HISTORY OF VERMONT'S LAKE CHAMPLAIN PHOSPHORUS REDUCTION EFFORTS

Eric Smeltzer[1]

INTRODUCTION

Vermont's first efforts to confront the problem of excessive eutrophication in Lake Champlain began during the 1960s in St. Albans Bay. Algal blooms and growth of aquatic plants in the bay prompted the formation of the St. Albans Bay Association, which sponsored treatments of the bay with the algicide copper sulfate. The benefits of these treatments were temporary at best and algal blooms continued to plague the bay.[2]

Paleolimnological research[3] has since shown that eutrophication in St. Albans Bay accelerated during the early part of the 20th century, coincident with the construction of sewer lines serving the growing urban population and industrial users in the bay's watershed. Analysis of sediment cores

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1. Eric Smeltzer received a Master's degree in ecology with a specialization in limnology from the University of Minnesota and an undergraduate degree in biology from Bates College. He worked at the Vermont Department of Environmental Conservation for thirty-five years as an Environmental Scientist before retiring in 2015. Most of his work focused on Lake Champlain, including the development of water quality standards for the lake, the design and oversight of the Lake Champlain Long-Term Monitoring Program, and the execution of scientific and management studies of the lake. He led the development of the 2002 Lake Champlain Phosphorus TMDL and worked closely with the EPA on the modeling for the 2016 TMDL. He lives in Waterbury Center, Vermont and can be reached at smeltzerde@gmail.com.

2. Author's personal knowledge; *see also Blue-Green Algae in Lake Champlain*, LAKE CHAMPLAIN COMM., https://www.lakechamplaincommittee.org/lcc-at-work/algae-in-lake/ [https://perma.cc/XK9D-5Y8K] (last visited Apr. 2, 2016) (highlighting that blooms still persist on Lake Champlain).

3. Suzanne N. Levine et al., *The Eutrophication of Lake Champlain's Northeastern Arm: Insights from Paleolimnological Analyses*, J. GREAT LAKES RES. 25, 38 (2012).

indicated that severe algal blooms in Missisquoi Bay did not appear until much later, beginning in the 1970s with the intensification of regional agriculture.[4]

I. EARLY PLANNING AND LEGISLATIVE EFFORTS

Vermont began to address these problems in Lake Champlain as an international scientific and policy debate unfolded about the causes of lake eutrophication and the appropriate management responses.[5] A scientific consensus emerged during the 1970s that phosphorus was the key nutrient limiting algal growth in freshwater. Attention turned to detergents and wastewater as major controllable sources of phosphorus in the Great Lakes.[6]

Lake Champlain was the subject of a series of studies during the 1970s that produced the first estimates of phosphorus loading to the lake from its tributaries and various source categories.[7] These studies estimated the total load of phosphorus to the lake at the time was 637 metric tons per year ("mt/yr"), of which wastewater discharges contributed 307 mt/yr (48%).[8]

Vermont responded quickly to the growing scientific understanding of the phosphorus issue. Legislation passed in 1977 prohibited the sale of household laundry detergents containing phosphorus above trace amounts and required phosphorus removal to a 1.0 milligram per liter ("mg/L") concentration or less in wastewater effluent from designated facilities in the Lake Champlain Basin.[9]

The New England River Basins Commission produced a comprehensive Lake Champlain Basin Study in 1979 that recommended a number of actions designed to hold constant or reduce phosphorus inputs to the lake until 1990.[10] The recommended actions included: a continuation of phosphorus detergent bans in Vermont, New York, and Quebec; the

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4. *Id.*

5. JOHN R. VALLENTYNE, THE ALGAL BOWL: LAKES AND MAN 5 (J.C. Stevenson et al. eds., 1974).

6. INT'L JOINT COMM., POLLUTION OF LAKE ERIE LAKE ONTARIO AND THE INTERNATIONAL SECTION OF THE ST. LAWRENCE RIVER 7, 23 (1970), http://ijc.org/files/publications/ID364.pdf [https://perma.cc/R6LU-DQXK].

7. ENVTL. PROT. AGENCY, LAKE CHAMPLAIN NEW YORK AND VERMONT: EPA REGIONS I AND II 5-6 (1974); E.B. HENSON & GERHARD K. GRUENDLING, THE TROPHIC STATUS AND PHOSPHORUS LOADINGS OF LAKE CHAMPLAIN IV–V (1977); KENNETH BODGAN, LAKE CHAMPLAIN BASIN STUDY, ESTIMATES OF THE ANNUAL LOADING OF TOTAL PHOSPHOROUS TO LAKE CHAMPLAIN 2–21 (1978).

