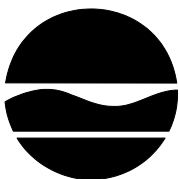


Interim Report

Nonpoint Source Implementation Of The Phase II Phosphorus TMDLs In The New York City Watershed

March 2002

Prepared in accordance with the New York City Watershed Memorandum of Agreement (January 1997).



New York State Department of
Environmental Conservation

Division of Water



P R E F A C E

This report represents the next step in the implementation process for phosphorus load reductions in the New York City (NYC) Watershed. It has been prepared in accordance with the NYC Watershed Memorandum of Agreement (MOA, January 1997) and focuses on nonpoint source (NPS) implementation efforts that can contribute to the attainment of Phase II Phosphorus Total Maximum Daily Loads (TMDLs).

The report provides a snapshot of the current status of implementation programs, projects and activities and next steps toward a final implementation plan. It has been released as “Interim” since it does not include all of the specific implementation components outlined in the MOA and expanded upon in the U.S. Environmental Protection Agency’s (EPA’s) October 16, 2000 implementation strategy letter.

The New York State Department of Environmental Conservation (DEC) remains committed to the development of a final implementation plan. The Phase II Phosphorus TMDLs identified eight NYC reservoirs as water quality limited and needing nonpoint (NPS) reductions. These reservoirs are in the Croton portion of the City’s watershed and are located east of the Hudson River . Thus, the timing of the final implementation plan will depend on the findings and completion of Croton Planning in Putnam and Westchester Counties, as well as the implementation of Phase II Stormwater Regulations and continued monitoring in the Croton Watershed.

In light of the above, the DEC recommends the establishment of an institutional framework to coordinate, track and assist in the development of individual basin plans as described in the EPA’s October 16, 2000 letter. Over the next several months, the DEC will develop a process on how to proceed and will consult with the Watershed Protection and Partnership Council (WPPC).

It is important that key components to the development of an implementation plan, such as Croton Planning and Phase II Stormwater Regulations implementation, remain on schedule. Additionally, a long-term emphasis needs to be placed on ambient monitoring to assess the effectiveness of applied best management practices (BMPs) and water quality improvements in individual basins. The specifics of nonpoint source implementation that are unavailable at this point in time should evolve from the efforts above. In summary, these include:

- identification of BMPs specific to each reservoir basin to meet TMDLs and achieve downstream standards;
- a list of municipal entities designated by Phase II Stormwater Regulations;
- quantification of upstream, additional load reductions, above those to meet the TMDL for that waterbody and necessary to achieve downstream standards;
- a description of implementation mechanisms;
- the time frame for implementing the actions;
- funding sources for implementation; and,
- a plan for evaluating/monitoring plan effectiveness.

We look forward to the continued support of all involved agencies and watershed stakeholders as the TMDL implementation process progresses.

A C K N O W L E D G M E N T S

Several agencies and many people have contributed to the development of this Nonpoint Source (NPS) Implementation Report. The New York State Department of Environmental Conservation (NYSDEC) would like to take this opportunity to say “Thank You”.

The Total Maximum Daily Load (TMDL) Work Group, composed of scientists and engineers from the New York City Department of Environmental Protection (NYCDEP), the U.S. Environmental Protection Agency (USEPA), and the New York State Department of Environmental Conservation (NYSDEC) have provided input, comments and technical guidance for this report. Special thanks to Dr. Kimberlee Kane of the NYCDEP and Ms. Maureen Krudner of the USEPA for their assistance.

Additionally, several people contributed to specific portions of the report:

- ! Sabrina Charney - Westchester County Department of Planning**
- ! Gerry Chartier & Tom Boekeloo - NYSDEC, Nonpoint Source Management Section**
- ! Pat Ferracane - NYSDEC, Region #3 (Tarrytown, NY)**
- ! John Lynch - Putnam County Department of Planning**
- ! Ken Markussen - NYSDEC, Division of Water**
- ! Howard Pike - NYSDEC, Division of Water**

Also, thanks to Barbara J. Crier for typing and formatting this report.

TABLE OF CONTENTS

	<u>Page No.</u>
Table of Contents	i
List of Tables	ii
List of Figures	ii
 1. Introduction	 1
1.1 Report Background	1
1.2 TMDL/MOA Overview	1
1.3 Other Considerations	2
2. TMDL Background	4
2.1 Summary of Phase II TMDL Process	4
2.2 Phase II TMDL Results	5
3. Implementation of Phase II TMDLs-Programs	10
3.1 New York State Programs	11
3.1.1 Phase II Stormwater Regulations	13
3.1.1.a Federal Regulations - Background and Criteria	13
3.1.1.b Enhanced Stormwater Management	15
3.1.2 Safe Drinking Water Act and Water Resources Development Act Projects	 16
3.1.3 NYSDEC Region 3 Programs	17
3.1.4 Watershed Data Management and Software Development Project	 18
3.2 New York City Department of Environmental Protection Programs	19
3.3 New York City Watershed Partnership Program	20
3.3.1 Putnam County Croton Plan	20
3.3.2 Westchester County Croton Programs	22
4. Implementation of Phase II TMDLs - Actions To Be Taken	26
4.1 Background	26
4.2 NYSDEC Actions	26
4.3 Actions Recommended	27
4.3.1 USEPA	27
4.3.2 New York City	28
4.3.3 Local Government	29
4.3.3.a Putnam County	29
4.3.3.b. Westchester County	29
4.4 Implementation Schedule	30
5. Implementation Mechanisms and Next Steps	32
5.1 Watershed Approach	33
5.2 Monitoring and Evaluation	35
5.3 Conclusion	35
 Appendix A SDWA and WRDA Funded Projects	
 Appendix B New York City Watershed Data Management and Software Tools Development Project	

LIST OF TABLES

	<u>Page No.</u>
Table 2.1 Land Use Area - Croton System Reservoirs	8
Table 2.2 Nonpoint Source Phosphorus Loads - Croton System Reservoirs	9
Table 2.3 Upstream Phosphorus Loads	10

LIST OF FIGURES

	<u>Page No.</u>
Figure 1.1. Map of Croton Watershed	3

1. INTRODUCTION

1.1 Report Background

The New York City (NYC) Watershed Memorandum of Agreement (MOA) prescribed a multi-step process for Phosphorus Total Maximum Daily Load (TMDL) development in the Watershed. Article VI, Section 162(h)(v) provides for the continuance of this process with the Nonpoint Source (NPS) Implementation of Phase II TMDLs as follows:

“Within six months of receiving a report (April 2001) ¹ identifying potential management practices for nonpoint source pollution, the New York State Department of Environmental Conservation (NYSDEC) shall work jointly with the New York City Department of Environmental Protection (NYCDEP) and shall identify potential nonpoint source management practices it will implement and recommend potential nonpoint source management practices to be implemented by other parties. NYSDEC shall provide a description and a schedule of the implementation mechanisms.”

Additionally, in its October 16, 2000 letter to the NYSDEC, the U.S. Environmental Protection Agency (USEPA) recommended several components for inclusion in the NPS Implementation Reports and related programs. These recommendations were related to a number of topics including better quantification of phosphorus load reductions, NPS management practices and implementation mechanisms and the time frame and funding sources for implementation. In summary, the EPA letter provided some guidance for the development of the NPS Reports and the importance of stakeholder involvement in the implementation process.

Based on the MOA directive above and EPA’s October 16, 2000 letter, the focus of this report is to continue the process of outlining the strategy for achieving the load allocations (LAs) for watershed TMDLs.

1.2 TMDL/MOA Overview

Phase I TMDLs/WLAs/LAs for the Croton and Catskill-Delaware Watersheds were approved by the USEPA in April of 1997. The Phosphorus TMDL development process continued in Phase II with several enhancements over Phase I. These are outlined beginning on page two of NYSDEC’s Phase II

¹ Nonpoint Source Implementation of the Phase II TMDLs (April 2001).

TMDL document.² Dated June, 2000, the Phase II Phosphorus TMDLs were ultimately approved by EPA in October, 2000. The Phase II TMDLs identified eight Croton reservoirs as water quality limited. Each of these waterbodies is located east of the Hudson River and requires nonpoint source reductions of phosphorus loads. The eight reservoirs are part of the Croton Watershed as illustrated in Figure 1.1.

EPA's approval initiated the development of NPS Implementation Reports as directed by the MOA. The first of these reports was issued in April, 2001 by NYCDEP along with NYSDEC. This second report is the next step in the NPS Implementation process.

1.3 **Other Considerations**

This report will pull together pertinent information from several programs and activities. These include: the Phase II Phosphorus TMDLs for the New York City Watershed, NYCDEP's March 1999 TMDL Related Reports and its Croton Watershed Strategy, New York State's Nonpoint Source Management Program, Croton Planning for Putnam and Westchester Counties, NYSDEC's Phase II Stormwater Program, including efforts by the Center for Watershed Protection and projects funded by Safe Drinking Water Act (SDWA) and Water Resources Development Act (WRDA).

In spite of the above programs and ongoing activities that relate to NPS implementation efforts, there are limitations to what can be incorporated at this time. For example:

- a. The time frame for the completion of this report does not coincide with the completion of the many ongoing activities, planning efforts and their prospective findings. Croton Plans for Putnam and Westchester Counties are scheduled for release in May 2002 and final agreement in November 2002. Also, the New York City Watershed Project (Information Technology) presented in Section 3.1.4 is scheduled for completion in the Spring of 2003.
- b. Various data and information gaps in the implementation process have been identified. These include: an integrated, GIS-based water quality data management program; a flexible, adaptive GIS land use database; a modeling support tool-set consisting of modules to support terrestrial modeling (GWLF and the Upstate Freshwater

² NYSDEC Phase II Phosphorus Total Maximum Daily Loads For Reservoirs In The New York City Watershed (June 2000).

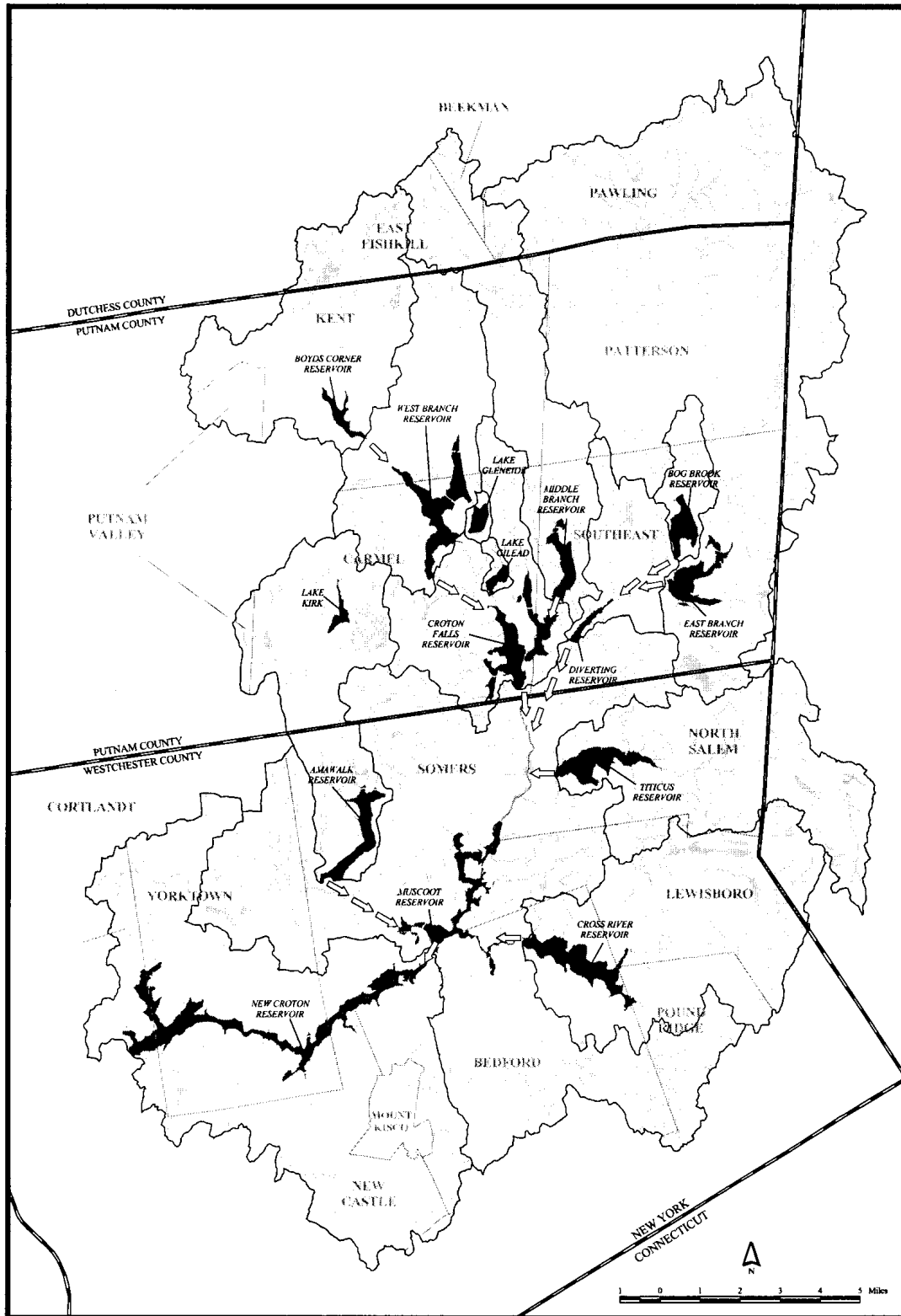


Figure 1.1. Map of the Croton Watershed.

Institute's (UFI's) reservoir model for phosphorus; improved user access to such data, information and models.

- c. Relating the necessary upstream NPS phosphorus reductions to the attainment of downstream, in-reservoir phosphorus standards - numerically, among municipal boundaries and geographical boundaries - is incomplete. Section 3 discusses various implementation programs including the need to develop more specific information on NPS pollutant sources of phosphorus and the associated local capacity to take targeted actions that allow for the most efficient opportunities to reduce phosphorus loads.
- d. Practices that are needed to control many NPS cannot be identified for specific locations at this time. These decisions ultimately are best linked to local decision-making processes as specific practices are defined and scheduled for implementation.

2. TMDL Background

2.1 Summary of Phase II TMDL Process

The Clean Water Act [CWA §303(D) 33 U.S.C.A §1313(D)] requires states to develop TMDLs for water quality limited waters, or those waterbodies that do not attain water quality standards after the application of technology-based controls. Such waterbodies are listed in New York State's 303(d) list which is derived from the Priority Waterbody List (PWL). NYSDEC has identified New York City Watershed reservoirs as priority waters for TMDL development for phosphorus in the 1994, 1996 and 1998 303(d) listings as required by the Clean Water Act.

