

**PHASE II PHOSPHORUS
TOTAL MAXIMUM DAILY LOADS FOR RESERVOIRS IN
THE NEW YORK CITY WATER SUPPLY WATERSHED
(Delaware, Dutchess, Greene, Putnam,
Schoharie, Sullivan, Ulster, and
Westchester Counties)**

June 2000

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***Developed in Conformance with
Section 303(d) of the
Clean Water Act***

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Table of Contents

	<i>Page No.</i>
PHASE II TMDL PROPOSAL	3
I. WATERBODY NAME, LOCATION, BASIN	4
II. USE IMPAIRMENT	5
III. APPLICABLE WATER QUALITY STANDARD	5
IV. TMDL DEVELOPMENT	10
V. MONITORING	12
VI. IMPLEMENTATION\REASONABLE ASSURANCE	12
VII. PUBLIC PARTICIPATION	15
VIII. FUTURE TMDL DEVELOPMENT	15
IX. PHASE II TMDL SUMMARY	16
X NEW YORK CITY WATER SUPPLY RESERVOIR PHASE II TMDL SUMMARIES ..	21
<u>A. CROTON RESERVOIR SYSTEM</u>	21
AMAWALK RESERVOIR	22
BOG BROOK RESERVOIR	24
CROSS RIVER RESERVOIR	25
CROTON FALLS RESERVOIR	26
DIVERTING RESERVOIR	27
EAST BRANCH RESERVOIR	28
MIDDLE BRANCH RESERVOIR	29
MUSCOOT RESERVOIR	30
NEW CROTON RESERVOIR	32
TITICUS RESERVOIR	33
<u>B. CATSKILL-DELAWARE RESERVOIR SYSTEM</u>	34
ASHOKAN RESERVOIR	35
BOYD CORNERS RESERVOIR	36
CANNONVILLE RESERVOIR	37
KENSICO RESERVOIR	39
NEVERSINK RESERVOIR	40
PEPACTON RESERVOIR	41
RONDOUT RESERVOIR	42
SCHOHARIE RESERVOIR	43
WEST BRANCH RESERVOIR	45

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The New York State Department of Environmental Conservation (NYSDEC), with the cooperation and technical assistance of the New York City Department of Environmental Protection (NYCDEP) and the United States Environmental Protection Agency (USEPA), has completed its Phase II analyses of the total maximum daily loads (TMDLs) for phosphorus in the reservoirs of the New York City Water Supply Watershed (Watershed). A phased approach to the development of phosphorus TMDLs in the reservoirs in the Watershed has been selected by NYSDEC. Phase II was discussed in the Phase I TMDLs that were submitted to USEPA on January 31, 1997. Phase II TMDLs are hereby submitted to USEPA for approval.

Section 303(d) of the Clean Water Act requires states to identify the waterbodies in the state which, after application of technology-based effluent limitations required by the Act, do not meet water quality standards. These waterbodies are identified as water quality limited. The Act requires the states to establish, and USEPA to approve, TMDLs which, upon implementation, will achieve the water quality standards. NYSDEC has identified the New York City Watershed reservoirs as priority waters for TMDL development for phosphorus in the 1994, 1996 and 1998 303(d) listings of waters required by the Clean Water Act.

A TMDL for a pollutant is the reservoir's loading capacity for that pollutant. A TMDL is the sum of the point source wasteload allocations (WLAs) and the nonpoint source load allocations (LAs) plus a margin of safety to account for the uncertainty in the relationship between the pollutant loads and the reservoir's water quality.

NYSDEC is applying a phased approach to establishing TMDLs for phosphorus in the New York City reservoirs. Phase I TMDLs (approved by USEPA on April 2, 1997) were initial assessments of each reservoir system to test model solutions against monitoring data. The Phase I TMDLs determined which reservoir systems had reached their loading capacity for phosphorus. Calculations of the potential reduction of phosphorus from wastewater treatment plants (WTPs), resulting from the implementation of provisions in the New York City Watershed Rules and Regulations (NYCWRR), as adopted by both NYCDEP and New York State Department of Health (NYSDOH), were provided in Phase I. Also, calculations of necessary nonpoint source reductions were provided in the Phase I TMDLs, where appropriate.

The Phase II analysis provides several enhancements over Phase I:

1. An accounting mechanism for phosphorus retention by the larger lakes and ponds upstream of the City's reservoirs.
2. The use of the Generalized Watershed Loading Function (GWLF) model to estimate nonpoint source loadings of phosphorus from several land use categories. This model was applied to the Catskill and Delaware Watersheds.
3. The reservoir models used in Phase II, covered a time span of four consecutive years (1993-1996). Phase I modeled one year (1993) only. These four most recent years contain unusually wet conditions, as well as drought conditions, providing a rigorous test for the phosphorus model regarding seasonal variation. The TMDL for each reservoir is based on the geometric mean of phosphorus for growing seasons from 1992-1996.
4. The data used in the Phase II assessment of reservoir status is more recent (1992-1996) than the data set used in the Phase I assessment (1990-1994).
5. The Phase II Margin of Safety (MOS) used in the TMDL analyses has been revised to reflect the variability of phosphorus data for each reservoir. For Phase II, a factor of 10% was applied as a baseline to each reservoir to account for general uncertainty in the analysis. An additional factor was added to the 10% to account for the variability in each reservoir's actual phosphorus data. As a result, Phase II margins of safety can range from 10 to 20 percent.

In addition to the enhancements above, there has been significant effort on the part of NYCDEP toward the proposal and ultimate development of a water supply numeric criterion for phosphorus¹. NYSDEC has reviewed NYCDEP's work and determined that the adverse effects of eutrophication on the water supply have led to the development of Phase II TMDLs recognizing the following:

1. The existing New York State aesthetic-based (recreation) phosphorus guidance value of 20 $\mu\text{g/L}$.
2. The application of the existing New York State narrative standard for phosphorus and nitrogen, and a site-specific interpretation of that standard.

¹ *Development of a Water Quality Guidance Value for Phase II Total Maximum Daily Loads (TMDLs) in the New York City Reservoirs*; NYCDEP; March 1999. Available on the Web at: <http://www.ci.nyc.ny.us/html/dep/html/tmdl.html>

3. NYCDEP's distinction between source water and upstream reservoirs.¹
4. The expectation that USEPA will provide guidance on eutrophication parameters. EPA's "National Strategy for the Development of Regional Nutrient Criteria (June, 1998)" projects the establishment of nutrient criteria by the end of 2000.
5. NYSDEC's commitment to review applicable information with regard to a site-specific phosphorus water quality standard and/or guidance value for the NYC Watershed.
6. Continued monitoring efforts that will be supported by NYSDEC and USEPA. In particular, monitoring will be linked to the upgrades currently underway at wastewater treatment facilities in the Watershed. This will assist in the assessment of point source phosphorus loads and the loading reductions accomplished.
7. Refined modeling and monitoring efforts based on Cannonsville mechanistic-type models that are being undertaken. Each reservoir basin will be subject to continued monitoring and regular assessment of phosphorus load allocations.
8. An assessment of the impacts of the recommendations made in the Putnam County and Westchester County Wastewater Diversion Studies and watershed planning efforts in the Croton or Catskill/Delaware systems when those efforts are completed.
9. USEPA's proposed revisions to the TMDL Regulations (40CFR Part 130).
10. Implementation of nonpoint source controls assisted by the completion of Nonpoint Source Practices Report and Implementation Strategies Report.

PHASE II TMDL PROPOSAL

NYSDEC is presenting the following for USEPA's approval:

Phase II TMDLs/WLAs/LAs for 9 reservoirs in the Watershed where the critical load is currently exceeded (water quality limited).

Phase II TMDLs/WLAs/LAs for 10 reservoirs in the Watershed where the critical load is currently not exceeded (effluent limited).

Phase II point source phosphorus loads (WLAs²) for surface water discharges in the Watershed. These loads are developed from phosphorus effluent requirements (Section 18-36) in the NYCWRR.

Phase II nonpoint source “aggregated” phosphorus loads (LAs²) for each reservoir. All nonpoint source loads in the Watershed will be further evaluated using the best management practices assessment and the implementation recommendations.

The following information is part of the proposed TMDL/WLA/LA.

