

OPPORTUNITIES FOR ACTION

An Evolving Plan for the Future of the Lake Champlain Basin



**Prepared by the Lake Champlain Steering Committee
November 2010**

TO THE CITIZENS OF THE LAKE CHAMPLAIN BASIN:

On behalf of the States of New York and Vermont and the US Environmental Protection Agency, we are pleased to approve the revised *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin* (2010).

Opportunities for Action is comprehensive in its scope and focused in its mission. This revision of the plan builds on the success of the past 14 years of plan implementation and also responds to continuing and emerging environmental challenges, in order to better protect the future of Lake Champlain. The successes achieved to date are the result of tremendous dedication and hard work by thousands of individuals over the last two decades since initiation of the planning process for Lake Champlain management in 1990.


Many of the challenges facing Lake Champlain and its drainage basin, such as the persistent problems of nutrient enrichment and of new invasive plants and animals, are made still more difficult to resolve because of regional changes in climate. However, with combined federal and state funding substantial progress has been possible in reducing municipal wastewater discharges to the Lake, increasing agricultural best management practices on farms throughout the Basin, urban stormwater management improvements and an unprecedented level of community involvement in pollution reduction. These improvements in management New York and Vermont have been paralleled by similar progress in the northern sector of the Missisquoi River watershed, by partners in Québec.

In this revised and updated version of *Opportunities for Action* each jurisdiction has offered for inclusion specific action items reflecting their intended stewardship priorities for the years ahead. While other documents concern specific regulatory, enforcement and compliance matters, *Opportunities for Action* represents a different approach, emphasizing instead the vital partnerships among the jurisdictions and members of the public that are necessary for an effective program of adaptive management of the Lake Champlain Basin as a whole. Emerging priorities, continuing tasks, new initiatives, and special needs not recognized in earlier versions of the plan, are included here. The Lake Champlain Basin Program (LCBP) will publish *Opportunities for Action* on the LCBP website, both to inform readers of the specific priority actions planned, and to include a continual account of progress made towards the implementation of each action through the years ahead. Consequently, the new online version of *Opportunities for Action* includes both the comprehensive management plan and a continual accountability reference for all citizens of the Lake Champlain Basin.

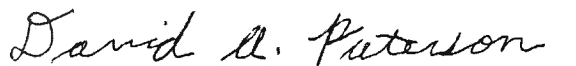
Implicit in our approval of the revised plan is our continuing commitment to direct the resources of our respective agencies towards the implementation of recommendations set forth in this plan, and recognition that adequate funding will be crucial to the continued success of *Opportunities for Action*.

We also look forward to the continued commitment of citizens throughout the Basin to achieve a Lake Champlain that supports multiple uses – including commerce, a healthy drinking water supply, wildlife habitat, and recreation, such as swimming, fishing, and boating, so that future generations may enjoy the Lake as fully as the current generation.

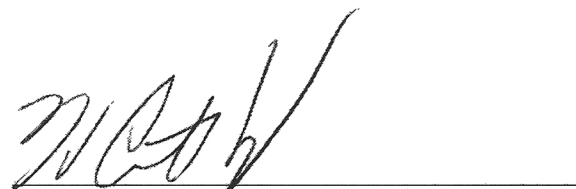
We congratulate the Lake Champlain Basin Program, its Steering Committee, advisory committees, and staff for their work on these revisions of *Opportunities for Action*. We look forward to continued cooperation among all parties to foster its actions and goals.


James H. Douglas
Governor of Vermont

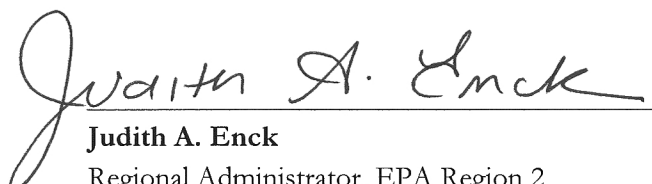
11/30/10
Date


David A. Paterson
Governor of New York

11/30/2010
Date


H. Curtis Spalding
Regional Administrator, EPA New England

11/29/2010
Date


Judith A. Enck
Regional Administrator, EPA Region 2

11/22/10
Date

The plan is signed by the signatories above. We are also pleased to include a strong message of support from the Premier of Québec, Jean Charest. This message, in French and English, was provided to the Lake Champlain Basin Program on November 9, 2010.



Gouvernement du Québec

Message du premier ministre

The renewal of the Lake Champlain Action Plan:
A model of sustainable development

Québec is proud to once again be associated with its partners, the states of Vermont and New York, in the implementation of this revised action plan to restore and protect the water quality and develop the natural and cultural heritage of Lake Champlain. *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin* totally fits into the Québec's sustainable development policy scheme and is a clear illustration of the exceptional international cooperation that has been forged over the years with our American partners.

Opportunities for Action was revised as part of the activities of the Steering Committee, whose role is set out in the *Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain among the Government of Québec, the State of New York and the State of Vermont*, which was extended in March 2010. Québec is a member of this Steering Committee and intends to continue to play a major role on it in order to actively contribute to the integrated management of Lake Champlain and, more especially, the protection of the waters of Missisquoi Bay.

The updated *Opportunities for Action* plan identifies specific goals and actions to restore and protect the ecological and cultural resources of the basin while, at the same time, maintaining the vital economic activity that is so essential to the region. A number of goals have been given high priority in the action plan based on comments from residents and other interested parties at public meetings and on the recommendations of advisory committees.

It is with steadfast determination that the Government of Québec once again signals its desire to actively participate with all its partners in the management of Lake Champlain for future generations.

Jean Charest



Gouvernement du Québec

Message du premier ministre

Le renouvellement du Plan d'action du lac Champlain :
Un modèle de développement durable

Le Québec est fier de s'associer de nouveau à ses partenaires des États du Vermont et de New York afin de mettre en œuvre ce plan d'action révisé pour la restauration, la protection des eaux et la mise en valeur du patrimoine écologique et culturel du lac Champlain. Le plan, intitulé *Perspectives d'action : un plan progressif pour l'avenir du bassin du lac Champlain*, s'inscrit clairement dans la démarche de développement durable que nous soutenons au Québec et illustre l'excellence de la coopération internationale établie depuis plusieurs années avec nos partenaires américains.

La révision du plan *Perspectives d'action* a été réalisée dans le cadre des activités du comité directeur dont le rôle est souligné dans l'Entente de coopération en matière d'environnement relativement à la gestion du lac Champlain entre le gouvernement du Québec, l'État de New York et l'État du Vermont reconduite en mars 2010. Le Québec est membre de ce comité directeur et entend continuer à y jouer pleinement son rôle pour contribuer activement à la gestion intégrée du lac Champlain et plus particulièrement à la protection des eaux de la baie Missisquoi.

Dans le cadre de l'actualisation du plan *Perspectives d'action*, des objectifs et des actions précis ont été établis afin de restaurer et de protéger les ressources écologiques et culturelles du bassin, tout en préservant l'activité économique essentielle à la région. Des domaines d'intervention prioritaires ont été consignés dans le plan à la suite des recommandations des comités consultatifs et des commentaires présentés lors des assemblées publiques par les résidents et les autres parties intéressées.

C'est avec une détermination indéniable que le gouvernement du Québec signifie de nouveau sa volonté de participer activement, avec tous ses partenaires, à la gestion du lac Champlain pour les générations futures.

Jean Charest

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As required by the Antideficiency Act, 31 U.S.C. 1341 and 1342, all commitments made by EPA in this plan are subject to the availability of appropriated funds. Nothing in this plan, in and of itself, obligates EPA to expend appropriations or to enter into any contract, assistance agreement, interagency agreement, or incur other financial obligations that would be inconsistent with Agency budget priorities. This plan does not exempt the parties from EPA policies governing competition for assistance agreements. Any transaction involving reimbursement or contribution of funds between the parties to this plan will be handled in accordance with applicable laws, regulations, and procedures under separate written agreements.

This plan does not create any right or benefit, substantive or procedural, enforceable by law or equity, between or against the States of New York and Vermont or EPA, their officers or employees, or any other person. This plan does not direct or apply to any person outside of the States of New York and Vermont and EPA.

1. INTRODUCTION

LAKE CHAMPLAIN BASIN RESOURCES

The Lake Champlain Basin, stretching from the peaks of the Adirondacks to the Green Mountains and north into Québec, is renowned as one of North America's most beautiful and valued resources. Residents and visitors alike enjoy Lake Champlain's high water quality for swimming, drinking, fishing, and recreation. In recent decades, many improvements in wastewater and sewage treatment have greatly reduced the contamination of beaches, shorelines, and water supplies in all parts of the Lake. Partners have worked together to address both point and nonpoint sources of pollution to Lake Champlain. The Lake, at 120 miles (193 km) long and 400 feet (122 m) deep, supports a complex freshwater ecosystem with diverse plant and animal species. But many problems remain to be resolved. In a changing world, the impacts of society on Lake Champlain also are changing. Lake Champlain is an enormous resource requiring special care and stewardship – this comprehensive management plan, *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin (OFA)*, is a coordinated effort to inform, guide, and assist that essential stewardship.

Long home to Native Americans and inhabited by more than 600,000 people today, the international Lake Champlain Basin draws millions of visitors to its waters and other natural and historic features. The importance of healthy natural resources to the Basin's people, its industries, and the economy as a whole is indisputable. Agriculture in the Basin, for example, which requires land for production and clean water for animals, generated about \$688 million in sales of agricultural products—such as milk, cheese, maple syrup, and apples—in 2008 (New England Agricultural Statistics 2009).

Recreation-related industries also depend on a clean Lake. Sport fishing generates tens of millions in revenues annually. Bird and other wildlife viewing activities generated more than \$122 million in 2006 in Vermont (USFWS 2006).

Dollar figures alone cannot convey the full value of Lake Champlain's resources. The biological riches of the area and unparalleled beauty of the mountains, historic resources, agricultural landscapes, small towns and villages, and rivers that flow into the magnificent Lake provide experiences and opportunities unique to the Lake Champlain Basin. Although the benefits of healthy resources are difficult to quantify, they are an essential part of any evaluation of the costs and benefits of resource management decisions.



1 Isaac Chellman, 2010

RESOURCE ISSUES FACING LAKE CHAMPLAIN

Although Lake Champlain remains a vital lake with many assets, several serious environmental problems demand action. High phosphorus levels, toxic substances and pathogens, and aquatic invasive species threaten a healthy Lake ecosystem and human use and enjoyment of Lake Champlain. Natural resources, such as fish, wildlife, and plants, are threatened by invasive species, wetland loss, habitat degradation and fragmentation, and diminished water quality. Other issues that face the Lake Champlain Basin include changes in hydrology, habitat and biodiversity, climate, impacts from continued land-use changes and habitat fragmentation, public access to the Lake, recreational user conflicts, and loss of cultural resources.

ADDRESSING THE ISSUES: THE LAKE CHAMPLAIN SPECIAL DESIGNATION ACT and LCBP



On November 5, 1990, the *Lake Champlain Special Designation Act* was signed into law [www.lcbp.org/appenda.pdf]. Sponsored by Senators Leahy and Jeffords from Vermont and Senators Moynihan and D'Amato from New York, this legislation designated Lake Champlain as a resource of national significance. Its goal was to bring together people with diverse interests in the Lake and to create a comprehensive plan for protecting the future of Lake Champlain and its surrounding watershed. The act specifically required examination of water quality, fisheries, wetlands, wildlife, recreational, and cultural resource issues. The challenge has been both to identify particular problems requiring management action and to chart an integrated plan for the future of the Lake Champlain Basin. The Lake Champlain Special Designation Act was reauthorized in 2002, with the *Daniel Patrick Moynihan Lake*

Champlain Basin Program Act, authorizing expenditures of up to \$11 million per year to accomplish this goal [www.lcbp.org/PDFs/H.R.1070_LCBPAuthorization_2002.pdf].

The Special Designation Act created the Lake Champlain Basin Program (LCBP), a nonregulatory partnership among the States of New York and Vermont, the Province of Québec, the US Environmental Protection Agency, other federal and local government agencies, and many public and private local groups. The LCBP works cooperatively with many partners to protect and enhance the environmental integrity and the social and economic benefits of the Lake Champlain Basin. The program is guided by the Lake Champlain Steering Committee, a board comprised of a broad spectrum of representatives of government agencies and the chairs of advisory groups representing citizen Lake users, scientists, and educators. During the past two decades, the LCBP has sponsored a great variety of projects to reduce pollution in the Lake, educate and involve the public, and gather information about Lake issues. The LCBP also has funded education, planning, demonstration, research, and monitoring projects to restore and protect water quality and the diverse natural and cultural resources of the Lake Champlain Basin.

OPPORTUNITIES FOR ACTION: AN EVOLVING PLAN

OFA establishes a plan for coordinated action by each jurisdiction and community in the Basin, as well as members of the public, to restore and protect water quality and the diverse natural and cultural resources of the Lake Champlain Basin. Successful implementation of the plan is achieved by developing many joint partnerships among natural resource agencies, citizens, and other Lake and watershed stakeholders, to achieve the actions described herein.



The LCBP has worked to involve the public and to respond to current management, research, and monitoring needs in developing and implementing *OFA* since 1991. The first version of the plan was signed in 1996; the second version was signed in 2003. The plan, including its goals and priorities, will continue to be formally revised and signed approximately every five years. In the current revision, partners have committed to specific management tasks based on funding available in 2010 and anticipated in subsequent years; however, additional needed tasks have been

identified at the end of each chapter and may be addressed as funding becomes available.

The 2010 update of *OFA* is available as a paperless, dynamic management plan, available to the public through the LCBP website, allowing easy navigation to various topics and a searchable database of key information. This new format will give managers, researchers, partner agencies and organizations, and public stakeholders access to the entire plan or to specific segments via menu navigation or search tools. Website visitors can view regularly updated accomplishments and search for specific goals and actions as well as the status of each task. Lead partners are identified for each task in order to promote accountability. The online format also allows for the integration of an adaptive management process, the structured method for updating the plan as new information and understanding becomes available. This approach will allow *OFA* to remain current in the evolving process to protect and restore the Lake Champlain ecosystem.

The public has played an integral role in developing and implementing *OFA* during the last twenty years. Numerous public input meetings, citizen perception surveys, focus group discussions, technical workshops, and research, monitoring, and demonstration projects have helped identify the issues and priority actions presented in this plan. Guidance from the public has been reinforced through public comments during the past fifteen years of implementation. Readers should feel welcome to continue to provide input into the planning process. Please contact the LCBP at 1-800-468-5227 or (802) 372-3213, or visit the LCBP website [www.lcbp.org/events.htm] for more information on the public meetings of all LCBP advisory or governing committees.

Vision Statement

The Vision Statement for *OFA* was originally published by the Lake Champlain Management Conference in 1996. The Lake Champlain Steering Committee was formed as a result of the Management Conference and is now included in the Vision Statement below.

The Lake Champlain Steering Committee represents a broad-based diverse group of interests that share a common goal of developing a management program to protect and enhance the environmental integrity and the social and economic benefits of Lake Champlain and its watershed.

The Steering Committee envisions a Lake Champlain that supports multiple uses – including commerce, a healthy drinking water supply, wildlife habitat, and recreation, such as swimming, fishing, and boating. These diverse uses will be balanced to minimize stresses on any part of the Lake system. The Steering Committee recognizes that maintaining a vital economy that values the preservation of the agricultural sector is an integral part of the balanced management of the Lake Champlain Basin. Implementing a comprehensive management plan will ensure that the Lake and its Basin will be protected, restored, and maintained so that future generations will enjoy its full benefits.

Goals

OFA identifies eight specific goals to meet the vision statement for the Lake Champlain Basin. These goals aim to protect and restore the ecological and cultural resources of the Basin while maintaining a vital regional economy. Based on comments from citizens and other stakeholders at public meetings and on the recommendations of advisory committees, the goals listed below and outlined in Chapters 3 through 10 of this plan have been designated by the Lake Champlain Steering Committee as the highest priorities of the plan. Please refer to these chapters for more information.

- Promote a better understanding and appreciation of Lake Champlain Basin resources and threats as well as personal responsibility that leads to behavioral changes and actions to reduce pollution. [Chapter 3]
- Reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of the Lake. [Chapter 4]
- Reduce contaminants that pose a risk to public health and the Lake Champlain ecosystem. [Chapter 5]
- Maintain a resilient and diverse community of fish, wildlife, and plants in the Lake Champlain Basin. [Chapter 6]
- Prevent the introduction, limit the spread, and control the impact of non-native aquatic invasive species in order to preserve the integrity of the Lake Champlain ecosystem. [Chapter 7]
- Identify potential changes in climate and develop appropriate adaptation strategies to minimize adverse impacts on Lake Champlain's ecosystem and natural, heritage, and socioeconomic resources. [Chapter 8]
- Build on existing knowledge; make new discoveries of the history, culture, and special resources of the Champlain Valley National Heritage Partnership; and make this information accessible to all. [Chapter 9]

- Promote healthy and diverse economic activity and sustainable development principles within the Lake Champlain Basin while improving water quality and conserving the natural and cultural heritage resources on which the regional economy is based. [Chapter 10]

The Lake Champlain Steering Committee considers these eight goals to be vital in addressing the long-term health of the Lake Champlain Basin and recommends that agencies and organizations strive to maintain them as highest priorities in managing and enhancing the resources of the Basin. Priority objectives, actions, and tasks have been designated for each of these goals and are presented in the plan. These priority actions are considered critical to a management program that addresses the issues facing the Lake Champlain Basin. Implementation of all actions, regardless of priority status, is contingent upon both the availability of funds and the cooperation and assistance of residents and visitors in the Lake Champlain Basin.

Citations

New England Agricultural Statistics. 2009. New England Cash Receipts 2008 [www.nass.usda.gov/Stastics_by_State/New_England_includes/Publications/cashrec08.pdf].

US Fish and Wildlife Service. 2006. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation: Vermont. [www.census.gov/prod/2008pubs/fhw06-vt.pdf].

Vermont Agency of Natural Resources. 1996. Environment 1996: An Assessment of the Quality of Vermont's Environment. Waterbury, VT: VTANR.

SOMMAIRE EN FRANÇAIS

LES RESSOURCES DU BASSIN DU LAC CHAMPLAIN

La réputation du bassin du lac Champlain n'est plus à faire. Reconnu comme l'une des plus belles ressources naturelles du continent nord-américain, il s'étend des cimes des Adirondacks aux Montagnes Vertes et fait une incursion au Québec dans sa section nord, le bassin de la baie Missisquoi. La région est habitée depuis longtemps par les autochtones et compte maintenant plus de 600 000 résidents. Le bassin accueille chaque année des millions de visiteurs qui viennent profiter de ses eaux et de tous ses autres attraits naturel et historique. En 2000, on estimait à 3,8 milliards de dollars US les revenus touristiques dans tout le bassin. Il ne faut pas croire que la valeur des ressources du lac Champlain ne se calcule qu'en dollars. Les richesses écologiques de la région et la beauté inégalée des montagnes, des ressources patrimoniales, des paysages agricoles, des petites villes et des villages, sans oublier celle des rivières qui se jettent dans le magnifique lac, sont des sources d'expérience et de possibilités qui singularisent le bassin du lac Champlain. Les avantages découlant de la qualité des ressources sont difficiles à quantifier, mais ils occupent néanmoins une place importante dans l'évaluation des coûts et des retombées des décisions en matière de gestion des ressources.

Les ressources du lac sont exploitées à des fins multiples dont l'approvisionnement en eau potable, les activités récréatives, l'agriculture et les activités industrielles. Comme le lac contribue grandement à l'essor économique de la région, il importe de préserver la qualité de son eau et de toutes les ressources naturelles qui y sont reliées. La préservation de cet environnement constitue une préoccupation d'intérêt public majeure et demeure un enjeu prioritaire au niveau de l'allocation des ressources. Gérer ces ressources de manière à soutenir tous les usages actuel et futur, voilà le défi de taille que les gouvernements américain et québécois se sont engagés à relever dans le plan d'action Perspectives d'action.

ENJEUX LIÉS AUX RESSOURCES DU LAC CHAMPLAIN

Bien que le lac Champlain demeure un lac d'importance vitale et doté de nombreux atouts, la présence de plusieurs problèmes environnementaux exige que l'on prenne des mesures. La charge élevée de phosphore, la présence de toxines par les cyanobactéries et de pathogènes et les espèces aquatiques nuisibles représentent des menaces à l'écosystème et aux usages du lac Champlain. Dans certains secteurs du lac Champlain, comme ceux de la baie Missisquoi, Northeast Arm et South Lake, la charge en phosphore est si élevée qu'elle entraîne un développement excessif d'algues et de plantes aquatiques qui donnent une couleur verte à l'eau, qui nuisent aux usages récréatifs et économiques et qui, en réduisant la concentration en oxygène de l'eau, causent différents problèmes à la vie aquatique du lac. Le phosphore qui est à la source de ces problèmes vient à la fois des rejets des stations d'épuration et des eaux de ruissellement des terres agricoles, résidentielles et urbaines.

Malgré que des progrès ont été réalisés ces quinze dernières années dans la réduction des apports de phosphore, principalement par la construction et la modernisation des stations d'épuration et par une amélioration des pratiques dans certaines exploitations agricoles, les apports diffus et

ponctuels de phosphore doivent être réduits davantage afin de promouvoir un écosystème sain et optimiser l'utilisation du lac par les gens qui le fréquentent. Cette nouvelle version de *Perspectives d'action* propose des stratégies basées sur l'expérience acquise ces dernières années pour parvenir à ces réductions.

PERSPECTIVES D'ACTION

Le 5 novembre 1990, le Congrès américain entérinait la Loi sur la désignation spéciale du lac Champlain (“ Lake Champlain Special Designation Act ” (Annexe A)). Destinée à protéger le bassin versant du lac Champlain, cette loi reconnaissait le principe de confier à des personnes aux intérêts divergents la responsabilité d'élaborer un plan concerté de prévention de la pollution, de suivi et de restauration. La première version a été signée en 1996, le plan intitulé “ *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin*” (*Perspectives d'action : un plan progressif pour l'avenir du bassin du lac Champlain*) a permis la réalisation de nombreux projets. Le plan a été renouvelé en 2003 et endossé pour la première fois par le premier ministre du Québec.

En 2010, le plan a été actualisé dans un nouveau format basé sur la gestion adaptative (adaptive management) et sera rendu public sous forme électronique sur le site du LCBP. Ceci permettra au public, gestionnaires, chercheurs et partenaires gouvernementaux d'avoir accès et de suivre plus facilement les actions retenues et leur avancement pour atteindre les objectifs fixés. Pour chaque action, les responsables sont identifiés pour faciliter la mise en œuvre du plan et sa mise à jour. L'approche par gestion adaptative identifie une série d'indicateurs écologiques qui permet d'informer les gestionnaires de la réponse de l'écosystème au plan d'action. Les gestionnaires sont alors en mesure d'évaluer en continuité notamment les programmes de réduction du phosphore et de faire des modifications nécessaires pour améliorer leurs efficacités.

La mise en œuvre de ce plan est possible grâce à la création de nombreux partenariats regroupant des organismes gouvernementaux et de protection des ressources naturelles, des citoyens ainsi que d'autres partenaires concernées par le lac et son bassin, provenant de toute la région du bassin hydrographique. En tant que membre du Comité directeur du Programme de mise en valeur du lac Champlain, le Québec joue un rôle important dans la protection du lac. Plusieurs ministères, municipalités et organismes non gouvernementaux se sont engagés dans la planification de l'avenir du lac Champlain. Le point de vue des citoyens est aussi considéré. Plusieurs centaines de Québécois et de Québécoises ont d'ailleurs pu exprimer leur avis lors de rencontres publiques d'information. L'implication concrète du Québec se traduit par la participation de représentants dans divers comités, dont le Comité consultatif des citoyens, le Comité consultatif pour l'éducation et la sensibilisation, le Comité consultatif technique et le Comité consultatif du patrimoine culturel et des activités récréatives.

PRIORITÉS D'ACTION

Le document *Perspectives d'action* est un plan détaillé en constante évolution afin d'assurer une intervention coordonnée visant la restauration et la protection de la qualité de l'eau et des diverses ressources naturelles, économiques et culturelles du bassin du lac Champlain.

Dans le cadre de l'actualisation du plan *Perspectives d'action*, des objectifs précis et des actions ont été établis dans les chapitres 3 à 10 afin de restaurer et de protéger les ressources écologiques et culturelles du bassin tout en préservant l'activité économique essentielle de la région. À la lumière des commentaires présentés lors des assemblées publiques par les résidents et les autres parties intéressées et des recommandations des comités consultatifs, des domaines d'intervention prioritaires ont été consignés dans le plan.

Les niveaux de priorité des actions sont sujets à des modifications selon les problèmes qui surviendront. Le plan fera l'objet d'une mise à jour constante et la mise en œuvre des actions, peu importe leur niveau de priorité, dépendra de la disponibilité des fonds et de la coopération et implication des citoyens et visiteurs du bassin du lac Champlain.

QUE CONTIENT LE PLAN RÉVISÉ?

Le plan *Perspectives d'actions* comporte dix chapitres. Le premier présente l'ensemble des thèmes et des priorités du plan. Le chapitre 2 décrit les stratégies de mise en œuvre du plan. Le chapitre 3 porte sur l'information et la participation du public. Le chapitre 4 traite de la réduction du phosphore. Le chapitre 5 nous entretient de la réduction des substances toxiques et des pathogènes. Le chapitre 6 porte sur la gestion de la faune aquatique et terrestre. Le chapitre 7 présente la gestion des plantes et de la faune aquatiques nuisibles. Le chapitre 8 discute des effets des changements climatiques sur l'écosystème du lac Champlain. Le chapitre 9 porte sur les ressources récréatives et culturelles et le dernier chapitre 10 aborde le développement durable du bassin du lac Champlain. À la fin du document, on trouve des références, un glossaire, une liste d'abréviations et des annexes.

Pour de plus amples informations, veuillez communiquer avec le Programme de mise en valeur du lac Champlain au 802 372-3213. Des informations sont également disponibles à l'Organisme de Bassin Versant de la baie Missisquoi (CBVBM) au 450 248-0100.

2. A STRATEGY FOR IMPLEMENTING THE PLAN

Plan implementation includes coordinating state, federal, and provincial programs for the protection and restoration of Lake Champlain; assuring that the public is involved in Lake issues; and building local support through nongovernmental organizations and municipalities. Long-term monitoring of the Lake Champlain ecosystem's health and measuring the success or weaknesses of the plan are also important. Implementation must also link Lake issues to legislative bodies and interest groups and provide financial resources for specific projects and research.

Many cooperating agencies, organizations, and individuals have contributed their time, knowledge, and commitment to producing a comprehensive pollution prevention, control, and restoration plan for Lake Champlain. The result of these efforts, *Opportunities for Action (OFA)*, outlines priority strategies for protecting and enhancing the environmental, cultural, recreational, and economic activities of or relating to the Lake. The challenge now is to implement these strategies.

La mise en oeuvre du Plan

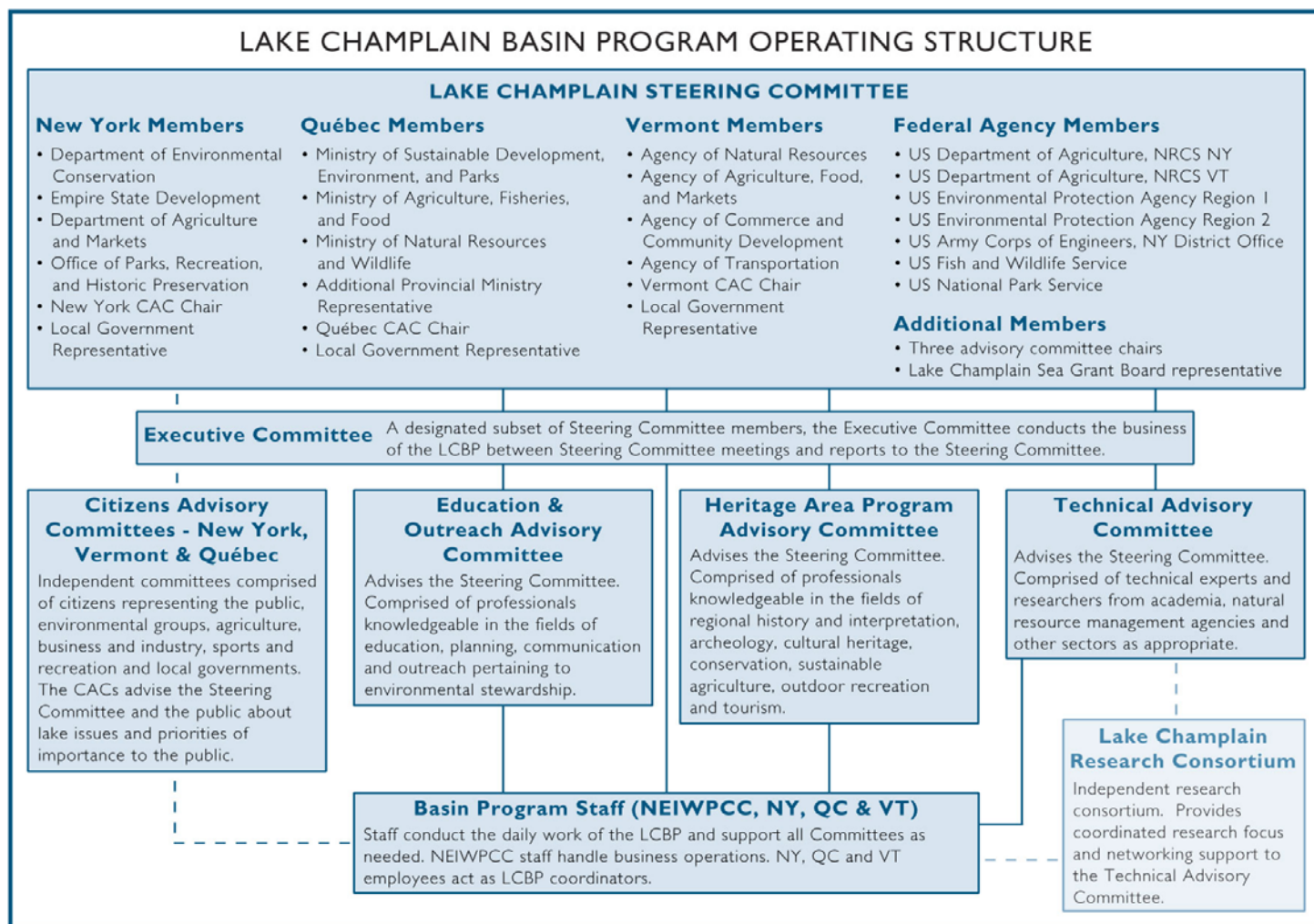
La mise en oeuvre du plan comporte plusieurs étapes dont la coordination des programmes d'assainissement de l'État du Vermont, de l'État de New York, de la province de Québec et du gouvernement fédéral américain, l'engagement du public dans la protection du lac et l'appui local par le biais des municipalités et des organismes non gouvernementaux. Le suivi continu de l'état des écosystèmes du lac et l'évaluation des succès et des échecs du plan occupent une place tout aussi importante. Finalement, la mise en oeuvre du plan doit se faire en collaboration avec les autorités gouvernementales et les groupes d'intérêt et prévoir des ressources suffisantes pour financer des recherches et des projets particuliers.

Le plan de prévention et contrôle de la pollution et la restauration du lac Champlain ont nécessité l'implication et la collaboration de plusieurs niveaux de gouvernement, l'engagement du public et des organismes non gouvernementaux. Le résultat de ces efforts se matérialise dans le document Perspectives d'Action où sont décrits les stratégies prioritaires pour protéger et améliorer l'environnement, la culture et les activités récréatives et économiques du bassin versant du Lac Champlain. Maintenant, le défi est la mise en œuvre de ces stratégies.

LAKE CHAMPLAIN BASIN PROGRAM ROLE AND STRUCTURE

As a partnership of provincial, state, and US federal agencies, the Lake Champlain Basin Program (LCBP) brings cross-boundary and multidisciplinary leadership experience to coordinating and implementing the plan. The LCBP works cooperatively with many partners to protect and enhance the environmental integrity and the social and economic benefits of the Lake Champlain Basin. The program is guided by the Lake Champlain Steering Committee, a board comprised of a broad spectrum of representatives of government agencies and the chairs of advisory groups representing citizen lake users, scientists, and educators. Steering Committee membership from New York, Québec, and Vermont reflects each jurisdiction's commitment to

the 2010 *Memorandum of Understanding on Environmental Cooperation on the Management of Lake Champlain among The State of New York, The State of Vermont and the Gouvernement of Québec*. US federal agency participation in the Lake Champlain Steering Committee, codified in *OFA*, reflects the federal commitments established in the *Special Designation Act of 1990* and the *Daniel Patrick Moynihan Lake Champlain Basin Program Act of 2002*.



For more information about the role and membership of each committee, see the descriptions below this section.

The US Environmental Protection Agency (USEPA) regularly enters into grant agreements with the New England Interstate Water Pollution Control Commission (NEIWPCC), New York, and Vermont to implement tasks according to a single coordinated LCBP workplan approved by the Lake Champlain Steering Committee. Most tasks are implemented by LCBP staff who, as NEIWPCC employees, provide management and continuity through annual budget cycles and who coordinate the advisory committees and procedures involved in annual operations. The states of New York and Vermont each enter into grant agreements with the USEPA to manage implementation tasks that may be more efficiently accomplished by state personnel. Both states maintain Lake Champlain Coordinators, with LCBP funding, who ensure that implementation

managed by the states reflects the intentions of the Lake Champlain Steering Committee. Other work in the U.S. sector of the basin is funded by federal appropriations to the National Park Service (NPS) and through other federally funded agencies and commissions. Federal appropriations reflect both the executive branch priority as a line in the President's budget and the Congressional commitment, through substantial and continuing Congressional support.

Work in the Canadian sector of the basin is funded by provincial appropriations in the Canadian Province of Québec. Led by the Québec Ministère du Développement durable, de l'Environnement et des Parcs (Ministry of Sustainable Development, Environment and Parks - QCMDDEP), the highest priorities of *OFA* are included in annual provincial ministry action plans.

Many essential research, monitoring, and resource management endeavors are developed with common methodologies on each side of the border so that data may be shared, analyzed, and reported easily. The successful experience of one jurisdiction is regularly shared with neighboring jurisdictions, and replication often is successful. Cross-marketing of programs, initiatives, and events and collaborative planning efforts are characteristic of the working relationships maintained by Steering Committee members.

Lake Champlain Steering Committee

As affirmed through the *Memorandum of Understanding* signed by the Governors of New York and Vermont and the Premier of Québec in May 2010, the Lake Champlain Steering Committee will continue its present role as a participatory forum in which key state, provincial, U.S. federal, and local leaders from New York, Québec, and Vermont can discuss issues of Lake Champlain and its watershed and coordinate policies and programs. As further codified by the *Daniel Patrick Moynihan Lake Champlain Basin Program Act of 2002* (U.S. Public Law 107-303), the LCBP is identified and authorized as the coordinated effort to implement *OFA*, with U.S. federal government participation and with federal funds.

Steering Committee Composition

Each (state and provincial) jurisdiction has identified its chief delegate, who hosts and chairs Steering Committee meetings in rotation; this pattern contributes to cross-boundary coordination and teamwork. The states of New York and Vermont and the province of Québec maintain the following (twenty-nine) partners on the Steering Committee to ensure a diversity of informed partners in the leadership of the LCBP.

- **Four New York State** agency representatives appointed by the governor: New York should consider the Department of Environmental Conservation (NYSDEC), Empire State Development (ESD), the Department of Agriculture and Markets (NYSDAM), and the Office of Parks, Recreation, and Historic Preservation (NYSOPRHP).
- **Four Vermont State** agency representatives appointed by the Governor: Vermont should consider the Agency of Natural Resources (VTANR), the Agency of Agriculture, Food, and Markets (VTAAFM), the Agency of Commerce and Community Development (VTACCD), and the Agency of Transportation (VTRANS).

