

2018 Section 305(b) Water Quality Report

Water quality reporting under the Clean Water Act (CWA) Section 305(b) and Section 303(d) are highly visible ways of communicating to the public about the health of the nation's waters. Under Section 305(b), states are required to periodically report on the quality of all water resources in the state and whether these waters are fully supporting water supply use, recreation activities and aquatic life. Section 303(d) requires states to identify waters of the state where water quality standards are not met and where uses are not supported. The Section 303(d) List includes those waters (and associated pollutants) that do not support uses, *and which require development of a Total Maximum Daily Load (TMDL) strategy*. Because the Section 303(d) List of Impaired/TMDL Waters is concerned with only impaired waters – and within the universe of impaired waters, only those impaired waters that can be addressed with a TMDL strategy – the Section 305(b) Report provides a more comprehensive assessment of statewide water quality.

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2018 Section 305(b) Water Quality Report Executive Summary

The 54,471 square miles of New York State are rich in water resources. Freshwater resources include more than 87,000 miles of rivers and streams, nearly 7,900 lakes and ponds totaling about 690,000 acres (not including Great Lakes), and over 400 miles of Great Lakes coastline. The marine waters of the state include more than 1,530 square miles of estuaries, as well as about 120 linear miles of Atlantic Ocean coastline. New York State is the only state in the country that has some of all five of these designated waterbody types. Additionally, about six million residents draw drinking water from abundant groundwater resources in the state. Water quality in a majority of these waters supports all intended uses. However, there are waterbodies that are affected by some level of water quality impact, use impairment, or are otherwise threatened by various human activities.

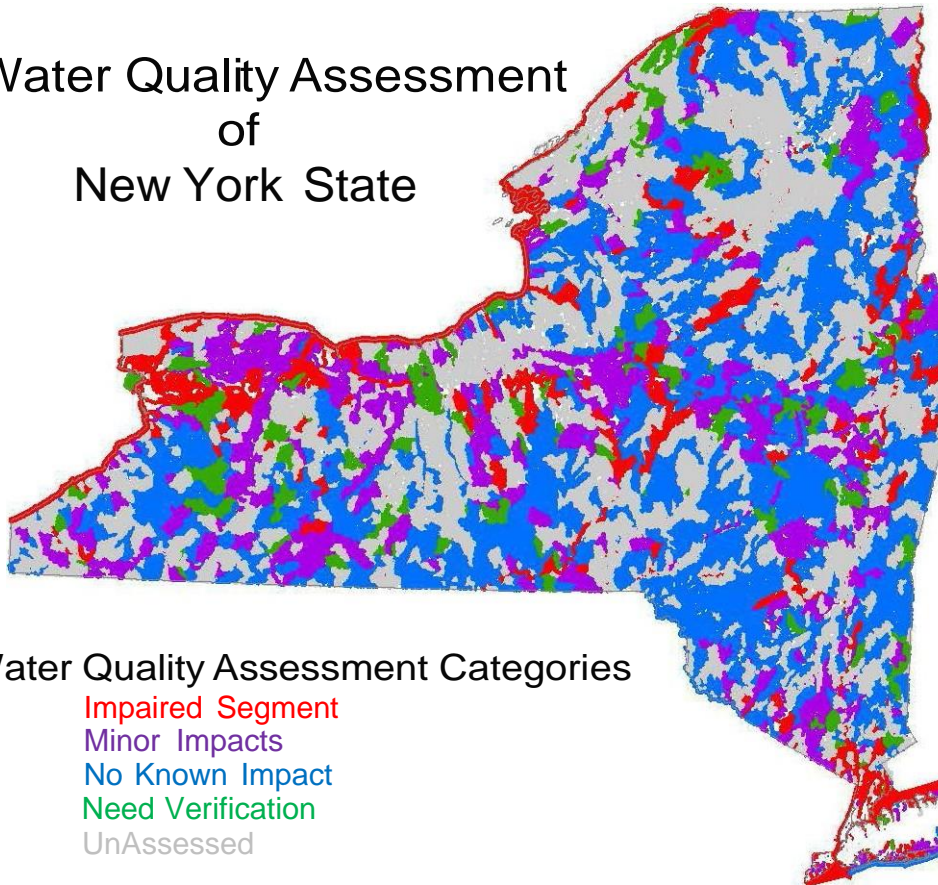
The New York State Department of Environmental Conservation (NYSDEC) Division of Water maintains an extensive inventory/database of these waters. The *Waterbody Inventory/Priority Waterbodies List* (WI/PWL) provides waterbody-specific summaries of water quality conditions, tracks the degree to which the waterbodies support (or do not support) a range of uses, and monitors progress toward the identification and resolution of water quality problems, pollutants and sources. Information from the WI/PWL serves as the basis for this *Clean Water Act Section 305(b) Water Quality Report*.

Water Quality Assessment Map

An overview [map](#) on the following page shows current water quality conditions in New York State. The map shows how the waters of the state correspond to five assessment categories:

- Impaired Waters
- Waters with Minor Impacts
- Waters with No Known Impacts
- Waters Needing Verification of Impact
- UnAssessed Waters

Water Quality Assessment of New York State



Water Quality Assessment Categories

Impaired Segment

Minor Impacts

No Known Impact

Need Verification

UnAssessed

Overall Support of Uses in New York State Waters

Overall use support for various types of waterbodies in New York State is as follows:

Rivers and Streams: Sixty-two percent of the 87,526 miles of New York State river and stream miles are assessed. Approximately 9% are categorized as being *Impaired Waters* that do not fully support their designated use. About 16% of river/stream miles are assessed as having *Minor Impacts or Threats* but still support uses, while 1% *Need Verification* of impact to determine standards attainment/use support. One-third of assessed rivers/stream miles have *No Known Impacts*. About 38% percent remain *UnAssessed*; this percentage of UnAssessed waters is down from 45% in 2008.

Lakes and Reservoirs: As of 2018, roughly 40% of New York State lake and reservoir acres have been assessed. Nearly 20% are impaired. About 11% of assessed lake and reservoirs have *Minor Impacts or Threats* but still support uses, while 8% of these waters *Need Verification* of impact to determine water standards attainment/use support. Nearly 40% of assessed lake acres have *No Known Impacts*. About 60% percent remain *UnAssessed*.

Estuary Waters: About 62% of New York State estuary waters are categorized as *Impaired Waters* that do not fully support uses. Most (over 90%) of the *Impaired Waters* are the result of fish consumption; shellfishing impairment occurs in about one-quarter of *Impaired Waters*. About 30% of estuary waters have *Minor Impacts or Threats* but still support uses. Only about 5% of estuary waters have *No Known Impacts*.

Great Lakes Shoreline: The New York State Great Lakes shoreline is categorized as being *Impaired Waters* that do not fully support designated uses.

Atlantic Ocean Coastline: Most of the New York State ocean coastal waters is considered to have *No Known Impacts* and support all designated uses. Only 2% of Atlantic Ocean Coastline in NYS is categorized as *Impaired*.

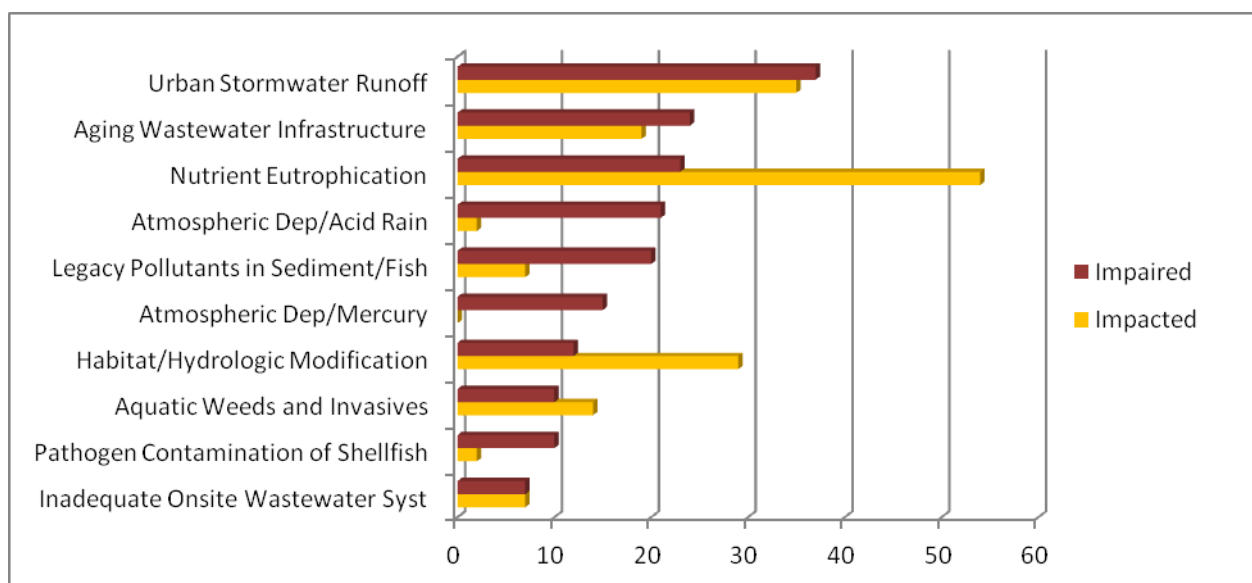
Top Ten Water Quality Issues in New York State

The NYSDEC Water Quality Assessment Program has identified the Top Ten most prevalent causes/sources of water quality impact/impairment in the assessed waters of New York State. These are:

- Urban Stormwater Runoff

- Aging/Inadequate Wastewater Treatment Infrastructure
- Nutrient Eutrophication
- Atmospheric Deposition and Acid Rain
- Legacy Pollutants in Sediments and Fish
- Atmospheric Deposition of Mercury
- Habitat/Hydrologic Modification
- Nuisance Aquatic Weed Growth and Invasive Species
- Pathogen Contamination of Shellfish
- Inadequate Onsite Wastewater Treatment

The figure below shows the frequency for which a specific cause/source is noted as a significant contributing factor in New York State waters. The figure shows the occurrence of each cause/source as a percentage of all waters assessed as impaired (red) or impacted (yellow).



Note: Frequency totals do not equal 100% because categories are not mutually exclusive.

Each of these causes/sources is discussed in greater detail on individual [Fact Sheets](#).

These fact sheets outline the nature of the specific problem, the significance of the problem, what New York State waters are most susceptible to the problem and what is being done to address the problem.

Waterbody Inventory and Assessment Coverage

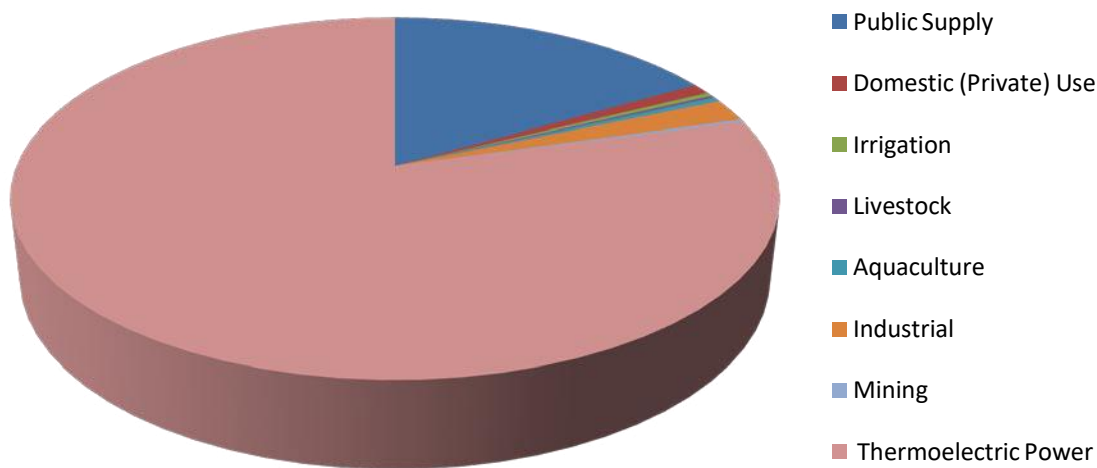
Originally the New York State water quality assessment effort focused on assessing waters with known or suspected water quality problems. However, beginning in the mid-1990s and continuing through the present, that focus has shifted to producing a more comprehensive and representative assessment of all the waters of the state. Although the comprehensive

assessment goals have yet to be fully realized, considerable progress has been made toward the assessment of 100% of the waters of the state.

Water Resources Use

More than 15 billion gallons of water are withdrawn each day from the lakes, rivers, streams, estuaries and groundwaters of New York State for uses that include domestic consumption, industrial use, irrigation and livestock watering, mining, and thermoelectric power generation. Thermoelectric power is by far the most significant of all water use categories, accounting for nearly 80% of total water withdrawn. Public water supply accounts for nearly 17%.

**Total Water Use by Category
in New York State (2005)**



About two-thirds of the total water withdrawn is fresh water. The other third is taken from saline waters and is used primarily for thermoelectric power generation. Surface water withdrawals account for nearly 94% of all freshwater withdrawals in New York State, the remaining 6% of withdrawals are taken from groundwater sources.

Public water supply use and other domestic water withdrawals uses (including normal household uses such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets and watering lawns and gardens) account for about 26% of all freshwater withdrawals in the state. The majority of these withdrawals (76%) are drawn from surface waters, while the remaining need is provided by groundwater.

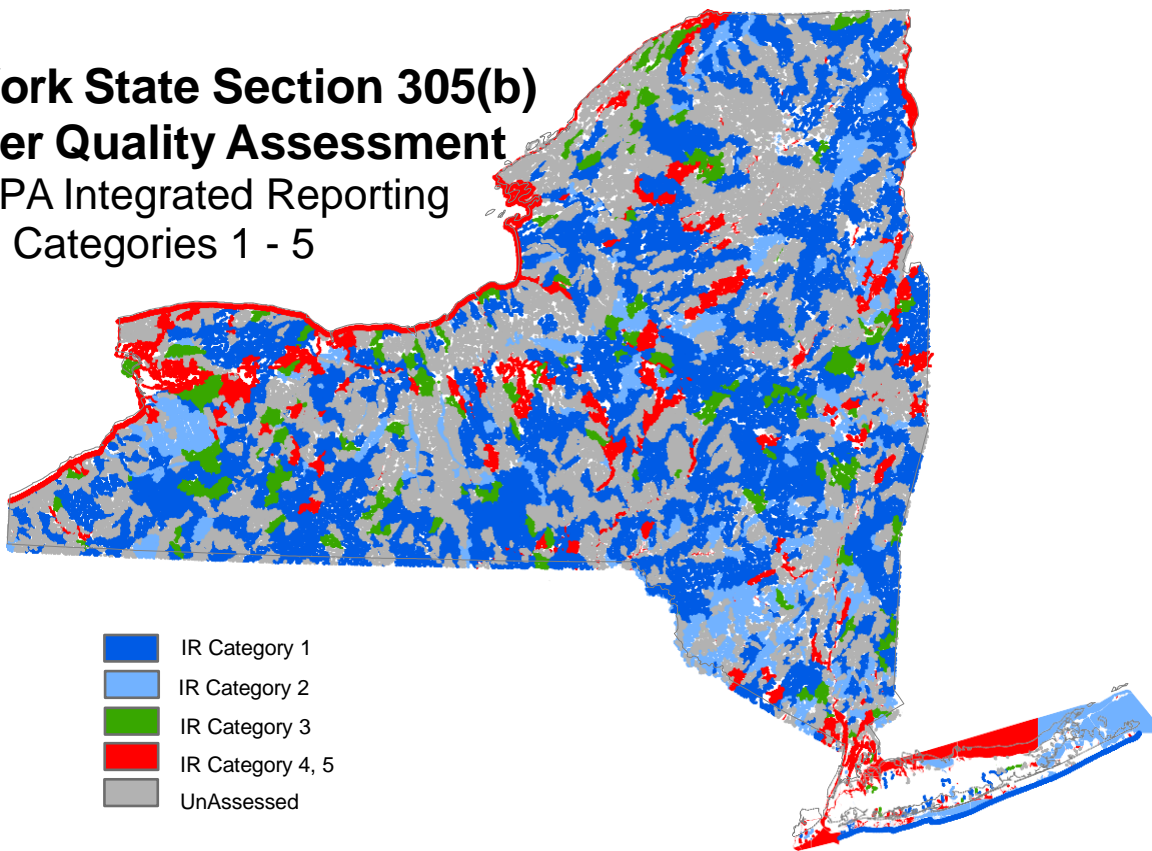
Community water supply systems throughout the state withdraw, treat, and distribute water for domestic, municipal, commercial and some industrial uses. In New York, community water supply systems serve 90% of the state population. The largest 10% of these systems supply water to more than 95% of New York State residents in the larger urban and suburban areas. This includes the majority of New York City residents, whose 1.5 billion gallon per day water supply is drawn from a series of reservoirs located upstate in Delaware, Sullivan, Schoharie,

Greene and Ulster counties. The vast majority of the community water systems in the state, however, are rather small with each serving on average only a few hundred people. People not served by community systems are self-supplied; virtually all of the self-supplied population relies on groundwater withdrawals from their own wells. In all, nearly 30% of New York State's population depends on groundwater, including much of the population of Long Island.

In addition to these consumptive uses, the water resources of New York State also support numerous exceptional recreational activities for state residents and tourists alike. Swimming, fishing, and boating opportunities abound throughout the state. More than 100 state parks and forests – including the six-million- a c r e Adirondack Park and 650,000- a c r e Catskill Park and Forest Preserves – feature various forms of water recreation. The state offers a variety of public beaches, from the sandy shores of the Atlantic Ocean and Long Island Sound, to the clear, cool lakes of the Adirondacks, scenic beauty of the Finger Lakes area, or majesty of the Great Lakes. Boating on the extensive Erie Barge Canal System and canoeing or rafting outings through forested wilderness areas are also popular outdoor pastimes.

Water Resources data is from *Estimated Use of Water in the United States in 2005*, U.S. Geological Survey Circular 1344, 2009. <http://pubs.usgs.gov/circ/1344/>

New York State Section 305(b) Water Quality Assessment USEPA Integrated Reporting Categories 1 - 5



New York State Clean Lakes Assessment

According to the best available estimates, New York State has 7,650 ponded bodies of water (lakes, ponds, reservoirs, etc.) covering a surface area of over 790,000 acres (not including Lakes Ontario and Erie, which collectively cover more than 3,000,000 acres within New York's borders alone). For this assessment, New York State considers lakes, ponds and reservoirs included in the current state indexing system as "significant" waters. The reporting system in New York State does not distinguish between what might be defined as private versus public lakes, since all of the waters of the state are considered public (public versus private status is usually conferred upon issues of access, not ownership of the waters themselves). As such, this report will consider all sampled waters to be significant publicly owned and subject to assessment in this document. The assessment has been conducted on a total of 1,931 different significant water bodies representing 516,200 acres of surface area (not including Lake Ontario); about 75 percent of these waters are located in the Adirondack Region of the state. This statewide total represents a larger number than reported in 1996, since more than 45 previously unsampled lakes are included in this report.

The characterization of trophic status has been conducted using total phosphorus, chlorophyll *a*, and Secchi transparency, along with true color to distinguish waters which are stained or "colored" from organic material and have low transparency. True, or soluble, color of the water is a surrogate of organic material in the water and should be included in the evaluation since phosphorus associated with the organic material is unavailable for uptake by organisms but is contained in the total phosphorus results reported from water quality analysis.

About 54 percent (1047) of the total (1,931) waters in which trophic indicators and color were measured had true color values less than or equal to 30 mg/l platinum color units, comprising a surface area of 428,560 acres. These waters were classified into trophic state using total phosphorus and Secchi transparency. There were 227 waters classified as eutrophic based on total phosphorus, 163 waters classified as eutrophic based on Secchi transparency, and 143 waters classified as eutrophic based on chlorophyll *a*. Chlorophyll *a* was not very useful in this analysis since relatively few waters (only about 30 percent of the 1,931 assessed) had chlorophyll *a* data available.

Only 165 of the 884 waters with true color values greater than 30 mg/l Pt could be classified into trophic state, using available chlorophyll *a* data (color readings have not been obtained for the balance of the assessed waters (80)). Based on this criterion, 9 waters were oligotrophic, 81 waters were mesotrophic, and 75 waters were eutrophic.

Acidity status was assessed using midsummer pH of the surface water. Waters are considered impaired if pH is < 5.0, threatened if pH is ≥ 5.0 and ≤ 6.0 , and acceptable if pH is > 6.0. A total of 1,978 waters in New York State, including 1,376 waters through the Adirondack Lake Survey Corporation study, were assessed for acidity. There were 363 ponded waters impaired, 316 waters threatened, and 1299 waters had acceptable conditions. The waters impaired by acidity represent less than two percent of the total surface area included in the current assessment.

Significant Waters and the Lakes Inventory

New York State uses an indexing system to identify ponded waters within the state. The pond number, or *P*-, is the number that has been assigned to a specific ponded water by the NYSDEC in Part 800 of its

*Codes, Rules and Regulations.*¹ These Rules and regulations pertain to Article 15 of the New York State Environmental Conservation Law.² With reference to the *Guidelines for the Preparation of the 1990 State Water Quality Assessment (305(b) Report)*,³ New York State defines "significant" waters as those lakes, ponds and reservoirs that are included in the indexing system at the present time.

Although New York State has over 7,600 ponded waters within its boundaries, not all of these waters are indexed and included in the state inventory at the present time, and the exact number of ponded waters is not known. Surface area is one fundamental limitation that precludes certain waters within the state from being included in the inventory since waters below a certain size will not appear on USGS topographic maps. The Division of Water has regularly updated the *Codes, Rules and Regulations* to reclassify some waters and add many of the ponded waters that are not indexed.

A partial inventory of state waters is included in *Characteristics of New York State Lakes; Gazetteer of Lakes, Ponds and Reservoirs*, 3rd Edition (1987), which lists nearly 3,500 ponded waters that have surface areas greater than 6.4 acres, appear on USGS 7.5 minute topographic maps, are named and indexed. The 6.4 acre, or 0.01 square mile, surface area was the minimum size included in the previous gazetteer by Greeson and Robinson⁴ and has remained the minimum ponded water acreage in all recent updates. A summary of different categories of ponded waters within the state with reference to the current inventory process is presented below.

Table 1 Categories of Ponded Waters in New York State			
Number of Lakes/Ponds	Lake/Pond Characteristics		
	Size/Surface Area	Included in Inventory	Named Lake/Pond
135	Greater than 500 acres	yes	yes
2,911	6.4 to 500 acres	yes	yes and no
832	less than 6.4 acres	yes	yes and no
3770 (est)	less than 6.4 acres	no	yes and no

The total number of lake waterbodies in the state is currently estimated to be 7,849 representing are total cumulative surface area estimated to be over 790,000 acres (not including Lakes Ontario and Erie).

¹ State of New York. 1984. Official Compilation of Codes, Rules and Regulations. Title 6, Volumes A-F, New York State Department of State.

² State Of New York. 1984. Environmental Conservation Law of New York. Volumes 1-11, New York State Department of State.

³ United States Environmental Protection Agency. 1997. Guidelines for the Preparation of the State Water Quality Assessment (305(b) Report) and Electronic Updates. Assessment and Watershed Protection Division (4503F), Washington, D.C.

⁴ Greeson, P. E. and F. L. Robinson. 1970. Characteristics of New York State Lakes. Part I. Gazetteer of Lakes, Ponds and Reservoirs. Bulletin 68, U. S. Geological Survey and N. Y. S. Department of Environmental Conservation. 124 p.

Lake Assessment Methods

The data that were used to prepare this lake assessment were compiled from several local, State and Federal sources. Samples included in the current assessment were collected between 1982 and 2007. The 1982 cutoff corresponds with a previous lake water quality assessment report submitted to USEPA by New York State (Mikol, 1983), as well as a distinct 25-year interval. The sources of data in the present report are the Adirondack Lake Survey (NYS Department of Environmental Conservation and Empire State Electric Energy Research Corporation, 1984 through 1987), the Eastern Lake Survey (USEPA, 1984) which was Phase IA of the National Surface Water Survey, the Lake Classification and Inventory Project (NYSDEC, 1982 through 1991, and beginning again in 1996 until the present day), the Citizens' Statewide Lake Assessment Program (NYSDEC, 1986 through the present), the Water Quality Surveillance Network (NYSDEC, 1982 to 1986), the Rensselaer County Water Quality Program (1990), the Adirondack Effects Assessment Program (AEAP; Rensselaer Polytechnic Institute, NYSDEC, and other institutions, 1994-present) and various Clean Lakes Projects and special studies. Water quality data for approximately 150 lakes throughout the state were also collected by the USEPA and USFWS through the Environmental Monitoring and Assessment Program (EMAP)-Surface Water and TIME (Temporally Integrated Monitoring of Ecosystems) programs (1991 through 1996), but these data have only been released for individual lakes through 1993; all later data cannot be included in this assessment. Systematic monitoring of the eleven Finger Lakes was commenced in 1996 by the NYSDEC Lake Services Section and Upstate Freshwater Institute and continues through the present. All of the data were collected and analyzed using USEPA approved quality assurance - quality control protocols. Except for several of the Clean Lakes Projects and the Rensselaer County data, all laboratory analyses were conducted by either NYSDEC or New York State Department of Health laboratories prior to 1998. Beginning in 1998, analyses were performed by either one or more contract laboratories (for sampling conducted for the LCI, Finger Lakes, and AEAP programs, and CSLAP after 2000) or the NYS Department of Health (CSLAP prior to 2002).

All data were obtained from the original sources in computer compatible form and were entered into a database using Microsoft Excel, running on a Dell Pentium computer. Although the full database contains information on a wide variety of water quality measurements, the present draft of this report has been restricted to a summary of parameters related to trophic classification and acidity status, unless otherwise noted.