I. WATERBODY NAME, LOCATION, BASIN

Reservoirs in the Croton River watershed; Westchester and Putnam Counties, New York; the Croton River is tributary to the Lower Hudson River. The 12 reservoirs are as follows:

Boyd’s Corner Reservoir
West Branch Reservoir
Cross River Reservoir
Titicus Reservoir
Bog Brook Reservoir
Middle Branch Reservoir
Croton Falls Reservoir
East Branch Reservoir
Diverting Reservoir
Muscoot Reservoir
New Croton Reservoir
Amawalk Reservoir

Kensico Reservoir in the Bronx River watershed; Westchester County, New York; the Bronx River is tributary to Long Island Sound.

Reservoirs in the Schoharie Creek, Rondout Creek, Esopus Creek and Delaware River watersheds; Delaware, Greene, Schoharie and Ulster Counties, New York; Schoharie Creek in the Mohawk River drainage basin, Rondout Creek, and Esopus Creek in the Hudson River drainage basin, and the Delaware River. The six reservoirs are as follows:

² Wasteload allocations are expressed as phosphorus loadings in both pounds per day and kilograms per year. Phosphorus load allocations for nonpoint sources are presented in aggregate for each reservoir system and are expressed as kilograms per year.

Neversink Reservoir
Pepacton Reservoir
Rondout Reservoir
Cannonsville Reservoir
Schoharie Reservoir
Ashokan Reservoir

II. USE IMPAIRMENT

- A. The 19 reservoirs in the Watershed are listed on the New York State Section 303(d) listing for 1994, 1996 and 1998. These reservoirs are identified as high priority waters for TMDL development.
- B. The primary pollutant of concern is listed as phosphorus, and various waters are listed as impaired, threatened or stressed.
- C. The sources of the impairment are point and nonpoint sources of phosphorus that discharge to the watersheds of the respective reservoirs.

III. APPLICABLE WATER QUALITY STANDARD

The Phase I Total Maximum Daily Loads (TMDLs) were based on New York State's current guidance value for phosphorus of 20 $\mu\text{g/L}$ which was derived to protect primary and secondary contact recreational uses from impairment due to aesthetic effects. In its review of the Phase I TMDLs, USEPA commented that the 20 $\mu\text{g/L}$ value was not specifically derived to protect the drinking water use of the water bodies requiring TMDLs. Drinking water supply is one of the best uses of these water bodies, as defined in 6NYCRR Parts 701.5 and 701.6. The 19 reservoirs in the New York City Watershed are classified as either Class AA or Class A. One of the best uses of Class AA waters is as a source of unfiltered water supply for drinking. One of the best uses of Class A waters is as a source of filtered water supply for drinking. While the 20 $\mu\text{g/L}$ guidance value that was used in the Phase I TMDLs was derived to protect primary and secondary contact recreation from impairment due to aesthetic effects, it indirectly provides considerable protection for the drinking water use by limiting eutrophication. As such, the guidance value of 20 $\mu\text{g/L}$ served as a sound basis for the Phase I TMDLs.

However, as noted in the USEPA's comments, one of the objectives of the Phase II TMDLs is to utilize an approach that better addresses the best use of the water bodies within the New York City Watershed (i.e., the drinking water use).

To better address the best use of the water bodies, the USEPA, NYSDEC and NYCDEP agreed to work toward the development of water supply-based phosphorus criteria for the Watershed. As part of the Phase II TMDL process, a workgroup was charged with this task in 1997. The initial focus of the group was the link between ambient phosphorus concentrations, algal growth and trihalomethane (THM) formation potential. The group was unable to establish a quantitative relationship between phosphorus concentrations and THM formation³ which would result in the development of THM-based phosphorus criteria.

Subsequently the workgroup explored a weight-of-evidence approach. The approach utilized all available reservoir-specific data to develop a relationship between phosphorus and chlorophyll *a* levels, and a selected set of water quality variables which have been demonstrated to negatively affect the water quality of the drinking water supplied by the reservoirs in the Watershed. Five water quality variables that are important concerns to water supply and are associated with excessive nutrient loading and reservoir water quality were selected:

- ! percent incidence of algal blooms (defined as an exceedance of the New York City criteria 2000 Standard Areal Units (SAU) per ml);
- ! percent incidences where blue-green algae is reported as the dominant algal class;
- ! percent exceedance of the color MCL (equal to 15 standard color units) in the epilimnion and hypolimnion;
- ! percent reported odor occurrences; and
- ! THM precursor concentrations for certain reservoirs.

Using the weight-of-evidence approach, NYCDEP recommended that, at this time, a guidance value of 15 $\mu\text{g/L}$ was an adequate ambient phosphorus level to protect source water reservoirs. The basis for this recommendation is included in the NYCDEP Guidance Value Report.⁴ Seven of the 19 reservoirs in the NYC Watershed are considered source water reservoirs, defined as waterbodies capable of receiving

³ FAD deliverable report entitled *The Relationship Between Phosphorus Loading, THM Precursors, and the Current 20 $\mu\text{g/L}^{-1}$ TP Guidance Value*; NYCDEP; December 1997.

⁴ Report entitled *Development of a Water Quality Guidance Value for Phase II Total Maximum Daily Loads (TMDLs) in the New York City Reservoirs*; NYCDEP; March 1999. Available on the Web at (<http://www.ci.nyc.ny.us/html/dep/html/tmdl.html>)

surface runoff and located just prior to initial disinfection. These seven reservoirs are: Ashokan, Cross River, Croton Falls, Kensico, New Croton, Rondout and West Branch. The remaining 12 reservoirs in the NYC Watershed are Upstream reservoirs; they are not a direct source of unfiltered water to the distribution system.

NYSDEC believes that for the purpose of TMDL development in the Watershed, a link between phosphorus concentrations and protection of the best use of the reservoirs must be established. This link is best made through a site-specific interpretation of New York State's existing narrative ambient water quality standard for phosphorus and nitrogen (6NYCRR 703.2). This standard, which applies to both Class AA and Class A surface waters, is "none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages."

NYSDEC has determined that NYCDEP has demonstrated a link between phosphorus concentrations, algal growth and certain indicators of use impairments such as taste & odor complaints. Therefore, there is technical justification to support using the 15 $\mu\text{g/L}$ value for phosphorus as a site-specific interpretation of the narrative standard to protect the drinking water use in the source water reservoirs listed above. DEP's weight of evidence approach demonstrates that 15 $\mu\text{g/L}$ of phosphorus is adequate to protect source water reservoirs.

Based upon current information, the NYSDEC is unable to establish technically defensible site-specific objectives for phosphorus for the protection of drinking water in the remaining 12 (upstream) reservoirs. The reason for this is that an adequate link has not been made between upstream water quality and water quality in the downstream source waters. This link must consider many complex factors such as the distance to the downstream source water reservoirs, additional time for processes such as phosphorus uptake, settling, die-off of algae and oxygenation of water as it travels between reservoirs. These chemical, physical and biological processes significantly affect water quality and directly influence the appropriate phosphorus values necessary to protect the drinking water use in the downstream source water reservoirs. Since this link is not a part of the Phase II analysis, it is not appropriate to apply 15 $\mu\text{g/L}$, as the numeric interpretation of the narrative standard to these reservoirs because they are not source water reservoirs, and do not serve as a direct supply of drinking water to the distribution system. The 20 $\mu\text{g/L}$ existing guidance value for recreational use will serve as the basis for the Phase II TMDLs for these 12 upstream reservoirs.

Table 1 identifies the specific classifications, and other applicable associated information, for each of the 19 reservoirs in the Watershed.