- **Four Québec Provincial** representatives appointed by the Premier: Québec should consider three provincial representatives from the Ministère du Développement durable, de l'Environnement et des Parcs (QCMDDEP, Ministry of Sustainable Development, Environment and Parks), Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (QCMAPAQ, Ministry of Agriculture, Fisheries, and Food), and Ministère des Ressources naturelles et de la Faune du Québec (QCMRNF, Ministry of Natural Resources and Wildlife), and a fourth representative from provincial ministry leadership..
- **Three Local Government** representatives from municipalities in New York, Québec, and Vermont will ensure that Steering Committee decisions are well informed regarding local community interests. Local governments and the Steering Committee may nominate representatives and the corresponding governor or premier is encouraged to make a corresponding appointment.
- **Three Citizen Advisory Committee** chairs are Steering Committee members, one each from New York, Québec, and Vermont.
- **Three Advisory Committee** chairs, from the Technical Advisory Committee (TAC), Education and Outreach Advisory Committee (E&O), and Heritage Area Partnership Advisory Committee (HAPAC), are Steering Committee members.
- **One Lake Champlain Sea Grant** representative may serve as a member of the Steering Committee.
- **Seven US Federal Agency** representatives serve on the Steering Committee. Represented in these positions are:
 - the US Department of Agriculture Natural Resources Conservation Service, New York State Conservationist;
 - the US Department of Agriculture Natural Resources Conservation Service, Vermont State Conservationist;
 - the US Environmental Protection Agency Region 1;
 - the US Environmental Protection Agency Region 2;
 - the US Army Corps of Engineers, New York District Office;
 - the US Department of the Interior – Fish and Wildlife Service; and
 - the US Department of the Interior – National Park Service.Members of the New York and Vermont congressional delegations may participate in Steering Committee meetings in a nonvoting liaison role.

Committee Operating Protocols

- a) Steering Committee meetings are chaired by the member from the environmental agency of the jurisdiction hosting the meeting, QCMDDEP, NYSDEC, or VTANR.
- b) The Steering Committee conducts all meetings in compliance with the laws of the host jurisdiction while:
 - a. keeping meetings open and accessible to the public unless obligated to meet in executive session;
 - b. meeting in executive session only when considering confidential matters limited to:
 - review of competitive bids and awards,
 - personnel discussions related to appointment to or removal from a LCBP committee,

- LCBP human resource matters,
 - matters that would, in any of the three jurisdictions, be required to be maintained in confidence.
- c. taking no formal actions while in executive session.
- c) On a meeting-by-meeting basis, any Steering Committee member may, by written communication to the LCBP Manager in advance of the meeting, designate another individual to participate in his or her stead at a Steering Committee meeting with proxy voting rights. Written proxy authorizations are maintained in the files of the LCBP.
- d) No votes *in absentia* are permitted; members participating in real-time through conference call or other electronic or internet media sharing are considered present.
- e) Steering Committee meeting draft agendas will be shared with all members, interested media, and members of the public at least one week prior to a regularly scheduled meeting.
- f) Meeting minutes will be posted on the LCBP website within one week of approval.
- g) Committee members will maintain close adherence to the *LCBP Conflict of Interest Guidelines for Committee Members and Peer Reviewers*.

Steering Committee Charge

The charge of the Steering Committee includes:

- a) Provide a forum for discussion of policies and issues of mutual concern.
- b) Identify topics of mutual interest in which the exchange of information and cooperative actions will be beneficial.
- c) Implement the Lake Champlain Basin's long-term management plan *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin (OFA)*.
- d) Identify key budget priorities annually to guide the draft budget development by LCBP committees and management and identify additional resources necessary for plan implementation.
- e) Review the progress of cooperative efforts for management of Lake Champlain and make recommendations for future activities.
- f) Seek the involvement of the public and appropriate academic institutions in the joint effort to guide management of the Lake.
- g) Promote interaction among regulatory and management programs in the review of developments that affect the Lake.
- h) Revise and update *OFA* on a five-year schedule.
- i) Negotiate partnerships and commitments among agencies and groups to further implementation of *OFA*.
- j) Meet at least four times each year to facilitate communication and coordination among key partners working to implement *OFA*.
- k) Monitor and evaluate progress against plan benchmarks and communicate that information by periodically producing an annual implementation status report and other education and outreach tools.
- l) Select contractors and grant recipients for competed funds and approve Records of Decision as appropriate.
- m) Charge the Executive Committee and advisory committees with tasks as appropriate and form *ad hoc* subcommittees for special tasks as needed.

- n) Appoint chairs and members of the TAC, E&O, and HAPAC based on nominations recommended by the Executive Committee and forwarded by its Chair.
- o) Oversee the coordination of cultural heritage and recreational resource enhancement and stewardship programs of the Champlain Valley National Heritage Partnership.
- p) Make adjustments in the composition of the Steering Committee as needed to achieve the goals of the plan.

Executive Committee

To increase its effectiveness, the Steering Committee has assigned eleven of its members to comprise an Executive Committee to meet six to eight times per year between Steering Committee meetings to conduct LCBP business on behalf of the Steering Committee. New York, Vermont, and the US Environmental Protection Agency (USEPA) share chairmanship of the Executive Committee in a two-year rotation; this pattern contributes to stability in operational guidance of the LCBP, with appropriate leadership duties provided by the jurisdictions in which the LCBP is principally funded and in which the office is located.

Executive Committee Membership

The Executive Committee includes Steering Committee representatives of the New York State Department of Environmental Conservation, Québec Ministère du Développement durable, de l'Environnement et des Parcs (Ministry of Sustainable Development, Environment and Parks), Vermont Agency of Natural Resources, USEPA Region 1, USEPA Region 2, and the chairs of the six advisory committees (New York, Québec, and Vermont Citizen Advisory Committees (CACs), Technical Advisory Committee (TAC), Education and Outreach Advisory Committee (E&O), and Heritage Area Partnership Advisory Committees (HAPAC)). These eleven members make up the regular voting membership of the Executive Committee. However, any Steering Committee member may participate in any Executive Committee meeting with the option of voting if present. Executive Committee meeting draft agendas are distributed to the full Steering Committee one week in advance of meetings.

Executive Committee Charge

- a) Meet regularly to guide the work of the LCBP between Steering Committee meetings and provide interpretation of the intent of the Steering Committee to the LCBP management.
- b) Receive its charge for special tasks from the Steering Committee and report its actions to the Steering Committee, which has final authority on all LCBP policy matters. The Executive Committee is normally delegated to act between Steering Committee meetings with the full authority of the Steering Committee.
- c) Prepare the draft LCBP budget each fall based on task proposals recommended by LCBP management, and the chairs of TAC, E&O, and HAPAC. The Executive Committee Chair presents the recommended draft budget to the Steering Committee each winter for Steering Committee review, adjustment, and approval.
- d) Nominate chairs and members of the TAC, E&O, and HAPAC, based on recommendations from Steering Committee members and LCBP staff. The Executive Committee is the sole source of advisory committee nominations eligible for consideration by the Steering Committee.

- e) Consider potential contractors and grant recipients for competed funds based on LCBP staff reports of the competitive review processes and approve awards through records of decision as appropriate.
- f) Adhere to the meeting protocols applicable to Steering Committee meetings.

Citizens Advisory Committees (CACs)

The New York, Québec, and Vermont CACs serve as important liaisons to the public. As positions become available on the CACs, the states and province ensure that representatives from environmental groups, agriculture, business and industry, sports and recreation, and local governments are included.

CAC Membership

Stakeholder groups may nominate representatives, and the persons or agencies in New York, Québec, and Vermont who have the authority to appoint CAC representatives should include those nominees in the pool considered for appointment. All members of the CACs serve up to three-year appointments. The CACs elect their chairs, who serve as voting members of the Steering and Executive Committees.

The Role of the CACs

- a) Inform and involve the public on issues concerning the Lake and the Basin.
- b) Provide a regular forum for interest groups and local governments to discuss the issues facing the Lake and the Basin.
- c) Advise the Steering Committee about public concerns and interests.
- d) Provide a link between the Steering Committee and LCBP staff and state legislative bodies and groups implementing the plan at the local level.
- e) Provide recommendations to the Steering Committee about the reassessment and priorities of plan recommendations.
- f) Advise and encourage agencies responsible for implementing plan actions to follow through with their commitments, for example, by presenting an annual report of recommendations to the legislatures.
- g) Participate in review panels for LCBP grant programs as requested.
- h) Host public meetings for information exchange regarding plan implementation.

Technical Advisory Committee (TAC)

The Steering Committee appoints (for staggered three-year terms that are renewable), a Technical Advisory Committee comprised of professionals from academia, natural resource management agencies, and other sectors as it deems appropriate.

TAC Membership

TAC is comprised of five jurisdictional members and additional members-at-large appointed to three-year terms that are renewable.

- a) Five jurisdictional members: one technical expert each from New York State Department of Environmental Conservation, Québec Ministère du Développement durable, de l'Environnement et des Parcs (Ministry of Sustainable Development, Environment and Parks), and Vermont Agency of Natural Resources will be appointed by their respective jurisdictions to provide both objective technical and scientific expertise *and*

representation of their respective jurisdictional perspectives on technical issues. US Environmental Protection Agency Regions 1 and 2 each are represented on TAC, with nonvoting status, so that technical expertise from the primary funding agency is available in TAC discussions.

- b) All other TAC members are members-at-large. Members-at-large are appointed by the Steering Committee solely based on their technical and scientific expertise, in order to provide objective technical and scientific expertise needed by the TAC, but not to represent institutional or jurisdictional entities. No attempt is made to provide specific stakeholder representation on TAC, but balance of representation from jurisdictional areas may be considered. TAC members serve at the pleasure of the Steering Committee. The chair of the TAC is appointed by the Steering Committee and serves as a voting member of the Steering and Executive Committees.

The Role of the TAC

The role of the TAC includes the following:

- a) Present the Steering Committee and LCBP staff with objective information to be used in the decision-making process as requested, including:
 - i. emerging technical and scientific management issues,
 - ii. the necessary research or actions to address those issues, and
 - iii. draft task descriptions and funding recommendations.
- b) Provide professional review of proposals for LCBP-funded technical and scientific studies and projects, as requested.
- c) Evaluate interim and final products and reports for LCBP-funded technical and scientific studies and projects, as requested.
- d) TAC meetings are open and accessible to the public except when TAC is obliged to meet in closed session.
 - i. TAC will meet in closed session only when considering confidential matters limited to:
 - a. review of competitive bids and awards,
 - b. review of interim or final reports drafts submitted to the LCBP by a contractor.
 - ii. TAC will take no formal actions while in closed session.
- e) On a meeting-by-meeting basis, any TAC member may, by written communication to the LCBP Manager in advance of the meeting, designate another individual to participate in his or her stead at a TAC meeting with proxy voting rights. Proxy authorizations are noted in TAC meeting summaries.
- f) No votes *in absentia* are permitted; members participating in real-time through conference call or other electronic or internet media sharing are considered present.
- g) Committee members will maintain close adherence to the *LCBP Conflict of Interest Guidelines for Committee Members and Peer Reviewers*.

As organizations and partnerships established independently of the LCBP continue to address technical issues in the Basin and function in their own right, they also may provide important input to the TAC. These organizations include the Lake Champlain Fish and Wildlife Management Cooperative, the Aquatic Invasive Species Rapid Response Task Force, the Lake

Champlain Research Consortium, Lake Champlain Sea Grant, and several other groups and partnerships.

Heritage Area Partnership Advisory Committee (HAPAC)

The Steering Committee appoints the Heritage Area Program Advisory Committee to provide advice concerning the implementation priorities for the *Champlain Valley National Heritage Partnership Management Plan*.

HAPAC Membership

HAPAC is composed of professionals from public and private sectors knowledgeable in fields that address regional history, historical interpretation, archeology, cultural heritage, conservation, sustainable agriculture, outdoor recreation, and tourism. HAPAC appointments are made solely on the basis of professional expertise in order to provide objective guidance needed by the LCBP, but not to represent institutional or jurisdictional entities. No attempt is made to provide stakeholder representation on HAPAC. HAPAC members serve at the discretion of the Steering Committee. The chair of the HAPAC, appointed by the Steering Committee, serves as a voting member of the Steering and Executive Committees.

The Role of the HAPAC

The role of the HAPAC includes the following:

- a) Present the Steering Committee and LCBP staff with objective information to be used in the decision-making process as requested, including:
 - i. emerging heritage resource management issues,
 - ii. the necessary research or actions to address those issues, and
 - iii. draft task descriptions and funding recommendations.
- b) Provide professional review of proposals for LCBP-funded heritage-related implementation tasks as requested.
- c) Evaluate interim and final products and reports for LCBP-funded heritage-related studies and projects as requested.
- d) Advise the Steering Committee and staff regarding opportunities for trans-boundary partnerships, key partnerships, and cooperative projects both within the Champlain Valley National Heritage Partnership and adjacent areas.
- e) HAPAC meetings are open and accessible to the public except when HAPAC is obliged to meet in closed session.
 - i. HAPAC will meet in closed session only when considering confidential matters limited to:
 - a. review of competitive bids and awards,
 - b. review of reports drafts submitted to the LCBP by a contractor.
 - ii. HAPAC will take no formal actions while in closed session.
- f) On a meeting-by-meeting basis, any HAPAC member may, by written communication to the LCBP Manager in advance of the meeting, designate another individual to participate in his or her stead at a HAPAC meeting with proxy voting rights. Proxy authorizations are noted in HAPAC meeting summaries.
- g) No votes *in absentia* are permitted; members participating in real-time through conference call or other electronic or internet media sharing are considered present.

- h) Committee members will maintain close adherence to the *LCBP Conflict of Interest Guidelines for Committee Members and Peer Reviewers*.

As organizations and partnerships established independently of the LCBP to address cultural heritage and recreational issues in the Basin continue to function independently, they may also provide input to the HAPAC. These organizations include the regional marketing organizations and chambers of commerce, scenic byways programs, cultural heritage tourism initiatives, arts councils in both states, and several other groups and partnerships.

Education and Outreach Advisory Committee (E&O)

The Steering Committee should appoint an E&O Advisory Committee comprised of professionals from educational institutions and organizations in the Basin and with representation from the CACs and other appropriate sectors. The E&O members serve at the discretion of the Steering Committee. The chair of the E&O Committee, appointed by the Steering Committee, serves as a voting member of the Steering and Executive Committees.

E&O Committee Membership

The E&O Committee is composed of professionals from public and private sectors knowledgeable in fields that include education, public information technology, electronic and broadcast media, and outreach pertaining to environmental stewardship and related topics of the plan. E&O appointments are made solely on the basis of professional expertise in order to provide objective guidance needed by the LCBP, but not to represent institutional or jurisdictional entities. No attempt is made to provide stakeholder representation on E&O. E&O members serve at the discretion of the Steering Committee. The chair of the E&O Committee, appointed by the Steering Committee, serves as a voting member of the Steering and Executive Committees.

The Role of the E&O Committee

The role of the E&O Committee includes the following:

- a) Present the Steering Committee and LCBP staff with objective information to be used in the decision-making process as requested, including:
 - i. emerging educational and outreach opportunities and issues,
 - ii. the necessary programmatic actions to address those issues, and
 - iii. draft task descriptions and funding recommendations.
- b) Provide professional review of proposals for LCBP-funded education and outreach implementation tasks, as requested.
- c) Evaluate interim and final products and reports for LCBP-funded education and outreach tasks, as requested.
- d) Advise the Steering Committee and staff regarding opportunities for trans-boundary partnerships, key partnerships, and cooperative projects to enhance education and outreach program effectiveness.
- e) Advise the Steering Committee and staff regarding opportunities for the application of multimedia and multimodal technical tools to enhance education and outreach program effectiveness.

- f) E&O meetings are open and accessible to the public except when E&O is obliged to meet in closed session.
 - i. E&O will meet in closed session only when considering confidential matters limited to:
 - a. review of competitive bids and awards,
 - b. review of reports drafts submitted to the LCBP by a contractor.
 - ii. E&O will take no formal actions while in closed session.
 - g) On a meeting-by-meeting basis, any E&O member may, by written communication to the LCBP Manager in advance of the meeting, designate another individual to participate in his or her stead at an E&O meeting with proxy voting rights. Proxy authorizations are noted in E&O meeting summaries.
 - h) No votes *in absentia* are permitted; members participating in real-time through conference call or other electronic or internet media sharing are considered present.
 - i) Committee members will maintain close adherence to the *LCBP Conflict of Interest Guidelines for Committee Members and Peer Reviewers*.
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KEY FUNCTIONS OF *OPPORTUNITIES FOR ACTION*

The Lake Champlain Steering Committee has identified key functions that must be accomplished to successfully implement the plan. These functions include the following:

Coordinate Programs and Implementation Activities

Coordination among government agencies, regional and local governments, the public and private sectors, nonprofit organizations, residents, and visitors is critical to successful implementation of the plan. Coordination involves facilitating data management and information exchange, resource and data sharing, and improving efficiency among key partners while not duplicating programs or creating new layers of bureaucracy.

Inform and Involve the Public

Public information and involvement efforts are required for successful implementation of the plan. A public that understands the Basin's water quality and resource management issues can make informed choices about the long-term protection and restoration of the Lake. A commitment to lifelong education about Basin resources is needed to facilitate this process. Furthermore, involving the public in planning and implementation increases both the sphere of responsibility for action and support for recommended actions.

Support Local Level Implementation

Implementation at the local level is the cornerstone of successful plan implementation. Addressing pollution problems at the local level is important because those most affected by an issue are often best able to address that issue. Many communities have existing resources and organizations to help implement programs, but may lack technical expertise, adequate funding, or access to additional human and financial resources. Building local capacity for plan implementation requires strengthening technical assistance to community groups and may require additional financial support for local programs.

Measure and Monitor Success Relative to Plan Benchmarks

A critical component of watershed planning is monitoring, which must accomplish two roles. First, it must be a source of information regarding the health of the Lake and Basin. Management capacity hinges on the availability and reliability of comprehensive monitoring of key ecosystem indicators. Second, monitoring must measure the success of management programs and ensure accountability to the public. Monitoring can help determine progress toward goals and whether or not priorities need to be adjusted.

Create Links with Legislative Bodies

Successful plan implementation depends greatly on the ability to gain political support for recommended actions. A framework is needed to communicate needs and recommend actions concerning the Lake to legislative bodies who formulate federal, state, and local laws and appropriate funds to various programs.

Create Links with Interest Groups

Implementation of the recommended actions in the plan depends greatly on continued support from numerous individuals and groups. Decisions concerning the management of the resources in the Lake Champlain Basin should be made through a consensus-based, collaborative process that encourages the expression and understanding of diverse viewpoints. This process helps integrate economic and environmental goals into plan implementation and ensures that a focus on implementation at the local level is maintained.

Conduct Research

The plan identifies several areas in which research is needed. Research has been an important component of preparing and updating the plan and will continue to provide critical information as implementation evolves. Improved knowledge of the physical, chemical, biological, and social characteristics of the Lake and Basin will help resource managers make effective policy and management decisions in the future.

Secure and Direct Funding

The cost of implementing the plan is high, though not as high as the potential costs of failing to act. The ability to implement watershed programs rests heavily on the availability of and access to funding sources. A mechanism must be in place to seek public and private funding for program implementation as appropriate and to allocate resources to appropriate entities based upon recommended priorities. Refer to *Strategies for Funding Implementation* for a discussion of funding implementation efforts.

Update Plan Recommendations

Because environmental conditions in the Basin change over time and new technologies will be discovered, priorities for action in the plan may change. Some management programs may become more important, others less. The plan should be reviewed and updated periodically to reflect these changing conditions. Moreover, the Steering Committee periodically should identify new actions requiring implementation based on reports of emerging issues from advisory committees and the LCBP's adaptive management initiative.

Advise and Encourage Agencies Responsible for Implementation

As the plan evolves, various agencies will fulfill their responsibilities for implementing certain actions. Listed benchmarks provide gauges for monitoring success. Those responsible for implementing actions must be encouraged to follow through with their commitments and reach these benchmarks. Regular reporting of accomplishments, presented with the plan on the LCBP website plan.lcbp.org will both document and communicate progress as it is achieved.

PARTNERS IN OPPORTUNITIES FOR ACTION IMPLEMENTATION

Countless partners – including federal, state, and provincial agencies, watershed and conservation groups, heritage and recreation organizations, and local citizens – are working to prevent pollution and protect, restore, enhance, and enjoy the water quality of the Lake Champlain Basin. *OFA* provides a common road map for all of the various partners in New York, Québec, and Vermont. While many different groups may work on any given task in order to accomplish a general action, the tasks presented in Chapters 3 through 10 are associated with potential “*lead partners*” who can play a pivotal role in accomplishing the goals of this plan in order to protect Lake Champlain. The organizations, agencies, and jurisdictions identified as lead partners for the tasks are the signatories of *OFA* and will be responsible for addressing progress and periodically updating the status of each task.

The Lake Champlain Steering Committee, which sets resource management policy and approves budget allocations for the LCBP, relies on the efforts of all partners. As *OFA* is a plan for all sectors of society, the following sections describe the general roles and responsibilities that fall to the public, various levels of government, organizations, and the private sector in meeting the demands to protect the aquatic resources of the Lake Champlain Basin.

Local Residents and Visitors

The cumulative results of many individual actions make perhaps the greatest difference in the complex issues facing the Lake Champlain Basin. In this context, all members of the public are key partners in implementation of *OFA*. Nearly 600,000 people live, work, and play in the Lake Champlain Basin, which they share with more than six million visitors annually. Underlying all of the actions in the plan is the need for increased public involvement in the care of the Lake and its Basin. Residents of the Basin can and must be involved in the implementation process in many ways. They can change activities in their own households and workplaces, maintain septic systems properly, and reduce the use of toxic chemicals in cleaning and lawn care. They can support local initiatives for action or demand action and leadership in their own communities to address problems where progress is inadequate. They also can volunteer for local boards, monitor their community’s activities, and participate in citizen groups advocating for a cleaner Lake. Most importantly, residents can inform themselves about caring for their watershed and ensure that their own behavior contributes to improvements. The plan emphasizes education and outreach programs for this reason. Without effective public involvement, the efforts of jurisdictions will not succeed.

Visitors often become involved in implementation of the plan through their support of the economic and environmental integrity of the Basin. The inherent beauty of the Basin is a key attraction for visitors, who often bring a heightened sense of appreciation of the quality of the

natural environment. They spend numerous dollars in the Basin and can act in environmentally sound ways when they are here. Business must work to encourage responsible behavior of their clients, particularly by demonstrating their own commitments and actions to reduce contamination and improve the water quality of the Lake and its Basin.

State and Provincial Agencies

State and provincial agencies in New York, Québec, and Vermont have several key roles in protecting the Basin's resources. They administer a number of critically important resource management programs, including water-quality protection programs, wetlands protection programs, fish and wildlife management programs, and recreation and cultural resource programs, among others. The states and province also provide technical and financial assistance, such as training for wastewater treatment plant operators and funding for local nonpoint source pollution control projects, to ensure that the appropriate people have the expertise to implement their programs.

Although several state and provincial agencies are listed in the plan, the Regional Director of the New York State Department of Environmental Conservation (NYSDEC), the Regional Director of Québec Ministère du Développement durable, de l'Environnement et des Parcs (Ministry of Sustainable Development, Environment and Parks - QCMDDEP), and the Secretary of the Vermont Agency of Natural Resources (VTANR) have major roles in implementation. As the leading environmental agencies in each jurisdiction, NYSDEC, QCMDDEP, and VTANR have critical responsibilities in every major action area in the plan. Other key state agencies are the Vermont Agency of Agriculture, Food, and Markets (for agricultural land use, nonpoint source and pesticide issues) and the New York Department of Agriculture and Markets (for nonpoint source issues); Vermont Agency of Commerce and Community Development and New York's Empire State Development (for economic issues); New York and Vermont Departments of Health (for health advisories); and Vermont Division for Historic Preservation, New York State Office of Parks, Recreation, and Historic Preservation, and New York Department of State (for recreation and cultural resource issues). Other key ministries in Québec include Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (Ministry of Agriculture, Fisheries, and Food), and Ministère des Ressources naturelles et de la Faune du Québec (Ministry of Natural Resources and Wildlife).

US Federal Agencies

Many of the activities necessary to implement the plan need to occur at the local level and, to some degree, at the state level. However, environmental restoration in the Lake Champlain Basin often benefits from collaboration and support from federal agencies carrying out restoration projects on the ground. US federal agencies have taken a vital role in providing support for plan implementation in the unique network of partnerships reflected below. Several federal agencies have signed a *Memorandum of Understanding* to facilitate their cooperation and coordination through the LCBP. Representatives of these agencies are active in many of LCBP activities.

- The **USEPA** provides financial and technical support to the states for implementing several federal environmental programs and is responsible for implementation and enforcement of the Clean Water Act and other key environmental laws. It ensures that all

Americans are protected from significant risks to human health and the environment where they live, learn, and work.

- The **US Department of Agriculture** provides financial and technical assistance on best management practices for controlling nonpoint source pollution and especially for preventing pollution from agricultural runoff.
- The **US Department of the Interior** supports the management plan through three services.
 - The **US Fish and Wildlife Service** (USFWS) cooperates with the states in the management of fish and wildlife resources, carries out site-specific habitat restoration projects, operates a National Wildlife Refuge and a National Fish Hatchery in the Basin, and helps ensure that the actions of other federal agencies are consistent with the needs for fish and wildlife conservation.
 - The **National Park Service** serves as a partner through the National Heritage Areas Program to provide support, financial assistance, and advice on managing the important cultural heritage and recreational resources within the newly designated Champlain Valley National Heritage Partnership.
 - The **US Geological Survey** (USGS) provides financial and technical support through stream gauge monitoring and watershed research concerning nutrients and contaminants of concern.
- The **US Army Corps of Engineers** (USACE) is authorized by Section 542 of the Water Resources Development Act of 2000 (revised 2007) to provide assistance with planning, designing, and implementing projects that contribute to protection and enhancement of the Lake Champlain water quality, water supply, ecosystem, and other water-related issues while preserving and enhancing the economic and social character of the communities within the watershed.

The types of projects eligible for assistance include, but are not limited to, river restoration, stormwater management, wetland creation/restoration, watershed plans, planning aid reports, alternatives analyses, invasive species control/removal, and wastewater treatment plant studies. All projects and studies are cost shared 65-35 with a nonfederal partner (any local governmental agency, Indian Tribe, or nongovernmental organization). The non-federal 35 percent share may be provided as in-kind services directly related to the task or as cash.

The USACE works in partnership with the LCBP to implement the Section 542 program within the Lake Champlain Basin. The LCBP coordinates invitations to and applications from interested parties within the Basin to request USACE assistance in the development of projects under the Section 542 program. The USACE then selects projects ranked highest in priority by the LCBP for implementation, given funding availability. Approved projects are then coordinated solely through the USACE throughout implementation.

In addition to the program-specific authority discussed above, the USACE also has several general and single-project authorities that can provide assistance to Lake Champlain. Please contact the New York District Office for particulars.

- The **US Department of Commerce**, through the National Oceanographic and Atmospheric Administration and its National Sea Grant College Program, provides financial and technical support for research, management of fisheries and other aquatic resources, and related watershed programs operated by Lake Champlain Sea Grant.
- The **U.S. Department of Transportation**, through the **National Scenic Byways** program, provides financial and technical support for recreational, economic, and water-quality programs including the Lake Champlain Byways programs (Vermont) and Lakes to Locks Passage (New York).

New England Interstate Water Pollution Control Commission (NEIWPCC)

Established by the US Congress in 1947, NEIWPCC is a 501 (c)(3) corporation that also operates under a seven-state compact. NEIWPCC's primary mission is to assist member states (New England and New York) by providing coordination, public education, training, and leadership in the protection of water quality and related work in the region. The role of NEIWPCC in the Lake Champlain Basin is to conduct the business and financial affairs of the LCBP, including staffing and administration of grants and contracts, according to its rules and procedures. LCBP operations handled by NEIWPCC conform to its Quality Management Plan, approved by the USEPA.

Local Governments

Most of the solutions to problems affecting the Basin, such as nonpoint source pollution from urban and agricultural land uses, failing septic systems, planning for future development, and recreation conflicts, are best implemented at the local level. The plan identifies several actions that local governments can implement to address these matters. Key partners likely to implement such actions are local boards and commissions. Because local governments have primary authority over planning and zoning (in all cases except agriculture and silviculture in Vermont) and some public health issues, transferring authority to other groups is not envisioned in most situations. Local governments can also incorporate a watershed planning focus into local comprehensive plans.

Regional Government Organizations

Protecting Lake Champlain requires cooperation among the communities within its watershed. Watersheds cross town boundaries, and one town acting alone may not be sufficient to address all issues. Protecting the entire Basin demands a high level of attention from all municipalities in the watershed. Regional organizations – such as the county planning offices in New York and the regional planning commissions in Vermont – work with a number of jurisdictions to coordinate efforts that address issues of mutual concern. They will continue to be key partners in focusing implementation efforts through a watershed approach to planning and ensuring that the recommendations of the plan are carried out equitably.

Legislative Bodies

Legislative bodies in the Basin are responsible for passing laws and appropriating funds for many programs important to the Lake. Several actions in the plan call for consistent policies among New York, Québec, and Vermont. This requires extensive cooperation among their legislative bodies. Successful implementation also requires that legislative bodies respond to the will of their constituents and act decisively and creatively to protect and enhance the resources of the Basin in the face of technical, political, and financial obstacles.

Nongovernmental Organizations

Many actions in the plan list nonprofit and citizen-based organizations as potential key partners. Watershed associations and environmental groups have long been active in organizing and supporting the activities of individual interests in the Basin. Examples of activities by nonprofit/nongovernmental organizations that implement elements of the plan include water-quality monitoring, research, and conservation of cultural heritage resources found submerged in the Lake. Citizen groups, including watershed organizations, have been especially successful in implementing educational workshops, streambank stabilization, toxin reduction initiatives, aquatic species control, public forums, the restoration of contaminated sites, the encouragement of low-impact recreational activities, and continued communication with the LCBP about emerging issues and priorities.

Academic Institutions and Research Organizations

Academic institutions, research organizations, and cooperative extension programs have served vital roles in studying Lake Champlain and its Basin. Institutions such as the University of Vermont, SUNY Plattsburgh, Paul Smiths College, St. Michaels College, Institut de Recherche et de Développement en Agroenvironnement (IRDA), McGill University, Université de Sherbrooke, Cornell University, Middlebury College, Green Mountain College, Johnson State College, and others have conducted various research projects on the Lake and the Basin. They also have been highly effective in educating students, teachers, and other citizens about Lake Champlain issues. Many actions in the plan call for research concerning Lake-wide problems and emerging issues. Continued plan implementation requires continued participation by academic institutions and research organizations and depends greatly on the soundness of data and information collected by them.

Several academic institutions have established a multidisciplinary research and education program called the Lake Champlain Research Consortium. Membership in the Consortium currently consists of academic institutions conducting research within the Basin boundaries. The Lake Champlain Research Consortium collaborates with the LCBP periodically to sponsor research symposia and conferences, and identifies research needs and priorities related to the management issues in the plan.

Coordinating Organizations

The need for state and international communication and cooperation regarding the management of the Lake Champlain Basin has been apparent since the 1940s. Numerous successful efforts have brought the two states and countries together to deal with common issues since that time.

The Lake Champlain Fish and Wildlife Management Cooperative was created through a written agreement in 1973 by the USFWS, the NYSDEC, and the Vermont Department of Fish & Wildlife. The Cooperative Agreement, which has been updated several times, created a Policy Committee consisting of program directors from the three agencies and management and technical committees of agency staff. The Cooperative works closely with the Québec Ministère des Ressources naturelles et de la Faune.

The Lake Champlain Ecosystem Team is an association of organizations involved in the conservation of plants, animals, and their habitats in the Lake Champlain watershed. The Lake Champlain Ecosystem Team maintains and enhances ecological integrity throughout the Basin. Their efforts include enhancing interdisciplinary cooperation and partnerships among federal, state, and private conservation organizations and academic institutions; facilitating and coordinating biological resource conservation activities; and exchanging information.

International Treaty Organizations

The Boundary Waters Treaty of 1909 created the International Joint Commission (IJC) to resolve and to avoid potential disputes regarding the use of boundary waters along the US and Canadian border. IJC membership is comprised of six commissioners appointed by the President of the United States and the Prime Minister of Canada. The IJC convened a Champlain-Richelieu Board during the 1970s to examine regulation of water levels in Lake Champlain and more recently has convened a Study Board to guide LCBP research and planning endeavors that it is funding in the Missisquoi River Basin.

The International Great Lakes Fishery Commission (GLFC) was created by the 1954 Convention on Great Lakes Fisheries between the United States and Canada to coordinate fisheries research, facilitate multi-jurisdictional cooperation through strategic planning, and manage sea lamprey populations in the Great Lakes. The Great Lakes and Lake Champlain share many natural resource challenges. The GLFC, the LCBP, and the USFWS entered into a *Memorandum of Understanding on Native Species and Habitat Restoration and Water Quality Improvements* in 2010.

International Partnerships

The Lake Champlain Basin and Adirondack Region have been designated as one of the United Nations Education, Scientific, and Cultural Organization's (UNESCO) international biosphere reserves. This designation is strictly honorary and carries with it no restrictions, regulations, or funding. Additionally, the Lake Champlain Basin is a demonstration watershed for the UNESCO Hydrology for the Environment, Life, and Policy (HELP) initiative led by the International Hydrological Programme. HELP focuses on integrated resource management through the creation of a framework for water law and policy experts, water resource managers, water scientists, and users to work together on water-related problems.

The LCBP is a founding member of the Governing Board of the North American Network of Basin Organizations (NANBO) which is associated with the International Network of Basin Organizations, devoted to collaboration among management entities in the stewardship of watersheds. Based in Québec and with initial funding from the Province of Québec, NANBO members from Canada, the United States, and Mexico meet regularly to share information on

water resource management challenges and to exchange experience in addressing common contaminant problems in respective jurisdictions. LCBP represents the US watersheds on the Governing Board.

Through these international partnerships, the LCBP has served as a model for integrated water resources management. Working with other basins that have similar hydrologic parameters has led to scientific data exchange and enhanced management of water resources that benefit all partners. *OFA* plan implementation has resulted in a number of valuable tools and lessons – such as the development of water-quality indicators, a rapid response plan for aquatic invasive species in the Basin, and diverse stakeholder engagement through nonbinding consensus-based agreements – that may be shared with HELP, NANBO, and INBO basins.

Business and Industry

The activities of private businesses and chambers of commerce are a critical component of protecting the resources that support the economic vitality of the Basin. Voluntary efforts to recycle and prevent pollution are examples of how the private sector has been active in implementing elements of the plan. Educational partnerships with television and other news media have tremendously increased public awareness of the importance of individual citizen participation and community involvement in good Lake stewardship practices. Chambers of commerce have been effective at drawing together business interests to assist in the planning process and will continue to contribute knowledge through the course of plan implementation.

THEMES FOR IMPLEMENTATION

Several themes that have emerged from the planning process should guide agencies, organizations, and individuals as they implement *OFA*. These themes include:

Partnership Approach

Numerous agencies and organizations are currently involved in successful programs to manage the resources of the Basin. Implementation of the plan relies on these groups to continue their successful efforts and expand their capabilities through the formation of partnerships. Partnerships can increase communication and coordination among various levels of government, the private sector, and citizens. Partnerships also reduce duplication of efforts, increase efficiency and effectiveness in the use of human and financial resources, evolve as needed, contribute to an informed and involved citizenry, accomplish important goals without the use of new regulations or new layers of government, and ensure a sharing of responsibility for implementing the plan.

Ecosystem-Based Approach

OFA calls for an ecosystem-based approach to planning and management that considers the Lake and its entire drainage Basin as a whole, interconnected, complex system. Each component of the system, including humans, affects other parts of the system. For instance, increased phosphorus levels in the Lake cause algal blooms that deplete oxygen levels, thereby affecting fish populations and populations of other Basin species that depend on fish as a food source. Sound resource management must take into consideration the ways in which various actions will affect other resources in the ecosystem.

Watershed Approach

More than 95 percent of the water in Lake Champlain passes through the 8,234 square miles (21,326 km²) of the Basin as surface and subsurface runoff before reaching the Lake. As a result, land-use activities and pollution sources throughout the Basin have a tremendous impact on the Lake and its ecosystems. Restoration or protection based on watershed boundaries rather than political boundaries better address polluted or threatened areas. In addition to applying the watershed approach on a Basin-wide level, *OFA* encourages the watershed approach at a local level. This offers opportunities for citizens to improve water quality based on their knowledge of their local area and for neighboring communities to develop innovative ways to solve pollution problems within their local watersheds. Empowering local communities and their organizations to collaborate gives any effort a better chance of real, sustained success. Implementation of the plan continues to use a watershed approach that links the Lake with activities in its watershed.

Integration of Environmental and Economic Goals

A healthy Lake Champlain is crucial to a strong regional economy, and a strong economy is good for the Lake. This plan recommends actions to protect and restore the ecological and cultural resources of the Basin while ensuring economic benefits for long-term positive change in the Lake. Finding the most cost-effective actions to protect and enhance the quality of the Lake while maintaining the economic health of the region is an extremely important and difficult task in implementing the Plan.