The data were coded with a single character to identify the source. The codes were *L* (NYSDEC Lake Classification and Inventory), *C* (Citizens' Statewide Lake Assessment Program), *B* (NYSDEC Biota Survey), *W* (NYSDEC Water Quality Surveillance Network), *A* (Adirondack Lake Survey Corporation), *E* (USEPA Eastern Lake Survey), *R* (Rensselaer County), *T* (TIME and USEPA/USFWS EMAP Program), *P* (RPI/NYSDEC/etc. Adirondack Effects Assessment program), *F* (Finger Lakes study), and *S* (Special studies). An *M* (multiple source) indicates that more than one program collected information on the ponded water.

Certain identifying information has been presented for most of the lakes and ponds in the data summary including the name of the water body, the index number (*Pond No.*) which consists of the watershed number and the pond number, the surface area (*Surf. Area*) in hectares (ha), the current water quality classification (*W.Q. Class.*), and the county code (*County*) for the location of the water body.

The water quality data summary was produced using **EXCEL** to calculate average or median values for the various parameters included in the assessment. The data summary represents samples that were collected during midsummer from the upper portion of the water column (sample depth $\leq 3\text{m}$). Data summaries were prepared for the following parameters: Secchi depth (*Secchi*, in meters), trophic state

based upon Secchi (*Secchi T.S.*), chlorophyll *a* (*Chl a*, in µg/l), trophic state based upon Chlorophyll *a* (*Chl a T.S.*), total phosphorus (*TotP*, in mg/l), trophic state based upon total phosphorus (*TotP T.S.*), pH (*pH*, in standard units), pH status (*pH Status*), acid neutralizing capacity (*ANC*, in µeq/l), true color (*True Color*, in mg Pt units/l), and the source of the data (*Code*). For lakes from which samples were collected over several years or programs, reported averages correspond to the summer mean values from all programs averaged over the number of years sampled. Although median values may be used for some calculations, unless otherwise noted, all calculations for central tendency are based on sample mean.

The USEPA Eastern Lakes Survey (ELS) data collected on 240 ponded waters were not incorporated into the calculation of average values for the data summary since the ELS field sampling was conducted during the fall, not midsummer, of 1984. As a result, significant differences occurred in the values of certain parameters collected from the same ponded water by one source during midsummer and by the ELS during the fall.

Lake Trophic Status

The current assessment has employed the traditional classification of trophic status, i.e., oligotrophy, mesotrophy and eutrophy, as a framework for water quality assessment by using the values and ranges for transparency, total phosphorus, and chlorophyll *a* outlined in Table 2.

Table 2 Assessment Criteria for Lake Trophic Status			
Parameter	Oligotrophic	Mesotrophic	Eutrophic
Transparency (m)	> 5	2 - 5	< 2
Total Phosphorus (µg/l)	< 10	10 - 20	> 20
Chlorophyll <i>a</i> (µg/l)	< 2	2 - 8	> 8

The values and ranges of values generally agree with trophic status criteria that are reported in the literature, although the ranges for chlorophyll *a* are somewhat lower than have been used in historical versions of this report. The present report will highlight any apparent discrepancies or “trends” that are actually the result of the shift in reporting ranges. New York State has not adopted a statistical definition related to the categories hypereutrophic or dystrophic; therefore, these categories are not included here.

Classification of trophic status using traditional criteria has very limited application in certain regions of New York State, however. In the Adirondacks and Catskills, for example, transparency is not a good indicator for all water bodies since many waters are stained or "colored" and have low transparency from humic and fulvic acids. The presence of these compounds in the water indicates the incomplete microbial decomposition of the organic compounds of green plants and does not necessarily relate to productivity. True, or soluble, color of the water is a surrogate of this organic material and should be included in the evaluation of trophic status since phosphorus associated with organic material in the water is unavailable for uptake by organisms but is a portion of the total phosphorus analyzed in water samples.

Information presented in Table 3 from an analysis of trophic status in the Adirondacks⁵ illustrates the significance of adding true color to the classification of trophic status. The results are total phosphorus and true color analyses for 1469 Adirondack waters that were sampled by the ALSC between 1984 and 1987.

Just over 50 percent (730) of the Adirondack waters surveyed had high color imparted by organic material, and most of these waters had moderate to high levels of unavailable phosphorus associated with the organic material and part of the total phosphorus fraction. The balance (638) of the waters surveyed are clear, and can be separated into trophic categories, based on phosphorus concentration, as shown in Table 4.

Table 3 True Color as Indicator of Trophic Status in Adirondacks/Catskills				
True Color	Total Phosphorus			Total Lakes/Ponds
	<10	10 - 20	> 20	
≤ 30	314	225	99	638
> 30	76	296	358	730
Total Lakes/Ponds	390 (29%)	521 (38%)	457 (33%)	1,368

As shown in the tables, evaluating the trophic status of Adirondack waters without consideration of true color would lead to 33 percent (457) of the waters being categorized as eutrophic instead of 15 percent (99) of the waters.

Table 4 Lake Trophic Status for “Clear” Waters (True Color > 30)			
	Oligotrophic	Mesotrophic	Eutrophic
Total Phosphorus (µg/l)	< 10	10 - 20	> 20
Total Lakes/Ponds	314 (49%)	225 (35%)	99 (15%)

Since about 75 percent of the water bodies included on the current water quality assessment list for New York State are within the Adirondack Region, true color has been incorporated into the current analysis of trophic status as an indicator of organic material (and associated phosphorus). Adding this information allows clearwater lakes and ponds (true color ≤ 30 mg Pt/l, or simply 30 Pt_u) to be distinguished from

⁵ Sutherland, J. W., S. A. Kishbaugh, J. A. Bloomfield, W. T. Lavery, and F. E. VanAlstyne. 1990. Water Resources and Water Quality in the Adirondack Park. Issue Paper #5e in Volume II, Technical Reports, Commission on the Adirondacks in the Twenty-first Century. Division of Water, NYSDEC, Albany, N.Y. 141 p.

waters with a visible stained appearance (true color > 30 mg Pt/l). In ponded waters with visible color (true color > 30 mg Pt/l), the Secchi depth was not included in the evaluation of trophic condition. If a value for true color was not available, then the soluble organic carbon (SOC) value was used instead. If the SOC was greater than 7.0 mg/l, the Secchi was not used to assess trophic status. Both true color and SOC typically are used to characterize the level of yellow organic (humic and fulvic) acids.

There is one other limitation in the current assessment that must be mentioned. Chlorophyll *a*, although a good indicator of trophic state, was not very useful in the current analysis since relatively few waters (only 30 percent of the 1,931 assessed for trophic indicators) had any chlorophyll *a* data. Most of the water quality data for this assessment were collected by the ALSC during the Adirondack survey, 1984 through 1987, and chlorophyll *a* was not one of the parameters sampled in this program.

The results of the current assessment of trophic status of significant waterbodies are presented in Table 5 and show number of waters and surface area in acres (in brackets) for each category (these area data do not include Lake Ontario).

If it is assumed that an equivalent percentage (in the assessed database) of unassessed lake numbers and lake areas possess color readings less than 30 Pt, then trophic conditions in weakly colored waters are not known for approximately 3200 lakes comprising an area of 230,000 acres.

A total of 884 waters in the current assessment had true color values greater than 30 mg/l Pt, and total phosphorus and Secchi transparency were not used to evaluate the trophic status. Unfortunately, only 165 of these waters had chlorophyll *a* data and could be classified. The results are presented in Table 6.

Table 5 Lake/Pond Condition for Waters with True Color ≤ 30 (1047 Lakes/Ponds covering 428,562 acres)				
Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Total Phosphorus	428 lakes (122,002 Ac)	380 (240,728)	227 (64,904)	12 (928)
Secchi	166 (107,586)	636 (282,493)	163 (37,240)	82 (1,244)
Chlorophyll	64 (65,474)	201 (261,368)	143 (72,184)	639 (29,536)

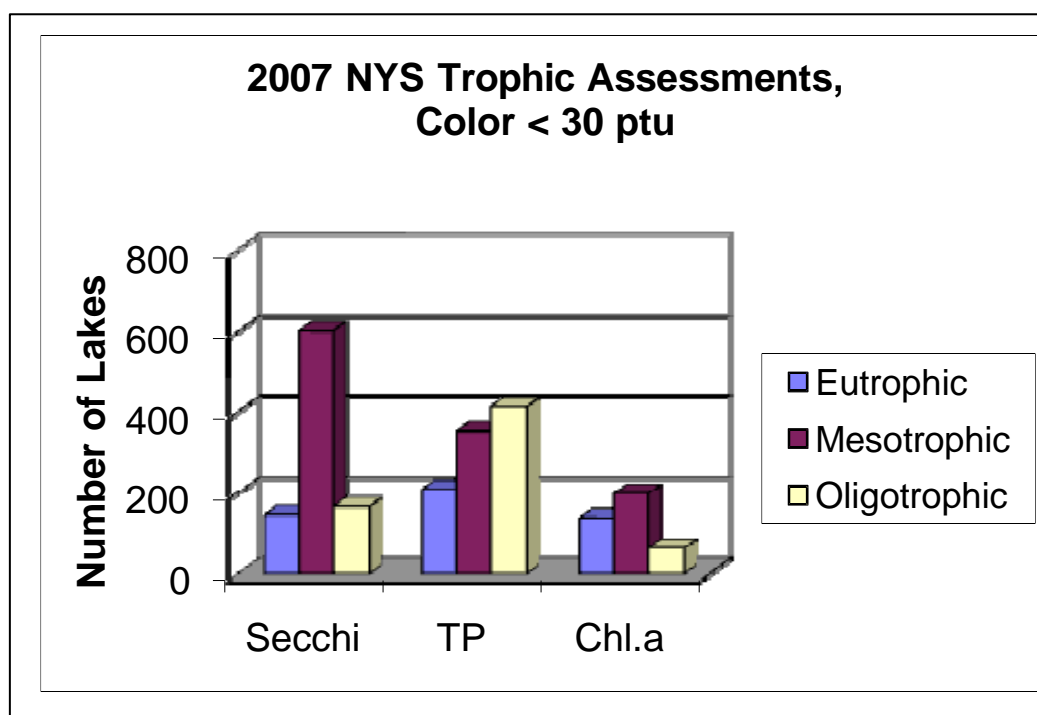
The discrepancy between the totals for some of the assessment indicators in Table 5 is due to the lack of data for some indicators (for example, some lakes were sampled for phosphorus only, or for phosphorus and water clarity only). A total of 228 waters were excluded from the above analyses because true color data were not available. If it is assumed that an equivalent percentage (in the assessed database) of unassessed lake numbers and lake areas possess color readings greater than 30 Pt, then trophic conditions in highly colored waters are not known for approximately 2700 lakes comprising an area of 25,000 acres. The evaluation of trophic status itemized above is presented graphically in Figure 16.

Table 6

Lake/Pond Condition for Waters with True Color > 30

(884 Lakes/Ponds covering 38,376 acres)

Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Chlorophyll	9 (3,953)	81 (9,154)	75 (6,632)	719 (18,637)



In summary, a total of 1,930 waters are included in the current water quality assessment, and about 75 percent of these waters are located in the Adirondack Region of the state. About 54 percent (1047) of the total waters assessed had true color values less than 30 mg/l Pt and these waters

were classified into trophic state using total phosphorus, Secchi transparency, and chlorophyll *a*. There were 227 waters classified as eutrophic based on total phosphorus, 163 waters classified as eutrophic based on Secchi transparency, and 143 waters classified as eutrophic based on chlorophyll *a*. Only 165 of the 884 waters with true color values greater than 30 mg/l Pt could be classified into trophic state at the present time, using chlorophyll *a* data.

The itemization of trophic status for the ELS waters surveyed in New York State is presented in Table 7. As mentioned previously, these data were kept separate from the remainder of the database since the ELS was conducted during the fall instead of during midsummer. Chlorophyll *a* was not determined by the ELS, and so the assessment of trophic status is based upon total phosphorus, Secchi depth and true color. There were 158 of the 240 ELS waters with true color ≤ 30 mg/l Pt and the assessment of trophic state is presented below. Seventy-eight ELS waters had true color values > 30 mg/l Pt and were not assessed for trophic state. True color was missing in 4 ELS waters (surface area = 410.0 acres), and these waters were not included in the current analysis.

Table 7**Lake/Pond Condition for ELS Waters with True Color \leq 30 Ptu****(158 Lakes/Ponds covering 69,262 acres)**

Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Total Phosphorus	99 lakes (58,522 Ac)	20 (4,392)	13 (981)	26 (5,367)
Secchi	41 (53,950)	91 (11,105)	26 (4,206)	0 (0)

It has been determined that at least half of the 240 waters sampled by the ELS also were sampled by some other program in the current dataset.

Water Quality Standards Applicable to Ponded Waters

New York State classifies all surface waters by *best use*, a designation that considers such factors as stream flow, existing water quality, and the past, present and desired uses of the waters and bordering lands. Best use is defined as the use that requires the "cleanest" water and includes drinking waters, swimming, fish (or shellfish) propagation and survival. For example, all surface fresh and salt waters must be safe, at least, for aquatic organisms, all fresh groundwater must be protected for drinking water supply. Although waters are classified to achieve best use, including all uses that require less demanding water quality standards, the best use may not be achievable under current conditions. A summary of New York State Water Quality Classifications is presented in Appendix B of this report. NYSDEC continues to reclassify waters within the state as better information becomes available to aid in this process.

The water quality standards most applicable to New York State lakes are the standards corresponding to pH, and dissolved oxygen, although guidance values and safety requirements on swimming beaches are also applicable to total phosphorus concentrations and water clarity, respectively. While other numeric or narrative water quality standards may be of concern for individual waters within the state, either the existing database does not support broad assessment of the resources of the state for applicable standards (such as bacteria) or the standards are not violated for the vast majority of waterbodies in the state. The state pH standard for all waters Class C or higher is between 6.5 and 8.5. For Class D waters, the pH standard is between 6.5 and 9.5

The state dissolved oxygen standard is as follows: for all but Class D and A-special lakes (none in either category assessed in this report):

"For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/L from other than natural conditions. For trout waters, the minimum daily average shall not be less than 6.0 mg/L, and at no time shall the concentration be less than 5.0 mg/L. For non-trout waters, the minimum daily average shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L".

Evaluation of lake DO data can be confounded by the time of sampling (samples generally collected prior

to June or after September may correspond to destratified lake conditions, in which temperature and oxygen concentrations are usually uniform throughout the water column), depth of the lake (shallow lakes and ponds may not thermally stratify, limiting shifts in DO to the microlayer just above the sediment-water interface, a zone difficult to accurately monitor), and samples collected outside the deepest hole in the lake. It may be most appropriate to evaluate oxygen conditions only in waterbodies sufficiently deep (say > 5 meters) to thermally stratify, during the period in which thermal stratification is stable (generally June through September).

The phosphorus guidance value for Class B and higher waters corresponds to 0.020 mg/L. No such value has been designated for any lakes classified as Class C or lower.

The minimum recommended (by the NYS Department of Health Sanitary Code) water clarity for designated swimming beaches is 4 feet (= 1.2 meters). While this recommendation could apply to all Class B and higher waters (and even to many of the Class C waters that are used for contact recreation), the lack of an inventory of waterbodies with “designated” swimming beaches precludes a strict application of this recommendation. However, the water clarity database will be presented for the purposes of broadly assessing water quality conditions as related to potential for swimming impairments.

Table 8 summarizes the extent to which these standards and/or guidance values have been violated. pH, water clarity, and phosphorus criteria are evaluated against mean values for each analyte, while the dissolved oxygen criteria are evaluated against minimum values within the hypolimnion. While most of the sampling programs include pH, water clarity, and phosphorus among the measured parameters, dissolved oxygen data are either not universally collected (for example, in CSLAP or in some isothermal lakes) or have not been electronically stored (in the ALSC and many other monitoring programs from prior to 1990). It should also be noted that, in many monitoring programs such as the ALSC project, oxygen “profiles” are often limited to discrete samples at a small number of points (usually two) within the water column.

The data in Table 8 suggest that violation of water quality standards and/or guidance values or criteria is common among assessed lakes. The violations of the pH standard and phosphorus guidance value have been discussed above. A relatively small number of lakes have experienced systematic violations of the recommended water clarity readings at swimming beaches. It is likely that a larger percentage of sampled lakes have experienced occasionally low water clarity readings; as such, these figures may not accurately reflect the percentage of lakes in which poor water clarity results in at least some aesthetic and bathing impairments. However, these figures also include some moderately colored waters and a small number of very shallow lakes for which water clarity is measurable (i.e. the Secchi disk is not visible while sitting on the lake bottom) but is nonetheless adversely affected by lake depth. In other words, these figures also include some waterbodies for which water clarity may not be an accurate “water quality” indicator. Table 8 also suggests that, at least among the relatively small number of assessed waterbodies, dissolved oxygen standards are commonly violated, and anoxic conditions (functionally defined as DO readings < 1 mg/l to account for inaccuracies in very low level dissolved oxygen measurements and the lack of DO data within the last meter or two of water depth immediately above the sediment-water interface) are routinely experienced. This table shows that **more than 70% of assessed waters that are thermally stratified experience hypoxia in the hypolimnion**. There has been much discussion about the occurrence of “natural” DO depletion in lakes due to morphometry and focusing. Without sediment coring data for the vast majority of these lakes, it is impossible to separate out natural and culturally induced DO depletion in these lakes. It must also be conceded that Table 8 reflects a database (mostly publicly accessible, moderately sized, moderately high profile LCI lakes, often with some pre-sampling evidence of water quality problems that led to its inclusion in the monitoring program) that may not be fully representative

of the “typical” NYS lake. However, the high percentage of assessed lakes experiencing hypoxic conditions suggests that this phenomenon needs to be far more closely monitored and evaluated. The NYSDEC will devote significant effort in the upcoming 305b cycle to fully assessing the existing (electronic and hard copy) dissolved oxygen database, recognizing the limitations inherent in comprehensively evaluating the paucity of full profile data, as well as a renewed effort to collect additional full water column profiles in all subsequently sampled lakes

Table 8 Statewide Assessment of Lake Water Quality						
Water Quality Indicator		Water Quality Criterion	Percent of All Lakes that: (Percent of Assessed Lakes that:)			
			Violate Standard	Meet Standard	Sampled, but Not Assessed**	Sampled, but Not for this Indicator
pH	Lower	6.5 SU	44%	56%	< 1%	< 1%
	Upper	8.5 SU	1%	98%	< 1%	< 1%
Dissolved Oxygen	Trout Waters	5.0-6.0 mg/l	7% (71%)	5% (29%)	83%	6%
	Non-Trout Water	4.0 mg/l	7% (75%)	2% (25%)	82%	10%
	Hypoxia*	4.0 mg/l	7% (71%)	3% (29%)	83%	8%
	Anoxia*	1.0 mg/l	--- (59%)	--- (41%)		
Total Phosphorus (Class B and higher)		20 µg/l	30%	68%	< 1%	2%
Water Clarity (Class B and higher)		1.2 m	7%	83%	10%	< 1%
* Analysis limited to thermally stratified lakes sampled from June through September. ** Dissolved Oxygen data for these lakes have either not been converted to electronic formats or were not collected as part of depth profiles, thus limiting their utility. It is anticipated that subsequent editions of the 305(b) Report will include these data.						

New York State Lake Programs

Lake water quality monitoring by New York State is currently being conducted by the NYSDEC and includes the following ongoing components: The Citizens' Statewide Lake Assessment Program (CSLAP), the Lake Classification and Inventory (LCI) Survey, the Lake Champlain Monitoring Program, and special studies

involving acid rain, lake use impairment, USEPA Clean Lakes projects, special projects as related to local, short-term problem assessment, and other miscellaneous activities. The NYSDEC Inland Lakes and Freshwater Section also works jointly with other institutions in other contemporary or recently completed lake monitoring projects, including the Adirondack Effects Assessment Program (AEAP, with RPI and others), Finger Lakes Monitoring (with UFI), the Environmental Monitoring and Assessment Program (EMAP, with USEPA, USFWS, and others), and stormwater monitoring of tributaries to several NYS lakes, including Lake George and several NYC reservoirs.

The *Citizens' Statewide Lake Assessment Program* was started in 1986 and is a scientific and educational program in which citizen volunteers are trained to collect water quality information. The program is a cooperative effort between the NYSDEC and the Federation of Lake Associations, Inc., a coalition of organizations dedicated to the preservation and restoration of all lakes, ponds, and rivers throughout New York State. During 2007, there were about 225 lakes and ponds associated with the program, although only about 90-100 are actively sampled in any particular year. Biweekly sampling begins in mid-June and continues for 15 weeks through early October. Water quality data collected as part of the program include Secchi disk transparency and the following chemical parameters: total phosphorus, nitrate-nitrogen, true color, pH, specific conductance, and chlorophyll *a*. At some lakes, dissolved oxygen, lake level, amount and pH of precipitation, and aquatic plant populations also are assessed. Volunteer monitors also complete user and (since 1992) field perception surveys, the latter of which are cross-referenced against instantaneous water quality data collected to provide a linkage between public opinion and measured eutrophication parameters. These linkages are being utilized to develop phosphorus guidance values serving as the endpoint in the revision of aforementioned phosphorus effluent TOGS.

The *Lake Classification and Inventory Program*⁶ was initiated in 1982. Each year, approximately 10-25 water bodies are sampled in a specific geographic region of the State. The waters selected for sampling are considered to be the most significant in that particular region, both in terms of water quality and level of public access. Samples are collected for pH, ANC, specific conductance, temperature, oxygen, chlorophyll *a*, nutrients and plankton at the surface and with depth at the deepest point of the lake, four-seven times per year (with stratified lakes sampled more frequently than shallow lakes). Sampling generally begins during May and ends in October. This project had been suspended after 1992, due to resource (mostly staff time) limitations, but was resumed on a smaller lake set beginning again in 1996. Since 1998, this program has been geographically linked with the Rotating Intensive Basin Sampling (RIBS) stream monitoring program conducted by the NYSDEC Bureau of Watershed Assessment. LCI sites are chosen within the RIBS monitoring basins (Susquehanna River basin in 2003, Long Island Sound/Atlantic Ocean and Lake Champlain basins in 2004, Genesee and Delaware River basins in 2005, the Mohawk and Niagara Rivers basins in 2006, Upper Hudson River and Seneca/Oneida/Oswego Rivers basins in 2007, and the Lake Champlain, Lower Hudson River, and Atlantic Ocean/Long Island Sound basin in 2008) from among the waterbodies listed on the NYS Priority Waterbodies List for which water quality data are incomplete or absent, or from the largest lakes in the respective basin in which no water quality data exists within the NYSDEC database. Sampling via this program is also conducted in two-year intervals, with limited (1-2x) sampling in the first year for lakes without water quality data, and monthly for NYS PWL lakes for which data are incomplete. These are referred to as “mass attack” and “rotating basin” sampling, respectively, after the RIBS stream sampling model (to complete the model, the NYS ambient lakes monitoring program considers the CSLAP and Finger Lakes dataset to be the “fixed site” or “index lake” network sites).

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New York State Department of Environmental Conservation. 1982. New York State Lake Classification and Inventory Annual Report - 1982. Bureau of Water Research, Albany, N.Y.

New York State Lake Restoration Efforts

NYSDEC does not have an organizational unit that is responsible for statewide lake management. However, within the Division of Water, the Inland Lakes and Freshwaters Section (ILFS) comes the closest to fulfilling that responsibility. The ILFS (previously referred to as the Lake Services Section, or LSS) consists of five scientists, three engineers, one technician, and associated support staff (from the NYSDEC regions) who work on various aspects of lake management. The ILFS is responsible for administering the Federal Clean Lakes Program and equivalent State-funded projects. In recent State Fiscal Years, the latter consisted of projects exceeding \$1 million, affecting more than 50 lakes. The State-funded projects are not part of a competitive grants program, but rather the State legislature determines annual eligibility for funding. The ILFS staff is then responsible for working with the locality to prepare a Program Narrative, developed with the guidelines contained in the Federal Clean Lakes Rules and Regulations. A second difference between the Federal and State programs is that monitoring, diagnosis, feasibility, and implementation can all be conducted simultaneously by the locality. The State program has no requirement for phased design and implementation.

The ILFS staff also assists local governments in the conduct of specific State and Federal Clean Lakes Projects. They also are responsible for carrying out all the lake monitoring for NYSDEC (except for fish sampling). The LSS staff also acts as a liaison to the public for lake-related matters and are involved in the preparation of Lake Management Plans for specific lakes. This responsibility has necessarily been reduced by the limited scope of the Federal Clean Lakes Program in recent years.

In most lake restoration projects, a cooperative agreement between the public and governmental agencies must be reached to ensure success. Working relationships between federal (USDA-SCS, USEPA), state (NYSDEC, NYSDOH), county planning or environmental management councils, health, lake protection and preservation districts, and local offices all contribute to the management of the lake and surrounding watershed.

Restoration Techniques

The techniques used for lake restoration can be categorized as in-lake treatments and watershed management programs. Watershed management involves the implementation of methods to reduce nutrients and/or sediments from entering the lake. This requires the identification of the problem(s), assessment of the magnitude of the problem(s), and the development of management practices/controls to mitigate the controllable problem(s). Most restoration projects consist of a combination of in-lake and watershed management techniques in order to achieve long-term benefits.

In-lake restoration techniques are typically applied after nutrient reduction or diversion plans have been accomplished. The purpose of employing in-lake restoration techniques is to remove the sediments and/or nutrients to reduce algal blooms, reduce the nuisance growth of aquatic plants and eliminate oxygen depletions in the deeper waters. The method selected will be determined in large part by what is causing the water quality impairment. In some instances, the use of multiple restoration methods may be required.

The following is a discussion of in-lake restoration techniques that have been conducted in New York State through USEPA Clean Lakes Phase II projects or other lake management efforts. The list is ranked by the frequency of use as a restoration technique, although it is likely that locally funded and sponsored projects

utilize some techniques such as drawdown and mechanical weed harvesting more frequently. Several techniques which have not been utilized within the State Clean Lakes process, but to some extent via “private” projects, include lake aeration/circulation, dilution/flushing, and biological controls, such as sterile grass carp. These techniques will be discussed at the end of this section. The use of aquatic herbicides and algaecides has not been associated with any Clean Lakes projects, although these lake management strategies have been commonly utilized by lake communities and managers.