8. BOGDAN, *supra* note 7.

9. VT. STAT. ANN. tit. 10, §§ 1266a, 1382(a) (2012).

10. LAKE CHAMPLAIN BASIN STUDY, SHAPING THE FUTURE OF LAKE CHAMPLAIN: THE FINAL REPORT OF THE LAKE CHAMPLAIN BASIN STUDY 83 (1979).

construction of phosphorus removal facilities at a number of Vermont municipal wastewater treatment plants; and increased efforts to curtail nonpoint sources of phosphorus loading, particularly from agricultural sources.[11]

Vermont implemented many of the recommendations from the Lake Champlain Basin Study during the 1980s. Phosphorus detergent bans remained in effect in all three jurisdictions and the Vermont law was estimated to have reduced the amount of phosphorus discharged from municipal wastewater treatment plants by forty percent.[12] Of the sixteen wastewater treatment plants in the Lake Champlain Basin initially designated for phosphorus removal under the 1977 statute, twelve such facility upgrades were operational by 1990.[13] Vermont expanded the statutory wastewater treatment requirements in 1992 by lowering the maximum effluent phosphorus concentration limit to 0.8 mg/L at 29 of the largest facilities in the Lake Champlain Basin.[14] The State and the U.S. Department of Agriculture implemented best management practices during the 1980s throughout the Shelburne Bay and St. Albans Bay watersheds under programs that included ten years of intensive water quality monitoring to document the benefits of the practices. Significant reductions in agricultural phosphorus loading did not occur in either watershed. This is possibly due to insufficient numbers, types of conservation practices implemented, or long time lags in response to treatment.[15]

When Vermont proposed a new fish hatchery for Kingsland Bay State Park in 1983, the controversial project exposed several weaknesses in Vermont's phosphorus management policies for Lake Champlain.[16] The discharge from the hatchery would contain significant amounts of phosphorus from uneaten fish food and feces. However, no water quality

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11. *Id.* at 87.

12. VT. DEP'T OF WATER RES. & ENVTL. ENG'G WATER QUALITY DIV., SPECIAL REPORT TO THE VERMONT GENERAL ASSEMBLY ON THE EFFECTIVENESS OF THE PHOSPHORUS DETERGENT PROHIBITION IN HOUSEHOLD CLEANSING PRODUCTS AND COMPLIANCE WITH A 1.0 MILLIGRAM PER LITER DISCHARGE LIMITATION 16 (1981), https://anrweb.vt.gov/PubDocs/DEC/WSMD//lakes/docs/lp_phosphorusdetergentbanreport.pdf [https://perma.cc/2DAE-7XLL]; LAKE CHAMPLAIN BASIN PROGRAM & MISSISQUOI BAY PHOSPHORUS REDUCTION TASK FORCE, A DIVISION OF RESPONSIBILITY BETWEEN QUÉBEC AND VERMONT FOR THE REDUCTION OF PHOSPHORUS LOADS TO MISSISQUOI BAY 10 (2000) [hereinafter QUÉBEC & VERMONT FOR THE REDUCTION OF PHOSPHORUS LOADS].

13. VT. AGENCY OF NAT. RES., PHOSPHORUS REDUCTION PLAN (1990), http://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/ANR1990_PhosphorusReductionPlan.pdf [https://perma.cc/G2KK-UGNY].

14. *Id.*; VT. STAT. ANN. tit. 10, § 1266a.

15. *Hatchery Plan on Lakes Stirs a Vermont Dispute*, N.Y. TIMES (Nov. 2, 1986), http://www.nytimes.com/1986/11/02/us/hatchery-plan-on-lake-stirs-a-vermont-dispute.html [https://perma.cc/569U-TMTG].

