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TOTAL MAXIMUM DAILY LOAD (TMDL) FOR 65 ACID IMPAIRED NEW HAMPSHIRE PONDS (FINAL)

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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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ACKNOWLEDGEMENTS

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We also thank the U.S. Environmental Agency for providing the funding necessary to complete this project.

CHAPTER 1
INTRODUCTION

1.1. BACKGROUND

Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water quality limited segments that are not meeting designated uses under technology-based controls for pollution. The TMDL process establishes the allowable loadings of pollutants for a waterbody based on the relationship between pollutant sources and lake water quality conditions, so that states can establish water quality based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources.

1.2 PURPOSE OF THIS STUDY

The purpose of this study is to develop a TMDL for 65 acid impaired New Hampshire lakes. A total of 76 lakes were listed on the State's 2004 303(d) list as a high priority because of pH values that exceed (are less than) the state's surface water quality criteria for the protection of aquatic life. To be listed as impaired for acidity, a lake needed a minimum of 10 samples in the last 10 year period and a minimum of 3 needed to be less than 6.5. Eleven impaired lakes were not included in this TMDL because of lack of data or borderline conditions (3 values were less than 6.5 but the average of the 10 values exceeded 6.5).

CHAPTER 2
PROBLEM STATEMENT

2.1 WATERBODY DESCRIPTION / FOCUS OF STUDY

Acid deposition (commonly called acid rain) occurs when emissions of sulfur dioxide (SO_2) or nitrogen oxides (NOx) react in the atmosphere with water, oxygen and oxidants to form acidic compounds. These compounds are carried varying distances from their source and are deposited as precipitation (rain, snow), as fog or as dry particles (dust). Acid deposition is a major environmental concern for a variety of reasons, including their toxic impact on the aquatic life of surface waters.

The New Hampshire Department of Environmental Services has been monitoring the impacts of acid rain in sensitive lakes since 1981 under the remote pond (30 lakes) and acid outlet (20 lakes) programs. In addition, lake pH is measured in the Volunteer Lake Assessment Program lakes (initiated in 1985 and now including 150 lakes) and in the Lake Trophic Survey program (initiated in 1975). The assessment of data from these various programs resulted in 76 lakes being listed as impaired for pH on the 2004 303(d) list. This Total Maximum Daily Load (TMDL) document determines the annual loading limits for 65 of the 76 impaired lakes. The lakes are listed and located in Figure 1 and the assessment unit IDs along with the lake name and town are provided in Table 1.

Because the source and type of the problematic loading was similar for all the lakes, a single analytical approach was used to determine each lake's acid loading capacity or critical load. This approach allowed the packaging of all the lake loading determinations into a single document.

This document provides the necessary information to satisfy requirements for TMDL development but not to explicitly give the derivation of the critical loading estimates for the 65 lakes. Attached to this document as Appendix A is a document entitled "*Calculating critical loads of acidity and exceedances for acid impaired lakes in New Hampshire using the steady state water chemistry (SSWC) model*". This document thoroughly examines the derivation of the critical loads for each lake.

The establishment of critical loads of acidity for these lakes provides an important component to fully document the acid depositional process. The critical loads establish the necessary levels of acidic deposition to each watershed to allow for the recovery of the lakes. However, additional information on distant sources and transport patterns are necessary to initiate proper controls. The critical load provides a framework from which to "backtrack" and trace the origin and magnitude of the acidity sources to the atmosphere and their transport to New Hampshire. Combined with atmospheric transport and deposition modeling, they will provide a basis for evaluating the environmental effectiveness of alternative national or regional emission control programs, or quantifying the adverse contributions from specific emission sources if effective national legislation is not forthcoming. They also provide a "benchmark" from which to quantitatively measure the effects of future changes in emissions and deposition. The critical loads established in this TMDL will facilitate a better understanding of the status and magnitude of acidic atmospheric deposition on New Hampshire lakes and ultimately lead to the control of significant acid sources.