Phase II Phosphorus TMDLs for each NYC reservoir represent the reservoir's phosphorus loading capacity. The TMDL is the sum of the point source wasteload allocations (WLAs) and the nonpoint source load allocations (LAs) plus a margin of safety (MOS) to account for the uncertainty in the relationship between the phosphorus loads and the reservoir's water quality.

NYCDEP has contributed significantly to the Phase II TMDL development process. The following three reports, each dated March 1999, can be found on NYCDEP's Website (<http://www.ci.nyc.ny.us/htm/dep/tmdl/html>).

- 1. Methodology for calculating Phase II Total Maximum Daily Loads (TMDLs) of Phosphorus for the New York City Drinking Water Reservoirs.

2. Proposed Phase II Phosphorus TMDL Calculation Reports for Each Reservoir.
3. Development of a Water Quality Guidance Value for Phase II Total Maximum Daily Loads (TMDLs) in the New York City Reservoirs.

These reports contain information on the following:

- « phosphorus source modeling
- « impact estimates of wastewater treatment plant upgrades
- « basin/reservoir status with respect to the critical phosphorus load
- « information and recommendations for a water supply-based criteria number for phosphorus
- « land use information and related nonpoint source phosphorus loads
- « Proposed Phase II TMDL calculations for each reservoir, including initial wasteload allocations (WLAs) and load allocations (LAs)

2.2 **Phase II TMDL Results**

NYSDEC's June 2000 TMDL Document contains Phase II TMDL results in a couple of different formats. Pages 21-45 cover each of New York City's 19 reservoirs with a summary write-up based on information in NYCDEP's Phosphorus TMDL Calculations Reports (3/99). Additionally, there are a number of tables that help summarize results. Table 2.1 of the April 2001 NPS Report also provides a TMDL summary.

Phosphorus Sources

Throughout the TMDL process in the NYC Watershed both point and nonpoint sources of phosphorus have been modeled. Point sources include discharges from wastewater treatment plants in the Watershed and carryover phosphorus loads from upstream reservoirs. Nonpoint source phosphorus loads are a function of land use activities, phosphorus export coefficients and the modeling. The land use categories were: urban, forest, agriculture and water. Septic systems with 100 feet of a stream or reservoir were also included as sources of phosphorus.

Point Source Reductions of Phosphorus

The New York City Watershed Rules and Regulations contain requirements for upgrading wastewater treatment plants in the Watershed to tertiary treatment with phosphorus removal. SPDES permit modifications to reflect this are in place and plant upgrades are underway. This will result in a significant reduction in point source phosphorus loads to the reservoirs. DEP's TMDL modeling calculations reflect these point source reductions since the wasteload allocations (WLAs) assume full compliance with the Watershed Regulations.

Nonpoint Sources

Table 4 from DEC's June 2000 TMDL document has been expanded in the tables below with additional information about nonpoint source phosphorus loads for water quality limited reservoirs in the Croton Watershed. Additionally, primary land use activities that relate to NPS phosphorus loads have been identified by area and estimated load contribution. The significance of this information directly relates to the remaining phosphorus reductions needed for water quality limiting reservoirs after point source loads are in conformance with New York City Watershed Rules and Regulations.

Table 2.1 presents land use information for each of the 12 Croton Watershed Reservoirs. As indicated in the Phase II TMDL Methodology Document (March 1999), the land use data is the same as that used for the Phase I TMDLs. It is derived from satellite data (LANDSAT TM) at a 28.5m resolution. Composites of 1987, 1988 and 1990 scenes were used for the East of Hudson region. It should be noted that much of the Forest and Open Space land area is actually low density residential which can present opportunities for phosphorus reductions. Currently, NYSDEC, USEPA and the NYCDEP are working together to develop improved land use coverages. This ongoing project is presented in detail in Section 3.1.4 and Appendix B.

The first eight reservoirs listed in Table 2.1 are water quality limited for phosphorus. The next four are not. It can be seen that nearly 75% of the land area in the Croton Watershed is considered forest. Approximately 11% of the area falls into the urban category. This information is important when examining where NPS phosphorus reductions can be attained.

Table 2.2 expands further on the nonpoint source information base. Here, approximate NPS phosphorus loads are tabulated as a function of land use export coefficient (Methodology Document of March 1999) for each land use category. This tabulation does not take into account upstream load

contributions of phosphorus from upstream reservoirs. The loads here are calculated from land use activity within each listed reservoir basin.

Examination of this information leads to several conclusions:

1. While forested area represents nearly three quarters of the Croton's land use activity, its phosphorus load contribution is only about 20% of the total.
2. Clearly urban areas yield most of the NPS phosphorus load at nearly 60% and would seemingly present the most opportunity for load reductions.
3. Water and septic categories are relatively small contributors of phosphorous.
4. For three reservoirs: Amawalk, Middle Branch and Titicus, a reasonable reduction of NPS urban phosphorus load would meet the necessarily identified reductions in the TMDL.
5. When comparing the other five water quality limited reservoirs' urban phosphorus loads with the remaining phosphorus reductions needed it becomes obvious that substantial NPS reductions are needed to meet the TMDLs. In the East Branch, Muscoot and New Croton Basins, more than 60% reduction in urban NPS loads is needed. In Croton Falls and Diverting, the necessary phosphorus reduction significantly exceeds the urban NPS load. This means that the reductions must come from sources in addition to in-basin urban NPS.
6. The remaining four reservoirs in the Croton Watershed are not water quality limited for phosphorus and are not significant contributors of phosphorus to downstream reservoirs. The exception to this is Cross River's urban load at nearly 600 kg/yr.

The next table presented here, Table 2.3, provides an additional column of information, the calculated phosphorus loading contributed by upstream lakes or reservoirs. On the listing of eight WQL reservoirs, this upstream source of phosphorus ranges from zero or insignificant to very significant. The "daisy-chain" effect of interconnected reservoirs was discussed in Section 4.2.3 of the first NPS Report (April 2001). The list of WQL reservoirs can be rearranged in increasing order of upstream phosphorus load contributions to numerically follow this chain.

While Titicus Reservoir receives no upstream lake/reservoir phosphorus loading, the next three reservoirs (Amawalk, East Branch and Middle Branch) each have upstream lakes contributing to their phosphorus load.

These are: Lake Mahopac to the Amawalk, Peach and Putnam Lakes to East Branch Reservoir, and Lake Carmel to the Middle Branch. These upstream lakes are areas where opportunities exist for phosphorus reductions particularly in the urban and septic categories. The most significant of these loads is the upstream load from Lake Carmel to the Middle Branch Reservoir, estimated at 528 kg/yr.

Table 2.1
Croton Watershed Reservoirs
(Located East of Hudson)
Land Use Area (Hectares)

<i>Reservoir</i>	<i>Forest</i>	<i>Urban</i>	<i>Open/Ag</i>	<i>Water</i>	<i>Total</i>	<i>Phase II TMDL Phosphorus Reduction³ (kg/yr)</i>
Amawalk	3,409	852	616	856	5,733	122
Croton Falls	2,921	531	215	474	4,141	885
Diverting	1,234	545	67	99	1,945	983
East Branch	15,545	1,738	2,386	902	20,571	993
Middle Branch	7,001	806	420	514	8,741	204
Muscoot	13,533	3,170	1,713	646	19,062	2,058
New Croton	11,161	2,059	1,116	1,047	15,383	1,356
Titicus	4,347	676	869	371	6,263	140
TOTALS FOR EIGHT WQL RESERVOIRS	59,151	10,377	7,402	4,909	81,839	6,741
% EACH LAND USE	(72.3)	(12.7)	(9.0)	(6.0)		
Bog Brook	603	131	64	160	958	
Boyd's Corners	7,199	92	192	539	8,022	
Cross River	6,574	657	727	696	8,654	
West Branch	4,164	196	180	598	5,138	
TOTALS FOR NON-WQL RESERVOIRS	18,540	1,076	1,163	1,993	22,772	
% EACH LAND USE	(81.4)	(4.7)	(5.1)	(8.8)		
TOTALS - ALL CROTON WATERSHED RESERVOIRS	77,691	11,453	8,565	6,902	104,611	
% LAND USE	(74.2)	(11.0)	(8.2)	(6.6)		

Table 2.2
Croton Watershed Reservoirs
(Located East of Hudson)
NPS Phosphorus Loads (kg/yr) By Land Use
And Export Coefficients Calculation

<i>Reservoir Name</i>	<i>Phase II TMDL Phosphorus Reduction ³ (kg/yr)</i>	<i>Forest (0.05)</i>	<i>Urban (0.9)</i>	<i>Open/Ag (0.3)</i>	<i>Water (0.1)</i>	<i>Septic ⁴</i>	<i>Total</i>
Amawalk	(122)	170	767	185	86	83	1,291
Croton Falls	(885)	146	478	65	47	43	779
Diverting	(983)	62	491	20	10	24	607
East Branch	(993)	777	1,564	716	90	171	3,318
Middle Branch	(204)	350	725	126	51	18	1,270
Muscoot	(2,058)	677	2,853	514	65	227	4,336
New Croton	(1,356)	558	1,853	335	105	168	3,019
Titicus	(140)	217	608	261	37	96	1,219
TOTALS FOR WQL RESERVOIRS		2,957	9,339	2,222	491	830	15,839
("P" % EACH USE)		(18.7)	(59.0)	(14.0)	(3.1)	(5.2)	
Bog Brook		30	118	19	16	4	187
Boyd's Corners		360	83	58	54	80	635
Cross River		329	591	218	70	186	1,394
West Branch		208	176	54	60	63	561
TOTALS FOR NON-WQL RESERVOIRS		927	968	349	200	333	2,777
% EACH LAND USE		(33.3)	(34.9)	(12.6)	(7.2)	(12)	

³ After Wastewater Treatment Plant Upgrades are achieved.

⁴ Kg/yr Septic Phosphorus Load from NYCDEP Reservoir Reports.

"P" NPS LOAD TOTALS		3,884	10,307	2,571	691	1,163	18,616
% ALL CROTON WATERSHED RESERVOIRS		(20.9)	(55.4)	(13.8)	(3.7)	(6.2)	

Clearly, the next four reservoirs listed (Croton Falls, Diverting, Muscoot and New Croton) receive significant portions of their phosphorus loadings from upstream sources. The long-term key to meeting reservoir phosphorus criteria there rests in the reduction of these loadings. This will necessitate efficient, targeted actions, best management practices and programs as well as local stakeholder involvement in the process.

Table 2.3 Upstream Phosphorus Loads		
<i>Reservoir</i>	<i>Upstream Phosphorus Loading (kg/yr)</i>	<i>Phase II TMDL Phosphorus Reduction ³ (kg/yr)</i>
Titicus	0	140
Amawalk	80	122
East Branch	189	943
Middle Branch	528	204
Croton Falls	1,083	885
Diverting	2,618	983
Muscoot	5,579	2,058
New Croton	9,108	1,356

3. Implementation of Phase II Phosphorus TMDLs - Programs

Background

In April 2001, the NYCDEP and the NYSDEC jointly issued a report which identified potential management practices and programs for controlling nonpoint source pollution. If implemented, these practices and programs would provide reasonable assurances toward attaining nonpoint source phosphorus reductions identified in Phase II TMDLs.

³ After Wastewater Treatment Plant Upgrades are achieved.

A recurring theme in discussions held leading up to the preparation of this second report has been that the report should be specific in its recommendations where possible and focus on the processes of implementation. Such “processes” to be considered include:

- incorporating ongoing programs and projects
- coordination among various stakeholders and their programs
- problem identification and prioritization
- improved NPS data base and analysis
- funding sources and implementation schedules

As indicated in the April 2001 NPS Report, existing programs that may impact nonpoint sources of phosphorus must be assessed. There are numerous State, City, County and Local program activities that will need to be evaluated relative to their impact on identified nonpoint source phosphorus reductions. Are these programs sufficient or will they require modifications or additions to accommodate TMDL implementation? Obviously, program assessment and coordination will be key to implementation efforts.

3.1 **New York State NPS Programs**

In accordance with Section 319 of the Clean Water Act, the NYSDEC has prepared a Nonpoint Source Assessment and a Nonpoint Source Management Program. The Nonpoint Source Assessment was initially completed in 1988 and approved by the EPA on July 1989. An update of this Assessment has been prepared every two years. The latest assessment is in the 1996 Priority Waterbodies List. Since then, the Department has published the PWL assessment information on a 5-year rotating schedule established as part of a Comprehensive Assessment Strategy. The strategy is fully described in the October 2000 NPS Management Program, Appendix D. The Nonpoint Source Management Program was approved by the EPA in January 1990. The Management Plan was updated and approved by the EPA in October 2000. Copies of the Management Program are available from Gerry Chartier (grchart@gw.dec.state.ny.us) (518) 402-8244.

New York State's Nonpoint Source Management Program is charged with the control, reduction or treatment of polluted runoff through the implementation of structural, operational or vegetative management practices. The New York State Department of Environmental Conservation (NYSDEC) works with the New York Nonpoint Source Coordinating Committee (NYNPSCC) to administratively coordinate various state agencies and other interested partners having regulatory, outreach, incentive-based, or funding programs that foster installation of management practices for any of the identified sources of nonpoint pollution threatening or impairing the waters of New York. Local implementation and statewide coordination and evaluation are conducted on a watershed basis.

Nonpoint source pollution usually is best prevented or remediated by employing one or more management practices. A management practice is a means of preventing or reducing the availability, release or transport of

substances which adversely affect surface and groundwaters. It is a practice used to prevent or reduce the impact of nonpoint pollutants usually from a specific source category. Appendix E of the NPS Management Plan describes four statewide workgroups addressing six of New York's priority source categories through project recommendations, management practice updating, policy recommendations and information exchange and distribution.

New York has developed a series of ten Management Practices Catalogues each containing management practices for a particular source category. For this list of tested and approved practices, the best practice should be selected and used by individuals or groups wherever needed to diminish the impact of nonpoint source pollution. They can be used without a formal planning process or without an identification of a specific problem. They make good environmental sense. Use of appropriate management practices helps build environmental responsibility. A summary of management practices by land use was provided in the April 2001 NPS Report. The complete catalogues are also available from Gerry Chartier.

NYSDEC has a New York City Watershed Data Management and Software Tool Development Project that will develop an integrated high resolution GIS data base with a suite of management tools integral to the database that will be used to map and model the NYC Watershed. The data and tool suite is to be internet accessible. It is our intent to use the NYC Watershed project as a template for other watersheds in the state. One result of many will be a better capability to target management practices for greater effectiveness. This work should be completed by the Spring of 2003. See full project description in Section Appendix B.