Table 1: NYC Water Supply System Reservoirs, Classification, Type and Phosphorus Values

Name	Classification	Type	Recreational Based Guidance Value For Phosphorus	Drinking Water Source Objective For Phosphorus
Catskill/Delaware System				
Ashokan	AA (T)	Source water	20 µg/L	15 µg/L
Cannonsville	AA(T)	Upstream	20 µg/L	*
Neversink	AA(T)	Upstream	20 µg/L	*
Pepacton	AA(T)	Upstream	20 µg/L	*
Rondout	AA	Source water	20 µg/L	15 µg/L
Schoharie	AA(TS)	Upstream	20 µg/L	*
West Branch	AA	Source water	20 µg/L	15 µg/L
Boyd's Corner	AA	Upstream	20 µg/L	*
Kensico	AA	Terminal, Source water	20 µg/L	15 µg/L

<i>Table 1: NYC Water Supply System Reservoirs, Classification, Type and Phosphorus Values</i>				
Name	Classification	Type	Recreational Based Guidance Value For Phosphorus	Drinking Water Source Objective For Phosphorus

<i>Croton System</i>				
Amawalk	A	Upstream	20 µg/L	*
Bog Brook	AA	Upstream	20 µg/L	*
Cross River	AA(T), A(T)	Source water	20 µg/L	15 µg/L
Croton Falls	AA(T), A(T)	Source water	20 µg/L	15 µg/L
Diverting	AA	Upstream	20 µg/L	*
East Branch	AA	Upstream	20 µg/L	*
Middle Branch	A	Upstream	20 µg/L	*
Muscot	A	Upstream	20 µg/L	*
New Croton	AA, A	Terminal, Source	20 µg/L	15 µg/L
Titicus	AA	Upstream	20 µg/L	*

* No value has been established at this time (see text).
 Shading indicates the application of the more stringent value in the TMDL.

IV. TMDL DEVELOPMENT

A. Method Used to Derive TMDLs, WLAs, LAs and MOS.

The procedure used in the Phase II TMDLs is contained in the NYCDEP report entitled *Methodology for Calculating Phase II Total Maximum Daily Loads (TMDLs) of Phosphorus for the New York City Drinking Water Reservoirs*, March 1999. (<http://www.ci.nyc.ny.us/html/dep/html/tmdl.html>) The procedures contained in the methodology document are consistent with NYSDEC, Division of Water, TOGS 1.3.1, *Total Maximum Daily Loads and Water Quality-Based Effluent Limits*.

B. Available Ambient Data and Listing of Pollutant Sources and Loading Data.

Ambient data and loading information are summarized and referenced in the 19 individual NYCDEP reports entitled *Proposed Phase II Phosphorus TMDL Calculation Reports*, March 1999 (<http://www.ci.nyc.ny.us/html/dep/html/tmdl.html>).

C. Modeling

It was anticipated that the Cannonsville Reservoir model would be utilized for Phase II TMDL calculations. The model was completed as of March 1, 1999, about the same time as the release of the Phase II Reservoir Calculation reports and the Phase II TMDL Methodology document. Significant site-specific data is still needed along with additional time before this model is used for TMDL development. Work continues to progress in applying the Cannonsville Model to the remaining Catskill-Delaware reservoirs. In the meantime, Phase II has proceeded based on the Vollenweider Lake Model. It is anticipated that multi-tiered, time variable models (based on the Cannonsville model) for the Catskill and Delaware Reservoirs can be utilized in the future to assess Phase II TMDLs and particular phosphorus load reduction strategies.

It should be noted that Phase II TMDL loads are generally higher than those calculated in Phase I. This is the result of using improved analysis of the system and additional monitoring data. For those reservoirs east of the Hudson River, this is due to residence time adjustments based on more sophisticated water budget analyses. Higher outflows result in shorter residence times and a greater predicted phosphorus load. Higher phosphorus loads west of the Hudson River relate to the use of the Generalized Watershed Loading Function (GWLF) model to estimate loads from various land uses. The GWLF model accounts for large particulate loads of phosphorus delivered during high flows. The Vollenweider Equation was adjusted to accommodate these increased loads to WOH reservoirs. Interannual variability in

phosphorus loads due to precipitation differences was not factored into the Phase I analysis.

D. Loading Capacity/Critical Conditions

Phase II phosphorus TMDLs have been developed to address the trophic state of each reservoir. The trophic state is a summary statistic typically based on a growing season average of phosphorus. EPA's guidance (USEPA 1991 and others) supports this as an appropriate measure that relates to a state's water quality standard and the problem to be addressed. In the case of nutrients like phosphorus, an annual or growing season cycle is the accepted method rather than a daily load calculation.

In Phase II, phosphorus data from May to October was used to approximately address the trophic status during this critical growing season period. Current loads were then compared to a reservoir's loading capacity, calculated as a function of its applicable phosphorus criteria number. If the current load exceeded a reservoir's loading capacity, the reservoir was deemed water quality limited. Where the current load is less than a reservoir's loading capacity, that reservoir was listed as effluent limited.

E. Margin of Safety (MOS)

TMDLs can rely on implicit and explicit approaches for the margin of safety. Phase II TMDL calculations have incorporated both. Conservative assumptions that are implicit to this submittal are:

1. The use of permitted flows vs actual flows for point source phosphorus load calculations from sewage treatment plants. In many cases, actual flows are less than what is permitted.
2. The assumption that phosphorus loads from upstream reservoirs are treated as point sources with no net loss of phosphorus with the transmission of water to downstream reservoirs.
3. TMDL calculations are based on total phosphorus. The Phase II methodology assumes that all the total phosphorus from point and nonpoint sources is available for algal growth. Dissolved phosphorus as a portion of total, is generally more available for algal growth. Therefore, the use of total phosphorus is conservative.

The explicit margin of safety utilized in Phase II TMDL calculations can range from 10 to 20 percent. A 10 percent MOS factor was applied as a baseline to each reservoir to account for general uncertainty in the analysis. An additional factor was added to

the 10 percent baseline to account for the variability in each reservoir's phosphorus data (March 1999 Phase II Methodology Document).

F. Seasonal Variability

The Phase II Phosphorus TMDL inherently accounts for seasonal variability. The trophic state of each reservoir is not a spot measurement but a summary statistic typically based on a growing season average of phosphorus. In short, eutrophication is a seasonal condition which is assessed using seasonal averages. New York State's guidance value is applied as a growing season average. It is anticipated that the National Nutrient Criteria will be developed based on growing season average concentrations. Therefore, an annual average load reflects variability as applied to a seasonal condition.

Detailed reservoir and terrestrial models currently under development may point to a critical phosphorus loading time period that can be applied to future TMDL calculations for each reservoir individually.

V. MONITORING

NYCDEP continues to monitor and model water quality in its drinking water reservoirs. Additional data ('92-'96) formed the basis for Phase II Phosphorus TMDL development. DEP maintains a comprehensive monitoring program to support complex eutrophication and hydrothermal models which are under development and can be utilized to adjust loading estimates and where necessary, revise wasteload allocations and load allocations.

As indicated above, Phase II Phosphorus TMDLs incorporate a site-specific interpretation of NYS narrative standard for nutrients (phosphorus), an improved data base, an enhanced modeling framework, and a reservoir-specific approach to calculate the margin of safety. Continued ambient and point source monitoring by NYCDEP and NYSDEC is necessary to develop multi-tiered reservoir models and assess the impacts of point and nonpoint control measures on reservoir water quality as well as future phosphorus reduction strategies for each reservoir.

VI. IMPLEMENTATION/REASONABLE ASSURANCE

A. Point Sources

Implementation of the TMDL is closely associated with the implementation of the conditions of New York City Watershed Memorandum of Agreement (MOA) signed

in January 1997. Consequently, implementation has been started and is ongoing. Proposed permit modifications for 108 point sources in the Watershed were developed after the Phase I TMDL was approved. Ninety-two permits have been modified and issued. All eight Wastewater Treatment Facilities owned and operated by the City of New York have been upgraded to provide phosphorus removal and micro-filtration. A few of these 108 facilities now no longer have a surface water discharge. All significant point source related changes that have taken place since the approval of the Phase I TMDL have been incorporated into Phase II.

The implementation of Sewage Treatment Plant (STP) upgrades associated with the permit modifications discussed above, will result in phosphorus load reductions in both the Croton and Catskill-Delaware systems. In the Catskill Delaware system there is one water quality limited reservoir, Cannonsville. The load reduction needed to achieve the TMDL will likely be met through the STP upgrades associated with the modified permits. In the Croton system, point source load reductions will contribute to the overall load reductions needed, but additional nonpoint source controls are needed to achieve the TMDLs.

B. Nonpoint Sources

In September of 1998, NYSDEC completed its preparation of the report entitled ***“Nonpoint Source Management Practices to Achieve Phase I TMDL Load Allocation in the Croton System, NYC Watershed”***. Implementation is proceeding, consistent with Section 6 of that report.