Figure 1. Locational map of New Hampshire's acid impaired ponds

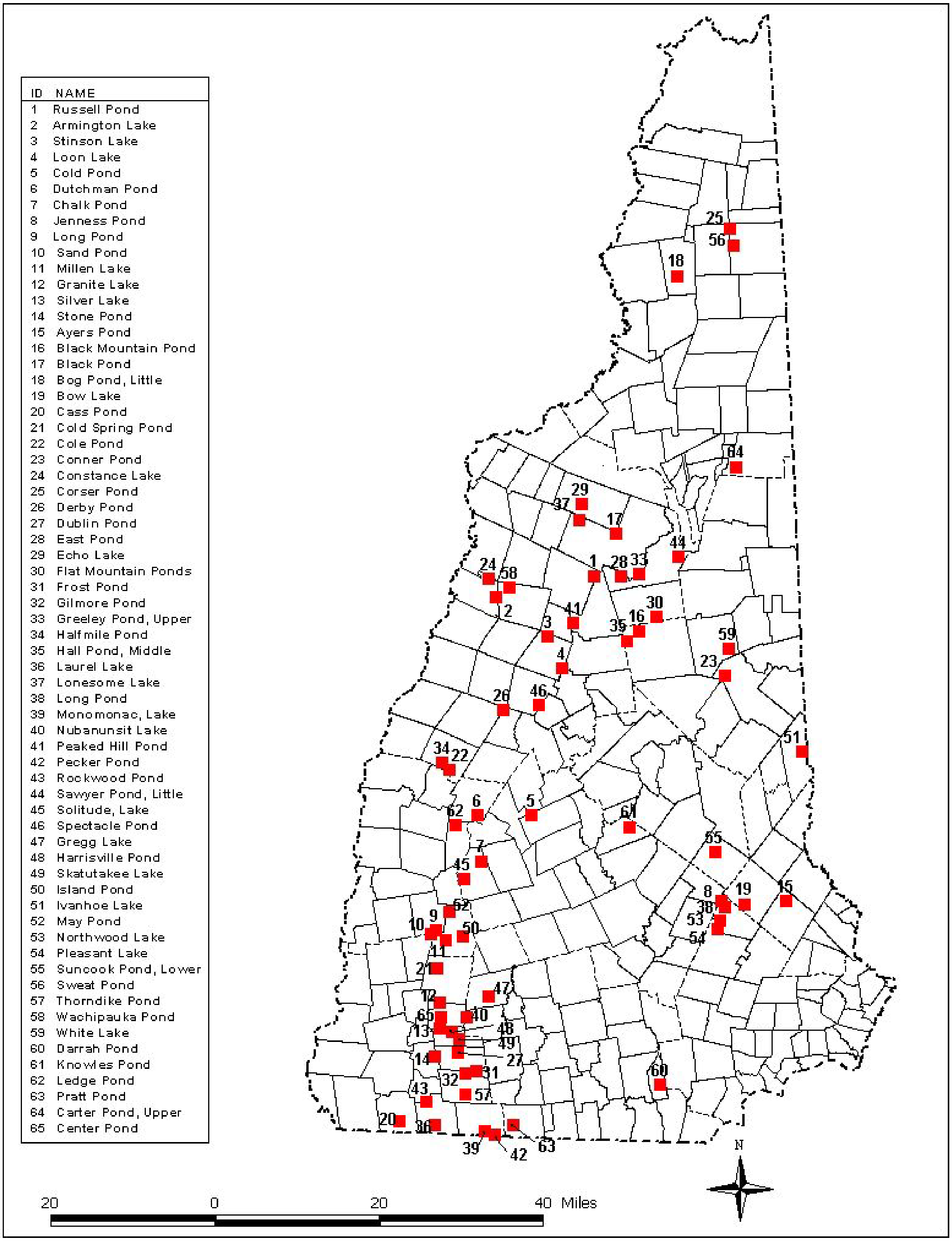

Table 1. Waterbody ID and lake name for acid impaired ponds

Waterbody ID	Lake	Town	Class
NHLAK801040201-01	ARMINGTON LAKE	PIERMONT	B
NHLAK600030607-01	AYERS POND	BARRINGTON	B
NHLAK700010402-01	BLACK MOUNTAIN POND	SANDWICH	B
NHLAK700010104-01	BLACK POND	LINCOLN	B
NHLAK801010706-01	BOG POND, LITTLE	ODELL	B
NHLAK600030604-01-01	BOW LAKE	STRAFFORD	B
NHLAK600020104-01	CARTER POND, UPPER	BEANS PURCHASE	B
NHLAK802020203-01	CASS POND	RICHMOND	B
NHLAK802010201-02	CENTER POND	NELSON	B
NHLAK801060402-03	CHALK POND	NEWBURY	B
NHLAK700030403-03	COLD POND	ANDOVER	B
NHLAK802010102-01	COLD SPRING POND	STODDARD	B
NHLAK801060105-01	COLE POND	ENFIELD	B
NHLAK600020802-02	CONNER POND	OSSIPEE	B
NHLAK801030701-01	CONSTANCE LAKE	PIERMONT	B
NHLAK400010502-02	CORSER POND	ERROL	B
NHLAK700061002-01-01	DARRAH POND	LITCHFIELD	B
NHLAK700010304-02	DERBY POND	CANAAN	B
NHLAK802010202-05	DUBLIN POND	DUBLIN	B
NHLAK801060402-06	DUTCHMAN POND	SPRINGFIELD	B
NHLAK700010204-01	EAST POND	LIVERMORE	B
NHLAK801030302-01-01	ECHO LAKE	FRANCONIA	B
NHLAK600020602-02	FLAT MOUNTAIN POND (1&2)	WATERVILLE	B
NHLAK700030102-02	FROST POND	JAFFREY	B
NHLAK700030101-05	GILMORE POND	JAFFREY	B
NHLAK802010201-05	GRANITE LAKE	STODDARD	B
NHLAK700010401-04	GREELEY POND (UPPER)	LIVERMORE	B
NHLAK700030108-02-01	GREGG LAKE	ANTRIM	B
NHLAK801060401-07	HALFMILE POND	ENFIELD	B
NHLAK700010402-04	HALL POND, MIDDLE	SANDWICH	B
NHLAK700030103-05-01	HARRISVILLE POND	HARRISVILLE	B
NHLAK700030204-03	ISLAND POND	WASHINGTON	B
NHLAK600030403-03	IVANHOE, LAKE	WAKEFIELD	B
NHLAK700060502-06	JENNESS POND	NORTHWOOD	B
NHIMP700020203-01	KNOWLES POND	NORTHFIELD	A
NHLAK802020202-02-01	LAUREL LAKE	FITZWILLIAM	B
NHLAK801060402-08	LEDGE POND	SUNAPEE	A
NHLAK700010201-03	LONESOME LAKE	LINCOLN	B
NHLAK802010101-04	LONG POND	LEMPSTER	B
NHLAK700060502-07	LONG POND	NORTHWOOD	B
NHLAK700010307-01	LOON LAKE	PLYMOUTH	B
NHLAK802010101-05	MAY POND	WASHINGTON	B
NHLAK802010101-06-01	MILLEN POND	WASHINGTON	B
NHLAK802020103-06	MONOMONAC, LAKE	RINDGE	B
NHLAK700060502-08-01	NORTHWOOD LAKE	NORTHWOOD	B
NHLAK700030103-07	NUBANUSIT LAKE	NELSON	B
NHLAK700010205-02	PEAKED HILL POND	THORNTON	B