OFA includes recreational and cultural heritage interests in its Basin-wide approach to watershed protection. Protecting and expanding opportunities for Basin residents to enjoy clean water and encouraging public appreciation of the rich cultural heritage associated with the Lake are integral elements of both watershed protection and regional economic goals.

Pollution Prevention

Pollution prevention focuses on reducing or eliminating the generation of pollutants at their sources. Pollution-prevention efforts often cut industrial and public costs in the long run by reducing the need for expensive waste treatment, hazardous waste disposal, and cleanup. Such efforts can also reduce the need for regulatory compliance measures, which are costly and time consuming. Pollution prevention is often more economically feasible than subsequent remediation of polluted sites and is a prime method for deterring future harm to ecosystems.

Consensus-Based, Collaborative Approach to Decision Making

OFA is the result of numerous cooperating agencies, organizations, and individuals combining their efforts to protect and enhance the resources of the Lake Champlain Basin while solving identified problems. Implementing the plan continues to involve a broad range of participants in a consensus-based approach to decision making. Encouraging numerous stakeholders to provide input strengthens the outcomes of the decision-making process and broadens the base of citizens and organizations responsible for and active in plan implementation.

Adaptive Management and Ecosystem Indicators

Since its inception, *OFA* has been an evolving plan to restore and protect water quality and the remarkable natural and cultural resources of the Lake Champlain Basin. Building a formal adaptive management framework into the latest edition ensures that this evolution continues to

be responsive to the outcomes of management actions and a changing understanding of the ecosystem. Adaptive management consists of a structured approach to management decisions that incorporates past experience, current knowledge, and future projections about the effectiveness of environmental policies. In adaptive management, an action plan is developed based on best current professional judgment, the plan is implemented, data are collected and evaluated to monitor effectiveness, and adjustments are made to reflect new knowledge (Watzin 2007). It is a dynamic process that results in an evolving document rather than a static plan. Successful program implementation relies on creating measurable priority actions and tasks in order to assess their level of implementation and resulting effectiveness.

Lead partners have been identified in this document for all actions and tasks. In addition, where possible, the actions have measurable outcomes so that progress can be tracked and made publicly available. Using an adaptive management plan, implementation is monitored, along with the state of the ecosystem and the human pressures on it. This is done through an ecosystem indicators approach that LCBP adopted and first presented in 2008 through the *State of the Lake* and *Ecosystem Indicators* reports. New versions of these reports will be published periodically on indicators directly related to *OFA*.

In developing the first edition of *OFA* (1996), the Lake Champlain Management Conference analyzed the capabilities of existing local, regional, state, and federal organizations and determined that these organizations should be responsible for implementing the plan as part of an integrated effort. Informing and involving the public at the local level is an important means through which recommended actions are successfully carried out. When the first edition of *OFA* was approved, the planning task of the Management Conference was concluded and it ended its existence, passing the tasks of plan implementation to the Lake Champlain Steering Committee.

The Lake Champlain Steering Committee has followed the guidance of the Management Conference through the subsequent fifteen years of plan implementation (1996 through 2010). This chapter describes the framework that the Lake Champlain Steering Committee finds most effective for continued implementation of the plan. The framework described below is based on the established patterns of operations, is responsive to the requirements and constraints of the US federal appropriations that comprise the principle funding of the LCBP, and relies extensively on the partnerships developed in the past fifteen years of implementation.

Measuring and Monitoring the State of the Lake

Monitoring environmental conditions in the Lake and Basin is an integral component of measuring the effectiveness of lake and watershed management efforts. Data produced from monitoring activities provide information on water-quality trends, natural processes, and basic ecosystem characteristics. Managing this information and making it available to policymakers, managers, researchers, community groups, and public stakeholders maximizes the success of management efforts and helps managers recognize strategies that are unsuccessful. Monitoring projects cover a wide range of interests from forest health and biodiversity to atmospheric deposition and surface water quality.

LCBP's annual monitoring programs include the Lake Champlain Long-Term Water Quality and Biological Monitoring Program, the Blue-green Algae Monitoring Program, the Lake Champlain

Zebra Mussel Monitoring Program, and the Vermont Lay Monitoring Program, which has assessed eutrophication-related parameters using citizen volunteers and a consistent methodology every year since 1979 (Picotte 2008).

Recent analyses conducted by the USGS to assess nutrient concentrations entering the Lake through the tributary network indicate that phosphorus loads from many tributaries decreased slightly between 1999 and 2008. These analyses rely on long-term phosphorus data sets, include the relative roles of point source versus nonpoint source pollution, incorporate groundwater into the depiction of surface water quality, and reduce the confounding influence of substantial year-to-year variations in stream flow. The results show encouraging progress toward achieving ecosystem restoration goals in several parts of the Lake Champlain Basin. Trends show that loads for thirteen tributaries had overall decreases between 1990 and 2008, nine tributaries had decreases between 1990 and 2000, and fifteen tributaries had decreases between 2000 and 2008 (Medalie and Hirsch 2010).

Role of the LCBP and Partners in Water Quality and Biological Monitoring

Water-quality and biological monitoring data are necessary to understand the health of the Lake and its Basin. These data can help partners to measure the relative success of Lake and watershed management efforts and to track progress over time. Monitoring data provide indicators of success and inform the adaptive management process to continue to improve the water quality of Lake Champlain. Below are several key tasks for partner implementation that will continue and expand water-quality and biological monitoring in the Lake Champlain Basin.

PRIORITY ACTIONS

2.1) Continue and expand monitoring of key baseline parameters in the Lake Champlain Basin to support the adaptive management process.

ID	Lead Partner	Task
2.1.1	LCBP, New York, Québec, Vermont	Continue the bistate Lake Champlain Long-Term Water Quality and Biological Monitoring Program and related monitoring in Québec.
2.1.2	LCBP	Continue annual recommendation to fund the stream gauging network.
2.1.3	LCBP	Expand monitoring in targeted watersheds to evaluate effectiveness of BMP implementation for control of nonpoint source pollution.
2.1.4	LCBP	Support and coordinate development of annual data reports, annual load estimates, and periodic trends analyses.
2.1.5	LCBP, New York, Vermont	Expand monitoring at tributary mouths to obtain data sufficient to calculate annual loadings and to measure success of phosphorus reduction goals more accurately.
2.1.6	LCBP, USEPA, New York, Québec, Vermont, LCSG	Improve understanding of Lake Champlain hydrodynamics and its effects on in-Lake phosphorus concentrations, toxic substances, and pollutant transport to drinking-water intakes. Potential monitoring parameters could include water level, temperature, and water current. Coordinate with local academic institutions to accomplish this task.
2.1.7	LCBP	Continue and expand ecosystem indicators project and periodically publish State of the Lake Reports.

2.2) Create a unified data access system for coordination and data sharing among stakeholders in the Basin and produce timely and accessible summary reports for the

general public.		
ID	Lead Partner	Task
2.2.1	LCBP	Establish an online information center with searchable data sets and links to repositories.
2.2.2	LCBP	Identify and locate existing data sets, including historical data where appropriate.
2.2.3	LCBP	Update existing data repositories and establish new ones where important gaps in data exist.
2.2.4	LCBP	Identify protocols for data input, data summaries, and accessibility and ensure that new data collected follow these protocols.

Citations

Medalie, L. and R. M. Hirsch. 2010. Trends in phosphorus concentrations and loads in Lake Champlain tributaries 1990-2008: An evaluation using new statistical methods. Presented at the Lake Champlain Research Conference, 7 June, University of Vermont, Burlington, VT.

Picotte, Amy. 2008. Lake Champlain Lay Monitoring Report. Waterbury, VT: VTANR. [www.anr.state.vt.us/dec/waterq/lakes/docs/lp_lmpchamplainpart12008.pdf]

Watzin, M.C. 2007. The Promise of Adaptive Management. Pages 147-158 in: Managing Agricultural Landscapes for Environmental Quality: Strengthening the Science Base, M. Schnepf and C. Cox, eds. Soil and Water Conservation Society Press, Ankeny, IA.

3. INFORMING AND INVOLVING THE PUBLIC

GOAL: Promote a better understanding and appreciation of Lake Champlain Basin resources and threats as well as personal responsibility that leads to behavioral changes and actions to reduce pollution.

INTRODUCTION

The future of the Lake Champlain Basin rests in the hands of its citizens and leaders. Public information and outreach efforts must continue and expand to actively involve people in protecting and appreciating the resources of the entire Basin. Ultimately, a public that understands the Basin's water quality and resource management problems as well as possible solutions can make informed choices about protection and restoration. Informing the public about how to change personal and collective behaviors and providing opportunities to change those behaviors are critical steps in reducing our impact on Lake Champlain.

Informing the public and promoting direct citizen involvement can help achieve many of the priority actions discussed in this plan. Each priority action recognizes the need for strong public support and personal action. For example, an effective way to reduce phosphorus from residential lawns is to target media and training campaigns for specific audiences, including retail stores and landscapers. Additional outreach efforts may be achieved through news stories, interpretive signs or displays, literature, presentations, and citizen task forces.

Partnerships are critical in delivering messages to multiple audiences within the watershed. Educators, for example, benefit from professional development opportunities offered through the six partners of the Champlain Basin Education Initiative (CBEI), from the student programs that many organizations deliver in the classroom or on-site at their facilities, from research presentations offered by university professors, from watershed curricula that is available online, and from visits to the Resource Room at the ECHO Lake Aquarium and Science Center located at the Leahy Center for Lake Champlain. Partnerships are also essential in delivering stormwater runoff messages, reaching homeowner associations and shoreline groups, and encouraging private sector initiatives.

Although Basin-wide education is important, support for the more than thirty watershed and river groups as well as other nonprofits and communities is also critical to fully implementing this plan. Therefore this chapter also includes actions that support initiatives, provide technical and financial assistance, and promote information sharing at the local level.

OBJECTIVES

- Enhance learning opportunities at all educational levels to develop an understanding of and appreciation for Lake Champlain Basin resources, the related threats, and the priority actions needed to address them.

- Promote awareness within the community of issues facing the Lake Champlain Basin and the priority actions needed to address them.
- Develop programs that assist people in adopting behavioral changes that reflect a personal commitment to protecting and improving resources in the Basin.
- Build local-level implementation capacity to support Lake Champlain clean-up efforts.

PRIORITY ACTIONS & TASKS

3.1) Enhance educator and student learning about watershed issues.		
ID	Lead Partner	Task
3.1.1	LCBP	Coordinate watershed professional development opportunities with CBEI partners to offer annual training for 15 to 80 teachers from New York, Québec, and Vermont through alumni events and 1- to 11-day training programs, many of which include service learning.
3.1.2	LCBP	Obtain sufficient funding, (\$20,000 to \$40,000) annually to complete task 3.1.1.
3.1.3	LCBP	Meet with 3 to 5 New York institutions in 2011-2012 seeking opportunities to promote CBEI offerings, to better assess New York educator needs, and to identify a new New York partner(s) for CBEI.
3.1.4	LCBP	Facilitate a CBEI partner workshop in 2011 to develop a 3-year strategic plan for workshop development and participant recruitment and to identify which school systems receive programs from partners.
3.1.5	LCBP	Host a 1-day Lake Champlain Educator Summit in 2011 to showcase the program offerings of our natural resource and cultural heritage educational partners.
3.1.6	LCBP	Complete up to 40 student classroom or field day presentations annually using 3-D watershed models, nationally approved curriculum activities, and current Lake science knowledge.
3.1.7	LCBP	Produce updated Lake Champlain watershed maps, land-use maps, and other Basin resources and distribute them to educators and students free of charge and via the LCBP website.
3.1.8	LCBP	Partner with Shelburne Farms and other CBEI partners to formally evaluate the success and shortcomings of educator professional development at least once for every 3 courses offered through <i>Watershed for Every Classroom</i> and other CBEI initiatives.
3.1.9	LCBP	Enhance the collection of national and local curriculum resource materials made available through the LCBP Resource Room and post local <i>Watershed for Every Classroom</i> service learning examples to the LCBP website by 2011.
3.1.10	New York	Provide outreach programs on watershed issues through field day programs such as those hosted by Cornell Cooperative Extension.
3.1.11	New York	Promote Adirondack habitat and watershed student learning through partnerships with the Wild Center in Tupper Lake.
3.1.12	Québec	Plan a workshop at ECHO at the Leahy Center for Lake Champlain for teachers from Québec by 2012.
3.1.13	Québec	Produce an education section to educators and students free of charge on the OBVBM website by 2012.
3.1.14	Québec	Evaluate the four-phase <i>Clear Water Musketeer</i> program from Missisquoi Bay and implement in 3 English- and 10 French-speaking schools in Québec by 2011.
3.1.15	Vermont	Coordinate annually with EPSCoR Vermont Streams Project to involve students in assessing priority surface water in the Basin.
3.1.16	Vermont	Conduct <i>Science on the Green</i> , a conservation and natural science workshop for grades

		K-12 annually.
3.1.17	Vermont	Incorporate Project WET activities and outdoor water-quality monitoring training into the CBEI and school district professional development trainings for teachers.
3.1.18	LCSG	Provide watershed and water-quality education programs for K-12 youth, teachers, and adults by offering hands-on, inquiry-based curriculum, technical expertise, equipment, and human resources to at least 15 programs annually in the Basin.

3.2) Build awareness and understanding among residents and visitors about Lake Champlain Basin resources and behaviors that contribute to pollution.

ID	Lead Partner	Task
3.2.1	LCBP	Conduct or facilitate 20 presentations or public forums on Lake issues annually to special interest groups, communities, businesses, and local government decision makers.
3.2.2	LCBP	Provide watershed and Lake Champlain educational materials and displays for at least 10 conferences, fairs, expos, and other venues that attract targeted public audiences annually.
3.2.3	LCBP	Develop new material for the LCBP website to ensure that it remains informative and accurate and reflects current online technology.
3.2.4	LCBP	Use social marketing techniques to address issues of key concern within specific audiences and in conjunction with outreach partners. Examples include recent efforts with <i>Don't P on Your Lawn</i> with businesses, pesticide applicators, and landscape companies.
3.2.5	LCBP	Provide resources, exhibits, answers to information requests, and watershed research assistance to about 25,000 annual visitors to LCBP's comprehensive Resource Room in ECHO at the Leahy Center for Lake Champlain.
3.2.6	LCBP	Develop a <i>State of the Lake</i> report every 3 years, including 2011 and 2014, in a format accessible to the general public, lake managers, and policymakers to share current science and research results, and make it available on the LCBP website.
3.2.7	LCBP	Seek 2 new venues for long-term interpretive outreach materials in New York municipalities by 2011.
3.2.8	LCBP	Foster partnerships with local media, including print, television, and radio, to cover Basin issues regularly through PSAs and other methods.
3.2.9	LCBP	Communicate progress on plan implementation to the public, special interest groups, communities, and government agencies via an updateable online plan, news releases, and e-newsletters distributed 6 times a year.
3.2.10	New York	DEC staff will set up watershed related exhibit materials at 5 or more community events each year.
3.2.11	Québec	Promote awareness of issues facing the Lake Champlain Basin to the boater's community at the <i>Station Nautique Ile-aux-Noix</i> (marina) by 2011.
3.2.12	Québec	Provide interpretive outreach materials, exhibits, and displays in partnership with the local watershed groups for at least 3 conferences, fairs, expos, and other venues that attract targeted public audiences annually.
3.2.13	Vermont	Conduct education forums in target watersheds to educate stakeholders about priority surface water issues and engage partners in implementing high-priority water-quality strategies in conjunction with DEC's Basin planning effort.
3.2.14	Vermont	Conduct at least 3 annual DEC education workshops concerning fluvial erosion using the demonstration flume in the Champlain Basin.
3.2.15	Vermont	Publish <i>Out of the Blue</i> , a statewide newsletter focusing on watershed activities 2 times a year through DEC.
3.2.16	Vermont	ANR staff, Vermont League of Cities and Towns, Natural Resources Conservation District, and Regional Planning Commissions provide annual technical assistance and training for municipalities seeking to take greater steps to protect water quality.
3.2.17	LCSG	Provide opportunities to improve public understanding of climate change and the implications for Lake Champlain ecosystem management by 2013.

3.3) Provide hands-on citizen action opportunities to improve the watershed and change behaviors that contribute to pollution.

ID	Lead Partner	Task
3.3.1	LCBP	Support partnership opportunities through local grants to increase public, youth, and local business involvement to clean up rivers and lakes, reduce toxic materials in homes and businesses, use Lake friendly gardening techniques, and participate in recycling programs, etc through community projects, student programs, and youth corps.
3.3.2	LCBP	Help watershed and other organizations publicize citizen action and outreach opportunities through the LCBP website, assistance with news releases, and other methods.
3.3.3	LCBP	Coordinate 3 workshops to encourage communities to participate in the Climate Smart Communities [www.dec.ny.gov/energy/50845.html] programs to reduce water and energy consumption and reduce waste generation by 2012.
3.3.4	Québec	Help landowners along the Missisquoi Bay protect and restore their banks annually.
3.3.5	Québec	Assist landowners along the Pike River with characterization and protection of their banks annually.
3.3.6	Vermont	Support citizen involvement through the Vermont Lay Monitoring Program for Lake Champlain.
3.3.7	Vermont	Support citizen involvement in surface water assessments by allocating laboratory analytical capacity grants under the LaRosa Partnership Program. Enroll at least 8 groups annually and seek to engage new monitoring groups.
3.3.8	Vermont	Continue to promote the EPA-offered Volunteer Monitoring Equipment Loan program to Vermont watershed monitoring groups.
3.3.9	LCSG	Provide rain garden demonstrations and implementation projects as noted in the Phosphorus Chapter: Action 2.5.

3.4) Improve communication and cooperation among the diverse groups involved in Lake Champlain Basin education and outreach.

ID	Lead Partner	Task
3.4.1	LCBP	Host an annual meeting of local watershed groups to provide technical support on issues of mutual interest and to facilitate communication among organizations.
3.4.2	LCBP	Increase regular communication with Regional Planning Commissions, New York Soil and Water Conservation Districts and Vermont Natural Resource Conservation Districts to facilitate action on issues of mutual interest.
3.4.3	New York	Provide support to Soil and Water Conservation Districts that are assisting local communities with pollution prevention implementation.
3.4.4	Québec	Host 4 meetings annually to make local governments aware of issues facing the Lake Champlain Basin and of the role of the OBVBM; provide technical support.
3.4.5	Québec	Coordinate with local groups, especially with the Missisquoi North and Sutton River watersheds, to facilitate communication among organizations annually.
3.4.6	Vermont	Restructure the Basin Planning Program by developing a Statewide Surface Water Management Plan that identifies priority issues addressing Vermont's surface waters. The statewide plan will identify priorities and assist in the simultaneous implementation of the numerous planning and implementation initiatives in which ANR participates, including <i>OFA</i> and the <i>Lake Champlain TMDL Implementation Plan</i> .
3.4.7	Vermont	Identify and develop geographically targeted implementation steps that are ready for funding in conjunction with the development of the Statewide Surface Water Management Plan.
3.4.8	LCSG	Host trainings for stakeholders on invasive species spread prevention, fisheries management, and water quality improvement and protection.

3.5) Provide local groups, schools, and municipalities financial and technical resources to implement <i>Opportunities for Action</i> in Basin communities and watersheds.		
ID	Lead Partner	Task
3.5.1	LCBP	Implement an annual local grants program that provides financial support for local organizations working to address tasks in <i>OFA</i> , especially for priority issues (e.g., phosphorus, toxins, and aquatic invasive species) and education and outreach.
3.5.2	LCBP	Provide annual organizational support and professional development mini-grants to strengthen administrative, technical, communication, and field skills for local watershed staff and board members.
3.5.3	LCBP	Inform the public informed about financial and educational support pertaining to water-quality issues available through the LCBP.
3.5.4	Québec	Provide technical resources to local groups, schools, and municipalities that are implementing actions in Missisquoi Bay Watersheds annually.
3.5.5	Vermont	Make annual funding available to local watershed groups through the license plate grant program, Vermont's Clean and Clear funding, and Section 319.
3.5.6	LCSG	Provide technical assistance to nongovernment organizations and municipalities on low-impact development, stormwater best management practices, shoreline protection, and other topics.

4. REDUCING PHOSPHORUS POLLUTION

GOAL: Reduce phosphorus inputs to Lake Champlain to promote a healthy and diverse ecosystem and provide for sustainable human use and enjoyment of the Lake.

INTRODUCTION

As in all living systems, the balance of nutrients within the Lake Champlain ecosystem is critically important in maintaining the condition of the Lake. If the concentrations of nutrients are significantly altered, the ecosystem will become unbalanced and noticeable changes in Lake condition will result. Like most lakes in the northeast, the concentration of phosphorus in Lake Champlain is a key factor in determining the quality of the ecosystem as humans have come to know and enjoy it.

Phosphorus is typically known as the limiting nutrient in a lake ecosystem, meaning that algal growth is limited by the amount of phosphorus that is available. Algae require other nutrients as well, but phosphorus is commonly the one nutrient that is most needed. When phosphorus is available in excessive amounts, more algal growth than usual may result, including unsightly algae blooms. These changes in plant growth, in turn, can affect many other aspects of the Lake ecosystem, including the amount of oxygen in the water, the types of fish we catch, the smell, the appearance, and potability of the water itself.

Residents and visitors to the Basin can take many actions to reduce the phosphorus load carried by streams to Lake Champlain. The Lake Champlain Basin Program (LCBP), together with its governmental partners, has identified a number of specific actions that are most needed to protect the lake. These actions are provided in the tables at the end of this chapter, accompanied by the intended schedule for their implementation.

Sources of Phosphorus

Phosphorus is most commonly found attached to soil particles and may be released into the water column when soils are disturbed. Phosphorus typically arrives in Lake Champlain bound to sediments carried down rivers and streams or as dissolved phosphorus that has been released from the sediments into the water column. For purposes of this plan, phosphorus pollution is grouped into two general categories. The most obvious category is ***point source pollution***, in which pollutants can be directly attributed to a tangible source in a particular place – a wastewater treatment plant, for example. Point source pollution accounts for about 5 percent of the total load reaching Lake Champlain. The second category, while less obvious, is currently the more important problem in the Lake Champlain watershed, about 95 percent of the total phosphorus load (Smeltzer et al. 2009), and is called ***nonpoint source pollution***. Nonpoint source pollution is associated with discharges of stormwater and snowmelt and is produced across a broader geographical region. Examples include soil erosion and runoff from agricultural fields; stormwater washing off roads, lawns, and parking lots; and unstable streams and stream bank erosion from modified water flows. Because the exact origin of nonpoint source

phosphorus cannot easily be identified, it is much harder to control. Management actions to address nonpoint source phosphorus pollution are addressed in this chapter.

Recent research in the Lake Champlain Basin shows that, *acre for acre*, developed land contributes up to four times more nonpoint source phosphorus than average agricultural lands and seven times more than forests (Troy et al. 2007). However, far more acres of Basin land are in agriculture and forests than in urban settlements; it is now clear that substantial reductions in nonpoint phosphorus runoff are required in both agricultural and developed lands in order to meet our targets for a clean Lake Champlain. Developed lands contributed about 46 percent of the phosphorus runoff Basin-wide in 2001, and agricultural lands contributed about 38 percent. These proportions, however, vary greatly among the various sub-watersheds. For example, in 2001 developed land was the largest contributor to phosphorus in Burlington Bay, Vermont (about 99 percent) and Cumberland Bay, New York (about 57 percent). But agricultural land contributes the majority of phosphorus load to the Missisquoi Bay, Vermont and Québec (about 64 percent) (Troy et al. 2007).

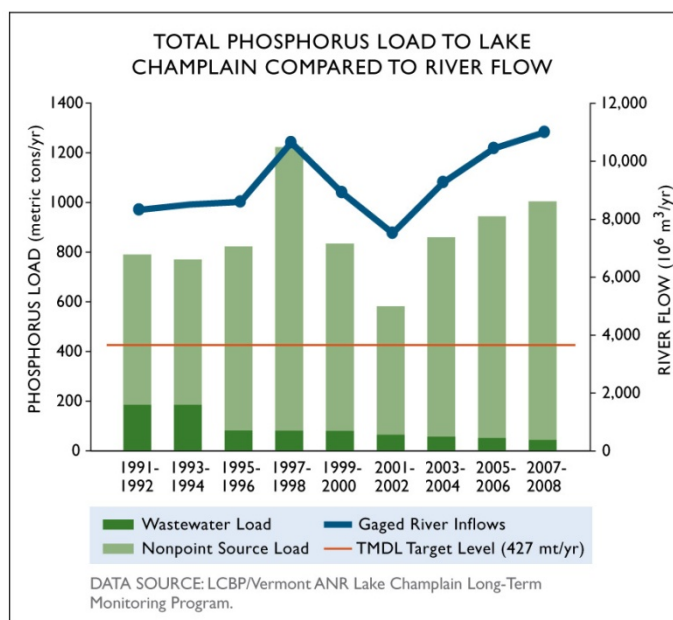
The Lake Champlain Phosphorus Total Maximum Daily Load

The Lake Champlain phosphorus total maximum daily load (TMDL) provides the fundamental phosphorus management framework for the Lake. The TMDL defines the maximum amount of phosphorus loading that the Lake can receive and still achieve the in-Lake phosphorus concentration criteria established for each segment of the Lake.

Because the TMDL for phosphorus is exceeded in numerous parts of Lake Champlain, a TMDL plan has been developed to reduce in-Lake phosphorus concentrations to the maximum allowable levels. This TMDL Plan identifies the total phosphorus-loading capacity among the various sources of phosphorus and includes implementation plans for Vermont and New York to achieve the necessary phosphorus reductions over time, to reduce phosphorus

concentrations to the TMDL level in the Lake. The TMDL establishes individual waste load allocations for each wastewater treatment facility in Vermont and New York and defines phosphorus allocations for agricultural, developed, and forested land in each sub-watershed draining to the lake. The Lake Champlain Phosphorus TMDL [

www.vtwaterquality.org/lakes/docs/lp_lctmdl-report.pdf] was developed jointly by Vermont and New York under the US Clean Water Act, and was approved by the US Environmental Protection Agency (USEPA) in 2002. Vermont issued a revised TMDL Implementation Plan in 2010 [www.anr.state.vt.us/cleanandclear/news/TMDL%20impl%20plan%20final%20-%20011510.pdf]



Adaptive Management

The LCBP and partners support a formal adaptive management approach to reducing phosphorus loadings into Lake Champlain. This approach is not new to the LCBP, but with the development of a formal adaptive management plan for the Basin, resource managers will be able to more accurately assess the effect of different programs in reducing phosphorus pollution in the Lake. Adaptive management is a structured approach to making decisions about managing the Lake that will incorporate both experience and careful projections about the effectiveness of management policies based on the best science and professional judgment available. A well-designed adaptive management plan assesses specific ecological indicators that inform managers about how the ecosystem has responded to the management actions. Management actions are continually evaluated to determine how effective they are at reducing phosphorus loading. Managers can then modify actions to further improve phosphorus reduction or shift support to other practices that may be more effective at reducing phosphorus pollution. A more detailed description of the overall adaptive management process for Lake Champlain can be found in Chapter 2, A Strategy for Implementing the Plan.

Threats: Urban and Rural

Numerous and diverse threats challenge water quality in Lake Champlain. Threats are attributable to human actions – our actions – on the landscape and encompass a wide variety of activities, such as: failure to manage and/or treat stormwater runoff from existing or new areas of developed land (residential, commercial, and industrial), poor management of cropland and pasture, loss of forests and wetlands, development encroachment on stream banks and shorelines, road construction and maintenance practices, and inadequate wastewater treatment.

Similar to the diversity of threats to water quality in Lake Champlain, there is a wide range of strategies that can be employed to reduce phosphorus pollution. Examples include:

- implement a suite of voluntary and regulatory programs at the state/provincial and municipal levels to address stormwater runoff;
- provide technical and financial assistance to farmers to support implementation of recommended best management practices;
- use regulation, zoning, and incentives to prevent conflicts between infrastructure and streams and rivers;
- provide financial and technical assistance to support forest stewardship, wetland protection, and restoration efforts;
- improve the ability of financial assistance programs, including the state revolving fund, to target phosphorus reduction projects; and
- implement a suite of best management practices for roadways that specifically address drainage, maintenance, and erosion control.

These strategies involve one or more of the following policy tools:

- regulatory requirements that provide specific steps that must be taken to control pollution and reduce impacts;
- financial incentives that link funding eligibility to specific actions or use subsidies to control pollution and reduce impacts; and
- technical assistance that supports sharing information on water-quality impacts and suggests techniques to reduce impacts.

Phosphorus Reduction Efforts in Missisquoi Bay

Blue-green algal blooms have become a forefront issue in Missisquoi Bay since the 1990s. Severe algal blooms in Missisquoi Bay have inhibited recreational activities during the busy summer months in several recent years and have impacted access to the bay in both Québec and Vermont. The impacts of these algal blooms are of binational concern, leading to the creation of a formal agreement between Québec and Vermont [www.lcbp.org/PDFs/missbay_agreeEN.pdf], commonly known as the 60/40 agreement, in which the State of Vermont has agreed to assume 60 percent of the responsibility for reducing phosphorus loading to the bay, and Québec will assume 40 percent of the responsibility. The International Joint Commission (IJC), an organization established by the 1909 Boundary Waters Treaty between the federal governments of the United States and Canada, also provides support for reducing phosphorus loads.

The LCBP and its partners have made numerous efforts to reduce phosphorus loads into Missisquoi Bay in recent years. The Rock River watershed, a sub-watershed of Missisquoi Bay, has been targeted as a short-term focus area for expanded outreach and implementation efforts. Significant resources have been allocated to research and implementation of new management programs to minimize the impacts of different land uses in this watershed. A recent LCBP-funded project by researchers at the University of Vermont developed an accounting system to track nonpoint sources of phosphorus in this watershed. A new project targeting the Rock River watershed will provide incentives to farmers to initiate best management practices on their farms to reduce pollution due to runoff. Resource managers in the Province of Québec recently completed a successful “Green Buffers” project, which encouraged farmers to plant perennial crops within nine meters (30 feet) of the water’s edge along the riparian corridors of their fields. These crops provide a buffer to waterways adjacent to agricultural fields during the growing season while also providing a source of income for the farmer.

Current LCBP-funded projects range from identifying specific sources of phosphorus within the Missisquoi Bay Basin, examining the impacts of sedimentation due to stream bank erosion, evaluating the effects of phosphorus loading from the sediments within Missisquoi Bay itself, and implementing small best management practices on farms within the basin. LCBP is also working with its partners to acquire light detection and ranging (LiDAR) coverage for a majority of the Missisquoi Basin. LiDAR is a remote sensing technology that uses pulses of light to determine characteristics of the earth’s surface, such as topography and land cover, and provides very high-resolution imagery. LiDAR imagery thus enables more accurate elevation models and land cover classifications than previously supported by satellite imagery. The resulting data can delineate the micro-topography of an area, such as water and pollution transport networks through ditches and gullies, and reveal more detailed land cover, such as narrow riparian buffers between rivers and agricultural fields. Many other projects, current and proposed, are identified within the lists of priority actions below.

Knowledge gained by resource managers from each of the Missisquoi Bay projects can be applied to many other sub-watersheds of the Lake, especially those dominated by agricultural land use. The LCBP will ensure that resource managers have the necessary tools and information to successfully apply knowledge gained by this work to reduce phosphorus pollution around the Lake Champlain Basin. For example, the phosphorus critical source analysis project will result in a list of landscape characteristics and management practices that combine to produce high

phosphorus loads into our waterways. This project also aims to compare the results generated by complex modeling tools to those obtained by simple GIS analysis to determine if analytical efficiencies are possible and can be affordably applied throughout the Basin.

Progress

Major efforts have been undertaken in the last two decades to maintain good water-quality conditions in several segments of Lake Champlain and around the Basin as a whole. Burlington Bay, Shelburne Bay, and Cumberland Bay, three of Lake Champlain's most heavily developed lakefront areas, remained below phosphorus concentration targets in most recent years. Water quality in the Main Lake, Isle LaMotte, and Otter Creek lake segments has changed minimally through the last two decades despite sustained conversion from agricultural and forest lands to developed lands. Phosphorus loads from wastewater treatment plants around the Basin have been reduced by nearly 80 percent since 1990. Phosphorus loads from wastewater treatment plants contributed approximately 25 percent of the total Basin-wide load in 1990-1991; in 2007-2008, that number was estimated at only 5 percent. Despite increased land use conversion for development within the Basin, tributary phosphorus loads and flow-weighted mean inflow concentrations to most regions of the Lake were stable or decreasing from 1991 to 2008 (Smeltzer et al. 2009). This assessment is reflected in a recent study by the US Geological Survey (USGS) using new statistical methods illustrating that trends in phosphorus concentrations adjusted for stream flow have decreased in fifteen tributaries since 1999, suggesting that a positive response to watershed management efforts may be underway (Medalie and Hirsch 2010).

Significant challenges in achieving water-quality goals remain. For example, Lake phosphorus concentrations remained above the TMDL targets during all or nearly all years in five Lake segments. Levels were below the TMDL targets during nearly all years in two lake segments, and the remaining six lake segments had borderline conditions in which the mean phosphorus concentrations varied above and below their targets. Four Lake segments had significant increasing linear trends in phosphorus concentrations over the 1990-2008 time period; however, no Lake segment exhibited a significant decreasing phosphorus trend. Additionally, phosphorus loading rates remained above the total loading capacities established in the Lake Champlain Phosphorus TMDL in all but two Lake segments (Smeltzer et al. 2009).

Introduction to the Phosphorus Objectives, Priority Actions, and Tasks

The new framework of *Opportunities for Action (OFA)* identifies broad objectives designed to reduce phosphorus concentrations in Lake Champlain, more focused priority actions to meet those objectives, and specific tasks agreed to by *OFA* signatory agencies. The priority actions have been developed to collectively address the objectives that have been identified for this chapter, all of which are ultimately working toward the goal of reducing phosphorus concentrations in Lake Champlain to promote a healthy and diverse ecosystem and to provide for sustainable human use and enjoyment of the Lake. All LCBP partners are active in watershed management programs within the Basin, implementing many projects that are not described in the task lists below, and are working to achieve the objectives identified in this chapter. The tasks included with each priority action below are projects identified by the LCBP partners who have signed *OFA* as a comprehensive management plan for their organizations and jurisdictions to achieve within the time frames provided and to the extent that funding is available.

The Implementation Role of the Public

While it is essential for governments, agencies, and departments at all levels to work toward the common goal of phosphorus load reduction, it is no less important for citizens in every part of the Lake Champlain Basin to participate effectively at home and in their workplaces. The challenge of phosphorus load reduction is a responsibility of residents and visitors alike, and success can be achieved only through effective community-wide participation. For this reason, many citizen-oriented tasks directed at phosphorus load reduction are described in the *Informing and Involving the Public* chapter of this plan.

Role of the LCBP in Achieving these Objectives

The LCBP, with the help of the jurisdictional and public partners, will aggregate all phosphorus-loading data available for the Basin into a report that will provide minimal interpretation. This data report will provide policymakers in each jurisdiction access to the nutrient management criteria and an updated understanding of the phosphorus-loading pressures within the Basin.

- LCBP will use this data report to:
 - Inform the decision-making process.
 - Assess the full period of record.
 - Conduct a trend analysis using more recent data where possible:
 - a) develop a mechanism to assess the current status of all wastewater treatment plants in the TMDL with respect to phosphorus loading,
 - b) develop a mechanism to assess the current status of point and nonpoint source phosphorus loads using data from the Long Term Monitoring Program and other sources
 - c) track changes in land use throughout the Basin on a regular basis.
- LCBP will assemble information from all partners to develop this data report and provide the report to the Steering Committee annually.
- LCBP will prioritize implementation grant proposals from nongovernmental organizations and municipalities that focus on phosphorus reduction.
- LCBP will continue to review proposals to the US Army Corps of Engineers under Section 542 of the Water Resources Development Act that focus on reductions to phosphorus and sediment loading.
- LCBP will assist in cross-boundary transfer of management practices found to be successful in other regions and applicable to the Basin.
- LCBP will support tasks identified by the LCBP Steering Committee to address immediate needs for phosphorus reduction through grants and contracts.
- LCBP will help track the success of TMDL implementation activities on both sides of the Lake
- LCBP will continue to assess phosphorus concentrations and loads by Lake segments.

Citations

Medalie, L. and R. M. Hirsch. 2010. Trends in phosphorus concentrations and loads in Lake Champlain tributaries 1990-2008: An evaluation using new statistical methods. Presented at the Lake Champlain Research Conference, 7 June, University of Vermont, Burlington, Vermont.