Physical or Mechanical Techniques

Dredging has been used more frequently in New York than any other type of in-lake physical restoration technique, with the possible exception of drawdown. Used in conjunction with diversion or measures to reduce siltation upstream, dredging removes the sediments that may continue to be a significant source of nutrients to the overlying water column. This technique is also useful to control aquatic plant growth by the reduction in light penetration to the deeper waters.

There are two types of dredging for lake restoration projects, hydraulic and dry excavation. The method selected will depend upon the degree of treatment required, lake morphology, whether the lake can be drained properly and cost. The use of dry excavation has been utilized on eight Phase II projects in New York State, while hydraulic dredging has been used on two other Phase II restoration or demonstration projects since 1976. Smaller scale dredging activities have been conducted on many more small NYS lakes.

The disposal of the spoils from the dredging operation, the disruption of the littoral zone and benthic fauna and flora, destruction of wetland habitat (including the submergent vegetation), increased turbidity to the surrounding waters and possible impairment of use during the dredging operation all have increased the difficulty of obtaining the necessary environmental permits that are required to initiate new projects. Restrictions on the location of new spoils area and new, more restrictive weight limits for dump trucks also have contributed substantially to an increase in the costs of these projects.

The benefits derived from a dredging project generally are considered to last longer than the benefits derived from other lake restoration techniques, thus ameliorating the cost differences.

Small-scale dredging projects, particularly drawdown excavation, are much more common than in-lake or hydraulic dredging projects in New York State, although navigational dredging (to deepen a waterway to open or enhance navigation) and dredging to clean up contaminants is more common in river systems and some portions of lakes. These projects including dredging on the Great Lakes and Cumberland Bay in Lake Champlain, and Collins Lake. Excavation dredging was performed at Belmont Lake in Long Island for the control of fanwort in the early 1970s, and a number of lakes in the past (Central Park Lake, Hyde Park Lake and Van Cortlandt Park Lake in New York City, Steinmetz Lake in Schenectady, Delaware Park Lake in Buffalo, Washington Park Lake, Tivoli Lake, Buckingham Lake, and Hampton Manor Lake in the Albany area, Scudders Pond in Long Island, etc.). Navigational dredging was conducted in Glen Lake in 2006. There have also been proposed dredging projects (Lake Montauk, Lake George, Cuba Lake, Tannery Pond, Quaker/Red House Lake, etc.) in recent years for navigation or water quality improvement rather than for weed control. The removal of sediment as a medium to enhance weed growth (and water deepening) may result in reduction in nuisance weed growth. Projects associated with the federal Clean Lakes program are described below.

Phosphorus precipitation/inactivation is also used in conjunction with nutrient diversion or reduction. The degree of treatment, i.e. the amount of chemical applied, determines which method is being utilized. Phosphorus precipitation is employed when the lake sediments are not a significant source of nutrients. Phosphorus inactivation is used in all other applications.

The object of phosphorus precipitation is to add enough chemical to bind with the soluble phosphorus in the water column, forming a chemical floc which then settles to the bottom. Phosphorus inactivation not only strips the phosphorus in the water column, but enough additional chemicals are applied to form a barrier on top of the sediments that inhibits the release of phosphorus back into the water. The expected benefits from phosphorus inactivation may last several years.

Alum is the chemical most often used for phosphorus precipitation/inactivation. The addition of alum will lower the pH of the water, through a series of chemical reactions. If the pH is lowered below 4.5, the aluminum can be solubilized and create a toxicity problem to fish and invertebrates. The dosage rates of alum have to be carefully determined and monitored during the application to maintain the pH above 4.5.

In New York, Saratoga Lake and Irondequoit Bay have been treated with alum in an experimental manner to determine its effectiveness in phosphorus inactivation. The Irondequoit Bay, treated during the summer of 1987, has increased water clarity, reduced levels of chlorophyll *a* and lowered phosphorus levels within the hypolimnetic waters. The long-term effect on the recycling of nutrients from the sediments will be determined by further monitoring. There was no appreciable improvement in the water quality in Saratoga Lake as a result of the alum application. This was due to the small treatment area and low application rates. An experimental low-level alum treatment is presently (2001 onward) being conducted (and closely monitored) in Kinderhook Lake. This technique will be utilized more often in the future, possibly to replace dredging in certain cases due to costs and environmental considerations. It may be especially well suited in small lakes or ponds to control algal blooms, provided these lakes have significant internal nutrient loading.

Lake-Level Drawdown has been used to control the growth of aquatic vegetation in near shore areas where lake levels can be controlled. Since drawdown affects only plants growing near shore, it is often utilized in conjunction with other in-lake restoration techniques. The control of vegetation is achieved through the freezing action on the exposed sediments during the winter months. Not all vegetation responds to the freezing action in the same manner. While some species may be affected negatively, others may not be affected at all, or may actually increase in abundance.

Drawdown during the winter months also allows ice scouring to disrupt the roots of plants. The exposed soils are compacted and much of the fine-grained organic materials are removed to deeper waters. Another advantage of this technique is that it requires little or no expense.

In addition to possible shift in aquatic plant species, drawdown can result in increased turbidity and/or algae blooms. The turbidity increase is usually the result of a lack of vegetation along the shoreline which acted as a buffer to the wave energy. Lowering of the lake during the winter months may also result in a fish kill if an insufficient amount of water volume remains. Lake levels

need to be restored to near normal by spring to provide adequate fish spawning areas. Finally, lake residents are often concerned that the lake will not reach its normal lake level by summer. There is no guarantee that adequate runoff will fill the lake by the time people want to use it.

Drawdown has been commonly utilized at many New York State lakes, most often for benefits not associated (or directly geared toward) aquatic plant control. The NYS lakes for which drawdown was used as a weed control method include Galway Lake (Saratoga County), Saratoga Lake, and Greenwood Lake (on the New Jersey/New York border), and some of the lakes in the Fulton Chain of Lakes (interior Adirondacks) for controlling Eurasian watermilfoil, Forest Lake in the southern Adirondacks to control Elodea and pondweed, and Minerva Lake (southern Adirondacks) for the control of native plants. Most of these have been fairly successful, although immediately after drawdown a different mix of invasive plants have often colonized and dominated the aquatic plant community before the lakes reached equilibrium after a few years. For example, the dominant plants in Robinson Pond (Columbia County) shifted from Eurasian watermilfoil to bushy pondweed after the lake was regularly drawn down (for maintaining fisheries habitat downstream rather than for weed control), although this shift reversed several years later..

Mechanical Aquatic Plant Harvesting is restricted to applications where macrophyte growth impairs the use of the lake. The aquatic harvesters cut and remove vegetation below the surface of the water and transport the biomass to a conveyor for disposal away from the lake. Although the plants will grow back, some species requiring several harvests during a growing season, this technique removes the vegetation and associated nutrients from the lake. There also is evidence that the long-term harvesting, especially late in the season, causes some disruption to the growth cycle of some species of plants.

Although harvesting is only a temporary solution to vegetation problems and generally is not fundable as a sole restoration technique through the Clean Lakes Program, it has been used on the Saratoga Lake project in conjunction with other lake restoration techniques and watershed management programs. In fact, this technique is the most commonly used short-term method of vegetation control by lakes in this State, whether done “formally” with full-sized mechanical harvesters, informally with cutting bars and hand removal of floating plants, or individual cutting with plants removed from downwind shorelines.

Mechanical harvesters have been seen on lakes large and small throughout the state for many years, although in recent years the use of herbicides has largely superseded harvesting as the most common means for “whole lake” control of nuisance plants. While the use of harvesters in New York State dates back at least to the 1950s, the most significant regional activities originated with the advent of the Aquatic Vegetation Control Program in the Finger Lakes region in the late 1980s. In this program, state (member item) funds were provided to several counties in the Finger Lakes Region to conduct a variety of lake management activities. In some counties, this included the purchase of mechanical weed harvesters or harvesting services for several Finger Lakes, embayments to Lake Ontario, and some smaller waterbodies in these counties. The harvesting program at Chautauqua Lake has been used to evaluate nutrient removal from harvesting operations. Large lakes outside of the Finger Lakes region that have been harvested

include Lake Champlain and Oneida Lake (for water chestnut) and Greenwood Lake (for Eurasian watermilfoil). A statewide inventory of lakes that utilize mechanical harvesters has not been compiled, in large part due to the lack of regulatory oversight (and therefore a paper trail of permits) in most parts of the state.

Another type of mechanical harvesting, suction harvesting, utilizes divers, hoses, and a pump to create suction to remove aquatic plants. This technique is relatively new but may provide longer term control of vegetation by removing the roots as well as the plants. The process of having diver(s) remove aquatic plants by suction hoses is more selective at removing only the nuisance species, thus leaving the native plants to recolonize the disturbed area. The removed plants and roots are discharged to a collection basket where they are then properly disposed of.

Suction harvesting is a slow and expensive operation when compared to mechanical harvesters but is ideally suited as a secondary treatment when combined with rotovating or dredging and for new infestations of exotic plants. This technique has been used in several lakes in New York, including Lake George, East Caroga Lake and Saratoga Lake. Results from these studies indicate suction harvesting to be an effective means for controlling weed populations when applied under the appropriate circumstances.

Rotovating (also called rototilling) is a relatively new form of mechanical control for aquatic vegetation that uses a rototilling machine to cut and dislocate aquatic plants and roots from the sediment, and then removes the cut plants from the lake. **Hydroraking** is essentially the same technique that uses a mechanical rake and collects and removes some of the cut material.

A rototilling machine is usually mounted on a barge. The machine has a large rotating head with several protruding tines that churn up the sediments, dislodging the roots and plants. The rotating head can be easily positioned with a hydraulic boom winch and winch cable (as hydroraking). The plants are either brought up on the rotator and disposed of on shore, or the floating vegetation is raked up for proper disposal.

There is only a short history of the use of rotovating and hydroraking in New York State, and specific examples have not been documented for any New York State lakes, although rotovating is being used at an increasing frequency in small plots in much larger lakes, particularly in the Finger Lakes region and in western NYS. It is believed that much small scale rotovating- outside individual properties- occurs under the regulatory radar screen, brought to the attention of regulatory agencies only through the vigilance of concerned neighbors

Aeration/Artificial Circulation have been used in other state Clean Lake projects to alleviate depleted oxygen in the hypolimnion with limited success. These two techniques have not been used on any Clean Lake projects in New York, although they have been utilized in privately funded work. Aeration introduces oxygen to the hypolimnion without disrupting the temperature gradients, while artificial circulation mixes the entire water column. This latter treatment is not recommended in lakes where cold water fish species are present.

The use of imported water to replace existing lake water is referred to as dilution or flushing techniques. The objective is to exchange the high nutrient waters with water that is low in nutrients. The use of groundwater or nearby streams with low nutrient concentrations are sources for flushing. The lack of sufficient water of desirable quality and the cost of operation

and maintenance limit the use of this technique.

Shading involves the use of chemical dyes to inhibit light penetration to the lake bottom, ultimately controlling the growth of nuisance aquatic vegetation in areas greater than two to four feet deep. These non-toxic vegetable dyes work by reducing light penetration in the water ("shading"), and by the absorption of wavelengths within the photosynthetically active region of light. Absorbing these wavelengths prevents the plants from photosynthesizing and growing.

The dyes treat the entire waterbody and are usually not used on large lakes due to cost limitations. Dyes are most effective in small waterbodies with little or no flow where the appropriate concentration can be maintained. The duration for treatment for either large or small lakes is a function of water retention time. Dyes will be significantly and quickly diluted or washed downstream in lakes with inflow and outflow.

There is little historical information on the use of shading agents in New York State lakes, although they have been commonly used on ponds, particularly golf course and ornamental ponds, for many years. Perhaps the only large-lake experiments involving lake dyes was in Adirondack Lake in the late 1980s.

Chemical Techniques

Aquatic Herbicides and Algicides have been utilized for the control of nuisance aquatic plants; *herbicides* have been used to reduce populations of excessive rooted aquatic macrophytes, while *algicides* have been used to control nuisance algae growth (including macroalgae such as *Chara*). Herbicides are available in liquid or granular form, utilizing a variety of formulations and active agents. Some herbicides elicit toxic reactions to the plant leaves and/or root structure, while other herbicides disrupt the photosynthetic or metabolic processes in plants. Algicides control algae by toxicity. While algae control has required primarily whole-lake treatments, herbicidal control of nuisance weeds has occurred as both spot and whole-lake treatments. Treatment duration, effectiveness, and selectivity are largely functions of the choice of herbicide, extent and type of plant coverage, bottom sediment structure, hydrologic characteristics of the lake, and other factors.

The primary aquatic herbicides registered for use in New York State are 2,4-D, Endothall (and other like formulations), Diquat, Rodeo, and Sonar. While herbicide treatments have historically focused on a variety of nuisance native and exotic submergent and emergent plants, much attention in recent years has been focused on exotic submergent species, primarily *Myriophyllum spicatum* (Eurasian water milfoil). Sonar, a fluridone-based compound utilized in other states for control of *M. spicatum* (and other nuisance macrophytes), was permitted for use in New York state in 1995, and has been utilized increasingly for the control of *M. spicatum* in NYS lakes (at least 40 lakes larger than 25 acres), although not in any lakes utilizing Clean Lakes funding. However, 2,4-D, and other herbicides have a long history of use for controlling Eurasian water milfoil throughout the state. Algicides are primarily formulations of copper-based compounds. Both herbicides and algicides are regulated through an extensive licensing and permitting process by the NYSDEC.

Most of the New York State lakes treated with aquatic herbicides have not been closely studied either before or after treatment. The most closely monitored lakes include Waneta Lake in Schuyler County and Snyders Lake in Rensselaer County, both infected by Eurasian watermilfoil. Permits have been issued for aquatic herbicides in nearly every part of New York State. In fact, upwards of 500 permits are issued annually, not including purchase permits for small farm ponds. However, in some regions of the state, such as the Adirondacks, no aquatic herbicide permits have been issued. The myriad of reasons include overlapping regulatory authority (the DEC and the Adirondack Park Agency), strong sentiments about the use of herbicides, the presence of and concern for protecting rare and endangered species, and the lack of historical precedent in the use of many aquatic plant control strategies (due in part to the historical lack of problems with invasive plants). A paucity of permits is also the case for lakes in other regions of the state used for potable water intake or encompassing wetland areas, since the permitting rigor is often more significant in these waterbodies. On the other hand, many lakes in the downstate region have been treated with aquatic herbicides.

Copper sulfate has been used for many decades on many New York State lakes- some on an annual basis- and each year is used on more than 300 lakes and ponds throughout the state (mostly small ponds less than 3 acres in size). Most of these small pond treatments have not been well documented, although the NYSDEC has conducted a study of relatively small lakes with persistent copper sulfate treatments.

Biological Techniques

Herbivorous fish control of nuisance aquatic plants has been used for several years on small NYS ponds and lakes, and in the last few years on larger lakes with control structures, though there have been no treatments through the Clean Lakes Program. The use of sterile hybrid grass carp (*Ctenopharyngodon idella* x *Hypophthalmichthys nobilis*) was approved in New York on June 1, 1990, for waterbodies less than five acres, having no inlet or outlet and which lie wholly within the boundaries of the individuals requesting a permit. Up to 15 certified triploid grass carp per acre will be allowed where submergent vegetation and/or duckweed (*Lemnaceae*) occupy over 30% of the water's surface area and significantly impair the intended use of the waterbody. A more rigid permitting process is utilized for applications in larger lakes.

There have been literally thousands of permits issued by the DEC for the use of grass carp since 1991; the vast majority of these are for very small (< 1 acre "farm") ponds with no inlet or outlet and a single landowner. The majority of the stockings appear to be in Finger Lakes region and western New York (nearly 1000 every year), and in the downstate region (nearly 500 per year). The effectiveness of these stockings has not been documented. The grass carp stocking and aquatic plant response of Walton Lake in Orange County, one of the original (experimental) stockings in the state, has been documented by the DEC Division of Fish and Wildlife. Information about other stockings is largely anecdotal.

Biomanipulation is another restoration alternative that has not been widely used but may prove useful in some situations. The objective of this technique is to control the growth of algae by increasing the populations of zooplankton which graze on the algae. This is accomplished by reducing or eliminating small fish which feed on the zooplankton by increasing predation or restocking.

Although biomanipulation has been commonly used in New York State as a fisheries management tool, it has not been regularly utilized or documented as a lake management activity to restore or enhance water quality conditions. For example, rotenone has been used within the Adirondacks to restore native brook trout (by removing other fish that outcompete the brook trout), but this undertaking was not intended to improve water quality. Biomanipulation has largely been limited to either accidental introductions of exotic species (such as zebra mussels or Eurasian watermilfoil) or unintended results from the introductions of fish such as alewives in Conesus Lake. A small scale biomanipulation project has been conducted at Lake Neatahwanta

Herbivorous insects have been increasingly used in NYS lakes to control the growth of nuisance levels of *Myriophyllum spicatum*. Although several different herbivorous insects have been implicated in natural crashes of Eurasian watermilfoil through North America, only two have been reared and stocked in NYS lakes. *Euhrychiopsis lecontei*, the milfoil weevil, is native to many NYS lakes and is stocked commercially by a private company in Ohio. Adult weevils live submersed and lay eggs on milfoil meristems. The larvae eat the meristem and bore down through the stem, consuming the cortex, and then metamorphose lower on the stem. The consumption of meristem and stem mining by larvae are the two main effects of weevils on the plant and this damage can suppress plant growth, reduce root biomass and carbohydrate stores and cause the plant to sink from the water column (information from Ray Newman, University of Minnesota, Department of Fisheries and Wildlife). The milfoil weevil has been stocked in six NYS lakes since 1998. At present there do not appear to be any NYS stocked weevil populations that have become self-sustaining or have been demonstrated to adequately reduce Eurasian watermilfoil populations, although these lake stockings continue to be watched. There is some evidence that native populations of *Euhrychiopsis lecontei* have caused a crash in Eurasian watermilfoil in Findley Lake.

The milfoil moth, *Acentria ephemerella*, has been cited as the cause of a substantial crash of Eurasian watermilfoil in the northern end of Cayuga Lake. Although not native to NYS lakes, it has effectively become naturalized in many lakes since the late 1920s and is now found in most surveyed NYS lakes. The moth caterpillars use their silken thread to bind milfoil's feathery leaves into individual nests (larval retreats), effectively halting growth of the plant stems. The moth has been introduced experimentally on a small scale into Dryden Lake and on a larger scale into Lincoln Pond. Commercial or other non-experimental stocking activities have not yet been conducted.

Although recent surveys have indicated that both the milfoil weevil and moth are found in most surveyed New York State lakes, the history of herbivorous insect stockings in New York State lakes dates back only to the late 1990s. Aquatic weevils have been stocked in small plots in several small New York State lakes, including Lake Moraine in Madison County, Sepasco Lake in Dutchess County, Findley Lake in Chautauqua County, and Millsite Lake in Jefferson County, as well as an experimental stocking in Saratoga Lake. Each of these projects has exhibited some very limited successes, but in no cases have migration out of the treatment plots, or long-term reductions of milfoil beds, been observed. This has been closely monitored for several years, although longer-term successes have also not been observed.

Current and Completed Clean Lakes Projects

Over the past 20 years the Department of Environmental Conservation, under the Federal Clean Lakes Program (Section 314 of the Federal Clean Water Act), has conducted 26 lake management and restoration projects on *public* lakes. The various projects cover almost every aspect of lake management from vegetation harvesting to the control of agricultural runoff. Since 1983, NYSDEC, through its Inland Lakes and Freshwater Section, also has supervised nearly 80 additional projects, financed solely with State funds, amounting to almost \$15 million dollars. These projects, conducted in areas that comprise over 75 percent of the State's population, have improved the use of lakes and ponds as water supplies, and for swimming, fishing, and water-based recreational activities.

The Clean Lakes program is broken down into two components, Phase I and Phase II cooperative agreements. Phase I projects are the diagnostic/feasibility studies to determine a lake's quality, evaluate possible solutions to existing pollution problems and recommend a feasible program to restore or preserve the quality of the lake. A Phase II project is undertaken to implement the recommended methods for controlling pollution entering the lake, and to restore the lake. Applications to the U.S. Environmental Protection Agency (USEPA) for a Clean Lakes project must be made by the NYSDEC. The proposal to conduct a Phase I or Phase II project can be submitted to the NYSDEC by any government entity for a public water body.

Federal cost-sharing for Phase I projects are 70 percent of the total budget, with a maximum Federal grant of \$100,000. Phase II grants are 50/50 cost sharing, with no maximum limit. The match to the Federal grant can be composed of state and/or local monies which are not being matched to any other Federal program.

Prior to 1980, USEPA funded Demonstration projects that were similar, in scope, to the present Phase II projects. New York completed seven of these demonstration projects before the regulation was adopted that established the present Clean Lakes program. Since that time, the State has completed ten Phase I studies, four Phase II projects, and currently has five Phase II programs that are active.

During 1994, the Department submitted six new Phase I applications and one Phase II grant application to USEPA. USEPA Region 2 recommended that one of the Phase I applications be funded while no Phase II studies or other Phase I grant applications be awarded. USEPA Region 2 also recommended funding the state lake water quality assessment grant, used to fund some of the aforementioned monitoring activities. Since funding for Section 314 projects has been eliminated, no additional Phase I or Phase II applications have been submitted to the USEPA since 1994, and some activities funded under the Water Quality Assessment Grant have been transferred to the Nutrient Assessment program.

The following is a summary of the completed and ongoing Clean Lakes projects.

I. Demonstration Projects.

- A. *Washington Park Lake and Buckingham Lake, City of Albany* (\$46,500 Federal, \$46,500 Local). Project completed in 1978. Lakes were dredged of accumulated bottom sediments to restore water depth.
- B. *Hampton Manor Lake, Town of East Greenbush* (\$50,000 Federal, \$50,000 Local). Project completed in 1979. Project consisted of hydraulic dredging to increase water depth.
- C. *Steinmetz Lake, City of Schenectady* (\$36,680 Federal, \$36,680 Local). Project completed in

1979. Restoration consisted of dredging of bottom sediments to increase water depth and to reduce aquatic plant growth.

- D. *Tivoli Lake*, City of Albany (\$202,645 Federal, \$202,645 Local). Project completed in 1981. Restoration included dredging contaminated sediment, diversion of stormwater runoff around the lake, rehabilitation of the earthen dam and establishment of wetland wildlife areas. The Lake was restocked with Largemouth bass, and presently is the only "natural" city park in upstate.
- E. *Central Park Pond*, City of New York (\$498,000 Federal, \$498,000 Local). Project completed in 1981. Project consisted of dredging of accumulated sediment, rehabilitation of inlet and outlet structures and improvement of shoreline riprap. The purpose of the project was to increase water depth, as the pond is in a high use area of Central Park, Manhattan.
- F. *Scudder's Pond*, Village of Sea Cliff, and Glen Cove (\$50,000 Federal, \$50,000 Local). Project completed in 1982. Restoration included dredging of accumulated sediment, and construction of sediment traps to treat surface runoff. The pond is part of an environmental recreation area and is used for fishing.
- G. *Ann Lee Pond*, Albany County (\$98,246 Federal, \$98,246 Local). Project completed in 1982. Restoration measures consisted of hydraulic dredging to increase water depth, and repair of the outlet dam. The pond is now used for fishing and is the focus of a wildlife area.

II. Completed Phase I projects

- A. Lake Champlain, NYSDEC (\$234,860 Federal, \$100,654 State). Project period from 6/26/89 to 12/30/93. A cooperative Phase I diagnostic/feasibility study with the State of Vermont, completed as merger with Lake Champlain Management Plan.
- B. Otsego Lake, SUNY Oneonta (\$100,000 Federal, \$50,000 Local). Project period from 7/22/91 to 6/30/97. A diagnostic/feasibility study examining nutrient inputs from the watershed and develop management plan to maintain current water quality.
- C. *Upper Saranac Lake*, NYSDEC and the Upper Saranac Lake Association (\$100,000 Federal, \$136,000 State). Project period from 10/1/94 to 9/30/96. A diagnostic/feasibility study examining nutrient inputs and development of a management plan for the lake and its watershed.
- D. *Chautauqua Lake*, Chautauqua County Planning Dept. (\$100,000 Federal, \$50,000 Local). Project period from 7/22/91 to 4/30/97. A diagnostic/feasibility study examining nutrient inputs and develop management plan to reduce eutrophication in lake.

III. Completed Phase II Projects (Phase I project completed prior to implementation).

- A. *Hyde Park Lake*, Niagara County (\$894,667 Federal, \$894,667 Local). Project completed in 1984. Restoration included dredging of accumulated sediment, excavating the inlet and outlet tributaries, and providing for a source of clean make up water for dilution. The lake is in the only park in the City of Niagara Falls, and is used for boating, fishing, and aesthetic enjoyment.
- B. *Delaware Park Lake*, City of Buffalo (\$3,741,500 Federal, \$2,000,000 State, \$1,741,500 Local). Project completed in 1985. Restoration included diversion of the incoming stream around the Lake, rerouting of storm sewers, and dredging to remove accumulated sediment. The Lake is in a major city park and is used for fishing, boating and aesthetic enjoyment.
- C. *Lake Ronkonkoma*, Suffolk County (\$335,572 Federal, \$335,572 Local). Project completed in 1986. Project consisted of public land acquisition, and the development of a management

plan for the lake and its watershed. Two experimental biofilters for treating stormwater were constructed and evaluated as part of the project.