Coastal NPS Pollution Control Program

The Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) included a section devoted to coastal nonpoint pollution control, now known as Section 6217. This federal legislation requires New York and about 30 other states and territories with approved coastal management programs to develop and implement programs to control nonpoint pollution to restore and protect coastal waters. The Croton Watershed falls within the geographic scope of 6217.

The central purpose of Section 6217 is to strengthen the links between federal and state coastal zone management and water quality programs. Another purpose is to enhance state and local efforts to manage land use activities that degrade coastal waters and coastal habitats.

At the federal level, the program is administered jointly by EPA and the National Oceanic and Atmospheric Administration (NOAA), respectively, the federal water quality and coastal management agencies. This approach is echoed at the state level, where DEC and the Department of State's (DOS) Division of Coastal Resources are jointly responsible for program development and implementation. The two agencies entered into a partnership (through a Memorandum of Understanding) to develop New York State's Coastal Nonpoint Pollution Program Document. New York received conditional approval on November 18, 1997. Several NPS pollution control strategies were submitted to EPA/NOAA since then; the last in December 2001. The strategies describe how DEC and DOS programs address the conditions necessary for full program approval.

The EPA and NOAA guidance lists 57 management measures in six source categories. DEC and DOS have determined, after a review of existing programs, that about two-thirds of these management measures are already in place in New York State. Such programs as waste oil recycling and wetland protection programs already achieve many of the goals of the 6217 program. Given the wide range of programs and agencies involved in nonpoint pollution management in New York, DEC and DOS have purposely decided to build on existing programs wherever possible when implementing the 6217 program.

3.1.1. Phase II Stormwater Regulations and Their Implementation in Putnam and Westchester Counties

Introduction

DEC is evaluating the geographic scope of permit issuance for municipal separate storm sewer systems and to expand the permit requirement for construction activities in Westchester and Putnam Counties. This is due to the implementation of the Federal Phase II Stormwater Regulation and the Phase II Total Maximum Daily Loads (TMDL).

3.1.1.a Federal Phase II Stormwater Regulations

Background and Designation Criteria

On October 29, 1999, USEPA issued its Phase II Stormwater Regulations. The Phase II regulations require certain municipal separate stormwater sewer systems (MS4s) and construction activities to apply for Clean Water Act permits and to implement stormwater discharge management controls.

Municipal Separate Sewer Systems

Most of Westchester and Putnam Counties are categorically covered by EPA's Phase II Rule as urbanized areas. All MS4s in areas designated as urbanized will be required to have a permit no later than March of 2003. The permit will require that all MS4s develop and implement a stormwater management program which includes at least the following six (6) minimum control measures:

- « Public Education and Outreach
- « Public Participation/Involvement
- « Illicit Discharge Detection and Elimination
- « Construction Site Runoff Control
- « Post Construction Runoff Control
- « Pollution Prevention/Good Housekeeping

The following towns, and any municipal stormwater systems within them, are categorically covered:

Carmel	Putnam County
Kent	Putnam County
Patterson	Putnam County
Phillipstown	Putnam County
Putnam Valley	Putnam County
Bedford	Westchester County
Cortlandt	Westchester County
Eastchester	Westchester County
Greenburgh	Westchester County
Harrison	Westchester County
Mamaroneck	Westchester County
Mount Pleasant	Westchester County
New Castle	Westchester County
North Castle	Westchester County
Ossining	Westchester County
Pelham	Westchester County
Pound Ridge	Westchester County
Rye	Westchester County
Somers	Westchester County
Yorktown	Westchester County

In addition to requiring permits in the "urbanized areas," the federal Phase II regulation provides that DEC may require permits if discharges from an MS4 "cause or have the potential to cause, an adverse impact on water quality."

The regulation suggests criteria for these discharges including:

- « discharge to sensitive waters
- « high population density;
- « high growth or growth potential;
- « contiguity to an urbanized area;
- « significant contributor of pollutants to waters of the United States; and
- « ineffective control of water quality concerns by other programs.

DEC believes that MS4 discharges in Westchester and Putnam Counties may meet these criteria.

Small Construction Activities (Statewide)

The Phase II regulations also expand the permit requirement to small construction activities, automatically designating as a small construction activities land disturbances of equal to or greater than one and less than five acres. (Land disturbances of greater than five acres are regulated under the Phase I rule.) DEC will develop specific requirements for Stormwater controls on Phase II construction activities.

DEC is reviewing whether to use the existing Phase I general permit for construction activities as a guide for the Phase II permits. A stormwater pollution prevention plan would likely need to be developed for each construction site greater than one acre. It is also possible that the construction activity general permit may need to include some conditions that are geographically specific for construction activities in watersheds that need stormwater controls for phosphorous.

3.1.1.b Enhanced Stormwater Management

In order to determine the best way to assure more protection from stormwater discharges in Westchester and Putnam Counties, DEC has engaged the services of the Center for Watershed Protection (CWP). CWP has considerable experience developing watershed specific programs for the control of stormwater runoff, and conducting local stormwater program reviews for communities in Massachusetts, Ohio, Maryland and Virginia.

The Center will:

- Review existing stormwater programs and policies in Westchester and Putnam Counties;
- Review management measures employed elsewhere to protect water supply watersheds;

- Evaluate alternatives and make recommendations to control pollutants from existing development;
- Evaluate alternatives and make recommendations for controlling pollutants from new development;
- Evaluate alternatives and make recommendations for controlling sediment discharge from small construction sites.
- Review existing stormwater programs and policies in Westchester and Putnam Counties; and
- Meet with and solicit input from stakeholders to discuss its review and evaluation.

Based upon this information, DEC will develop a specific plan to implement the Phase II Stormwater Regulations in Westchester and Putnam Counties. This may include the designation of all the area in the East of Hudson Watershed area or Counties located as an "urbanized area" requiring a permit for municipal separate storm sewers (MS4s) and the development of special permit conditions for the MS4s and construction permits.

SCHEDULE

An initial meeting has been held with CWP to begin work. A meeting was held with Westchester and Putnam Counties to discuss the implementation of the Phase II TMDLs and Phase II Stormwater Permits. CWP has met with environmental stakeholders to gain a better understanding of their views on stormwater controls in the Westchester and Putnam Counties. CWP will make final recommendations by June 2002. It is anticipated that DEC will fully develop a plan for the implementation of stormwater permits by December 31, 2002 and begin the process of implementing the program in January 2003.

3.1.2 Safe Drinking Water Act and Water Resources Development Act Projects

Several projects that are funded by SDWA and WRDA are presented in detail in Appendix A. They relate directly or indirectly to phosphorus water quality concerns in the Croton Watershed and can help provide opportunities for phosphorus load reductions. These projects are associated with the following activities:

- « Wetlands Mapping and Assessment

- « Educational Outreach
- « BMP Assessment
- « Phosphorus Management
- « Monitoring and Modeling
- « Community Involvement and Stewardship
- « Enhancement Program for Land Use Planning and Zoning Regulations
- « Stormwater Management Facilities Evaluation
- « Sewer System and Wastewater Treatment Facility Projects
- « Agricultural NPS Assessment
- « Croton Stormwater Conveyance and Implementation Projects
- « Agricultural BMP Implementation

From the standpoint of program integration and coordination, it is important that the products of these, and all projects in the Croton Watershed, be accessible to Putnam and Westchester Counties. Existing implementation mechanisms need to be utilized and new implementation mechanisms need to be developed to link Croton Planning to ongoing projects.

3.1.3 **NYSDEC Region 3**

The DEC's Region 3 Office is involved with several NPS programs which may directly or indirectly reduce NPS phosphorus loads in the Croton Watershed. These include:

1. Stormwater Enforcement Initiative - Since January 2001, the Region has implemented an enhanced Stormwater Enforcement Initiative designed to assure compliance with the SPDES General Permit for Stormwater Discharges from Construction Activity and the NYCDEP Watershed Rules and Regulations for stormwater. The Initiative, which is implemented through a coordinated effort with NYCDEP, includes site monitoring and formal enforcement actions for noncompliance. Department Consent Orders, designed to penalize violators and achieve site compliance, are developed for all projects found to be in violation. By assuring compliance with the Department's and NYCDEP's stormwater management requirements, phosphorous loads associated with stormwater run off from construction activity will be significantly reduced.
2. Westchester County Stormwater Advisory Committee - Regional DOW staff are participants in the Stormwater Advisory Committee, which was formed by the Westchester County Legislature. The Committee's purpose is to identify regulatory, educational, and technical issues the County, and its communities, will need to address to upgrade existing local stormwater control programs. Identifying local stormwater management program needs, and developing

solutions, will reduce NPS phosphorus loads from existing and future development areas.

3. Education - Regional staff participate in the delivery of educational programs designed to increase the public's awareness of water quality issues associated with stormwater runoff. The educational programs include problem identification, potential solutions, and funding programs/sources. An increase awareness of stormwater quality impacts and their solutions will generate public resolve to mitigate adverse stormwater impacts, including the reduction of phosphorous loads to the NYC Water Supply Watershed.
4. Coordinated NPS Control Efforts - Through participation in County programs, such as County Water Quality Coordinating Committees, Regional staff assist in the development and implementation of efforts to coordinate NPS runoff projects with Federal, State, County, local municipalities, and private environmental organizations.
5. Funding - Regional staff assist municipalities in the identification of NPS water quality issues and potential solutions, and sources available to secure funding for corrective measures.

3.1.4 **New York City Watershed Data Management and Software Tools Development Project**

This project is funded by the EPA and the DEC and utilizes SDWA funds. It will develop an integrated high resolution GIS data base with a suite of management tools integral to the database that will be used to map and model the NYC Watershed. The data and tool suite is to be internet accessible. It is the DEC's intent to use the NYC Watershed project as a template for other watersheds in the state. This work should be completed by the Spring of 2003. A complete write-up of this project is presented in Appendix B.

Project Summary Watershed protection requires the cooperation of the Federal, State and local governments. Non-point source pollutant mitigation is highly dependant on land use changes and/or the modification of land use practices. Changing the behavior of local people for the benefit of the quality of our water resources is extremely difficult. Sweeping regulatory edicts targeted at local governments and property owners based on generally suspected water quality limiting land use practices will not work. We need to build local capacity to use and understand the importance of the land use practices on water quality. To do that we need to have a level of sophistication that can identify specific pollutant sources and the means to reduce the sources of pollutant loading. This will allow targeted actions to be considered and enacted with the cooperation of the local governments.

The goal of this project is to develop an improved Information Technology framework to better assess both the East of Hudson (EOH) and West of

Hudson (WOH) regions of the New York City (NYC) Watershed. In particular, there is a significant requirement in demonstrating the relative progress towards achieving the goals stated in the 1997 Watershed Memorandum of Agreement (MOA). It is the overall objective of this project to complement the existing New York City Department of Environmental Protection's watershed planning and management program by developing higher resolution data, improving the technological tools to make the program more effective and efficient and by developing a common Geographic Information System to leverage the capability of the watershed program.

This project has the following five key objectives:

1. Develop an integrated, GIS-based, water quality data management tool set for improved watershed management for the NYC Watershed.
2. Develop a flexible, adaptive GIS database framework which has the capability to integrate a variety of existing geospatial data.
3. Develop a semi-automated modeling support tool set that would consist of a modules to support the terrestrial model (GWLF), and Upstate Freshwater Institute's (UFI's) reservoir model.
4. Based upon a set of priorities established by NYSDEC and NYCDEP, develop scenario support tool set to address Stormwater Best Management Practices (BMPs), phosphorous loads, land acquisition, stewardship, and stream bank restoration programs.
5. Develop a capability to allow different levels of user access to other interested agencies, including NYSDEC, USEPA, local government as well as selected non-governmental organizations.

3.2 New York City Department of Environmental Protection Programs

The April 2001 NPS Implementation Report detailed the various NYCDEP implementation programs and efforts that are underway. These include: the Wastewater Treatment Plant Upgrade Program, the Watershed Agricultural Program, Water Quality Investment Funds, Watershed Protection and Partnership Programs, Watershed Rules and Regulations, Filtration Avoidance Determination, Croton Process Studies, the Croton Watershed Strategy and Croton System Special Studies.

Information relating to the above programs can be found in Sections 3 and 5 of the April Report. This can be accessed at DEP's website (<http://www.ci.nyc.ny.us/html/dep>) under TMDL Reports

Additionally, NYCDEP is directly involved with many of the Programs and Projects summarized in this Section of the Report. The individual write-ups indicate DEP's active role.

3.3 New York City Watershed Partnership Program - Croton Planning

The New York City Watershed Partnership Program was formed by Executive Order in October 1997. It has introduced a number of initiatives to create partnerships to protect and enhance water quality. The Watershed Protection and Partnership Council (WPPC) has been formed as a permanent, regional forum to aid in the long-term protection of drinking water quality and the economic viability of watershed communities.

Most of the Watershed Partnership Programs have been funded by New York City and include projects such as infrastructure improvements, environmentally sound development, wastewater treatment plant upgrades, sewer extensions, septic system rehabilitation/replacement, stormwater retrofits or new stormwater controls and stream corridor protection. As part of the partnership program, a Croton Watershed Protection Plan is being developed by Putnam and Westchester Counties. One of the goals of Croton Planning is to improve water quality in the Croton Watershed thereby assisting in the attainment of water quality standards including phosphorus.

3.3.1 Putnam County Croton Plan

Activities Completed to Date

Putnam County's Croton Plan began on November 7, 1997 with the signing of an Intermunicipal Agreement (IMA) between Putnam County and the Putnam municipalities in the New York City watershed. The IMA determined that the Putnam Croton Plan would be produced jointly by the County and the watershed municipalities. NYCDEP is a partner in plan preparation and the NYSDOH is available for consultation.

In 1998, the County produced a resource document and prepared a planning analysis of regulatory impacts on current municipal master plans and zoning ordinances. The planning analysis will serve as an appendix in the completed Croton Plan. From 1998 to the present, each municipality has been working on their Croton Plans. All six municipalities have completed drafts. Two of the six municipalities have final drafts.

Ongoing Activities/Projects

Four municipalities are in the process of working on responses to comments received from drafts. The County is in the process of drafting a summary section, which will highlight municipal findings and recommendations. In four of the six municipalities, master plan and zoning ordinance revisions have been completed

or are in progress. The towns of Carmel and Patterson have adopted new master plans. The towns of Southeast and Putnam Valley have master plan revisions in progress. Carmel and Putnam Valley have zoning ordinance revisions in progress. Kent will likely begin master plan and zoning ordinance revisions in 2002. Patterson and Southeast will likely begin zoning ordinance revisions in 2002. No master plan or zoning ordinance changes are anticipated in Brewster in the next few years.

Aside from master plan and zoning ordinance work, which will incorporate recommendations from municipal Croton Plans, work will be done by various municipalities on other environmental ordinances. Additionally, land use planning work will be supplemented by land acquisitions and projects related to wastewater and stormwater improvements.