Smeltzer, E., F. Dunlap and M. Simoneau. 2009. *Lake Champlain Phosphorus Concentrations and Loading Rates, 1990-2008*. Lake Champlain Basin Program Technical Report # 57. [www.lcbp.org/publication_detail.aspx?id=221].

Troy, A., D. Wang, D. Capen, J. O'Neil-Dunne and S. MacFaden. 2007. *Updating the Lake Champlain Basin Land Use Data to Improve Prediction of Phosphorus Loading*. Lake Champlain Basin Program Technical Report # 54. [www.lcbp.org/publication_detail.aspx?id=211]

OBJECTIVES

- Attain phosphorus-loading targets and sustain necessary reductions for Lake segment watersheds that are consistent with the TMDL and the phosphorus reduction agreement between Vermont and Québec for the Missisquoi Bay Watershed.
- Attain the in-Lake phosphorus criteria specified in the TMDL because this is the most probable remedy to reducing algal blooms in Lake Champlain.
- Identify actions and funding levels needed to attain TMDL loading targets by 2016 and beyond.

PRIORITY ACTIONS & TASKS

4.1) Reduce the phosphorus load that is being generated by agricultural land uses, including farmsteads, cropland, and pasture lands in the Basin.		
ID	Lead Partner	Task
4.1.1	LCBP	Support voluntary implementation of BMPs or NMPs through annual small grants programs.
4.1.2	LCBP	Make recommendations for improved consistency and new approaches in agricultural management practices based on annual assessments of the current management techniques.
4.1.3	LCBP	Research the contribution to phosphorus loading by agricultural tiling and ditching.
4.1.4	LCBP	Track the agricultural phosphorus reductions achieved across the jurisdictions in support of an overall mass balance for phosphorus within the basin by 2014.
4.1.5	USEPA	Support efforts to reduce phosphorus inputs to Lake Champlain on an ongoing basis by providing information on relevant phosphorus reductions efforts taking place elsewhere in the country; sharing fact sheets, results of pilot projects, and other national efforts to reduce phosphorus loads; and sharing various assessment, modeling, and management tools as they are developed (e.g., Chesapeake Bay Program and other aquatic systems).
4.1.6	USEPA	Work with Lake Champlain stakeholders to develop pilot projects for reducing phosphorus. Share the results of this work with other aquatic systems throughout the country.
4.1.7	USEPA	Ensure that New York and Vermont implement the CAFO program in accordance with the new regulations promulgated in November 2008.
		Farmsteads – Provide financial and technical assistance and regulatory oversight needed to support construction and maintenance of proper waste containment/treatment structures and exclusions from clean water.

4.1.8	USEPA	Make the Lake Champlain watershed a priority watershed for enforcement activities, targeting 5 EPA inspections per year, and work with Vermont and New York to ensure that MFOs, LFOs, and/or CAFOs are routinely inspected.
4.1.9	USDA-NRCS	Ensure EQIP contract implementation by making shorter term contracts available by 2010 and continually improving the accuracy of practice cost estimates.
4.1.10	USDA-NRCS	Implement new USDA-NRCS standard on silage leachate as part of CNMP development and implementation by 2010.
4.1.11	USDA-NRCS	Expand the role of the O&M agreements for EQIP practices and work with partners to determine the feasibility of an O&M incentive payment for farms implementing structural practices by 2011 in order to raise awareness of the need to properly operate and maintain installed systems.
4.1.12	USDA-NRCS	Continue to provide technical and financial assistance to 50 livestock farms annually to address barnyard water management, manure management, milk house waste, and silage leachate issues to reduce phosphorus inputs from agricultural sources by 2015.
4.1.13	New York	Ensure that, through inspections, enforcement actions, and penalties, all (28) CAFOs have CNMPs prepared and updated, at least annually, by a certified planner (based on the number of farms available as of 2009).
4.1.14	New York	Ensure that all (8) large CAFOs continue to properly operate and maintain the structural BMPs identified in their CNMPs (based on the number of farms available as of 2009). As part of this effort each large CAFO will be comprehensively inspected at least once per year by NYSDEC and evaluated with respect to implementation of its CNMP. [Note: as of 8/2009, all 8 large CAFOs have constructed their structural BMPs.]
4.1.15	New York	Ensure that all (20) medium CAFOs complete construction of the structural BMPs identified in their CNMPs by June 30, 2014 (based on the number of farms available as of 2009). As part of this effort each medium CAFO will be inspected at least once every 3 years by NYSDEC and evaluated with respect to implementation of its CNMP. Follow-up on all water-quality-related complaints involving small (non-CAFO) farms.
4.1.16	New York	Continue to encourage livestock and crop farms to develop and advance conservation plans developed through the AEM program. Partnerships between public and private agricultural service providers will advance 75 plans by 2012.
4.1.17	New York	The AEM partnership will evaluate 75 livestock and crop farms with implemented conservation plans to further advance operation, maintenance, and performance.
4.1.18	Québec	Maintain the inspection program of all farms in the Basin (831 total farms visited since 2003) to ensure compliance with regulation.
4.1.19	Québec	Ensure compliance regarding proper manure storage for farms (mainly small farms under 50 cows) on solid manure annually. NOTE: All farms with more than 50 cows and on liquid manure must have proper waste structures required by regulation.
4.1.20	Vermont	Ensure that all (118) MFO farms in the Basin have the necessary structures in the production area needed to prevent direct farmstead discharges by 2013 (based on the number of farms available as of 2009).
4.1.21	Vermont	Annually ensure that all (11) LFO farms in the Basin continue to operate and maintain the existing structures that prevent farmstead discharges (based on the number of farms available as of 2009).
4.1.22	Vermont	Complete <i>Small Farm Production Area Assessment</i> or Vermont AEM surveys for 108 farms in the Rock River, St Albans Bay, and Hungerford Brook watersheds by 2010, as well as at least 18 small farms in Rutland and Addison counties by 2010 (based on the number of farms available as of 2009).
4.1.23	Vermont	Continue to manage an effective water-quality compliance and enforcement program. All complaints are investigated and the appropriate enforcement actions taken (640 SFO, 150 MFO, and 100 LFO visits since 2003) (based on the number of farms available as of 2009).
4.1.24	Vermont	Assure that all new, modified, or expanded waste storage structures receiving technical or financial assistance from the VAAFM meet professional engineering standards.
4.1.25	Vermont	Vermont will prepare a draft CAFO permit for EPA review by December 31, 2010.

4.1.26	Vermont	Following EPA review of the draft CAFO permit, Vermont will finalize the permit and begin to implement CAFO requirements as appropriate and as expeditiously as feasible.
		Cropland - Support and promote implementation of erosion control practices on annual cropland, emphasizing nutrient management and riparian buffers.
4.1.27	USDA-NRCS	Provide financial and technical support to meet Vermont's 2012 CREP goal of 600 cropland acres by 2012 in partnership with the State of Vermont and USFWS.
4.1.28	USDA-NRCS	Provide additional outreach and financial incentives to implement alternative manure spreading methods on 1,250 acres in Vermont annually, for a total of 5,000 acres by 2014.
4.1.29	USDA-NRCS	Provide additional outreach and financial incentives for farmers to implement conservation tillage on 125 acres annually in Vermont, for a total of 500 acres by 2014.
4.1.30	USDA-NRCS	Use the EQIP program to implement 35 acres of buffers annually in the New York portion of the Basin for a total of 175 acres by 2015.
4.1.31	USFWS	Provide financial and technical support in partnership with New York, Vermont, and the USDA-NRCS to support the enrollment of 600 acres of riparian forested buffer through the Partners for Fish and Wildlife Program by 2012.
4.1.32	USFWS	Provide financial and technical support for the improvement of 5 farm road stream crossings that are incompatible with aquatic habitat connectivity by 2012.
4.1.33	USEPA	Work during FFY2010 to evaluate adherence to NMPs in the basin. Evaluation of 2 NMPs per year is planned.
4.1.34	New York	Maintain 30,000 acres in nutrient management plans.
4.1.35	New York	Ensure that all (28) CAFOs comply with erosion-control requirements specified in USDA-NRCS-NY Part 590 Conservation Practice Standard and ensure compliance with the individual field management practices identified in their CNMPs, including field-specific manure application rates, methods, and timing and implementation of riparian buffers in accordance with Land Grant University guidelines and all applicable USDA-NRCS conservation practice standards (based on the number of farms available as of 2009).
4.1.36	New York	Provide manure applicator training on the appropriate rate, timing, amount, and method of manure application for all (8) large CAFOs by 2015 (based on the number of farms available as of 2009).
4.1.37	New York	Increase by 50 percent the number of acres in the farmland protection program by 2015 (currently, about 6000 acres of farmland in the New York portion of the Basin are protected, either by conservation easement or through acquisition of development rights).
4.1.38	New York	Follow up on all water-quality-related complaints involving small (non-CAFO) farms.
4.1.39	New York	Work to increase conservation funding (EQIP, CREP, WRP, etc.) to the South Lake watershed by 25 percent over 5 years.
4.1.40	Québec	Evaluate 20 farms for compliance with their NMPs annually.
4.1.41	Québec	Ensure compliance with manure-spreading dates, especially after October 1, as well as with distances according to regulation.
4.1.42	Québec	Ensure compliance with the progressive schedule for disposal of animal manure, which requires that farms have 100 percent of cropland needed for spreading, as defined by their NMP, by 2010.
4.1.43	Québec	Increase minimum tillage areas with more than 30 percent residue by 50 percent.
4.1.44	Québec	Increase no tillage and rotation with fall cereals by 25 percent.
4.1.45	Québec	Increase riparian buffers (minimum of 3m) in agriculture land in the target watershed by 50 percent.
4.1.46	Québec	Promote perennial crops in targeted Critical Source Areas within the Missisquoi Basin.
4.1.47	Québec	Increase cover-cropped acreage by 25 percent.
4.1.48	Québec	Support the implementation of hydro-agricultural outfitting at the field level to control erosion and sediment transport in ZIPP and targeted subbasins.

4.1.49	Québec	Monitor the flows, sediments, and nutrients following the Lisière Verte project by the Coopérative de solidarité du bassin versant de la baie Missisquoi. Monitor the water quality in the targeted subbasin (Ewing) following the implementation of 9 meters cultivable riparian buffers, the conversion of annual crops to perennial crops in flood-plains areas, and the installation of runoff control facilities (inlet drains by IRDA).
4.1.50	Vermont	Continue annual inspections on all (11) LFO farms in the Basin to assure that nutrient management plans are being followed to protect water quality and are in compliance with the farm's individual permit (based on the number of farms available as of 2009).
4.1.51	Vermont	Review the nutrient management plans for each MFO inspection to assure they are being followed and are in compliance with the general permit.
4.1.52	Vermont	Continue enforcement of the winter manure-spreading ban (December 15-April 1) to minimize the water-quality impacts associated with spreading manure on frozen or snow covered ground.
4.1.53	Vermont	Continue investigating all manure spreading or erosion-related complaints on farms and enforce as necessary.
4.1.54	Vermont	Continue enforcement of manure-spreading setbacks established in the AAPs, MFO, and LFO rules.
4.1.55	Vermont	Expand the number of cover-cropped acres enrolled in the state program from 5,000 in 2008 to 12,000 in 2012; the ultimate goal is to have cover crop on all annual cropland that can be planted by October 15.
4.1.56	Vermont	Enroll a total of 2,600 acres of crop, hay, and pasture land in CREP by 2012, including at least 600 acres of annual cropland in partnership with USDA-NRCS-VT and USFWS.
4.1.57	Vermont	Establish the use of alternative manure-spreading methods (e.g., manure injection), with a goal of treating 5,000 total acres by 2012.
4.1.58	Vermont	Use soil aeration techniques on 45,000 acres in the northern Lake Champlain Basin prior to manure applications by 2012.
4.1.59	Vermont	Continue to work with partners to identify flow accumulation or critical source areas in agricultural fields within the Missisquoi Basin and educate farmers on the potential impacts and conservation practices that can be employed.
		Pasture – Encourage and support grassland agriculture and proper pasture management.
4.1.60	USEPA	Work with other federal partners to perform a riparian regulatory gap analysis in the Missisquoi Basin in FFY2012 and establish a timetable to analyze riparian regulatory gaps in other subbasins in subsequent years.
4.1.61	USDA-NRCS	Provide financial and technical support needed to meet Vermont's goal of enrolling 200 acres of pasture annually into CREP.
4.1.62	USDA-NRCS	Implement 2,500 acres of prescribed grazing systems annually in Vermont in conjunction with partners for a total of 10,000 acres by 2014.
4.1.63	USDA-NRCS	Implement up to 150 acres of pasture management per year in New York by emphasizing the use of short-duration rotational grazing for priority conversions of continuously grazed pastures and cropland for a total of 750 acres by 2015.
4.1.64	USDA-NRCS	Redesign and implement 4 stream crossings per year in New York for grazers to minimize livestock access to streams for a total of 20 by 2015.
4.1.65	USDA-NRCS	Install 4 livestock-watering facilities each year in New York in an effort to prevent uncontrolled livestock access to streams for a total of 20 by 2015.
4.1.66	USFWS	Provide financial and technical support to enroll 20 miles of riparian forest buffer each year.
4.1.67	New York	Encourage limited or controlled livestock access to all tributaries in the Basin by promoting livestock exclusion practices, alternative water supplies, stabilized stream crossings, and conservation buffers through the AEM program.
4.1.68	New York	Maintain the partnership with USDA-NRCS and federal cost share assistance to achieve 35 acres of stream buffer practices annually.
4.1.69	New York	Convert 5 continuous grazing systems to prescribed, rotational grazing systems by 2015.

4.1.70	New York	Follow up on all water-quality-related complaints involving small (non-CAFO) farms.
4.1.71	Québec	Continue to provide 90 percent cost share for use-exclusion fencing from rivers/streams in order to ensure compliance.
4.1.72	Québec	Support the implementation of specialized diagnostics, collective projects, and work in ZIPP that drain directly into Missisquoi Bay (especially Beaver Creek, East Swamp Ditch, MacFee, Black, Labonté, Tipping Desranleau).
4.1.73	Vermont	Assess the effectiveness of livestock exclusion regulatory and voluntary programs with partners to identify the scope of the issue and solutions to improve water-quality impacts by 2011.
4.1.74	Vermont	Continue to investigate and enforce as necessary the livestock access to streams provision in the AAPs.
4.1.75	Vermont	Continue to ensure that livestock do not have access to surface waters in production areas on MFOs and LFOs.
4.1.76	Vermont	Continue to provide 80 percent cost share for use-exclusion fencing from rivers/streams where other voluntary incentive programs, such as CREP, are not feasible.
4.1.77	Vermont	Enroll at least 200 acres of pasture or hayland in CREP annually with a minimum of 50,000 linear feet of fence installed each year between now and 2012.

4.2) Reduce the nonpoint source phosphorus load that is being generated by runoff from developed lands in the Basin.

ID	Lead Partner	Task
4.2.1	LCBP	Create a Stormwater Subcommittee of the TAC to recommend improved management strategies for reducing phosphorus in developed watersheds by 2011.
4.2.2	LCBP	Assess potential effectiveness of models established in other watersheds for increased stormwater ordinances by 2014.
4.2.3	LCBP	Assess potential usefulness of local stormwater utilities for communities throughout the basin by 2014.
4.2.4	LCBP	Evaluate the relative importance of wash-off and altered hydrology in stormwater phosphorus loadings in support of a mass-balance study.
4.2.5	LCBP	Track the developed land phosphorus reductions achieved across the jurisdictions in support of an overall mass balance for phosphorus within the Basin by 2014.
4.2.6	USEPA	Work with Vermont and New York to ensure that P-loads associated with new development are minimized to the extent practicable by collaborating on new strategies, such as LID, retrofit strategies, and new stormwater manual elements that increase phosphorus reductions from stormwater controls.
4.2.7	USEPA	Share lessons learned on phosphorus reductions with all partners in other parts of the country on an ongoing basis.
		Provide technical assistance and regulatory oversight needed to manage stormwater discharges from construction sites and new development.
4.2.8	New York	Inspect 20 percent of annual permitted construction activities in the Basin and take enforcement action as needed to achieve compliance.
4.2.9	New York	Report compliance rates based on results from inspections of annual permitted construction activities.
4.2.10	Québec	Produce a guideline for controlling stormwater at new development sites by 2010.
4.2.11	Vermont	Inspect 10 percent of all permitted construction and 5 percent of all operational stormwater sites annually in order to capture a representative sample of all permitted sites; document the number of sites inspected, percent of sites in substantial compliance when inspected, and the number of sites brought into compliance.

4.2.12	Vermont	Update <i>Stormwater Management Manual</i> by 2011 to further incorporate and encourage LID practices into the suite of technologies available to stormwater designers.
		Support maintenance and upgrade of existing stormwater infrastructure.
4.2.13	New York	Inspect 20 percent of permitted stormwater operating structures in the Champlain portion of the MS4 communities annually and take enforcement action as necessary to achieve compliance. Seek stable funding source for maintenance of stormwater infrastructure, including structural replacements, upgrades, and retrofits by 2015.
4.2.14	Québec	Evaluate the feasibility of installing stormwater infrastructure to control flow and sediment in targeted subbasins (Pike River, Rock River, and North Missisquoi River).
4.2.15	Québec	Evaluate the implementation of stormwater infrastructure to control flow and sediment on the new Highway 35 at the Section 3B.
4.2.16	Québec	Inspect the stormwater infrastructure on permitted transportation project construction sites.
4.2.17	Québec	Promote the maintenance of road ditch stabilization with the Centre de service de Foster du MTQ, MRC, and municipalities.
4.2.18	Vermont	Complete at least 15 stormwater treatment retrofits in the North Lake watershed by 2013, with more than half concentrated in St. Albans City or Town.
4.2.19	Vermont	Complete and publish results of stormwater infrastructure survey in St. Albans City and Town, Swanton, Enosburg, Highgate, and Sheldon by the end of 2010 and complete similar surveys for at least 5 additional towns in the basin annually through 2012.
		Minimize phosphorus inputs through source control and education.
4.2.20	LCSG	Promote bioengineering for erosion control and shoreline stabilization via workshops, demonstrations, and technical assistance to municipalities and Lake Champlain shoreline property owners.
4.2.21	New York	Provide technical assistance to applicants, permittees, and interest groups on best practices related to stormwater management, shoreline stabilization, riparian buffers, stream culvert installation, and similar activities in conjunction with local SWCDs. This effort will include preparation of informational/instructional materials as needed; co-sponsor annual stormwater trade shows with CWICNY.
4.2.22	New York	Collaborate with CWICNY, NYSDOT, USFWS, and municipal DPWs on culvert assessment and replacement and road ditch/critical source area stabilization.
4.2.23	New York	Continue oversight of the MS4 Stormwater Program and coordinate this effort with SWCDs.
4.2.24	Québec	Promote nonpoint source pollution prevention in urban development projects.
4.2.25	Vermont	Develop educational materials for towns to use when reviewing building permit applications by 2012 and assist towns in developing questions related to obtaining stormwater permits (construction and operational) on all building and zoning permit applications.
4.2.26	Vermont	Create technical training and materials related to erosion prevention, sediment control, and post-construction stormwater management practices for projects that do not trigger state jurisdiction by 2012 and provide the training to appropriate municipal officials in 20 towns each year thereafter.
4.2.27	Vermont	Continue to coordinate the RSEP through the MS4 permit to facilitate municipal stormwater training and outreach activities.
4.2.28	Vermont	Continue to provide technical and financial assistance to at least 75 municipalities to implement best management practices and construction techniques for upgrading and maintaining rural roads.

4.3) Protect and restore forests, wetlands, floodplains, and stream corridors to maximize storage of phosphorus in the watershed.		
ID	Lead Partner	Task
4.3.1	LCBP	Research potential phosphorus storage functions in wetlands in impaired drainage basins by 2015.
4.3.2	LCBP	Research current regulations for septic and stormwater management in all three jurisdictions to evaluate their effectiveness in reducing stormwater phosphorus load by 2015.
		Protect river corridors, wetlands, and undeveloped floodplains.
4.3.3	USACE	Continue to implement the WRDA Section 542 program in partnership with the LCBP and the approved General Management Plan.
4.3.4	New York	Follow up on all wetland, stream, and water body disturbance complaints and take enforcement action as necessary.
4.3.5	New York	Work with partners to improve the delivery of WRP, CRP, Partners for Fish and Wildlife, and other such programs.
4.3.6	New York	Work with local governments on NFIP regulation, compliance, and community assistance by visiting 15 communities and conducting 4 NFIP workshops for all New York local code enforcement officers by 2015.
4.3.7	New York	Conduct compliance inspections of 10 percent of the stream/wetland-related construction activities permitted in any given calendar year.
4.3.8	New York	Reduce construction-related impacts to wetlands, streams, and water bodies through careful administration of regulatory programs and by providing technical assistance to permit applicants.
4.3.9	New York	Work with private landowners to develop and implement forest stewardship plans with a goal of enlisting 3000 acres per year on average.
4.3.10	Québec	Promote hydro-agricultural outfitting at the watershed level to control sediment transport.
4.3.11	Québec	Provide training and technical assistance to municipal inspectors in the contents of the Buffer, Shoreline and Floodplain Protection Policy.
4.3.12	Vermont	Complete FEH mapping for 75 communities; ensure that 10 communities per year adopt municipal FEH ordinances by 2012.
4.3.13	Vermont	Provide technical oversight to the FEMA map modernization process to provide 10 enrolled communities per year with updated maps or model ordinances design to surpass floodplain protection beyond the NFIP minimum standards.
4.3.14	Vermont	Develop and purchase river corridor easements for 10 reaches of river identified as key sediment attenuation areas in completed geomorphic-based river corridor plans.
4.3.15	Vermont	Expand the <i>Portable Skidder Bridge Initiative</i> , fabricating and making 20 additional portable skidder bridges available to loggers for purchase, loan, or rental by 2012.
		Restore wetlands and natural floodplain connections within the watershed.
4.3.16	USDA-NRCS	Restore 500 acres of wetland annually for a total of 2,000 acres by 2014 through the WRP in partnership with the State of Vermont and USFWS.
4.3.17	USFWS	Assess wetland restoration potential and provide technical and financial support for 500 acres of degraded wetlands each year between 2010 and 2012.
4.3.18	USFWS	Assess floodplain restoration potential on 50 acres and 2 miles of degraded floodplain each year between 2010 and 2012.
4.3.19	USFWS	Provide technical and financial support to restore floodplain connectivity of 20 acres and 1 mile of floodplain each year between now and 2012.
4.3.20	USFWS	Provide financial and technical support to establish 20,000 native trees and shrubs each year between 2010 and 2012.

4.3.21	New York	Use the Priority Waterbody List (a list of impaired waterways) to identify sediment-impacted streams resulting from stream/stream bank instability and set priorities for corrective action funding with a goal of completing 5 projects by 2015.
4.3.22	New York	Increase collaboration with New York partners (River Associations, TU, TNC, CWICNY, NY Rivers, etc.) with a goal of improving the effectiveness of stream projects authorized under New York's Protection of Water Law (ECL 15-05).
4.3.23	New York	Work to enlist at least 2 landowners per year into USDA-NRCS's WRP.
4.3.24	Québec	Provide financial and technical support to establish 10,000 native trees and shrubs each year along riparian buffers in the Basin.
4.3.25	Vermont	Complete 4 floodplain restoration projects annually through 2012.
4.3.26	Vermont	Reestablish buffer vegetation for all completed river corridor easement projects (10 reaches per year) and complete buffer replanting projects on 5 additional reaches per year as prioritized in geomorphic-based river corridor plans, through 2012.
4.3.27	Vermont	Complete 4 encroachment removal/retrofit projects per year (including structures such as berms and stream crossings) through 2012.
4.3.28	Vermont	Provide outreach and education needed to sign up at least 60 landowners in the Basin for USDA-NRCS's WRP by 2012.

4.4) Address phosphorus loads associated with inadequately treated sewage.

ID	Lead Partner	Task
4.4.1	LCBP	Assemble and summarize spatial and temporal patterns of wastewater treatment plants to assist the adaptive management process by compiling end-of-pipe data and other pertinent data as provided by the jurisdictions annually, beginning in 2011.
4.4.2	USEPA	Ensure that WWTF permits are consistent with the requirements of the Clean Water Act and that necessary upgrades are completed expeditiously as part of ongoing review of Vermont and New York's implementation of the Lake Champlain TMDL.
4.4.3	New York	Oversee upgrades to the wastewater treatment plant in the Village of Ticonderoga, oversee construction of a new wastewater treatment plant in the hamlet of Essex, and oversee through consent decree major rehabilitation in the Village of Whitehall (completion date is 01/2014) and work to complete remaining point source upgrades in the TMDL (4) by 2012, including development of compliance schedules.
4.4.4	New York	Continue SSO elimination and abatement efforts with municipalities in the Basin under New York's SPDES Permit Compliance Program and ensure consistency with EPA guidance for dealing with SSOs, with a goal of eliminating 100 percent of these SSOs by 2015.
4.4.5	New York	Continue with CSO reduction efforts with a goal of implementing all SPDES permit schedule requirements pertaining to Long-Term Control Plans by 2020 and eliminating 50 percent of the existing (as of 5/2009) CSOs by 2020.
4.4.6	New York	Work with partners, principally CWICNY, USDA-NRCS, and the SWCDs, to secure cost share funds for 1 septic tank pump-out program annually sponsored by Lake associations.
4.4.7	Québec	Pursue the follow-up inspection program of the wastewater treatment systems for about 100 facilities located off networks in the Ewing and Morpions subbasins and the Sutton and North Missisquoi Rivers. Inspections are planned for 20 new facilities annually.
4.4.8	Québec	Ensure the compliance of authorized establishments.
4.4.9	Québec	Ensure compliance with regulations for municipal sewage disposal for individual septic systems (Q-2, r 8).
4.4.10	Québec	Finalize wastewater treatment plants for Notre-Dame-de-Stanbridge, Pointe Jameson (Venise-en-Québec), Frelighsburg, and Stanbridge East.
4.4.11	Québec	Implement point-source upgrades at facilities that discharge directly into Missisquoi Bay and to tributaries upstream of the Bay to further reduce phosphorus loading by improving filtration systems and maintaining phosphorus discharge requirements.

4.4.12	Vermont	Complete implementation of remaining point-source upgrades specified in the TMDL at Waterbury, Proctor, and Troy/Jay by 2012.
4.4.13	Vermont	Complete and publish results of illicit discharge detection efforts for urbanized villages in the North Lake, including Swanton, Enosburg Falls, Richford, Highgate Falls, Montgomery, and North Troy by 2010 and then assist the communities with follow-up plans, including necessary corrective measures.
4.4.14	Vermont	Ensure that each of the 60 facilities in the Basin has an approved sewage spill prevention plan for the treatment plant and collection system by 2012.
4.4.15	Vermont	Continue the CSO elimination and abatement program, which, to date, has resulted in eliminating 34 of the 55 outfalls in the Lake Champlain basin.

4.5) Use education to empower the general public to reduce phosphorus contributions.

ID	Lead Partner	Task
4.5.1	LCBP	Continue phosphorus-reduction outreach campaigns, such as “Don’t P on Your Lawn” and other stormwater reduction efforts, using social marketing techniques.
4.5.2	LCBP	Continue to implement the annual Lake Champlain Farm Awards in New York, Québec, and Vermont to recognize exemplary management practices.
4.5.3	LCBP	Additional actions that incorporate outreach for phosphorus reduction are listed in the Informing and Involving the Public Chapter. [Chapter 3]
4.5.4	LCSG	Provide watershed, lake, and water-quality education programs for K-12 youth, teachers, and adults by offering hands-on, inquiry-based curriculum, technical expertise, equipment, and human resources to at least 15 programs annually in the Basin.
4.5.5	LCSG	Support adoption of low-input, no-phosphorus lawn care practices by commercial, institutional, and business property managers in impaired watersheds.
4.5.6	LCSG	Provide education and technical support to municipalities and homeowners to increase use of rain gardens, rain barrels, and other stormwater reduction techniques.
4.5.7	LCSG	Increase awareness and adoption of LID by municipalities through workshops, publications, and demonstration projects.
4.5.8	LCSG	Support the “Don’t P on Your Lawn” campaign through education, outreach, demonstrations, and technical support for lawn-care providers, gardening-supply retailers, and municipalities.
4.5.9	New York	Meet with partner organizations involved in water-quality monitoring/improvement (e.g., NY CAC, CWICNY, Water Quality Coordinating Committees, LCSG, TU, and river associations) at least 3 times per year to align priorities, support projects, and leverage resources.
4.5.10	New York	Continue to make up to \$100,000 per year of EPF and other grant monies for phosphorus-reduction projects available to local municipalities.
4.5.11	Québec	Expand information, education, and diffusion activities concerning the impacts of agricultural and urban nonpoint source pollution, the protection of water bodies, and sustainable urban development with the watershed group.
4.5.12	Vermont	Continue to make up to \$500,000 per year of Clean and Clear Ecosystem Restoration grants and other grant monies for phosphorus-reduction projects available to local municipalities and nonprofits.
4.5.13	Vermont	Install stream-crossing signs in at least one subwatershed within the Basin annually.

4.6) Develop and implement a framework for Critical Source Area analysis that will serve as a basis for targeting management actions in order to achieve the greatest phosphorus reductions and address Lake segments furthest from their water-quality targets.

ID	Lead Partner	Task
4.6.1	LCBP	Continue the IJC project, <i>Identification of Critical Source Areas of Phosphorus Pollution in the Missisquoi Bay Watershed</i> , through December 2011.
4.6.2	LCBP	Develop a process for applying results of the IJC project to other priority watersheds in the Basin by 2013.
4.6.3	LCBP	Facilitate meetings among New York and Vermont partners to develop a phosphorus load reduction management strategy for the South Lake by 2011.
4.6.4	LCBP	Continue to research internal nutrient dynamics in Missisquoi Bay to inform and develop a eutrophication model for the Bay.
4.6.5	USDA-NRCS	Incorporate results from the IJC Critical Source Area project in setting priorities for federal financial and technical resources and assist in the extension of the analysis procedures to other watersheds.
4.6.6	USDA-NRCS	Update the Missisquoi Area-Wide Plan in Vermont by 2011 and continue to implement recommendations from the plan.
4.6.7	New York	Seek funding sources to support analysis of Critical Source Areas in the New York portion of the South Lake watershed, similar to the Missisquoi Bay initiative funded by the IJC.
4.6.8	New York	Work with the Warren, Washington, and Essex County SWCDs and County WQCCs to identify, prioritize, and remediate excess sources of phosphorus on private lands in the South Lake watershed at a rate of 1 per county annually in partnership with USDA-NRCS-NY.
4.6.9	New York	Ensure that local groups (SWCDs, WQCC's, municipalities, and other NGOs) are aware of grant opportunities as they arise (state, federal, LCBP, etc).
4.6.10	New York	Identify excess sources of phosphorus on DEC-managed state lands in the South Lake watershed and develop a plan for their remediation (Forest Preserve lands, boat launch sites, state day use/campground facilities, etc.).
4.6.11	New York	Work with NYS DOT as well as county and local DPWs to identify phosphorus-source areas within highway ROWs and develop plans for their remediation with the goal of assessing 1 subwatershed and undertaking 3 corrective actions per year.
4.6.12	Québec	Actively participate in the ongoing IJC project, <i>Identification of Critical Source Areas of Phosphorus Pollution</i> , in the Missisquoi Bay watershed.
4.6.13	Québec	Advise and integrate management of soils and water (GRISE project) by IRDA and McGill University for agricultural consultants. Develop and validate a parcel map management tool based on the segmentation of digital ground models and digital imaging.
4.6.14	Vermont	Actively participate in the on-going IJC project, <i>Identification of Critical Source Areas of Phosphorus Pollution in the Missisquoi Bay Watershed</i> .
4.6.15	Vermont	Incorporate results from the IJC project in setting priorities for state financial and technical resources and extend the analysis to include other watersheds.
4.6.16	Vermont	Work with USDA-NRCS-VT and EPSCoR to pilot development of an "enhanced" hydrography dataset for the Rock River by the end of 2010.
4.6.17	Vermont	Implement a procedure for estimating contributions of stream banks to the total sediment load being delivered by Vermont tributaries to Missisquoi Bay by 2011. Extend the results of this project to tributaries throughout the Basin by 2014 in partnership with New York, Québec, LCBP, and USDA-NRCS-VT.

4.7) Develop a coordinated adaptive management decision plan for evaluating progress in reducing phosphorus inputs to Lake Champlain across the jurisdictions.

ID	Lead Partner	Task
4.7.1	LCBP	Develop an ecosystem indicators database to support the adaptive management process and the annual State of the Lake report using pressure-state-response modeling.
4.7.2	LCBP	Relate subwatershed management practices to phosphorus TMDL load allocations and reductions through quantitative analysis using an adaptive management process for Lake Champlain tributaries based on current monitoring data by 2015.
4.7.3	LCBP	Continue the Adaptive Management Workgroup and bring nationally recognized experts to the region to promote a broad professional exchange of adaptive management theory and applications through annual workshops.
4.7.4	LCBP	Develop an adaptive management framework that can be used to evaluate future implementation scenarios and the phosphorus reductions that may be achieved.
4.7.5	LCBP	Evaluate nonpoint source loading management tools that have been successfully applied in other water-quality programs and prepare a report by 2011.
4.7.6	LCBP	Facilitate the dynamic reporting of management actions by all jurisdictions on the LCBP website.
4.7.7	USEPA	Regions 1 and 2 will continue to encourage, cooperate with, and evaluate the Lake Champlain TMDL implementation by Vermont and New York on an ongoing basis.
4.7.8	USEPA	Work with Vermont, New York, and other partners to develop and implement an adaptive management framework to ensure that TMDL implementation steps are tracked, and that these steps are making progress toward meeting water-quality goals. Part of this initiative could be accomplished by targeting resources (e.g., enforcement, funding, other management actions) in certain areas of the Basin where loading targets are furthest from being met.

4.8) Estimate how climate change is altering the delivery of phosphorus to Lake Champlain and how it necessitates changes in implementation strategies.

ID	Lead Partner	Task
4.8.1	LCBP	Create a Climate Change Subcommittee of the TAC to focus on climate change scenarios and investigate implementation strategies that can minimize the effect of changes on phosphorus loading by 2011.
4.8.2	LCBP	Support efforts by NWS and NOAA to update the rainfall atlas for the northeastern states.
4.8.3	LCBP	Synthesize the best available information on the likely impact of climate change on phosphorus loading by 2012.
4.8.4	LCBP	Recommend adjustments needed in management practices to effectively respond to climate change by 2012.
4.8.5	Québec	Assess the effect of climate change on surface water hydrology and sediments and nutrients export at the level of the Pike River Basin.
4.8.6	USDA-NRCS, USEPA, New York, Vermont, Québec	Develop appropriate strategies for coping with projected changes in precipitation and runoff in collaboration with other partners within the Basin. (USGS, Cornell University, UVM, NOAA, USACE, and others).
4.8.7	Vermont	Compare current 10-year, 25-year, and 100-year design storms to recent climate-change driven precipitation projections in order to better prepare for changing phosphorus loads to Lake Champlain due to rain events.

4.9) Opportunities for Future Actions: Identify research and monitoring projects that can improve management programs and conduct when funding resources become available.		
ID	Lead Partner	Task
		Research Programs
4.9.1		Investigate nutrient dynamics in Missisquoi Bay.
4.9.2		Explore management tools that can be used to identify critical source areas and effective interventions.
4.9.3		Develop and distribute a high-resolution electronic atlas pertinent to a dripping diagnostic, rural water development and soil and phosphorus losses (phosphorus export diagnostic tool, ODEP by IRDA in Québec).
4.9.4		Characterize phosphorus mobility in surface runoff and in the tile drainage system.
4.9.5		Evaluate the impact of internal phosphorus loading on water quality, as described in the TMDL.
		Management and Monitoring Programs
4.9.6		Develop management programs targeting reduction of dissolved phosphorus near the Lake to limit algae blooms.
4.9.7		Update information on land use, agricultural practices, and extent of natural habitats in the Basin to assess their impact on nonpoint source loads.
4.9.8		Monitor the flows, sediments, and nutrients following the Lisière Verte project by the <i>Coopérative de solidarité du bassin versant de la baie Missisquoi</i> .
4.9.9		Monitor the water quality in the targeted subbasins in Québec (Castors, Granger, Pelletier, Petit Ruisseau, and Ewing) following the implementation of 9-meter cultivable riparian buffers, the conversion of annual crops to perennial crops in floodplains, and the installation of runoff control facilities (inlet drains by IRDA).