- D. *Iroquois Lake*, City of Schenectady (\$290,747 Federal, \$240,000 State, \$50,747 Local). Project completed 1987. Restoration consisted of dredging for deepening and vegetation control, stormwater diversion and sealing of the bottom with clean fill. The Lake was restocked with fish and is used for boating, fishing, and aesthetic enjoyment.
- E. *Irondequoit Bay*, Monroe County (\$329,743 Federal, \$165,000 State, \$164,743 Local). Project period 6/1/85 to 12/21/89. Project consisted of alum addition for the control of phosphorus release from deep anoxic sediments. Monroe County also has developed a management plan for reducing urban and agricultural runoff impacts from the Lake's watershed.
- F. *Belmont Lake*, NYSOPR&HP, Suffolk County (\$290,000 Federal, \$290,000 State). Project period 9/1/83 to 12/21/89. Restoration consists of removal of accumulated bottom sediment for control of the exotic plant fanwort (*Cabomba caroliniana*). The Lake is used extensively for boating, fishing, and aesthetic enjoyment.
- G. *Saratoga Lake*, NYSDEC, Saratoga County (\$339,241 Federal, \$180,000 State, \$159,241 Local). Project period 6/1/84 to 5/31/89. Project consists of water level control, agricultural runoff controls, aquatic vegetation harvesting, alum addition for nutrient inactivation, and formation of a lake management district. The Lake is an excellent warm water fishery with a severe infestation of Eurasian watermilfoil (*Myriophyllum spicatum*).
- H. *Van Cortlandt Park Lake*, City of New York (\$88,759 Federal, \$88,759 Local). Project period 6/1/86 to 5/31/92. Restoration was to consist of dredging to increase water depth, stormwater diversion and the use of existing wetlands to filter stormwater runoff. No work done due to City unable to come up with match for project.
- I. *Collins Lake*, Village of Scotia (\$221,821 Federal, \$110,000 State, \$111,821 Local). Project period 4/1/85 to 3/31/95. Project to include hydraulic dredging to increase water depth by 1 meter to reduce growth of the exotic plant Curlyleaf pondweed (*Potamogeton crispus*). The Lake is used extensively for swimming, boating, and fishing.
- J. *Greenwood Lake*, Greenwood Lake Watershed Management District, Inc. (\$369,000 Federal, \$240,000 State, \$129,600 Local). Project period 6/26/89 to 9/30/95. Project to control aquatic vegetation and reduce nutrient loadings to the lake. Methods include drawdown, mechanical harvesting, stormwater management, development of a septic management district, fisheries survey, and a basin-wide sensitive lands management plan.
- K. *Lake George*, NYSDEC (\$367,390 Federal, \$367,390 State/Local). Project period from 6/26/89 to 5/31/93. Project includes aquatic plant management, critical land acquisition, and monitoring. An increase in federal funds for this project is currently being requested.

IV. Special Grants

- A. Water Quality Assessment Grant, NYSDEC (\$50,000 Federal, \$21,429 State). Project period from 9/1/94 to 8/31/96. A grant to assist DEC in the administration of its Lake Water Quality Assessment Program.
- B. Onondaga Lake Management Conference, NYSDEC (\$1,750,000 Federal, \$750,000 State). Project period from 6/26/89 to 9/30/94. A compilation/review of studies to determine additional monitoring necessary and what strategies would succeed in the restoration of Onondaga Lake.
- C. Lake Champlain Management Conference, NYSDEC (\$2,000,000 Federal, \$857,143 State). Project period from to 9/30/94. To convene a management conference to study and address the water quality concern in Lake Champlain. The project is conducted with the State of

- Vermont.
- D. TMDL-Mini Grant for In-Lake Sedimentation Study (\$15,000 Federal). Project Period 10/1/93 to 9/30/94. A grant to conduct sedimentation chemistry and rate studies on several lakes of various trophic conditions
 - E. Nutrient Assessment Grants (two grants, total \$125,000 Federal, \$53,573 State). Project Period 7/1/98 to 9/30/00. A grant to assist DEC administration of its Nutrient Assessment Program.
 - F. Nutrient Criteria Development Grant (\$30,000 Federal (EPA Regions I, II, and V), awarded to the NYS Federation of Lake Associations). Project Period 10/1/01-6/30/03. A grant to evaluate the use of lake perception data in developing nutrient criteria

Acidification of Lakes

The assessment of lakes and ponds for acidity in New York State is based upon a system to categorize waters as being in acceptable, threatened, or impaired ("affected") condition as determined by midsummer acidity levels (Pfeiffer and Festa, 1980). The system relates the environmental requirements for survival of endemic fish populations and current acidification status. The categories of pH are

Impaired condition	pH < 5.0 standard units
Threatened condition	pH \geq 5.0 and \leq 6.0 standard units
Acceptable condition	pH > 6.0 standard units

In previous 305(b) reports, the presence of a viable fish population also was used to determine acidity status. Although not a direct measure of trophic state, this classification provides important information about the concurrent use impairment due to the severity of the acidification problem.

A total of 1,850 lakes and ponds representing 503,400 acres have been assessed for acidity in New York State (not including Lake Ontario). Most of the information for the current evaluation came from the Adirondack Lakes Survey Corporation field investigations of 1,469 ponded waters between 1984 and 1987. The ELS waters were not sampled during midsummer and are not included in the current assessment. The 1,376 waters included in the current assessment from the ALSC report represent about 50 percent of the total number of water bodies in the Adirondack Region.

The results of the current assessment for acidity status based upon midsummer air-equilibrated pH values are outlined on Table 9 (with the ALSC data summarized in parentheses).

The 365 ponded waters impaired by acidity represents about 20 percent of the total number of lakes, but less than 2% of the total surface area included in the current acidity status assessment.

The specific sources of acidity in the acid deposition that affects Adirondack lakes and ponds are the millions of tons of sulfur dioxide and oxides of nitrogen that are emitted annually into the atmosphere. Deposition of sulfate and nitric acid takes place in both "wet" (precipitation) and "dry" (direct deposition to the ground surface) forms.

Table 9 Assessment of Lake Acidification			
	Impaired	Threatened	Acceptable
Air-Equilibrated pH	< 5.0	5.0 - 6.0	> 6.0
Number of Lakes/Ponds	365 (326)	289 (257)	1184 (793)
Percent of Total Assessed	20% (24%)	16% (19%)	64% (58%)
Total Number of Lake Acres	7,210 (4,155)	16,374 (8,030)	436,311 (36,255)

Ohio, Pennsylvania, and West Virginia, immediately southwest of New York State, are major contributors of sulfur dioxide. In previous years these three states together contribute 21 percent of the sulfur deposition at the Whiteface receptor, 23 percent at the western Adirondack receptor, and 36 percent at the Catskill receptor. These three states, together with New York State, Ontario and Quebec at one time accounted for most of the sulfur dioxide emissions west of, and within, 1000 km of the Adirondacks, 68 percent of the deposition at Whiteface, 67 percent of the deposition in the western Adirondacks, and 68 percent of the deposition at the Catskill receptor. The remaining 30 percent of the deposition at these three receptors was contributed by several widely separated regions. New York State's contribution to total sulfur deposition at all receptors in New York State ranged from 14 percent to 31 percent.

The predominant contributors to oxides of nitrogen emissions are motor vehicles located in heavily urbanized areas. The largest non-New York contributors to the New York receptors are located immediately to the southwest of the State and include the western Pennsylvania, eastern Ohio, and West Virginia areas. This region contributes about 14 percent of the total emissions sources. The Canadian contribution to nitrate deposition at some receptors is considerably higher than that found for sulfate deposition, which reflects the influence of large Canadian metropolitan areas such as Montreal and Toronto. New York State's contributions to emissions in the general area at one time ranged from 2.6 percent at Muskoka, which is west of New York State, to 32 percent at Brookhaven on the eastern end of Long Island.

Based on ionic contributions and other evidence, acidification of waters in the Adirondacks has occurred primarily from the atmospheric deposition of sulfate. Higher concentrations of nitrate occur during events such as snowmelt and influence short-term changes in pH and ANC.

The NYSDEC began neutralizing certain acidic waters in 1959 as a management tool used to help restore or protect valuable fisheries. The neutralizing material used is agricultural limestone. The NYSDEC liming program has in recent years included 32 waters, all of which are located within the Adirondack Park. As another alternative to mitigate the harmful effects of high acidity, the Lake Acidification Mitigation Project (LAMP) conducted research on watershed liming to determine the effects of liming the entire ecosystem on the water chemistry, terrestrial vegetation, and soil biota.

Mitigation Measures for High Phosphorus

More than 40 small lakes have been identified as impaired due to excessive nutrients, warranting their inclusion on the New York State Section 303(d) list. Most of these systems suffer from a lack of nutrient loading data, but most are also found within a single jurisdiction with relatively small watersheds. As such, nutrient loading to these systems could be modeled with relatively simple desk-top modeling programs, leading to the development of total maximum daily load (TMDL) calculations required for 303(d) listed waterbodies. The NYSDEC Division of Water, working with EPA and their consultants, identified candidate waterbodies for inclusion in a small lakes TMDL modeling project, and several representative lake watersheds for calibrating these models. The lack of event-based monitoring data for many of these systems resulted in the choice of a steady-state watershed and lake response model to characterize contemporary nutrient loading and lake conditions, and to predict lake response to changes in nutrient inputs.

The ArcView Generalized Watershed Loading Function (AVGWLF) model was used in combination with BATHTUB to develop three TMDLs for small lakes impaired by phosphorus. The approach employed by an EPA contractor consisted of using AVGWLF to determine mean annual phosphorus loading to the lake, and then using BATHTUB to define the extent to which this load must be reduced to meet the water quality target. This approach required no additional data collection thereby expediting the modeling efforts. These TMDLs did not involve any Waste Load Allocations.

The EPA contractor is also using the AVGWLF model to review watershed loads in several other impaired lakes. Most of these lakes have larger, more complicated watersheds and the TMDLs will need to set Waste Load Allocations for wastewater treatment discharges or Municipal Separate Storm Sewer Systems. This relatively simple, desktop, model-based approach will be adopted to address TMDL development for 40-50 small lake systems throughout New York State.

Mitigation Measures for High Acidity

1. Acid Rain Lakes Total Maximum Daily Load (TMDL)

About 400 waters are included on the New York State Section 303(d) list because of impairment to aquatic life support attributed to acid rain. The majority of these lakes were added to the list in 1998 and were based on chemistry and biologic data from the mid-1980s or prior. The focus of the Acid Rain Lakes restoration strategy/TMDL is limited to those affected lake waters that fall within New York State Adirondack Forest Preserve lands. The reason for limiting the universe of waters to be covered is due to the applicable water quality standards for these waters. The applicable pH standard for most waters outside the Forest Preserve lands is “not less than 6.5.” While this is a scientifically derived standard based on the support of aquatic life, it might not be a realistic standard for all waters of the Adirondacks, where natural limitations such as limited acid neutralizing capacity (ANC), soil characteristics, geology and hydrology and other considerations suggest some of these

waters may have never attained a pH of 6.5. Even so, acid rain may still restrict aquatic life support in these waters.

The ultimate goal for all waters would be that they achieve all water quality standards for classified waters and support a full and diverse aquatic community. However, State water quality standards such as the pH standard of 6.5 have not been applied to waters within the Forest Preserve because of the alternative protection provided in Article 14 of the New York State Constitution. If State standards were applied, a TMDL would have to demonstrate that prescribed loading reductions could meet this standard. The lack of specific, numeric water quality standards for Forest Preserve Waters allows for some flexibility in developing interim TMDL endpoints.

The nature of the loading sources responsible for this impairment to New York State waters also complicates the loading reduction strategy called for in this restoration plan. Because significant sources lie outside New York State borders any effective loading reduction strategy must include national (regional) reduction efforts. Beyond any initial reductions, additional reductions are likely to be needed to attain water quality standards and restore uses of at least some of these waters. However, the complexity of the transport, deposition, in-water effects, and appropriate natural limitations – factors that vary somewhat across the range of 143 target waters – suggest that an incremental/phased approach is appropriate.

While retaining a minimum pH of 6.5 as the ultimate goal for these waters, this phased TMDL uses a hierarchy of interim aquatic life support thresholds. As the emission of acid rain precursors are reduced regionally, monitoring data will be used to assess pH recovery and aquatic life support, and to refine simulation models to see what additional reductions would be necessary to achieve further recovery and a higher level of aquatic life support. This iterative adaptive management cycle is an appropriate strategy to deal with the complexities of restoring these acid rain waters.

2. Northeast Regional Mercury (TMDL)

Seven states— New York, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont—collaborated with the New England Interstate Water Pollution Control Commission (NEIWPCC) to produce the plan for reducing mercury in the waters of New York State and New England to eliminate fish consumption advisories caused by mercury from air deposition. In the Northeast, elevated levels of mercury in certain fish species, such as large and smallmouth bass and walleye, are of great concern. In New York, more than 80 water bodies have advisories for fish consumption based on elevated levels of mercury. While most of the waters are in the Adirondacks and Catskills, others such as parts of the Hudson and Susquehanna Rivers and Lake Champlain are also affected.

This Northeast regional TMDL will help address the link between mercury emissions and mercury pollution in water and highlights the need for implementation of a comprehensive, nationwide mercury reduction strategy that would improve the natural

resources not only in New York, but in all states. The participating states believe that mercury deposition deserves to be a national priority and requires federal programs to address it. The TMDL acknowledges the success of the Northeast states in eliminating many in-state sources of mercury contamination. Nearly a decade of work has resulted in regional reductions of greater than 70 percent in mercury emissions and discharges, including reductions in emissions from incinerators. As New York State continues to look for new ways to reduce in-state sources of mercury, the TMDL recognizes that the majority of mercury in state waters comes from out-of-state sources. The draft TMDL stipulates the amount by which mercury arriving in the region from out-of-state sources must be reduced if waters are to be removed from the impaired list and the fish consumption advisories rescinded.

The TMDL indicates that by reducing overall mercury deposition to the region by between 86 percent and 98 percent, fish-tissue mercury will decline to levels where fish advisories will no longer be required.

Assessment of Lake Water Quality Trends

The Inland Lakes and Freshwater Section has attempted to provide some preliminary assessments of long-term water quality trends of the lakes in New York State. Such an assessment is ultimately limited by the relatively small number of lakes that have been sampled for a sufficient period of time (5-10) years to provide long-term trend analysis and dampen the interannual variability due to changing weather conditions, slight differences in sampling schedules, and other sampling artefacts. Moreover, questions about the representativeness of the ambient monitoring programs datasets (as a cross section of all NYS lakes, or even lakes within a particular region, size range, or water quality classification) further limits the extrapolation of trend analyses within these datasets to assessments of trends within NYS lakes, however the latter may be defined. The EMAP Program was intended to support the collection of long-term baseline data to identify water quality trends. However, since this section of the report is dealing with water quality data collected primarily since 1982, the paucity of long-term data for the majority of state lakes precludes an adequate trend analysis.

Trend analyses can be attempted in a number of ways. Perhaps the simplest would be to evaluate changes in water quality indicators (trophic status, acidification status, etc.) over defined intervals, such as changes in these indicators by decade of sampling. The historical NYS dataset lends itself to this type of analysis, since many lakes were sampled on only a limited basis in relatively short-term water quality monitoring programs within each of the last four decades- the DEC and Eastern Lakes surveys of the 1970s, the ALSC, LCI and CSLAP programs in the 1980s, and the LCI, CSLAP, and Finger Lakes monitoring programs of the 1990s and 2000s.

Another method is traditional long-term data analyses on continuous datasets, such as those collected via CSLAP. At one time, the Citizens Statewide Lake Assessment Program monitored individual lakes for at least five-year intervals. At the end of that time, individual lake associations were provided the option of monitoring the lake at their own expense (using the same sampling procedures, equipment, and laboratory for analyses) or be dropped from the program to include other lakes on the waiting list. Since a five-year monitoring program does not generally provide the long-term data to provide a water quality

trend, and due to funding restrictions within the program, participating lake associations assumed a portion (appx 5-15%) of the program costs beginning in 2002, and thus were provided opportunities to continue monitoring without five-year sampling restrictions. It is anticipated that this may dramatically increase the number of lakes with continuous datasets and provide more years of water quality data for more rigorous trend analysis. At present, 138 CSLAP lakes have been sampled, at present, for at least five years under this program, with 38 lakes sampled for at least 10 years, and 9 lakes sampled for at least 15 years, although they may not have had contiguous records. In recent years, rudimentary statistical analyses have been conducted on individual CSLAP lakes. These analyses can be grouped to provide a summarized simple analysis of water quality trends in these lakes (and by extension a subset of NYS lakes) since the mid-1980s.

There are more than 230 lakes that have been sampled in two or more of the decades of the 1970s, 1980s, 1990s and 2000s (inclusive of 2006) by one or more of the above described monitoring programs and/or ambient water quality monitoring conducted by the NYSDEC during the 1970s but not summarized in this report. However, since many of these programs collected information on a subset of NYS lakes that may not be representative of the entirety of water resources in the state, such as the mostly acidified lakes sampled in the ALSC project, the larger public access lakes sampled in the LCI, and the mostly larger populated lakes sampled through CSLAP, comparing results from one program to the next (and therefore from one “decade” to the next) may not provide great insights about the recent historical condition of NYS lakes.

Among the lakes sampled in two or more decades since the early 1970s, the trophic condition of these lakes is described in Table 10. Trophic status in each decade was evaluated by evaluating the median value for the trophic indicators for the entire decade.

Review of the data in Table 10 shows that comparisons from one decade to the next are extremely difficult since only a small subset of lakes were sampled in the 1970s, 1980s, 1990s, and 2000s. However, with the larger pool of lakes sampled from the 1970s to the 2000s, from the 1980s to the 2000s, and from the 1990s to 2000s, a tentative assessment of changing trophic status can be presented. This assessment is shown in Table 11.

It appears that there is a trend toward decreasing productivity (trophy), particularly when evaluating total phosphorus concentrations, in the subset of commonly sampled lakes, although it is clear that the majority of these lakes did not change in trophic status over the twenty years of data collection. The discrepancy between chlorophyll *a* and the other indicators reflects both the relative lack of chlorophyll *a* data from the 1980s (it was not collected through the ALSC project) and perhaps the greater consistency in the data collected in the 1990s (in which mean values may be unduly influenced by extremely high early and late summer readings, although this was somewhat accounted for by evaluating median values for these indicators). The large “drop” in trophy from the 1980s to the 1990s as assessed by total phosphorus concentrations may be due in part to questionable (overestimated) total phosphorus data from the ALSC (1980s) study. However, in comparing data from common lakes sampled in the LCI (1980s to 2000s) and CSLAP and AEAP programs (1980s to 2000s), where laboratory methodologies are consistent, 20-30% showed a decrease in trophic status (lower productivity) as determined by total phosphorus concentrations, while only 5-10% showed an increase. This may continue to represent decreases in nutrient concentrations in response to the phosphorus detergent ban instituted in the 1970s.

Table 10**Trophic Condition of Lakes from the 1970s through 2007**

Trophic Status Based on:	Oligotrophic	Mesotrophic	Eutrophic	Total Lakes/Ponds
1970s Lake Assessment *				
Total Phosphorus	14	9	19	42
Secchi	9	20	12	41
Chlorophyll	5	16	14	35
1980s Lake Assessment **				
Total Phosphorus	56	71	51	177
Secchi	29	108	40	178
Chlorophyll	12	51	30	93
1990s Lake Assessment ***				
Total Phosphorus	100	78	53	231
Secchi	39	130	61	230
Chlorophyll	48	122	61	231
2000s Lake Assessment****				
Total Phosphorus	43	43	26	112
Secchi	18	71	30	119
Chlorophyll	20	57	32	109
<p>* Lakes sampled in the 1970s by the NYSDEC, and also sampled in the 1980s (by the CSLAP, LCI or ALSC programs) and/or in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs).</p> <p>** Lakes sampled in the 1980s (by the CSLAP, LCI or ALSC programs) and in the 1970s by the NYSDEC, in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs) and/or in 2000 or 2001 via CSLAP or the LCI.</p> <p>*** Lakes sampled in the in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs), and in 1970s by the NYSDEC, the 1980s (by the CSLAP, LCI or ALSC programs) and/or in 2000 or 2001 via CSLAP or the LCI.</p> <p>**** Lakes sampled in 2000 -06 via CSLAP or the LCI and in the 1970s by the NYSDEC, in the 1980s (by the CSLAP, LCI or ALSC programs) and/or in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs).</p>				

Table 11**Trophic Condition of Lakes: 1970s to 2000s**

Change in Trophic Status Based on:	Increasing Productivity	Decreasing Productivity	No Change in Productivity / Trophic Status
1970s to 1990s Lake Assessment			
Total Phosphorus	5	12	24
Secchi	7	11	21
Chlorophyll	4	3	27
1970s to 2000s Lake Assessment			
Total Phosphorus	2	8	11
Secchi	4	5	14
Chlorophyll	2	3	14
1980s to 1990s Lake Assessment			
Total Phosphorus	11	41	110
Secchi	17	15	131
Chlorophyll	14	8	65
1980s to 2000s Lake Assessment			
Total Phosphorus	5	15	45
Secchi	11	4	56
Chlorophyll	10	13	27
1990s to 2000s Lake Assessment			
Total Phosphorus	7	9	90
Secchi	13	13	79
Chlorophyll	8	15	83

However, the decrease in trophic over this period, as evaluated by the total phosphorus (and to a lesser extent chlorophyll) data, does not appear to be borne out by changes (responses) in water clarity over this period. Most of the longer-term data sets indicate variable responses in water clarity, with trophic

status decreasing (higher clarity) when evaluating the 1970s to 1990s datasets but increasing (lower clarity) when evaluating the 1980s/90s to 2000s dataset. A closer evaluation of these datasets indicates that most of the decreases in water clarity do not appear to be statistically significant, but are large enough to move the median values for these lakes across the boundaries separating trophic categories (such as a drop in median water clarity from 5.1 meters to 4.9 meters).

Long-term trends can also be evaluated by looking at the summary findings of individual lakes from a consistent data set, such as CSLAP, and attempt to extrapolate consistent findings to the rest of the lakes. Given the non-Gaussian distribution of many of the water quality parameters evaluated in this report, non-parametric tools may be the most effective means for assessing the presence of a water quality trend. However, these tools do not indicate the magnitude of the trend. As such, a combination of parametric and non-parametric tools may need to be employed to evaluate trends.

The Kendall tau ranking coefficient has been utilized by several researches and state water quality agencies to evaluate water quality trends via non-parametric analyses. Kendall tau ranking orders paired observations by one of the variables (say arranging water clarity readings by date). Starting with the left-hand (say earliest date) pair, the number of times that the variable not ordered (in this case clarity readings) is exceeded by the same variable in subsequent pairs is computed as P, and the number of times in which the unordered variable is not exceeded is computed as Q. This computation is completed for each ordered pair, with N= total number of pairs, and the sum of the differences $S = \sum P-Q$. The Kendall tau rank correlation coefficient τ is computed as:

$$\tau = 2S/(N*(N-1))$$

Values for τ range from -1 (complete negative correlation) to $+1$ (complete positive correlation). As above, strong correlations (or simply “significance”) may be associated with values for τ greater than 0.5 (or less than -0.5), and moderate correlations may be associated with values for τ between 0.3 and 0.5 (or between -0.3 and -0.5), but the “significance” of this correlation must be further computed. Standard charts for computing the probabilities for testing the significance of S are provided in most statistics textbooks, and for values of N greater than 10, a standard normal deviate D can be computed by calculating the quotient

$$D = S\sqrt{18} / \sqrt{[(N(N-1) (2N+5))]$$

and attributing the following significance:

$D > 3.29 = 0.05\%$ significance

$2.58 < D < 3.29 = 0.5\%$ significance

$1.96 < D < 2.58 = 2.5\%$ significance

$D < 1.96 = > 2.5\%$ significance

For the purpose of this exercise, 2.5% significance or less is necessary to assign validity (or, using the vernacular above, “significance”) to the trend determined by the Kendall tau correlation. It should be noted again that this evaluation does not determine the magnitude of the trend, but only if a trend is likely to exist.

Parametric trends can be defined by standard best-fit linear regression lines, with the significance of these data customarily defined by the magnitude of the best fit regression coefficient r or R^2). This can be

conducted using raw or individual data points, or seasonal summaries (using some indicator of central tendency, such as mean or median). Since the former can be adversely influenced by seasonal variability and/or imprecision in the length and breadth of the sampling season during any given year, seasonal summaries may provide more realistic measures for long-term trend analyses. However, since the summaries may not adequately reflect variability within any given sampling season, it may be appropriate to compare deviations from seasonal means or medians with the “modeled” change in the mean/median resulting from the regression analyses.

When similar parametric and non-parametric tools are utilized to evaluate long-term trends in NYS lakes, a few assumptions must be adopted:

- Using the non-parametric tools, trend “significance” (defined as no more than appx. 3% “likelihood” that a trend is calculated when none exists) can only be achieved with at least four years of averaged water quality data. When looking at all summer data points (as opposed to data averaging), a minimum of forty data points is required to achieve some confidence in data significance. This corresponds to at least five years of CSLAP data. The “lesson” in these assumptions is that data trends assigned to data sets collected over fewer than five years assume only marginal significance.
- As noted above, summer data only are utilized (as in the previous analyses) to minimize seasonal effects and different sampling schedules around the fringes (primarily May and September) of the sampling season. This reduces the number of data points used to compile averages or whole data sets but is considered necessary to best evaluate the CSLAP datasets.

As of 2006, there were 157 CSLAP lakes that have been sampled for at least five years. Table 12 summarizes the “trend” indicated from the parametric and non-parametric analyses – the latter consists of both methods indicated in note 1) above, while the former consists of the best-fit analysis of summer (June 15 through September 15) averages for each of the eutrophication indicators (with trends attributable to instances in which deviations in annual means exceed the deviations found in the calculation of any single annual mean). As alluded to earlier, Table 12 includes only those lakes with more than four years of water quality data. When this method is applied to sampling parameters that are more characteristic of succession than cultural eutrophication, such as conductivity, a much higher percentage of significant change occurs (more than 20% of CSLAP lakes sampled for at least five years have exhibited a significant increase in conductivity), suggesting this methodology may be adequate to reveal significant changes. The decrease in chlorophyll *a* reading in the absence of decreasing nutrient concentrations suggests some localized management of algae, such as the use of algacides. However, some of the discrepancy between lower phosphorus and algae levels may reflect the shift in CSLAP laboratories after 2002- algae levels have been lower in many CSLAP lakes since the shift in laboratories.