Schedules

Putnam's Croton Plan is scheduled for release in May 2002. Final agreement on the plan is scheduled for November 2002. Between May and November, there will be a public comment period.

Funding Sources

Funding for water quality improvement projects and land acquisition may come from the East of Hudson Water Quality Investment Program and other sources such as the Clean Water/Clean Air Bond Act. Local funds will be the likely source for municipal land use planning activities. In terms of project funding, a dedicated source of funds is needed. Reliance for project funding should not be on competitive grants or loans that fund multi-purpose program categories.

Opportunities for NPS BMPs And/or Other Load Reduction Strategies for Phosphorus at the County/local Level:

Opportunities for load reduction strategies have been identified in the Croton Plan. Strategies include both specific problem remediation, control of potential future problems, and policy recommendations. Opportunities for load reduction will seek to maximize the use of existing programs and fill gaps with future programs. Land acquisition, revised land use regulations, and specific project implementation will be mixed with the county's existing Lake Management Program, land acquisition program, Agricultural Environmental Management Program, and Groundwater Assessment Program.

Mechanisms for Implementation

Mechanisms for land use regulation and existing program implementation are in place through local planning and zoning boards. Mechanisms for new program implementation will need to be developed and will depend on program responsibility, project location, and funding source. At this time, it is anticipated that

a county level coordinating committee will be needed. It is also anticipated that additional staff may be needed at the county and/or municipal level.

Coordination with NYCDEP and NYSDEC

Coordination will occur as needed. The primary coordination functions will be determining project priority, funding, and monitoring for project impact.

3.3.2 Westchester County Croton Watershed Protection Programs

Croton Planning

In the Spring of 1998, the ten Westchester County Croton Watershed Communities of Bedford, Cortlandt, Lewisboro, Mt. Kisco, New Castle, North Castle, North Salem, Pound Ridge, Somers and Yorktown passed municipal resolutions to cooperate with Westchester County and develop the Croton Watershed Water Quality Protection Plan (the Croton Plan) as outlined in the Rules and Regulations to Protect New York City's Drinking Water Supply.

Scope of the Croton Plan

In December 1998, the Work Plan for the Development of the Comprehensive Croton System Water Quality Protection Plan in Westchester County was developed. The Work Plan outlined various studies which would achieve the goals of the Croton Plan.

The following information provides a summary of the various components of the Croton Plan expected to be complete by May 2002.

Land Use Summary

A Land Use Summary will provide an overview of land use in the Croton Watershed both on a municipal basis and from a watershed perspective. The foundation of the land use summary is a watershed land use classification system that was developed to address the "environmental condition" of properties within the Croton Watershed. The watershed classification system was created to define land use as it relates to water quality (i.e. the pollutant potential of differing land uses). Each parcel of land within the Croton Watershed was classified into a category where a "pollutant loading" coefficient could be associated with the parcel. This approach allows for distinction of land use by the uses potential environmental impact. In addition, production of this report includes detailed geographic information system datalayers of tax parcel mapping, land use and zoning.

County and Local Ordinance Review

The Rules and Regulations to Protect New York City's Drinking Water Supply are only one level of land use control in the Croton Watershed. Each of the Croton Watershed municipalities, including Westchester County, have their own local controls that shape development and protect the environment. An analysis of the level of protection that these ordinances provide for the watershed and the way that they shape new development within each of the communities is nearing completion.

A comparison of the protection standards set forth in New York City's Rules and Regulations is also nearing completion.

Determining the Impact of Local Environmental Controls and NYCDEP's Rules and Regulations (Build-Out Analysis)

The Rules and Regulations to Protect New York City's Drinking Water Supply may have implications on the way that Westchester County's communities are growing, developing and sustaining themselves. Some of the controls found within the Rules and Regulations to Protect New York City's Drinking Water Supply may conflict with the way a municipality envisions its growth through existing local land use controls (master plans and zoning) and other local ordinances. Currently an analysis is being conducted to determine the amount of development that can be expected to occur within a municipality and to identify the development potential of parcels that may be impacted by the Rules and Regulations to Protect New York City's Drinking Water Supply.

Municipal Housekeeping Practices

Westchester County surveyed each of the Croton Watershed municipalities regarding the type of housekeeping practices (street sweeping, recycling, catch basin cleaning, etc.) that they employed. The results of the survey led to a focused approach regarding road and stormwater infrastructure maintenance because it was an area of most concern to the municipalities, as well as an area where the most significant potential changes could occur to improve water quality. Summarizing the survey results along with other related information into a road and highway practices report is currently underway.

Water Resource Condition Report

A compilation of existing water quality information regarding the seven watershed drainage basins, such as known water quality problems and existing water chemistry, is nearing completion. This report serves as the water quality baseline for recommendations made within the Croton Plan.

Point Source Pollution

Information regarding point sources of pollution in the watershed was collected during the data collection phase for the Water Resource Conditions Report. SPDES permit sites, hazardous waste sites and solid waste sites have been mapped in each of the subwatershed areas. The Sewage Diversion Study identified 30 wastewater treatment plants and 31 "focus areas" (areas where septic problems are suspected or anticipated due to density of development) which are part of the mapping information for this report. Discussions and mitigation strategies for leaking underground storage tanks and septic problem areas are underway. Developing mitigation strategies for the remaining point sources of pollution (WWTPs, hazardous

waste sites, etc.) goes beyond Westchester County's level of authority because these point sources of pollution are regulated by New York State.

Surface Waters

As part of the Croton Streamwalk program, Municipal Action Teams (local committees established to assist with the planning process) received information regarding "priority areas" as identified in the Water Quality Conditions Report. Priority areas consist of streams where known or suspected water quality impairments exist. In addition, areas where there is insufficient information to make a water quality determination are noted. The Municipal Action Teams organized Streamwalk Volunteers. Westchester County held training seminars for Streamwalk Volunteers in throughout June, July and August 2001. Volunteers were asked to walk stream segments between June and September. Given the dry weather conditions, the streamwalk was extended through November 2001. Once the surveys are complete (expected in early January 2002), County staff will verify the impairments. General restoration recommendations and cost estimates will be made based on the impairments at each site. Restoration priorities will be identified based on the location of the impairment in the watershed, the suspected water quality impact of the impairment, as well as the number of impairments identified within each town and within each subwatershed. Detailed implementation schedules and associated timelines will be determined as part of project implementation, not as part of the planning process.

Groundwater Resources

A majority of the population within the Croton Watershed maintains private wells for drinking water. Given the prevalence of well usage, Westchester County has developed a groundwater study to inventory existing groundwater information and determine future directions based on the assessment of existing information.

Stormwater

Westchester County received a Water Resources Development Act grant award to map and assess the stormwater conveyance system in the Croton Watershed. This study is currently underway. The study, while scheduled to be complete after the Croton Plan is completed, will provide the Croton Watershed municipalities with a stormwater guidance manual and detailed information regarding stormwater restoration in a demonstration watershed.

Watershed Stakeholders

Residents, business people, not-for-profit organizations, etc. each have a stake in the environmental conditions of the watershed. In January, a web-based Croton Watershed Organizational Directory will be available on the Westchester County Web Site.

Watershed Education and Outreach

Westchester County, working with the watershed municipalities, developed education priorities regarding water quality protection. This information is being compiled into an education and outreach plan including education messages, target audiences and implementation strategies that each municipality and the County will commit to implement after the Croton Plan is agreed to.

Other Water Quality Initiatives

Westchester County is working to protect its water resources. The following countywide water quality initiatives and special studies have been established in 2001:

- « Westchester County developed a water quality awareness campaign with “Chester the Trout” who delivers and promotes a water quality message to “Keep Westchester’s Water H₂O”. Chester can be found on Westchester County’s water quality website at www.westchestergov.com/waterquality.
- « A joint executive/legislative Stormwater Advisory Committee (SWAC) was established. In addition to the SWAC’s exploration of stormwater issues throughout Westchester County, a Stormwater Management Study of the Croton Watershed was initiated. This study, focusing on the Hallocks Mill Brook, will lead to the development of a land use and watershed protection guide for municipal officials
- « The Westchester County Septic Service Contractor Licensing Program was developed to assure consistent and adequate septic system installation and maintenance. In addition, this program includes the development of a database to track septic permitting and maintenance activity.
- « To protect agricultural land throughout Westchester County, the County, with State approval, established a county-wide Agricultural Protection District.
- « Westchester County began working with the DEC to establish a Volunteer Citizen’s Monitoring Program which will involve training County volunteers to monitor water quality in their backyards and report their findings on a web-based database.
- « Westchester County conducted three Watershed Education Symposia. The Watershed Symposium involved participation from 18 schools throughout Westchester. The Watershed Symposia is an annual conference where students gather to discuss water quality, watersheds and land use decision-making.

4. Implementation of Phase II Phosphorus TMDLs-Actions to be Taken

4.1 Background

As indicated earlier, the MOA has prescribed a multi-step process for Phosphorus TMDL development in the NYC Watershed. This includes an implementation process that requires NYSDEC to identify potential NPS practices and programs that will be implemented by DEC and other parties.

4.2 Actions NYSDEC Will Implement

1. NYSDEC will continue implementing the Statewide Nonpoint Source Management Program which was updated in October 2000.
2. NYSDEC will continue to implement all elements of its approved Coastal Nonpoint Source Management Program. This program includes all of the Croton Watershed.
3. New York State will continue to provide funding to encourage the implementation of nonpoint source management practices. Funding priority is given to the implementation of NPS management practices that are in watersheds with approved TMDLs such as the Croton Watershed.
4. New York State will implement Phase II Stormwater regulations in the Croton Watershed as well as General SPDES Permit conditions.
5. New York State will continue to work with NYC, USEPA and all affected parties to fully implement the NYC Watershed Agreement. New York State remains committed to the implementation of the Watershed Agreement. This commitment involves the expenditure of more than \$53 Million over a 15 year period. Program commitments are summarized throughout this report and are geared toward the protection of the City's water supply and the economic vitality of upstate watershed communities.
6. When identified as lead agency, New York State should utilize the State Environmental Quality Review Act (SEQRA) to:
 - « Consider the potential for Phosphorus loading of a proposed project in its early stages, and when necessary, require an Environmental Impact Study (EIS) to address water quality.
 - « Address stormwater issues associated with a proposed project.
 - « Evaluate compliance with the phosphorus TMDLs in the Croton Watershed.

7. NYSDEC will continue to work with USEPA and NYCDEP on the New York City Watershed Data Management and Software Tool Development Project.

This project is viewed as a significant component of nonpoint source implementation efforts in the Watershed. It includes the following key objectives:

- « Improved Information Technology by developing GIS-based water quality management tool set for improved watershed management in the NYC Watershed.
 - « Develop flexible, adaptive GIS-based database.
 - « Develop modeling support tool set.
 - « Develop tool set able to address Stormwater Best Management Practices (BMPs), phosphorus loads, etc.
 - « Develop capability for different levels of user access.
8. NYSDEC will continue to work on projects funded by the SDWA and WRDA. These projects are described in detail in Appendix A.
 9. New York State has revised the general stormwater permit for industrial categories and will continue to implement the industrial general permit program. The general permit for construction activities is in the process of being revised as part of the Phase II Stormwater Permit Program.

4.3 Actions Recommended To Be Taken By Others To Implement Phase II Phosphorus TMDLs

4.3.1 The USEPA should:

1. Reauthorize the Clean Water Act. There is a need to reauthorize the CWA to focus more on nonpoint source concerns and to provide adequate funding to the states and local municipalities to implement water quality programs. Specifically, there is a need to increase the federal government's contribution to clean water. Including: reauthorize Title VI of the State Revolving Fund Program and increase funding to two billion dollars annually; Authorization for state program grants under section 106 should be increased to 400 million dollars; funding for the Nonpoint Source Program should be authorized at 300 million dollars annually. Meanwhile EPA should continue Clean Water Act Implementation.
2. Provide continuous funding for SDWA and WRDA projects including monitoring.

3. Continue with its evaluation and reauthorization processes for the New York City Watershed Filtration Avoidance Determination (FAD).
4. Finalize regulations for TMDLs and provide guidance that addresses the role of watershed planning in TMDL implementation.

4.3.2 New York City should:

1. Fully implement all elements of the NYC Watershed Agreement;
2. Continue FAD development;
3. Continue with its Croton Watershed Strategy and Process Studies;
4. Work with USEPA and NYSDEC on the Watershed Data Management and Software Tools Development Project. The improved information base and models resulting from this project is expected to play an integral part in targeted phosphorus reduction implementation opportunities;
5. Continue to implement its Watershed Protection and Partnership Programs through funding, technical expertise and coordination;
6. Continue its water quality monitoring and assessment programs. These efforts are key to understanding, on a system-wide basis, the impacts of NPS implementation projects.
7. Implement the findings of NYCDEP's 1997 report entitled, "Croton Water Supply System - Extended Special Study Program". The report specifically recommends the restoration of wetlands and construction of extended detention ponds as best management practices (BMPs) to reduce phosphorus loads within the Croton System.
8. When identified as lead agency, New York City should utilize the State Environmental Quality Review Act (SEQRA) to:
 - « Consider the potential for Phosphorus loading of a proposed project in its early stages, and when necessary, require an Environmental Impact Study (EIS) to address water quality.
 - « Address stormwater issues associated with a proposed project.
 - « Evaluate compliance with the phosphorus TMDLs in the Watershed.

4.3.3 Actions To Be Taken By Local Government

4.3.3.a. Putnam County should:

1. Continue with the local master planning, zoning ordinance and land use planning efforts as they are integral to phosphorus loading controls.
2. Continue to utilize local planning and zoning boards as mechanisms for land use controls, particularly as they relate to NPS phosphorus loads.
3. Explore the development of County Level Coordinating Committee for Croton Planning Projects and Actions.
4. Act as a facilitator to utilize the outputs of the Information Technology Project (3.1.4.) And communicate and distribute the project's management tools to local decision makers.
5. Use funding provided by New York City as a part of the Water Quality Investment Program to help implement projects to reduce nonpoint source phosphorus loads in the Croton Watershed.
6. Consider implementation of the findings of NYCDEP's 1997 report for the Croton Water Supply System referenced above, and its specific BMP recommendations.
7. When identified as lead agency, Putnam County should utilize the State Environmental Quality Review Act (SEQRA) to:
 - « Consider the potential for Phosphorus loading of a proposed project in its early stages, and when necessary, require an Environmental Impact Study (EIS) to address water quality.
 - « Address stormwater issues associated with a proposed project.
 - « Evaluate compliance with the phosphorus TMDLs in the Croton Watershed.
8. Complete Croton Planning as scheduled for November 2002.