5. REDUCING TOXIC SUBSTANCES AND PATHOGENS

GOAL: Reduce contaminants that pose a risk to public health and the Lake Champlain ecosystem.

INTRODUCTION

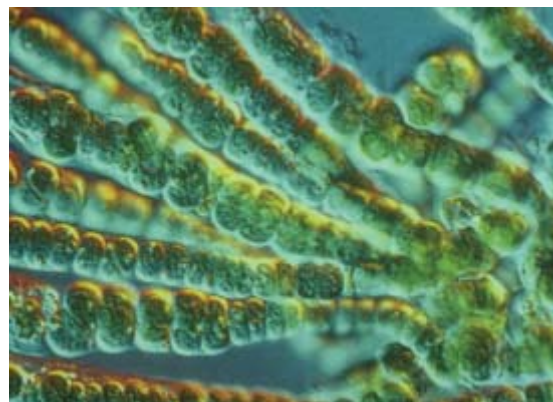
Toxic substances include a diverse group of chemical contaminants, both natural and man-made, that can adversely affect plants, animals, humans, and the overall quality of the Lake Champlain ecosystem. Their impacts may be acute, occurring immediately, or they may be chronic, occurring after a prolonged period of exposure. Exposure to these substances may carry a risk of injury or illness to humans and other organisms. Toxicity varies based on the physical properties, quantity, and persistence of these compounds in the environment. Adverse effects of some substances have been observed in the Lake, but the long-term effects on the ecosystem, aquatic life, and human health of persistent, low-level exposure to many chemicals are not well understood. Even at very low concentrations, certain types of chemicals may affect the reproduction, development, behavior, and survival of aquatic organisms. Pathogens are infectious agents that cause illness, and, where they occur in the waters of the Lake Champlain Basin, they pose a risk to human health.

Categories of Contaminants

The Lake Champlain Basin Program (LCBP) Toxics Management Workgroup has identified toxic substances of concern, grouped into several categories, and will publish a *Lake Champlain Toxic Management Strategy* report. More information about each of these substances will be found in the report, anticipated for release in 2011. Other contaminants of concern include pathogens such as *E. coli* and minerals such as road salt.

Bioaccumulating Toxins: This group includes substances that persist in the environment and increase in concentration with each step up in the food web. Bioaccumulating toxins are incorporated into plankton, which are eaten by fish, in which they may accumulate and become concentrated. Fish that eat these fish then accumulate the toxins in ever higher concentrations. Examples of bioaccumulating toxic substances currently found in the Lake Champlain Basin include mercury, polychlorinated biphenyls (PCBs), and dioxins (from pesticides). These substances are typically found in sediments or are deposited from wind currents on which they are transported from locations outside of the Basin. Mercury is one example of a toxic substance whose source is now predominantly atmospheric deposition. Achieving the reduction targets of the Northeast Regional Mercury TMDL will significantly advance the states toward their goal of reducing mercury levels enough to eliminate fish consumption advisories. In addition, the northeast states filed a §319(g) petition for the US Environmental Protection Agency (USEPA) to convene a management conference of states that are contributing nonpoint source (atmospheric deposition) pollution that is, in part, causing water-quality impairments in our states. Vermont and New York continue to be very active in these mercury-control efforts using Clean Water Act tools for the benefit of Lake Champlain and many other fresh waters in the northeast.

Cyanobacterial Toxins: Two toxins of primary concern in Lake Champlain are anatoxin and microcystin, which are produced by several species of cyanobacteria that form blooms under certain environmental conditions. These cyanobacteria blooms are frequently caused by combinations of excess nutrients present in the water column and warm, calm surface waters. Excess nutrients can come from sources higher up in the watershed that are delivered through the tributary network or from within the Lake's sediments. More information about these issues can be found in the Phosphorus Reduction chapter.



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Pesticides: This group includes all chemical compounds that are used to control or limit the growth of nuisance plants, animals, and fungi and includes herbicides, lampricides, insecticides, and fungicides. These compounds are found in the Lake, often from runoff from agricultural fields, urban lawns, and golf courses as well as other commercial and residential applications.

Pharmaceuticals and Personal Care Products (PPCPs): This group includes all forms of medications, fragrances, surfactants, detergents, and antimicrobial additives. This group is an emerging issue; many PPCPs have been detected in the Lake, but the impacts of their presence are still under investigation. Recent research indicates that many PPCPs (hormones, in particular) do impact several forms of aquatic biota, although the short- and long-term effects of most PPCPs on the Lake ecosystem remain unknown. PPCPs typically enter the Lake via wastewater treatment systems as they are washed off or excreted and flushed through the wastewater system.

Trace Elements: This group includes such elements as arsenic, manganese, cadmium, chromium, lead, nickel, silver, zinc, and copper; all of which are persistent in the environment in localized areas (i.e., sediment or fish) at levels above current human and wildlife health guidelines. Sources include historical contamination at industrial sites in the Basin, atmospheric deposition, aquatic nuisance control activities, natural geological formations, and stormwater runoff events.

Other Toxins: This group includes a variety of toxic substances not identified in the groups above, such as chlorinated phenols, polybrominated diphenyl ethers (PBDEs), persistent organics, and solvents.



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Pathogens: These disease-causing agents also occasionally pose a health risk in the Lake Champlain Basin. Pathogens – such as bacteria, viruses, and parasites – can create gastrointestinal illness when ingested. Public beaches on the Lake are tested for coliform bacteria because it is an indicator that human or animal waste is in the water. New York, Québec, and Vermont all have their own monitoring protocols for popular beaches during the summer months.

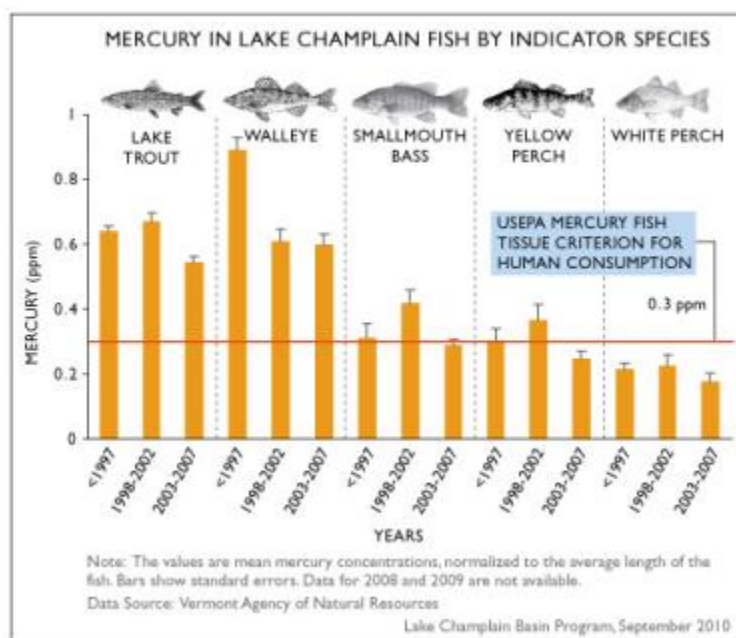
Road Salts: This contaminant group includes sodium chloride

and calcium chloride, both of which are used in road deicing during winter months throughout the Basin. Routine monitoring of these salts has indicated that concentrations have increased throughout the Lake and its tributaries during the last decade (LCBP Long-term Monitoring Program, unpublished data).

Sources of Toxins

Lake Champlain is well studied for some toxic substances (i.e., mercury and PCBs), but only recently have studies been initiated to look at newer types of toxic substances and their sources. Active sources, routes of transport, delivery methods, and quantity of these substances still need to be explored in order for management to be effective. Common sources of toxic substances include: spills, sewage, industry, stormwater runoff, combined sewer overflows, agriculture, landfills, hazardous waste sites, household hazardous materials, and atmospheric deposition. Once toxic substances enter the aquatic environment, they may accumulate in the sediments, remain suspended or dissolved in the water column, or be consumed or absorbed by aquatic organisms and enter the food chain. Some toxic compounds may change form and become different compounds with different properties and toxicities, and the synergistic effects of multiple toxins remains unknown.

Mercury and PCBs remain a significant threat to the Lake and to human health. These substances persist in the environment and accumulate in sediments and aquatic organisms, including fish. Considerable research and management has been undertaken to reduce the level and threat of mercury and PCB contamination, although atmospheric deposition from sources beyond the Lake Champlain Basin remains the primary source of mercury. While new sources of PCBs within the Lake Champlain Basin have been minimized, PCBs continue to persist in the environment and need continued monitoring. Safe consumption of fish remains a top concern for people residing in the Basin; New York, Québec, and Vermont continue to issue fish consumption advisories in order to limit human exposure to mercury and PCBs.



The landscape of toxic contamination in Lake Champlain is changing. New chemicals are being used and introduced into the environment on a daily basis. Continual advances in analytical techniques allow for increased detection of compounds that are released into the environment from domestic, agricultural, and industrial applications. Pesticides, road salts, detergent additives, pharmaceuticals, and personal care products that are used in our daily lives are all compounds of emerging concern for the Lake Champlain ecosystem. Both the extent of contamination and the magnitude of potential effects from these compounds are poorly understood.

Monitoring Contaminants of Concern

Cyanobacteria, commonly known as blue-green algae, are a normal part of the Lake Champlain ecosystem. However, high densities of algae in blooms can produce toxins that cause



gastrointestinal problems, skin irritation, and, in high concentrations, can affect the liver and nervous system. Nearly annual blooms have been observed in some locations in Lake Champlain since 2000. The LCBP has coordinated blue-green algae monitoring in Lake Champlain for the last decade in partnership with the University of Vermont (UVM), the States of Vermont and New York, the Lake Champlain Committee, and the Province of Québec. Monitoring occurs on all sections of the lake. The Québec Ministère du Développement durable, de l'Environnement et des Parcs (Ministry of Sustainable Development and Parks) monitors Missisquoi Bay north of the border and sends regular information to Vermont and New York about conditions in Canadian waters. Monitoring in US waters happens through a partnership that includes citizen volunteers.

Weekly testing occurs from July through early September. UVM summarizes the results of this testing and circulates information about Lake conditions to public health officials. Public information about conditions, and any beach closures or public health hazards are posted on the Vermont Department of Health and the LCBP web sites. Public alerts (including a map) direct Lake users to areas that are generally safe and list any areas that contain algae accumulations and should be avoided. This monitoring and alert system has successfully prevented people from adverse exposure to cyanotoxins; since implementation, no documented major illnesses based on exposure to cyanotoxins have been recorded.

A recent study conducted by US Geological Survey (USGS) in the Lake Champlain Basin indicated that domestic and agricultural chemicals and their breakdown products have been detected in Lake Champlain and its tributaries (Phillips and Chalmers 2009). More than seventy different chemicals were identified in the study, including flavorants, fire retardants, plasticizers, pesticides, fragrances, pharmaceuticals, and detergent degradates. Many of these chemicals enter surface water through the wastewater stream. Wastewater treatment facilities remove many types of contaminants, preventing them from entering surface water, but no facility or treatment process is capable of removing all compounds. The highest concentrations of pharmaceuticals and antimicrobials detected in the USGS study were found in the effluent of the wastewater treatment plant that services a hospital. High concentrations were also detected during combined sewer overflow events, when some waste bypasses the treatment plant. However, few contaminants were detected in the waters of Lake Champlain itself.

The co-occurrence of these compounds with caffeine emphasizes the degree to which Basin residents are both the source of and solution to this issue and the heretofore unpredictable fates of these compounds is being clarified by new science outside of the Lake Champlain Basin. For one example, recent literature suggests that dioxin-like compounds found in sediments may be the partial product of waste treatment reactions with the common antibacterial compound *triclosan* (Buth et al. 2010). Many aspects of emerging contaminants still require assessment in the Lake Champlain Basin (e.g., incidence of agricultural hormones, the effects of exposure to

mixtures of very low-level compounds). Management of these compounds relies on personal choice in the products we use and industry response to the public requirement for products with lower levels of toxic compounds. This is exemplified by very significant documented declines in the estrogen-mimicking compound p-nonylphenol due to its removal from detergents by manufacturers (Phillips 2010). Research and management must now focus on these *new-generation* contaminants.

Toxin Reduction Efforts

Detection of chemicals in Lake Champlain and its tributaries indicates that management and preventive measures may be necessary to reduce potential threats to the ecosystem and human health. The overall strategy for the management of toxic substances should be guided by a pollution prevention approach and the Precautionary Principle, which states that when there is a suspected health or environmental concern, preventive actions should be considered even without scientific certainty that harm will ensue. The precautionary principle is the central tenet of the European Union's approach to management of hazardous and toxic substances in conjunction with the "Restriction on Hazardous Substances" Directive. Management for toxins should be employed at personal, business, municipal, and state levels. Every person living or working in the Basin has the responsibility and ability to minimize toxic substances from reaching the ecosystem.

A new clean-up effort on the Saranac River in Plattsburgh, New York, began in June 2010. Sediments from the river bed are contaminated with coal tar from a former manufactured gas plant. This project will involve construction of a temporary river water diversion and fish passageway from the work area, construction of a temporary water treatment plant, and erection of a structure to process the sediments as they are removed from the river bed and shipped off-site. This project is estimated to remove 40,000 cubic yards of contaminated sediments by project completion in 2012.

Vermont continues to implement the provisions of the 2007 mercury product legislation, which includes reviewing sale restriction exemption applications, updated labeling and notification plans, and maintaining the auto switch collection program. Additions to the law in 2008 established a thermostat collection incentive program with manufacturer-funded recycling and financial incentives. Vermont captured nearly 1,800 pounds of mercury-containing products, 33 pounds of elemental mercury, and 3 pound of mercury from more than 1.2 million fluorescent bulbs in 2008 (the most recent year for which data are completely available).

As part of an earlier project, Vermont's Agency of Agriculture, Food, and Markets (VAAFM), its municipal solid waste districts, and Department of Environmental Conservation (VTDEC) located, removed, and replaced all known mercury manometers from working and nonworking dairy farms. A total of 180 manometers were removed and 159 non-mercury replacements were installed for a total of 77 pounds of mercury removed from Vermont farms.

Brownfields are also of concern to human health; these are parcels that could be expanded or redeveloped and may be contaminated by hazardous substances from previous uses. Redevelopment projects that are proposed for brownfields parcels are required to survey, clean up, and monitor potential contaminants before the project can occur. Redevelopment of

brownfields parcels can help ease development pressure on green spaces and working landscapes, in addition to protecting the environment by mitigating the contaminated site. These projects are overseen by the USEPA Brownfields Program [www.epa.gov/brownfields], and EPA grant funding is available for assessment, clean up, revolving loan funds, and job training.

The new framework of *Opportunities for Action (OFA)* identifies broad objectives designed to help managers better understand the issues and to make efforts to reduce contaminants in the waters of the Lake Champlain Basin more effective. The actions and tasks identified in this chapter will help partners work toward the goal of reducing contaminants that pose a risk to public health and the Lake Champlain ecosystem. Efforts made by all partners, including those listed in this plan, will promote the reduction of toxins, pathogens, and other contaminants of concern.

Citations

Buth, Jeffrey, Peter O. Steen, Charles Sueper, Dylan Blumentritt, Peter J. Vikesland, William A. Arnold, Kristopher McNeill. 2010. *Dioxin photoproducts of triclosan and its chlorinated derivatives in sediment cores*. *Environmental Science & Technology* 44(12): 4545-4551.

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OBJECTIVES

- Prevent pollution from toxic substances in the Lake Champlain Basin.
- Meet existing human health standards and identify all public health risks related to drinking water, public contact, and fish consumption.
- Improve public understanding of the impacts of toxic substances in Lake Champlain and the research and management programs related to toxic substances.
- Communicate water-quality-related health risks to the public promptly and implement plans to reduce that risk.
- Improve public understanding of health issues related to water recreation and drinking water.
- Control sources of pathogens found in the Lake and its Basin to ensure drinkable and swimmable water and reduce the frequency of beach closures.

PRIORITY ACTIONS & TASKS

5.1) Publish and implement the <i>Lake Champlain Toxic Management Strategy</i> that emphasizes pollution prevention while continuing to mitigate pollution problems throughout the Lake by 2015.		
ID	Lead Partner	Task
5.1.1	LCBP	Work with the LCBP Toxics Management Workgroup to publish the <i>Lake Champlain Toxic Management Strategy</i> report by 2011.
5.1.2	LCBP	Revise and update the list of Toxic Substances of Concern and related strategies identified in the Management Strategy for the Basin every 3 years after publication.
5.1.3	New York	Manage all reported chemical and petroleum spills in the New York portion of the Basin and remediate with NYS DEC oversight or, in the absence of a viable responsible party, by NYSDEC.
5.1.4	New York	Working from the List of Potentially Contaminated sites, New York will establish the actual status of all sites within the Lake Champlain Basin and develop Corrective Action Plans, as appropriate, by 2015.
5.1.5	New York, USEPA	Finalize the designation of a vessel wastewater “No Discharge Zone” for the entire Champlain Canal by 2010 (complete in May 2010).
5.1.6	New York	Revise the human-health-related water-quality standard for Arsenic by 2015 and establish an ambient water-quality value for PBDEs by 2011.

5.2) Provide education and outreach to encourage homeowners, industries, health care facilities, businesses, governmental agencies, and public institutions to prevent pollution and recycle by 2015.		
ID	Lead Partner	Task
5.2.1	LCBP	Provide technical notes from the scientific literature to watershed associations for interpretation to lay audiences annually.
5.2.2	LCBP	Support mercury instrument exchange programs when and where possible.
5.2.3	LCBP	Host a workshop for private, local, and state/provincial roadway deicing applicators to discuss methods to reduce road salt application by 2013.
5.2.4	LCBP, Québec, Vermont	LCBP will work with partners to promote sustainable business practices and encourage implementation of BMPs to reduce toxin pollution. Québec will do this on an annual basis, through education and outreach. Vermont will continue to focus on toxics use and waste reduction and environmentally preferable purchasing through the Vermont Business Environmental Partnership offered through the VTDEC [www.vbep.org].
5.2.5	USEPA	Promote and maintain the Environmental Stewardship search engine [yosemite.epa.gov/oepi/stewardship.nsf] to explore a variety of pollution prevention and recycling opportunities.
5.2.6	USEPA	Promote and distribute “Planning for a Sustainable Future” [www.epa.gov/region2/sustainability/greencommunities/] to local governments, with emphasis on the sections “Solid Waste Generation and Recycling” and “Protecting Water Quality and Ensuring Future Supply.”
5.2.7	USEPA	Continue development of EPA Partnership Programs [www.epa.gov/partners/] that address a wide variety of environmental issues, including toxics and pathogens, by working in collaboration with companies, organizations, communities, and individuals within the Lake Champlain Basin.
5.2.8	New York	New York’s Pollution Prevention (P2) Institute will identify and prioritize facilities within the Basin that could benefit from environmental assessments or process improvements by 2015.
5.2.9	New York	New York’s Pollution Prevention (P2) Institute will conduct at least 1 workshop that

		targets a priority topic within the Basin by 2012.
5.2.10	New York	New York will conduct a pharmaceutical outreach effort in support of DEC's "Don't Flush Your Drugs" campaign, will conduct a pilot drug collection event for residents of the Basin, and will assist communities with local drug collection events by 2011.
5.2.11	New York	NYSDEC will conduct a "Chemical Management" workshop for schools in the Basin by 2015.
5.2.12	New York	NYSDEC will develop and maintain a list of "green formulations" that can substitute for commonly used commercial and household chemical cleaners, fertilizers, and preservatives and promote the use of these green alternatives in the Lake Champlain watershed by 2015.
5.2.13	New York, LCBP	NYSDEC will implement the "Be Green Organic Yards - NY Program" [www.dec.ny.gov/public/65071.html] – a new initiative to foster organic landscaping practices. NYSDEC and LCBP will identify targets for media contact and web outreach by 2012.
5.2.14	Québec	Continue to annually promote best management practices related to toxin use reduction programs and energy conservation by implementing the QC MDDEP's 2006-2012 Climate Change Action Plan at [www.mddep.gouv.qc.ca/changements/plan_action/index-en.htm] and the Agence de l'efficacité énergétique du Québec [www.aee.gouv.qc.ca/en/the-aee/]
5.2.15	Vermont	Encourage homeowners, industries, businesses, governmental agencies, and public institutions to prevent pollution and recycle through the VTDEC Small Business and Municipal Compliance Programs and pollution prevention programs. [www.anr.state.vt.us/dec/ead/index.htm]
5.2.16	Vermont	Implement mercury thermostat recycling programs at wholesaler and retailer locations to capture 65 percent or more of discarded thermostats (25-35 lbs of mercury per year) by 2013. [www.mercvt.org/]
5.2.17	Vermont	Implement mercury lamp recycling programs for residential and small business sectors to promote high rates of recycling (5-10 lbs of mercury per year), by 2012.
5.2.18	Vermont	VAAFM will collect 285,000 pounds of pesticides through its waste pesticide collection program run in conjunction with Vermont Solid Waste District's household hazardous waste collection events by 2010. This program began in 1991 and will continue to be active.
5.2.19	Vermont	VAAFM will remove more than 2 pounds of mercury from the Vermont Maple Sugar Producer's Mercury Thermometer Exchange Program by 2010. Additional mercury thermometers will be exchanged for digital replacements pending future funding. Update: 80 mercury thermometers were exchanged for digital instruments.

5.3) Investigate and address the distribution, fate, and effects of contaminants of concern and sites of concern.

ID	Lead Partner	Task
5.3.1	LCBP	Coordinate a workshop to develop a Basin-wide database to track retail sales of pesticides, pharmaceuticals, veterinary medicines, fertilizer substances, and other materials containing toxics as identified on the list of Toxic Substance of Concern by 2014.
5.3.2	LCBP	Provide a statistically sound dataset on toxic substances of concern in fish tissue for coordinated management use by both human health officials and fish and wildlife managers by 2014.
5.3.3	New York	NYSDEC will expand New York's Pesticide Monitoring program of groundwater to include, by 2015, an upstate county located within the Basin.
5.3.4	New York	Continue the ambient monitoring program (Rotating Integrated Basin Studies) utilizing bioassays to assess and identify aquatic toxicity concerns. Evaluate this program's effectiveness in assessing overall aquatic habitat quality by 2015.
5.3.5	New York	Continue the fish-tissue monitoring program in Cumberland Bay to assess the

		effectiveness of the PCB remediation project completed in 2000, by 2015.
5.3.6	New York, Vermont	Inventory winter road salt use at state, county, and local levels. Identify areas that are particularly sensitive to road salt.
5.3.7	Vermont	Continue groundwater monitoring for nutrients and pesticides associated with agricultural activities in order to evaluate whether these activities are contributing to contamination of the groundwater of Vermont.
5.3.8	Vermont	Continue to monitor pesticides in the surface waters of Vermont as funding is available in order to better understand and manage mechanisms of pesticide runoff.
5.3.9	Vermont	Continue to track commercial pesticide use in the Vermont sector of the Lake Champlain Basin and across Vermont to determine trends in pesticide use.

5.4) Implement actions to monitor, investigate the causes of, and reduce the frequency of blue-green algae toxins in the Lake.

ID	Lead Partner	Task
5.4.1	LCBP, New York, Vermont	Coordinate monitoring of blue-green algae blooms through 2011 and work to move monitoring responsibility to jurisdictional partners by 2015. New York and Vermont will monitor blue-green algae Lake-wide through the Long-Term Water Quality and Biological Monitoring Program. [www.anr.state.vt.us/dec/waterq/lakes/htm/lp_longterm.htm]
5.4.2	LCBP	Support and document research within the Lake Champlain Basin that will clarify the causes of localized blue-green algae blooms by 2015.
5.4.3	USEPA	Provide annual updates on work completed under 2 grant programs (P2 and SRA, see below) as relevant to the Lake Champlain Basin and advertise funding opportunities to partners within the Basin as they become available. EPA's Pollution Prevention Program administers 2 grants (the P2 Grants Program and the Source Reduction Assistance [SRA Grants Program]). P2 grant dollars provide 50 percent matching funds, for state and tribal programs only, to support pollution prevention activities across all environmental media and to develop state- or tribal-based programs. SRA grant dollars require only 5 percent matching funds and are targeted at nonprofit organizations and state, county, municipal, and tribal technical assistance programs to help businesses and industries identify better environmental strategies and solutions for reducing or eliminating waste at the source across all environmental media.
5.4.4	Québec	The QCMDDEP will maintain its BGA monitoring program. Québec will coordinate research regarding cyanobacteria blooms, impacts and driving factors with Vermont based on the Blue-green Algae Action Plan 2007-2017 [www.alguesbleuvert.gouv.qc.ca/en/index.asp] .
5.4.5	Vermont	Provide cyanobacterial toxin testing through the Department of Health (VTDOH) Laboratory for water suppliers and waterfront homeowners at no or limited cost.
5.4.6	Vermont	Continue to provide data on cyanobacteria to Basin drinking water suppliers. Work with suppliers through their association to develop and modify appropriate monitoring and response strategies to the occurrence of cyanobacteria in the vicinity of drinking water intakes.

5.5) Identify public health risks associated with toxic substances (including blue-green algae toxins) and communicate risk to the public through advisories from the three jurisdictions.

ID	Lead Partner	Task
5.5.1	LCBP	Update the LCBP website annually with interpretive materials and links to appropriate jurisdictional authorities for information about water-related public health issues.
5.5.2	LCBP, New	Work with state and provincial departments of health to raise awareness and educate

	York, Québec, Vermont	health care providers on symptoms of cyanobacteria toxicity by 2013.
5.5.3	USEPA	Coordinate with ongoing efforts by the Centers for Disease Control and potential Office of Research and Development studies regarding cyanobacteria blooms, impacts, and driving factors. Update the LCBP Steering Committee with progress by May 2011.
5.5.4	New York	Publish annual fish consumption advisories based on latest data available.
5.5.5	Québec	Publish health advisories about blue-green algae toxins and share best management practices to reduce algal growth. [www.alguesbleuvert.gouv.qc.ca/en/fiche.asp?sujet=16]
5.5.6	Vermont	Continue to post information on current cyanobacteria advisories, bloom locations, and health-related information on the VTDOH webpage [www.healthvermont.gov/enviro/bg_algae/bgalgae.aspx] . Annually update and maintain interpretive and educational materials about cyanobacteria on VTDOH and VTDEC websites [www.anr.state.vt.us/dec/waterq/lakes/htm/lp_cyanobacteria.htm] . Provide new health-related information as it becomes available.
5.5.7	Vermont	Continue to work with local recreational water managers, Vermont State Parks, local parks and recreation departments, town health officers, and other concerned parties on beach monitoring for both <i>E. coli</i> and cyanotoxins.
5.5.8	Vermont	Continue to work with towns in the Champlain Valley to educate their residents and lakeshore property owners about the occurrence of cyanobacteria and cyanotoxins. Issue an annual reminder about the presence, identification, and avoidance of cyanobacteria before the summer recreational season.

5.6) Determine sources of and reduce the threat of pathogens to public health in Lake Champlain Basin waters; communicate risk to the public through advisories from the three jurisdictions.

ID	Lead Partner	Task
5.6.1	LCBP	Provide a workshop to explore applications or operational use of a DNA/microbial source tracking library for <i>E. coli</i> by 2012.
5.6.2	LCBP	Encourage common pathogen monitoring protocols among jurisdictions within the Basin by 2015.
5.6.3	New York	Revise ambient water-quality criteria for pathogens pending the EPA's national reassessment of pathogen criteria, expected in October 2012.
5.6.4	New York	Assess sewer pump-out capabilities at all Lake Champlain marinas and provide education and technical support on opportunities available to construct new or upgrade existing pump-out facilities through the Clean Vessel Assistance Program [www.nysefc.org/dotnetnuke/OtherPrograms/CleanVesselAssistanceProgram.aspx] by 2012.
5.6.5	New York	Make WQIP grants available to municipalities to extend sewers into previously unsewered areas and to create new sewer districts to help reduce and eliminate on-site systems in marginal and poor soils by 2015.
5.6.6	Vermont	VTANR will pursue revisions to the <i>E. coli</i> water-quality standard with the Vermont Water Resources Panel by 2011.
5.6.7	Vermont	VAAFM will continue to support the CREP and the best management practices program to help minimize bacteria and pathogens in agricultural runoff.
5.6.8	Vermont	VAAFM will continue to enforce manure setback requirements under the AAPs, MFO, and LFO rules to minimize bacteria and pathogens in runoff.
5.6.9	Vermont	VAAFM will continue to enforce livestock exclusion from production areas on medium and large farms in Vermont to minimize the spread of pathogens.

5.7) Opportunities for Future Actions: Identify research and monitoring projects that can

improve management programs and conduct when funding resources become available.		
ID	Lead Partner	Task
5.7.1		Periodically measure toxic substances in Lake Champlain waters, including contaminants of concern and new-generation chemicals in the water column and lake bottom sediments.
5.7.2		EPA staff will review the Mercury Reduction Plans for New York and Vermont to assess TMDL implementation progress.

6. MANAGING FISH, WILDLIFE, AND PLANTS

GOAL: Maintain resilient and diverse communities of fish, wildlife, and plants in the Lake Champlain Basin.

INTRODUCTION

The Lake Champlain Basin is a large freshwater ecosystem with a rich diversity and abundance of native fish, wildlife, and plants. These living natural resources occupy a mosaic of interconnected aquatic and terrestrial habitats, including broad open waters, tributaries, wetlands, forests, agricultural lands, and other areas. The natural resources of this ecosystem provide tremendous social, recreational, economic, and environmental benefits to the Lake Champlain Basin.

Fish, wildlife, and plants throughout the Basin are intrinsically linked in a food web, from microscopic plankton to fish, birds, other wildlife, and plants. Phytoplankton and zooplankton are at the base of the food web and are linked to keystone predators such as game fish and birds of prey through a complex relationship of intermediary predator and prey species. The structure, function, and balance of the food web are closely connected to water quality, habitat diversity, and human health. Lakes, ponds, and streams provide habitat for many different species of fish, invertebrates, amphibians, and reptiles, some of which are threatened or endangered. Wetland areas provide critical habitat for fish and wildlife while also improving water quality by serving as sinks for nutrients that would be delivered to the Lake through the tributary network. Wetlands also help control flooding, protect groundwater and drinking water supplies, reduce erosion, and protect shorelines. Rivers and streams draining upland portions of the Basin complete the network, linking upland terrestrial and aquatic habitats to floodplains and associated wetlands and, ultimately, Lake Champlain itself. The abundance of fish, wildlife, and plant communities within the Basin attract a wide array of recreational users, including hunters, anglers, trappers, paddlers, hikers, and bird watchers, providing a significant economic benefit to the regional economy. Natural species diversity is a highly valued part of the region's natural heritage and a critical component of the ecosystem that we all share.

The native flora and fauna of the Lake Champlain Basin have changed significantly during the last few centuries, both in diversity and abundance. New species have been introduced to the ecosystem, others have been lost, and some are more dominant now than historically. Some species, such as original strains of lake trout, will not likely return to Lake Champlain in their native form. Losses of native keystone species like the lake trout, Atlantic salmon, and American eels have a significant detrimental impact on the ecosystem, changing the natural balance of the Lake Champlain food web. Management agencies throughout the Lake Champlain Basin are working to restore many of these species to self-sustaining populations.

Threats

The Lake Champlain Basin provides a rich and varied habitat for aquatic and terrestrial species and boasts healthy natural communities. These natural communities face many threats, including loss of wetland and riparian habitat functionality, overexploitation of highly valued species (e.g.,

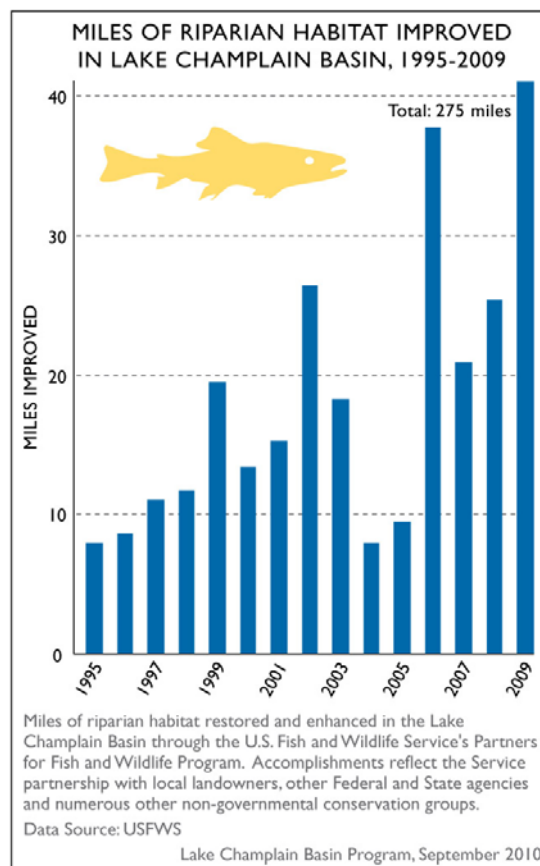
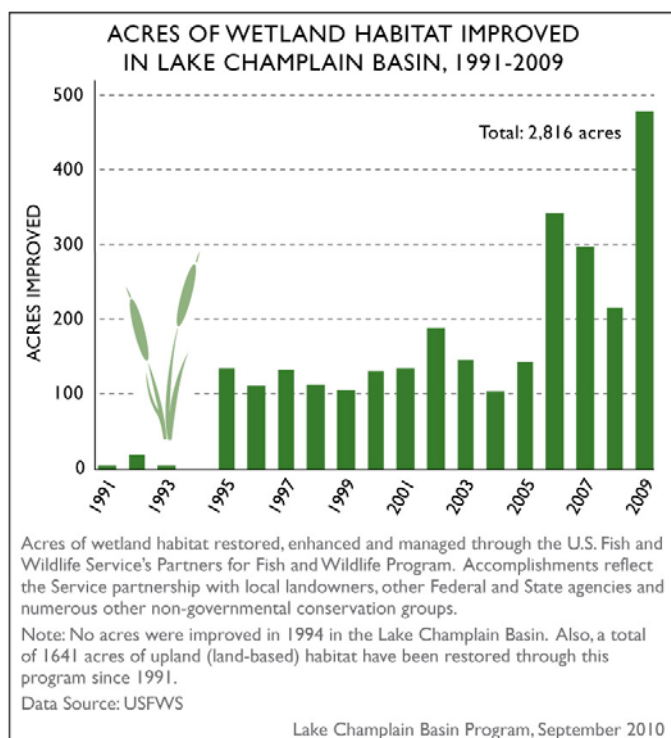
lake trout, Atlantic salmon), and introduction of new species to the ecosystem (e.g., alewife). Changes to any component of the ecosystem can have substantial impacts on the rest of the ecosystem. Loss of wetlands to agricultural, residential, or commercial development has far reaching impacts including loss of critical wildlife habitat, reduced flood storage, and reduced pollutant filtering. Dams and improper culvert placement can reduce fish habitat by interrupting passage from one stream segment to another. Poorly planned land development also can lead to reduced habitat connectivity, increased erosion and sedimentation, stream bank instability, and increased nutrient and sediment loadings in rivers resulting in further degradation and loss of aquatic habitats.

Invasive species, both plant and animal, can change the balance of the natural ecosystem. Invasive plant species such as water chestnut may outcompete and displace native species. This, in turn, can disrupt the food web that waterfowl and other wildlife rely on. Invasive animal species also have the potential to impact the food web. Alewife, for example, can become a primary food source for native Lake Champlain salmonids, but a diet featuring alewife has been shown to inhibit the natural reproduction of native Lake Champlain salmonids and also may alter the zooplankton community, which could affect the entire food web within the Lake.