These data suggest that while most NYS lakes have not demonstrated a significant change, those lakes that have experienced some change show a trend toward less productive conditions. The lesser significance associated with the chlorophyll *a* readings is probably the result of higher sample-to-sample variability associated with this analysis. There does not appear to be any obvious shared characteristics among these lakes. Some are highly productive, others are quite unproductive, some have been actively managed, some have been sampled for only a few years or are small shallow lakes or are located in the western part of the state, while others are just the opposite. As noted above, there does not appear to be any clear pattern between weather and water quality changes. However, all of these lakes may be the long-term beneficiaries of the ban on phosphorus in detergents in the early 1970’s, which with other local

circumstances (perhaps locally more “favorable” weather, local management, etc.) has resulted in less productive conditions.

Table 18 Trends in Lake Water Quality		
Water Quality Indicator	Number (%) of CSLAP Lakes	Acres of Lakes
Total Phosphorus		
Increasing	14 (9%)	17,200
Stable or Fluctuating	96 (56%)	44,900
Decreasing	17 (11%)	50,900
Trend Unknown	35 (24%)	30,500
Secchi Disk:		
Increasing	13 (8%)	55,300
Stable or Fluctuating	107 (61%)	61,800
Decreasing	13 (8%)	4,400
Trend Unknown	34% (22%)	21,700
Chlorophyll <i>a</i>:		
Increasing	7 (4%)	700
Stable or Fluctuating	90 (57%)	112,500
Decreasing	28 (18%)	11,300
Trend Unknown	32 (20%)	18,800

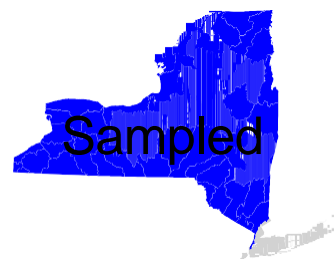
New York State Groundwater Assessment

Each day, ground water directly touches the lives of approximately six million New York State residents, or about one-third of the state's population, as their source of residential drinking water using an estimated average 110 gallons per day each. This and an untold number of additional state and non-state residents also incorporate New York's ground water into their daily activities, while away from home, to an extent that is often unseen. This may include use at work, school, recreation, or leisure activities, and amounts associated with the manufacture or production of goods and services.¹

New York's population dependence on ground water is considerable (Figure 1). Of New York State's 62 counties a total of 27 (44%) are more than half dependent on ground water for their combined public and self-supplied domestic water needs. Even more telling, seven counties (Cortland, Nassau, Queens, Suffolk, Schenectady, Chenango, and Tioga) representing a population of 5.3 million people, are more than 95% dependent on ground water.

New York State's considerable dependence on ground water points out the critical need to protect the quality of this vital resource. The following sections focus on potential sources of contamination that commonly threaten ground water and the programs or activities New York State has established to minimize the effects these potential sources will have on the state's ground water resource. Table 1 lists major sources of ground water contamination indicating the top 10 considered to be of highest concern. Table 2 provides a listing of superfund registry and non-registry remediation sites providing an indication of the extent of ground water contamination in NYS.

New York continues to make progress in assessing ambient ground water quality across the state through the establishment of a basin approach to ground water sampling. As with the surface water program, ground water sampling is planned for each of NY's 8-digit Hydrologic Unit Code (HUC) basins over a five-year period. The studies are being conducted jointly with USGS. As of the start of 2010, New York has conducted ambient ground water quality monitoring in 46 of the state's 51 8-digit HUCs representing 96% of the state. A summary of individual studies for the 2003-2007 sampling efforts is included at the end of this chapter. Final reports for the 2008 studies are expected in the near future with 2009 study reports due out next year.



¹ Estimated Use of Water in the United States in 2000; USGS CIR 1268; 2004

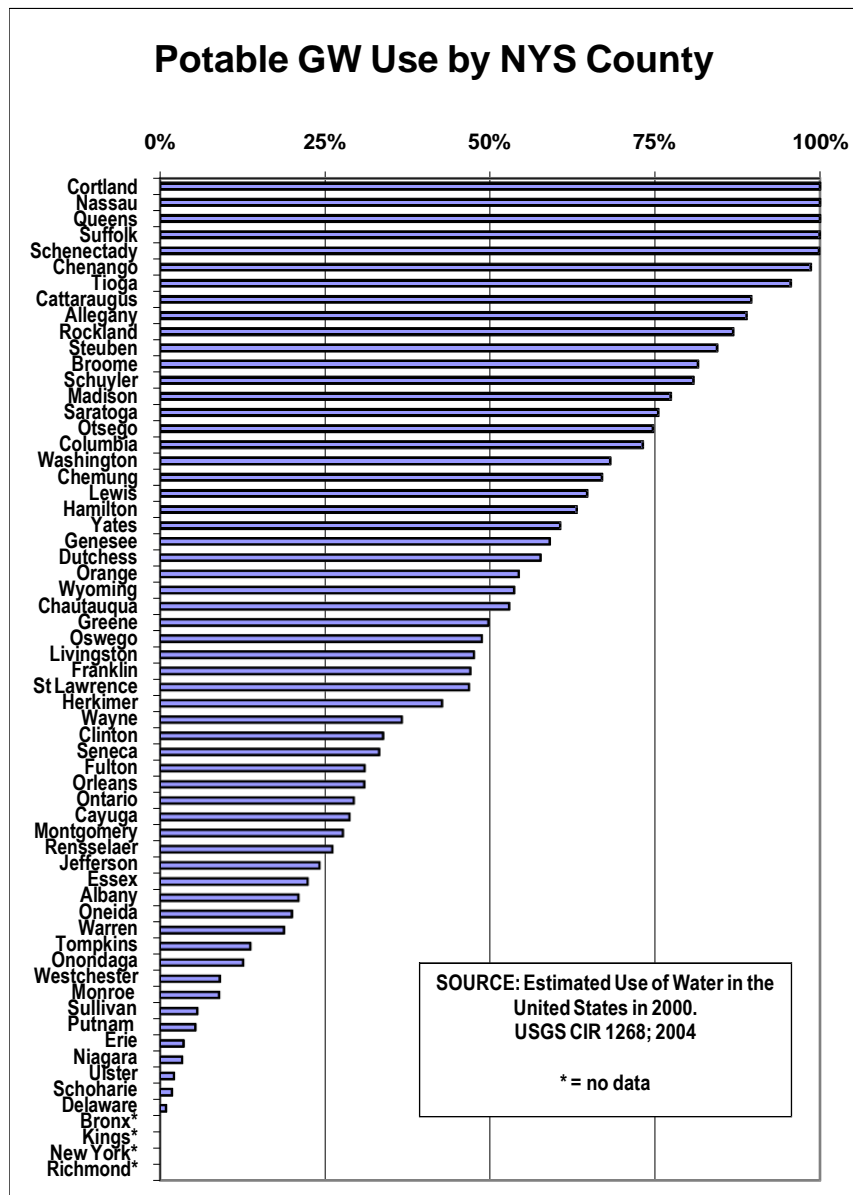


Figure 1

Overview of Ground Water Contamination Sources

Table 1: Major Sources of Ground Water Contamination

Contaminant Source	Ten Highest-Priority Sources (v) ⁽¹⁾	Factors Considered in Selecting a Contaminant Source ⁽²⁾	Contaminants ⁽³⁾
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications			
Irrigation practices			
Pesticide applications	√	A, B, E, H	A, B
On-farm agricultural mixing and			
Land application of manure			
Storage and Treatment Activities			
Land appl. (Regulated/ Permitted)			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	√	A, H	A, B, C, D
Surface impoundments			
Waste piles/ Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	√	A, E	C, D, H
Septic systems	√	A, B, H	E, J, L, C
Shallow injection wells			
Other			
Hazardous waste generators	√	A, H	C, D, H
Hazardous waste sites	√	A, E	C, D, H
Large industrial facilities			
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines			
Salt storage and road salting			
Saltwater intrusion			
Spills	√	A, H	A, B, C, D
Transportation of materials			
Urban runoff			
Small-scale manuf. / repair shops	√	A, H	C, D, H
Other sources (state added)			
Abandoned Oil & Gas Wells	√	A, E	D
Radon	√	A, B, F	I

Notes for Table 1

1. A check (✓) indicates up to ten contaminant sources identified as highest priority in New York State. Ranking is not indicated.
2. Factor(s) used to select each of the contaminant sources, denoted by corresponding letter (A through I) and listed in order of importance. Additional or special factors of importance within New York State are described in accompanying narrative.

A.	Human health / environmental risk (toxicity)	E.	Hydrogeologic sensitivity
B.	Size of the population at risk	F.	State findings, other findings
C.	Location of the sources relative to drinking water sources	G.	Documented from mandatory reporting
D.	Number / size of contaminant sources	H.	Geographic distribution / occurrence
		I.	Other criteria (Described in the narrative)

3. Contaminants/classes of contaminants considered associated with each of the sources checked. Contaminants/contaminant classes are selected based on data indicating that certain chemicals or classes of chemicals may be originating from an identified source. Contaminants/classes of contaminants denoted by corresponding letter below (A through M).

A.	Inorganic pesticides	H.	Metals
B.	Organic pesticides	I.	Radionuclides
C.	Halogenated solvents	J.	Bacteria
D.	Petroleum compounds	K.	Protozoa
E.	Nitrate	L.	Viruses
F.	Fluoride	M.	Other (Described in narrative)
G.	Salinity/brine		

Discussion of Ground Water Contamination Sources

AGRICULTURAL ACTIVITIES

AGRICULTURAL CHEMICAL FACILITIES

- EPA defines agricultural chemical facilities as those having a Standard Industrial Classification (SIC) code of 3253 under the new North American Industrial Classification System (NAICS). This code refers to the manufacturing and production of fertilizers, pesticides, and other miscellaneous agricultural chemicals. The latest Economic Census (2002) from the U.S. Census Bureau (www.census.gov/econ/census02) shows 26 facilities in New York. This is further broken down to: two fertilizer manufacturing facilities, 18 fertilizer mixing only facilities, and six pesticide & other agricultural chemical manufacturing facilities.
- Level of Concern – Low
- Scope of Concern - Regional

ANIMAL FEEDLOTS

- CONCENTRATED ANIMAL FEEDING OPERATION (CAFO) – Since 1999, NYS law has required Animal Feeding Operations (AFO) with animal numbers above designated values (e.g. 200 mature dairy cows, 300 beef cattle or heifers) to apply for a pollution discharge general permit from DEC. Each permit requires a Comprehensive Nutrient Management Plan (CNMP) prepared by a NRCS certified planner. Those AFOs not required to obtain a discharge permit are encouraged to participate in a voluntary assessment program and also implement a voluntary CNMP. This activity remains a concern due to the number of facilities exempt from CAFO requirements.
- Level of Concern – Intermediate
- Scope of Concern - Regional

DRAINAGE WELLS

- Drainage well is one example of a Class V injection well as designated by EPA's Underground Injection Control (UIC) program. Drainage wells include agricultural, storm water, or other special types of drainage wells. These wells are typically used to inject (dispose of) excess untreated surface and subsurface water. Such waters often contain contaminants that exceed New York State's water quality discharge standards. Primacy for the UIC program in NYS remains with USEPA. Storm water drainage wells are "authorized by rule," which means they may be operated without an individual permit so long as the injection does not endanger an aquifer.
- Level of Concern – Intermediate
- Scope of Concern – Regional

FERTILIZER APPLICATIONS

- Much of NYS remains in use for agricultural purposes. Impacts to groundwater from the use of agricultural fertilizers remains a concern largely due to their widespread use. Increasingly, there is also concern for residential lawn fertilizing whether by the homeowner or by a lawn care service. Results from DEC's ambient groundwater monitoring program, beginning in 2002, have found relatively low detectable levels of nitrate in wells sampled (see table below). With one exception, all results were below the current MCL of 10 mg/L. (These results may not exclusively represent contributions from fertilizers).

Study Year	Study Basin (HUCs)	Wells Sampled	Nitrate > 10 mg/L*	Nitrite > 1 mg/L*	Nitrite plus Nitrate > 10 mg/L*	Nitrite plus Nitrate > 1 mg/L
2002	Mohawk R. (02020004)	23	0	0	0	8
2003	Chemung R. (02050105)	37	0	0	0	11
2004	Lake Champlain (02010001, 02010004, 02010006) U. Susquehanna R. (02050101, 02050102, 02050103)	22	0	0	0	4
		33	1	0	1	16
2005	Delaware R. (02040101, 02040102, 02040104) St. Lawrence R. (04150301 through 04150307) Genesee R. (04130002, 04130003)	19	0	0	0	6
		25	0	0	0	2
		22	0	0	0	5
2006	Mohawk R. & Schoharie Ck. (02020004, 02020005) Allegheny R. (05010001, 05010002) Lk. Erie, W. Lk. Ontario & Niagara R. (04120101 – 04120104, 04130001)	27	0	0	0	4
		33	0	0	0	7
2007	Upper Hudson (02020001 – 02020003) Finger Lks., Lk. Ontario (04140201 - 04140202, 04140101, 04140102)	25	2	0	2	6
		35	0	0	0	8

* The MCL for Nitrate is 10 mg/L, for Nitrite is 1 mg/L, for Nitrite plus Nitrate is 10 mg/L

- Level of Concern – Low
- Scope of Concern – Regional

IRRIGATION PRACTICES

- Concerns for ground water contamination related to irrigation practices potentially involve induced capture of pesticides or nutrients applied to farmlands. A combination of high ground water pumping rates in areas immediately adjacent to farmlands and excessive watering may serve to pull contaminants deeper into aquifers than would otherwise happen. The latest available USGS water use data (2000) ranks NYS 35th in the nation (including several US territories) in terms of groundwater use for irrigation. USGS

estimates 23.3 mgd of groundwater is used for irrigation in NYS compared with 11,600 mgd of groundwater for the highest irrigation use state. Overall, this activity is not believed to be a significant concern.

- Level of Concern – Low
- Scope of Concern – Regional

PESTICIDE APPLICATIONS

- Pesticides, including insecticides, fungicides, herbicides, and other subcategories, remain in widespread use in agricultural, commercial, residential, and other parts of society. Results from DEC's ambient groundwater monitoring program, beginning in 2002, have found detectable levels of pesticides or degradates on average in nearly one of every two wells sampled (see table below). Regionally, northern NY is below this average while the Chemung & Upper Susquehanna basins are above. All results were below current state & federal drinking water MCLs however their prevalence is worth noting. There is continuing high concern for the overuse or misuse of pesticides and the potential for groundwater contamination.

Study Basin (HUCs)	Study Year	Wells Sampled	Wells With Detectable Pesticide Levels
Mohawk R. (02020004)	2002	23	12
Chemung R. (02050105)	2003	27	16
Lake Champlain (02010001, 02010004, 02010006) U. Susquehanna R. (02050101, 02050102, 02050103)	2004	22 33	7 20
Delaware R. (02040101, 02040102, 02040104) St. Lawrence R. (04150301 through 04150307) Genesee R. (04130002, 04130003)	2005	19 25 22	10 4 12
Mohawk R. & Schoharie Ck. (02020004, 02020005) Allegheny R. (05010001, 05010002) Lk. Erie, W. Lk. Ontario & Niagara R. (04120101 – 04120104, 04130001)	2006	27 33	6 14
Upper Hudson (02020001 – 02020003) Finger Lks., Lk. Ontario (04140201 - 04140202, 04140101, 04140102)	2007	25 35	11 17

- Level of Concern – **High**
- Scope of Concern - Statewide

ON-FARM AGRICULTURAL MIXING AND LOADING PROCEDURES

- NYS's Agricultural Environmental Management (AEM) Program was enacted through state legislation in August of 2000, under the State Soil and Water Conservation Committee, to assist farmers in identifying and correcting environmental risks associated with farming. As part of the AEM program a guidance worksheet was developed in 2001 specifically dealing with Pesticide Storage, Mixing & Loading. The guidance references and incorporates standards developed by NRCS for agri-chemical mixing facilities. This information is disseminated through 58 County Soil and Water Conservation Districts representing all of NYS. This activity remains of moderate concern.
- Level of Concern – Intermediate
- Scope of Concern – Statewide

LAND APPLICATION OF MANURE (UNREGULATED)

- Land application facilities for animal manure and associated bedding material are exempt from NYS solid waste regulations. Facilities of sufficient size to be regulated as Concentrated Animal Feeding Operations (CAFOs) would however require an Agricultural Waste Management Plan (AWMP) prepared by an NRCS certified planner.
- Other wastes, not considered manure, which are also exempt from land application regulations include: food processing wastes that are visually recognizable as a part of a plant or vegetable, aquatic plants or a combination of such wastes, and leaves and/or grass. This exemption contains numerous requirements including minimizing impacts to ground water.
- Concern remains for facilities not regulated as CAFO's and possibly non-manure land application of materials containing pesticides or nutrients.
- Level of Concern – Intermediate
- Scope of Concern - Regional

STORAGE AND TREATMENT ACTIVITIES

LAND APPLICATION (REGULATED OR PERMITTED)

- Land application and associated facilities for disposal of septage, nonrecognizable food processing wastes or fish hatchery waste is regulated by NYS through DEC's solid waste program.
- Level of Concern – Low
- Scope of Concern - Regional

MATERIAL STOCKPILES

- Salt storage stockpiles are dealt with as a concern elsewhere in this section.
- Mined products stockpiles are regulated by DEC. Each mining permit application requires consideration for the potential of ground water contamination from stockpiles.
- Stockpiles that may be of concern for ground water contamination include treated woods. Although the

use of CCA is no longer allowed, continuous stockpiling of other unprotected treated woods may be a concern especially at wood treatment facilities. New York's Inactive Hazardous Waste Registry currently includes a former lumber pressure treatment facility (NY Id 401046) with a hazard classification of 02, which indicates a significant threat.

- Level of Concern – Intermediate
- Scope of Concern – Statewide

STORAGE TANKS (ABOVE GROUND)

- PETROLEUM TANK REGISTRATION – Since 1986, NYS law has required owners of petroleum tanks with a combined storage capacity of more than 1,100 gallons to register as petroleum storage facilities with DEC. This law applies to both aboveground and underground tanks. Facilities must re-register every five years. Owners are subject to construction, operation, and maintenance requirements. Concern remains for aboveground tanks currently exempt from regulation.
- CHEMICAL TANK REGISTRATION – Since 1989, NYS law has required owners of any underground tank of any size or aboveground stationary storage tanks equal to or greater than 185 gallons capacity, that store a defined hazardous substance, to register each with DEC. Concern remains for aboveground tanks currently exempt from regulation.
- Level of Concern – **High**
- Scope of Concern - Statewide

STORAGE TANKS (UNDERGROUND)

- PETROLEUM TANK REGISTRATION – See PETROLEUM TANK REGISTRATION under 'STORAGE TANKS (ABOVE GROUND)'. Concern remains for underground tanks currently exempt from regulation.
- CHEMICAL TANK REGISTRATION – See CHEMICAL TANK REGISTRATION under 'STORAGE TANKS (ABOVE GROUND)'. Concern remains for underground tanks currently exempt from regulation.
- Level of Concern – **High**
- Scope of Concern - Statewide

SURFACE IMPOUNDMENTS

- DEC regulations allow water impoundments to be constructed and used during mining activities however any discharge of water to either surface or subsurface waters must meet NYS water quality standards.
- DEC regulations allow the use of surface impoundments at facilities that treat, store, or dispose of hazardous waste provided they are designed, constructed, and installed to prevent any migration of wastes.
- DEC regulations allow the use of surface impoundments for treatment of solid waste provided they are located, designed, and operated so as to assure that there will be no migration of any hazardous constituent into ground water or surface water at any future time.
- DEC regulations allow the use of surface impoundments for treatment of municipal wastewater as outlined

in Recommended Standards For Wastewater Facilities². Construction standards include the sealing of cells to prevent seepage loss. Standards also require assessment of industrial wastes for possible pretreatment prior to this method of treatment.

- DOH regulations do not allow the use of surface impoundments for individual wastewater treatment systems.

This activity is of low concern due to the amount of regulatory oversight.

- Level of Concern – Low
- Scope of Concern – Statewide

WASTE PILES

- Regulations require piles of material classified as hazardous waste must be covered and bottom lined to prevent the migration of hazardous constituents.
- WASTE TIRES – Although waste tires do not pose a direct significant threat to ground water, there is increasing concern for waste tire fires and the associated toxic materials released to the environment, including ground water, during such an event. Since 1989 there have been at least 17 major waste tire fires in NYS consuming over 3 million tires. Waste tires have been regulated in NYS, as solid waste, since 1988 however there remains a concern for waste tire stockpiles.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

WASTE TAILINGS

- Since at least 1991 NYS regulations have required mining applications to include, among other things, the proposed location(s) and size of mineral and spoil storage areas along with existing or proposed drainage and water control features. Each application must also include proposed methods of pollution prevention. Due to the regulatory requirements involved in this activity, concern for ground water contamination is low for newer activities and high for activities that predate 1991.
- Level of Concern – Low / **High**
- Scope of Concern – Regional

DISPOSAL ACTIVITIES

DEEP INJECTION WELLS

- Currently there are six brine disposal wells, greater than 500 feet deep, permitted for use in five western or central NY counties (Genesee, Cayuga, Livingston, Steuben, and Allegany). Of those, four are associated with oil & gas production, two with gas storage operations, and the last with cavern construction. Rigorous

² Recommended Standards For Wastewater Facilities, Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 1997

construction, operation, and closure regulations are in place for brine disposal wells. Wells less than 500 feet are not permitted for use in brine disposal.

- There are no other deep wells in NYS where a permit has been approved for disposal of untreated waste.
- Level of Concern – Low
- Scope of Concern - Regional

LANDFILLS

- Landfills, including Construction & Demolition (C&D) Debris Landfills, have extensive NYS siting, design, operating and monitoring requirements. The last unlined landfill operating in New York State was closed in 2001. New, unlined landfills have not been issued permits to operate in NYS since 1988. Landfills constructed since then therefore do not pose the same threat to ground water as previous unlined facilities. Numerous older, closed landfills continue however to pose a threat to ground water. Currently, 121 former landfill sites are listed in the State Superfund Program.
- Level of Concern – **High**
- Scope of Concern - Statewide

SEPTIC SYSTEMS

- Septic systems must be properly sited, designed, constructed, maintained, and used in order to prevent ground water contamination. Procedures are in place at state and local levels to address the first three issues. Maintenance and use of Onsite Wastewater Treatment Systems (OWTS) usually falls to the discretion of each owner. Neglect, careless or intentional misuse of an OWTS remains a concern throughout the state.
- Level of Concern – **High**
- Scope of Concern - Statewide

SHALLOW INJECTION WELLS

- Some geothermal well systems employ an ‘open loop’ design that involves return of water by way of a shallow injection well. This activity is reviewed by DEC to determine if a discharge permit is required. Where it can be demonstrated that the initial water quality meets discharge standards and nothing will be substantially added during use, the system is not required to obtain a discharge permit. The system owner is however advised of and referred to EPA’s Underground Injection Control (UIC) program. All other types of shallow injection wells are likewise referred to EPA’s UIC program.
- Level of Concern – Low
- Scope of Concern – Statewide

OTHER ACTIVITIES

HAZARDOUS WASTE GENERATORS

- DEC has established three categories of hazardous waste generators: New York State Conditionally Exempt Small Quantity Generators (NYCESQGs), Small Quantity Generators (SQGs), and Large Quantity Generators (LQGs). Hazardous waste generation is categorized by DEC as either aqueous, or non-aqueous hazardous waste. In 2000 an estimated 72.0 million tons of aqueous hazardous waste was generated in NYS. In the same year, 836.8 thousand tons of non-aqueous hazardous waste was generated in NYS. Although 2% of LQGs accounted for 90% of this total, a significant amount of hazardous waste is generated by the remaining regulated community as well as those not subject to regulations. Concern remains high for this activity due to the widespread occurrence of generators and the human health risks of the wastes generated.
- Level of Concern – **High**
- Scope of Concern - Statewide

HAZARDOUS WASTE SITES

- New York State currently has (as of July 14, 2010) a list of Inactive Hazardous Waste Sites (IHWS) totaling 884. Sites are ranked from Class 1, (posing imminent danger) to Class 5 (completely remediated). DEC's website database of inactive hazardous waste sites has a breakdown as follows: Class 1 sites = 0; Class 2 sites = 523; Class 3 sites = 70; Class 4 sites = 275; Class 5 sites = 16. Class 5 sites are eventually delisted from the site registry and noted as a class C. This total includes 86 federal NPL sites.
- MANUFACTURED GAS PLANT (MGP) SITES – Currently approximately 200 sites have been identified as former MGP sites needing action. At this time, it is estimated there is a total of roughly 300 former MGP sites in NYS. Manufactured gas plants operated in many cities and towns across New York, primarily during the 1850s to 1950s. The plants converted coal, or a combination of coal, oil, and water, into a gas product used for lighting and heating. The potential wastes and substances of concern at former MGP sites may include coal, ash, cinders, coal tars, coal tar-related liquids and sludges, and gas purification wastes. Such materials may contain various organic and/or inorganic chemicals that are classified as hazardous substances or potentially regulated solid waste under State and Federal laws.
- Level of Concern – **High**
- Scope of Concern - Statewide

LARGE INDUSTRIAL FACILITIES

- Large industrial facilities can pose a threat to ground water in numerous ways. Often however they involve activities for which they are regulated in some manner whether it is storage, treatment, disposal, or generation of materials and wastes. For this reason, these facilities are not a high concern.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

MATERIAL TRANSFER OPERATIONS

- Concerns associated with this activity center on spills, see section on *SPILLS* for discussion of concerns.
- Level of Concern – **High**
- Scope of Concern - Statewide

MINING AND MINE DRAINAGE

- NYS regulations require discharges from mining operations must meet established water quality requirements including ground water. Due to existing regulatory programs, this activity is of lower concern for ground water contamination.
- Level of Concern – Low
- Scope of Concern - Statewide

PIPELINES AND SEWER LINES

- PIPELINES - Individual product pipelines that traverse large portions of NYS generally carry natural, propane or similar gas products. One major petroleum pipeline serves the NYC/NY-NJ Harbor area (details are no longer publicly available). Due to the types of products handled or the low occurrence of petroleum pipelines traversing the state, this activity is not a significant ground water contamination concern.
- SEWER LINES – Sewer lines are found in NYS communities of all sizes. Systems are commonly operated by gravity feed or at relatively low pressure. Forced mains are also used in some areas or from collection points to treatment plants. The frequency of ground water contamination from sewer lines is believed to be low in NYS however this is difficult to confirm. The potential for contamination is higher for forced mains however any such occurrence is usually detected and corrected quickly. Generally, sewer areas are also served by public water. This greatly reduces the potential of private well contamination.
- Level of Concern – Low
- Scope of Concern - Statewide

SALT STORAGE AND ROAD SALTING

- A 1991 report from the National Research Council³ suggests NYS may lead the nation in the total amount of salt used for roadway deicing with 450,000 tons used annually. A comparison of usage per road mile was not provided. To lessen the impacts of road salt the State Department of Transportation (DOT) has established recommended storage and handling procedures for its facilities including covered storage structures and, when needed, the use of temporary covering measures. Concern remains for this activity due to the amount used and its continuing impact on aquifers and at times, drinking water supplies.
- Level of Concern – Intermediate
- Scope of Concern – Statewide

³ Special Report 235; Highway Deicing, Comparing Salt and Calcium Magnesium Acetate; Transportation Research Board, National Research Council; 1991

SALT WATER INTRUSION

- Saltwater intrusion has long been recognized as an important issue in the coastal New York counties of Nassau, Suffolk, Kings (Brooklyn) and Queens which are heavily dependent on ground water. Some additional concerns exist in isolated areas of the state where ground water encounters salt deposits at relatively shallow depths.
- Level of Concern – Intermediate
- Scope of Concern - Regional

SPILLS

- There were 14,639 spills reported to DEC during 2009. This compares to 15,337; 15,085; 16,784; 16,084, 15,713; 15,522; 14,915; 14,564; and 16,522 for the years 2008 - 2000 respectively. These totals reflect a wide range of volumes and materials spilled as well as the manner of spills and the resulting response. Although many spills were small, contained, or quickly cleaned up, the overall number, volume, materials involved, and their possible effect on ground water, remain a high concern.
- Level of Concern – **High**
- Scope of Concern - Statewide

TRANSPORTATION OF MATERIALS

- Risks to ground water associated with the transportation of materials are discussed in several other sections. See sections regarding *SPILLS*, *PIPELINES AND SEWER LINES*, and *MATERIAL TRANSFER OPERATIONS*.
- Level of Concern – **High**
- Scope of Concern - Statewide

URBAN RUNOFF

- Urban runoff is generated from nonporous surfaces like roads, bridges, parking lots, and buildings. Examples of urban runoff contaminants of concern include oil; grease; toxic chemicals; nutrients; pesticides; pathogens; road salts; and heavy metals. This activity is already recognized as a significant concern to surface water quality. With increasing use of designed infiltration areas, storm water collection basins, or constructed wetlands there is concern that these vegetated areas will not be able to sufficiently treat or store runoff contaminants allowing their passage to ground water. There is additional concern for ground water contamination where natural or constructed infiltration areas are not vegetated, properly maintained, or the vegetation has been degraded from excessive pollutant loads.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

SMALL-SCALE MANUFACTURING AND REPAIR SHOPS

- Small-scale manufacturing and repair shops, like large industrial facilities, can pose a threat to ground water in numerous ways. Small-scale facilities however may not be subject to the same level of regulatory

oversight. They are also less likely to have dedicated staff, programs, or advanced methods and training in the prevention of ground water pollution. There is a higher concern for this activity for these reasons as well as their higher geographic occurrence throughout the state.