16. *Id.*

standards were in place that defined maximum acceptable concentrations of phosphorus in the lake region that would be affected by the hatchery discharge. There was no cap on the lake's total loading capacity for phosphorus that could be used to evaluate and control the cumulative impacts from individual small phosphorus sources, such as the proposed fish hatchery. Lacking clear policy guidance regarding the regulation of new phosphorus sources, the Vermont Department of Environmental Conservation relied on ad hoc modeling and other case-specific considerations in developing a discharge permit for the facility.[17] The Weed Fish Culture Station was eventually built in Grand Isle, Vermont where the lake's assimilative capacity was greater, and the facility was permitted with tight phosphorus limits, but the need for a more comprehensive phosphorus management framework for Lake Champlain was apparent.[18]

II. DEVELOPMENT OF A COMPREHENSIVE PHOSPHORUS MANAGEMENT FRAMEWORK

The signing of the Vermont, New York, and Quebec Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain in 1988 and the creation of the Lake Champlain Management Conference in 1990 provided the vehicle to develop a comprehensive phosphorus management framework for the lake.[19] This framework included: (1) adoption of in-lake phosphorus criteria to serve as the ultimate management targets; (2) completion of a phosphorus source assessment and budget for the lake; (3) development of a lake phosphorus mass balance model linking loads to in-lake concentrations; (4) determination of the total loading capacity for each segment of the lake; and (5) allocation of the maximum phosphorus loads to the various sources.[20]

In 1991, Vermont adopted in-lake total phosphorus concentration criteria for twelve segments of Lake Champlain that still remain in effect in the Vermont Water Quality Standards.[21] These criteria were generally lower

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17. Author's personal knowledge.

18. *Ed Weed Fish Culture Station*, VT. FISH & WILDLIFE, http://www.vtfishandwildlife.com/fish/fish_stocking/vist_a_hatchery/ed_weed_fish_culture_station/ [https://perma.cc/6HLW-XAWR] (last visited Apr. 4, 2016).

19. ERIC Smeltzer, *Phosphorus Management in Lake Champlain*, *in* LAKE CHAMPLAIN IN TRANSITION: FROM RESEARCH TOWARD RESTORATION 435–51 (Tom Manley et al. eds., 1999) https://anrweb.vt.gov/PubDocs/DEC/WSMD/lakes/docs/lp_phosmanage99.pdf [https://perma.cc/S99J-WG53].

20. *Id.*

21. VT. AGENCY OF NAT. RESOURCES, VERMONT WATER QUALITY STANDARDS ENVIRONMENTAL PROTECTION RULE CHAPTER 29(a) 5 (2014),

than the existing phosphorus levels in the lake and significant phosphorus reductions were therefore mandated. The Lake Champlain Steering Committee appointed a Lake Champlain Phosphorus Management Task Force. The task force reviewed and endorsed the Vermont phosphorus criteria with minor modifications and New York, Quebec, and Vermont formally accepted the criteria in a 1993 Water Quality Agreement as joint management goals for the lake.[22]

In order to obtain the data needed to support a comprehensive phosphorus management framework for Lake Champlain, Vermont and New York initiated a phosphorus budget and modeling study in 1990 with funding and technical support from the U.S. Environmental Protection Agency ("EPA") and the U.S. Geological Survey.[23] The study measured phosphorus loads to the lake from all major sources during a two-year period, including thirty-one tributaries, eighty-eight wastewater discharges, and direct precipitation to the lake's surface.[24] The study recorded phosphorus concentrations at fifty-two locations within the lake.[25] The data supported the development of a mass balance model that simulated the effects of phosphorus loads on the concentration of phosphorus in each segment of Lake Champlain. The states then used the model with a minimum-cost optimization procedure to define preliminary phosphorus loading targets for each state and each lake segment in a manner predicted to achieve the in-lake phosphorus concentration criteria.[26]

The Lake Champlain Management Conference incorporated these preliminary phosphorus loading targets into early drafts of its comprehensive plan for Lake Champlain.[27] However, a change of political administration in New York in 1995 caused the state to reconsider its commitment to these targets. A central issue was whether New York would adopt a wastewater phosphorus removal policy equivalent to Vermont's statutory 0.8 mg/L concentration limit as a required component of achieving the loading targets.[28] A dispute emerged between the two states

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http://dec.vermont.gov/sites/dec/files/documents/WSMD_WaterQualityStandards_2014.pdf [https://perma.cc/BPX7-DES9].

22. LAKE CHAMPLAIN PHOSPHORUS MGMT. TASK FORCE, REPORT OF LAKE CHAMPLAIN PHOSPHOROUS MANAGEMENT TASK FORCE (1993), https://anrweb.vt.gov/PubDocs/DEC/WSMD/lakes/docs/lp_phostaskforce93.pdf [https://perma.cc/E6GQ-2GRE].

23. Eric Smeltzer & Scott Quinn, *A Phosphorus Budget, Model, and Load Reduction Strategy for Lake Champlain*, 12 J. LAKE & RESERVOIR MGMT. 381, 381 (1996); SMELTZER & QUINN, *supra* note 20.