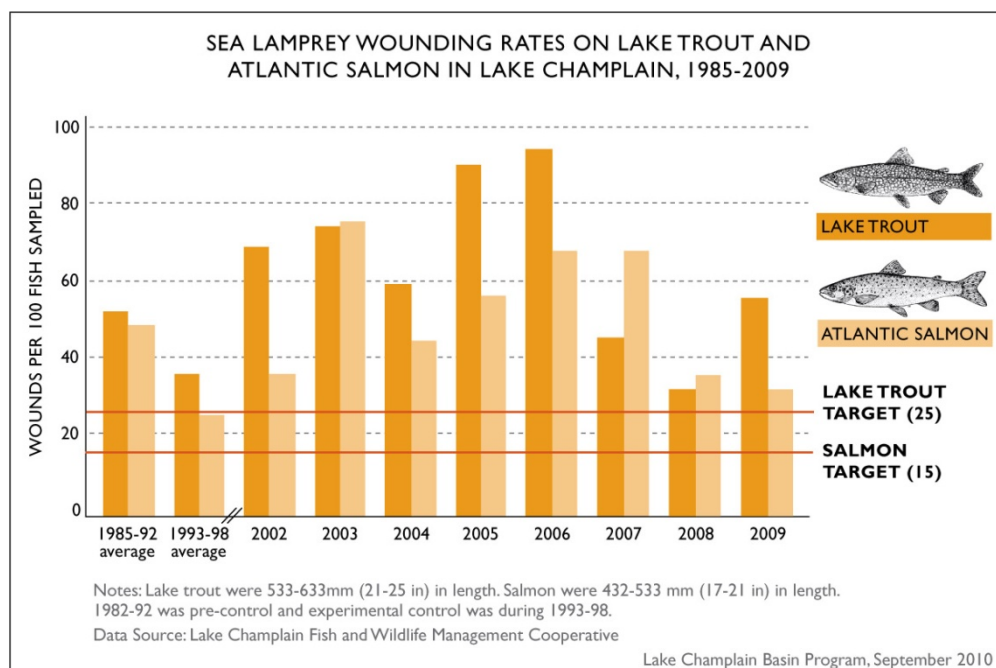
Unmanaged native species also have the potential to impact the balance of the ecosystem. Uncontrolled cormorant populations result in loss of nesting habitat for other bird species, including heron and tern. An unmanaged sea lamprey population would result in increased wounding rates on salmonids and ultimately a decline in their populations in the Lake, subsequently impacting other critical components of the food web. Efforts to restore the Lake Champlain fishery rely heavily on the success of the sea lamprey management program.

Progress

Much work is being done through the collaborative efforts of many partners, from federal and state agencies to local volunteer and nonprofit groups and private sector entities, to protect the fish, wildlife, and plant resources of the Basin. Local implementation grants administered through the Lake Champlain Basin Program (LCBP) have funded local watershed groups to implement projects to stabilize eroding stream banks, establish stream bank plantings, and manage invasive plant species. The Nature Conservancy continues to partner with the LCBP, the states of New York and Vermont, and the US Fish and Wildlife Service (USFWS) to identify valuable wetlands and to identify funding sources to permanently protect these areas. Similar efforts have been undertaken by Basin partners in Québec. Conservation cost-share programs target agricultural lands to help create conservation easements, set aside wetlands, and establish vegetated buffers along streams. Aggressive long-term management of water chestnut in South Lake Champlain has made great strides in pushing its range southward and helping to reestablish a balanced community structure in some areas.



The Lake Champlain Fish and Wildlife Management Cooperative regularly monitors populations of landlocked Atlantic salmon, lake trout, brown trout, walleye, and northern pike, as well as aquatic organism passageways to evaluate fish movement and the success of stocking programs. The goal of the Cooperative is to restore and maintain salmonid and other fish communities through natural reproduction, supplemented by stocking when necessary. The salmonid fishery has not been developing as well as expected in large part due to sea lamprey parasitism. However, a comprehensive long-term sea lamprey control program has recently begun to show some signs of success. Although wounding rates for both lake trout and landlocked Atlantic salmon remain above target values, there is some indication of a downward trend approaching the targets set by the Cooperative (Fisheries Technical Committee 2009).



Progress has been made in providing passage upstream for spawning and corridors for habitat. Stream crossing structures in two New York watersheds have been assessed and inventoried. Three dams have been removed in Vermont in the last four years and thirteen aquatic organism passage barriers will be removed in New York and Vermont in the next year.

Biodiversity is also changing within the Basin. Seventeen additional species of breeding birds have been discovered in Vermont since 1981, including bald eagles, great egrets, and sandhill cranes. Breeding bald eagle populations are increasing in the Lake Champlain region. A record number of bald eagles were observed in a January 2008 survey on the New York side, although a similar survey in 2009 yielded a record low (winter aerial surveys have been conducted since 2006; Nye 2009). Several other species, such as the pink heel splitter (a native mussel), common tern, lake sturgeon, and spiny softshell turtle, are listed as rare, threatened, or endangered and are under state or federal protection. Many state, provincial, and federal programs offer financial and technical assistance to private landowners to improve wildlife habitat and stabilize stream banks for protection of these species. Active cormorant management programs have helped reduce competition and restore nesting habitat, resulting in an increase in native nesting colonial birds.

Fish, Wildlife, and Plants Management Objectives, Priority Actions, and Tasks

Considerable efforts are underway to protect the fish, wildlife, and plant resources of the Basin. However, increasing pressures continue to threaten the Basin ecosystem through habitat loss or fragmentation, as well as degradation. A continual collaborative effort among all of the LCBP partners is necessary to successfully address these threats and to restore and maintain the rich diversity of native fish, wildlife, and plant communities that we currently enjoy in the Lake Champlain Basin. Many examples of coordination among these agencies to enhance application of an ecosystem approach to management and conservation in the Lake Champlain Basin could be cited. This chapter sets broad conservation objectives and describes natural resource agencies work to protect and enhance fish, wildlife, plants, and their habitats. The priority actions and

tasks below highlight the efforts of LCBP partners to protect, restore, and maintain the aquatic flora and fauna of the Lake Champlain Basin, with a special emphasis on biota within the lake.

Citations

Fisheries Technical Committee, 2009. Strategic Plan for Lake Champlain Fisheries. Lake Champlain Fish and Wildlife Management Cooperative, USFWS, Essex Junction, VT

Nye, P. 2009. New York State Bald Eagle Report 2009. New York State Dept. of Environmental Conservation, Albany, NY.

OBJECTIVES

- Protect and enhance aquatic, wetland, riparian, and terrestrial habitats.
- Restore and maintain a robust fish community and fishery.
- Restore and manage water-dependent wildlife and plants.
- Manage native fish, wildlife, and plant species that become a nuisance.
- Use biological indicators to monitor change in the Lake Champlain ecosystem.
- Protect and enhance aquatic, wetland, riparian, and terrestrial habitats

PRIORITY ACTIONS & TASKS

6.1) Develop a list of high-priority habitats in need of protection.		
ID	Lead Agency	Task
6.1.1	LCBP, New York	Hold a workshop or series of workshops by the end of 2010 to identify types and locations of high-priority habitats for conservation and to identify priority area criteria with the help of partners by 2010. Apply those criteria to existing knowledge of Basin resources to begin to identify those specific habitats and their locations in need of protection by the end of 2011. New York will contribute information on critical fish spawning and migration routes to help this effort
6.1.2	USFWS	Identify high-priority habitats for migratory birds in the Bird Conservation Region 13 plan [www.acjv.org/bcr13_plan.htm].
6.1.3	USFWS	Staff at the Missisquoi National Wildlife Refuge will work with partners, the public, and landowners to develop a Preliminary Project Proposal (PPP), to identify high-priority habitats, especially those along the Missisquoi River corridor, the lakeshore of Lake Champlain, and other important habitats in the Missisquoi River watershed by 2010.
6.1.4	USFWS	Staff at the Missisquoi National Wildlife Refuge will work with partners, the public, and landowners to develop a Land Protection Plan (LPP) by 2011. The LPP will identify in detail those lands that are seeking protection as part of the NWR system or through one of our land protection partners.
6.1.5	Québec	Inventory the upper Richelieu River to identify high-priority habitats for conservation. This task will be accomplished by 2015 by staff of the QC MRNF.

6.2) Undertake long-term conservation decisions in coordination with existing “open space” and federal, state, and local habitat protection programs by 2015.

ID	Lead Agency	Task
6.2.1	LCBP	Coordinate a meeting with partners to address this priority by the end of 2011, undertaking long-term conservation decisions in coordination with existing “open space” and federal, state, and local habitat protection programs.
6.2.2	USFWS	Staff of the USFWS Migratory Bird Program will provide coordination with the Atlantic Coast Joint Venture and grant opportunities for habitat restoration and acquisition under NAWCA.
6.2.3	Québec	Coordinate meetings with partners to address habitat restoration and acquisition (QC MDDEP, Ducks Unlimited, Nature Conservancy Canada, local partners like <i>Organisme de Bassin Versant de la Baie Missisquoi</i>) by the end of 2011.

6.3) Where appropriate, restore connections between aquatic habitats within the Lake Champlain Basin by managing or removing dams and other potential barriers (including in-lake barriers) to allow aquatic organism passage (AOP).

ID	Lead Agency	Task
Manage or remove dams and other potential barriers (including in-lake barriers) to allow AOP.		
6.3.1	LCBP	Support competitive local grants to improve habitat connectivity within the Basin through an RFP process by the end of 2010.
6.3.2	LCBP, USACE	Conduct feasibility study and an environmental impact study of removal of the Carry Bay causeway by 2013.
6.3.3	USFWS	Identify potential dam removal projects in the Lake Champlain Basin and work with local stakeholders to develop removal plans.
6.3.4	Vermont, USFWS	Vermont will assess the feasibility of removing the Swanton Dam on the Missisquoi River. USFWS will assist Swanton with removal if it is found to be feasible.
6.3.5	New York	Research aquatic organism passage at the Imperial Dam on the Saranac River in Plattsburgh and continue to operate the Willsboro Fishway on the Boquet River, providing salmon access to spawning habitat upstream of the Willsboro Dam.
6.3.6	Québec	Restore at least 1 dike between marshes and lake in Missisquoi Bay by 2015.
Inventory and improve road-crossing structures that pose a barrier to AOP.		
6.3.7	USFWS	Develop a priority list of structures that need to be improved for AOP. This includes assisting with inventory of culverts in one subwatershed each year. Replace or retrofit 2 culverts each year.
6.3.8	Vermont	VTANR staff will review culvert replacements and proposed new culverts for VTrans needs.
6.3.9	Vermont	Vermont will continue to ensure that all new and retrofitted bridges and culverts on the state roadway system support AOP as required by federal regulation.
6.3.10	New York	NYSDEC staff will seek improvements in bridge and culvert design via Article 15 permit application reviews.
6.3.11	New York	NYSDEC staff will incorporate ASCN into at least 1 transportation planning project, using State Wildlife Grant funding.
6.3.12	Québec	Review culvert replacements and proposed new culverts for AOP needs. Replace or retrofit at least 3 culverts by 2015.

6.4) Enhance and conserve riparian and wetland habitats.

ID	Lead Agency	Task
6.4.1	LCBP	Support the NAWCA process for acquisition of federal funds for riparian and wetland conservation.
6.4.2	USDA-NRCS, Vermont, USFWS	Provide financial and technical support for the enhancement of 20 miles and 2600 acres of riparian buffer annually in 2010, 2011, and 2012.
6.4.3	USDA-NRCS, Vermont, USFWS	Provide financial and technical support for the establishment of 20,000 native trees and shrubs in riparian and wetland habitat annually in 2010, 2011, and 2012.
6.4.4	USDA-NRCS, USFWS, Vermont	Assess wetland restoration potential on 500 acres of degraded wetlands annually in 2010, 2011, and 2012. Provide financial and technical support for the hydrologic restoration of 500 wetland acres annually in 2010, 2011, and 2012.
6.4.5	New York	NYSDEC staff will minimize construction-related impacts to streambeds and banks via review of Protection of Water permit applications. NYSDEC staff will reduce construction-related impacts to wetlands, streams, and water bodies through careful administration of regulatory programs and technical assistance to permit applicants.
6.4.6	New York	NYSDEC will work with other partners (WRP, CRP, Partners for Fish and Wildlife, etc.) to improve the delivery of programs that conserve, restore, or enhance riparian and wetland habitats.
6.4.7	Québec	Coordinate meetings with partners to address wetland and riparian habitat restoration and acquisition by the end of 2015. This task will be accomplished by the QCMDDEP, Ducks Unlimited, Nature Conservancy Canada, and local partners such as <i>Organisme de Bassin Versant de la Baie Missisquoi</i> .

6.5) Conserve important wildlife corridors associated with riparian habitats.

ID	Lead Agency	Task
6.5.1	LCBP	Facilitate meetings and networking among partners who have the ability or resources to acquire land for conservation purposes.
6.5.2	USFWS	Assess floodplain restoration potential on 50 acres and 2 miles of degraded floodplain annually in 2010, 2011, and 2012.
6.5.3	USFWS	Provide technical and financial support to restore the floodplain connectivity of 20 acres and 1 mile of floodplain annually in 2010, 2011, and 2012.
6.5.4	New York, Vermont	Work with partners in the State Wildlife Grant-funded “Staying Connected in the Northern Appalachians” to maintain, enhance, and restore habitat connectivity in the Adirondack/Green Mountain corridor for forest-dwelling species of concern.
6.5.5	Québec	The Nature Conservancy Canada will acquire wetlands and riparian areas to protect eastern spiny softshell turtle habitats in Missisquoi Bay.

6.6) Restore native fish species and enhance Lake Champlain Basin fisheries.

ID	Lead Agency	Task
6.6.1	LCBP	Promote tasks that reduce excessive sediment load in spawning habitat.
6.6.2	LCBP	Promote stream bank restoration projects on small tributaries that provide forest canopy cover for fish habitat improvement.
6.6.3	LCBP	Support at least 1 research project on the effects of climate change on the relative extent of cold- and warm-water fisheries in Lake Champlain (i.e., distribution and population viability of cold- and warm-water fisheries) by 2012.
6.6.4	LCBP	Support AIS management programs as a mechanism to protect Lake Champlain Basin fisheries programs and native fish communities.

6.6.5	LCFWMC	Stock Atlantic salmon and lake trout into Lake Champlain per LCFWMC Fish Technical Committee recommendations to enhance fisheries and restore self-sustaining populations.
6.6.6	Vermont, USFWS, Québec	Vermont will raise walleye fry and fingerlings to stock into Lake Champlain per the walleye restoration plan [www.lcwalleye.org/Old%20Walleye%20Plan.pdf]. USFWS will monitor walleye age, growth, and abundance in the South Bay of Lake Champlain. Québec will Monitor Pike River walleye spawning population in 2012.
6.6.7	USFWS, Québec	Restore American eel populations. USFWS will monitor eel abundance in US areas of Lake Champlain. Québec will monitor American eel population trends at fish ladders in the Chambly River and optimize American eel passage in the St-Ours River in cooperation Hydro-Québec. Québec will also continue an American eel stocking program in the Richelieu River and Lake Champlain until 2015.

6.7) Develop a Lake-wide colonial water bird management plan. Undertake management activities consistent with goals set forth in the plan.

ID	Lead Agency	Task
6.7.1	LCBP	Facilitate and support meetings of the LCFWMC to develop a Lake-wide colonial water bird management plan by 2015.
6.7.2	USFWS	Provide a large-scale perspective and help to integrate management changes from the Lake Champlain lake-wide colonial water bird management plan into the Upper Mississippi Valley/Great Lakes Colonial Waterbird Management Plan [www.pwrc.usgs.gov/nacwcp/umvgl.html].
6.7.3	USFWS, New York, Québec	Monitor populations and participate in management efforts recommended in Lake-wide colonial water bird management plan in each partner's jurisdiction.

6.8) Restore communities of native plants and high-priority habitats to benefit riparian restoration in the Lake Champlain Basin.

ID	Lead Agency	Task
6.8.1	USFWS, USDA-NRCS, Vermont	Work with local landowners to restore 50 acres of riparian or wetland community habitat each year. Maximize efforts toward using 100 percent native trees and shrubs, derived from local seed sources for all restoration projects.
6.8.2	LCBP	Support native nurseries in the Basin for restoration plantings. Support native plant restoration within competitive local grant processes.
6.8.3	Québec	Support local and provincial initiatives for restoring native plants in the Lake Champlain Basin.

6.9) Develop and implement recovery plans for federal, state, and provincially listed threatened and endangered species in the Lake Champlain Basin.

ID	Lead Agency	Task
6.9.1	LCBP, New York, Québec, Vermont	LCBP will coordinate with jurisdictions to develop common strategies for species recovery programs.
6.9.2	USFWS	Support the protection and restoration of federally endangered Indiana bats in the Lake Champlain Basin. Identify and protect roosting, foraging, and maternity habitat. Coordinate response to WNS by assisting Vermont and New York in summer bat acoustic monitoring surveys and emergence counts and determining its effects on resident bat populations.
6.9.3	USDA-NRCS	Restore or improve 100 acres per year of Indiana bat and other bat species habitat in Vermont.
6.9.4	USFWS, New	USFWS will coordinate with Vermont and New York in proposed wind farm reviews to

	York, Vermont	determine effects on Indiana bats and other bat species.
6.9.5	USFWS	Participate in or coordinate freshwater mussel surveys of a species of concern, <i>A. varicosa</i> (brook floater), as part of a range-wide population assessment (and other mussel species as needed).
6.9.6	USFWS, Vermont	USFWS will coordinate with Vermont in identifying potential habitat for the federally threatened <i>Isotria medioloides</i> (small whorled pogonia) in Chittenden County.
6.9.7	New York	Utilize State Wildlife Grant funding to develop recovery plans for select Threatened, Endangered, or Species of Special Concern. Most relevant to the Lake Champlain watershed will be recovery planning for sauger and timber rattlesnakes.
6.9.8	New York	Provide technical assistance to at least 1 municipality in the Basin to protect Species of Greatest Conservation Need (SGCN) through development of local land-use plans and ordinances.
6.9.9	New York	Monitor populations of select listed species and require NYSECL Article 11 “Taking Permits” for projects that will impact listed species or their habitats.
6.9.10	Québec	Participate in or coordinate surveys of channel darter (<i>Percina copelandi</i>), eastern sand darter (<i>Ammocrypta pellucida</i>), and copper redhorse (<i>Moxostoma hubbsi</i>) in the Richelieu River and continue to implement the recovery plans for these species.
6.9.11	Québec, Vermont	Develop a joint recovery plan for the eastern spiny softshell turtle in Québec and Vermont to protect more essential habitats for this species.

6.10) Manage native fish, wildlife and plant species that become a nuisance.

ID	Lead Agency	Task
		Continue implementing long-term sea lamprey assessment and control activities on Lake Champlain to restore lake trout, landlocked Atlantic salmon, and Lake Sturgeon.
6.10.1	LCFWMC, LCBP, USACE	Participate in state-of-the-art sea lamprey control, including application of lampricides, construction of innovative barriers, trapping adults, and population assessments. More than 20 rivers, streams, and deltas will be assessed from 2010 to 2013, of which about 15 sites are anticipated for lampricide treatment. Six rivers and streams will be trapped annually. LCFWMC will also conduct annual surveys to assess sea lamprey wounding rates on lake trout and Atlantic salmon. LCBP will support policy favoring comprehensive management of sea lamprey within the Lake Champlain Basin, including alternative management techniques.
		Continue implementing cormorant and ring billed gull assessment and control activities on Lake Champlain.
6.10.2	LCBP, USFWS, NRCS, Vermont, New York	Continue active participation with the LCFWMC to implement cormorant and ring billed gull assessment and control activities on Lake Champlain.
6.10.3	USFWS	Review applications for permits to take gulls. Review annual proposals and reports filed under the Cormorant Public Resource Depredation Order by the USDA-NRCS-WS and the states. Missisquoi NWR will coordinate implementation of appropriate control actions on the refuge with partners,

6.11) Use biological indicators to monitor change in the Lake Champlain Ecosystem. Continue assessment of species diversity and abundance.

ID	Lead Agency	Task
6.11.1	LCBP	Monitor and assess zoo- and phytoplankton species diversity and abundance throughout Lake Champlain as an indicator of food web health.
6.11.2	LCBP	Model and project the impacts of climate change on fish and wildlife communities in the Lake Champlain Basin that may result from climate change.
6.11.3	LCBP, NY,	Establish a common classification system for the assessment of littoral, benthic, and

	VT	shoreline habitat quality for Lake Champlain. Hold a workshop(s) by the end of 2011 with regional and national experts to establish an appropriate classification system and, ultimately, identify priority areas for conservation. Vermont will apply littoral habitat assessment methodology to the Lake Champlain shoreline.
6.11.4	LCBP, USFWS, Québec, Vermont	Monitor fish communities. Vermont and USFWS will conduct annual forage fish abundance surveys, primarily through annual sampling of rainbow smelt and alewife by trawl and hydroacoustics, allowing managers to respond to fluctuations in the prey base by manipulating predator numbers through harvest control and stocking. Québec will conduct a fish survey of Missisquoi Bay by 2015. LCBP will communicate the results of this work to the public through regular web updates.

6.12) Opportunities for Future Actions: Identify research and monitoring projects that can improve management programs and conduct these projects when funding resources become available.

ID	Lead Agency	Task
6.12.1		Conduct expanded analysis of trends in the long-term data set of zoo- and phytoplankton species diversity and abundance to relate these data to fisheries.
6.12.2		Assess effects of eutrophication and siltation on spawning areas and aquatic organisms.
6.12.3		Identify amount of accessible Atlantic salmon spawning habitat in the Lake Champlain Basin and determine impediments to recruitment of naturally produced Atlantic salmon.
6.12.4		Inventory all priority habitats requiring protection in the New York portion of the Basin.
6.12.5		Assess effects of cormorant predation on fish populations Lake-wide.
6.12.6		Evaluate the status of largemouth and smallmouth bass populations in Lake Champlain to assess the long-term impact of fishing tournaments on these populations.
6.12.7		Determine the status of the sauger in Lake Champlain and, if appropriate, develop strategies to restore the species.

7. MANAGING AQUATIC INVASIVE PLANTS AND ANIMALS

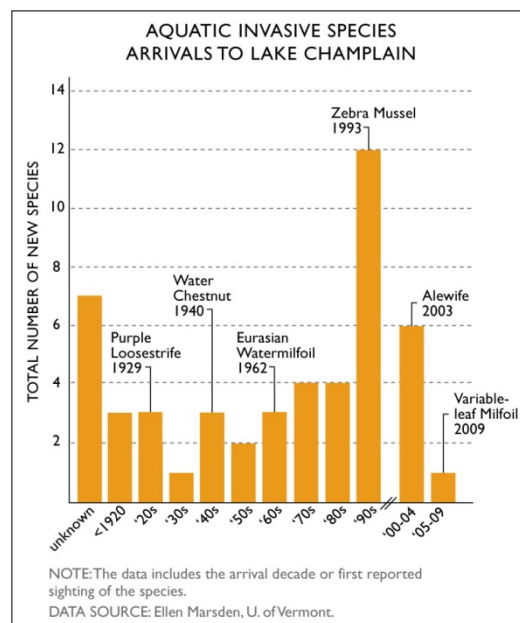
GOAL: Prevent the introduction, limit the spread, and control the impact of non-native aquatic invasive species in order to preserve the integrity of the Lake Champlain ecosystem.

INTRODUCTION

Aquatic invasive species (AIS) are non-native species that harm the environment, economy, or human health. AIS include aquatic plants, animals, and pathogens. Lake Champlain was home to 49 known non-native aquatic species in 2010, many of which are invasive. Once introduced into Lake Champlain, AIS have the potential to spread to other inland water bodies in the Basin. AIS that become established in the Basin can pose serious threats to indigenous fish, wildlife and native plant populations; impede recreational activities; significantly alter the ecosystem of the Lake; and damage the economy of the region.

AIS have entered the Lake Champlain Basin through a number of different pathways, most commonly through interconnected waterways, such as the Champlain and Chambly Canals and Richelieu River, or overland through human activities, such as boating and bait transport. Other pathways include accidental water garden releases, aquarium dumping, and illegal fish stocking. The interconnected waterways of Lake Champlain transcend the authority of any single state or jurisdiction, necessitating coordination among the different management agencies. AIS currently found in Lake Champlain include zebra mussels, Eurasian watermilfoil, water chestnut, and alewives. Asian clams and didymo are examples of recent AIS introductions in the Basin. Recent research has indicated that sea lamprey are native to Lake Champlain; more information on sea lamprey may be found in the Fish, Wildlife, and Plants chapter.

Lake Champlain is threatened by non-native aquatic species known to occur in connected waterways such as the St. Lawrence Seaway, which has more than 85, the Great Lakes with close to 190, and the Hudson River Basin with more than 90. AIS that exist in these waterways include the spiny waterflea, quagga mussel, round goby, and the fish disease viral hemorrhagic septicemia. Other threats in the region include hydrilla, snakehead, and Chinese mitten crab.





Management Plans

The Lake Champlain Basin Program (LCBP) is involved in regional and national coordination to prevent the introduction and spread of AIS. The *Lake Champlain Basin Aquatic Nuisance Species Management Plan* [www.lcbp.org/PDFs/ANS_Mgmt_Plan_2005Final.pdf] was revised and approved by the National Aquatic Nuisance Species (ANS) Task Force in 2005. The LCBP and its partners belong to the Northeast ANS Panel, one of six regional panels of the ANS Task Force, which is co-chaired by the National Oceanographic and Atmospheric Administration (NOAA) and the US Fish and Wildlife Service (USFWS). New York also has an approved *Adirondack Park Aquatic Nuisance Species Management Plan*. These management plans call for technical and financial assistance to local groups working in partnership with regional, state, provincial, and federal resource management agencies on invasive species management as well as strong public involvement. Objectives of these plans include strengthening coordination for plan implementation; increasing public education and outreach; enhancing detection, monitoring, and research; and developing, prioritizing, and implementing AIS management actions and rapid responses. Ongoing implementation of these plans aims to reduce and slow the introduction and spread of AIS to the Basin. These management plans are important companion documents to *Opportunities for Action (OFA)*, as priority actions in all of these regional AIS management plans are closely aligned.

Rapid Response

The introduction of a new AIS or spread of existing AIS to a new location in the Lake Champlain Basin may warrant rapid response actions to remove the species before it becomes established and causes harm to the environment, economy, or human health. The LCBP Steering Committee approved the *Lake Champlain Basin Rapid Response Action Plan for Aquatic Invasive Species* [www.lcbp.org/PDFs/2009-AIS-Rapid-Response-Plan.pdf] in May 2009; it

recommends the formation of a Rapid Response Task Force to quickly respond to and counter, if possible, any new AIS infestations in the Lake Champlain Basin. The plan calls for sharing expertise, staff, and equipment to eradicate new AIS or prevent the spread of existing AIS to new locations, regardless of where it occurs in the basin. Members of the Rapid Response Task Force would respond to a new infestation and conduct a species risk assessment to determine what control actions may be technically, economically, and socially feasible. The plan recommends the Incident Command System in the US section of the Lake – a standardized, on-scene, all-hazards incident management approach that is part of the US Federal Emergency Management Agency’s National Incident Management System – in any rapid response control action that involves multiple stakeholders and jurisdictions within the Lake Champlain Basin.

AIS Laws and Rules

AIS laws and policies have been developed to address multiple pathways of introduction. Vermont and New York implemented baitfish regulations in 2007 to prohibit the movement of baitfish from one body of water to another to prevent the spread and introduction of aquatic invasive baitfish and any diseases or pathogens they might carry. Anglers may purchase and transport certified bait to one body of water within a specified time for use only on that specified water body. Once there, baitfish may be stored for use, but may not be transported to another body of water. Any harvested live bait can be used only on the body of water from which it was harvested. Vermont joined Alaska in 2010 by passing a law that bans the use of felt-soled waders, on which AIS such as didymo (or “rock snot”) and New Zealand Mud Snail might be transported, in all Vermont waters. Additionally, as of July 1, 2010 it is illegal to transport any aquatic plants, zebra mussels, or quagga mussels overland on a boat or trailer in the state of Vermont; New York is considering a similar transport law. The development and implementation of rules and regulations that prevent the spread and introduction of AIS also help to inform the public about these pathways and support citizen behavioral changes.

Spread Prevention

The first objective in AIS management is to prevent introductions. Once AIS enter the Basin and become established, however, preventing their spread to other bodies of water requires strong education and outreach campaigns as well as partnerships between local, state, provincial, and federal agencies and organizations for management.

The LCBP has worked in partnership with the New York State Canal Corporation (NYSCC) to address the threat of AIS spread through the Champlain Canal. Canals are the leading pathway of AIS introduction to Lake Champlain, and they may in turn serve as a route for AIS to move from Lake Champlain to the Hudson River Basin and St. Lawrence Seaway. LCBP partners are working together to support an AIS feasibility study for a barrier within the Champlain Canal.

The LCBP has continued to support the successful Lake Champlain Boat Launch Steward Program since its inception in 2007. Lake Champlain continues to attract users from around the United States and Canada who trailer vessels and bring equipment that may be carrying AIS from other areas. The Boat Launch Steward Program places stewards at high-use New York State Department of Environmental Conservation (NYSDEC) and Vermont Fish and Wildlife Department (VTFWD) Lake Champlain boat launches to conduct courtesy boat inspections for AIS and gather information about which water bodies boat-launch users come from and if they

take any measures to prevent the spread of AIS. Data from the 2009 field season indicated that more than 4 percent of boaters that launched or retrieved their boats in Lake Champlain had AIS on their boats, trailers, or recreational equipment. Public behavior change to check, clean, and dry all vessels, boats, and equipment can reduce the risk of AIS introductions and spread [www.stopaquatichitchhikers.com].

AIS Management in the Basin

LCBP and partners have been working for decades to manage aquatic invasive fish and animals in the Basin. Management of AIS is complicated by limited knowledge concerning the presence and extent of many of these species within the Basin and the impact that introduced species have on indigenous species, habitats, and the food web. While measurable impacts of AIS to the environment and economy are hard to track, invasive species are a leading known cause of biodiversity loss, second only to habitat loss (Wilson 2006).

Adequate information based on surveys and monitoring programs is essential to forming effective management strategies for AIS. Evaluating technologies that exclude or eliminate these species and coordinated research and management efforts outside the Basin are also important to implementing the *Aquatic Nuisance Species Management Plan*. The LCBP has an AIS Subcommittee comprised of technical experts from federal, state, and provincial agencies; research and academic institutions; environmental nonprofit organizations; and local river and watershed organizations that meet to discuss and share AIS management techniques, research, policy, and public outreach strategies.

In order to make the best possible management decisions, it is necessary to understand the effectiveness, cost, and secondary impacts of AIS control strategies. The implementation of a control strategy must incorporate research as well as pre- and post-management monitoring. All control strategies, long-term or experimental, should be continually reevaluated for their efficacy in achieving management goals.

The water chestnut partnership management program provides a useful example of how control strategies support management goals. Water chestnut displaces other aquatic plant species, is of little food value to wildlife, and forms dense vegetative mats that alter aquatic habitat and interfere with recreational activities. In 1998, the Vermont Department of Environmental Conservation (VTDEC), The Nature Conservancy (TNC), NYSDEC, and the US Army Corps of Engineers (USACE) established a cooperative partnership to reduce the negative impacts and prevent the further spread of water chestnut in Lake Champlain and other Basin waters. Partners have been able to reduce the number of infested sites within the Lake by using a combination of mechanical harvesting and hand-pulling; in 2009, sixteen out of eighty-five sites were found to be free of water chestnut (Hunt and Marangelo 2010). Additionally, the water chestnut population in Red Rock Bay off Burlington, Vermont, was removed in 2009, which marked the first time that area was free of water chestnut since 1982.

The success of AIS programs, such as water chestnut management, is highly dependent on continued financial support and priority commitments from all partners involved. LCBP and partners are developing an integrated AIS management approach to be able to respond to new infestations and the spread of AIS, prevent the introduction and establishment of new species,

and educate the public about preventing the spread of AIS. Effective AIS management must address AIS introduction pathways (such as canals) through partnerships, overland transport through boat launch steward programs, and the movement of bait through legislation. Managing AIS infestations once they become established is more costly than preventing them. Citizens can do their part by always checking, cleaning, draining, and drying their boats and equipment and never moving any plant or animal species between water bodies or releasing aquarium or other pets into the wild. LCBP and partners are committed to working together to address policy gaps, respond to new and spreading AIS, and raise public awareness in order to protect the species diversity and richness of the Lake Champlain Basin.

Citations

Hunt, T. and P. Marangelo. 2010. 2009 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters. VT Dept. of Environmental Conservation, Waterbury, VT and The Nature Conservancy, West Haven, VT.

Wilson, E.O. 2006. *The Creation: An Appeal to Save Life on Earth*. New York: WW Norton and Company Inc.

OBJECTIVES

- Prevent the introduction and reduce the spread of AIS that currently or potentially may damage the environment, economy, or human health in the Lake Champlain Basin.
- Conduct early detection monitoring and rapid response management of AIS in the Basin and document the extent of infestations.
- Increase public understanding of, involvement in, and behavior change related to the spread, prevention, and control of AIS through education and outreach programs.
- Manage AIS using current and new technologies and evaluate the efficacy of these technologies
- Support comprehensive invasive species spread-prevention policy and support local, regional, and national cooperation.

PRIORITY ACTIONS & TASKS

7.1) Prevent the introduction of aquatic invasive species into the Lake Champlain Basin.		
ID	Lead Agency	Task
		Prevent the introduction of aquatic invasive plants, animals, and pathogens via overland transport.

7.1.1	LCBP	Support boat launch steward programs at high-use access sites on Lake Champlain and other inland lakes and rivers through funding and training. Expand boat launch steward programs by 50 percent by 2014 in the Lake Champlain Basin.
7.1.2	LCBP, LCSG	Evaluate surveyed boat launch user AIS spread-prevention behaviors annually and compare surveyed behaviors to results of previous years' surveys. Report annually to the Steering Committee.
7.1.3	USFWS	Provide a full-time wildlife inspector, on-call 24 hours, at the Champlain, New York, border crossing to interdict invasive and injurious species and conduct routine species identification training with Customs and Border Protection personnel. Provide annual reports.
7.1.4	New York, LCSG, Vermont	Support the Lake Champlain boat launch steward program and its expansion by assisting in the training of boat launch stewards.
7.1.5	New York	Maintain ANS signage at all state boat launches in the Basin.
7.1.6	Vermont	Provide technical assistance and annual training to help groups implement and sustain access-area greeter programs. Provide financial assistance for these programs through the ANC Grant-in-Aid program when possible.
7.1.7	Vermont	Annually identify high-priority and high-traffic access areas around the Basin as candidates to be staffed by boat launch stewards/greeters.
7.1.8	Vermont	Post signs at public access areas within the Basin warning users to stop the transport of AIS. Repost downed signs as needed.
		Prevent the introduction of aquatic invasive plants, animals, and pathogens via connected waterways.
7.1.9	LCBP, New York, LCSG	Organize biannual meetings with the NYCC, hold public meetings, and engage appropriate partners to address AIS in the canals. Report number of stakeholders and partners in attendance.
7.1.10	LCBP	Develop a bilingual AIS pamphlet for distribution to Champlain and Chambly Canal visitors by 2012.
7.1.11	LCBP	Develop and distribute a coordinated bilingual PSA about AIS in canal ways by 2012.
7.1.12	LCBP, New York, Québec	Develop an AIS spread-prevention sign for all canal locks in the Champlain and Chambly Canals by 2014. Each jurisdiction is responsible for posting their locks by 2014.
7.1.13	LCBP, New York	Provide staff support to the USACE and other partners to conduct a feasibility assessment of a barrier strategy for the Champlain Canal by 2015.
7.1.14	LCSG	Support the development of AIS exclusion technologies via technology transfer of systems/methods found to be useful in the Great Lakes or elsewhere.
7.1.15	USFWS	Conduct a feasibility assessment of a spiny water flea and other AIS barrier strategy for the Glens Falls Feeder Canal by 2012.
		Prevent the introduction of aquatic invasive plants, animals, and pathogens via the pet and aquarium trade, aquaculture, bait industry, and horticultural nurseries.
7.1.16	Vermont	Inspect aquarium retailers and horticultural nurseries selling live aquatic plants for prohibited species.
7.1.17	Vermont	Survey aquarium retailers for sales of crayfish and prohibited species (e.g., fish, amphibians, reptiles) by 2015.
7.1.18	New York	Identify opportunities to promote voluntary spread prevention including “green” certification, clean stock initiatives, and best management practices through collaborations with New York agencies and stakeholders and implement 3 such opportunities by 2015.