4.3.3.b. Westchester County should:

1. Continue Croton Planning including efforts relating to the following components: Land use summary; County and local ordinance review; build-out analysis; survey of municipal housekeeping practices; water quality streamwalk program; stormwater assessment study; watershed education and outreach, .

2. Continue stormwater advisory committee (SWAC) efforts working toward the development of a land use and watershed protection guide for municipal officials.
3. Continue County-wide programs and awareness campaigns relating to septic systems, agricultural protection and water quality monitoring.
4. Act as a facilitator to utilize the outputs of the Information Technology Project (3.1.4.) And communicate and distribute the project's management tools to local decision makers.
5. Use funding provided by New York City as a part of the Water Quality Investment Program to implement projects to reduce nonpoint source phosphorus loads in the Croton Watershed.
6. Consider implementation of the findings of NYCDEP's 1997 report for the Croton Water Supply System referenced above, and its specific BMP recommendations.
7. When identified as lead agency, Westchester County should utilize the State Environmental Quality Review Act (SEQRA) to:
 - « Consider the potential for Phosphorus loading of a proposed project in its early stages, and when necessary, require an Environmental Impact Study (EIS) to address water quality.
 - « Address stormwater issues associated with a proposed project.
 - « Evaluate compliance with the phosphorus TMDLs in the Croton Watershed.
8. Complete Croton Planning as scheduled for November 2002.

4.4 Implementation Schedule

The Phase I version of this report provided a schedule for the implementation of activities and recommendations. These scheduled efforts have been tracked and updated as follows:

IMPLEMENTATION SCHEDULE (September 1998)			
<i>Action</i>	<i>Responsible Party</i>	<i>Target Date</i>	<i>Action Date</i>
Complete Statewide NPS Management Program Update	NYSDEC	12/98	10/00
Complete Actions for Full Approval of NYS's NPS Program	NYSDEC NYSDOS	12/99	10/00
Implement All Elements of Approved NPS and Coastal NPS Management Programs	NYSDEC NYSDOS Local Governments	Continuous Ongoing	Continuous Ongoing
Provide Funding for Implementation of NPS Management Practices	NYS NYC Local Governments	Annually	Annually
Revise and Update General Stormwater Permits	NYSDEC	12/98	Phase II Stormwater Regulations
Fully Implement NYC Watershed Agreement	USEPA NYS NYC Local Governments	Ongoing	Ongoing
Reauthorize CWA	Federal Government	1999	2002
Promulgate Phase II Stormwater Regulations	USEPA	1999	10/99
Develop Comprehensive Croton System Water Quality Protection Plan	Putnam Co. Westchester Co.	To Be Determined	Draft: 5/02 Final: 11/02
Fund Projects to Implement NPS Projects in Croton Watershed	Putnam Co. Westchester Co.	Upon Completion of Croton WQ Protection Plan	Upon Completion of Croton WQ Protection Plan
Complete Phase II Methodology	NYCDEP NYSDEC USEPA	7/98	3/99
Develop Phase II TMDLs	NYSDEC NYCDEP	9/99	6/00
Approve Phase II TMDLs	USEPA	10/99	10/00
Issue Report Identifying Potential Management Practices for Phase II	NYCDEP NYSDEC	9/99	4/01
Issue Report Identifying Potential Management Practices To Be Implemented	NYSDEC	3/00	3/02

Building on the schedule above, more recent implementation actions can be added.

IMPLEMENTATION SCHEDULE (December 2001)		
<i>Action</i>	<i>Responsible Party</i>	<i>Target Date</i>
Complete NYC Watershed Data Management and Software Tool Development Project	USEPA NYSDEC	Spring 2003
Implement Phase II Stormwater Regulations in Putnam and Westchester Counties	Plan for Permits MS4's Permitted	1/02 3/03
Center for Watershed Protection Recommendations	CWP	6/02
Continue to Monitor and Assess NYC Watershed Reservoir System	NYCDEP	Ongoing

5. Implementation Mechanisms and Next Steps

Section 3 of this Report identified numerous program activities and projects that are achieving NPS phosphorus reductions or are working toward phosphorus reduction strategies in the Croton Watershed. Examples of implementation mechanisms that are already in-place include:

- # environmental education work shops - where information and training on programs and practices can be disseminated.
- # wastewater treatment plant construction to eliminate septic system problems - where nonpoint source loadings from failing onsite wastewater treatment systems can be eliminated.
- # advisory committees - such as Westchester County's stormwater advisory committee can facilitate the upgrading of local stormwater control programs.
- # local planning and zoning boards - that can utilize information on nonpoint sources when making land use decisions and where appropriate, land use regulations can be put in place.

Consideration should be given to establishing an institutional framework for the Croton Watershed, in order that implementation will proceed in an effective manner. The DEC will consult with the Watershed Protection and Partnership Council regarding how to proceed with this.

When implementing the actions necessary to achieve the NPS reductions identified in the TMDL it is important to recognize that beyond the individual reservoir reductions, in many situations there also is a need to consider reductions that contribute to achieving downstream goals.

5.1 Watershed Approach

In EPA's Phase II TMDL approved letter of October 17, 2000 a table labeled "Attachment A" was included. It addressed six of the water quality limited basins in the Croton Watershed that receive significant phosphorus loads from upstream waterbodies. The right-hand column presented herein lists preliminary upstream reduction estimates for upstream basins by reservoir system. These reduction amounts can be found in the April 2001 NPS Report and are in addition to those identified in each TMDL. The magnitude of these numbers helps put in perspective, the tasks at-hand with regard to NPS implementation.

The following items are important to implementing NPS load reductions in the Croton Watershed:

1. Improved, more detailed land use information and modeling such that implementation can be specifically targeted, prioritized and efficient.
2. A coordinating effort to facilitate NPS implementation efforts with a focus on the Croton Watershed.
3. Program Coordination and Integration - the ability to continue and sustain the implementation process and connect it to the results of Croton Planning by Putnam and Westchester Counties.
4. Local involvement in the phosphorus reduction process translating reservoir basin reduction needs to the Town level and beyond.
5. DEC's program to implement Phase II Stormwater Regulations in Putnam and Westchester Counties.
6. The continuation and refinement of a monitoring program to assess the progress of implementation efforts.
7. The possible development of task forces by topic to facilitate implementation (Urban Stormwater, Highway Runoff/Deicing, Agriculture/Open Space).
8. The ability to reassess phosphorus TMDLs where appropriate based on additional data and improved models.

The above elements can be viewed as next steps in the implementation process. NPS programs and projects must continue as identified so that progress can be made toward effective implementation and the attainment of water quality standards.

“Attachment A”			
Six of the water quality-limited basins in the Croton Watershed receive significant loads from upstream waterbodies. In addition to in-basin nonpoint source reductions, NYSDEC has identified reduction in nonpoint sources of phosphorus in upstream basins as possible management options to achieve necessary load reductions in water quality-limited basins. In upstream water quality-limited basins, additional reductions beyond those needed to achieve their TMDLs may be needed to meet the necessary load reductions in downstream basins. Upstream basins that meet water quality standards may also require nonpoint source reductions for downstream reservoirs to achieve TMDLs.			
Water Quality-Limited Reservoir	Required NPS Reductions (kg/yr)	Upstream Basins Potentially Requiring Additional Reductions to Meet Downstream TMDLs (kg/yr) ⁵	
New Croton	1356	Muscoot	893
Muscoot	2058	Cross River *	206
		Amawalk	123
		Titicus	207
		Croton Falls	546
		Diverting	552
Croton Falls	885	Middle Branch	199
		Diverting	633
		West Branch *	N/A
Middle Branch	204	Lake Carmel	N/A
Diverting	983	Bog Brook *	94
		East Branch	1022
East Branch	993	Putnam Lake *	N/A
		Peach Lake	N/A

⁵ Preliminary Upstream Reduction Estimates based on following factors: additional amounts listed are subsequent to 25% NPS phosphorus reduction already applied to each of the six WQL reservoir basins and include upstream reservoir retention factors for phosphorus per April 2001 NPS Report.

* Not currently water quality-limited.

5.2 Monitoring and Evaluation

As programs and projects are completed and best management practices are applied, there will be an need for monitoring data, its analysis and the evaluation of NPS implementation efforts.

The best way to do this is a system-wide assessment, based on endpoint monitoring (reservoir or downstream), to document improvements in water quality due to the application of phosphorus load reduction measures.

NYCDEP should continue to monitor and model water quality in its reservoirs. DEP maintains a comprehensive monitoring program which is necessary to assess the impacts of point and nonpoint control measures on reservoir water quality as well as future phosphorus reduction implementation strategies.

5.3 Conclusion

The DEC is committed to the TMDL Program. It is recognized that there is an ongoing need to reduce phosphorus loads, particularly in the Croton Watershed. It is also recognized that the implementation of NPS management practices does not follow the same regulatory framework as with point sources. As Croton Planning moves toward implementation, the combination of the recommendations resulting from Croton Watershed Protection Plans and Stormwater Pollution Prevention Plans required by Phase II-Stormwater Regulations is important to achieving significant NPS phosphorus reductions.

The specific implementation components listed in the Preface represent the framework for the development of a final implementation plan. They can be summarized as follows:

- identification of BMPs specific to each reservoir basin to meet TMDLs and achieve downstream standards;
- a list of municipal entities designated by Phase II Stormwater Regulations;
- quantifications of upstream, additional load reductions, above those to meet the TMDL for that waterbody and necessary to achieve downstream standards;
- a description of implementation mechanisms;
- the time frame for implementing the actions;
- funding sources for implementation; and,
- a plan for evaluating/monitoring plan effectiveness.

The specifics of implementation and the development of individual basin plans will rely on key activities previously outlined such as: Croton Planning, Phase II Stormwater Regulations implementation and continued ambient water quality monitoring. Therefore, it is important that these activities remain sufficiently funded and on schedule.

APPENDIX A

SDWA and WRDA Funded Projects

**NONPOINT SOURCE IMPLEMENTATION MEASURES
FROM SDWA FUNDED PROGRAMS
FOR PHASE II PHOSPHORUS TMDLs**

Wetlands Mapping Westchester County

This 2001 - 2002 wetlands mapping project is reviewing existing and potential wetlands and amend the State designated wetlands in the NYC Watershed portion of Westchester County consistent with the requirements in Article 24 of the NYS Environmental Conservation Law and 6NYCRR Part 664. This activity is being conducted, partly, in response to a request from NYC to review all wetlands in the NYC Watershed. DEC staff is conducting the program through contract and provides oversight to field work, spot-checks field verification, attends public hearings and reviews all documentation. Contract work includes conducting aerial photograph review and field verification of potential new wetlands under Article 24 jurisdiction in addition to wetland boundary changes on existing mapped wetlands. Potential wetlands identified include: wetlands identified originally by DEC; wetlands identified by a preliminary review of the National Wetland Inventory (NWI) Maps and USGS topographic quadrangles encompassing the study area; wetlands of Unusual or Local Importance (ULI) identified by DEC's Endangered Species Unit and NYC DEP; and, wetlands identified through review of hydric soils from soil survey information.

Evaluation of wetland boundary changes will be based on a comparison of NWI Map boundaries and existing Article 24 mapped wetlands. Aerial photographs are being reviewed to determine the correct boundaries. This project also includes all other tasks to complete the map amendment process, such as, producing draft and final maps, completing landowner lists and notification, attending/facilitating hearings, landowner follow-up and filing of final maps. A final report, including appropriate maps, will be prepared.

Estimated Cost: \$285,000
Estimated Completion Date: July 2004

Streamkeeper Project

Riverkeeper, the Stroud Water Research Center (Stroud), and Hudson Basin River Watch (HBRW) are conducting a New York City Watershed Streamkeeper Project which was initially started in 2000 and continued in 2001 and is scheduled to continue in 2002. This is a program designed to enhance teacher professional development, improve environmental science education, and complement on-going stream monitoring programs throughout the Delaware-Hudson region of the New York City Watershed. The program is enhancing a basin-wide network linking students, teachers, and the environmental data gathered by them on their local streams. The program seeks to have a large number of secondary schools spread over a broad geographic area participate in the Streamkeeper Project whereby students generate "stream health" data (using common methods) and share it with one another in order to understand the health of a stream in their backyard.

The program components include: first, a series of teacher summer workshops that will give groups of teachers common understanding and knowledge of stream ecology and instructions in using a curriculum kit called "The Leaf Pack Experiment," a noninvasive aquatic macroinvertebrate sampling kit, and the "Hudson Basin Guidance Document" monitoring protocols; second, each school assesses the health of a nearby stream using common field, laboratory, and analytical techniques contained in the Leaf Pack Kit and HBRW Guidance Document; third, each school places their data into a common database, which not only puts their results into a local and regional perspective, but also facilitates sharing and communication between students and teachers in otherwise disconnected school systems and social settings; fourth, the pooling of data creates a network of sampling points such that each individual school experiment (sampling point) contains far more value than it would as a separate project; and fifth, as each subsequent new class performs the experiment (year after year), the strength of the database grows and the local value of this school project escalates. Teachers are involving groups of students in a long-term ecological monitoring project that is strengthening the local school curriculum.

The goals of this project are: to promote an awareness of stream biodiversity and its connection with the landscape; to promote an understanding of local stream health and how it relates to local land use practices; and to improve local science education and relate student learning to local environments.

This project is designed to be widely applicable to schools throughout the New York City watershed. Intended as a supplement to the local curriculum, participating teachers can incorporate the HBRW protocols and Leaf Pack Experiment materials easily. All participating schools are required to conduct their field studies within a particular project time window so that data gathered will be comparable between the various participating groups. Both Stroud and HBRW are providing field and in-school support during this implementation period. A system of Quality Assurance/Quality Control is being developed for the data, including a reference macroinvertebrate specimen collection created at each school.

Estimated Cost: \$146,250
Estimated Completion Date: September 2002 (and on-going as funding permits)

Golf Course BMP Study

This project is being conducted in 2002 to determine to what extent golf course superintendents and facility managers employ best management practices to ultimately protect water quality and minimize off site impacts. Nutrient (nitrogen and phosphorous) and pesticide fate studies funded by a multitude of agencies conclude on an academic level that through the adherence to Best Management Practices (BMP's), the use of agrochemicals on golf courses are of negligible or no environmental impact; also, the findings of the scientific community have reinforced the existence of golf courses as a responsible type of land use when in conformity to BMPs. However, efforts to date have failed to address the final component required to fulfill the initial vision that initiated all prior research. Thus, to assess the level of conformity to BMPs and potential influences on environmental quality, the objectives of this project are to: 1) identify golf courses with various management expertise and environmental management philosophy; 2) conduct an exhaustive assessment of cultural, pest, and environmental management practices for

conformity to BMPs; and 3) validate the impacts of completing Audubon International's Cooperative Sanctuary Certification program requirements.