24. *Id.* at 382.

25. *Id.* at 383.

26. *Id.* at 392.

27. *Id.*

28. *Id.*

with newspaper headlines such as "N.Y. balks at limits on phosphorus"[29] and "Dispute threatens lake cleanup plan," [30] highlighting the issue publically. Without a phosphorus reduction agreement between Vermont and New York as the centerpiece of the Management Conference plan, the entire effort was at risk of failure.

EPA, charged with the responsibility for approving the Management Conference plan under the Lake Champlain Special Designation Act, stepped in at this point and mediated negotiations between the two states to reach a resolution.[31] The states agreed to the phosphorus loading targets for each sub-watershed developed by their joint modeling work while retaining flexibility regarding the balance of wastewater versus nonpoint source reductions implemented to achieve the loading targets. [32] The Lake Champlain Management Conference incorporated the Vermont and New York phosphorus reduction agreement into its 1996 comprehensive plan called *Opportunities for Action*, which was signed by the Governors of both states and the two EPA Regional Administrators.[33] The agreement divided the lake's estimated total loading capacity of 439 mt/yr, assigning Vermont and Quebec 319 mt/yr and New York 120 mt/yr, with specific loading targets assigned to each sub-watershed in each state.[34] The plan specified the overall net loading reductions required to achieve these targets to be 56 mt/yr in Vermont and 1.0 mt/yr in New York, relative to 1995 levels.[35]

The 1996 *Opportunities for Action* plan[36] indicated that Vermont would seek an agreement with the Province of Quebec on sharing responsibility for phosphorus reduction in Missisquoi Bay. Vermont and Quebec subsequently established a Missisquoi Bay Phosphorus Reduction Task Force ("Task Force") charged with the tasks of (1) reviewing the phosphorus loading data and modeling analyses used to establish the total loading capacity for Missisquoi Bay; (2) assessing the magnitude of

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29. Nancy Bazilchuk, *N.Y. Balks at Limits on Phosphorus*, BURLINGTON FREE PRESS, July 25, 1995, at A1.

30. Nancy Bazilchuk, *Dispute Threatens Lake Champlain Cleanup Plan New York Questions Phosphorus Study*, BURLINGTON FREE PRESS, Oct. 12, 1995, at B1.

31. *Lake Champlain Nutrient Pollution Policy and Data*, U.S. ENVTL. PROT. AGENCY, https://www.epa.gov/nutrient-policy-data/lake-champlain [https://perma.cc/9QRH-6RHE] (last visited Apr. 4, 2016).

32. *Phosphorus Reduction Strategies*, LAKE CHAMPLAIN BASIN PROGRAM, http://www.lcbp.org/water-environment/water-quality/nutrients/phosphorus-reduction-strategy/ [https://perma.cc/9AQD-ZA7S] (last visited Apr. 4, 2016).

33. LAKE CHAMPLAIN MGMT. CONFERENCE, OPPORTUNITIES FOR ACTION: AN EVOLVING PLAN FOR THE FUTURE OF THE LAKE CHAMPLAIN BASIN (1996), http://www.lcbp.org/wp-content/uploads/2013/03/OFA-1996.pdf [https://perma.cc/83QM-4YJD].

34. *Id.* at 11.

35. *Id.*

36. *Id.* at 10.

phosphorus loading from sources in Vermont and Quebec; (3) reviewing policies and programs in Vermont and Quebec to implement point and nonpoint source phosphorus reductions; and (4) proposing a fair and practical division of responsibility between Vermont and Quebec for achieving the target load reductions for Missisquoi Bay.[37]

The Task Force issued its report to the Lake Champlain Steering Committee in 2000.[38] The Task Force reaffirmed the acceptance of the in-lake phosphorus concentration criterion of 0.025 mg/L, which had been previously established for Missisquoi Bay.[39] But, the October 5, 2001 addendum proposed that the total loading capacity of 109.7 mt/yr defined for Missisquoi Bay in the 1996 *Opportunities for Action* be reduced to 97.2 mt/yr in order to fully attain the bay's concentration criterion. After reviewing land use data and a watershed phosphorus export modeling analysis conducted for the Lake Champlain Basin Program, the Task Force determined that Vermont contributed 60% of the phosphorus load to the bay and Quebec contributed 40%.[40] Using this information, the Task Force recommended a simple 60/40 basis for a division of load reduction responsibility between the two jurisdictions.[41] Vermont would be assigned 60% (58.3 mt/yr) of the total loading capacity and therefore 60% of the load reduction responsibility while Quebec would be assigned 40% (38.9 mt/yr) of the total capacity and 40% of the load reduction responsibility.[42] The two governments accepted these recommendations in an agreement concerning phosphorus reduction in Missisquoi Bay signed in 2002.[43]