7.2) Reduce the spread of aquatic invasive species within the Lake Champlain Basin.		
ID	Lead Agency	Task
		Maintain water chestnut management and reduce the extent of dense water chestnut mats in Lake Champlain to a level manageable by surveillance and hand-pulling only by 2019. The 2009 cost estimate is \$1.34 million per year through 2019.
7.2.1	LCBP	Provide support for the mechanical and hand-harvesting efforts as funding is available and coordinate biannual water chestnut workgroup meetings with New York, Québec, and Vermont to discuss management and funding challenges.
7.2.2	USFWS	Annually survey, remove, and quantify water chestnut in the Missisquoi National Wildlife Refuge. Provide financial support for control activities on 20 acres of wetland habitat in the Basin each year.
7.2.3	New York, Vermont	Partner with TNC, Missisquoi National Wildlife Refuge, LCBP, USFWS, USACE, and QCMDDEP to continue annual water chestnut eradication efforts in Lake Champlain. Monitor and manage for new water chestnut occurrences in the basin.
7.2.4	Québec	Continue and report annually on the water chestnut eradication and monitoring program in River du Sud and other water courses where it might be found in Québec.
		Identify proper disposal options for alewife fish kills
7.2.5	New York	Approve plan for handling large-scale alewife die-offs by 2011
		Support technical control programs for other invasive plants, animals, and pathogens in the Lake Champlain Basin.
7.2.6	LCBP	Report new management technologies annually to the LCBP Steering Committee.
7.2.7	New York	Annually provide technical assistance to water body residents, municipalities, and others to help them design and implement water body-specific, long-range AIS control projects.
7.2.8	New York	Control invasive plant species on Wildlife Management Areas and continue to partner with the APIPP to manage invasive plants on other public and private lands throughout the basin.
7.2.9	Québec	QCMDDEP will prepare an action plan for AIS that will threaten the Québec sector of Lake Champlain and will include an approved early detection system, by 2015.
7.2.10	Québec	Collaborate with LCBP partners on the evaluation of possibilities and technologies available for the control of AIS on an as-needed basis.
7.2.11	Vermont	Develop a rapid response general permit for invasive species by 2012.
7.2.12	Vermont	Provide technical assistance to water body residents, municipalities, and others to help them design and implement water body-specific, long-range AIS control projects. Offer financial assistance (when available) through the ANC Grant-in-Aid program to support these projects. Report annually on implemented control projects.

7.3) Promote the early detection of and rapid response to aquatic invasive species entering the Lake Champlain Basin.		
ID	Lead Agency	Task
		Promote the early detection of AIS.
7.3.1	LCBP, New York	Continue the Long-Term Biological Water Quality Monitoring Program on Lake Champlain and the sampling of targeted inland lakes in the Basin. LCBP will provide financial support and coordinate this program with other research efforts as part of an AIS early detection program. New York will monitor the Champlain Canal as part of the Long-Term Monitoring Program for early detection of invasive species. Report results annually.
7.3.2	LCBP	Provide an AIS detection curriculum for agency field staff with the help of partners (NYSDEC, VTDEC, LCSG, Québec) by 2012.
7.3.3	LCBP	Work with partners to conduct yearly ecological surveys of the Champlain and Chambly Canals to facilitate early identification of new invaders. Report results to the Steering Committee and publish in the State of the Lake Report.
7.3.4	LCBP	Work with partners to identify AIS program and monitoring gaps in order to make recommendations to facilitate Basin-wide monitoring by 2014.
7.3.5	Québec	Develop early detection networks for invasive aquatic, wetland, and terrestrial plants by 2015.
7.3.6	Vermont	Examine samples collected in the annual fisheries surveys within the Lake Champlain Basin for AIS and report results annually.
7.3.7	Vermont	Survey infested water bodies to monitor expanding and declining populations of AIS and search other water bodies in an effort to detect invasions as early as possible. Submit annual reports on number of lakes surveyed and results.
7.3.8	Vermont	Maintain and continue to expand a VIPs Program, which trains volunteers in identification and search techniques for AIS. Number of volunteers trained each year will be available.
7.3.9	New York	Work with APIPP and other partners to establish and delineate ISPZs for the Basin by 2015.
7.3.10	New York	Identify new, expanding, and declining populations of AIS by continued, annual monitoring of New York waters and report annually on results.
7.3.11	New York	Continue to support and expand the Volunteer Lake Monitoring Program in the Adirondacks.
		Promote rapid response to AIS.
7.3.12	LCBP	Implement the Lake Champlain Basin AIS Rapid Response Action Plan beginning in 2010. The LCBP, USEPA, NYDEC, APA, VTANR, MDDEP, QCMRNF, DFO Canada, USFWS, and USDA-NRCS will adopt internal procedures and designate personnel to help implement the plan.
7.3.13	LCBP, New York, Québec, Vermont	Establish a Lake Champlain Basin AIS Rapid Response Task Force by 2011. Jurisdictions will designate representative. The LCB Rapid Response Task Force will conduct at least 2 species risk assessments a year and report these findings to the LCBP Steering Committee.
7.3.14	LCBP	Report new and emerging AIS threats to the Basin annually to the LCBP Steering Committee.

7.4) Support cooperation with the public and local, regional, and national organizations to reduce aquatic invasive species threats.		
ID	Lead Agency	Task
7.4.1	LCBP	Coordinate regionally with the NEANS Panel and ANS Task Force by attending biannual meetings to prevent the introduction of AIS and conduct spread prevention.
7.4.2	LCBP	Coordinate boat launch steward programs with VTDEC, VTFWD, APIPP, NYSDEC, Paul Smiths College, Lake George Association, QCMDDEP, and other partners.
7.4.3	LCBP, New York, Québec, Vermont, LCSG	Work with NEANS, NYSDEC, VTANR, Québec, LCSG, and NYSCC to develop similar stickers, pamphlets, and other educational materials in French and English with consistent AIS messaging by 2015.
7.4.4	LCBP, USFWS	Support the Lake Champlain Basin Aquatic Nuisance Species Management Plan. LCBP will update the plan every 5 years and support implementation. USFWS will provide annual funding, dependent on congressional allocations, to support implementation.
7.4.5	LCBP	Hold quarterly Aquatic Nuisance Species Subcommittee meetings and Spread Prevention Workgroup meetings, participate in the meetings of the New York State Invasive Species Council Advisory Committee and the Adirondack Invasive Species Program. Report annually to the Steering Committee.
7.4.6	LCSG	Serve as lead of the NYS Invasive Species Council's Four-tier Team (through mid-2010), continue to chair the Spread Prevention Workgroup of the LCBP Aquatic Nuisance Species subcommittee, and participate in the meetings of the NEANS Panel and Adirondack Invasive Species Program.
7.4.7	Québec	Annually facilitate the exchange of information through the Great Lakes Panel on ANS, the NEANS Panel, neighboring provinces, and local partners. Develop education and outreach material to prevent the introduction and spread of AIS.
7.4.8	Vermont	Participate in the meetings of the Federation of Vermont Lakes and Ponds, NEANS Panel, NEAPMS, NECNALMS, NEAEB, and the Vermont Invasive Exotic Plant Committee.
7.4.9	New York	Participate in meetings and the work of regional and national coordinating bodies, including the National Invasive Species Advisory Committee, the Northeast Aquatic Nuisance Species Panel, and the Great lakes Aquatic Nuisance Species Panel, among others.
7.4.10	New York	Ensure that effective coordination occurs among DEC divisions and other state agencies on all invasive species issues.

7.5) Support education and outreach efforts related to aquatic invasive species.		
ID	Lead Agency	Task
7.5.1	LCBP	LCBP and partners (LCSG, New York, Québec, Vermont) will initiate social marketing campaign(s) (bilingual where appropriate) for stakeholders such as anglers, fishing tournament participants, recreational boaters, marina owners, aquarium owners, and scuba divers to encourage the practice of AIS spread-prevention measures (proper procurement and disposal of bait fish, boat washing, live well drainage, self-inspections, etc.) by 2013. Two marketing campaigns for specific stakeholders will be developed annually.
7.5.2	LCBP, LCSG, Vermont	Work with LCSG and other partners to provide training programs in AIS spread-prevention to groups such as marina operators, aquarium owners, state park operators, fishing tournament operators, law enforcement officers, departments of transportation, and dive shop operators.

7.5.3	LCBP, New York, Vermont	New York will add an AIS spread-prevention component to Boater Safety Course. LCBP will encourage and facilitate similar AIS spread-prevention training as part of boater safety courses in Vermont by 2015. Vermont will review and update existing AIS spread-prevention component of boater safety state course.
7.5.4	New York	Provide AIS education/outreach for all tournaments run from state boat launches as part of the TRP permit process. Support education and outreach efforts at privately owned launches.
7.5.5	Québec	Develop and conduct education and general outreach activities with watershed organizations.
7.5.6	Vermont	Run large AIS spread-prevention ads in the <i>Guide to the Marinas of Lake Champlain & the Champlain Canal</i> map publication.
7.5.7	Vermont	Provide information about VHS and basic spread prevention as part of fishing tournament permitting.
7.5.8	Vermont	Develop and disseminate appropriate education and outreach materials to aquarium retailers and hobbyists. Educate internet retailers selling live aquatic plants about Quarantine Rule #3.
7.5.9	Vermont	Update <i>Baitfish of Vermont</i> booklet to reflect new regulations regarding movement and use of baitfish and disseminate to retailers, fishing guides, and anglers.

7.6) Support comprehensive policy development, implementation, and enforcement in New York, Québec, and Vermont to prevent the introduction and spread of aquatic invasive species in the Lake Champlain Basin.

ID	Lead Agency	Task
7.6.1	LCBP, New York, Vermont	Draft model regulatory language on importation, transport, sale, possession, and use of established or potential AIS, including baitfish. Share with jurisdictional partners, who will propose, implement, and enforce such regulations as feasible. Jurisdictions will report annually on the enforcement of AIS laws.
7.6.2	LCBP	Work with partners to develop necessary informational materials to support AIS transport laws in the basin and to inform the public through programs like the boat launch steward program, LCBP publications, and web resources.
7.6.3	LCBP, Vermont, LCSG, New York	Provide AIS identification training workshops for law enforcement officials every other year or as requested by New York, Québec, and Vermont or other partners. Vermont will train state police troopers and VTFWD wardens.
7.6.4	New York	Support proposed state legislation that will regulate AIS transport by recreational boats and trailers with a goal of having a law in place by 2015.
7.6.5	New York	Prevent the introduction/spread of AIS by enforcing existing regulations on fish transport, stocking, use, and possession.
7.6.6	New York, LCSG, LCBP	Complete the 4-tier report (a regulatory system for preventing the importation and/or release of non-native species) by 2010. LCSG will lead the Fish and Aquatic Invertebrates Assessment component of this effort.
7.6.7	New York	Conduct species assessments to develop, by 2012, initial lists of prohibited, regulated, and unregulated species to apply to the 4-tier report.
7.6.8	Québec	Develop priority species lists through the Interdepartmental Committee on Exotic Invasive Species by 2012.
7.6.9	New York, Québec, Vermont	Develop and circulate best management practices for spread prevention targeted at field work and recreational activities by 2014, using Hazard Analysis and Critical Control Point (HACCP) plans where appropriate.

7.7) Conduct targeted research related to aquatic invasive species within and adjacent to the Basin.		
ID	Lead Agency	Task
		Research the economic and ecological impacts of existing and potential AIS within the Basin.
7.7.1	LCBP, New York	Support research projects to assess the economic impacts of current and future AIS threats to the basin.
7.7.2	LCBP, New York	Support research projects to assess the effects of AIS on native species and the ecosystem.
7.7.3	LCSG	Assist the SUNY Plattsburgh Lake Champlain Research Institute's investigation of AIS impacts to aquatic invertebrate communities in Lake Champlain.
		Inventory and document known populations of AIS within and adjacent to the Basin.
7.7.4	LCBP, New York, Québec, Vermont, LCSG	Work with partners to gather records of known populations of AIS throughout the Basin and place in a GIS database by 2014. Partnership will consider using iMap Invasives to host the database.
7.7.5	LCBP, New York, Québec, Vermont, LCSG	Identify potential invaders and nearest established populations and develop and provide maps linked to a central database. This will allow the region to assess the ecological risk from each potential known invader by 2014. New York will share regional information from iMap Invasives database. Québec will obtain information from other Canadian provinces. LCSG will contribute through collaboration with the Great Lakes Sea Grant Network. Vermont will share available data.
		Document AIS management strategies occurring within the Basin.
7.7.6	LCBP	Work with partners to create a central database to track and locate AIS management strategies within the Basin by 2014.

7.8) Determine the impact of climate change on the spread and management of aquatic invasive species.		
ID	Lead Agency	Task
7.8.1	LCBP, LCSG	Create a list of high-priority AIS not yet present in the Basin and evaluate whether range expansions are likely by 2014. Reevaluate this list with partners every 5 years.
7.8.2	LCBP, Québec	Reevaluate management procedures for AIS in light of predicted climate conditions by 2014.

7.9) Opportunities for Future Actions: Identify research and monitoring projects that can improve invasive species management programs and conduct these projects when funding resources become available.		
ID	Lead Agency	Task
7.9.1		Analyze the potential economic and ecological impacts of alewives on zooplankton, phytoplankton, and fish populations, particularly smelt and salmonids.
7.9.2		Develop AIS indicators to track species management efforts over time.
7.9.3		Conduct special demonstration projects to assess the effectiveness of various management and spread-prevention techniques as resources allow.
7.9.4		Conduct annual evaluations of spread-prevention measures and rapid response actions to identify opportunities for improvement; revise response plans and associated documents as needed.

7.9.5		Conduct a cost-benefit analysis for the Lake Champlain water chestnut-harvesting program.
7.9.6		Survey fish communities in areas of water chestnut cover before and after harvesting to assess changes in fish community composition by 2014.

8. EFFECTS OF A CHANGING CLIMATE ON THE LAKE CHAMPLAIN ECOSYSTEM

GOAL: Identify potential changes in climate and develop appropriate adaptation strategies to minimize adverse impacts on Lake Champlain's ecosystem and its natural, heritage, and socioeconomic resources.

INTRODUCTION

Large-scale changes in environmental conditions are not new for the Lake Champlain Basin. Less than 15,000 years ago much of the Adirondacks and Green Mountains were covered by ice more than a mile thick, and less than 10,000 years ago, the Champlain Valley contained the Champlain Sea, a salt-water extension of the Atlantic Ocean and the Gulf of St. Lawrence. When viewed in geological time, the natural ecosystems of this region are relatively young. While our regional ecosystems have been shaped by incremental environmental changes of the last 15,000 years, the effects of global climate change during the last several decades are greater than at any other time in the period of record documented to date. Much of this change is driven by increasing levels of atmospheric greenhouse gases associated with fossil fuel use and by land-use changes attributed to increasing global human impact and economic activity (IPCC 2007).

Climate data collected within the Lake Champlain Basin provide strong evidence that accelerated climate changes have occurred here for decades. Many of these changes are irreversible in the time scale of human lives. Resource managers must plan for ongoing changes and take action to minimize changes that are likely to occur in the future. In particular, resource management strategies must adapt to changing climate and work to ensure that public investments in Lake stewardship remain effective. The following trends have already been recognized within the Basin and are almost certain to continue.

- The average annual air temperature in the region increased by 2.1° F (1.2° C) from 1976 to 2005 (Stager and Thill 2010).
- The number of days of annual ice cover on Lake Champlain has decreased. The date that freeze-up occurs on the Lake is about two weeks later than it was in the early 1800s, and the Lake has not frozen at all more often in recent decades. The Main Lake did not freeze over only three times in the 1800s; it has frozen over in fewer than half of the winters since 1975 (Stager and Thill 2010). An extended period of open water during winter increases water loss by evaporation and produces local lake-effect snow. Ice cover also provides protection for some species and helps to moderate water temperature.
- More winter precipitation now falls as rain instead of snow, which decreases the spring Lake and ground-water levels needed to maintain wetlands that support spring spawning of some fish and many amphibians (Stager and Thill 2010).
- Since 1976, total annual precipitation has increased about 3 inches over the previous 80 years. Recent climate data also indicate that more summer rain falls during intense storms, which can cause flash floods in rivers and streams, thereby increasing nutrient and contaminant inputs to Lake Champlain from erosion and from municipal combined sewer overflows (Stager and Thill 2010).

- Fish community structure has changed in many parts of North America because of decreased spawning and recruitment success of cold-water fishes, such as salmon and trout, and cool-water fishes, such as walleye and northern pike. Simultaneously, populations of warm-water species, such as bass and the invasive white perch, have increased. Some of these prey on juveniles of the cold-water species. Similar trends are apparent in Lake Champlain (Casselman 2010).
- Lake surface temperatures have increased throughout the northeastern United States and Great Lakes. This can contribute to intense and potentially toxic algal blooms. It may also result in longer periods of summer stratification and increased risk of low benthic oxygen levels (UCS 2006; Kling et al. 2003).

Climate change analyses for both the northeastern United States and the Great Lakes highlight trends that will have a significant impact on our aquatic ecosystems and indicate that these changes are already occurring. These analyses provide specific predictions for “high carbon emission” scenarios (if there is a continuation of the current emission trends) and “low carbon emission” scenarios (if significant economic, social, and political changes result in rapid and sustained reductions in carbon emissions). Some predicted outcomes based on these two scenarios are provided in the table below.

	High Emissions (carbon status quo)	Low Emissions (significant carbon reductions)
Number of snow-covered days each winter season by 2100 (UCS 2004)	50% reduction	25% reduction
Low-flow conditions in local rivers and streams by 2100 (UCS 2004)	Begin several weeks earlier and last several weeks longer in the fall	Last about two weeks longer in the fall
Average air temperature increase from 2010 to 2099 (Stager and Thill 2010)	6-11° F	1-6° F
By about year 2070, our local climate in Lake Champlain will feel like years 1960-1990 climate in (UCS 2004):	northern Virginia	Pennsylvania

Although there are no large cities in the Lake Champlain Basin, it is worth noting that climate changes in large cities in the northeastern United States will likely be even more extreme. Some major US cities are expected to average twenty to thirty days each summer with temperatures over 100° F by 2100 (UCS 2004). These heat waves would increase regional demand for electricity, which could affect the Lake Champlain region. Higher temperatures could result in both additional economic opportunity and increasing environmental pressures as people visit the Lake Champlain region to escape the heat in warmer urban areas.

The economic, social, and political choices that are made, both locally and globally, in the coming years will determine whether the climate of the Lake Champlain Basin will more closely resemble those of Pennsylvania or northern Virginia 60 years from now. Predicted climate

change outcomes based on published emission scenarios describe a compelling need for policies targeted at reducing regional and global emissions of greenhouse gases. Responsible stewardship of the Lake Champlain Basin requires management and policy planning to address likely outcomes of each of the different future scenarios in order to mitigate increasing environmental pressures and protect Lake water quality and ecosystem integrity.

Predicted climatic changes will continue to affect the regional physical infrastructure, particularly transportation and public works. The governmental agencies involved need to research and adopt new standards to accommodate increases in storm events and subsequent tributary flows and impacts to roads, bridges, and culverts. Increased storm flows will affect wastewater treatment plants that are not disconnected from stormwater systems. Designs for aquatic organism passageways and flood control systems must be informed by these predicted changes.

Role of the LCBP in Addressing Climate Change in the Lake Champlain Basin

The LCBP acknowledges that many organizations are working locally and globally to implement carbon emission reduction programs to slow predicted impacts on global climate. The LCBP will primarily work with partners and stakeholders to adapt to a changing climate in the Lake Champlain Basin. These climate-change tasks are highlighted in the tables below, and are cross-referenced in relevant *Opportunities for Action (OFA)* chapters.

Citations

Casselmann, J. 2010. Effects of a changing climate on freshwater fish and fisheries: Driving environmental factors and shifting baselines - what to expect, how to adapt. Presented at the Lake Champlain 2010 Conference, 7-8 June, Burlington, Vermont.

IPCC. 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, Pachauri, R.K and A. Reisinger, eds.]. Geneva: IPCC.

Kling, G.W., K. Hayhoe, L.B. Johnson, J.J. Magnuson, S. Polasky, S.K. Robinson, B.J. Shuter, M.M. Wander, D.J. Wuebbles, D.R. Zak, R.L. Lindroth, S.C. Moser, and M.L. Wilson. 2003. *Confronting Climate Change in the Great Lakes Region: Impacts on our Communities and Ecosystems*. Cambridge, Mass: Union of Concerned Scientists and Washington, DC: Ecological Society of America. [ucsusa.org/assets/documents/global_warming/greatlakes_final.pdf]

Stager, C. and M. Thill. 2010. *Climate Change in the Lake Champlain Basin: What natural resource managers can expect and do*. Keene Valley, NY and Montpelier, VT: The Nature Conservancy.

[www.nature.org/wherewework/northamerica/states/vermont/files/champlain_climate_report_5_2010.pdf]

UCS. 2006. *The Changing Northeast Climate: Our choices, our legacy*. Cambridge, Mass: Union of Concerned Scientists.

[www.ucsusa.org/assets/documents/global_warming/The-Changing-Northeast-Climate.pdf]

Additional Reading

Jenkins, J. 2010. *Climate Change in the Adirondacks: The path to sustainability*. Ithaca, NY: Cornell University Press. [www.cornellpress.cornell.edu/cup_detail.taf?ti_id=5901]

NYS DEC Climate Change: [www.dec.ny.gov/energy/44992.html]

EPA Climate Change: [www.epa.gov/climatechange]

VT Climate Collaborative: [www.uvm.edu/~vtcc/]

Québec Climate Change: English [www.mddep.gouv.qc.ca/changements/plan_action/index-en.htm] | French [www.mddep.gouv.qc.ca/changements/plan_action/index.htm]

OBJECTIVES

- Examine appropriate climate change scenarios for the Lake Champlain Basin.
- Adjust management strategies as needed to reflect predictions from climate change scenarios.
- Develop adaptation strategies to minimize adverse ecological outcomes.
- Expand public education programs to improve climate change literacy.

PRIORITY ACTIONS AND TASKS

Cross-listed from other OFA chapters

Chapter 3. Informing and Involving the Public:

3.2) Build awareness and understanding among residents and visitors about Lake Champlain Basin resources and behaviors that contribute to pollution.		
ID	Lead Partner	Task
3.1.17	LCSG	Provide opportunities to improve public understanding of climate change and the implications for Lake Champlain ecosystem management by 2013.
3.3) Provide hands-on citizen action opportunities to improve the watershed and change behaviors that contribute to pollution.		
ID	Lead Partner	Task
3.3.3	LCBP	Coordinate 3 workshops to encourage communities to participate in ClimateSmart Communities [www.dec.ny.gov/energy/50845.html] programs to reduce water and energy consumption and reduce waste generation by 2012.

Chapter 4. Reducing Phosphorus Pollution:

4.8) Estimate how climate change is altering the delivery of phosphorus to Lake Champlain and how it necessitates changes in implementation strategies.		
ID	Lead Partner	Task
4.8.1	LCBP	Create a Climate Change Subcommittee of the TAC to focus on climate change scenarios and investigate implementation strategies that can minimize the effect of changes on phosphorus loading by 2011.
4.8.2	LCBP	Support efforts by NWS and NOAA to update the rainfall atlas for the northeastern states.
4.8.3	LCBP	Synthesize the best available information on the likely impact of climate change on phosphorus loading by 2012.
4.8.4	LCBP	Recommend adjustments needed in management practices to effectively respond to climate change by 2012.
4.8.5	Québec	Assess the effect of climate change on surface water hydrology and sediments and nutrients export at the level of the Pike River Basin.
4.8.6	New York, USDA-NRCS, USEPA, Vermont, Québec	Develop appropriate strategies for coping with projected changes in precipitation and runoff in collaboration with other partners within the Basin. (USGS, Cornell University, UVM, NOAA, USACE, and others).
4.8.7	Vermont	Compare current 10-year, 25-year, and 100-year design storms to recent climate-change driven precipitation projections in order to better prepare for changing phosphorus loads to Lake Champlain due to rain events.

Chapter 5. Reducing Toxic Substances and Pathogens:

5.2) Provide education and outreach to encourage homeowners, industries, health care facilities, businesses, governmental agencies, and public institutions to prevent pollution and recycle by 2015.		
ID	Lead Partner	Task
5.2.6	USEPA	Promote and distribute “Planning for a Sustainable Future” [www.epa.gov/region2/sustainability/greencommunities/] to local governments, with emphasis on the sections “Solid Waste Generation and Recycling” and “Protecting Water Quality and Ensuring Future Supply.”
5.2.14	Québec	Continue to annually promote best management practices related to toxin use reduction programs and energy conservation by implementing the QC MDDEP’s 2006-2012 Climate Change Action Plan at [www.mddep.gouv.qc.ca/changements/plan_action/index-en.htm] and the <i>Agence de l’efficacité énergétique du Québec</i> [www.aee.gouv.qc.ca/en/the-aee/]

Chapter 6: Managing Fish, Wildlife, and Plants:

6.5) Conserve important wildlife corridors associated with riparian habitats.		
6.5.4	New York, Vermont	Work with partners in the State Wildlife Grant-funded “Staying Connected in the Northern Appalachians” to maintain, enhance, and restore habitat connectivity in the Adirondack/Green Mountain corridor for forest-dwelling species of concern.
6.6) Restore native fish species and enhance Lake Champlain Basin fisheries.		
6.6.3	LCBP	Support at least 1 research project on the effects of climate change on the relative extent of cold- and warm-water fisheries in Lake Champlain (i.e., distribution and population viability of cold- and warm-water fisheries) by 2012.
6.11) Use biological indicators to monitor change in the Lake Champlain Ecosystem. Continue assessment of species diversity and abundance.		
ID	Lead Agency	Task
6.11.2	LCBP	Model and project the impacts of climate change on fish and wildlife communities in the Lake Champlain Basin that may result from climate change.

Chapter 7: Managing Aquatic Invasive Plants and Animals:

7.8) Determine the impact of climate change on the spread and management of aquatic invasive species.		
ID	Lead Agency	Task
7.8.1	LCBP, LCSG	Create a list of high-priority AIS not yet present in the Basin and evaluate whether range expansions are likely by 2014. Reevaluate this list with partners every 5 years.
7.8.2	LCBP, Québec	Reevaluate management procedures for AIS in light of predicted climate conditions by 2014.

Chapter 10: Sustainable Economic Development in the Lake Champlain Basin

10.3 Develop adaptive management capacity to manage the anticipated impacts of climate change, particularly on the changing dynamics between hydrological processes and eutrophication.		
ID	Lead Agency	Task
10.3.1	LCBP	Identify impacts and indicators of climate change on the regional economy as related to agriculture, business (water quality related), forest products, and tourism by 2013.
10.3.2	LCBP	Subsequent to completion of 10.3.1, incorporate mitigation of climate change into an adaptive management framework for the Lake Champlain economy by 2015.
10.3.3	LCBP	Identify the long-term benefits of river restoration programs by 2013, given the expected increase in the severity and frequency of storm events.

9. CULTURAL HERITAGE AND RECREATION RESOURCES

MISSION: Build on existing knowledge; make new discoveries of the history, culture, and special resources of the Champlain Valley National Heritage Partnership; and make this information accessible to all.

INTRODUCTION

Lake Champlain is an iconic natural resource that is deeply embedded in the cultural heritage of residents throughout the region. The public commitment to environmental stewardship of Lake Champlain relies, in large part, on an appreciation of the Lake itself and the associated resources of the Basin. People make connections to these resources in a variety of ways. Some learn about the region's rich history by visiting one of the valley's world-class museums. Others begin to appreciate a clean Lake while paddling on it for the first time. Many become aware of its uniqueness as they ride the 1100 miles of bike routes along the Lake and its tributaries, through farmland, forest, and town. These activities and many other cultural heritage and recreational opportunities have been made more accessible by the efforts the Lake Champlain Basin Program (LCBP) and its partners.

The Basin's vast recreational opportunities and various cultural heritage attractions also contribute to the region's economy. The various marketing brands of the Lake Champlain Basin rely on a mix of recreational opportunities and cultural attractions in beautiful settings. Creating new opportunities for exploring the region and supporting cultural attractions helps support those branding efforts.

Since its inception, the LCBP has funded more than 350 grants for cultural heritage and recreation projects—efforts that foster stronger personal connections between people and resources of the Lake Champlain Basin while supporting the local economy. The LCBP has supported projects that range in scope from simple architectural assessments of historic buildings to new cycling and paddling guides and a detailed underwater archeological survey of the entire Lake. More than \$1 million in grants has been awarded to communities and organizations working to implement the proposed actions listed in the Cultural Heritage and Recreation Resources chapter of *Opportunities for Action: An Evolving Plan for the Lake Champlain Basin (OFA)* since 1992.

Champlain Valley National Heritage Partnership

The United States Congress established the Champlain Valley National Heritage Partnership [www.champlainvalleynhp.org] (CVNHP) in 2006. This national heritage area was designated to recognize the importance of the historical, cultural, and recreational resources of the Champlain Valley; to preserve, protect, and interpret those resources; to enhance the tourism economy; and to encourage partnerships among state/provincial and local governments and nonprofit organizations in New York, Québec, and Vermont to carry out the purposes of the legislation.

Most of the CVNHP is located within the Lake Champlain Basin, but the Partnership area also includes Bennington (Vermont) and Saratoga (New York) Counties, outside the Basin to the

south. The enabling legislation of the CVNHP—and the goals, objectives, and actions of *OFA*—prioritizes partnership building among governments, organizations, and individuals in New York, Québec, and Vermont. The CVNHP Management Plan is a component of *OFA*. The strategic issues—the goals, objectives, and actions—of the CVNHP Management Plan are integrated into the “new format” and include the areas of the Basin that are not included in the CVNHP.

The Cultural Heritage and Recreation Resources chapter of OFA and the CVNHP Management Plan offer the same goals, objectives, and actions that encourage stewardship of our cultural heritage and enhancement of our recreation resources. The sustained support for these efforts within the Basin and the CVNHP region will continue to foster a sense of stewardship for our cultural and natural resources.

Cultural and Historical Research

Goal: *To build on existing knowledge; make new discoveries of the history, culture, and special resources of the CVNHP; and make this information accessible*

9.1) Provide support for needed historical and archeological research and accelerate the identification, evaluation, protection, and interpretation of heritage resources, including ethnographies of the cultures within the Champlain Valley National Heritage Partnership.		
ID	Lead Partner	Task
9.1.1	LCBP	Support historical and archeological research and documentation.
9.1.2	LCBP	Support ethnographic research and documentation of the cultures within the CVNHP.
9.1.3	LCBP	Use new and existing research and documentation to support the evaluation, conservation, and interpretation of natural and cultural heritage resources.

9.2) Manage a comprehensive online heritage resource database.		
ID	Lead Partner	Task
9.2.1	LCBP	Maintain and update the CVNHP online heritage resource database.
9.2.2	LCBP	Assess the compatibility of the New York and Vermont GIS databases. Investigate the availability of similar resources in Québec.
9.2.3	LCBP	Identify, develop, and maintain CVNHP GIS data layers for chosen heritage features.
9.2.4	LCBP	Promote use of the resource database and GIS information among partners.

Conservation of Heritage Resources

Goal: *To support the conservation of the historical, archeological, natural, and cultural resources of the CVNHP.*

9.3) Develop a voluntary stewardship program to strengthen non-regulatory protection of cultural and natural heritage resources.		
ID	Lead Partner	Task
9.3.1	LCBP	Review existing tax incentives for natural and cultural heritage resource protection on private property and explore the creation of new incentives.
9.3.2	LCBP	Increase landowner awareness of non-regulatory protection tools, such as sale of development rights, tax benefits through donating easements, tax credits, barn grants,

		and other incentive programs.
9.3.3	LCBP	Provide professional development resources to build the stewardship capabilities of non-profit groups to conserve cultural and natural heritage resources.

9.4) Develop and implement Champlain Valley National Heritage Partnership cultural and natural heritage resource protection programs.

ID	Lead Partner	Task
9.4.1	LCBP	Inventory, evaluate, and post online the federal, state, and local legislation governing the protection of cultural and natural heritage resources.
9.4.2	LCBP	Develop criteria for selecting priority cultural/natural heritage resources based on their importance, fragility, recreational opportunities, and economic benefits and develop consistent strategies for conservation.
9.4.3	LCBP	Examine mechanisms for providing technical assistance to landowners, communities, non-profit organizations, and other resource conservation organizations that wish assistance.
9.4.4	LCBP	Provide assistance to organizations that wish to develop comprehensive conservation plans that address individual issues in a regional context.

9.5) Develop and implement a management strategy for underwater cultural heritage resources in the Champlain Valley National Heritage Partnership.

ID	Lead Partner	Task
9.5.1	LCBP	Continue to survey, document, and evaluate underwater cultural heritage resources.
9.5.2	LCBP	Continue to monitor the impacts of zebra mussels and study the potential impacts of Quagga mussel on shipwrecks.
9.5.3	LCBP	Examine ways to collaborate with partners to support the establishment of underwater preserves on the Upper Hudson River, Champlain Canal, and Richelieu River.
9.5.4	LCBP	Work with the LCBP's Lake Champlain Aquatic Nuisance Species Rapid Response Team to reduce the risk of Quagga mussel introduction.
9.5.5	LCBP	Integrate the results of shipwreck research with other resource studies.
9.5.6	LCBP	Make the results of supported research available to the public through a variety of interpretive materials.
9.5.7	LCBP	Support a bi-state management approach to the Lake Champlain Underwater Historic Preserve program that includes reasonable public access to appropriate sites as well as enhanced protection, maintenance, and operations.

Recreation and Accessibility to Resources

Goal: To provide sustainable and accessible recreational opportunities for everyone within the CVNHP.

9.6) Support initiatives that promote sustainable recreational activities that feature the natural, cultural, and historical resources in the Champlain Valley National Heritage Partnership.

ID	Lead Partner	Task
9.6.1	LCBP	Develop or improve natural and cultural heritage interpretative trails using wayside exhibits and other informative media.
9.6.2	LCBP	Continue to support regional, multi-jurisdictional programs that promote accessible and sustainable use of resources.
9.6.3	LCBP	Continue to develop and maintain the Lake Champlain Underwater Historic Preserve System and the Lake George Submerged Heritage Preserve Program and investigate the creation of a similar system in the Upper Hudson and Richelieu Rivers.
9.6.4	LCBP	Examine the feasibility of establishing a "national historic water trail" to connect the resources of the CVNHP, Hudson River Valley National Heritage Area, and the Erie

		Canalway National Heritage Corridor, similar to the Captain John Smith Chesapeake National Historic Trail.
9.6.5	LCBP	Support efforts to link communities through transportation routes that feature interpretation of heritage resources.
9.6.6	LCBP	Develop a comprehensive guide to all types of public access opportunities on the interconnected waterways of the CVNHP, including winter access sites.
9.6.7	LCBP	Encourage the expansion of facilities and services along the interconnected waterways, such as restaurants, lodging, and equipment rentals, in a manner that minimizes impacts on recreational, cultural, natural, and historic resources and that features environmental sustainability.

9.7) Increase and improve public access opportunities to the interconnected waterways of the Champlain Valley National Heritage Partnership for diverse recreational activities.

ID	Lead Partner	Task
9.7.1	LCBP	Update and analyze resource inventories to identify gaps in public accessibility along the interconnected waterways of the CVNHP.
9.7.2	LCBP	Develop an online CVNHP public access guide.
9.7.3	LCBP	Facilitate regional partnerships to manage public access improvements.

9.8) Support a public information program that emphasizes recreational ethics, public safety, sustainable use, and stewardship of cultural and natural resources.

ID	Lead Partner	Task
9.8.1	LCBP	Support efforts to educate residents and visitors on the hunting, fishing, and trapping heritage of the region.
9.8.2	LCBP	Support tourism information centers, marketing organizations, regional byway initiatives, and the Non-motorized Tourism Clearinghouse to coordinate and disseminate information on opportunities for year-round use of recreational, natural, cultural, and historic resources of the CVNHP. These and similar programs will be encouraged to develop additional materials for distribution.
9.8.3	LCBP	Support the use of new information technology to provide quality information on heritage and recreation resources.

Interpretation and Education

Goal: To have a well-informed public that values the unique heritage of the CVNHP and understands the threats to its resources.

9.9) Connect, promote, and improve cultural and natural heritage sites through interpretation.

ID	Lead Partner	Task
9.9.1	LCBP	Continue to provide design services for interpretive materials.
9.9.2	LCBP	Establish a unified, broadly applicable design template for all interpretive materials sponsored by the CVNHP.
9.9.3	LCBP	Develop and maintain an online interpretive toolkit for the CVNHP.
9.9.4	LCBP	Support pilot projects that utilize emerging interpretive technologies.
9.9.5	LCBP	Provide general technical support for interpretation projects.
9.9.6	LCBP	Support professional development for interpreters.

9.10) Support the use of interpretive themes to link resources within the Champlain Valley National Heritage Partnership.

ID	Lead Partner	Task
9.10.1	LCBP	Continue to explore Key Partner opportunities for shared programs.
9.10.2	LCBP	Work with interested partner organizations to determine what they wish to identify as the appropriate interpretive themes and focus areas for individual sites, the programs

		that support those sites, and the possible collaborative role of the CVNHP.
9.10.3	LCBP	Collaborate with partners to develop an interpretive plan for the CVNHP that thematically links sites while preserving their individual identities and interpretive goals.
9.10.4	LCBP	Support initiatives that highlight the relationships among stakeholder sites and programs through interpretation, while maintaining the individual character of those sites.