- Level of Concern – **High**
- Scope of Concern - Statewide

OTHER SOURCES

ABANDONED OIL & GAS WELLS

- Drilling for oil & gas in NYS has occurred since the early periods of exploration in the U.S. During much of that time proper well abandonment was not performed once wells were no longer in use. This has resulted in the improper abandonment of potentially tens of thousands of oil & gas wells from the western most regions of NYS to the eastern areas of Lake Ontario. Concern for ground water contamination involves the uncontrolled vertical migration of hydrocarbons & other associated contaminants by way of the abandoned bore hole.
- Level of Concern – **High**
- Scope of Concern – Regional

Overview of State Ground Water Protection Programs

Table 2: Summary of State Ground Water Protection Programs

Programs or Activities	Check (v) ⁽¹⁾	Implementation Status ⁽²⁾	Responsible State Agency ⁽³⁾
Active SARA Title III Program	√	Fully established	NYSEMO*, NYSDEC
Ambient ground water monitoring system	√	Continuing efforts	NYSDEC, USGS
Aquifer vulnerability assessment	√	Continuing efforts	NYSDEC
Aquifer mapping	√	Continuing efforts	USGS, NYSDEC
Aquifer characterization	√	Continuing efforts	USGS, NYSDEC
Comprehensive data management system	√	Continuing efforts	NYSDEC
Ground water discharge permits	√	Fully established	NYSDEC
Ground water Best Management Practices	√	Continuing efforts	NYSDEC
Ground water legislation	√	Continuing efforts	Various agencies
Ground water classification	√	Fully established	NYSDEC
Ground water quality standards	√	Fully established	NYSDEC
Interagency coordination for ground water protection initiatives	√	Continuing efforts	NYSDEC
Nonpoint source controls	√	Continuing efforts	NYSDEC* NYSAGMKT
Pesticide State Management Program	√	Fully established	NYSDEC
Pollution Prevention Program	√	Fully established	NYSDEC
Resource Conservation and Recovery Act(RCRA) Primacy	√	Fully established	NYSDEC
Source Water Assessment Program	√	Fully established	NYSDOH*, NYSDEC
State Superfund	√	Fully established	NYSDEC
State RCRA Program incorporating more stringent requirements than RCRA Primacy	√	Fully established	NYSDEC
State septic system regulations	√	Fully established	NYSDOH*, NYSDEC

Underground storage tank installation Requirements	√	Fully established	NYSDEC
Underground Storage Tank Remediation Fund	√	Fully established	NYSOSC*, NYSDEC NYSOAG
Underground Storage Tank Permit Program	√	Fully established	NYSDEC
Underground Injection Control Program	√	Fully established	USEPA
Vulnerability assessment for drinking water/wellhead protection	√	Continuing efforts	NYSDOH*, NYSDEC
Well abandonment regulations	√	Continuing efforts	NYSDOH*, NYSDEC
Wellhead Protection Program (EPA- approved)	√	Fully established	NYSDOH*, NYSDEC
Well installation regulations	√	Fully established	NYSDOH
OTHER NYS PROGRAMS OR ACTIVITIES			
Freshwater Wetlands Program	√	Fully established	NYSDEC, USACE
Drinking Water State Revolving Fund (SRF)	√	Continuing efforts	NYSEFC*, NYSDOH
Clean Water State Revolving Fund (SRF)	√	Continuing efforts	NYSEFC*, NYSDEC
Clean Water/Clean Air Bond Act	√	Continuing efforts	NYSDEC

NYSDEC - New York State Department of Environmental Conservation	NYSEFC - New York State Environmental Facilities Corporation
NYSDOH – New York State Department of Health	NYSTAX – New York State Department of Taxation and Finance
NYSAGMKT - New York State Department of Agricultural & Markets	NYSGOSC - New York State Governor's Office for Small Cities
NYSEMO - New York State Emergency Management Office	USACE - United States Army Corp of Engineers
NYSOSC – New York State Office of the State Comptroller	USEPA – United States Environmental Protection Agency
NYSOAG – New York State Office of Attorney General	USGS - United States Geological Survey

Notes for Table 2

1. A check (✓) after a program or activity in Table 20 indicates existing applicable State program or activity.
2. Implementation status for each of the programs. Terms used to describe implementation status include "not applicable", "under development", "under revision", "fully established", "pending", or "continuing efforts". Implementation status of special programs or activities and the terms used are discussed in the accompanying narrative.
3. State agency, bureau, or department responsible for implementation and enforcement of the program or activity. The lead agency is indicated by an asterisk (*) where multiple agencies are involved in the implementation and enforcement of a program or activity.

Discussion of State Ground Water Protection Programs

ACTIVE SARA TITLE III PROGRAM - SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) was passed as part of the 1986 federal Superfund Amendments and Reauthorization Act (SARA). This act has four major provisions: Emergency planning; Emergency release notification; Hazardous chemical storage reporting requirements; and Toxic chemical release inventory. The NYS Emergency Management Office is the lead agency for New York's EPCRA program. One portion of SARA Title III, the TRI program, is handled by DEC. The state EPCRA requirements are fully established and active. [For further information, go to: www.semo.state.ny.us/programs/serc, www.dec.ny.gov/chemical/8434.html]

AMBIENT GROUND WATER MONITORING SYSTEM - In 2001 DEC's Division of Water initiated a pilot ambient ground water monitoring program with the goal of establishing a continuing yearly sampling program based on the Division's Rotating Intensive Basin Study (RIBS) surface water monitoring program schedule. The pilot focused on the Mohawk River basin and was conducted as a cooperative effort with the U.S. Geological Survey (USGS). Sampling by USGS personnel occurred in 2002. The following is a chronology of activity since:

- In 2003 a similar limited effort was conducted in the Chemung River basin. A data report for the study was first developed and published.
- In 2004, a more extensive effort was conducted in the Lake Champlain and Upper Susquehanna River basins. Data reports for each area were again developed and published.
- In 2005, groundwater studies were conducted in the St. Lawrence, Delaware, and Genesee River basins. Data reports are also available from USGS for these study efforts.
- In 2006 studies were conducted in the Allegheny River, Lake Erie, Western Lake Ontario, and Mohawk River basins with data reports available through USGS.
- In 2007 studies were conducted in the Central NY - Finger Lakes and Upper Hudson River basins. Data reports have been finalized and published by USGS.
- In 2008 studies were conducted in the Lower Hudson River, Black River, and the Chemung River basins. This year's efforts completed the first full rotation of ground water sampling studies for NYS excluding Long Island. Data reports for these three basins are expected to be published in late 2010.
- In 2009 studies were again focused on the eastern Susquehanna River and Lake Champlain basins. Data and data reports are expected in 2011.
- In 2010 studies are underway for the St. Lawrence, Delaware, and Genesee River basins.

Analytical results and data reports are generally available through USGS approximately 1-2 years following completion of respective studies. Analytical results for each of these studies are available online through the USGS National Water Information System (NWIS). The Division of Water expects to continue its ambient ground water monitoring program with plans to conduct ground water sampling efforts in two or three major basins each year with the goal of fully assessing the state every five years. [For further information, go to: www.dec.ny.gov/lands/36117.html, nwis.waterdata.usgs.gov/ny/nwis/qwdata]

AQUIFER VULNERABILITY ASSESSMENT - Aquifer vulnerability assessment is required as part of New York's State Environmental Quality Review Act (SEQR) which became effective in November of 1978. This law requires all state and local government agencies to consider environmental impacts whenever they must approve or fund a

privately or publicly sponsored action. It also applies whenever an agency directly undertakes an action. [For further information, go to: www.dec.ny.gov/permits/357.html]

AQUIFER MAPPING - DEC's aquifer mapping and ground water resource evaluation cooperative effort with USGS dates back to the Department's predecessor, the NYS Water Resources Commission. This effort is expected to continue with approximately one mapping effort undertaken every two years. Consideration is given to population served, resource magnitude, and growth pressures when choosing subsequent mapping efforts. [For further information, go to: www.dec.ny.gov/lands/36118.html]

AQUIFER CHARACTERIZATION - Aquifer characterization is accomplished in conjunction with DEC's cooperative aquifer mapping effort with USGS (see AQUIFER MAPPING section above). Typical information includes material type (i.e. sand & gravel, lacustrine, etc), potential yields, aquifer thickness, and cross sections. Aquifer characterization is expected to continue with mapping efforts of approximately one every two years.

COMPREHENSIVE DATA MANAGEMENT SYSTEM - Ground water data management is a challenging issue due to the numerous programs involved in groundwater data collection and use. DEC has been working both internally and with outside agencies to create a dedicated data system incorporating remedial program data, public water supply and water well reporting data along with other appropriate data. One example of this effort is the current or planned establishment of network nodes at DEC and DOH.

GROUND WATER DISCHARGE PERMITS - DEC has had an approved NPDES pollutant discharge permit program since 1975 and an approved General Permit program since 1992. Although the NPDES program does not require NPDES permits for discharges to ground water, DEC maintains stringent requirements as part of its permitting process for discharges greater than 1,000 gpd to ground water. Discharges to ground water of less than 1,000 gpd are generally residential systems, which are handled through state & local health departments. [For further information, go to: www.dec.ny.gov/permits/6054.html, <http://cfpub.epa.gov/npdes/>]

GROUND WATER BEST MANAGEMENT PRACTICES (BMPs) - Ground Water Best Management Practices include methods, measures or practices suggested or selected for use in protecting ground water. They include structural and nonstructural controls, operation, or maintenance procedures. DEC has developed a catalog of management practices as part of its Nonpoint Source Management Program. The catalog includes a separate review of management practices in nine separate activities relating to:

Urban/Stormwater Runoff Agriculture Silviculture	Construction Hydrologic/Habitat Modification Road/Right-of-Way Maintenance	Leaks, Spills, Accidents Resource Extraction On-Site Waste Disposal
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Each subject, while considering more than just impacts to ground water, specifically reviews ground water concerns. Other state programs including the Agricultural Environmental Management (AEM) Program, under NYS Agriculture and Markets, have also developed worksheets which, in part, consider ground water protection. In another example NYSDOT has developed an Environmental Handbook for Transportation Operations which is intended to provide general awareness and guidance related to state DOT operations. [For further information, go to: www.dec.ny.gov/about/859.html, www.agmkt.state.ny.us/SoilWater/aem, www.nysdot.gov]

GROUND WATER RELATED LEGISLATION

- SMALL BUSINESS POLLUTION PREVENTION AND ENVIRONMENTAL COMPLIANCE ASSISTANCE PROGRAM – This law took effect September 16, 2005 establishing a new Article 28 under Environmental Conservation

Law titled Pollution Prevention. Among other things this law specifically cites protection of groundwater.

- MTBE - As of January 1, 2004, NYS law prohibits gasoline products containing MTBE as an additive from being imported, sold, dispensed, or offered for sale in New York State.
- BROWNFIELD / GROUNDWATER GIS – In October of 2003, the NYS Brownfield Cleanup Program (BCP) was signed into law. This legislation sets forth requirements and criteria for participation and clean-up efforts as well as tax and grant incentives plus liability limitation once a Certificate of Completion is issued.

GROUND WATER CLASSIFICATION - Classification of ground water has been established through state environmental regulations since 1985. All fresh ground water in NYS is classified as GA. Class GA waters are assigned a best usage as a source of potable water supply. [For further information, go to: www.dec.ny.gov/chemical/23853.html]

GROUND WATER QUALITY STANDARDS - Regulations establishing ground water quality standards in NYS were first promulgated in 1967. These regulations continue under authority of NYS Environmental Conservation Law and are enforced by DEC. Under NYS law DEC maintains these standards as part of its charge to protect the waters of the state. These standards closely parallel but should not be confused with NYS drinking water standards maintained by NYS DOH for public water supplies. [For further information, go to: www.dec.ny.gov/chemical/23853.html]

INTERAGENCY COORDINATION FOR GROUND WATER PROTECTION INITIATIVES - Interagency coordination of ground water protection issues occurs on various levels of federal, state and local governments from staff level on up through the bureau and director levels including both short and long term committees such as the NYS Nonpoint Source Coordinating Committee, Water Quality Coordinating Committees, the NYS Soil and Water Conservation Committee, and the Source Water Protection Coordinating Committee (SWPCC). Most recently coordination between DEC, NYSDOH, and USGS has been underway concerning the development of a groundwater related data system. (See section on COMPREHENSIVE DATA MANAGEMENT SYSTEM for additional details.)

NONPOINT SOURCE CONTROLS - New York's strategy for dealing with nonpoint source pollution is based on the following source control mechanisms: planning, monitoring, direct implementation, regulatory programs, financial incentives, demonstration projects, technical assistance, technical training, and outreach. This strategy is pursued at the state level through the New York Nonpoint Source Coordinating Committee (NPSCC) representing 18 federal, state, and local agencies. It is also pursued at the local level by County Water Quality Coordinating Committees (WQCCs) established through the efforts of the NYS Soil and Water Conservation Committee (NYSSWCC) and DEC. [For further information, go to: www.dec.ny.gov/docs/water_pdf/npsmgt.pdf, and www.agmkt.state.ny.us/soilwater/aem]

PESTICIDE STATE MANAGEMENT PROGRAM - DEC is responsible for the regulation of pesticides and pesticide application reporting, providing compliance assistance, water quality monitoring for pesticides, public outreach activities and enforcement of State pesticide laws. Registration of pesticides in New York State predates DEC's creation in 1970. Products that constitute a major change in use or contain a new active ingredient undergo a thorough review prior to approved registration. Commercial application businesses are required to register with DEC with certification required for each individual who performs pesticide application. NYS has also adopted a Neighbor Notification Law that requires the posting of visual notification markers when 100 square feet or more of residential lawn application occurs. This law is in effect only when adopted at the county level. January 1, 2008, the following have "opted in": Albany, Erie, Monroe, Nassau, Rockland, Suffolk, Tompkins, Ulster, and Westchester Counties, and New York City. Lastly, a permit is required for the sale of restricted use pesticides in New York State. Pesticides are also a component of New York States' Department of Agriculture and Markets Agricultural Environmental Management (AEM) program. The voluntary, incentive-based program has developed two pesticide

management worksheets dealing with use, storage, mixing, and loading. AEM operates at state and local levels providing financial, educational, and technical assistance to farmers to deal with environmental concerns. [For further information, go to: www.dec.ny.gov/chemical/298.html, and www.agmkt.state.ny.us/soilwater/aem]

POLLUTION PREVENTION PROGRAM - The Pollution Prevention Unit of DEC works to "Reduce or eliminate the use of toxic substances and the generation of pollutants at the source." This is done through technical assistance outreach and targeted prevention planning development with small & large businesses, local governments, state agencies, and the public. [For further information, go to: www.dec.ny.gov/about/817.html]

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PRIMACY - New York State initially received EPA interim base authorization to implement and enforce the federal RCRA-C program in July of 1982, with final base authorization granted in May of 1986. Currently, NYS has adopted 100+ percent of the federal program, including some optional rules. [For further information, go to: www.dec.ny.gov/chemical/8477.html]

SOURCE WATER ASSESSMENT PROGRAM - In NYS, the Source Water Assessment Program (SWAP) was developed and implemented by the New York State Department of Health (DOH) with input from other government agencies and private and public interest groups⁴. New York's SWAP was approved by EPA in November 1999. Over 9,000 public water systems maintain a total of approximately 14,000 sources of water in NYS. There are roughly 1,700 additional systems that purchase their water and were excluded from SWAP requirements. To accomplish the assessments, DOH awarded a contract to URS Corporation for upstate New York including 8,400 public water systems with 12,300 wells. An additional contract was awarded to Camp, Dresser and McKee to complete assessments for Nassau and Suffolk counties including over 500 public water systems with more than 1,500 wells. The source water assessments for the approximately 350 public supply surface water sources and springs in New York State were completed by NYSDOH. [For further information, go to: www.health.state.ny.us/nysdoh/water/swap.htm]

STATE SUPERFUND - In NYS the Superfund program is known as the Inactive Hazardous Waste Disposal Site Remedial Program. The program seeks to identify and characterize suspected inactive hazardous waste sites and remediate those that have consequential amounts of hazardous waste which pose a significant threat to public health and the environment⁵. As part of the program a registry of sites is maintained with each assigned a classification based on its current stage of investigation or remediation. For a breakdown of the current list see section titled Summary of Ground Water Contamination Sources. [For further information, go to: www.dec.ny.gov/chemical/8439.html]

STATE RCRA PROGRAM INCORPORATING MORE STRINGENT REQUIREMENTS THAN RCRA PRIMACY - New York State has adopted the full federal RCRA program including some optional rules making the state program more stringent than RCRA primacy requirements, see *RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PRIMACY* above. [For further information, go to: www.dec.ny.gov/chemical/8477.html]

STATE SEPTIC SYSTEM REGULATIONS - Statewide minimum regulations for septic systems with a design capacity of 1,000 gallons per day (gpd) or less have been in place since 1967 under NYS Public Health Law regulations (NYCRR Title 10, Volume A-1a, Part 75 including Appendix 75-A). Septic systems with a design capacity of 1,000 gpd or more must be designed or approved by a licensed professional and require a wastewater discharge permit from NYSDEC. [For further information, go to: www.health.state.ny.us/nysdoh/water/appendix_75a.htm]

⁴ Source Water Assessment Program Plan, NYS Dept. of Health, November 1999.

⁵ Remedial Programs Annual Report for State Fiscal Year 2004-05, NYSDEC, Div. of Environmental Remediation, 625 Broadway, Albany, New York 12233-7010

UNDERGROUND STORAGE TANK INSTALLATION REQUIREMENTS - Since 1994 DEC regulations have contained standards for the installation of new or replacement underground hazardous substance storage tanks dealing with tank construction specifications; secondary containment; leak monitoring; installation; piping; spill/overflow prevention; vents, gauges, and alarms; and tank labeling. Similar regulations have been in effect for new or replacement underground petroleum storage tanks since 1985 for facilities with a combined capacity of 1,100 gallons or more. [For further information, go to: www.dec.ny.gov/chemical/287.html]

UNDERGROUND STORAGE TANK REMEDIATION FUND - This fund was established by the New York State Legislature in 1977 and is officially known as the New York Environmental Protection and Spill Compensation Fund. It is more commonly known as the (NYS) Oil Spill Fund and other times as the Leaking Underground Storage Tank Fund. The fund is used where the responsible party is unknown or unable to pay for a cleanup that is considered necessary to prevent risking public health or the environment. The fund is administered by the State Comptroller's Office. Technical guidance is provided by NYSDEC while the NYS Attorney General's Office pursues fund compensation and criminal charges as appropriate. [For further information, go to: www.osc.state.ny.us/oilspill/index.htm , www.oag.state.ny.us/press/reports/oil_spills/oil_spill.html , www.dec.ny.gov/chemical/8638.html]

UNDERGROUND STORAGE TANK PERMIT PROGRAM - New York State has had a tank registration program since 1986. See section on *STORAGE TANKS (ABOVE GROUND)* for discussion of this item.

UNDERGROUND INJECTION CONTROL PROGRAM - Currently NYS has not requested program primacy for the federal UIC program. As indicated above, NYS does maintain stringent requirements through its SPDES permitting process for discharges to ground water greater than 1,000 gpd. While this may exclude smaller facilities of concern, larger municipal & industrial ground water discharges are regulated. [For further information, go to: www.epa.gov/safewater/uic/index.html]

VULNERABILITY ASSESSMENT FOR DRINKINGWATER/WELLHEAD PROTECTION - Vulnerability assessments have been undertaken for each public drinking water supply as part of the Source Water Assessment Program implemented by NYSDOH. See *SOURCE WATER ASSESSMENT PROGRAM* for additional details.

WELL ABANDONMENT REGULATIONS - Abandonment of mineral resource related wells is regulated by DEC. Types of wells include oil, gas, solution mining, geothermal, and exploration. To ensure proper closure of wells, DEC requires each applicant to post appropriate financial bonding. NYS DOH has established regulations for abandonment of public and private water supply wells. [For further information, go to: www.dec.ny.gov/energy/1618.html, www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm , www.health.state.ny.us/environmental/water/drinking/part5/appendix5d.htm , www.dec.ny.gov/lands/5000.html]

WELLHEAD PROTECTION PROGRAM (EPA-APPROVED) - New York State's approved wellhead protection plan was transferred from DEC to DOH at the start of the Source Water Protection Program. DEC's program was approved by EPA in 1990. Wellhead protection is handled jointly by DOH and DEC for each new public water supply well as it goes through the water supply permitting process. [For further information, go to: www.health.state.ny.us/environmental/water/drinking/wellhead/wellfact.htm]

WELL INSTALLATION REGULATIONS - In 1999 the NYS Well Driller Registration Law was enacted and became effective in January of 2000. One aspect of this law called for the NYS Department of Health (DOH) to establish water well construction regulations. Separate regulations have been established for both private and public water supply wells. Important aspects of the regulations include minimum casing, grouting, and separation distances from contamination sources. [For further information, go to: www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm , and www.health.state.ny.us/environmental/water/drinking/part5/appendix5d.htm]

OTHER NYS PROGRAMS OR ACTIVITIES

FRESHWATER WETLANDS PROGRAMS - Freshwater wetlands are an important component of ground water protection. Wetlands help break down, use, and immobilize pollutants. This is particularly important where involved in recharging groundwater. New York's Freshwater Wetlands Program was established after state passage of the State Freshwater Wetlands Act in 1975. The state regulates wetlands larger than 12.4 acres including an adjacent area of 100 feet. The U.S. Army Corps of Engineers also regulates activities in wetlands of any size. [For further information, go to: www.dec.ny.gov/lands/4937.html]

DRINKING WATER STATE REVOLVING FUND (DWSRF) - The Drinking Water State Revolving Fund (DWSRF) was created in 1996 as a means to provide a significant financial incentive for municipally and privately owned drinking water systems to finance needed drinking water infrastructure improvements. The DWSRF is administered jointly by the New York State Department of Health (DOH) and the New York State Environmental Facilities Corporation (EFC). [For further information, go to: www.nysefc.org, and www.nyhealth.gov/environmental/water/drinking/water.htm]

CLEAN WATER STATE REVOLVING FUND (CWSRF) - The NYS Clean Water State Revolving Fund was established in 1990 to provide low-interest financing to preserve, protect, or improve water quality. Eligible projects may involve point or nonpoint sources of pollution. [For further information, go to: www.nysefc.org]

CLEAN WATER/CLEAN AIR BOND ACT - New York's Clean Water/ Clean Air Bond Act was approved by NYS voters in November 1996 part of which provided funding for investigations and cleanup of Environmental Restoration Projects. Enhancements to the program were enacted on October 7, 2003. Projects are evaluated on, among other things, the potential for public or recreational use after the site is cleaned up. Applications have not been approved since 2008 and new applications are not being accepted due to lack of funding. [For further information, go to: www.dec.ny.gov/chemical/8444.html]

Summary of Ground Water Contamination Sources

New York State Superfund Program

New York's Superfund Program maintains a Registry of Inactive Hazardous Waste Disposal Sites where a disposal of a consequential quantity of hazardous waste has occurred. The program also maintains a list of non-registry site (i. e., Brownfield Cleanup Program, Environmental Restoration Program, and Voluntary Cleanup Program sites) where remedial program work is underway. The breakdown of sites as of July 14, 2010 is shown in Table 2. For current information see www.dec.ny.gov/chemical/8439.html.