III. THE 2002 LAKE CHAMPLAIN PHOSPHORUS TMDL

With acceptance by Vermont, New York, and Quebec of a consistent set of in-lake phosphorus concentration criteria, the establishment of total loading capacities for each lake segment, and agreements on a division of responsibility for load reduction between the three jurisdictions, the

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37. MISSISQUOI BAY PHOSPHORUS REDUCTION TASK FORCE, A DIVISION OF RESPONSIBILITY BETWEEN QUÉBEC AND VERMONT FOR THE REDUCTION OF PHOSPHORUS LOADS TO MISSISQUOI BAY 2–3 (2000), http://www.lcbp.org/wp-content/uploads/2012/08/missbay_final.pdf [https://perma.cc/UB3D-YQVB]; SMELTZER & QUINN, *supra* note 20, at 124.

38. *Id.*

39. *Id.* at 1; QUÉBEC & VERMONT FOR THE REDUCTION OF PHOSPHORUS LOADS, *supra* note 12, at 6.

40. MISSISQUOI BAY PHOSPHORUS REDUCTION TASK FORCE, *supra* note 38, at 8.

41. *Id.* at 9.

42. *Id.*

43. AGREEMENT BETWEEN THE GOUVERNEMENT DU QUÉBEC AND THE GOVERNMENT OF THE STATE OF VERMONT CONCERNING PHOSPHORUS REDUCTION IN MISSISQUOI BAY (2002), http://www.lcbp.org/wp-content/uploads/2012/08/missbay_agreeEN.pdf [https://perma.cc/74QP-P8RS].

building blocks were in place to develop a total maximum daily load ("TMDL") for Lake Champlain.[44] Vermont and New York jointly prepared a Lake Champlain Phosphorus TMDL document in 2002[45] and submitted the TMDL to their respective EPA regional offices where it was approved.[46]

The 2002 Lake Champlain Phosphorus TMDL included individual phosphorus wasteload allocations for each treatment facility in Vermont and New York.[47] The Vermont TMDL wastewater limits incorporated additional restrictions beyond previous policy in two respects. First, annual phosphorus load allocations for 25 of the larger Vermont facilities were calculated based on an effluent concentration of 0.6 mg/L at their permitted flow rate rather than at the 0.8 mg/L limit specified in statute.[48] Second, the TMDL applied the 0.8 mg/L limit to 5 facilities using aerated lagoon treatment processes, which had been previously exempted from phosphorus removal requirements.[49] Vermont subsequently amended the phosphorus discharge statute to remove the aerated lagoon exemption for consistency with the TMDL.[50] The maximum wastewater phosphorus load allowed by the 2002 Lake Champlain TMDL for the 60 Vermont facilities in aggregate was 55.8 mt/yr.[51]

The 2002 Lake Champlain TMDL allocated the remaining non-wastewater loads within the maximum target loads established for each lake segment watershed in the 1996 Lake Champlain Management Conference Plan and in the 2002 Vermont-Quebec Water Quality Agreement.[52] Vermont made small adjustments to the total loading capacities for some lake segments. The TMDL assigned phosphorus allocations to sources including runoff from developed land, agricultural land, and forest land within each lake segment watershed.[53] Allocations to forest land were

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44. William G. Howland, *The Lake Champlain Basin Program: Its History and Role*, *infra* p. .

45. VT. AGENCY OF NAT. RES. DEP'T OF ENVTL. CONSERVATION & N.Y. STATE DEP'T OF ENVTL. CONSERVATION, LAKE CHAMPLAIN PHOSPHORUS TMDL (2002), http://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_2002_LC%20P%20tmdl.pdf [https://perma.cc/DW7L-VPJ9] [hereinafter LAKE CHAMPLAIN TMDL 2002].

46. Letter from Linda M. Murphy, Dir., Office Ecosystem Prot. to Christopher Recchia, Comm'r, Vt. Dep't Envtl. Conservation (Nov. 4, 2002).

47. LAKE CHAMPLAIN TMDL 2002, *supra* note 46, at 20.

48. *Id.* at 24.