Within six months of USEPA’s approval of the Phase II TMDLs, NYSDEC, working jointly with NYCDEP, will identify appropriate potential management practices for controlling nonpoint source pollution in the Watershed. When implemented, these practices would provide reasonable assurance that nonpoint source reductions attain identified LAs. Six months later, NYSDEC, with input from NYCDEP, will identify potential nonpoint source management practices it will implement and recommend potential nonpoint source management practices to be implemented by other parties.

The control of nonpoint source pollution and the achievement of the appropriate LAs will be accomplished through a mix of programs, projects and other activities, all developed with the objective of reducing and/or eliminating nonpoint sources of nutrients and other contaminants. New York State has developed a Statewide Nonpoint Source Management Program, updated in March 2000, and a Coastal Nonpoint Source Management Program. These programs coordinate the State’s efforts to control nonpoint sources. In addition, the recently promulgated Phase II Storm water Regulations provide a means of addressing storm water contributions of

phosphorous. It is anticipated that NYSDEC will use the authority of the Phase II Storm water Rule to designate those portions of the Croton Watershed not identified as “urbanized areas” under the Rule (currently approximately 20% of the land area).

Many of the programs included in the New York City Watershed Protection and Partnership Programs included in the Watershed MOA address nonpoint sources. Specific programs include:

Sewer Extensions - New York City will provide up to ten million dollars for a program to design and construct and installing extensions to sewerage systems serving city-owned WWTPs West of Hudson portion of the Watershed so as to alleviate existing water quality problems and reduce reliance on failing septic systems.

Septic System Rehabilitations and Replacements - New York City will provide over \$13 Million for a program to rehabilitate septic systems serving residences that are failing or likely to fail in the West of Hudson portion of the Watershed. These funds are also to be used for inspections and pumping out septic systems.

Stormwater Retrofits - New York City will provide up to \$7.625 Million to design, permit, construct, implement and maintain storm water best management practices in the West of Hudson portion of the Watershed.

Stream Corridor Protection - New York City will provide up to \$3 Million for a program of stream corridor protection projects such as streambank stabilization in the West of Hudson portion of the Watershed.

Future Stormwater Controls - New York City will provide \$31.7 Million for a program to design, construct implement and maintain new stormwater measures in the West of Hudson portion of the Watershed.

Alternate Septic Systems Design - New York City will provide \$3 Million to design, construct and install alternate design septic systems in the West of Hudson portion of the Watershed.

Forestry Management - New York City will provide up to \$0.5 Million for forestry management program that protect the water supply against run-off and other pollution in the West of Hudson portion of the Watershed.

Watershed Planning in the Croton System - New York City, Westchester County and Putnam County agreed to a comprehensive approach to basin-wide planning that would identify pollution sources, recommend measures to improve water quality,

prevent degradation and recommend measures to protect the character and special needs of the Croton Watershed communities. Putnam and Westchester Counties each received \$1 million for Croton planning.

East of Hudson Water Quality Investment Program - New York City will provide \$68 Million to support a program of water quality investments in the East of Hudson portion of the Watershed. This program will be used to fund design, construction and installation of projects including but not limited to: rehabilitation or replacement of subsurface sewage treatment systems; community septic systems and related infrastructure; Storm water Best Management Practices; sewerage collection systems or extensions to collection systems needed to serve areas with failing subsurface sewerage treatment systems; stream bank stabilization and protection measures that correct or reduce erosion, sedimentation or pollutant loading. Provisions of the MOA also address the funding of septic system pump-outs; septic maintenance districts that address the repair and replacement of septic systems.

Future Stormwater Controls for Single-family Houses, Small Businesses and Low-income Housing - In both the West of Hudson and East of Hudson portions of the Watershed, New York City will fund some or all of the costs of storm water measures for designing and implementing storm water pollution prevention measures for new individual residences and small businesses. The City will fund all the incremental costs of designing and implementing storm water pollution prevention measures for low-income housing.

The Croton System reservoirs that are water quality limited and require nonpoint source reductions are listed in Table 4. NYSDEC anticipates that the phosphorus reductions remaining after the point source upgrades will be achieved through the programs identified above.

VII. PUBLIC PARTICIPATION

The availability of the proposed Phase II Total Maximum Daily Loads for reservoirs in the Watershed was noticed in the State Environmental Notice Bulletin dated November 17, 1999. Four public meetings to discuss the proposed TMDL were held on December 9, 1999 in Stamford, NY and on December 16, 1999 and February 4, 2000 in White Plains, NY, and on December 13, 1999, in New York, NY. The public comment period closed on February 18, 2000 but comments were accepted into April, 2000.

VIII. FUTURE TMDL DEVELOPMENT

It should be noted that the New York City Watershed Memorandum of Agreement anticipated a continuation of the process. Article II, paragraph 162 (i) states:“ (i) After Phase II, NYSDEC and NYCDEP will continue to monitor and regularly assess phosphorus load allocations for each reservoir basin. As additional data become available, where appropriate and on a reasonable schedule, NYSDEC, NYCDEP and USEPA, together, will refine modeling efforts, adjust loading estimates and where necessary revise wasteload allocations and load allocations.

IX. PHASE II TMDL SUMMARY

A summary of the results of the Phase II TMDL analysis for reservoirs in the New York City water supply system is presented in the following tables. Table 2 summarizes TMDL information for all 19 reservoirs. Tables 3 and 3A summarize the TMDL/WLA/LAs submitted for each reservoir. Table 4 provides more details about those reservoirs that have been identified as water quality limited and need additional phosphorus loading reductions. Although the term TMDL implies daily loads, TMDLs can be expressed in a variety of ways that relate to a State’s water quality standards. In the case of phosphorus, an annual cycle or growing season cycle is appropriate. Therefore, the reservoirs were analyzed on a calendar year basis and the TMDLs, WLAs, and LAs are expressed as kilograms per year (Kg/yr). Current point source loads have been calculated using 1996 effluent flow and phosphorus concentrations.

Table 2: Phosphorus/TMDL Load Information¹				
RESERVOIR Catskill/Delaware System	TMDL (Kg/yr)	Available Load (TMDL-MOS) (Kg/yr)	Current Load (Kg/yr)	Water Quality Limited
Ashokan (East Basin) ² (West Basin) ²	19,542 45,399	17,588 40,859	16,484 32,833	No No
Cannonsville	53,650	46,944	52,368	Yes
Kensico ²	28,276	25,488	16,926	No
Neversink	22,553	20,298	6,863	No
Pepacton	79,167	71,250	37,327	No
Rondout ²	41,413	37,272	23,476	No
Schoharie	29,761	26,785	19,864	No
West Branch ²	12,760	11,484	8,662	No
Boyd's Corner	966	869	687	No
RESERVOIR Croton System	TMDL (Kg/yr)	Available Load (TMDL-MOS) (Kg/yr)	Current Load (Kg/yr)	Water Quality Limited
Amawalk	1,329	1,196	1,318	Yes
Bog Brook	375	337	321	No
Cross River ²	1,007	881	717	No
Croton Falls ²	3,565	3,030	5,010	Yes
Diverting	2,798	2,392	3,844	Yes
East Branch	2,822	2,469	3,462	Yes
Middle Branch	949	816	1,020	Yes
Muscoot	9,397	8,457	11,560	Yes
New Croton ²	9,731	8,758	11,189	Yes
Titicus	1,158	984	1,124	Yes

¹ Source: NYCDEP Phosphorus TMDL Calculations Reports (3/99)

² Source water reservoir where 15 ug/L site-specific objective has been applied.

