documented on the USGS website: http://nh.water.usgs.gov/WaterData/station_map.htm

year adequately represented typical flow scenarios. Climate change reports available in 2002, such as those referenced in the CLF complaint (*National Research Council, 2001*), included only very general conclusions about possible changes to precipitation and temperature patterns and provided no region-specific projections that could be relied upon in a TMDL. More geographically specific projections, such as those compiled by the Union of Concerned Scientists, were not available until several years after the TMDL approval (*Union of Concerned Scientists, 2006*).

The calculation of the loading capacity using a modified version of the BATHTUB program and the selected hydrologic base year was scientifically rigorous and consistent with EPA requirements. The lake model was developed and modified for the Lake Champlain application by William Walker, a nationally recognized water quality modeling expert who created the original BATHTUB program for the U.S. Army Corps of Engineers. The modeling process was guided by Dr. Walker together with experienced lake scientists from VTDEC and NYSDEC, with input from additional technical advisors. A paper describing the modeling process and results was published in a peer reviewed journal (*Smeltzer and Quinn, 1996*). A final report included a detailed description of the model development and calibration, and included assumptions and strengths and weaknesses of the chosen approach (*VTDEC and NYSDEC, 1997*). EPA's *Protocol for Developing Nutrient TMDLs* (*USEPA, 1999b*) listed the BATHTUB program among the simulation models recommended for lake nutrient TMDLs, and noted that a review by Ernst et al. (*1994*) cited BATHTUB as an effective tool for lake water quality assessment and management. Upon reconsideration, the Region still considers the modeling approach consistent with TMDL requirements.

EPA believes that the hydrologic record at the time of approval did not support the need for any adjustments to the hydrologic base year. Regarding future climate change, as noted above region-specific temperature and precipitation projection scenarios were not available in 2002. Sufficiently precise or reliable climate change projections did not exist at the time of TMDL approval to support adjustments to the loading capacity or other elements of the TMDL. Likewise, climate change information available at the time related to water temperatures and lake levels was not sufficiently well developed to use in the development of the loading capacity.[7]

In summary, the Region concludes that the calculation of the loading capacity using a modified version of the BATHTUB program and data from the 1991 base year was reasonable and consistent with EPA TMDL guidance and regulations applicable at the time of the Region's approval. The Region further concludes that the absence of specific climate change considerations in the development of the loading capacity and related TMDL components was

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[7] Although the Region focused its consideration of climate change on the loading capacity and allocations, the Region also considered the concerns identified in the CLF complaint regarding the potential effect of climate change on critical conditions and seasonal variation. However, because the lake phosphorus criteria are expressed as annual mean values and the lake is not sensitive to short-term or seasonal loading variations (including potential shifts in precipitation and loading amounts from one season to another), the Region reaffirms the conclusions of the 2002 TMDL approval document with respect to critical conditions and seasonal variation.

scientifically sound at the time of TMDL development and approval due to the high level of uncertainty associated with the regional impacts of climate change at the time.

E. Conclusion

Upon reconsideration of the four contested elements of the 2002 Vermont Lake Champlain Phosphorus TMDL, the Region concludes that two of the elements are consistent with EPA regulations and guidance available at the time of TMDL approval, and two elements are not. The aggregate expression of the stormwater component of the wasteload allocation is consistent with EPA's regulations and 2002 guidance on this topic. The calculation of the loading capacity and phosphorus allocations using the 1991 hydrologic base year is also consistent with EPA guidance and regulations, and based on sound science. However, the portions of the TMDL addressing the margin of safety and the establishment of wasteload allocations based on assumptions that nonpoint source reductions would be achieved are inadequate and inconsistent with EPA regulations and guidance.

Accordingly, the Region is hereby withdrawing its November 4, 2002 approval of the Vermont portion of the Lake Champlain Phosphorus TMDL. Further, the Region is hereby disapproving the Vermont portion of the TMDL.

Pursuant to Section 303(d)(2) of the Act and 40 C.F.R. § 130.7(d)(2), upon disapproval of a TMDL, EPA must establish a new TMDL as determined to be necessary to implement applicable water quality standards. Accordingly, the Region intends to commence development of a new phosphorus TMDL for the impaired Vermont segments in Lake Champlain. We hope to work collaboratively with the State in this effort. The Region will issue a public notice of the completion of the new TMDL and will seek public comment. After considering public comments and making any appropriate revisions in response to such comments, the Region will transmit the TMDL to the State.

While the Region's reconsideration focused on the TMDL and administrative record as it existed in 2002, the new TMDL will be based on an evaluation of all available current information as well as any applicable updated EPA guidance. Accordingly, the Region anticipates there may be refinements of several aspects of the new TMDL, not just the two components that the reconsideration determined were inadequate (i.e., margin of safety and reasonable assurance).

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