9.11) Promote cultural exchanges and international scholarship programs.

ID	Lead Partner	Task
9.11.1	LCBP	Support research and scholarship focusing on cross-border relationships of New York, Québec, Vermont, and other nations and cultures that relate to the Making of Nations, Corridor of Commerce, or Conservation and Community interpretive themes.
9.11.2	LCBP	Encourage youth cultural and education exchanges.

9.12) Produce coordinated education programs for students.

ID	Lead Partner	Task
9.12.1	LCBP	Continue to conduct teacher-training workshops.
9.12.2	LCBP	Develop a comprehensive CVNHP Resource Guide for educators to use in developing teaching units focused on the natural and cultural heritage of the region with an emphasis on conserving and protecting those resources.
9.12.3	LCBP	Use the Internet and other media to share CVNHP information with students and teachers.
9.12.4	LCBP	Promote the “Teaching the Hudson Valley” website and determine if a similar service is needed for the CVNHP.
9.12.5	LCBP	Work with state education departments to integrate CVNHP education into classrooms.
9.12.6	LCBP	Provide opportunities for teachers and students to participate in CVNHP-related field trips and restoration projects.
9.12.7	LCBP	Provide CVNHP-related presentations to schools.
9.12.8	LCBP	Provide bus transportation grants to improve school access to heritage sites and events within the CVNHP.
9.12.9	LCBP	Evaluate the success of CVNHP education initiatives.

Coordination, Communication, and Capacity Building

Goal: To serve as a conduit for information, to build professional capacity among stakeholders, and to foster strong working relationships among the partners of the CVNHP.

9.13) Support professional development among Champlain Valley National Heritage Partnership stakeholders, including an annual heritage partnership conference.

ID	Lead Partner	Task
9.13.1	LCBP	Provide a mini-grant program for professional development of heritage organizations.
9.13.2	LCBP	Sponsor training for conservation, education, interpretation, marketing, administration, and other topics as needed.
9.13.3	LCBP	Assess the Training to Sustain Heritage Center Operations program to determine suitability for replication throughout the CVNHP.

9.14) Encourage cooperation and enhance communication among partners within the Champlain Valley National Heritage Partnership.

ID	Lead Partner	Task
9.14.1	LCBP	Convene periodic meetings of organizations and regional stakeholder groups within CVNHP.

9.14.2	LCBP	Provide translation services for meetings among partners from the United States and Québec as needed.
9.14.3	LCBP	Develop an enhanced website that includes a calendar of events, topical information, and other tools.
9.14.4	LCBP	Regularly publish a newsletter highlighting best practices among CVNHP partners, funding opportunities, updates, etc.
9.14.5	LCBP	Support the continued success of existing regional stakeholder groups and the creation of new groups for underserved regions of the CVNHP.

9.15) Support and encourage cooperation to commemorate the bicentennial of the War of 1812 and the sesquicentennial of the American Civil War.

ID	Lead Partner	Task
9.15.1	LCBP	Convene stakeholders to discuss potential collaborative efforts to commemorate the Bicentennial of the War of 1812 and the American Civil War Sesquicentennial.
9.15.2	LCBP	Examine the potential for developing bi-state, international committees to coordinate efforts among New York, Québec, and Vermont for both the War of 1812 Bicentennial and the American Civil War Sesquicentennial.
9.15.3	LCBP	Support research, interpretation, and other individual efforts to mark the anniversaries.

Marketing the Champlain Valley National Heritage Partnership

Goal: To coordinate efforts among partners to promote the CVNHP as a world-class destination for heritage travelers.

9.16) Develop and maintain a consistent regional brand related to the interpretive themes of the Champlain Valley National Heritage Partnership.

ID	Lead Partner	Task
9.16.1	LCBP	Develop a template and design manual for maps, brochures, guides, and interpretive signs for the CVNHP that is based on the LCBP Wayside Exhibit design and provide design services to organizations willing to use the templates.
9.16.2	LCBP	Review existing local, regional, and state/provincial marketing efforts.
9.16.3	LCBP	Assign the HAPAC to recommend appropriate approaches to branding/marketing of the CVNHP.
9.16.4	LCBP	Develop a marketing plan for the CVNHP.

9.17) Use the Champlain Valley National Heritage Partnership website to promote the region.

ID	Lead Partner	Task
9.17.1	LCBP	Develop an enhanced website that promotes the region as a whole, while acting as a window to encourage users to visit existing stakeholder websites for more detailed information.
9.17.2	LCBP	Encourage the development of new website technologies for use on the CVNHP and stakeholder websites.
9.17.3	LCBP	Develop web resources with Key Partners to advance outreach concerning specific partnership projects and programs.

9.18) Support the development of bilingual materials, interpretation, and services.

ID	Lead Partner	Task
9.18.1	LCBP	Support bilingual interpretation of resources within the CVNHP.
9.18.2	LCBP	Support teaching French to stakeholder staff, including service industry staff.

Promoting Sustainability (to be incorporated if Alternative 2b is chosen)

Goal: To foster a sustainable relationship between people and the natural and cultural resources of the CVNHP.

9.19) Promote energy efficiency and resource conservation among Champlain Valley National Heritage Partnership partners.		
ID	Lead Partner	Task
9.19.1	LCBP	Encourage energy-efficient heritage tourism and recreation that has a low impact on the environment.
9.19.2	LCBP	Support energy efficiency audits and the development of energy conservation plans for cultural heritage facilities.
9.19.3	LCBP	Support the installation of energy-saving devices and materials in cultural heritage facilities.
9.19.4	LCBP	Encourage carpooling and the use of teleconferencing or web-based meetings for participation at regional meetings, conferences, and workshops.
9.19.5	LCBP	Support water conservation efforts at cultural heritage facilities.

9.20) Prevent the introduction of new aquatic invasive species and limit the spread of established aquatic invasive species (AIS) in the Champlain Valley National Heritage Partnership region.		
ID	Lead Partner	Action
9.20.1	LCBP	Support the development and distribution of AIS spread-prevention messages and public outreach campaigns at heritage and recreational venues in the CVNHP.
9.20.2	LCBP	Develop and implement a heritage Lake stewardship program to inform recreational waterway users about AIS spread prevention.
9.20.3	LCBP	Support projects to manage AIS appropriately in ecologically sensitive heritage sites.
9.20.4	LCBP	Develop and support AIS spread-prevention interpretation and signage on the Champlain and Chambly Canals.
9.20.5	LCBP	Promote use of all waterways within the CVNHP in an environmentally sustainable fashion.
9.20.6	LCBP	Provide heritage interpretation training to the LCBP boat launch stewards.

9.21) Prevent the introduction of new terrestrial invasive species (TIS) in the Champlain Valley National Heritage Partnership region.		
ID	Lead Partner	Action
9.21.1	LCBP	Support the development of TIS spread-prevention messages and public outreach campaigns to protect heritage resources.
9.21.2	LCBP	Develop an invasive species educational program that can be used by project managers in heritage sites.
9.21.3	LCBP	Develop and support TIS spread-prevention interpretation and signage within the CVNHP.
9.21.4	LCBP	Incorporate TIS interpretation at cultural heritage museums and sites in the region and at CVNHP-sponsored events that might include overnight camping.

9.22) Focus on land-use changes and effects of stormwater runoff on water quality.		
ID	Lead Partner	Action
9.22.1	LCBP	Promote improved understanding and interpretation of the environmental impact of the successive historical stages in settlement, forestry, agriculture, and development in the CVNHP.
9.22.2	LCBP	Promote improved understanding of the importance of minimizing pollution from stormwater runoff at cultural heritage facilities and events.

9.23) Promote sustainable agriculture practices in the Champlain Valley National Heritage Partnership.		
ID	Lead Partner	Action
9.23.1	LCBP	Support programs that encourage appropriate agricultural tourism in the CVNHP.
9.23.2	LCBP	Provide wayside exhibits to interpret the history and sustainable practices of the recipients of the Lake Champlain Farm Awards.
9.23.3	LCBP	Provide funding for the assessment of historic barns as heritage resources.
9.23.4	LCBP	Interpret sustainable farming and forestry practices in the context of agricultural tourism.

10. SUSTAINABLE ECONOMIC DEVELOPMENT IN THE LAKE CHAMPLAIN BASIN

GOAL: Promote healthy and diverse economic activity and sustainable development principles within the Lake Champlain Basin while improving water quality and conserving the natural and cultural heritage resources on which the regional economy is based.

INTRODUCTION

The health of the economy of the Lake Champlain Basin is fundamentally dependent on the health of the aquatic and terrestrial ecosystems of the Basin. The soils, tributaries, wetlands, ponds, lakes, and ecological processes therein make up the very infrastructure of the Basin ecosystem and economy alike. Earlier chapters have described the management of nutrient loads, toxics, invasive species, fish, wildlife, and impacts from climate change primarily in terms of their ecological dimensions. Each of these topics also has an economic and societal impact, and the magnitude of each impact is largely determined by economic and societal forces. The condition of our ecosystems and the long-term viability of our economies and communities are interdependent.

The connection between a healthy lake basin and a healthy regional economy is perhaps most obvious where livelihoods depend directly on natural resources. The tourism market draws on the natural beauty and cultural heritage of the Champlain Valley and opportunities such as fishing, sailing, and swimming that fundamentally benefit from high-quality aquatic systems. This economic dependence on our ecological infrastructure is most often measured in jobs, tax revenues, and income earned. Industries such as agriculture and forestry have equally obvious ties to the sustainability of renewable resources in the Basin. Often overlooked, however, are the dependencies of *all* economic sectors on the wide range of ecosystem services provided by the Lake Champlain Basin. Ecosystem services encompass ecological, economic, and social benefits people obtain from ecosystems. For example, services such as nutrient cycling, primary production, waste assimilation, and freshwater supplies are the ecological engines of the Basin economy. Although more difficult to measure in the currency of jobs or income, the ecological structure and functions of the Basin are fundamental to the healthy function of the economy and ecosystem alike.

As both the benefits from and impacts on ecosystem services are often ignored in economic decisions, the genuine net benefits of economic activity can be unclear. An ecosystem services framework is increasingly being used to assess and plan for the sustainability of Basin economies. Most significantly, the Millennium Ecosystem Assessment (MEA) [www.maweb.org/en/index.aspx] completed in 2005 provided a synthesis from more than 1,360 experts worldwide on the supporting, regulating, provisioning, and cultural services of ecosystems. Figure 1 highlights the four main categories of ecosystem services in relation to their contribution to various constituents of human well-being. Applying this assessment framework, the MEA found that fifteen of the twenty-four ecosystem services investigated

worldwide were “... being degraded or used unsustainably, including fresh water, capture fisheries, air and water purification, and the regulation of regional and local climate, natural hazards, and pests.”

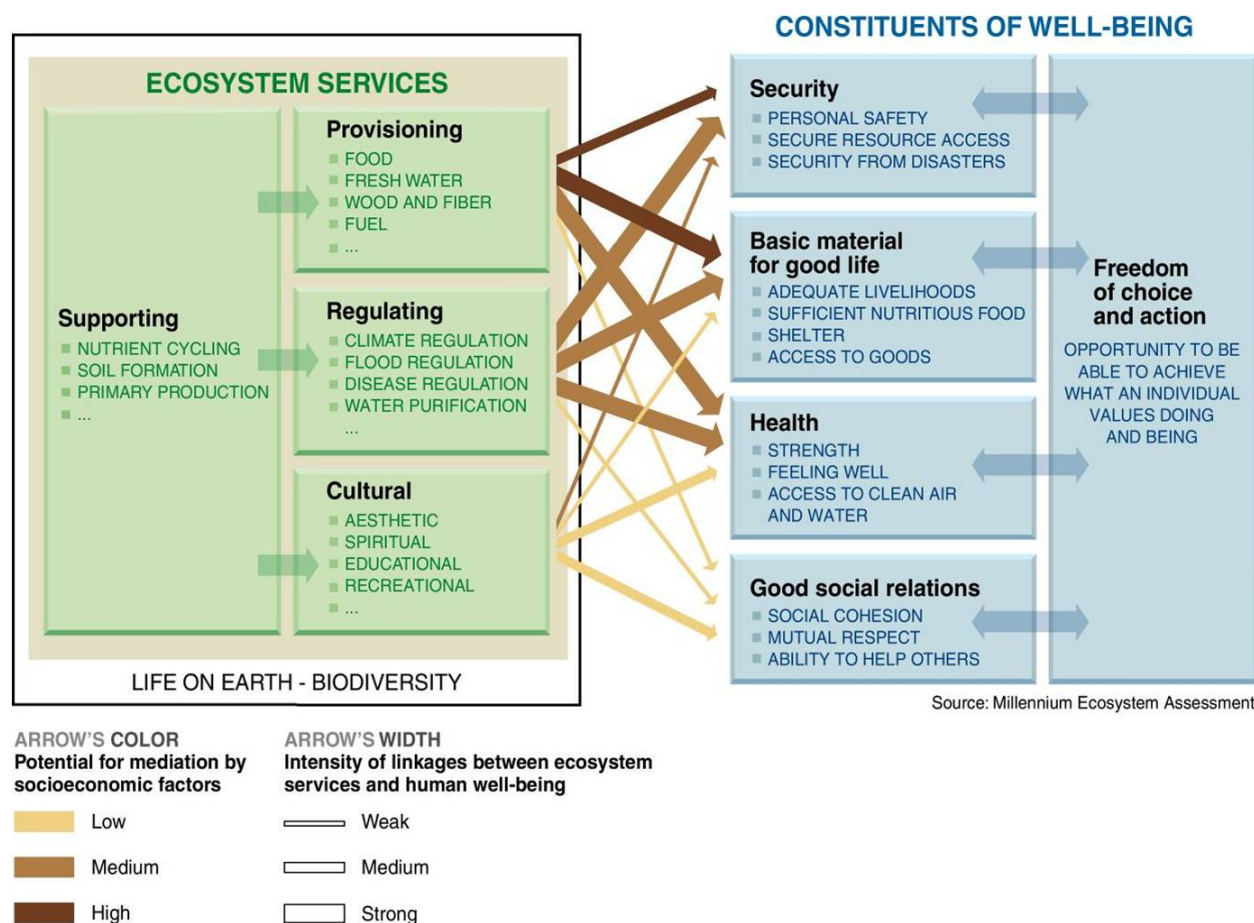


Figure 1. Ecosystem services framework adopted in Millennium Ecosystem Assessment.

Assessment of wetlands and freshwater systems are central to the body of work stemming from the MEA. The broad range of wetland services alone that are critical to human communities include fish and fiber, water supply, water purification, climate regulation, flood regulation, shoreline protection, and recreational opportunities. Research indicates that the total economic value of unconverted wetlands – including both the marketed and non-marketed economic benefits – is often greater than that of converted wetlands. However, wetlands are systematically undervalued and thus severely compromised worldwide. The MEA found that the degradation and loss of wetlands is more rapid than any other ecosystem (MEA 2005).

Among ongoing subglobal assessments of the MEA, the work most relevant to Lake Champlain is in the Northern Highlands Lake District of Wisconsin [www.maweb.org/en/SGA.Wisconsin.aspx]. Research led by the University of Wisconsin together with local stakeholder groups is assessing the status and trends of ecosystem services in the 5,300 km² (2,046 mi²) region, and analyzing policy options through detailed scenario

analysis of human population growth, zoning and infrastructure development, impacts on aquatic ecosystem services, and economic trends from local and regional to national and international.

The ecosystem services framework is also central to various Lake Champlain Basin management initiatives. For instance, Lake Champlain is one of twenty-eight case study lakes in the Global Environmental Facility's Lake Basin Management Initiative, highlighting impacts associated with shoreline effluent discharges, nonpoint source nutrients, and stormwater runoff. The recently released National Lakes Assessment (NLA) of the US Environmental Protection Agency (USEPA) takes a similar approach. For the Northern Appalachian ecoregion (including Lake Champlain) the main concerns included biological integrity, quality of lakeshore habitat, and level of eutrophication. Forty-five percent of lakes exhibited fair or poor biological condition relative to ecoregional reference conditions, while 57 percent of lakes were assessed at moderate to high levels of lakeshore disturbance. Twenty-six percent of lakes were considered oligotrophic, 54 percent mesotrophic, 17 percent eutrophic, and 3 percent hypereutrophic (US Environmental Protection Agency 2009).

Connecting ecosystem health to economic benefits through the assessment of ecosystem services is also gaining ground in US federal agencies (Cox and Searle 2009). The US Department of Agriculture has created a new office of Ecosystem Services and Markets to provide guidance for implementing Section 2709 of The Food, Conservation, and Energy Act of 2008. This policy calls for the Secretary of Agriculture to "establish technical guidelines that outline science-based methods to measure the environmental services benefits from conservation and land management activities in order to facilitate the participation of farmers, ranchers, and forest landowners in emerging environmental services markets." Also, the Ecosystem Services Research Program at the USEPA has initiated a coordinated research effort to "establish ecosystem services standards, indicators, and measurement protocols; advance valuation techniques; create institutional capacity for investment in natural capital; and to improve the ability to perform assessments across institutional, spatial, and temporal scales."

Four Types of Ecosystem Services: Supporting, Regulating, Provisioning, and Cultural

Supporting services. The complex interactions between abiotic and biotic components of the Basin create the soils that grow our food and fiber, hydrological cycle that affects our weather and supplies our water, primary production that determines food webs and creates our fisheries, and the capacity to break down and reuse the waste byproducts of the economy. Overuse and degradation of these fundamental ecological processes can have considerable economic impact. For example, a 2009 review of the potential economic damages from eutrophication of US freshwater systems found impacts on recreational water usage, waterfront real estate value, and spending on recovery of threatened and endangered species and drinking water to total approximately \$2.2 billion annually (Dodds et al 2009). Eutrophication and resulting algal blooms in Lake Champlain have measurable economic impacts from beach closures, increased water treatment costs, waterfront property devaluation, and fish kills. All of these examples negatively impact the water quality of the Lake, but also the accessibility of the Lake and, in turn, the local economy.

Regulating services in the Lake Champlain Basin include those indirectly affected by changes in supporting services, such as the impact of eutrophication on water purification. Lake Champlain provides drinking water for more than 30 percent of the Basin population, and the cost of additional water treatment at the municipal and household level due to water pollution is unknown. However, the influence of forest land cover on water filtration processes is a well-studied regulating function. An analysis of twenty-seven US water suppliers found that treatment costs for drinking water in watersheds covered with at least 60 percent forest cover were half the cost of watersheds with 30 percent forest cover and one-third the cost of treating water from watersheds with 10 percent forest cover (Postel et al 2005). Regulating services also include benefits, such as flood regulation, that are affected by land-use change. When a river is straightened or floodplain developed, the economic damages resulting from flood events can be significant. Damages from flooding in Vermont alone are estimated at \$16 million per year [www.vlct.org/d/eventcalendar/TownFair09/Vermont_flood_hazard.pdf]. A dramatic example of the loss of this ecosystem service comes from the MEA synthesis of wetland services. Historically the forested riparian wetlands adjacent to the Mississippi River had the capacity to store about sixty days of river discharge, but with the removal of wetlands through canalization, construction of levees, and draining, the remaining wetlands have a storage capacity of fewer than twelve days discharge – an 80 percent reduction.

Provisioning services of the Lake Champlain Basin produce the many extracted resources of food, fiber, fuel, and water – important inputs to informal and formal sectors of the Basin economy. Resource extraction that is “off the books” includes activities such as home woodlots and gardens; hunting, fishing, and trapping; and private water wells – significant activities in rural economies. The value of agriculture, forest products, and water for consumption in the formal sectors have direct, measurable economic value from established industries in the Basin. For example, Basin agriculture supports hundreds of farms across a diversity of activities. An ecosystem services approach would evaluate the positive value of agricultural products and services produced from the land as well as the negative externalities imposed (and not borne on the private farm) on water quality and other ecosystem services. A full accounting would capture the net benefits of farming in the Basin and provide the data necessary for a more integrated approach to management. An analysis of a performance-based incentive program for reducing phosphorus pollution from farms in the Missisquoi river watershed found that about 40 percent of the specific farm actions (twenty-two of fifty-four) to reduce phosphorus loss were estimated to be profitable at a \$25 per pound incentive payment level. Approximately 20 percent of actions were estimated to have zero cost to the farmer, with one action (reducing phosphorus fertilization) providing a savings to farmers (Winsten et al. 2007). The avoided cost of this pollution reduction to the Lake system has multiple values that could offset this public investment, not the least of which is reduced impact on the provisioning service of drinking water. More than 142,000 people in Vermont and New York were estimated to be served by municipal and community water supplies from Lake Champlain in 2005 (E. Royer, VT Rural Water Association 2010, unpub. data). The forest products industry is a major factor in the ecosystem services framework. Good logging practices, such as installation of temporary skidder bridges to protect stream banks from erosion, maintain the water quality downstream of the logging site. When properly managed, these types of projects simultaneously benefit the local economy while providing a service to the ecosystem in the form of protection of the resource.

Lastly, the **cultural services** of the Lake Champlain Basin include recreational, aesthetic, spiritual, and educational services. These have direct economic benefits as well as more difficult to measure contributions to human well-being. For example, visitors to Vermont spent an estimated \$1.6 billion in 2007, supporting more than 37,000 jobs (about 12 percent of all jobs) and contributing more than \$200 million in tax and fee revenues to the State (Economic and Policy Resources, Inc. 2008). Some sectors of the Vermont tourism economy, such as retail and dining, are estimated to be two to three times more dependent on visitor spending than the national average. A more detailed 2006 study exploring visitor's motivations found 21 percent of survey respondents cited boating and water activities, 45 percent participated in outdoor adventure activities, and 79 percent cited viewing, cultural, and learning activities during their Vermont visit (Economic and Policy Resources, Inc. 2007).

A study released in 1996 for the first *Opportunities for Action (OFA)* reported that visitor spending in the vicinity of Lake Champlain (within three miles of the Lake) in the summer was estimated at \$107 million (based on 1992 and 1993 summer surveys), and the direct and indirect effect of these visitor expenditures was \$154 million in 1992 (Holmes and Artuso 1995). A recent survey of Basin residents regarding public priorities for managing Lake Champlain found that water clarity, beach closures, safe fish consumption, land-use pattern, and invasive species were all of significant concern, with stated preference for water clarity and public beaches having the highest priority (Smith et al 2009). The impact on property values alone from water pollution can be substantial. A 1996 study of Maine lakes found that a 1 meter improvement in water clarity changed lake property values from \$11 to \$200 per foot frontage (Michael et al 1996). The sustainability of the economy in the Adirondack region of New York relies heavily on tourism, much of which is recreation based. A recent study examined the tourism trade in the Adirondacks and found that more than \$1 billion was generated in 2009, nearly all of which came from counties that are part of the Lake Champlain basin (Tourism Economics 2010). Almost \$130 million in state and local taxes were generated by tourism in these four counties in 2009. Declines in accessibility of these natural resources will affect not only the environmental health of the region, but also the economy of the Adirondacks as well. As beaches close, fish consumption advisories persist, and algae blooms become engrained in the public's experience with the Lake, what will be the long-term costs on Basin communities and culture? Lake Champlain beach closures hit record numbers in 2010, with pathogens such as *E. coli* exceeding limits acceptable for swimming on many hot July and August days. For example, August 4th water samples from eight of twelve monitoring sites in the Town of Colchester found *E. coli* levels to be three to thirteen times the Vermont standard of 77 CFU/100 mL. From June 14th to August 11th, eleven of seventeen monitoring days in Colchester (Monday and Wednesday mornings) found *E. coli* levels above the standard at one or more sites, resulting in beach closures on July 1st and 2nd, and August 5th, 6th, and 7th (view results: www.colchestervt.gov/water/results.htm).

Management programs have been put in place to support hundreds of water-quality projects throughout the Basin, ranging from securing river corridor easements, to paying farmers for cover cropping, to providing technical and financial assistance to reduce road-related erosion. The ecological, economic, and social benefits of these projects can be documented and incorporated into an overall ecosystem services assessment of the Basin. Economic benefits cited for the Lake Champlain phosphorus total maximum daily load (TMDL)

[www.vtwaterquality.org/lakes/docs/lp_lctmdl-report.pdf] plan in the Vermont Clean and Clear Action Plan [www.anr.state.vt.us/cleanandclear/costs.htm] include, “clean water to attract travel, tourism, and business; improved farm efficiency; reduced property and infrastructure damage from stream flooding; reduced town road maintenance costs; [and] reduced municipal wastewater operating costs at some plants.”

Nonuse (or intrinsic value) benefits also need to be considered as an economic component in the services that the Lake Champlain ecosystem can provide. An example of a nonuse value would be a parent’s desire for the water quality of Lake Champlain to be maintained as a natural legacy so that a child may be able to enjoy the Lake to the same extent that the parent can today. The child may not yet be able to appreciate the Lake to the same extent as the parent, but may be able to do so in the future. Many residents of the Basin feel deeply held philosophical or spiritual attachments to natural landscapes, scenic settings, and the life forms they include. These sentiments may foster more responsible personal behaviors and commitments to stewardship, reflecting the importance of these resources to individuals. Such intrinsic benefits have an economic value and a complementary ecosystem value that should be accounted for.

Adaptive management principles, as described in the Introduction to *OFA*, can be applied to all aspects of managing Lake Champlain, including the economic vitality of the Basin. In the face of growing demands on Basin resources, a platform for forward-looking, adaptive policy and planning is needed more than ever. Nearly half of Vermont’s population lives in the Lake Champlain Basin and, in aggregate, the population of Basin counties continue to grow. The viability of the dairy industry will be determined by persistent economic and ecological constraints. Population growth, however, is mostly limited to more urban and suburban areas of the basin, and trends in residential land-use change, larger home size, and greater extent of impervious surfaces present new policy and management challenges. These impacts all need to be evaluated in terms of the water quality and concordant economic impact, including the economic services lost from the impacted landscape.

Role of the LCBP in an ecosystem services assessment of the Lake Champlain Basin

The LCBP and partners recognize the need for a full assessment of the economic, social, and ecological services the Lake Champlain watershed can provide. LCBP recognizes that this project will require coordination among many groups locally and regionally. Numerous Basin organizations that the LCBP coordinates with are interested in this topic, including nonprofit organizations, local and regional academic institutions, and federal, state, and provincial agencies. The economic benefits of projects funded by the LCBP will be assessed whenever feasible, and in addition to reporting on the benefit to the ecosystem, LCBP will attempt to connect the health of the economic system to the structure and function of the ecological system. The LCBP acknowledges the direct link between the economy and the water quality of Lake Champlain and will work to identify opportunities for action that can shape a complementary relationship between economic prosperity and environmental protection.

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OBJECTIVES

- Strengthen the Lake Champlain Basin economy through investments in the management of nutrient loads, toxics, invasive species, fish, wildlife, and impacts from climate change as outlined in other *OFA* chapters.
- Measure the impact and efficiency of these investments through an ecosystem assessment for the Lake Champlain Basin, tying ecological action to economic outcomes.
- Engage Basin stakeholders in the development of forward-looking ecological impact and policy/management scenarios, including the assessment of climate change, eutrophication, nuisance species, and toxics on the economy and society.

PRIORITY ACTIONS & TASKS

10.1) Conduct full cost studies of the effectiveness of various policy and management initiatives, including water-pricing policy, stormwater utilities, farm management incentives, and point and nonpoint source regulation in the Basin to date.		
ID	Lead Agency	Task
10.1.1	LCBP	Hold a workshop or series of workshops by the end of 2012 with regional and national experts in the field of ecosystem services and ecological economics to identify other organizations currently doing work that will complement an ecosystem services assessment for the Lake Champlain Basin and identify an approach to develop a complete ecosystem services assessment of the Lake Champlain Basin.
10.1.2	LCBP	Identify long-term economic benefits that will be generated through near-term investment in conservation and restoration of the ecological engine of the Basin economy.
10.1.3	LCBP	Identify funding sources (internally and externally) to complete an ecosystem services assessment of the Lake Champlain Basin by 2013.
10.1.4	LCBP	Analyze the impact of current federal, provincial, state, and municipal policies on the delivery and sustainability of ecosystem services in the Basin and identify the impact of these policies by 2014.

10.2) Develop a scenario analysis with broad stakeholder input to evaluate various policy and management initiatives.		
ID	Lead Agency	Task
10.2.1	LCBP	Hold a series of workshops through 2012 involving local and regional stakeholders to provide input on policy and management initiatives directed toward each of the four types of ecosystem services (Supporting, Regulating, Provisioning, Cultural).
10.2.2	LCBP	Identify the value of Lake frontage in the Lake Champlain Basin relative to improving or diminished water quality, in terms of economic and ecological value by 2013.

10.3) Develop adaptive management capacity to manage the anticipated impacts of climate change, particularly on the changing dynamics between hydrological processes and eutrophication.

ID	Lead Agency	Task
10.3.1	LCBP	Identify impacts and indicators of climate change on the regional economy as related to agriculture, business (water quality related), forest products, and tourism by 2013.
10.3.2	LCBP	Subsequent to completion of 10.3.1, incorporate mitigation of climate change into an adaptive management framework for the Lake Champlain economy by 2015.
10.3.3	LCBP	Identify the long-term benefits of river restoration programs by 2013, given the expected increase in the severity and frequency of storm events.

10.4) Complete an ecosystem assessment of the Lake Champlain Basin.

ID	Lead Agency	Task
10.4.1	LCBP	Identify ways in which an ecosystem services approach will target management actions for the Lake Champlain Basin by 2012.
10.4.2	LCBP	Identify a plan to complete an ecosystem services assessment of the Lake Champlain Basin by 2013.

11. LIST OF ABBREVIATIONS

AAP Accepted Agricultural Practices
AEM Agricultural Environmental Management
AIS Aquatic Invasive Species
AOP Aquatic Organism Passage
ANC Aquatic Nuisance Control
ANS Aquatic Nuisance Species
APA Adirondack Park Agency
APIPP Adirondack Park Invasive Plant Program
ASCN Aquatic Species Conservation Needs
BCR Bird Conservation Region
BGA Blue-Green Algae
BMP Best Management Practice
CAC Citizens Advisory Committee
CAFO Concentrated Animal Feeding Operation
CBEI Champlain Basin Education Initiative
CBVBM Corporation Bassin Versant Baie Missisquoi
CNMP Comprehensive Nutrient Management Plan
CREP Conservation Reserve Enhancement Program
CRP Conservation Reserve Program
CSO Combined Sewer Overflows
CVNHP Champlain Valley National Heritage Partnership
CWICNY Champlain Watershed Improvement Coalition of New York
DFO Department of Fisheries and Oceans (Canada)
DPW Department of Public Works
E&O Education and Outreach
EPF Environmental Protection Fund
EPSCoR Experimental Program to Stimulate Competitive Research
EQIP Environmental Quality Incentives Program
FEH Fluvial Erosion Hazard
FEMA Federal Emergency Management Agency
FFY Federal Fiscal Year
GLFC Great Lakes Fishery Commission
GRISE Integrated soil and water management/Gestion raisonnée et intégrée des sols et de l'eau
HACCP Hazard Analysis and Critical Control Point
HAPAC Heritage Area Partnership Advisory Committee
HELP Hydrology for the Environment, Life, and Policy
IJC International Joint Commission
IRDA Research and Development Institute for the Agrienvironment/
l'Institut de recherche et de développement en agroenvironnement
ISPZ Invasive Species Prevention Zone
LiDAR Light Detection and Ranging
LCBP Lake Champlain Basin Program
LCFWMC Lake Champlain Fish and Wildlife Management Cooperative
LCSG Lake Champlain Sea Grant

LID Low Impact Development
LFO Large Farm Operation
LPP Land Protection Plan
MEA Millennium Ecosystem Assessment
MFO Medium Farm Operation
MS4 Municipal Separate Storm Sewer Systems
MTQ Ministère des Transports du Québec
MRC Regional Municipalities/Municipalité Régionale de Comté
NANBO North American Network of Basin Organizations
NAWCA North American Wetlands Conservation Act
NEAEB New England Association of Environmental Biologists
NEANS Northeast Aquatic Nuisance Species
NEAPMS Northeast Aquatic Plant Management Society
NECNALMS New England Chapter of the North American Lake Management Society
NEIWPC New England Interstate Water Pollution Control Commission
NFIP National Flood Insurance Program
NLA National Lakes Assessment
NMP Nutrient Management Plan
NOAA National Oceanographic and Atmospheric Administration
NPO Nonprofit Organization
NRCS Natural Resources Conservation Service
NWR National Wildlife Refuge
NWS National Weather Service
NYS New York State
NYSCC New York State Canal Corporation
NYSDAM New York State Department of Agriculture and Markets
NYSDEC New York State Department of Environmental Conservation
NYSDOT New York State Department of Transportation
NYSECL New York State Environmental Conservation Law
NYSP2I New York State Pollution Prevention Institute
O&M Operations and Maintenance
OBVBM Missisquoi Bay Watershed Organization/Organisme de bassin versant de la baie Missisquoi
OFA Opportunities for Action
ODEP Diagnostic Tool for Phosphorus Exportation/Outil de Diagnostic des Exportations de Phosphore
ORDR (NIH) Office of Rare Diseases Research (National Institutes of Health)
P Phosphorus
PAHs Polycyclic Aromatic Hydrocarbons
PBDEs Polybrominated Diphenyl Ethers
PBLC Programme Bassin Lac Champlain
PCBs Polychlorinated Biphenyls
PSA Public Service Announcement
RFP Request for Proposals
PPCPs Pharmaceuticals and Personal Care Products
PPP Preliminary Project Proposal

Project WET Project Watershed Education for Teachers

QC Québec

QC MDDEP Ministry of Sustainable Development, Environment and Parks of Québec

/Ministère du Développement durable, de l'Environnement et des Parcs du Québec

QC MAPAQ Ministry of Agriculture, Fisheries and Food of Québec/Ministère de

l'Agriculture, des Pêcheries et de l'Alimentation du Québec

QC MRNF Ministry of Natural Resources and Wildlife of Québec/Ministère des Ressources naturelles et de la Faune du Québec

QC MSSS Ministry of Health and Social Services/Ministère de la Santé et Services sociaux du Québec

QC SFP Society of Wildlife and Parks of Québec/Société de la Faune et des Parcs du Québec

RFP Request for Proposals

RIBS Rotating Integrated Basin Studies

RMO Regional Marketing Organization

ROW Right of Way

RPC Regional Planning Commission

RSEP Regional Stormwater Education Program

SCS Soil Conservation Service

SGCN Species of Greatest Conservation Need

SDWA Safe Drinking Water Act

SPDES State Pollutant Discharge Elimination System (New York)

SRA Source Reduction Assistance

SRF State Revolving Fund

SSO Sanitary Sewer Overflow

SPDES State Pollutant Discharge Elimination System

SUNY State University of New York

SWCD Soil and Water Conservation District

TAC Technical Advisory Committee

TMDL Total Maximum Daily Load

TNC The Nature Conservancy

TRP Temporary Registration Permit

TU Trout Unlimited

UNESCO United Nations Education, Scientific, and Cultural Organization

USACOE or USACE United States Army Corps of Engineers

USCDC United States Centers for Disease Control and Prevention

USDA-NRCS United States Department of Agriculture – Natural Resources Conservation Service

USDAWS United States Department of the Interior Wildlife Services

USDOI United States Department of the Interior

USEPA United States Environmental Protection Agency

USFS United States Forest Service

USFWS United States Fish and Wildlife Service

USGS United States Geological Survey

UVM University of Vermont

VAAFM Vermont Agency of Agriculture, Food and Markets

VCGI Vermont Center for Geographic Information

VHCB Vermont Housing Conservation Board
VHS Viral Hemorrhagic Septicemia
VIPs Vermont Invasive Patrollers
VOCs Volatile Organic Compounds
VT Vermont
VTACCD Vermont Agency of Commerce and Community Development
VTANR Vermont Agency of Natural Resources
VTRANS Vermont Agency of Transportation
VTDEC Vermont Department of Environmental Conservation
VTDFPR Vermont Department of Forests, Parks and Recreation
VTDHP Vermont Division for Historic Preservation
VTDOH Vermont Department of Health
VTFWD Vermont Fish and Wildlife Department
VNRC Vermont Natural Resources
WNS White-Nose Syndrome
WRDA Water Resources Development Act
WQCC Water Quality Control Commission
WQIP Water Quality Improvement Project
WRP Wetlands Reserve Program
WWTF Wastewater Treatment Facilities
ZIPP Phosphorus Priority Intervention Zone

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