Table 2 - Status of Sites Currently Listed on the Registry as of July 14, 2010		
Registry Class	Class Description	No. of Sites
Class 1	Causing or presenting an imminent danger of causing irreversible or irreparable damage to public health or environment - immediate action required	0
Class 2	Significant threat to the public health or environment - action required	523
Class 3	Does not present a significant threat to the public health or environment - action may be deferred	70
Class 4	Site properly closed - requires continued management	275
Class 5	Site properly closed - no further action required	16
	Sites on Registry	884
Class A	The classification assigned to a non-registry site in any remedial program where work is underway and not yet complete.	671
Class C	The classification used for sites where the Department has determined that remediation has been satisfactorily completed under a remedial program.	550
	Total	2,105

Federal Superfund Program

Some inactive hazardous waste disposal sites listed on New York's Registry are also listed on the National Priorities List (NPL). EPA is the lead agency responsible for remediating NPL sites in New York. The Department provides oversight of EPA's remedial program at NPL sites in New York. As of July 14, 2010, 90 sites in New York have been listed on the NPL. For current information see www.epa.gov/region02/superfund.

Summary of Ground Water Monitoring Data

NYS established a statewide Ambient Groundwater Monitoring Program in 2002 in cooperation with the U.S. Geological Survey (USGS). The program is designed to monitor all major drainage basins in the state once every five years. As of 2008 one full rotation of monitoring has been completed for the state. Since 2003 data reports have been developed for each major basin. Below are links to each year's data report for those that have been completed and published. Analytical data is also available online at the USGS National Water Information System (NWIS) web portal (waterdata.usgs.gov).

2003 - [Ground-Water Quality in the Chemung River Basin, New York, 2003](#)

2004 - [Ground-water quality in the upper Susquehanna River Basin, New York, 2004-05](#)

2004 - [Ground-Water Quality in the Lake Champlain Basin, New York, 2004](#)

2005 - [Ground-Water Quality in the Delaware River Basin, New York, 2001 and 2005-2006](#)

2005 - [Ground-Water Quality in the St. Lawrence River Basin, New York, 2005-06](#)

2005 - [Ground-Water Quality in the Genesee River Basin, New York, 2005-2006](#)

2006 - [Ground-Water Quality in the Mohawk River Basin, New York, 2006](#)

2006 - [Ground-Water Quality in Western New York, 2006](#)

2007 - [Ground-Water Quality in the Upper Hudson River Basin, New York, 2007](#)

2007 - [Groundwater Quality in Central New York, 2007](#)

New York State Wetlands Assessment

As stated in New York State freshwater and tidal wetlands laws (Articles 24 and 25 of the Environmental Conservation Law), it is the policy of the state to preserve, protect and conserve wetlands and the benefits derived therefrom, to prevent the despoliation and destruction of wetlands, and to regulate use and development to secure the natural benefits of wetlands, consistent with the general welfare and beneficial economic, social and agricultural development of the state. Protection of wetlands is a priority in the state.

Wetlands provide a suite of functions and benefits to the environment and the people of the state, including: flood and storm water control; erosion and sedimentation control; water quality maintenance; primary food production, fish and wildlife habitat; recreation, open space, and educational opportunities (see Table 1).

Extent of Wetlands Resources

New York has an estimated 2.5 million acres of freshwater wetlands and 25,000 acres of tidal wetlands. They encompass about nine percent of the land mass of New York. Wetlands types include marshes; hardwood, coniferous and shrub swamps; wet meadows; bogs; fens; and coastal marshes.

There are three main wetland inventories for New York State. Two are regulatory inventories prepared under state statutes. The tidal wetlands inventory shows tidally influenced wetlands on Long Island, in New York City, and in certain counties along the southern reaches of the Hudson River. Tidal wetlands currently are being mapped in the Hudson River up to the Troy Dam. The freshwater wetlands inventory shows all freshwater wetlands protected under Article 24, which outside the Adirondack Park includes those wetlands greater than 12.4 acres in size, and certain smaller wetlands of unusual local importance. Inside the Park, wetlands are protected down to one acre, or smaller if they are connected to an open water body. The National Wetlands Inventory maps, produced by the U.S. Fish and Wildlife Service, show all wetlands and deepwater habitats, to the extent they can be detected in aerial photography. New York recently worked with the FWS to update the maps for the lake plains, and to complete mapping in the Capital district.

The U.S. Fish and Wildlife Service estimates that over half of New York's wetlands have been lost since colonization. In order to evaluate the effectiveness of the state's tidal wetlands program in protecting wetlands under the Tidal Wetlands Act (Article 25 of the Environmental Conservation Law), a tidal wetlands trends analysis is being conducted by the New York State Department of Environmental Conservation. To date, the tidal wetlands trends analysis has shown the regulatory program to protect tidal wetlands from the historic "fill and build" damage is extremely successful. In many areas (e.g. Shinnecock and Moriches Bay on Long Island) there is no detectable loss due to those activities. In fact, the wetlands have increased over 250 acres in Shinnecock and Moriches Bay due to the landward migration of wetlands.

However, NYSDEC has observed significant losses of vegetated tidal wetlands, principally saltmarsh cordgrass (*Spartina alterniflora*) (Intertidal Marsh), in marsh islands of Jamaica Bay, New York City and in Nassau and Suffolk Counties. Over 1000 acres of vegetated tidal wetlands have been lost since 1974. Strategies are being discussed to identify causes and solutions. Initial observations indicate that relative sea level rise and sediment budget disruption play a significant role.

Table 1**Functions and Values of Wetlands**

Function	Value
Flood / Storm Water Control	During heavy rains and spring snow melt, wetlands serve as natural reservoirs for excess water which reduces peak flows, and slows the movement of water, thereby reducing flooding.
Erosion/ Sedimentation Control	By decreasing water velocity, wetland vegetation reduces erosion, filters sediment, and prevents suspended particles from entering navigational channels, lakes, and reservoirs. Similarly, wetlands also reduce shoreline erosion by buffering adjacent lands from wave or stream current effects.
Pollution Treatment/Reduction	Microorganisms in wetlands break down and use nutrients, reducing loads to surface water. Wetlands also lock up other pollutants, rendering them inaccessible. Wetlands are occasionally used in tertiary wastewater treatment.
Fish and Wildlife Habitat	Wetlands provide important habitats for many species of fish and wildlife, including migratory birds and species identified as endangered, threatened or of special concern. Wetlands also provide habitat for spawning, nursery, and cover for numerous fish species. Tidal wetlands, in particular, are critically important for marine species and the support of a significant commercial and recreational fishery. Wetlands are important components of the state=s biological diversity.
Primary Productivity	The products of vegetative photosynthesis and primary productivity support wetlands and are transported to adjacent waters for use in aquatic and estuarine food chains.
Nutrient Cycling	Wetlands filter and recycle sediment and organic and chemical nutrients, an important link in the food web.
Recreational Opportunities	Wetlands provide numerous recreational uses including hunting, trapping, fishing, boating, hiking, bird watching, and photography. Countless New Yorkers (and out-of-state tourists) participate in these activities, generating millions of dollars in revenue annually.
Open Space	Wetlands are often the only undeveloped areas in otherwise heavily developed areas, thereby providing open, green areas for quality of life and provide a link between local residents and natural communities.
Education/ Research Opportunities	Wetlands provide readily accessible outdoor biophysical laboratories, living classrooms and vast training and educational resources.

A status and trends report of freshwater wetlands was also completed, showing that New York had a net gain of approximately 15,000 acres of wetlands between 1985 and 1995. The report compared mid-1980 and mid-1990 aerial photographs of a sample of sites in five ecological zones of the state. Gains, losses, and changes in cover type were identified, and the causes of those changes noted.

Approximately 22,000 acres of wetlands were lost to causes primarily associated with development and agriculture. Approximately 37,000 acres of wetlands were gained, primarily from abandoned agricultural land reverting back to wetland, and from increased runoff flooding previously dry areas. The majority of gains were in the Lake Plains ecological zone. In the Appalachian highlands (southern tier), Adirondacks, and coastal plains (Long Island) gains and losses balanced each other. Net losses occurred in the Hudson valley.

While a net gain of acreage is good news for the state, it must be celebrated cautiously. New York State lost 11,000 acres of wetlands to development, resulting in a loss of wetlands benefits in urbanized areas. Gains were from abandoned agricultural land, resulting in gains in rural areas. Gains also occurred mostly in the lake plains, and net losses occurred in the Hudson Valley. Consequently, the state has seen a shift in where wetlands are located. Furthermore, most of the gains occurred from causes not attributable to wetlands conservation programs, but from changes in land use. When no more previously drained farmland is abandoned, and reversion of wetlands declines, New York State may again see a net loss of wetlands. New York is seeking funding to continue the status and trends study by evaluating the period from the mid-1990s to present.

Wetlands Protection Strategies

NYSDEC administers a broad array of regulatory and non-regulatory programs, undertaken in partnership with other federal, state, and local governmental agencies and with the non-governmental sector, to preserve, protect, and conserve wetlands. Through efforts such as restoration, acquisition, regulation, and management, NYSDEC strives to achieve a no overall net loss of wetlands acreage and function, and net gain in wetlands where feasible and desirable.

Planning

Planning is the means for providing a vision and context for wetlands conservation. It is integral to effectively implementing any wetlands conservation program because it establishes the context for implementation. The State Wetlands Conservation Plan was drafted to provide a broad context for wetlands conservation programs and activities in the state. However, at this time most planning that encompasses wetlands is occurring at the regional, watershed, and local levels. Planning can occur at any level of government or by the non-governmental sector but is often most effective when it is done through partnerships and when integrated with other land use and resource planning efforts. NYSDEC is including wetlands protection and restoration as components of landscape-level planning efforts, such as the DFWMR's Comprehensive Wildlife Conservation Strategy of 2005. NYSDEC's freshwater wetlands inventory and the National Wetlands Inventory are now available digitally, which increases the utility of the data in local planning efforts.

Acquisition

Acquisition is an important component of a long-term wetland conservation strategy, and New

York has a rich history of acquiring wetlands. In the past, the wetlands acquisition program was funded by Environmental Quality Bond Acts, and through various federal funding sources. Today, wetlands acquisition is coordinated through the State Open Space Conservation Plan. Acquisition, however, is expensive and other options are being sought, such as cooperative easements and agreements with landowners. There is also an increasing effort to coordinate acquisition efforts, pool resources, and emphasize a partnership approach.

Regulation

Regulation is often viewed as the primary wetlands conservation tool and is often equated with government=s overall wetlands conservation program, despite the full array of effective, positive efforts ongoing and available. Wetlands regulation at the state level began in the 1970s with the adoption of the Tidal Wetlands Act (Article 25 of the Environmental Conservation Law) in 1973. Certain freshwater wetlands are protected under the 1975 Freshwater Wetlands Act (Article 24 of the ECL). Both statutes require mapping of jurisdictional wetlands. Outside of the Adirondack Park, Article 24 only protects wetlands over 12.4 acres (5 hectares) in size or smaller wetlands of unusual local importance. This accounts for about 80 percent of the wetland acreage outside the Adirondack Park. Inside the Park, wetlands are protected down to one acre, or smaller if there is an open water connection with a permanent water body. A 100-foot adjacent area is also protected as a buffer to the wetland. Permits are required to conduct regulated activities, such as draining, filling, polluting, and dredging. Certain activities are exempt from regulation, including most normal agricultural activities (except filling). Wetlands also are regulated under Article 15, Protection of Waters Act, if they are adjacent to protected streams or state navigable waters. The vast majority of wetlands protection efforts are funded by the state=s Conservation Fund (hunting and fishing license revenues), excise tax fees, and a limited amount of General Fund dollars. There is no EPA Performance Partnership Program funding provided for the wetlands protection program.

Wetlands also are regulated under Section 404 of the federal Clean Water Act and Section 10 of the River and Harbors Act.

Federal statutes have no size thresholds, and regulate any dredging, filling, or mechanized land clearing activities that impair the nation=s waters, or if under Section 10, any navigability of the nation=s water.

Finally, local governments can regulate wetlands either pursuant to Article 24, or independently under Home Rule Authority. Three municipalities implement Article 24, and a few dozen have local ordinances affecting wetlands. In these areas, three permits may be required to conduct a regulated activity in certain wetlands.

Restoration, Creation and Management

These options include actual on-the-ground manipulation conducted to maintain, improve, or bring back degraded or altered wetlands. There is a broad variety of restoration and management efforts underway in the state, most of which are done in partnership between agencies and other stakeholders. Until recently, most of the restoration and management was for fish and wildlife habitat and was focused through the North American Waterfowl Management Plan and other similar efforts. However, restoration of aquatic habitat, water quality, and broad ecosystem function is becoming increasingly of interest in the state. Wetland restoration actions will be included in landscape-level planning efforts.

Incentive and Disincentives

These options generally receive unanimous support from all sectors, yet it is a very infrequently used approach to wetlands conservation, most likely because it usually includes financial motivation. Disincentive programs are often linked to denying economic benefits if a wetland is negatively impacted. While not regulatory, it still is viewed as punitive by those affected. Incentive programs try to make wetland ownership profitable, or at least less costly (e.g. tax breaks for landowners). Sometimes technical assistance or recognition may be sufficient incentive for landowners to take positive steps for conservation.

Research

Knowledge about wetlands has increased dramatically in the past ten years. Research on wetlands continues and interest by academic institutions appears to be growing as well. Gathering data through inventories, mapping, and monitoring is increasing, but gaps still remain. Use of Geographic Information Systems has drastically improved our ability to manage and track information about wetlands systems. All NYSDEC's regulatory freshwater wetlands maps are available digitally, as are some of Adirondack Park Agency's (APA) maps. Most of the National Wetlands Inventory maps are also digitized.

Education, Outreach and Technical Assistance

These programs provide the building blocks of sound conservation programs: information. They provide the delivery mechanism for information gathered through research, inventories and monitoring and provide information to decision makers to develop or modify programs. These programs deliver maps and inventory information to people who need it to make land purchases or to conduct site planning. Thus, information is translated into reality, as when agency staff work with a landowner to restore a wetland on an abandoned farm field. Education, outreach, and technical assistance are universally supported, but rarely adequately funded. In the past, USEPA Region II Office funded a number of education and outreach initiatives to improve the public's understanding of wetlands functions and programs to protect wetlands. NYSDEC and other agencies have been partners to these programs. Education through schools and not-for-profit groups has also increased in recent years.

Development of Wetland Water Quality Standards

Wetlands, as waters of the United States, are protected under the Clean Water Act, including water quality standards under Section 303 and monitoring under Section 305(b). In 1995, NYSDEC received a grant from USEPA under Section 104(b)(3) to develop narrative water quality standards that specifically incorporate wetlands. The standards were developed by NYSDEC's Division of Fish, Wildlife, and Marine Resources (DFW&MR), wherein the expertise resides for wetlands protection and conservation. Standards have not been adopted due to workload issues and the difficulty of smoothly incorporating wetlands protection into delivery of water quality standards.

Further Integration of Wetlands Assessments

Development of wetland water quality standards is an important step in better integrating wetlands protection into other aspects of implementation of the Clean Water Act. According to USEPA guidance: A development of wetland water quality standards provides a regulatory basis for a variety of water quality management activities including, but not limited to, monitoring and assessment under Section 305(b), permitting under Sections 402 and 404, water quality certification under Section 401, and control of nonpoint source pollution under Section 319. @

USEPA has begun the process of completing a National Wetland Condition Assessment. New York State will be participating in the completion of the national assessment. New York State is also planning to apply for an EPA Grant to develop a plan for wetland monitoring for New York State. We're hopeful that a plan can be completed but have not identified the funds for future monitoring efforts that would be needed as part of the plan. New York State has not yet integrated wetlands into existing surface water monitoring programs, nor undertaken efforts to monitor the biological, physical, and chemical integrity of wetlands.

Because no formal, coordinated monitoring of wetlands exists within NYSDEC, it is not possible to report on attainment of designated uses or to identify causes or stressors and sources of impairment. The Priority Waterbodies List effort includes wetland and other natural resources in determining impairments, and wetlands will be factored into future work. Both DFW&MR and the Division of Water recognize the need to work together to integrate wetlands into all appropriate aspects of the NYSDEC overall program to protect the chemical, physical and biological integrity of New York State waters.



Top Ten Water Quality Issues in New York State

Urban Stormwater Runoff

The Problem...

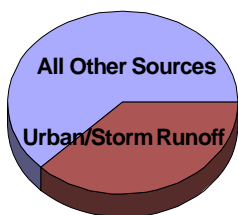
Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces such as paved streets, parking lots and rooftops and does not seep into the ground. Consequently, it accumulates and transports chemicals, nutrients, sediment or other pollutants and debris. If the runoff is not captured or it is discharged without first being treated, it can adversely affect water quality in the receiving lakes, rivers, and estuaries.

The impact from stormwater runoff is a more significant problem in urban and developed areas where there is a greater percentage of impervious surfaces. There are numerous Best Management Practices (BMPs) designed to capture and treat stormwater, however

retrofitting these approaches in long-established urban areas can be technically challenging and costly.

The Significance...

Urban stormwater runoff is identified as a major source in 37% of all waterbodies assessed as impaired in New York State. In another 40% of impaired waterbodies, urban stormwater runoff is a contributing source (though not the most significant source)? In addition, for 35% of the waters with less severe minor impacts or threats urban stormwater runoff is noted as a major contributing source of impact.



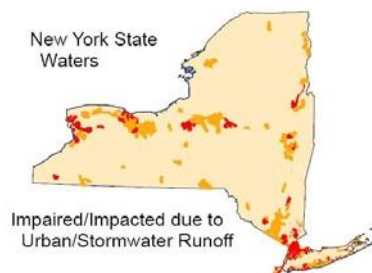
However, if atmospheric deposition of pollutants (acid rain, mercury) and legacy pollutants in river and lake sediments (PCBs, dioxin) B sources that are largely beyond the control of water programs B is not

considered, urban/stormwater runoff is cited as a contributing source in 75% of all impaired waters and a major contributing source in 61% of impaired waters in the state.

In addition to being cited as a major source in one-third of all impaired waters, urban/stormwater runoff is noted as a major source of contaminants in 36% of all waters that experience lesser, but measurable, minor impacts to water quality, and a contributing source in nearly half (47%) of waters with minor impacts.

Specific Waters...

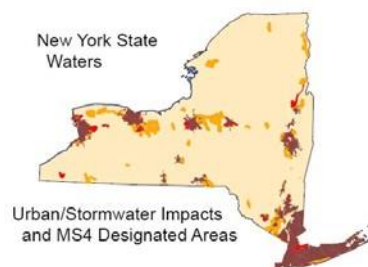
Waters that are impaired or impacted by urban stormwater runoff occur throughout New York State. Not surprisingly, however, such waters are most likely to occur in and around the major metropolitan areas of the state, such as New York City, Buffalo, Syracuse, Rochester, Albany, and other population centers.



What is Being Done...

Because of the impacts of stormwater on water quality, stormwater control has become a significant NYSDEC Water Program initiative. The cornerstone of this effort is implementation of the Phase II stormwater regulations, which require permits for stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s) in urban areas. NYSDEC has issued a general permit for MS4s in urban areas requiring that that these municipalities develop a Stormwater Management Plan (SWMP) that includes identification of Best Management Practices (BMPs) to be implemented, as well as public education and reporting components.

The MS4 areas, where much of the NYSDEC stormwater effort is concentrated, coincide closely with waters that are impaired and impacted by stormwater runoff.



More Information

NYSDEC Stormwater Control Program

<http://www.dec.ny.gov/chemical/8468.html>

US Environmental Protection Agency Stormwater Program



Top Ten Water Quality Issues in New York State

Aging Wastewater Treatment Infrastructure

The Problem...

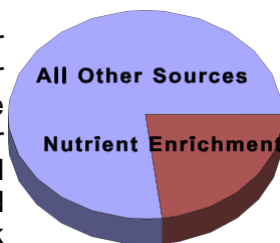
Across New York State over 600 wastewater treatment facilities serve more than 15 million people. These facilities range from New York City's system of 14 plants which process 1.3 billion gallons of wastewater per day, to small village systems of 100,000 gallons per day. When the Clean Water Act was passed in 1972, it was accompanied by considerable federal funding to support the construction and upgrading of these facilities to insure that impacts from municipal wastewater would be controlled. These efforts were largely successful, as the period from the 1970s through the 1980s saw significant water quality improvement across the state. However, since then funding for maintaining and upgrading these facilities has been greatly reduced. As many of these plants that reach

the end of their 30- to 40-year design lives, previous water quality gains are in danger of being lost.

In addition to the treatment plants themselves, sewer systems that convey wastewater to the plants for treatment are also deteriorating. More than 30% of these systems are in excess of 60 years old. Overflows of raw sewage from these sanitary systems as well as from older combined sewer systems that capture both sanitary wastewater and storm runoff and are designed to overflow during heavy rain and runoff events result in considerable water quality impacts across the state.

The Significance...

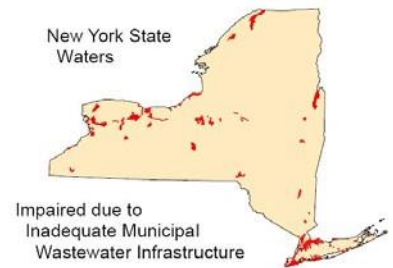
Discharges from municipal wastewater treatment plants and/or collection systems are identified as a major source in 24% of all waterbodies assessed as impaired in New York State. In another 12% of impaired waters, municipal sources are a



contributing source (though not the most significant source). In addition, 19% of the waters with less severe minor impacts or threats note municipal wastewater as a major contributing source.

Specific Waters...

Not surprisingly, water quality impacts due to inadequate municipal wastewater treatment typically occurs in the more populated areas of the state. Such impacts are of particular note in the metropolitan New York City/Long Island region of the state where municipal wastewater sources are cited as the cause of 54% of all impaired marine estuary acres. Other areas where such impacts occur include the large municipalities of Syracuse, Buffalo, and Utica. However, a number of smaller municipalities across the state, where limited resources make infrastructure upgrades difficult without state or federal assistance, experience similar quality impairments and impacts.



What is Being Done...

During the 20 years from 1987 to 2008, federal Clean Water Act funding was reduced by 70%, from \$2.4 billion to \$687 million. To increase awareness of the problem and advocate for resources necessary to address the issue, NYSDEC undertook the Clean and Safe Water Infrastructure Initiative. This Initiative led to the Clean Water Collaborative which is a coalition of state and local governments, elected officials and environmental and business organizations. The collaborative identifies federal, state, and local funding sources for a sustainable wastewater infrastructure program. Recent successes include \$432 million from federal stimulus legislation for wastewater infrastructure projects and a three-fold increase (\$232 million) in New York's Clean Water State Revolving Fund (CWSRF) for wastewater projects.

But beyond recent progress, it is clear that a new comprehensive and sustainable approach is needed. To that end, the initiative promotes strategies that provide incentives for infrastructure maintenance and reinvestment, water conservation, energy efficiency and innovative technology, including green infrastructure. Clearly addressing our infrastructure needs is both a financial and technical challenge.

More Information

NYSDEC Wastewater Infrastructure Needs Report

<http://www.dec.ny.gov/chemical/42383.html>

NYS Environmental Facilities Corporation Funding

<http://www.nysefc.org/home/index.asp?page=100>



Top Ten Water Quality Issues in New York State

Nutrient Loadings and Eutrophication

The Problem...

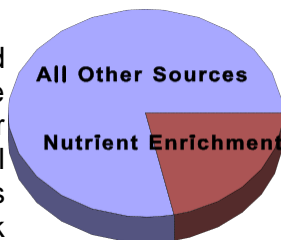
While waterbodies require nutrients to support healthy ecosystems, excessive nutrients, or eutrophication, can harm water supplies, recreational uses, and aquatic life. High levels of nitrogen and phosphorus in waters can produce nuisance algal blooms and increase aquatic weed growth (see also *Aquatic Weed Growth and Invasive Species*). Excessive algal and weed growth reduces water clarity and the recreational value of a waterbody. In addition, nutrients and resulting plant growth can draw oxygen from the water and produce "dead zones" where dissolved oxygen levels are so low that aquatic life cannot survive. This condition is referred to as hypoxia.

One of the reasons nutrients are such a problem is because the sources of phosphorus

and nitrogen are so prevalent. Sources and practices that result in excessive nutrients in waterbodies include municipal wastewater treatment plant discharges, urban runoff from impervious surfaces such as parking lots, lawns, rooftops and roads, agricultural activities that result in animal waste and sediments washing into waterbodies, flow from inadequate onsite septic systems, and atmospheric deposition.

The Significance...

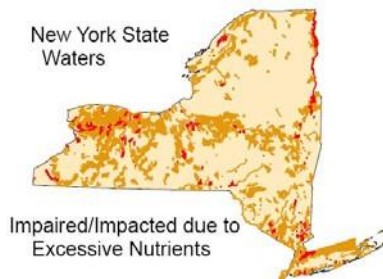
Excessive nutrients and eutrophication are identified as a major source in 23% of all waterbodies assessed as impaired in New York State. In another 29% of impaired water, nutrients and eutrophication are contributing sources (though not the most significant sources).