Table 3: Water Quality Limited Reservoirs - TMDL Summaries¹				
RESERVOIR	TMDL (Kg/yr)	Margin of Safety (Kg/yr)	WLA² (Kg/yr)	LA (Available Load - WLA) (Kg/yr)
Amawalk	1329	133	390	806
Cannonsville	53,650	6,706	1,086	45,858
Croton Falls	3,565	535	615	2,415
Diverting	2,798	406	322	2,070
East Branch	2,822	353	449	2,020
Middle Branch	949	133	184	632
Muscoot	9,397	940	1,405	7,052
Titicus	1,158	174	0	984
New Croton	9,731	973	209	8,549

¹ Source NYCDEP Phosphorus TMDL Calculations Reports (3/99)

² Anticipated Point Source Load in Conformance with NYCWRR

Table 3A: Effluent Limited Reservoirs - TMDL Summaries¹				
RESERVOIR	TMDL (Kg/yr)	Margin of Safety (Kg/yr)	WLA² (Kg/yr)	LA (Available Load - WLA) (Kg/yr)
Bog Brook	375	38	28	309
Cross River	1,007	126	108	773
Ashokan East	19,542	1,954	4	17,584
Ashokan West	45,399	4,540	264	40,595
Boyd Corners	966	97	0	869
Kensico	28,276	2,828	0	25,448
Neversink	22,553	2,255	0	20,298
Pepacton	79,167	7,917	386	70,864
Rondout	41,413	4,141	125	37,147
Schoharie	29,761	2,976	789	25,996
West Branch	12,760	1,276	28	11,456

¹ Source: NYCDEP Phosphorus TMDL Calculations Reports (3/99)

² Anticipated Point Source Load in Conformance with NYCWRR

Table 4: Water Quality Limited Reservoirs - Remaining Phosphorus Reductions

RESERVOIR	Current PS Loads (Kg/yr)	Current NPS Load (Kg/yr)	Available Load TMDL-MOS (Kg/yr)	WLA³ (Kg/yr)	LA (Available Load - WLA) (Kg/yr)	Total Reductions Needed (Kg/yr)	Remaining Reductions Needed⁴ (Kg/yr)
Amawalk	241	1,077	1,196	390	806	122	122
Cannonsville	7,401	44,958	46,944	1,086	45,858	5,415	No
Croton Falls	1,710	3,300	3,030	615	2,415	1,980	885
Diverting	159	3,685	2,392	322	2,070	1,452	983
East Branch	233	3,229	2,469	449	2,020	993	993
Middle Branch	99	921	816	184	632	204	204
Muscoot	1,631	9,929	8,457	1,405	7,052	3,103	2,058
New Croton	191	10,998	8,758	209	8,549	2,431	1,356
Titicus	0	1,124	984	0	984	140	140

³ Anticipated Point Source Load In Conformance with NYCWRR

⁴ After wastewater treatment plant upgrades are achieved.

X. NEW YORK CITY WATER SUPPLY RESERVOIR PHASE II TMDL SUMMARIES

The following reservoir write-ups summarize the information in NYCDEP's Phosphorus TMDL Calculations Reports (3/99).

A. CROTON RESERVOIR SYSTEM

AMAWALK RESERVOIR

The Phase II Phosphorus Calculations Report for the Amawalk Reservoir indicates the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 1,329 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 133 Kg/yr. Therefore, 1,196 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. At a WLA of 390 Kg/yr, the LA is then set at 806 Kg/yr.

The current load of 1,318 Kg/yr is greater than the available load. Even after reductions in point source loadings due to the application of NYC's Watershed Rules and Regulations, the available load will be exceeded by 122 Kg/yr. The urban land use category represents the highest nonpoint source load at 442 Kg/yr or about one-third of the total phosphorus load. The urban load would have to be reduced by approximately 25% to achieve the necessary phosphorus reduction of 122 Kg/yr. It is anticipated that this will be accomplished by the implementation of Phase II Storm Water Regulations throughout the Amawalk Basin.

The four-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 19.6 ug/l can be expected as a growing season average. This number excludes 1993 data due to the reservoir's drawn down condition.

The following table lists information for each of the point sources of phosphorus in the Amawalk Reservoir Basin with the proposed individual WLAs under the heading ***New York City*** Rules and Regulations, Phosphorus Loadings.

AMAWALK RESERVOIR

<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Carmel S.D. #4-Lake Secor	010 5252	182	139	0.8	0.5	200,000
Mahopac Falls Elementary	002 9394	5	28	0.16	1.0	19,000
Mahopac High	002 9394	12	69	0.42	1.0	50,000
Mahopac Middle	002 9394	3	39	0.23	1.0	28,000
Mahopac Vg. Ctr.	009 0646	11	25	0.15	1.0	18,000
Baldwin Place Shopping Ctr.	006 7741	4	37	0.22	1.0	26,600
Society Hill	020 7365	19	31	0.19	1.0	22,500
Williamsburg Ridge	016 5611	5	22	0.13		1,016,000
<i>Basin Totals</i>		<i>241</i>	<i>390</i>	<i>2.3</i>		<i>0.382 MGD</i>

Current Phosphorus Load calculated from 1996 effluent flows and phosphorus concentration data as available.

BOG BROOK RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Bog Brook Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 375 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 38 Kg/yr. Therefore, 337 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 321 Kg/yr is below the available load. However, NYSDEC is identifying a WLA of 28 Kg/yr and a LA of 309 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 17.3 ug/l can be expected as a growing season average.

The Phase II WLA is based on the requirements contained in the New York City Rules and Regulations for point source discharges. The following table lists information for the one point source of phosphorus in the Bog Brook Reservoir Basin. Additionally, the implementation of Phase II Storm Water Regulations throughout the Croton Basin will result in phosphorus load reductions in the Bog Brook Basin that will assist with downstream reduction needs.

BOG BROOK RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Towne Centre	0219045	8	28	0.17	1.0	20,000

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

CROSS RIVER RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Cross River Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 1,007 Kg/yr is based on the 15 ug/l site specific phosphorus objective for this source water reservoir and includes a 12.5% margin of safety (MOS) of 126 Kg/yr. Therefore, 881 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 717 Kg/yr is well below the available load of 881. However, NYSDEC is identifying a WLA of 108 Kg/yr and a LA of 773 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 13.7 ug/l can be expected as a growing season average.

The Phase II TMDL includes WLAs based on the requirements contained in the New York City Rules and Regulations for point source discharges. The following table lists information for the four point sources of phosphorus in the Cross River Reservoir Basin. Additionally, the implementation of Phase II Storm Water Regulations throughout the Croton Basin will result in phosphorus load reductions to the Cross River Reservoir that will assist with downstream reduction needs.

CROSS RIVER RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Lewisboro Elementary School	003 6684	2	14	0.08	1.0	10,000
Meadows at Cross River	009 9520	26	41	0.25	0.5	59,000
Michelle Estates	021 4841	2	42	0.25	0.5	60,000
Waccabuc Country Club	010 5708	28	11	0.07	1.0	8,000
<i>Basin Totals</i>		<i>58</i>	<i>108</i>	<i>0.65</i>		<i>0.137 MGD</i>

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

CROTON FALLS RESERVOIR

The Phase II Phosphorus Calculations Report for the Croton Falls Reservoir indicates the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 3,565 Kg/yr is based on the 15 ug/l site specific phosphorus objective for this source water reservoir and includes a 15% margin of safety (MOS) of 535 Kg/yr. Therefore, 3,030 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 5,010 Kg/yr is greater than the available load. However, a 1,095 Kg/yr reduction in point source loading is anticipated due to the application of New York City's Watershed Rules and Regulations. This leaves a phosphorus loading reduction of 885 Kg/yr. It is anticipated that this will be achieved by the nonpoint source programs listed in Section VI.

Based on the above loadings, a wasteload allocation (WLA) of 615 Kg/yr and a Load Allocation (LA) of 2,415 Kg/yr has been set for Croton Falls Reservoir.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 21 ug/l can be expected as a growing season average.

The following table lists information for each of the point sources of phosphorus in the Croton Falls Reservoir Basin with proposed individual WLAs under the heading New York City Rules and Regulations, Phosphorus Loadings.

CROTON FALLS RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Carmel SD #2	003 1356	945	305	1.8	0.2	1,100,000
The Fairways	016 5719	15	45	0.27	0.5	65,000
Fulmar Rd. Elem. School	002 9386	4	27	0.2	1.0	19,400
Lake Plaza	014 3693	3	28	0.2	1.0	20,000
Mahopac STP	002 6590	605	208	1.3	0.5	300,000
Putnam Hospital Center	009 5672	137	0	0.3	1.0	30,000
Ralph Morando Bldg.	006 2561	1	2	0.02	1.0	1,800
Basin Totals		1,710	615	4.1		1.54 MGD

Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

DIVERTING RESERVOIR

The Phase II Phosphorus Calculations Report for the Diverting Reservoir indicates the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 2,798 Kg/yr is based on the 20 ug/l guidance value and includes a 14.5% margin of safety (MOS) of 406 Kg/yr. Therefore, 2,392 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. At a WLA of 322 Kg/yr, the LA is then set at 2,070 Kg/yr.