49. *Id.*

50. VT. STAT. ANN. tit. 10, §1266a.

51. LAKE CHAMPLAIN TMDL 2002, *supra* note 46, at 22; S. 96, 2007-2008 Leg. Sess. (Vt. 2007).

52. *Id.* at 20.

53. *Id.* at 33.

specified at their existing base levels.[54] With the wastewater and forest load allocations determined, loads allocated to developed land and agricultural land were reduced by equal proportions from their estimated base levels in each lake segment watershed until the total loading capacity for the lake segment was achieved.[55]

The TMDL for the Vermont portion of the Missisquoi Bay watershed included a special "other" category of load allocation as a result of uncertainty about whether the available agricultural conservation practices were adequate to achieve the full extent of the required load reductions in that watershed.[56] The TMDL suggested that phosphorus loads associated with stream channel instability should be examined as a way to achieve the additional reductions.[57]

Vermont and New York used the lake model based on hydrologic conditions occurring during 1991 to develop the total loading capacities and load reduction amounts. Vermont and New York chose the base year of 1991 because average river flows during 1991 were comparable to median annual flows recorded over several previous decades at stream gauges in the Lake Champlain Basin.[58] The 2002 Lake Champlain TMDL established a total loading capacity of 427 mt/yr for the entire lake under 1991 hydrologic conditions, including 268 mt/yr for Vermont distributed among 12 lake segment watersheds.[59] The Vermont total loading capacity mandated a 35% reduction from the 1991 Vermont base load of 414 mt/yr.[60]

The 2002 Lake Champlain TMDL contained a detailed Vermont implementation plan with cost estimates for phosphorus reduction actions across several program areas, including wastewater discharges, agricultural sources, construction stormwater, local roads and other municipal sources, river corridor management, wetland protection and restoration, management of internal phosphorus loading in St. Albans Bay, river basin planning, long-term monitoring, implementation tracking, and program

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54. *Id.*
55. *Id.*
56. *Id.* at 36.
57. *Id.* at 78.
58. ERIC SMELTZER & SCOTT QUINN, *supra* note 20, at 75; LAKE CHAMPLAIN TMDL 2002, *supra* note 46, at 33.
59. VT. AGENCY OF NAT. RES. & VT. AGENCY OF AGRIC., FOOD & MARKETS, PROGRESS IN ESTABLISHING AND IMPLEMENTING THE TOTAL MAXIMUM DAILY LOAD (TMDL) PLAN FOR LAKE CHAMPLAIN 4 (2008), http://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/CandC2007RptANRACT43-Final011508.pdf [https://perma.cc/Z4YJ-YV4E] [hereinafter ANR & VAAFM 2008].
60. LAKE CHAMPLAIN TMDL 2002, *supra* note 46, at 15.

administration.[61] The TMDL estimated the total cost of the Vermont implementation plan to be $139 million over 14 years (2003–2016).[62]

IV. THE VERMONT CLEAN AND CLEAR WATER ACTION PLAN

The "reasonable assurances" section of the 2002 Lake Champlain TMDL referenced the phosphorus reduction commitments made by Vermont and New York in the 1996 *Opportunities for Action* plan and the formation of the Lake Champlain Basin Program to oversee implementation of the plan.[63] However, the TMDL document contained no specific strategy or commitment to fund the $139 million Vermont implementation plan.[64] Governor James Douglas addressed this gap in September 2003 when he announced the Vermont Clean and Clear Water Action Plan on the shore of Missisquoi Bay.[65] Governor Douglas stated that Vermont would "accelerate pollution reduction measures for Lake Champlain from [implementation in] 2016 to 2009 in every possible instance" using a combination of federal, state, local, and private funds.[66] The 20-year (1996–2016) phosphorus reduction timeline stated in *Opportunities for Action* and incorporated into the Vermont TMDL implementation plan would be shortened with a new deadline coinciding with the 2009 quadricentenniel of Samuel de Champlain's initial exploration of the lake.[67]

Over the next six years, the Governor proposed and the Legislature approved nearly $60 million in new state funds for the Clean and Clear initiative to implement the Lake Champlain TMDL and to address similar water quality problems statewide.[68] The state secured comparable amounts of federal funds to complement this effort. The Agency of Natural Resources and the Agency of Agriculture, Food and Markets increased staffing by about twenty-eight positions to support watershed management program expansions in the areas of stormwater, rivers, agriculture, wetlands, and forestry.[69] The Vermont Agency of Natural Resources