The implementation of agrochemicals on golf courses to maintain turf quality has been suggested as a source of contamination to surface and ground water supplies. In recognition of the involvement golf courses have within their communities and the ability for them to enhance environmental quality, Audubon International has acknowledged the potential for golf courses to serve as environmental leaders under their Cooperative Sanctuary and Signature certification programs. This project will identify various levels of environmental management programs implemented by public, private, and resort courses based on involvement with the Audubon Cooperative Sanctuary Program (ACSP) administered by Audubon International (AI). In support of research indicating that implementation of BMPs occur most effectively when small changes are made to existing programs rather than the commitment to substantial increase in expertise and resources, the project will explore the implementation of sustainable management practices employed by facility managers. Specifically, every aspect of course management including cultural programs such as mowing, fertilization, irrigation; pest management such as implementation of monitoring programs as part of an IPM system; and environmental management, such as buffer strips, wildlife habitat maintenance and wetland management will all be reviewed to open and reinforce discussion among key personnel, patrons/members and partnering agencies. Additionally, the project seeks to identify trends in current course management and identify areas that need additional educational efforts. This project will also explore the differences in management and consistencies to best management practices among public, private and resort golf courses. By surveying Audubon and non-Audubon affiliated courses, this project seeks to validate the effectiveness of participating in the Audubon Cooperative Sanctuary Program with regard to water quality and surrounding environmental impacts. A final report summarizing the findings will be prepared.

Estimated Cost:	\$20,000
Estimated Completion Date:	September 2003

NYCDEP Ambient Surface Water Quality Monitoring

This monitoring effort is a High Runoff Monitoring project that initially received SDWA funding during FFY1998. It involves the operation of automatic streamflow and water quality sample collection, laboratory analysis and reporting. The goals of this project are to provide streamflow and water quality data that are sufficient to calculate storm event loads of specific analytes generated at a catchment scale. The catchments that are monitored represent two areas where land use changes are expected to occur, and a third area where land use changes are not expected to occur. This latter area will be used as a reference site. The storm event loads will be used to evaluate the changes in water quality associated with the land use changes on the two catchments, as compared to the reference catchment. Following these land use changes, additional monitoring locations may be added to evaluate the effect that best management practices will have on water quality. In addition to these specific goals, data collected from this project will be available for Croton Process Studies and as input data for future Croton system terrestrial and reservoir models.

NYCDEP's watershed regulations rely upon the construction of best management practices during site development to minimize the effects of land use changes on water quality. Some data exists on the effectiveness of these structures at reducing analyte loads in stormwater runoff. During the stormwater pollution prevention plan application process, project developers typically utilize "cook book" values to assign pollutant removal rates to selected best management practices. This study will provide real data, applicable to the NYC watershed area, that may be able to validate or refute the pollutant removal values that are used during the stormwater pollution prevention plan review and approval process. This study may be able to provide important data in determining the effectiveness of the NYCDEP's watershed regulations in meeting both FAD and MOU requirements.

Rather than using the historic, routine fixed frequency monitoring program, these goals are best met through monitoring high runoff events at selected stream sites within the Croton watershed. Best Management Practices, and the Department's watershed regulations, are designed to control nonpoint source runoff and the increased pollutant concentrations and loads that occur during high runoff events. How well BMPs and the new regulations control both nonpoint source and stormwater runoff can only be assessed through intensive, long-term monitoring of high runoff events. The project will conduct sampling at two study sites and one reference site within the Croton watershed. These sites will be selected so that sampling locations can be placed downstream from two proposed development projects as well as downstream from a catchment that will not be affected by development during the course of the study, well before construction will occur (preferably, two years of sampling prior to construction). Sampling will continue throughout the construction phase, and then for several years after construction. In addition to these sampling locations, additional sampling locations may added following construction at each site. These additional locations will isolate inflows and outflows from BMPs constructed on the developing areas of the two study sites.

The funding for this fiscal year will allow us to continue storm event monitoring at the two impact sites and one control site identified and monitored under previous funding awarded for the first two years of this project. The analytes collected at the sites will be Total Phosphorus, Total Dissolved Phosphorus, Nitrite/Nitrate, Dissolved Organic Carbon and Total Suspended Solids. Approximately eight (8) storm events will be sampled each year. Samples will be collected and analyzed based on their location along the hydrograph. Approximately 10 samples will be collected from each sampling location during each storm event. The final report will present hydrograph and pollutograph information as well as pollutant loads for each storm at each site. Additional years of funding will be necessary to continue monitoring the project after development has occurred at the two study sites.

Estimated Cost: \$337,000
Estimated Completion Date: October 2003

NYCDEP's Total Phosphorus Management in Croton System

The TP Management in Croton System project will expand the scope of the Croton Watershed Strategy project to specifically address phosphorus reductions in the Croton System and improve the overall watershed strategy. The project is for the development

of a Tracking System that will be a GIS-based tool to track basin activities that are likely to effect phosphorus loading in the reservoir basins. The software will utilize the datasets and modeling tools developed as part of the Croton Watershed Strategy and will be developed as an intranet application using ArcView 8.1 and WEB technology. A wide variety of phosphorus reduction related projects would be included such as DEP programs (Project Review, Land Acquisition, WWTP upgrades, Watershed Agricultural Program), County programs, and State programs. For each basin, the Tracking System will estimate loading changes based on project scope, schedule and implementation status and generate status reports. While the primary focus will be phosphorus, nonpoint source pollution in general will be accommodated as well.

Estimated Cost: \$100,000

Estimated Completion Date: February 2003

NYCDEP's Croton System Reservoir Models

This project is for the Development and Testing of Hydrothermal and Water Quality Models for the Croton System. It is part of a three phase project. Phase I is currently underway and is for the development of one-dimensional hydrothermal modeling. This Phase IIa project will be for limited model testing and setup in the New Croton Reservoir. The remainder of Phase II will be conducted in the future consisting of full testing of the water quality model for the New Croton Reservoir and setup and testing of hydrothermal and water quality models for remaining Croton System Reservoirs. The future Phase III project will be for linkage of reservoir and terrestrial models and development of reservoir water quality management software. These models will serve as in-house management tools for NYC DEP and contribute to the effective management of this reservoir system. This work will build on three critical components that are presently underway for EOH reservoirs: (1) long-term monitoring programs conducted by NYC DEP of reservoir hydrology and operations, tributary and reservoir water quality, and meteorological conditions; (2) detailed process studies in the EOH reservoirs and watershed; and (3) Phase I EOH reservoir modeling. The process studies are intended to resolve origins of critical materials, to quantify key processes, and to accurately specify forcing conditions and temporal and spatial patterns for state variables of hydrothermal and water quality models. The findings of this work will enhance the credibility and predictive capability of the models to be developed as a part of this work, and therefore their value as management tools. Calibration of a one-dimensional hydrothermal model for seven of the reservoirs (Titicus, Diverting, Croton Falls, Amawalk, Cross River, Muscoot, and New Croton), as well as verification testing for two of these seven systems (Muscoot and New Croton), is to be supported in Phase I of the EOH modeling program. This hydrothermal model will serve as the mass balance and transport framework for the one-dimensional water quality models for the EOH reservoirs.

The tasks for Phase IIa will consist of testing of a two-dimensional hydrothermal model (this will include setup and calibration of a two-dimensional model for New Croton Reservoir for a single year) and setup of a one-dimensional water quality model (this will include setup for New Croton Reservoir only). Model setup involves preparation of the input data that would be used to operate the water quality model. This task does not include actual operation of the model; model operation including testing would take place later in the completion of Phase II. A summary report will be prepared.

Estimated Cost: \$200,000
Estimated Completion Date: May 2003

NYCDEP's Kensico Model Enhancement

This project is to adapt a three-dimensional (3-D) model for the Kensico Reservoir. This model will require minimal staff commitments (e.g., compatible with Microsoft Windows and with integrated graphic user interface). In addition to hydrodynamic and eutrophication (like other Catskill/Delaware models) model, the model will have sediment transport (alum floc), particle tracking (pathogen), spill (from adjacent road, bridge, & airport), and flexible user defined (pathogen, turbidity) constituent capabilities, with associated easy grid and control file generation, and post-processing. A fully 3-D model, including all Kensico Reservoir Branches, with associated graphical user interface will be developed along with four bathymetry files using the Grid generator module (initial bathymetry, bathymetry #1 with existing turbidity curtain for Malcolm brook, bathymetry #2 with existing recent dredging near aqueduct intakes, bathymetry #3 with future turbidity curtain for Whippoorwill cove). The model will be calibrated using dye study data from 1994 and temperature and other constituents using data from a year to be determined. The model calibration will be verified using data from another year to be determined. The model input will be prepared for the years 1992 through 1999, using digital data provided by NYC DEP.

Estimated Cost: \$70,000
Estimated Completion Date: December 2003

Department of State's Master Planning and Zoning Enhancement Program

This program began in 2001, and will continue through at least 2002, offers (1) enhanced training and technical assistance to municipalities to assist and encourage them to create or update community development tools, land use regulations, and environmental controls for enhancing water quality protection; and, (2) opportunity to commence certain local actions that have been identified during the development of the Croton Plan. Thus, the program is being used to:

- Update existing comprehensive plans to reflect land use goals consistent with the Watershed Agreement;
- Amend or adopt local land use regulations and environmental controls for Watershed and water quality protection;
- Prepare strategic capital investment programs to address existing non-point sources of water pollution; and
- Prepare strategic capital investment and management plans for Designated Main Street areas within the East of Hudson Watershed.

Estimated Cost: \$370,000
Estimated Completion Date: July 2003

Westchester County Volunteer Watershed Monitoring and Assessment Program

Westchester County will use education, community involvement and stewardship to monitor and assess streams and lakes throughout the County. The Croton and Kensico watersheds in Westchester County will be the first target area to deliver Westchester's Volunteer Watershed Monitoring and Assessment Program. Not only does 40% of the County's land area fall within these two watersheds, the majority of the lakes within the County are found within the New York City Watershed area, which serves approximately 85% of the County's drinking water. The program will be conducted in the Fall of 2001 and throughout 2002. It will include continuing and expanding the existing monitoring efforts; creation of a Westchester County Lake Group and associated Watershed Web; and, training and education of all volunteer monitors.

Estimated Cost: \$270,000

Estimated Completion Date: July 2004

NYCDEP Wetland Water Quality Functional Assessment

The goal of this study is to better understand the relationship between wetlands and water quality in the Catskill/Delaware system. This project is for a two year study that will: identify and monitor approximately 22 wetland sites located throughout the Catskill and Delaware Watersheds. During year one, baseflow water quality monitoring will be conducted at 22 reference wetlands located throughout the Catskill and Delaware Watersheds and detailed vegetation and soil sampling will be conducted at 11 of the 22 sites. During year two, baseflow monitoring will be continued at the 22 reference wetlands, vegetation and soil sampling will be completed at the 11 remaining year one sites, and detailed hydrogeological investigations will be conducted at a subset of the 22 reference sites. Analytes will include color, total phosphorus, total dissolved phosphorus, total suspended solids, and dissolved organic carbon at the inflows and outflows of the reference wetlands. The results of the study will be used to direct the development of wetland protection and nonpoint source programs, to quantify the roles of wetlands in water quality modeling and to provide guidance for regulatory permit decisions.

A benefit of the NYC DEP's Wetland Functional Assessment work is that it will provide maps derived from remotely-sensed data that denote wetlands that have the potential to supply eight benefits, some which correspond to the state's criteria for Unusual Local Importance (ULI). The functions assessed are: surface water detention, streamflow maintenance, nutrient cycling, sediment and particulate retention, shoreline stabilization, fish habitat, waterfowl and waterbird habitat, and other wildlife habitat.

NYCDEP will assess whether the 22 reference wetlands meet the States ULI criteria and will discuss the costs of re-mapping and benefits to water quality protection. NYCDEP will also provide the results of the Wetland Functional Assessment to the State to assist DEC in their policy decisions. NYC DEP has already presented preliminary classifications to the state DEC and EPA, ACOE and others at the Wetlands Interagency meetings.

Local governments have the authority to implement a freshwater wetlands protection law or ordinance and file a freshwater wetlands map that is more protective than the State's. This is more common to East of Hudson than to West of Hudson. To encourage

this, NYCDEP will present local governments with the results of the Wetland Functional Assessment work as it is accomplished and provide technical support.

Estimated Cost: \$500,000
Estimated Completion Date: July 2004

NYCDEP Monitoring Effectiveness of Stream Restoration - Demonstration BMPs

The purpose of this project is to monitor the effectiveness of BMPs installed on three unstable stream reaches over a five year period; however, only the first year of the five year study is included in this proposal. This project will include selection of three unstable stream reaches for installation of stream stability BMPs and six control/reference reaches; monitoring of the nine reaches before installation of BMPs for geomorphic assessment, bed mobility dynamics, biological assessment, riparian characterization and aquatic habitat characterization; and installation of 18 crest stage gages (at upstream and downstream end of the 9 reaches).

Stormwater Management Practices Monitoring Demonstration Project

The NYC is proposing a 3-year program to 1) assess watershed conditions, monitor water quality and evaluate sampling data, and identify incidences of improperly controlled stormwater that result in the discharge of pollutants to the water supply, and 2) through the design, construction and monitoring of stormwater management practices, eliminate nonpoint sources of pollution in the water supply watersheds and generate important data concerning the effectiveness of different stormwater management practices in reducing stormwater related pollution. Sites where stormwater practices will be implemented will be selected based upon the availability of water quality data, watershed condition and land use data, and the affected waterbody's classification on the DEC's Priority Waterbody List (PWL). The proposed program is consistent with both the New York State Nonpoint Source Management Plan and the applicable County Water Quality Strategies, which prioritize watershed assessment and remediation programs. The project is also consistent with the federal and state Unified Watershed Assessment, developed under the Clean Water Action Plan to integrate the protection and restoration of water and water-related natural resources.

Implementing the program will require the following steps:

- 1 Review existing water quality data and conduct site evaluations to determine current water quality conditions, identify additional data needs, and predict future water quality trends. Additional water quality data will be collected if necessary.
- 2 Identify source(s) of contaminants. Examples of sources to be investigated include eroding stormwater conveyance systems, improperly stabilized stormwater outfalls, and stream channel erosion.
3. Characterize pollutant loads from each source and prioritize need for remediation.
4. Identify appropriate stormwater management practices at selected sites.

5. Design stormwater management practices.
6. Secure all federal, state, and local permits necessary to implement appropriate stormwater management practices.
7. Construct practices.
8. Monitor, maintain and evaluate practice performance.
9. Transfer data to the National Stormwater BMP Database.