The current load of 3,844 Kg/yr is greater than the available load. Even after reductions in point source loadings due to the application of NYC's Watershed Rules and Regulations, the available load will be exceeded by 983 Kg/yr. The most significant portion of Diverting's phosphorus load comes from upstream sources (2,618 Kg/yr), more specifically East Branch Reservoir. Diverting's urban load of 491 Kg/yr is about 15% of the total load. It is anticipated that necessary phosphorus reductions would come from the nonpoint source programs in Section VI.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 27.8 ug/l can be expected as a growing season average.

The following table lists information for each of the point sources of phosphorus in the Diverting Reservoir Basin with proposed individual WLAs under the heading New York City Rules and Regulations, Phosphorus Loadings.

<i>DIVERTING RESERVOIR</i>						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Blackberry San. S.D.	006 2570	53	52	0.3	0.5	74,700
Brewster Heights S.D	011 0353	63	104	0.6	0.5	150,000
Brewster WWTP ¹	002 6581	43	166	1.0	0.5	240,000
<i>Basin Totals</i>		<i>159</i>	<i>322</i>	<i>1.9</i>		<i>0.465 MGD</i>

* Current Phosphorus Load calculated from 1996 effluent flows and phosphorus concentration data as available.

¹ Based on proposed expansion.

EAST BRANCH RESERVOIR

The Phase II Phosphorus Calculations Report for the East Branch Reservoir indicates the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 2,822 Kg/yr is based on the 20 ug/l guidance value and includes a 12.5% margin of safety (MOS) of 353 Kg/yr. Therefore, 2,469 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. A WLA of 449 Kg/yr and a LA of 2,020 Kg/yr has been set for East Branch Reservoir.

The current load of 3,462Kg/yr is greater than the available load. Even after reductions in point source loadings due to the application of NYC's Watershed Rules and Regulations, the available load will be exceeded by 993Kg/yr. Significant reductions in the urban runoff load of 1,141 Kg/yr and the 189 Kg/yr upstream loads from Peach and Putnam Lake sub-basins would have to be achieved to meet the 993 Kg/yr target. The nonpoint source programs listed in Section VI will be implemented to meet the East Branch Reservoir LA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 22.8 ug/l can be expected as a growing season average.

The following table lists information for each of the point sources of phosphorus in the East Branch Reservoir Basin with proposed individual WLAs under the heading New York City Rules and Regulations, Phosphorus Loadings.

<i>EAST BRANCH RESERVOIR</i>						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Big Birch Ski Area	009 5982	2	4	0.03	1.0	3,000
Brewster High School	002 9521	6	21	0.13	1.0	15,000
Cornwall Meadows	020 7438	28	28	0.17	1.0	20,000
Educational Alliance	021 5112	10	41	0.25	1.0	29,500
H.H. Wells Middle School	002 9530	9	29	0.18	1.0	21,000
Hostel #1228 Welfare Rd.	020 8108	8	3	0.02	1.0	2,100
John F. Kennedy Elem. Sch.	002 9548	12	15	0.1	1.0	11,000
Mt. Ebo Corp. Ctr.	014 8946	40	111	0.7	0.5	160,000
Patterson Vg. Condos	007 3466	75	27	0.16	1.0	19,700
Tracy Tertiary STP	021 4418	5	55	0.33	1.0	40,000
Watchtower Ed. Ctr.	016 5778	38	114	0.7	0.5	165,000
<i>Basin Totals</i>		<i>233</i>	<i>449</i>	<i>2.8</i>		<i>0.5 MGD</i>

Current Phosphorus Load calculated from 1996 effluent flows and phosphorus concentration data as available.

MIDDLE BRANCH RESERVOIR

The Phase II Phosphorus Calculations Report for the Middle Branch Reservoir indicates the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 949 Kg/yr is based on the 20 ug/l guidance value and includes a 14% margin of safety (MOS) of 133 Kg/yr. Therefore, 816 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. At a WLA of 184 Kg/yr, the LA is then set at 632 Kg/yr.

The current load of 1,020 Kg/yr is greater than the available load. Even after reductions in point source loadings due to the application of NYC's Watershed Rules and Regulations, the available load will be exceeded by 204 Kg/yr. The most significant contributor of phosphorus to the Middle Branch Reservoir is the upstream load from the Lake Carmel sub-basin at 528 Kg/yr. Therefore, reductions in this load coupled with reductions of the urban runoff load of 211 Kg/yr will be necessary in order to meet the TMDL. It is anticipated that the necessary phosphorus reductions will be achieved by implementing the nonpoint source programs listed in Section VI.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 22.1 ug/l can be expected as a growing season average.

The following table lists information for each of the point sources of phosphorus in the Middle Branch Reservoir Basin with proposed individual WLAs under the heading New York City Rules and Regulations, Phosphorus Loadings.

MIDDLE BRANCH RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Camp Edward Isaacs STP	010 1974	1	16	0.1	1.0	11,300
Camp Ludington	010 2181	5	5	0.03	1.0	3,300
Fox Run (Forest Haven)	003 7362	18	48	0.3	0.5	69,400
Frangel Realty	014 3863	2	4	0.03	1.0	3,200
George Fisher Middle School	014 9349	25	25	0.15	1.0	18,000
Hudson Glen (Christy Farms)	016 5531	36	48	0.3	0.5	68,500
Kent Nursing Home	002 8924	12	28	0.17	1.0	20,000
NYSDOT Res. Engr. HQ	014 9390	0	0	0	1.0	500
Highlands WWTP (proposed in offset program)	020 8441	----	2	0.01	0.1	12,000
Campus WWTP (proposed in offset program)	-----	----	9	0.06	0.1	68,000
Basin Totals		99	184	1.2		0.27 MGD

Current Phosphorus Load calculated from 1996 effluent flows and phosphorus concentration data as available.

MUSCOOT RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Muscoot Reservoir indicates that the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 9,397 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 940 Kg/yr. Therefore, 8,457 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. A WLA of 1,405 Kg/yr and a LA of 7,052 Kg/yr has been set for Muscoot Reservoir.

The current load of 11,560 Kg/yr is greater than the available load. Even after upstream loading reductions and reductions in point source loadings due to the application of NYC's Watershed Rules and Regulations, the available load will be exceeded by 2,058 Kg/yr.

Upstream phosphorus loads at 5,579 Kg/yr and Muscoot urban runoff loads at 2,853 Kg/yr are the two largest contributors of phosphorus to the Muscoot Reservoir. Significant reductions of these two loading sources would be needed to mitigate the 2,058 Kg/yr excess. The nonpoint source programs listed in Section VI will be implemented throughout the Croton System to achieve necessary phosphorus reductions for Muscoot Reservoir.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 24.6 ug/l can be expected as a growing season average.

The following table lists information for each of the point sources of phosphorus in the Muscoot Reservoir Basin with proposed individual WLAs under the heading New York City Rules and Regulations, Phosphorus Loadings.