In addition, for 54% of the waters with less severe minor impacts or threats nutrients and eutrophication are noted as major contributing sources of impact. Additionally, 9% of impaired waters show nutrients as a lesser contributing source in waters with minor impacts/threats.

Specific Waters...

Impaired waters (shown in red) or impacted/threatened waters (shown in orange) due to nutrients are fairly widespread across New York State. This broad distribution is a result of the multiple sources of nutrients to the waters of the state.



Municipal wastewater discharges and urban/storm runoff are the primary sources in more developed urban areas. Agricultural runoff, inadequate onsite septic systems, and other nonpoint sources contribute nutrients to waters in less populated rural areas. Nitrogen is the nutrient of greatest concern in and around Long Island and New York City marine waters, while phosphorus is typically the cause of enrichment in fresh waters of the state.

What is Being Done...

Recognizing the multiple and varied sources of nutrients to the waters of the state, NYSDEC has a number of programs in place aimed at reducing nutrient loadings. A comprehensive stormwater program focuses on runoff from urban areas and construction activities. Nutrient management from agricultural sources is the focus of the Concentrated Animal Feeding Operations (CAFO) program. And waterbody-specific nutrient reduction and allocation strategies, known as Total Maximum Daily Load (TMDL) plans, have been developed for Long Island Sound, Lake Champlain, waters of the Croton River watershed and a number of lake watersheds.

NYSDEC is also developing more specific statewide water quality criteria for nutrients in lakes and rivers to protect drinking water supplies, recreational use, and aquatic life. This is part of a national effort initiated by USEPA to address nutrient pollution, which causes significant and increasing impacts in waters all across the country.

More Information

NYSDEC - Nutrients Standards Plan

http://www.dec.ny.gov/docs/water_pdf/nutrientstandards.pdf

USEPA - Nitrogen and Phosphorus Pollution

<http://www.epa.gov/waterscience/criteria/nutrient/>



Top Ten Water Quality Issues in New York State

Atmospheric Deposition and Acid Rain

The Problem...

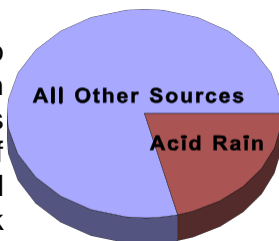
Acidic deposition, or acid rain, originates from the combustion of fossil fuels. When coal, oil, or other fossil fuels are burned, acid rain precursors—mainly nitrogen oxides (NO_x) and sulfur dioxide (SO_2)—are emitted into the atmosphere. Once in the atmosphere, NO_x and SO_2 are transformed into nitric acid and sulfuric acid and fall back to earth through both wet deposition such as rain, snow, fog, cloud water, and dry deposition of acids attached to particles, gases and aerosols. Rain and snow are somewhat naturally acidic due to the combining of carbon dioxide and water vapor in the air, which forms weak carbonic acid. However, the average acidity of rainfall in New

York State is up to 30 times greater than the level typically found in rainwater.

Increased acidity has a negative effect on water quality and aquatic life. Various insects that constitute an important food source for fish—such as mayflies—are sensitive to low pH. Low pH also increases the concentration of heavy metals—such as aluminum and mercury—in the water and can result in increased toxicity to aquatic life.

The Significance...

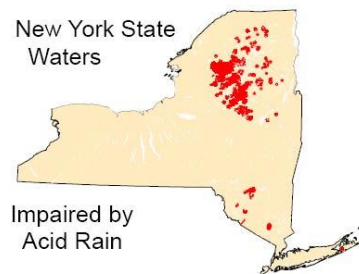
Low pH due to atmospheric deposition of acid rain is identified as a major source in 21% of all waterbodies assessed as impaired in New York State. However the actual impact of acid rain on the waters of New York may be somewhat greater than this figure reflects. Acid rain is more likely to affect smaller lakes and ponds, many of which are not tracked individually and/or are assessed with much larger waterbodies. The 2010 Section 303(d) List of Impaired Waters includes 72 additional lakes of less than 6.4



acres that have been identified as impaired by acid rain but that are not tracked separately in the Waterbody Inventory database.

Specific Waters...

While acid rain falls throughout New York State, many areas are less sensitive to acidity because of limestone deposits or the buffering capacity of surrounding soils which neutralize the acid. However, the lack of buffering ability in the soils and bedrock of the Adirondacks, Catskills, Hudson Highlands, and Rensselaer Plateau make these areas particularly sensitive to acid rain. In fact, small mountain lakes and streams of the Adirondacks and Catskills have emerged as poster children for the effects of acid rain.



What is Being Done...

Efforts in New York to reduce emissions which contribute to acidic deposition began in 1984 with passage of the first Acid Deposition Control Act in the nation. However even then it was clear that the state could not solve the acidic deposition problem by itself, due to the significant impact of air emissions originating primarily in the Midwest. It was reported at the time that over 80% of the sulfur deposition that occurred in the southwestern Adirondacks originated outside of New York State.

The state's early action precipitated national efforts to reduce levels of sulfur dioxide and nitrogen oxides. Title IV of the Clean Air Act of 1990 set a permanent cap on the total amount of SO_2 electric utility emissions at about half the amount emitted in 1980. NO_x emission-rate limitations for coal-fired electric utility units have resulted in a 27% reduction from 1990 levels.

However, in spite of these reductions, continued damage to sensitive ecosystems led New York State to require additional emissions reductions through the Acid Deposition Reduction Program (ADRP) in 2004. With the ADRP, as well as the federal Clean Air Interstate Rule aimed at control of acid rain nationwide, further reduction in acidic deposition should be forthcoming.

More Information

NYSDEC Acid Rain Management
<http://www.dec.ny.gov/chemical/283.html>
Adirondack Lakes Survey Corporation

<http://www.adirondacklakessurvey.org/>



Top Ten Water Quality Issues in New York State

Legacy Pollutants and Fish Consumption

The Problem...

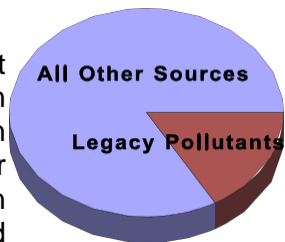
Prior to the routine regulation of industrial discharges and waste disposal practices that began in the 1960s and 1970s, a wide variety of toxic compounds were disposed of either by direct discharge into lakes and rivers or by disposal in landfills, many of which subsequently leaked into waterways. Since then, these originating industrial wastewater discharge and landfill sources of toxic pollutants have been largely addressed and loadings of PCBs, dioxins, mirex, DDT and other organic toxics, pesticides and heavy metals have been significantly reduced or eliminated.

However, these persistent toxic chemicals continue to contaminate lake and river

sediments in waters all across the state. They move from sediments through the aquatic food chain and accumulate in fish. This contamination results in health advisories that prohibit or limit the consumption by humans of fish taken from affected waters.

The Significance...

Legacy pollutants that result in fish consumption restrictions have been identified as a major source of contamination in 20% of all impaired waterbodies identified in New York State. These advisories typically restrict consumption of certain species of fish to either none at all, or no more than one meal per month.



In addition to waterbody-specific advisories, a general health advisory that recommends limiting consumption of fish from any water of the state to no more than one meal per week is also in place. This precautionary advisory

reflects the understanding that some chemicals (including PCBs) are commonly found in New York State fish and that not all waters of the state have been tested.

Specific Waters...

Fish consumption advisories that are the result of legacy contamination occur in waterbodies throughout New York State. Advisories for specific waters include many of the largest and most well-known waters: Hudson River, Lake Champlain, Saint Lawrence River, New York Harbor, and the shores of Lake Erie and Lake Ontario. These advisories are generally the result of known legacy discharges of contaminants. Less stringent precautionary advisories for nearly all waters of the state, as well as additional precautionary restrictions for children and women of childbearing age, are also in place.



What is Being Done...

Contaminated sediments in waterbodies are, by their nature, diffuse sources of pollution. Consequently, remediation of these sources and the restoration of fish consumption in these waters is often difficult to achieve. However, remediation activities are currently underway at sites throughout New York State. NYSDEC oversees the State Superfund and Brownfields cleanup programs and actively assists USEPA with Federal Superfund projects. The most notable of current large-scale remediation efforts linked to current fish consumption restrictions are in the Upper Hudson River and in Onondaga Lake. Other recent remediation efforts include the Grass River in Massena, Cumberland Bay on Lake Champlain, and a number of other sites on various smaller waterbodies. Remediation is planned for Utica Harbor along the Mohawk and in Eighteenmile Creek in western New York.

An extensive monitoring and modeling effort to identify the sources and movement of toxics within the New York Harbor (The Contamination Assessment and Reduction Program, or CARP) was completed in 2007 and is currently being used to develop toxic contaminant reduction strategies.

More Information

NYSDEC Fish Consumption Restrictions
<http://www.dec.ny.gov/outdoor/7736.html>

NYSDEC Environmental Remediation

<http://www.dec.ny.gov/chemical/brownfields.html>



Top Ten Water Quality Issues in New York State

Atmospheric Deposition of Mercury

The Problem...

Mercury is a toxic metal that poses risks to human health when released to the environment. The most common exposure pathway is when gaseous and particulate mercury is released to the atmosphere and is then deposited onto the land and water during precipitation. Once in the water, mercury can be converted to its most toxic form, methylmercury, which accumulates in fish and aquatic organisms. Humans are exposed to methylmercury and subjected to its associated health effects when they consume contaminated fish.

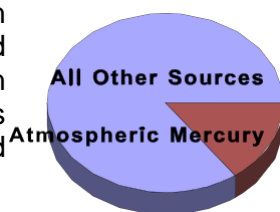
In New York State as well as throughout the Northeast, wide-ranging health advisories limiting the consumption of fish are in place due to elevated levels of mercury in certain fish

species. The vast majority of mercury contamination can be attributed to atmospheric deposition. However, while these states have achieved regional reductions in mercury emissions and discharges of approximately 70 percent over the past decade, the lack of available options to control out-of-state sources of atmospheric mercury remains a challenge for the region.

The Significance...

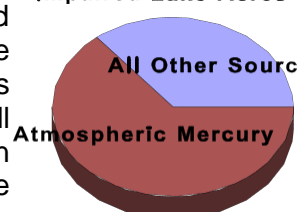
Atmospheric deposition of mercury is identified as a major source in 15% of all waterbodies assessed as impaired in New York State.

NYS Impaired Waters



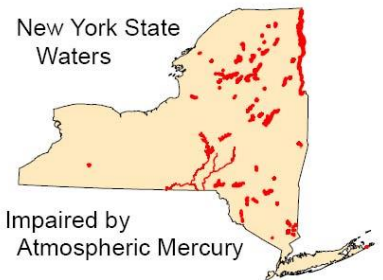
However, because these impaired waterbodies include some of the larger lakes in the state, 64% of all impaired lake acres in New York State are impaired by the atmospheric deposition of mercury.

Impaired Lake Acres



Specific Waters...

The majority of waters listed as impaired by the atmospheric deposition of mercury are located in the Adirondack and Catskill mountains. In fact, New York State has issued a regional advisory for women of child-bearing age and children limiting their consumption of fish from all Adirondack and Catskill waters for species of fish that typically have higher levels of contamination. There is also a general advisory for all freshwaters limiting fish consumption to no more than one meal per week. This advisory is issued as a precaution because some contaminants (including mercury) are more commonly found in fish and fish from many waters have not been tested.



What is Being Done...

New York State has moved aggressively to reduce the release of mercury into the environment. It has imposed mercury emission limitations on coal-fired power facilities based upon maximum achievable control technology (MACT). Under these regulations, facilities are not permitted to generate and trade mercury reductions with other facilities or states, which would be allowed under federal rules. Starting in 2015, the state will establish a facility-wide emission limit for each applicable facility. But as noted previously, much of the mercury in the atmosphere originates outside New York State. In 2007, New York, along with other northeastern states, established a pollutant reduction strategy known as a Total Maximum Daily Load (TMDL). The TMDL documented that over 97% of the mercury causing fish consumption impairment was due to atmospheric sources. Northeastern states have reduced mercury loads within their borders by 74%. However, it is not possible to meet TMDL targets without a comparable reduction in out-of-region sources. Clearly the ultimate solution to atmospheric deposition of mercury will require national or international approaches.

More Information

NYSDEC Mercury Management

<http://www.dec.ny.gov/chemical/285.html>

Northeast Regional Mercury TMDL

<http://www.dec.ny.gov/chemical/31304.html>



Top Ten Water Quality Issues in New York State

Habitat and/or Hydrologic Modification

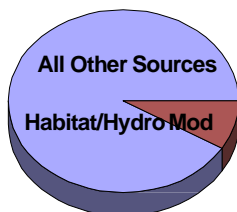
The Problem...

Habitat and hydrologic modifications include physical alterations to a stream channel and its associated corridor. Increased impervious surfaces in the stream watershed can also contribute to modification. Such modifications can interfere with the water cycle, disrupt the natural flow of water, cause increased erosion and sediment loadings, and result in a loss of suitable habitat for fish and wildlife. Common examples of such modifications to habitat or hydrology include the widening, deepening and channelization of streams, hardening of streambanks, dam and reservoir operations, poorly designed stream barriers (e.g., bridges, dams, culverts) and construction in and along stream riparian buffers and wetlands.

Despite ongoing programs aimed at restoring rivers and streams that have suffered impacts, recognition of thoughtful land use practices is only just beginning. Typically, habitat and hydrologic modification impacts—including increased erosion, higher temperatures, lower dissolved oxygen, excessive nutrient and sediment loads, degraded habitats, and the loss of property due to flooding and erosion—are the result of poor design and/or channel maintenance. However more recent emphasis on low-impact development and green infrastructure represents significant progress toward land use and development policies that may mitigate impacts of habitat and hydrologic modification on the waters of the state.

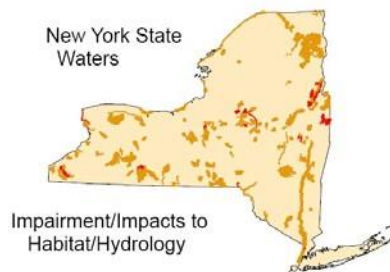
The Significance...

Habitat and hydrologic modification, including streambank erosion, is identified as a major source in 12% of all waterbodies assessed as impaired in New York State. In addition, for 29% of the waters with less severe minor impacts or threats, habitat/hydrologic modification is noted as a major contributing source.



Specific Waters...

Impaired waters (shown in red) or impacted/threatened waters (shown in orange) due to habitat and hydrologic modifications are scattered across different regions of New York State. Not surprisingly, such impacts are more likely to occur in developed or developing areas where human influences cause increased runoff and result in alterations to habitat and hydrology. In less populated areas nonpoint sources of silt and sediment from agricultural activity, road sanding during the winter or other practices can contribute to increased sediment loadings in streams and lakes, altering the water flow and aquatic habitat.



What is Being Done...

During the past decade, NYSDEC worked with a number of other state and local agencies and organizations to promote low-impact design, smart growth development and green infrastructure concepts for urban planning projects. These efforts are largely driven through implementation of the NYSDEC Phase II Stormwater Program, which requires urban municipalities to develop Stormwater Management Plans (SWMPs), implement best management practices and promote public education (see also *Urban Stormwater Runoff*). Similar programs are also in place to address runoff and sediment from construction and agricultural activity.

Efforts to coordinate other inter-agency and local activities to protect streams and habitat are led by the Hydrologic and Habitat Modifications Workgroup of the New York State Nonpoint Source Coordinating Committee. This workgroup continues to develop and promote strategies to protect the functions and natural resources of rivers and streams, minimize flooding and erosion, reduce stream barriers and advocate for the Aday-lighting@ of urban streams to enhance economic, recreational, and ecological benefits.

More Information

NYSDEC Stormwater Control Program

<http://www.dec.ny.gov/chemical/8468.html>

USEPA - Control of NPS Pollution from Hydromodification

<http://www.epa.gov/owow/nps/hydromod/index.htm>



Top Ten Water Quality Issues in New York State

Aquatic Weeds and Invasive Species

The Problem...

While rooted aquatic plants are a natural component of a healthy aquatic system, excessive weed growth can have significant negative effects on waterbodies. In addition, invasive species that alter the aquatic plant community also contribute to restriction of recreational and other uses.

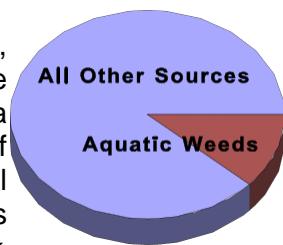
Aquatic plant populations are governed by a complex interaction of physical, chemical, and biological factors. These factors include light penetration into the lake, water, and sediment chemistry (see also *Nutrient Loadings and Eutrophication*), growing space and the

presence of invasive plants—the most common of which are Eurasian watermilfoil, water chestnut, curly leafed pondweed, and fanwort. When weed growth becomes excessive resulting problems include reduced plant biodiversity, weed blooms that deplete oxygen and cause odors when they die off, alteration of fish communities from larger game fish to pan fish, and nuisance growth that can reduce circulation, clog boat propellers and hinder swimmers. Healthy waterbodies reflect an appropriate balance of adequate, but not excessive, weed growth.

The Significance...

Nuisance aquatic weeds, algae and/or invasive species are identified as a major source of impairment in 10% of all waterbodies assessed as impaired in New York State. In another 6% of impaired waters, aquatic weeds/invasive plants are a contributing source of impact (though not the most significant source).

In addition, for 14% of the waters with less severe minor impacts or threats, aquatic

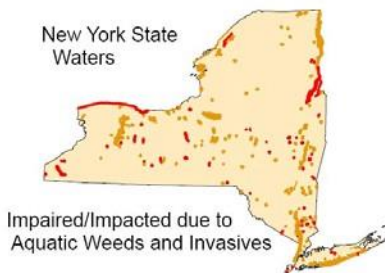


weeds and invasive plants are noted as a major contributing source of impact. These sources are also cited as contributing to an additional 4% of other waters with minor

Specific Waters...

Impaired waters (shown in red) or impacted/threatened waters (orange) due to aquatic weed growth are fairly widespread across New York State. This broad distribution is due in part to the fact that some weed growth is a normal feature of aquatic systems.

The factors that cause weed growth to become excessive—such as sources of nutrient loading and the presence of invasive plants—are also fairly common throughout the state.



What is Being Done...

Efforts to combat excessive aquatic weed growth and invasive species are underway in a number of areas. The most visible of these efforts was the creation of the Invasive Species Task Force in 2003 which brought together 17 New York State agencies and other organizations to identify actions and develop a strategy to address invasive species. The task force led to the establishment of the Office of Invasive Species within NYSDEC in 2007. Another initiative that grew out of the task force was the creation of Partnerships for Regional Invasive Species Management (PRISM). PRISM uses education, early detection, and rapid response to promote cooperative management of invasives on an integrated watershed level.

NYSDEC also has a number of programs in place aimed at reducing nutrient loadings, which promote aquatic weed growth. These include a comprehensive stormwater program, a Concentrated Animal Feeding Operations (CAFO) program, and waterbody-specific nutrient reduction and allocation strategies, known as Total Maximum Daily Load (TMDL) plans for specific lakes and other waterbodies. NYSDEC also provides assistance to local lake associations through the State Federation of Lake Associations for developing management strategies to address weed and other lake issues.

impacts/threats.

More Information

NYSDEC - Invasive Species Task Force

<http://www.dec.ny.gov/animals/6989.html>

New York State Federation of Lake Associations

<http://www.nysfola.org/>



Top Ten Water Quality Issues in New York State

Pathogen Contamination of Shellfish

The Problem...

The marine waters of New York State support a wide variety of shellfish and a significant shellfishing industry, as well as being a valuable recreational resource. However, much of the marine waters district is adjacent to highly populated areas of the state and subject to pathogen contamination that can make shellfish unsafe to eat. As a result, shellfishing is restricted in some waters and at various times.

NYSDEC regularly evaluates and monitors shellfishing waters and classifies them as either certified or closed for shellfishing. There are three types of closures. Regulatory closures are based on the water quality of an area over a long period and are not changed often. Temporary emergency closures occur when an area that is normally open experiences sudden, short-term degradations in water quality, usually the result of a storm event or the presence of a biotoxin in the water. Once the event has passed and water quality has improved, the area is reopened. Special shellfish closures are implemented in anticipation of conditions that pose a threat to water quality, such as holidays when boating use increases.

The Significance...

Pathogen contamination of shellfish is identified as a major source in 10% of all waterbodies assessed as impaired in New York State. Specific sources of pathogens include

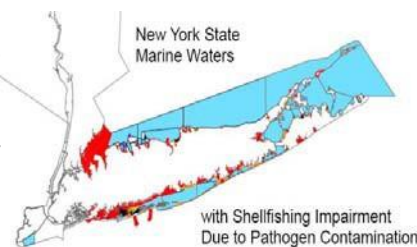


urban runoff, stormwater discharges, onsite septic impacts, and boating discharges.

While pathogen contamination of shellfish is responsible for only 10% of impaired waterbodies statewide, such contamination is responsible for 92% of the impairment found in waterbodies designated for shellfishing. Shellfishing restrictions affect 13% of the total estuary area classified as being otherwise appropriate for shellfishing.

Specific Waters...

Shellfishing restrictions are not a statewide issue, because shellfishing use only applies to certain marine waters. Waters that are designated for shellfishing are generally located around Long Island. The adjacent map shows areas where long-term water quality issues result in regulatory closures.



What is Being Done...

NYSDEC addresses the impact of pathogens that result in contamination of shellfish through two efforts. The first is the shellfishing management program. This effort relies on the collection of thousands of water samples each year to monitor the quality of shellfishing waters to make sure that human health is protected. If water quality is not up to New York State and national standards, DEC closes the area to shellfish harvesting.

NYSDEC is also moving forward in reducing the levels of pollutants entering the marine shellfishing waters of the state. The most significant of these is the implementation of Phase II stormwater regulations, which require permits for stormwater discharges from Municipal Separate Storm Sewer Systems (MS4) and mandate stormwater management plans and Best Management Practices to reduce runoff. NYSDEC has also developed Total Maximum Daily Load (TMDL) plans for a number of specific shellfishing impaired waters that identify sources of contamination and set pathogen load reduction targets for these sources. NYSDEC has also worked with local agencies to establish vessel waste no discharge zones to reduce wastewater impacts from boats in marine waters.

More Information

NYSDEC Shellfish Management Program

<http://www.dec.ny.gov/outdoor/345.html>

Shellfishing Closures

<http://www.dec.ny.gov/regs/4014.html>

NYSDEC Shellfish Pathogen TMDL

http://www.dec.ny.gov/docs/water_pdf/tmdlpathshel07.pdf



Top Ten Water Quality Issues in New York State

Inadequate Onsite Wastewater Treatment

The Problem...

While most residences are connected to sewer systems and larger centralized wastewater treatment plants, about one-quarter of New Yorkers and a comparable number of businesses and institutions are served by onsite wastewater treatment systems. Onsite systems are effective and economical when properly designed, installed and maintained. However the lack of an adequate onsite system, poor routine maintenance, increased density of homes served by onsite systems, undersized and overused systems (particularly due to conversion of vacation cottages and camps into year-round residences), and the installation of systems on sites with

unacceptable conditions can all lead to onsite system failure and water quality impacts.

Acute failures resulting in wastewater pooling on the ground, impacts to beaches or backups into buildings are potential health problems. Chronic problems can result in bacteria contamination of groundwater and nutrient loadings to nearby lakes and other recreational waters that spur excessive aquatic weed and algal growth (see also *Aquatic Weeds and Invasive Species*).

The Significance...

Inadequate and/or failing onsite wastewater treatment (septic) systems are identified as a major source in 7% of all waterbodies assessed as impaired in New York State. In another 20% of impaired waterbodies, onsite systems are noted as a contributing source (though not the most significant source).

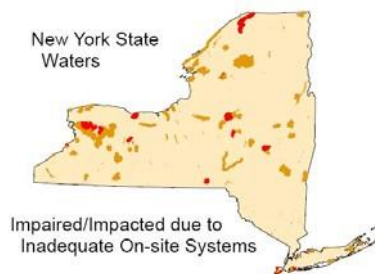


In addition, for 7% of the waters with less severe impacts or threats, onsite systems are noted as a major contributing source. Failing onsite systems are also cited as the major suspected source in 11% of waters where impacts need to be verified, while also being cited as suspected contributing sources for

Specific Waters...

Waters that are impaired or impacted by inadequate and/or failing onsite systems are located throughout New York State. Most such instances occur in smaller hamlets and communities that are not served by municipal collection and wastewater treatment

facilities. NYSDEC has identified over 100 unsewered communities where inadequate/failing onsite systems contribute to water quality problems and where improved onsite treatment and/or a centralized community system is being sought.



What is Being Done...

Since 1990, NYSDEC has worked with USEPA, state and local health departments, municipalities, local agencies and organizations, and universities to address siting, design, construction, and maintenance issues for residential and small community onsite wastewater treatment systems. The Onsite Training Network (OTN) has been established to provide wastewater treatment training events across the state to share knowledge and expertise with local officials, building inspectors and professional engineering firms.

Financing for projects to construct municipally owned decentralized wastewater treatment systems is available from the Clean Water State Revolving Fund. The fund provides low-interest funding for new projects or upgrades to address inadequate or failing systems, or to help establish sewer districts and alternative centralized treatment systems, where appropriate. However, properly functioning onsite systems typically provide effective wastewater treatment at a lower cost than centralized treatment plants, particularly in non-urban areas.

22% of waters needing verification of impacts.

More Information

Onsite Training Network -

http://www.delhi.edu/bcs/otn_wastewater/

NYSEFC Onsite Wastewater Treatment Systems
Funding -

<http://www.nysefc.org/home/index.asp?page=387>

USEPA Onsite (Septic) Systems Information -

<http://cfpub.epa.gov/owm/Septic/index.cfm>