The remediation project targets reservoirs and tributaries that are classified as priority waterbodies by the DEC's PWL in association with the DEP. The PWL is a statewide list of use impaired waters maintained by the DEC. It is an inventory of waterbodies that characterizes and tracks known and/or suspected water quality problems and issues throughout the state. The state is mandated to create and update a list of impaired waters by the Clean Water Act (Clean Water Act Sec. 305(b)). The DEC accepts waterbody nominations annually for consideration to be listed on the PWL. Regional planning boards make submissions, county water quality coordinating committees, watershed associations and local governments. The PWL Program uses a 5-year rotating basin cycle to evaluate all waterbodies in the state. In 1999, the program excepted nominations for waterbodies within the Lower Hudson Drainage of New York State. This contains the Croton, Rondout and Ashokan watersheds of the New York City drinking water supply. When available, the updated list will be incorporated into the site selection criteria.

Based upon the Department's experience in identifying and remedying improperly controlled stormwater management systems, the following budget/funding request is proposed.

Estimated Cost:	\$187,000
Estimated Completion Date:	December 2004

NYCDEP - Initiation of Model Testing for East-of-Hudson Reservoirs

This will represent Phase I of a multi-phase water quality modeling initiative for NYC's East-of-Hudson (EOH) reservoir system. The major tasks will include:

- calibration of a one-dimensional hydrothermal model for Cross River Reservoir for the conditions of 1999, including: obtaining and reviewing hydrologic data, meteorological data, hydrodynamic measurements and temperature profile data; hydrologic budget analysis; and hydrologic model development
- calibration of a one-dimensional eutrophication model for Cross River Reservoir for the conditions of 1999, including: obtaining and reviewing tributary and reservoir

water quality data; and evaluating speciality data sets of depositional data, optical studies, individual particle characterization, phosphorus fractions and bioavailability, phytoplankton growth kinetics, and zooplankton grazing data

The hydrothermal model serves as the transport framework (sub-model) for corresponding eutrophication/water quality models. This must be successfully calibrated before testing of the water quality model proceeds. The hydrothermal model corresponds to the frameworks that have been successfully applied to the Catskill/Delaware reservoirs. The eutrophication modeling effort for Cross River Reservoir will be the forerunner of model calibration testing to be conducted for 1999 conditions subsequently for eight other EOH reservoirs, and verification testing for all nine reservoirs. A report will document the development of model inputs, the distributions of model state variables, and the performance of the models in simulating the observed distributions.

Estimated Cost: \$100,000
Estimated Completion Date: December 2002

**NONPOINT SOURCE IMPLEMENTATION MEASURES
FROM WRDA FUNDED PROGRAMS
FOR PHASE II PHOSPHORUS TMDLs**

Project Name:

Evaluating the Effectiveness of Stormwater Management Facilities and the Utility of Stormwater Wetland Treatment Systems

Grant Recipient:

NYCDEP

Project Description:

The department proposes to construct and evaluate the pollutant removal capabilities and maintenance requirements of four stormwater management facilities. Two facilities will include created or enhanced wetlands as a stormwater treatment component. Three types of facilities are to be evaluated: infiltration basins, retention basins and extended detention basins with wetland components. The project is also designed to determine the wetland characteristics that will maximize pollutant removal capabilities of a wetland while minimizing maintenance requirements.

Total Project Cost:

\$ 546,667

WRDA Share:

\$ 410,000

Estimated Completion:

December 2004

Selection Highlights:

1. Environmental benefit: The project will provide much-needed site-specific information on facility performance, design standards and maintenance needs. This technical support will, in turn, advance non-point source and wetland regulatory programs. The study will broaden knowledge of the utility of and the long-range advantages and disadvantages of created wetlands.
2. Evaluation factors: The project appears to be an excellent way to determine the effectiveness of installed BMPs. There is also an opportunity for coordination with Westchester County for a stewardship program concerning installed BMPs.
3. Significance/role: The proposed project fills a significant gap in the scientific literature concerning maintenance requirements of the three types of facilities to be evaluated and the treatment abilities of certain design requirements. The information gained in the study will be directly applied to the Department's regulatory and non-regulatory stormwater and non-point source management programs. The information is also directly applicable to federal and state wetland and non-point source regulatory programs.

Project Name:

Patterson Hamlet Sewer Project

Grant Recipient:

Patterson, Town of

Project Description:

The scope of this project is for the plans, specifications, facility plan and permits for the creation of a municipal sewer district along with the design of a sewage treatment plant of approx. 100,000 gallons per day with an associated 9,500+- linear feet of sewage collection system. The project will be located in the Hamlet of the Town of Patterson, Putnam County. The project will combine two STPs and several subsurface sewage treatment systems into one "state of the art" sewage treatment plant.

Total Project Cost:

\$385,000

WRDA Share:

\$288,750

Estimated Completion:

December 2002

Selection Highlights:

1. Environmental benefit: The proposed project will combine two aging sewage treatment plants and several subsurface sewage treatment systems into one sewage treatment plant designed to meet current SPDES discharge standards. The combining of these two point discharges into one single municipal plant offers benefits: 1-reduced O&M costs. Larger flow sewage plants are generally more cost efficient to operate. 2-Better oversight of the monitoring of discharge to ensure compliance with the SPDES standards. 3- Guaranteed revenue source to ensure immediate correction of any malfunctions.
2. Evaluation factors: The creation of a new sewer district will be a community wide solution.
3. Significance/role: The new sewage treatment plant will reduce the phosphorous load from the two existing sewage treatment plants contribute 25.8% of the total phosphorous discharged from point sources in the East Branch Reservoir watershed.

Project Name:

Patterson Hamlet Sewer Project

Grant Recipient:

Town of Patterson

Project Description:

The scope of this project is for the construction of a municipal sewage treatment plant of approx. 100,000 gallons per day and associated about 9,500 linear feet of sewage collection system. The project will be located in Patterson Hamlet of the Town of Patterson, Putnam County. The project will combine two STPs and several subsurface sewage treatment systems into one "state of the art" sewage treatment plant. The design of the system was funded through an earlier WRDA grant. The funds being provided are to help with the construction costs. The remainder of costs are from MOA Paragraph 141: Upgrades to Existing WWTPs to Comply with Watershed Regulations, and Paragraph 140: East of Hudson Water Quality Investment Program.

Total Project Cost:

\$533,333

WRDA Share:

\$400,000

Estimated Completion:

December 2004

Selection Highlights:

1. Environmental benefit: The proposed project will combine two aging sewage treatment plants and several subsurface sewage treatment systems into one sewage treatment plant designed to meet current SPDES discharge standards. The combining of these two point discharges into one single municipal plant offers benefits: 1- reduced O&M costs. Larger flow sewage plants are generally more cost efficient to operate. 2- better oversight of the monitoring of discharge to ensure compliance with the SPDES standards. 3- guaranteed revenue source to ensure immediate correction of any malfunctions.
2. Evaluation factors: The creation of a new sewer district will be a community wide solution.
3. Significance/role: The new sewage treatment plant will reduce the phosphorous load from the two existing sewage treatment plants which contribute 25.8% of the total phosphorous discharged from point sources in the East Branch Reservoir watershed.

Project Name:

EOH Urban Stormwater, Erosion and Sediment Control Training

Grant Recipient:

Westchester County Soil and Water Conservation District

Project Description:

The proposed project is for stewardship and training for natural resources management in the areas of erosion and sediment control, stormwater quality and quantity in the urban Croton watershed. Issues covered during multiple technical workshops include: techniques and methods to quantify impacts of pollutants from development, evaluation of existing

conditions, the analysis of hydrologic changes using various runoff techniques, and BMPs to mitigate the effects of increased runoff and pollutant loading from developing areas in the watershed. Renowned technical experts will be retained by the District to present the information in the format of several technical workshops. The technical workshops are to be held at various locations throughout the Croton/Kensico watershed.

Total Project Cost:

\$25,775

WRDA Share:

\$19,331

Estimated Completion:

September 2002

Selection Highlights:

1. Environmental benefit: Attendees will benefit by gaining a thorough understanding of the natural and man-made contributing forces and effects of urban stormwater and erosion and sediment control on watershed water resources. Attendees will gain a practical understanding of how to apply urban watershed BMPs in the Croton System.
2. Evaluation factors: The project is well outlined, designed, good cost/benefit, well co-ordinated and ready to be implemented. There is a real need for this type of project, and even could be expanded to other areas.
3. Significance/role: This project fulfills a fundamental need for education among municipal officials, consulting engineers, environmental professionals and municipal public works staff, as well as interested citizens in the Croton watershed. The education provided under this proposed project will enable municipalities to address restrictions on increases in impervious surfaces as described in the MOA. Non-point source education is a major work program item of the County Soil and Water Conservation District. Furthermore, the Westchester County Water Quality Coordination Committee has determined that the Croton/Kensico watershed is of the highest priority for addressing non-point source pollution issues.

Project Name:

Brewster (V) Collection System Extension Phases 1, 2 and 3

Grant Recipient:

Brewster, Village of

Project Description:

The scope of this project is the plans, specifications, facility plan and permits for the sewage collection system for the central, eastern and western portions of the Village of Brewster. Once the plans are ready, NYC DEP has committed one million dollars for the construction of the collection system for the western portion of the project.

Total Project Cost:

\$721,000

WRDA Share:

\$540,750

Estimated Completion:

April 2002

Selection Highlights:

1. Environmental benefit: The project will halt the discharge of pollutants to the East Branch of the Croton River and the Diverting Reservoir, and by eliminating the discharge of pollutants, the potential improvement factor for the project will be reduced by two levels (impaired to none).
2. Evaluation factors: Once the design work is completed, the NYC DEP funding will be available for immediate work to provide sewage collection for the western portion of the village.
3. Significance/role: The primary method of wastewater treatment in the Village of Brewster is through on-site septic systems; these systems have a long history of repetitive failures. It is clear that such repeat failures in a densely populated and developed area immediately tributary to the NYC water supply have an adverse effect on that water supply. The proposed project will provide sewers to the village. Sewering is the single most comprehensive approach to solving the problem of repeating failures of on-site septic systems. It is also the most comprehensive approach to relieving the adverse impact of these failed systems on the water quality of the Diverting Reservoir.

Project Name:

Agricultural Non-point Source Pollution Assessment within the NYC Watershed

Grant Recipient:

Putnam, County of

Project Description:

The project is to conduct an agricultural non-point source (NPS) pollution assessment of the NYC Watershed within Putnam County. The assessment will use the Tiered planning approach of Agricultural Environmental Management (AEM) to identify which farms are contributing to NPS pollution, what the primary pollutants are and where they are originating from, and what potential actions/BMPs would control the pollution.

Total Project Cost:

\$87,067

WRDA Share:

\$65,300

Estimated Completion:

December 2002

Selection Highlights:

1. Environmental benefit: The project will identify all farms and their exact locations within the NYC Watershed within Putnam County, identify which farms are contributing NPS pollution, what the primary are, their origination, and what potential actions / BMPs would control pollution and improve water quality.
2. Evaluation factors: This project can have broad ranging effects in the county for a small amount of funding. It is also not in conflict with work of the Watershed Agricultural Council.
3. Significance/role: The district will conduct a voluntary Tier I and Tier II assessment of all agricultural operations within the watershed within Putnam County. This process will be implemented through personal contacts with all farmers to ensure full participation, initiate information exchange and provide educational opportunities. Due to public health concerns and the potential for water quality impairment, Putnam County SWCD, Putnam County Water Quality Strategy Committee and Putnam County Health Department have placed priority on efforts that control NPS pollutants originating from agricultural operations.

Project Name:

Phase I Croton Watershed Stormwater Conveyance and Implementation Projects

Grant Recipient:

Westchester, County of

Project Description:

This project is the first phase of a project to conduct a stormwater conveyance study in a pilot watershed area. The second phase of the project would be to implement BMPs which would reduce the pollutant (quality and quantity) potential of such stormwater runoff.

Total Project Cost:

\$600,000

WRDA Share:

\$450,000

Estimated Completion:

September 2002

Selection Highlights:

1. Environmental benefit: Terraced slopes and perched wetlands are expected to make different contributions to water quality. The aim of the methods used in this project are to entrain the majority of surface flow volumes into soils, rhizosphere, and subsurface flow (i.e., into the water table). Thus, water from a given storm delivered to down-gradient receiving waters via sub-surface flow will be free from phosphorous and nitrogen.
2. Evaluation factors: This project should proceed the implementation phase since it is difficult to predict costs of implementation.
3. Significance/role: The proposed project is consistent with the MOA concerns regarding the effects of impervious surfaces on water quality. The MOA concludes that impervious surfaces are inhibiting to water quality. Using this as the foundation, this project attempts to study stormwater conveyance, implement BMPs to reduce the impact of impervious surfaces and incorporate stormwater conveyance and BMP implementation into local government and construction process.

Project Name:

Agricultural BMP Implementation to Support Whole Farm Planning

Grant Recipient:

Watershed Agricultural Council

Project Description:

The scope of this project will include work in Dutchess County. The Watershed Agricultural Program (WAP) is working with watershed farmers to develop whole farm plans and implement BMPs that address agricultural non point pollution. This project would help expand the scope of the WAP by cost sharing implementation of BMPs, thereby allowing WAP to implement more BMPs on more farms throughout the watershed.

Total Project Cost:

\$157,000

WRDA Share:

\$117,750

Estimated Completion:

December 2003

Selection Highlights:

1. Environmental benefit: The BMPs that will be implemented by this grant application have been proven to help reduce and prevent agricultural non-point source pollution from impacting surface waters. There are five different BMPs that will be implemented with this grant.
2. Evaluation factors: The Watershed Agricultural Council (WAC) needs additional funds for BMP implementation. These are additional Whole Farm Plans that will have off the shelf BMPs installed. These implementations will be additional monies beyond WAP monies available.
3. Significance/role: The BMPs will be implemented as part of the WAP, which is a comprehensive effort to address agricultural non-point source pollution in the Catskill/Delaware Watersheds. The program has already exceeded its goal to have at least 85% of the commercial farms in the watershed participating in the program.

Project Name:

Lexington Avenue Storm Water Bio-filter Project

Grant Recipient:

Yorktown, Town of

Project Description:

The existing drainage on Lexington Avenue presently drains south along the existing road edge and drains into the West Branch Hunter Brook stream channel. The stream channel drains in a southerly direction into Mill Pond and ultimately into the New Croton Reservoir. The W Br Hunter Brook stream channel is a class "D" stream. The town is proposing to construct a bio-filter /first flush basin to trap and settle out as much of the sediments and nutrients as possible. The basin will collect the runoff and allow it to discharge into the existing wetlands and stream channel via a stone rip-rap overflow channel. This project

has been reviewed by our local Conservation Board and any of their comments have been incorporated into the design.