MUSCOOT RESERVOIR						
Facility Name	Permit No.	Current* Phosphorus Load (Kg/yr)	NYC Rules & Regulations Phosphorus Loadings			Permit Flow (GPD)
			Kg/yr	lbs/day	mg/l	
Bedford Hills Correctional Facility	010 1885	156	139	0.8	0.2	500,000
Bedford Hills Elderly Housing	021 4540	3	28	0.17	1.0	20,000
Bedford Middle School	010 5741	31	28	0.17	1.0	20,000
Bedford Park Apartments	003 3596	54	27	0.16	1.0	19,500
Country Manor (Carmel #7)	002 9017	141	52	0.3	1.0	37,200
Heritage Hills	002 6891	188	195	1.2	0.2	702,000
Holly Stream Condos	003 5254	74	26	0.16	1.0	19,000
I-684 Rest Area	003 5955	12	17	0.1	1.0	12,000
Increase Miller School	003 6692	3	14	0.08	1.0	10,000
Lincoln Hall STP	003 6994	17	69	0.4	1.0	50,000
Maple Hill Estates	014 8857	86	18	0.1	1.0	13,000
North Salem M.S.	010 5732	3	10	0.06	1.0	7,500
Reed Farm Condos	014 5858	22	69	0.4	1.0	50,000
Somers High School	003 5483	12	43	0.3	1.0	31,300
Somers Int. School	003 5491	0	29	0.18	1.0	21,000
Somers Manor Nursing	010 1877	16	42	0.25	0.5	60,000
Somers Office Building	016 5948	13	53	0.3	0.5	76,800
St. Mary of the Assumption	010 5724	0	44	0.26	0.5	63,000
Waterview Nursing Center	002 9653	71	44	0.27	1.0	32,000
Wild Oakes Utilities	006 5706	33	42	0.256	0.5	60,000
Yorktown Heights WWTP	002 6743	696	416	2.5	0.2	1,500,000
Basin Totals		1,631	1,405	8.4		3.3 MGD

Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

NEW CROTON RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the New Croton Reservoir indicates that the reservoir is water quality limited. The phosphorus TMDL of 9,731 Kg/yr is based on the 15 ug/l site specific phosphorus objective for this source water reservoir and includes a 10% margin of safety (MOS) of 973 Kg/yr. Therefore, 8,758 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 11,189 Kg/yr exceeds the available load by 2,431 Kg/yr. After upstream point source reductions, the excess is reduced to 1,356 Kg/yr. The nonpoint source programs listed in Section VI will be implemented throughout the Croton System to achieve necessary reductions for the New Croton Reservoir.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 17.3 ug/l can be expected as a growing season average.

The available phosphorus load of 8,758 will be met at a WLA of 209 Kg/yr and an LA of 8,549 Kg/yr. The point source information presented below reflects the diversion of Lakeside Village wastewater out of the New Croton Basin.

NEW CROTON RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current* Phosphorus Load (Kg/yr)</i>	<i>NYC Rules & Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Katonah Elementary School	025 9861	0	18	0.11	1.0	13,000
K'nal Ados Kashan (Hillcrest Ctr.)	014 7249	13	69	0.42	1.0	50,000
Riverwoods	016 5425	12	55	0.33	0.5	80,000
Lakeside Village STP	002 6727	Diversion Complete				
Walter Panas High School	003 5017	3	55	0.33	1.0	40,000
Yeshiva Kehil Yakov	014 7087	13	11	0.07	1.0	8,000
<i>Basin Total</i>		<i>41</i>	<i>209</i>	<i>1.3</i>		<i>0.29 MGD</i>

Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

TITICUS RESERVOIR

The Phase II Phosphorus Calculations Report for Titicus Reservoir indicates that the reservoir is water quality limited based on current conditions. The phosphorus TMDL of 1,158 Kg/yr is based on the 20 ug/l guidance value and includes a 15% margin of safety (MOS) of 174 Kg/yr. This leaves 984 Kg/yr available for allocation between point and nonpoint sources. The current load of 1,124 Kg/yr exceeds this value by 140 Kg/yr.

There are no point sources of phosphorus in the Titicus Basin. Therefore, the wasteload allocation (WLA) is set 0 Kg/yr.

An LA of 984 Kg/yr for nonpoint sources will achieve the reductions needed to meet the TMDL. Based on current phosphorus loads, this will necessitate a reduction of 140 Kg/yr of nonpoint source loads. It is anticipated that this reduction will be accomplished by the implementation of Phase II Storm Water Regulations throughout the Titicus Basin as well as the other nonpoint source programs listed in Section VI.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates that a phosphorus concentration of 19.8 ug/l can be expected as a growing season average.

X. NEW YORK CITY WATER SUPPLY RESERVOIR PHASE II TMDL SUMMARIES

The following reservoir write-ups summarize the information in NYCDEP's Phosphorus TMDL Calculations Reports (3/99).

**B. CATSKILL-DELAWARE
RESERVOIR SYSTEM**

ASHOKAN RESERVOIR

Analysis of the Phase II Phosphorus TMDL Calculations Report for the Ashokan Reservoir indicates that the Reservoir is not water quality limited. The Ashokan Reservoir is split into two basins by a dividing weir. Therefore, each basin has its own phosphorus TMDL based on specific physical and water quality characteristics.

<i>TMDL</i>	<i>East Basin (Kg/yr)</i>	<i>West Basin (Kg/yr)</i>
TMDL	19,542	45,399
Margin of Safety (10%)	<u>- 1,954</u>	<u>- 4,540</u>
Load Available for Allocation	17,588	40,859
Current Load	<u>- 16,484</u>	<u>- 32,833</u>
Remaining Load Available	1,104	8,026

The five-year average of 1992-1996 annual geometric means of reservoir data indicates phosphorus concentrations of 12.6 ug/l and 13.1 ug/l can be expected as growing season averages in the East and West Basins. These values are below the site-specific phosphorus objective of 15 ug/l for this source water reservoir. Each basin has a phosphorus load still available. However, NYSDEC is identifying the WLAs and LAs below to update the Phase I TMDL/WLA/LA previously approved by EPA.

	<i>East Basin (Kg/yr)</i>	<i>West Basin (Kg/yr)</i>
WLA	4	264
LA	17,584	40,595

The Phase II TMDL includes WLAs based on the requirements contained in the New York City Rules and Regulations for point source discharges. The table below lists information for the five point sources of phosphorus in the Ashokan Basin.

ASHOKAN RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Belleayre Mountain Ski Center	003 4169 Outfall 001 Outfall 002	7 2	21 19	0.12 0.12	1.0 1.0	15,000 14,000
Camp Timber Lake	024 0664	20	47	0.3	1.0	34,000
Onteora Jr.-Sr. High	009 9856	29	37	0.23	1.0	27,000
Pine Hill STP	002-6557	117	139	0.8	0.2	500,000
Mountainside Restaurant	025 1241	5	4	0.03	1.0	3,000
<i>Basin Totals</i>		180	268	1.6		0.6 MGD

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

BOYD CORNERS RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Boyd Corners Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 966 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 97 Kg/yr. Therefore, 869 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 687 Kg/yr is well below this available load. However, NYSDEC is identifying an LA of 869 Kg/yr and a WLA of 0 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The implementation of Phase II Storm Water Regulations throughout the Croton Basin will result in phosphorus load reductions to Boyd Corners Reservoir that will assist with downstream reduction needs.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 14.1 ug/l can be expected as a growing season average.

The Boyd Corners watershed does not currently have any wastewater treatment plants.

CANNONSVILLE RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Cannonsville Reservoir indicates that the Reservoir is water quality limited based on current conditions. The phosphorus TMDL of 53,650 Kg/yr is based on the 20 ug/l guidance value and includes a 12.5% margin of safety (MOS) of 6,706 Kg/yr. Therefore, 46,944 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 52,368 Kg/yr is greater than the available load. However, at a WLA of 1,086 Kg/yr, a 6,324 Kg/yr reduction in point source load is anticipated due to the application of New York City's Watershed Rules and Regulations. This would make the Cannonsville Reservoir not water quality limited. Based on current loads, the LA has been set at 45,858 Kg/yr.

There is a concern that the anticipated point source reduction in phosphorus may be an overestimate of the actual reduction that will occur. DEC is committed to continued monitoring to help verify current point source loads (e.g., the Walton WWTP) and confirm the magnitude of reductions achieved due to the application of NYC's Watershed Rules and Regulations.

Based on the loadings cited in the first paragraph, a load allocation (LA) of 45,858 Kg/yr phosphorus has been identified for Cannonsville nonpoint sources. The current estimated nonpoint source load is 44,968 Kg/yr. The five-year growing season average (1992-1996 annual geometric means) phosphorus concentration is 19.7 ug/l. Therefore, the LA will be monitored closely to determine if further reductions are necessary.

The following table lists information for each of the point source discharges of phosphorus in the Cannonsville Basin with proposed individual WLAs under the heading NYC Rules and Regulations, Phosphorus Loadings.