Waterbody ID	Lake	Town	Class
NHLAK802020101-01	PECKER POND	RINDGE	B
NHLAK700060502-09-01	PLEASANT LAKE	DEERFIELD	B
NHLAK700060901-03	PRATT POND	NEW IPSWICH	B
NHLAK802010303-04	ROCKWOOD POND	FITZWILLIAM	B
NHLAK700010203-02	RUSSELL POND	WOODSTOCK	B
NHLAK802010101-08	SAND POND	MARLOW	B
NHLAK600020102-02	SAWYER POND, LITTLE	LIVERMORE	B
NHLAK802010202-09	SILVER LAKE	HARRISVILLE	B
NHLAK700030103-08	SKATUTAKEE, LAKE	HARRISVILLE	B
NHLAK700030301-01	SOLITUDE, LAKE	NEWBURY	B
NHLAK700010601-01	SPECTACLE POND	GROTON	B
NHLAK700010306-01	STINSON LAKE	RUMNEY	B
NHLAK802010303-05-01	STONE POND	MARLBOROUGH	B
NHLAK700060402-10-01	SUNCOOK POND, LOWER	BARNSTEAD	B
NHLAK400010502-05	SWEAT POND	ERROL	B
NHLAK700030102-01-01	THORNDIKE POND	JAFFREY	B
NHLAK700010302-02	WACHIPAUKA POND	WARREN	B
NHLAK600020605-02-01	WHITE LAKE	TAMWORTH	A

2.2 APPLICABLE WATER QUALITY STANDARDS

2.2.1 Overview

Water Quality Standards determine the baseline water quality that all surface waters of the State must meet in order to protect their intended uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The standards are composed of three parts: classification, criteria, and antidegradation regulations.

Classification of surface waters is accomplished by state legislation under the authority of RSA 485-A:9 and RSA 485-A:10. By definition, (RSA 485-A:2, XIV), "surface waters of the state means streams, lakes, ponds, and tidal waters within the jurisdiction of the state, including all streams, lakes, or ponds, bordering on the state, marshes, water courses and other bodies of water, natural or artificial".

All State surface waters are either classified as Class A or Class B, with the majority of waters being Class B. DES maintains a list which includes a narrative description of all the legislative classified waters. Designated uses for each classification may be found in State statute RSA 485-A:8 and are summarized below.

Classification	Designated Uses
Class A -	These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification.
Class B -	Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies.

The second major component of the water quality standards is the "criteria". These are numerical or narrative criteria which define the water quality requirements for Class A or Class B waters. Criteria assigned to each classification are designed to protect the legislative designated uses for each classification. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use. Water quality criteria for each classification may be found in RSA 485-A:8, I-V and in the State of New Hampshire Surface Water Quality Regulations (Env-Ws 1700)

The third component of water quality standards are antidegradation provisions which are designed to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Antidegradation regulations are included in Part Env-Ws 1708 of the New Hampshire Surface Water Quality Regulations. According to Env-Ws 430.31, antidegradation applies to the following:

* all new or increased activity, including point and nonpoint source discharges of pollutants that would lower water quality or affect the existing or designated uses;
* a proposed increase in loadings to a waterbody when the proposal is associated with existing activities;
* an increase in flow alteration over an existing alteration; and
* all hydologic modifications, such as dam construction and water withdrawals.

2.2.2 Water Quality Standards Most Applicable to the Pollutant of Concern

This TMDL report is for ponds impaired because of excess acidity. The water quality criteria that applies to acidity is pH. Under RSA 485-A:8 and Env-Ws 1703.18, the pH criteria is:

The pH of Class A waters shall be as naturally occurs.

The pH of Class B waters shall be 6.5 to 8.0, unless due to natural causes.

Based on New Hampshire's Consolidated Assessment and Listing Methodology or CALM (NHDES, 2004) for listing impaired waters, low pH exceedances in waters where the apparent color was greater than 30 color units (based on visual comparisons to potassium chloroplatinate standards) were considered to be due to natural causes (i.e., natural tannic and humic acids in the water). The criterion for Class A waters is interpreted as the same as for Class B: the pH is considered natural unless the pH is less than 6.5 and the color is 30 or less. To list a lake as impaired due to pH, at least 10 data points are required, at least three out of the 10 are less than 6.5, and the color is 30 or less. Waters on the impaired list due to pH exceedances are listed as impaired for the aquatic life use.

2.3 TARGETED WATER QUALITY GOALS

Acid neutralizing capacity (ANC) of water is the endpoint of the SSWC model used to calculate critical loads of acidity. While pH is a measure of the acidity (and violations of the pH criterion is the reason for the impaired listing), ANC is used as the endpoint of the model because ANC is the best criterion for the protection of aquatic life. An ANC of 2.5 mg/L is generally considered to provide adequate buffering to acid inputs to protect aquatic life. However, the goal of this TMDL is to reduce the amount of acid deposition to the lakes not only to protect aquatic life but to allow the pH values to return to the water quality criterion level of 6.5. To use the model, a target ANC needs to be selected. A regression of pH and ANC for the lakes in question determined that an ANC of 3 mg/L (60 ueq/L) was approximately equivalent to a pH of 6.5 and was selected as the target goal (see Figure 1 in Appendix A).

The purpose of the TMDL is to link acidic loading to a lake's ANC and to quantify the maximum amount of acidity a watershed can receive and maintain the target ANC to protect aquatic life.