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61. *Id.* at 48.
62. *Id.* at 95
63. *Id.* at 46.
64. *Id.* at 95.
65. Gov. James H. Douglas, Clean and Clear Water Action Plan (Sept. 30, 2003), https://votesmart.org/public-statement/23255/clean-and-clear-water-action-plan-remarks-of-governor-james-h-douglas#.VvmWzxIrKCQ [https://perma.cc/XQ4C-YX5S].
66. *Id.*
67. *Id.*
68. VT. AGENCY OF NAT. RES. & VT. AGENCY OF AGRIC., FOOD, & MKTS., CLEAN AND CLEAR ACTION PLAN 2010 ANNUAL REPORT (2011), http://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/CleanAndClear2010AnnualReport.pdf [https://perma.cc/C39S-6E5N] [hereinafter ANR & VAAFM 2011].
69. LAKE CHAMPLAIN TMDL 2002, *supra* note 46, at 86.

established an Ecosystem Restoration Grant Program to support implementation work by local partner organizations.[70] The Legislature appropriated state capital funds for additional wastewater treatment facility upgrades needed to comply with the TMDL limits.[71] Of the fifty-five individual action items specified in the Vermont implementation plan in the 2002 TMDL, five had been completed by 2008, forty-seven were in progress (some with changes in scope), and only three saw no action.[72]

Despite this progress and less than three years after the first state appropriations for the Clean and Clear initiative were approved, the Vermont Senate introduced legislation declaring that the control measures under the Lake Champlain TMDL for phosphorus had failed and would not achieve the pollutant load reduction required to meet water quality standards.[73] As a result, the General Assembly enacted and the Governor signed Act 43 in 2007, requiring the Vermont Agency of Natural Resources to reopen the Lake Champlain TMDL, pending the results of a reassessment of the TMDL with respect to the efficacy of the Vermont implementation plan, the adequacy of the hydrologic data used for the TMDL modeling, and the feasibility and cost of additional wastewater phosphorus reduction requirements.[74] Act 43 also required that an independent program audit be conducted on the progress and efficacy of the Clean and Clear initiative.[75] Fortunately for the lake, the negative tone of the political discussion of the Clean and Clear program did not deter Governor Douglas from proposing, or the General Assembly from approving, appropriations for the program at a sustained level.[76]

The Agency of Natural Resources responded with a report in 2008 recommending against reopening the Lake Champlain TMDL on the grounds that the loading targets in the 2002 TMDL already provided clear direction regarding the large magnitude of phosphorus reductions needed.[77] The report concluded that the staffing and funding resources needed to redo the TMDL and to further upgrade wastewater phosphorus treatment processes would be better directed at controlling nonpoint sources of phosphorus loading to Lake Champlain.[78] The report also recommended

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70. *Ecosystem Restoration Program*, WATERSHED MGMT. DIV., http://www.watershedmanagement.vt.gov/erp.htm [https://perma.cc/V5PU-JGN9] (last visited Apr. 4, 2016).

71. VT. STAT. ANN. tit., 10 § 1625(e).

72. ANR & VAAFM 2008, *supra* note 60, at 5.

73. S. 96, 2007-2008 Leg. Sess. (Vt. 2007)

74. H.154, 2007-2008 Leg. Sess. (Vt. 2007).

75. *Id.* § 6.

76. ANR & VAAFM 2011, *supra* note 69, at 10.

77. ANR & VAAFM 2008, *supra* 60, at 8.

78. *Id.* at 1, 33.

that the Vermont Lake Champlain TMDL implementation plan should be periodically reevaluated and revised as experience was gained going forward and noted that this could be accomplished without reopening the entire TMDL.[79]

The Vermont General Assembly considered these agency recommendations and passed Act 130 in 2008, which postponed the date for reopening the Lake Champlain TMDL until 2013, but required the Agency of Natural Resources to issue a revised Vermont-specific implementation plan for the TMDL.[80] The agency released a revised Vermont Lake Champlain TMDL implementation plan in 2010 following a year-long public consultation process.[81] The revised TMDL implementation plan identified two-hundred potential actions to improve water quality in Lake Champlain and identified the ten next steps that were of highest priority for immediate action.[82] These steps included increasing staffing for agronomists to provide on-farm water quality technical assistance, requiring additional stormwater treatment at existing developed sites, and implementing water quality-based standards for municipal road maintenance. The Agency of Natural Resources took into account the experience gained in implementing the Clean and Clear program and revised the total cost estimate to implement the TMDL sharply upwards to $500–800 million.[83]

By the end of 2010, the magnitude of the challenge facing Vermont in achieving the Lake Champlain TMDL targets had become more fully apparent. Analysis of long-term water quality monitoring data showed few improving trends in phosphorus loading to the lake from any tributary.[84] Lake phosphorus concentrations remained above the criteria values in most lake segments and concentrations were increasing in some areas.[85] Vermont had achieved dramatic reductions in wastewater phosphorus loads with wastewater discharges contributing only three percent of the total phosphorus load to the lake from Vermont.[86] However, similar success had

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79. *Id.* at 1.