Total Project Cost:

\$125,000

WRDA Share:

\$ 93,750

Estimated Completion:

December 2003

Selection Highlights:

1. Environmental benefit: The installation of the bio-filter will reduce point source pollutants and sediments from entering the wetlands and ultimately Hunter Brook and New Croton Reservoir.
2. Evaluation factors: The region recommended this technology. The cost seemed high, but appears to be a good estimate. Project is contingent on studies being conducted. The project is ready to go, the plans and specs are in place to ask for bids in Spring 1999.
3. Significance/role: The project will provide a natural ecosystem approach to attenuating storm water carried pollutants and sediment that would otherwise be introduced in the wetland areas.

Project Name:

New Castle Yeshiva Sewer District

Grant Recipient:

New Castle, Town of

Project Description:

This project planning and engineering will be to provide sanitary sewer service to a residential area, which has had problems with sewer overflows contributing to the pollution of the New Croton Reservoir. Another part of the area is served by a STP which discharges into the Kisco River, which empties into the reservoir close to the intake of the New Croton Aqueduct. Benefits of sewerage the area will be the elimination of pollutants being discharged into the reservoir. Also abandonment of a STP.

Total Project Cost:

\$290,000

WRDA Share:

\$217,500

Estimated Completion:

January 2002

Selection Highlights:

1. Environmental benefit: Water quality will be greatly enhanced by the elimination of sub-surface sewage disposal systems which at times have failed and discharged effluent into the surface waters tributary to New Croton Reservoir.
2. Evaluation factors: high cost for engineering for > 100 homes sewer diversion study this area was noted as problem area they should use diversion study instead of doing all work themselves
3. Significance/role: This project is with the goals of NYC to eliminate pollution from its reservoir system. The treatment plant that will be eliminated is the closest one to the intake of the New Croton Aqueduct.

APPENDIX B

New York City Watershed Data Management and Software Tools Development Project

This project is funded by the USEPA and the NYSDEC and utilizes SDWA funds. It will develop an integrated high resolution GIS data base with a suite of management tools integral to the database that will be used to map and model the NYC Watershed. The data and tool suite is to be internet accessible. It is the DEC's intent to use the NYC Watershed project as a template for other watersheds in the state. This work should be completed by the Spring of 2003.

Watershed protection requires the cooperation of the Federal, State and local governments. Non-point source pollutant mitigation is highly dependent on land use changes and/or the modification of land use practices. Changing the behavior of local people for the benefit of the quality of our water resources is extremely difficult. Sweeping regulatory edicts targeted at local governments and property owners based on generally suspected water quality limiting land use practices will not work. We need to build local capacity to use and understand the importance of the land use practices on water quality. To do that we need to have a level of sophistication that can identify specific pollutant sources and the means to reduce the sources of pollutant loading. This will allow targeted actions to be considered and enacted with the cooperation of the local governments.

The goal of this project is to develop an improved Information Technology framework to better assess both the East of Hudson (EOH) and West of Hudson (WOH) regions of the New York City (NYC) Watershed. In particular, there is a significant requirement in demonstrating the relative progress towards achieving the goals stated in the 1997 Watershed Memorandum of Agreement (MOA). It is the overall objective of this project to complement the existing New York City Department of Environmental Protection's watershed planning and management program by developing higher resolution data, improving the technological tools to make the program more effective and efficient and by developing a common Geographic Information System to leverage the capability of the watershed program.

This systems integration effort will address multi-agency geospatial, hydrological, as well as water quality data. Key modular components include a comprehensive relational and Geographic Information System (GIS) database, custom model interface software, modeling support and visualization tools. The proposed framework will be developed in a two-phase program effort. The first phase will include the development of a prototype tool set, and the application of this system for a pilot study area – the Cannonsville reservoir/watershed. The second phase will be the conduct of a formal pilot study evaluation, and subsequent system enhancements and application to the other reservoir /watersheds, as well as the development of selected NYCDEP watershed management projects.

The proposed tool set configuration incorporates easy-to-use GIS graphical user interfaces (GUIs), and allows for distributed data capture and analysis at stakeholder agencies – including NYCDEP, New York State Department of Environmental Conservation (NYSDEC), US Environmental Protection Agency (USEPA), New York State Department of Health (NYSDOH), and designated non-governmental organizations (NGOs). Also, a scenario support tool set will be integrated to address potential MOA programmatic issues and concerns.

To better understand the problem, the project will commence with an overall needs assessment, which addresses existing NYCDEP watershed management and decision-making tools and data structure. This will provide the basis for subsequently conducting more in-depth assessments at the major task level. The resulting product will be a requirements document, which will serve as a detailed specification for each task. This document will further detail the amount of participation required of both NYSDEC and NYCDEP organizations. In addition, a data quality assurance and quality control plan will be included.

Based upon discussions with NYCDEP, there are two types of watershed programs that have been implemented in the NYC Watershed - remedial programs and protection programs. As highlighted in previous correspondence, these include West of Hudson community planning, land acquisition, stewardship, and stream management. Remedial programs address existing land uses with Best Management Practices (BMPs) or other remedial activities. Protection programs address future land uses with either limits on future land use development, or BMPs applied to new developments. The various data development and software tool-building efforts which have been suggested will be evaluated, in cooperation with the respective program manager, and an implementation strategy be developed.

The experience gained and lessons learned from NYSDEC programs related to the characteristic development of the NY State watersheds have been significant in generating the approach and concepts being forwarded for this program. Many elements of NYSDEC programs are being fulfilled by this project to the overall benefit and effectiveness of the NYC Watershed assessment.

This project has the following five key objectives:

1. Develop an integrated, GIS-based, water quality data management tool set for improved watershed management for the NYC Watershed.
2. Develop a flexible, adaptive GIS database framework which has the capability to integrate a variety of existing geospatial data.
3. Develop a semi-automated modeling support tool set that would consist of a modules to support the terrestrial model (GWLF), and Upstate Freshwater Institute's (UFI's) reservoir model.
4. Based upon a set of priorities established by NYSDEC and NYCDEP, develop scenario support tool set to address Stormwater Best Management Practices (BMPs), phosphorous loads, land acquisition, stewardship, and stream bank restoration programs.
5. Develop a capability to allow different levels of user access to other interested agencies, including NYSDEC, USEPA, and local governments, as well as selected non-governmental organizations.

Based upon our stated five project summary objectives, as well as USEPA, NRC, and ILSI findings, there is a two-phase effort, which is divided into 8 major tasks.

Task 1 comprises an imagery data collection and classification effort. This effort includes the collection of high resolution color-IR orthoimagery and IKONOS satellite imagery for the Cannonsville Watershed. In addition, remotely-sensed LIDAR digital elevation data, and Thermal-IR data will be collected for the watershed floodplain areas. Also, using LANDSAT and EMERGE imagery, a land cover classification will be conducted. Finally, a separate land use coverage will be created and incorporate demographics, ownership, property value, and land use/zoning information.

In Task 2, we will to conduct data mining and database development. One of the significant challenges to watershed assessment and management is the ability to synthesize and integrate complex environmental data. The proposed system will consist of a comprehensive relational and geographic info system database. Issues of back-up / recovery, as well as synchronization and configuration management will be addressed. Essentially, the system would allow for the integration of geospatial, hydrological, and water quality data.

Task 3 will develop a modeling and analysis framework in order to provide an analytical tool to evaluate total stream integrity. In particular, through the application of geographic information systems (GIS), useful patterns and extents of co-occurrence are more recognizable. The database developed in Task 2 will be interrogated by the modeling support tools, in order to allow for a better understanding of hydrological processes. The basic tool set will consist of the GWLF and UFI reservoir models, which will be later expanded to include other basin hydrology and hillslope / landscape models. Attributes of stream geomorphology including bank stability, pool quality, streambed, sedimentation, and substrate composition will be addressed through the development of an enhanced set of stream bank tools.

In Task 4, interactive, scenario support tool set will be developed to address "what-if" questions for the watershed management and planning. A series of candidate Best Management Practice editors are proposed. Also, based upon your guidance, other tool sets are offered including water quality visualization, water balance, and streambank evaluation tools.

In Tasks 5 and 6, the database and tool sets developed in Tasks 2-4 will be integrated and tested. In Task 5, based upon a defined system integration and test plan, system-level testing of an alpha release configuration of the software will be conducted. Any necessary system enhancements will be made prior to proceeding to the next task. In Task 6, a beta release configuration will be applied for a pilot study of the Cannonsville reservoir / watershed. During Task 6, a results comparison will be conducted between the manually-calibrated models and the new, semi-automated modeling analyses. Based upon the development of

additional modeling support and scenario software, additional investigations will be performed in cooperation with NYSDEC and NYCDEP staff.

Task 7, primarily a Phase 2 effort, will commence with a cooperative evaluation of the Cannonsville pilot study. In addition, an evaluation of the various proposed watershed management projects will be conducted. Based upon this evaluation, and a priority determination made by NYSDEC and NYCDEP, selected watershed management project tools will be developed.

Task 8 details the overall project management tasks including a master project schedule, organizational structure, and quality assurance plan.

There are some projects that have been accelerated as follows:

Build-Out Model Tool

The purpose of the Build-Out Model Tool (BMT) and Applications development is to create a state-of-the-art ArcGIS tool that will provide the NYCDEP the capability to model the effects and relationship of future land development scenarios with Land Use and Land Cover for selected geographic areas of the NYC Watershed. This task order is in support of a broader Build-Out Modeling initiative in support of the NYC Watershed Program. This task order will focus on the conversion and extension of the Land Transformation Model-2 (LTM-2) previously developed by Michigan State University. The use of LTM-2 provides the basis for developing a customized, operational tool, leveraging upon existing NYCDEP data and modeling assets.

Impervious Cover Classification

The objective of this task order is to develop a land cover classification of the East of Hudson (EOH) Watershed that delineates all surfaces on or above the ground that are impervious to water. In addition, NYCDEP has requested support for a related literature review for impervious surfaces.

The classified impervious surfaces will include rooftops, pavement, concrete, and any other surfaces with horizontal dimensions that are impervious to water. The final product will be a binary thematic raster map with each raster cell containing either a pervious or impervious value. This thematic raster will allow for tabulation of percentages of impervious surfaces inside political, hydrological, or property boundaries using GIS tools as well as providing an impervious surface " raster mask" for raster spatial analysis. It will also be useful for land management and water quality and quantity modeling. NYCDEP has stressed the importance of tracking impervious surfaces at both a watershed and parcel scale. Lastly, NYCDEP, NYSDEC, and USEPA will be able to map and track temporal changes in the location and area of

impervious surfaces over time by repeating this remote sensing/classification effort in the future.

A classification accuracy assessment will be performed based upon comparisons with digital aerial photography as well as other GIS reference data, and ground reconnaissance where necessary. One hundred samples of each class total populations will allow overall accuracy at a 95% confidence interval.

Runoff and Reservoir Modeling Support

Description: NYSDEC is interested in establishing a working relationship with both Cornell University and the Upstate Freshwater Institute at Syracuse University. The purpose of these institutional relationships is to improve our understanding of water quality modeling as it pertains to the New York City Watershed. We are requesting that the tools that are developed in each contract be linked to the GIS data base that we are developing for NYC Department of Environmental Protection. PAR Government Systems Corporation (PAR) is doing this work for NYCDEP. It is our intent to use the tools that are developed as a result of these contracts in other watersheds in the State. The work to be done by each of the contractors shall be well documented to provide other users with the ability to use the software. The tools are as follows:

Cornell University - Cornell University is developing a Soil Moisture Runoff (SMR) Model. It should be integrated into the tools sets that PAR is developing for NYCDEP. The following items of work shall be provided:

- 1) The Users Manual that documents the current interfaces and functionality of SMR.
- 2) The SMR software from the Geographic Resources Analysis Support System (GRASS) GIS to ESRI's Arc/GIS to insure that the same functionality is attained.
- 3) Support the development of SMR-based tools to include:
 - Improved new algorithms
 - Improved visualizations of inputs and outputs
 - Development of specific Whole Farm Program support modules.

Upstate Freshwater Institute (UFI) - UFI is developing reservoir modeling tools that should be integrated into the tools sets that PAR is developing for NYCDEP. The following items of work shall be provided:

- 1) The Users Manual that documents the current interfaces and functionality of the UFI Reservoir Management Modeling (1-D) software.
- 2) Develop a Graphical User Interface (GUI) for the UFI 2-D Reservoir Management Model (LINKRES). This should be developed to provide:
 - a) Capability to model compute and visualize the time of travel fro reservoirs acting in series for a range of user defined hydrologic and meteorological forcing functions..
 - b) Capability to model and visualize the impact of reservoir operational changes on downstream/withdrawal temperatures.
 - c) Capability to model, evaluate and visualize the potential spread of non-conservative constituents, as represented by simple first-order kinetics, during storm run-off events.
- 3) Modify UFI software to support modeling of the Kensico Reservoir to allow the modeling of hydrothermal processes and incorporate this into the LINKRES software. Capability to visualize the model outputs shall be provided.
- 4) Develop UFI based tools to improve the visualizations of inputs and outputs, incorporate the modifications developed in item earlier items. Develop specific TMDL support modules.

Stewardship Database and Applications

Description: NYCDEP has a significant responsibility to manage and acquire its land assets. Software is needed to allow NYCDEP to more efficiently and effectively administer the duties associated with this program. As part of another contract PAR is developing software to be integrated into a larger GIS Data Base Management System. This should entail the selection of commercial off the shelf software and the customization of that for NYCDEP. All of the NYCDEP functions and processes should be integrated into the software. These should include: Land Acquisition Assistance, Land Management Planning, Land Monitoring, Natural Resources Management, Public Access Management and Land Administration. This work should be done in phases to include selection and than an implementation phase. The selection phase should include a description of each process by function the inputs and outputs, relationships, problems and bottlenecks and priorities for automation. COTS software should be matched to the functions and

processes and a recommendation made. A selection should be made and the software should be purchased. The implementation phase should include process by function by priority, installation of the software, modifications to the software to meet the characteristics of the NYCDEP functions and programs, data integration and testing and training.

Web-based Data Browsing and Access

Description: This should develop a prototype capability for browsing and accessing newly acquired data and eventually all data collected as part of the NYC Watershed project. Meta data should be developed as well as spatial indices of current and planned data holdings. In addition there shall be a Web-based operational prototype capacity established for DEP and DEC.

Stormwater Pilot Studies

Description: This should use the remotely sensed data that is being collected as part of a larger NYCDEP Contract to establish a GIS database from which Stormwater Pilot Studies and Applications can be consistently derived. The data base should be able to support both the needs of the individual communities as well as the modeling and mapping needs of NYCDEP. This should build on the pilot study that is being done for the Village of Walton.