2.4 EVIDENCE OF WATER QUALITY IMPAIRMENT

Appendix A describes the monitoring programs providing data used to assess lakes for impairment and Table 1 in Appendix I of Appendix A lists the average pH and ANC (alkalinity) values used in the model. All 65 lakes were listed on the 2004 303(d) list because at least three pH values out of 10 were below 6.5. For a few lakes, the average pH value used in the model was 6.5 or higher. Impairments under New

Hampshire's Consolidated Assessment Listing Methodology are based on number of exceedances of a criterion and not on an average value. Thus an average value can meet a criterion despite sufficient exceedances of the criterion to cause an impairment listing.

CHAPTER 3
EXISTING POINT AND NONPOINT SOURCE LOADS

3.1 EXISTING POINT SOURCE LOADS

No known point sources of low pH discharges occur to the lakes nor are present in the watersheds of the lakes evaluated in this TMDL.

3.2 EXISTING NONPOINT SOURCE LOADS

It has long been understood that the deposition of strong mineral acids and acid forming compounds from the atmosphere have been the primary source of the acidification of hundreds of lakes throughout northeast North America as well as in other regions of the country and the world. The overwhelming source of acidity to these lake watersheds is from atmospheric deposition through rain, snow, fog and dust, and the source of the acids in the atmosphere is the emission of sulfur dioxides (SO_2) and nitrogen oxides (NO_x) from a variety of sources. While the specific sources of these acidifying pollutants are not identified here, national atmospheric emission inventories and decades of atmospheric modeling results clearly implicate “Midwestern” coal-fired electric utilities as a predominant historical and continuing source of wet and dry sulfate depositions in New England (and eastern Canada). Nitric acid deposition is also heavily contributed to by coal-fired utilities but also results from a broader range of emission source types including motor vehicles and industrial sources. From a water quality perspective, it is not the atmospheric concentrations but rather the atmospheric cleansing or deposition of these pollutants that matters.

CHAPTER 4
TOTAL MAXIMUM DAILY LOAD AND ALLOCATIONS

4.1 DEFINITION OF A TMDL

According to the 40 CFR Part 130.2, the total maximum daily load (TMDL) for a waterbody is equal to the sum of the individual loads from point sources (i.e., wasteload allocations or WLAs), and load allocations (LAs) from nonpoint sources (including natural background conditions). Section 303(d) of the CWA also states that the TMDL must be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety (MOS) which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In equation form, a TMDL may be expressed as follows:

TMDL = WLA + LA + MOS

where:

WLA = Waste Load Allocation (i.e. loadings from point sources)

LA = Load Allocation (i.e., loadings from nonpoint sources including natural background)

MOS = Margin of Safety

TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure [40 CFR, Part 130.2 (i)]. The MOS can be either explicit or implicit. If an explicit MOS is used, a portion of the total allowable loading is actually allocated to the MOS. If the MOS is implicit, a specific value is not assigned to the MOS. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they are sufficient to account for the MOS.

4.2 DETERMINATION OF TOTAL MAXIMUM DAILY LOAD (LOADING CAPACITY)

4.2.1 Seasonal Considerations/Critical Conditions

Due to the long-term nature and variability of acidic deposition, both wet and dry, and the watershed and internal lake processes that occur over long periods of time, it is more appropriate to express the load as an annual load rather than a daily load. A daily loading limit would be difficult to determine and of little use. It is the overall annual acid loading that affects the lake pH and ANC, and ultimately the biological communities.

Critical loads should be calculated using yearly average values of lake conditions but, to be more protective, are sometimes calculated using minimum values or spring time values. It is during the spring snowmelt runoff events, often associated with rain events that the annual acidity load peaks. As discussed in Section 2.1 above and in Appendix A, data for this analysis comes from a variety of monitoring programs and represent average values. Spring overturn, fall overturn and summer values were all used. Critical loads calculated using average annual data may not be fully protective for the worst case conditions of the spring.

4.2.2 Margin of Safety

The TMDL regulations require that a TMDL include a margin of safety to account for any lack of knowledge concerning the relationship between loading and attainment of water quality standards. In

2003, Vermont conducted a similar TMDL for its acid ponds and used a 5% margin of safety based on the fact that most of the data was current (5 years or less old) and site specific. This TMDL also used site specific data but some of the data was greater than 5 years old and some summer data was used, which may be less protective than spring time data. For these reasons, a slightly higher margin of safety (7.5 %) was used for this TMDL.

4.2.3 TMDL Calculation and Load Allocation

The purpose of the TMDL is to provide the link between acidic loadings and a lake's ANC by quantifying the maximum amount of acidity the watershed can receive to maintain the selected ANC. For this TMDL the Steady State Water Chemistry (SSWC) model was used to make this connection. Since the source of all the acidity is considered to be non-point, the waste load allocation is equal to zero and the TMDL or critical load is:

TMDL = load allocation + margin of safety

A brief description of the SSWC model is provided here; for a more detailed description, refer to Appendix A.

The SSWC model estimates the critical load of acidity to a watershed where the critical load is defined as the level below which significant harmful effects to specified elements of the environment do not occur. The underlying concept of the model is that excess base cations in a catchment should be equal to or greater than the acid anion inputs. This balance maintains the lake's ANC to support aquatic communities. The SSWC model has been used for critical load determinations in areas where acid deposition is a problem, namely northern Europe and Canada, and was used by the State of Vermont for an acid pond TMDL.

The SSWC model calculates critical loads based on in-lake water chemistry and accounts for annual surface runoff amounts and a user specified ANC limit. The ability to set a predefined ANC limit forces the model to output a critical load based directly on New Hampshire's water quality target of 3 mg/L of ANC. The critical load for each of the 65 lakes is given in Table 2 below.