CANNONSVILLE RESERVOIR						
Facility Name	Permit No.	Current * Phosphorus Load (Kg/yr)	New York City Rules and Regulations Phosphorus Loadings			Permit Flow (GPD)
			Kg/yr	lbs/day	mg/l	
Delhi WWTP ²	002 0265	1,270	169	1.0	0.15	815,000
Hobart WWTP	002 9254	202	111	0.8	0.5	160,000
Penn Quality Meats	022 3174	Now	Closed			
SEVA Institute	020 5800	0	9	0.006	1.0	(002) 6,600
		0	2	0.001	1.0	(003) 1,200
Allen Residential	002 9645	78	28	0.2	1.0	20,000
Stamford WWTP	002 1555	551	139	0.8	0.2	500,000
Walton WWTP	002 7154	5,175	325	2.0	0.2	1,170,000
Kraft	000 8494	124	300	1.8	0.2	1,080,000
Dairyvest ²	006 8292	0	0	Spray Irrigation	0.2	720,000
Del-Chenango BOCES	009 7446	1	3	0.002	1.0	2,500
Basin Totals		7,401	1,086	6.7		3.77 MGD

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

² Based on preliminary numbers from Delhi's variance request per NYCWRR. Dairyvest discharge is proposed for transmission to Delhi WWTP.

KENSICO RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Kensico Reservoir indicates that the Reservoir is not water quality limited. The phosphorus TMDL of 28,276 Kg/yr includes a 10% margin of safety (MOS) of 2,828 Kg/yr. Therefore, 25,448 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 16,926 Kg/yr is well below the available load. However, NYSDEC is identifying an LA of 25,448 Kg/yr and a WLA of 0 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 8.9 ug/l can be expected as a growing season average. This value is below the site-specific phosphorus objective of 15 ug/l for this source water reservoir.

The Kensico Reservoir does not have any wastewater treatment plants in its watershed.

NEVERSINK RESERVOIR

The Phase II Phosphorus TMDL Calculations Report the for Neversink Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 22,553 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 2,255 Kg/yr. Therefore, 20,298 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 6,863 Kg/yr is well below the available load. However, NYSDEC is identifying an LA of 20,298 Kg/yr and a WLA of 0 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 5.8 ug/l can be expected as a growing season average.

The Neversink Reservoir does not currently have any wastewater treatment plants in its watershed.

PEPACTON RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the Pepacton Reservoir indicates that the Reservoir is not water quality limited. The phosphorus TMDL of 79,167 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 7,917 Kg/yr. Therefore, 71,250 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 37,327 Kg/yr is well below the available load. However, NYSDEC is identifying a WLA of 386 Kg/yr and an LA of 70,864 to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 9.3 ug/l can be expected as a growing season average.

The Phase II TMDL includes WLAs based on the requirements contained in the New York City Rules and Regulations for point source discharges. The table below lists information for the five point sources of phosphorus in the Pepacton Reservoir Basin.

PEPACTON RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Camp Nubar (Seasonal)	002 3787	3	17	0.1	1.0	12,500
Camp Tai Chi (Seasonal)	010 4957	1	10	0.1	1.0	7,500
Margaretville STP	002 6531	547	277	1.7	0.5	400,000
Regis Hotel (Seasonal)	010 0382	3	13	0.1	1.0	9,600
Roxbury Run	009 9562	44	69	0.4	0.5	100,000
<i>Basin Totals</i>		598	386	2.4		0.53 MGD

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

RONDOUT RESERVOIR

The Phase II Phosphorus TMDL calculations Report for the Rondout Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 41,413 Kg/yr includes a 10% margin of safety (MOS) of 4,141 Kg/yr. Therefore, 37,272 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 23,476 Kg/yr is well below the available load. However, NYSDEC is identifying a WLA of 125 Kg/yr and a LA of 37,147 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 8.5 ug/l can be expected as a growing season average. This value is below the site-specific phosphorus objective of 15 ug/l for this source water reservoir.

The Phase II WLA is based on the requirements contained in the New York City Rules and Regulations for point source discharges. The following table lists information for the one point source of phosphorus in the Rondout Reservoir Basin.

RONDOUT RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Grahamsville STP	002 6549	151	125	0.75	0.5	180,000

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

SCHOHARIE RESERVOIR

The Phase II Phosphorus TMDL Calculations Report the for Schoharie Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 29,761 Kg/yr is based on the 20 ug/l guidance value and includes a 10% margin of safety (MOS) of 2,976 Kg/yr. Therefore, 26,785 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 19,864 Kg/yr is well below the available load. However, NYSDEC is identifying a WLA of 789 Kg/yr and a LA of 25,996 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

A phosphorus concentration of 13.2 ug/l can be expected as a growing season average. This is based on a four-year average of the annual geometric means of reservoir data for the period 1992-1995. Data from 1996 was excluded as 100 year flood conditions resulted in a significant and uncharacteristically high increase in phosphorus loading to the reservoir.

The Phase II TMDL includes WLAs based on the requirements contained in the New York City Rules and Regulations for point source discharges. The table below lists information for the 20 point sources of phosphorus in the Schoharie Reservoir Basin.

SCHOHARIE RESERVOIR						
Facility Name	Permit No.	Current * Phosphorus Load (Kg/yr)	New York City Rules and Regulations Phosphorus Loadings			Permit Flow (GPD)
			Kg/yr	lbs/day	mg/l	
Camp Loyaltown	010 4965	17	29	0.18	1.0	21,000
Colonel Chair Estates - Block 8	010 1001	19	42	0.25	1.0	30,000
Crystal Pond	022 3638	0	50	0.3	1.0	36,000
Elka Park	009 2991	4	14	0.083	1.0	10,000
Forester Motor Lodge	010 0374	7	5	0.03	1.0	3,900
Frog House Restaurant	022 4731	To GW				1,800
Golden Acres Farms (#001)	006 9957	2	8	0.05	1.0	5,800
Golden Acres Farms (#002)	006 9957	1	2	0.01	1.0	1,100
Golden Acres Farms (#003)	006 9957	1	3	0.02	1.0	2,300
Grand Gorge STP	002 6565	173	139	0.83	0.2	500,000
Harriman Lodge	010 0277	6	28	0.2	1.0	20,000
Hunter Highlands WPC	006 1131	1	55	0.3	0.5	80,000
Latvian Church Camp	007 2192	14	10	0.06	1.0	7,000
Lifside	021 2288	3	56	0.3	0.5	81,000
Mountain View HOA	024 1261	4	10	0.06	1.0	7,000
Mountain View Estates	021 2407	1	8	0.05	1.0	6,000
Ron-de-voov Restaurant	012 4672	1	1	0.008	1.0	1,000
Ski Windham	006 5315	74	83	0.5	0.5	120,000
Tannersville STP	002 6573	480	222	1.3	0.2	800,000
Thompson House Inc.	010 1168	6	7	0.04	1.0	4,800
Whistle Tree Development	003 0821	1	17	0.1	1.0	12,500
Basin Totals		815	789	4.7		1.75 MGD

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.

WEST BRANCH RESERVOIR

The Phase II Phosphorus TMDL Calculations Report for the West Branch Reservoir indicates that the reservoir is not water quality limited. The phosphorus TMDL of 12,760 Kg/yr includes a 10% margin of safety (MOS) of 1,276 Kg/yr. Therefore, 11,484 Kg/yr total phosphorus is available for allocation between point and nonpoint sources. The current load of 8,662 Kg/yr is well below the available load. However, NYSDEC is identifying a WLA of 28 Kg/yr and a LA of 11,456 Kg/yr to update the Phase I TMDL/WLA/LA previously approved by EPA.

The implementation of Phase II Storm Water Regulations throughout the Croton Basin will result in phosphorus load reductions to West Branch Reservoir that will assist in meeting downstream reduction requirements.

The five-year average of 1992-1996 annual geometric means of reservoir data indicates a phosphorus concentration of 10.8 ug/l can be expected as a growing season average. This value is below the site-specific phosphorus objective of 15 ug/l for this source water reservoir.

The Phase II WLA is based on the requirements contained in the New York City Rules and Regulations for point source discharges. The following table lists information for the one point source of phosphorus in the West Branch Reservoir Basin.

WEST BRANCH RESERVOIR						
<i>Facility Name</i>	<i>Permit No.</i>	<i>Current * Phosphorus Load (Kg/yr)</i>	<i>New York City Rules and Regulations Phosphorus Loadings</i>			<i>Permit Flow (GPD)</i>
			<i>Kg/yr</i>	<i>lbs/day</i>	<i>mg/l</i>	
Clear Pool Camp	0098621	2	28	0.17	1.0	20,000

* Current Phosphorus Load calculated from 1996 effluent flow and phosphorus concentration data as available.