80. H. 873, 2007-2008 Leg. Sess. (Vt. 2008).

81. VT. AGENCY OF NAT. RES., REVISED IMPLEMENTATION PLAN: LAKE CHAMPLAIN PHOSPHORUS TMDL (2010), http://dec.vermont.gov/sites/dec/files/wsm/lakes/docs/erp_revisedtmdl.pdf [https://perma.cc/XMU4-VGNL] [hereinafter ANR 2010].

82. *Id.* at 2.

83. *Id.* at 5.

84. ERIC SMELTZER ET AL., LAKE CHAMPLAIN PHOSPHORUS CONCENTRATIONS AND LOADING RATES, 1990-2008 27 (2009), http://www.lcbp.org/techreportPDF/57_Phosphorus_Loading_1990-2008.pdf [https://perma.cc/5YJ4-LVTN].

85. *Id.* at 1.

86. *Id.* at 33.

not been demonstrated in reducing nonpoint sources of phosphorus despite the greatly expanded program efforts.

Progress in reducing nonpoint sources of phosphorus can be slow and difficult for a number of reasons.[87] The time scale of nature's response to management actions can vary from years to decades, depending on the practices involved. This is because of the intermittent nature of runoff events, the large variability in annual runoff rates, and the long time it takes for soils, vegetation, farm fields, river channels, and lake sediments to respond to improved management.[88] Furthermore, most nonpoint source control practices require human behavioral changes by private landowners that are difficult to regulate and do not occur immediately. The main reason for the lack of progress, however, is that insufficient resources have been committed to the effort. The 2010 revised TMDL Implementation Plan[89] and a subsequent report by the Vermont Agency of Natural Resources to the Vermont General Assembly required by Act 138 of 2012[90] made clear that hundreds of millions of dollars and a sustained commitment over many years would be needed.

In early 2011, EPA revoked its approval of the Vermont portion of the 2002 Lake Champlain Phosphorus TMDL in response to a settlement of a lawsuit brought in federal court by the Conservation Law Foundation. EPA then embarked on what became a five-year process to produce a new Vermont TMDL for Lake Champlain.[91] The administration of Governor Peter Shumlin sustained Vermont's Lake Champlain TMDL implementation efforts during this period and the state produced a new TMDL implementation plan in 2014,[92] designed to achieve the higher standards of reasonable assurances and accountability required of Vermont by EPA for the new Lake Champlain TMDL. The Vermont Clean Water Act of 2015[93] provided additional authority, staffing, and funding resources

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87. ANR 2010, *supra* note 82, at 5, 26.

88. *Id.* at 26.

89. *Id.* at 5.

90. VT. GEN. ASSEMBLY, WATER QUALITY REMEDIATION, IMPLEMENTATION AND FUNDING REPORT: PART 1: CLEAN WATER NEEDS, FINANCIAL TOOLS, AND ADMINISTRATION, PART 2: LAKE SHORELAND PROTECTION AND RESTORATION MANAGEMENT OPTIONS 4 (2013), http://dec.vermont.gov/sites/dec/files/wsm/erp/docs/Act-138-Report-Water-Quality-Funding-Report-Jan-2013.pdf [https://perma.cc/E93C-RX4T].

91. David K. Mears & Trey Martin, *Foreward: Restoring and Maintaining the Ecological Integrity of Lake Champlain*, *supra* p. 474.

92. STATE OF VT., VERMONT LAKE CHAMPLAIN PHOSPHORUS TMDL PHASE 1 IMPLEMENTATION PLAN 1 (2014), http://dec.vermont.gov/sites/dec/files/wsm/erp/Champlain/docs/Ph%201_plan_Version_4.pdf [https://perma.cc/F9QX-MP9R].

93. H.35, 2015-2016 Leg. Sess. (Vt. 2015).

toward the state's commitments to implement the TMDL. These more recent efforts are described in other articles of this volume.