Positive critical load values indicate that the waterbody has some tolerance for acidic inputs and still be able to maintain the target ANC of 3.0 mg/L. The greater the critical load, the greater the tolerance of the waterbody to acid inputs. On the other hand, negative critical loads represent situations where the selected ANC target of 3.0 mg/L is higher than the original, pre-acidification, base cation concentrations would naturally allow. For these lakes the critical load is zero. In other words, these lakes can accept no acid loadings and, in fact, if loadings were reduced to zero, acidic conditions would continue.

The use of the SSWC model for critical load determination has many benefits. First, the model has a successful track record in northern Europe and Canada supporting establishment of source reduction targets. Second, the inputs for the model were generally available so that only limited additional data collection was required. Third, the model has the flexibility to adapt to the user-specific ANC target. This flexibility allows the direct output of the necessary critical loads without additional extrapolation.

The primary weakness of the model is not in its ability to calculate critical loads, but rather in its inability to predict responses to reduced deposition. For example, a reduction in acid loading may alter current weathering rates, soil base cation depletion or mineralization rates. Any of these changes may affect the future critical load. However, under the steady state conditions required by the model, the critical loading limits in this TMDL are the best estimates available with current data.

Table 2. Critical load of acidity for acid impaired ponds

Waterbody Name	Critical Load meq/m^2/yr	Waterbody Name	Critical Load meq/m^2/yr	Waterbody Name	Critical Load meq/m^2/yr
Armington Lake	67.63	Flat Mountain Ponds	22.83	Northwood Lake	60.94
Ayers Pond	32.22	Frost Pond	40.80	Nubanusit Lake	52.81
Black Mountain Pond	41.38	Gilmore Pond	-18.01	Peaked Hill Pond	47.54
Black Pond	105.58	Granite Lake	70.92	Pecker Pond	32.34
Bog Pond, little	99.37	Greeley Pond (Upper)	149.24	Pleasant Lake	45.26
Bow Lake	73.53	Gregg Lake	40.66	Pratt Pond	40.83
Carter Pond, upper	39.74	Halfmile Pond	21.06	Rockwood Pond	38.62
Cass Pond	63.88	Hall Pond, Middle	56.43	Russell Pond	88.70
Center Pond	61.08	Harrisville Pond	57.50	Sand Pond	-45.11
Chalk Pond	31.43	Island Pond	-146.53	Sawyer Pond, Little	91.44
Cold Pond	27.56	Ivanhoe, Lake	17.85	Silver Lake	54.81
Cold Spring Pond	45.48	Jenness Pond	42.61	Skatutakee, Lake	32.40
Cole Pond	58.06	Knowles Pond	24.89	Solitude, Lake	30.84
Conner Pond	59.58	Laurel Lake	32.71	Spectacle Pond	59.75
Constance Lake	-10.39	Ledge Pond	38.42	Stinson Lake	86.21
Corser Pond	21.61	Lonesome Lake	56.75	Stone Pond	61.99
Darrah Pond	-8.14	Long Pond	50.63	Suncook Pond, Lower	57.67
Derby Pond	44.36	Long Pond	53.43	Sweat Pond	53.81
Dublin Pond	53.28	Loon Lake	92.28	Thorndike Pond	42.66
Dutchman Pond	46.44	May Pond	41.33	Wachipauka Pond	71.67
East Pond	36.18	Millen Pond	38.26	White Lake	42.35
Echo Lake	17.94	Monomonac, Lake	14.47		

The primary source of acidity to these lakes is from wet and dry atmospheric deposition. As previously noted, the ultimate source of this atmospheric acidity is air emissions, primarily from fossil fuel burning power plants and motor vehicles. While these emissions can originate both within New Hampshire and outside the state and region, the mid-western region (the seven states of the Ohio River Valley) of the United States emits the greatest amount of sulfur and nitrogen oxides of any region in the nation (Driscoll, et al., 2001a).

Smokestacks and tailpipes and the atmospheric acid they emit appear to meet the definition of point source and pollutant. However, smokestack and tailpipe-related emissions have not been traditionally regulated under the Clean Water Act. Therefore, for the purposes of this TMDL, the total pollutant load, minus the explicit margin of safety, is allocated to nonpoint sources. Because of the difficulty of determining the specific air contaminant sources polluting New Hampshire's waters, no attempt has been made to sub-allocate the load allocation among either different geographic regions or types of sources of atmospheric acid.

Table 3 below summarizes the acid allocations for all 65 of the acid impaired waters covered under this TMDL.

Table 3. TMDLs and Allocations for NH Acid Ponds

Waterbody Name	Waste Load Allocation (meq/m^2/yr)	Load Allocation (meq/m^2/yr)	Margin of Safety (meq/m^2/yr)	TDML (Critical Load) (meq/m^2/yr)
Armington Lake	0	62.55	5.07	67.63
Ayers Pond	0	29.80	2.42	32.22
Black Mountain Pond	0	38.28	3.10	41.38
Black Pond	0	97.66	7.92	105.58
Bog Pond, Little	0	91.91	7.45	99.37
Bow Lake	0	68.02	5.51	73.53
Carter Pond, Upper	0	36.76	2.98	39.74
Cass Pond	0	59.09	4.79	63.88
Center Pond	0	56.50	4.58	61.08
Chalk Pond	0	29.08	2.36	31.43
Cold Pond	0	25.49	2.07	27.56
Cold Spring Pond	0	42.07	3.41	45.48
Cole Pond	0	53.71	4.35	58.06
Conner Pond	0	55.11	4.47	59.58
Constance Lake	0	-11.17	0.78	-10.39
Corser Pond	0	19.99	1.62	21.61
Darrah Pond	0	-8.75	0.61	-8.14
Derby Pond	0	41.04	3.33	44.36
Dublin Pond	0	49.28	4.00	53.28
Dutchman Pond	0	42.95	3.48	46.44
East Pond	0	33.47	2.71	36.18
Echo Lake	0	16.59	1.35	17.94
Flat Mountain Pond (1&2)	0	21.12	1.71	22.83
Frost Pond	0	37.74	3.06	40.80
Gilmore Pond	0	-19.37	1.35	-18.01
Granite Lake	0	65.60	5.32	70.92
Greeley Pond (Upper)	0	138.05	11.19	149.24
Gregg Lake	0	37.61	3.05	40.66
Halfmile Pond	0	19.48	1.58	21.06
Hall Pond, Middle	0	52.20	4.23	56.43
Harrisville Pond	0	53.19	4.31	57.50
Island Pond	0	-157.52	10.99	-146.53
Ivanhoe, Lake	0	16.51	1.34	17.85
Jenness Pond	0	39.41	3.20	42.61
Knowles Pond	0	23.02	1.87	24.89
Laurel Lake	0	30.26	2.45	32.71
Ledge Pond	0	35.53	2.88	38.42
Lonesome Lake	0	52.49	4.26	56.75
Long Pond	0	46.83	3.80	50.63
Long Pond	0	49.43	4.01	53.43
Loon Lake	0	85.36	6.92	92.28
May Pond	0	38.23	3.10	41.33
Millen Pond	0	35.39	2.87	38.26
Monomonac, Lake	0	13.39	1.09	14.47
Northwood Lake	0	56.37	4.57	60.94
Nubanusit Lake	0	48.85	3.96	52.81
Peaked Hill Pond	0	43.98	3.57	47.54
Pecker Pond	0	29.91	2.43	32.34
Pleasant Lake	0	41.87	3.39	45.26
Pratt Pond	0	37.77	3.06	40.83
Rockwood Pond	0	35.72	2.90	38.62
Russell Pond	0	82.05	6.65	88.70
Sand Pond	0	-48.50	3.38	-45.11
Sawyer Pond, Little	0	84.58	6.86	91.44
Silver Lake	0	50.70	4.11	54.81
Skatutakee, Lake	0	29.97	2.43	32.40

Waterbody Name	Waste Load Allocation (meq/m^2/yr)	Load Allocation (meq/m^2/yr)	Margin of Safety (meq/m^2/yr)	TDML (Critical Load) (meq/m^2/yr)
Solitude, Lake	0	28.53	2.31	30.84
Spectacle Pond	0	55.27	4.48	59.75
Stinson Lake	0	79.74	6.47	86.21
Stone Pond	0	57.34	4.65	61.99
Suncook Pond, Lower	0	53.35	4.33	57.67
Sweat Pond	0	49.77	4.04	53.81
Thorndike Pond	0	39.46	3.20	42.66
Wachipauka Pond	0	66.30	5.38	71.67
White Lake	0	39.17	3.18	42.35

CHAPTER 5
IMPLEMENTATION / REASONABLE ASSURANCE

5.1 STATUTORY/REGULATORY REQUIREMENTS

Section 303(d)(1)(C) of the CWA provides that TMDLs must be established at a level necessary to implement the applicable water quality standard. The following is a description of activities that have been implemented or proposed to restore acid impaired ponds in New Hampshire.

5.2 DESCRIPTION OF ACTIVTIES TO ACHIEVE TMDL

5.2.1 Implementation Plan

The New Hampshire Department of Environmental Services, Air Resources Division, maintains a *New Hampshire Clean Air Strategy* (NHDES, 1994) that contains an acid deposition component and is updated periodically. Sulfur emissions in NH are regulated by the department under both the federal Clean Air Act amendments and the state New Hampshire Acid Deposition Control Program (RSA 125-D and Env-A 400). DES launched a *Clean Power Strategy* in early 2001 to reduce emissions of four harmful air pollutants (SO_2, NO_x, mercury and CO_2) beyond reductions already required by existing state and federal programs, at three fossil fuel-burning power plants in New Hampshire.

NHDES is an active participant in the New England Governors and Eastern Canadian Premiers (NEG/ECP) Acid Rain Action Plan and has supported the adoption of the plan and goals to further reduce sulfur and nitrogen oxide emissions. The Action Plan calls for U.S. and Canadian reductions of sulfur dioxide emissions by an amount 50% greater than the current commitments by 2010, and reductions of nitrogen oxide emissions by an amount 20-30% greater than current commitments by 2007.

New Hampshire will continue to work with the state legislature and participate in the NEG/ECP conference to pursue all appropriate available avenues and adopt new and innovative strategies to reduce sulfur and nitrogen oxide emissions within the state. However, as discussed earlier, the bulk of the acidifying pollutants contributing to the acid impairments identified in this TMDL are from sources well beyond New Hampshire's borders. Because of sensitive ecosystems and high deposition rates, aquatic resources in New Hampshire, as well as all of northeast North America, continue to suffer more damage from acidic deposition than other regions of the country. Aside from participating in litigation to uphold federal requirements, New Hampshire has little direct control over these sources and is forced to rely on national enforcement efforts spearheaded by the USEPA. It is expected that reductions in upwind emissions of acidifying pollutants are needed to reduce the critical load exceedances in New Hampshire's acid impaired ponds

In short, implementation of this TMDL is primarily the responsibility of EPA. EPA began to address acid rain and other water quality impairing air contaminants under Title IV and section 112m of the Clean Air Act. However, 14 years after the Clean Air Act amendments of 1990 the problem of acid impaired waters remains. The USGAO (2000), USEPA (2003) and others (e.g., Driscoll, et al, 2001b; Jeffries, et al, 2003) have all concluded that, despite reductions in sulfur emissions and deposition, reduction targets in existing legislation are not sufficient for recovery in sensitive ecosystems and additional reductions are required. The solution is for EPA to work with the up-wind mid-western states to achieve significant reductions in sulfur and nitrogen oxide emissions from stationary and mobile sources.

5.2.2 Monitoring

DES plans to continue to monitor acid rain related parameters in the lakes and ponds of the state. As national efforts to control acid deposition to the northeast progresses, DES anticipates the ability to identify resultant changes to the waterbodies. DES will also continue to provide acid pond data for a selected 20 ponds to the NEG/ECP WARNING (Water Acidity Regional Network to Inform Northeast Governments) Network. The network collects acid rain data from the states and provinces of the region and periodically evaluates trends.

As described in more detail in Appendix A, DES has four lake monitoring programs that provided data for this 65-pond acid pond TMDL. Thirty-seven of the ponds were sampled annually as part of the remote pond (19 ponds) or semi-annually as part of the acid outlet (18 ponds) programs designed specifically to monitor trends in acid rain related parameters. Data for the remaining 28 lakes were from lake trophic surveys conducted once every 15 to 25 years or from volunteer lake monitoring (VLAP) sampling conducted three times per year each year during the summer. Twenty-four of these 28 lakes were in the VLAP program. Clearly the trophic surveys are not conducted at a frequency that lends itself for trend analyses. VLAP provides trend data for pH and ANC but cations and anions are not analyzed.

CHAPTER 6
PUBLIC PARTICIPATION AND LIST OF SUBSTANTIVE CHANGES

6.1 DESCRIPTION OF PUBLIC PARTICIPATION PROCESS

EPA regulations [40 CFR 130.7 (c) (ii)] require that calculations to establish TMDLs be subject to public review. On August 13, 2004, DES public noticed the draft TMDL on its website (http://www.des.state.nh.us/wmb/tmdl/draftTMDL.htm). Instructions for submitting comments were provided at http://www.des.state.nh.us/wmb/tmdl/commentform.htm. In addition to the general notice on the website, emails were sent to members and active participants on the DES Water Quality Standards Advisory Committee (WQSAC) notifying them of the opportunity to comment on the draft TMDL. The WQSAC and nonmembers who regularly attend meetings include representatives from a variety of agencies / organizations, as shown below:

Appalachian Mountain Club
Business and Industry Association (BIA)
Canobie Lake Protective Association
City of Concord
City of Portsmouth
Conservation Law Foundation
Consulting Engineers of NH
Granite State Hydropower
Habitat Conservation Division, National Marine Fisheries
Lamprey River Local Advisory Committee
Manchester Water Works
N.H. Association of Conservation Commissions
N.H. Department of Environmental Services
N.H. Department of Health and Human Services
N.H. Farm Bureau
N.H. Fish and Game Department
N.H. Lakes Association
N.H. Office of Energy and Planning
N.H. Rivers Council
N.H. Timberland Owners Association
N.H. Water Pollution Control Association
N.H. Waterworks Association
N.H. Wildlife Federation
Society for the Protection of NH Forests
U.S. Environmental Protection Agency, Region I
University of New Hampshire
U.S. Fish and Wildlife Service

The public comment period ended on September 13, 2004.

6.2 PUBLIC COMMENT AND DES RESPONSE

During the public comment period, DES received two comment letters; one from the consulting firm of Aries Engineering and the other from the New Hampshire Lakes Association. Comments and DES's response are provided below. Comments are italicized and have been paraphrased in some cases.

DES's response to comments received from Aries Engineering

Comment: After reviewing your report I find no real basis to raise the ANC level to 3.0 mg/l as discussed *on Page 6. Previous studies used a level of 2.5 mg/l and a pH of 6.0. Just because NH has a pH standard of 6.5 does not imply the model should be adjusted using a regression analysis for pH.*

DES Response: We agree that the model was developed to determine the critical load of acidity for the protection of aquatic life and that a pH of 6 (approximately equivalent to an ANC of 2 to 2.5 mg/L) is the generally accepted level to protect aquatic life. However, the purpose of the TMDL is to reduce the pollutant load such that water quality standards are met, and New Hampshire's pH criterion is 6.5 to 8.0. The model allows for the user to select an appropriate ANC endpoint and it is reasonable to select an ANC of 3.0 if the desired pH is 6.5.

Comment:This is especially true when you consider the comparable countries are Canada, Europe and the state of Vermont which has a more alkaline geology therefore raising issues regarding the reliability of the model in the naturally acidic soils and waters of NH.

DES Response: While Vermont has areas of the state with a more alkaline geology than New Hampshire, it is also true that areas of Vermont have low alkaline conditions and ponds sensitive to acid inputs. Vermont applied the SSWC model to its acid-impaired ponds, which have very low pH and ANC values.

Comment: Regarding naturally occuring acidic conditions for Stinson Lake and Loon Lake, Rumney, NH, it is not apparent from historic water quality data generated by your office and the VLAP program that the acidic condition is not a natural condition. I don't believe the CALM or the SSWC has been put forth as a rule and I question the applicability of it's use here for adjusting the meaning of naturally occurring water quality conditions.

DES Response: The CALM provides a consistent methodology for assessing surface waters. We agree that the process is not a rule but it was subject to public review and comment. Two major sources of acidity to surface waters exist: atmospheric deposition and runoff/seepage of natural humic acids from the breakdown of plant matter. Because humic acids are associated with tea-colored waters, it is reasonable to assume that atmospheric deposition is the major source of acidity to clear waters such as Stinson and Loon lakes.

Comment: Further, I doubt that the data has been assessed and I'm sure a QAPP was not performed prior to taking any of these samples. Additionally, from the data trends (if you could trust the data) it appears the situation certainly has not gotten any worse.

DES Response: The data has been assessed in accordance with the CALM. It is this assessment that placed Stinson and Loon lakes on the 303(d) list in the first place. The data used for the assessment is from our acid outlet sampling program (spring and fall overturn samples) along with one summer survey sampling for Stinson Lake. Samples were collected according to established SOPs and analyses were conducted in the DES EPA-approved laboratories. We agree that the data does not show that the situation is getting worse – the issue is that the current values do not meet the water quality criterion.

Comment: Further if F&G felt the water body could not support aquatic life at this ph, they would not be stocking this water body annually. Therefore, I don't believe your model, used in Europe and Canada, provides a scientific basis for listing these lakes and is likely beyond the Legislative intent of the existing water classification put forth in RSA 485-A-8. Nowhere in the statute can I find the word "impaired" as it relates to classifying state lakes or establishing TMDL's for acid impaired ponds.

DES Response: We agree that a pH of 6.5 does not impair aquatic life. However, pH 6.5 is the criterion we have in statute and, by definition, waters listed on the 303(d) list are waters that do not meet water quality standards and require a TMDL.

Comment: Obviously the next question is once a lake is on a list, how do you get it off and who pays for the remediation of the lake? You mention EPA is responsible for the TMDL process, are they establishing a new grant program to get these lakes remediated? Or do we spend the next 50 years waiting for congress to enact emissions controls in the mid west?

DES Response: Waters come off the 303(d) list when the assessment of the data demonstrates that the waters meet standards. Clearly, reducing acid emissions is a national issue and it's certainly possible that these waters could remain on the list for many years under the existing assessment process. Alternatively, it's possible that standards could be met sooner if the criterion or the assessment process is changed.

Comment: Therefore, I am asking you to reconsider this process, examine the accuracy and quality of your data base; look at the trends of data for individual lakes, change the model to use the 2.5 mg/l ANC, reduce the margin of safety to 5% as used in the original model and lower the critical loading to 50meq/m2/yr. I'm sure you will consider these comments and ask that DES think twice before artificially labeling a lake "impaired" based on data that is questonable, while admittedly, all taken in good faith.

DES Response: Please see our response to the previous comments above.

DES's response to comments received from the New Hampshire Lakes Association

Comment: Thank you for the opportunity to comment on the Draft Total Maximum Daily Load (TMDL) for 65 Acid Impaired New Hampshire Ponds. As you know, the New Hampshire Lakes Association (NHLA) is a statewide non-profit organization representing approximately 13,000 lake and pond enthusiasts. While we believe TMDLs are necessary to establish pollutant thresholds for our state's lakes and ponds, we find it equally important to implement appropriate remediation measures to minimize the impact of acid deposition to our state's public waters.

Although the issue of acid deposition is well studied by scientists, there is no environmental program dedicated to addressing atmospheric deposition of toxics despite mandates within the Clean Air Act to protect public health and the environment from its effects. The air contributions to specific waterways has been very difficult to determine, hence it is important to focus on remediation efforts that will benefit multiple listed waterways in the airshed.

In order to achieve quantifiable reductions of acid deposition into the state's public waters, a concerted effort is necessary to:

1. *Set targets for the reduction of atmospheric deposition of toxic chemicals into lakes and ponds.*
2. *Develop a comprehensive inventory of regional air toxic sources.*
3. *Coordinate state and federal environmental programs to quantifiably reduce air toxic emissions.*
4. *Coordinate and target modeling and monitoring efforts in order to set goals, track reductions, and identify effective controls.*

While TMDLs are helpful in achieving the desired water quality standards for locally generated pollutants such as phosphorous (i.e. lawn fertilizers) and sodium chloride, air-based pollutants containing mercury, nitrogen, and sulfur demand a regional remediation effort that includes modeling and toxic emission reductions.

We hope DES will consider the afore-mentioned recommendations to supplement the department's Draft TMDL proposal for 65 acid impaired ponds.

DES Response: These are all excellent points which DES will consider as we move forward with implementation of this TMDL. As stated in Chapter 5, this is a regional issue as the bulk of acidifying pollutants contributing to the acid impairments identified in this TMDL are from sources well beyond New Hampshire's borders. Since New Hampshire has little direct control over these sources, it is forced to primarily rely on national enforcement efforts spearheaded by the USEPA. Consequently we believe that implementation of this TMDL should primarily be the responsibility of EPA and that they should work with the up-wind mid-western states to implement the necessary reductions in sulfur and nitrogen oxide emissions from stationary and mobile sources.

6.2 SUBSTANTIVE DIFFERENCES BETWEEN THE FINAL AND DRAFT TMDL

The following represent the substantive differences between the final and draft TMDL.

Revision #	Description of Revision
1	Moved Table 4 " TMDL and Allocations for NH Acid Ponds" and associated paragraphs in Section 4.3 "Load Reductions Needed to Achieve the TMDL" to Section 4.2.3 "TMDL Calculation and Load Allocation". Table 4 was revised to be Table 3.
2	Deleted the rest of Section 4.3 "Load Reductions Needed to Achieve the TMDL". This section was inadvertently included in the DRAFT TMDL.

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