UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY

SEPTEMBER 1991

EPA

FINAL ENVIRONMENTAL IMPACT STATEMENT ON THE UPPER PASSAIC RIVER BASIN 201 FACILITIES PLAN

IN MORRIS, SOMERSET AND UNION COUNTIES, NEW JERSEY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
JACOB K. JAVITS FEDERAL BUILDING
NEW YORK, NEW YORK 10278

SEP 20 1991

To All Interested Government Agencies, Public Groups, and Citizens:

Enclosed for your review is a copy of the Final Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan in Morris, Somerset, and Union Counties, New Jersey. This final environmental impact statement (EIS) was prepared by the Environmental Protection Agency (EPA), with assistance from Gannett Fleming Environmental Engineers, and EcolSciences, Inc., in accordance with the National Environmental Policy Act (NEPA), and its implementing regulations.

In June 1981, EPA issued a draft EIS for the project that evaluated the potential environmental impacts of upgrading and expanding several municipal wastewater treatment plants (WWTPs) under the proposed Upper Passaic River Basin 201 Facilities Plan. Unfortunately, the draft EIS did not adequately address the project's impacts to the Great Swamp National Wildlife Refuge (GSNWR), which was a major issue identified in the EIS scoping process. With this in mind, following issuance of the draft EIS, EPA and the New Jersey Department of Environmental Protection (NJDEP) performed the Great Swamp Water Quality Study (GSWQS), which was designed to address point and non-point source water quality impacts to the GSNWR.

The EIS was initiated as a decision-making tool prepared to evaluate the environmental impacts of upgrading and expanding WWTPs in the Upper Passaic River Basin. However, since the issuance of the draft EIS, procedural changes mandated by the Water Quality Act of 1987 have shifted responsibility for management of financial assistance programs for construction of WWTPs from the federal government to the states. Further, many of the preferred alternatives discussed in the draft EIS have already been implemented. Therefore, this final EIS is prepared as a summary document, reflecting work completed to date on the WWTPs, funding program changes since 1981, an analysis of the GSWQS, a re-evaluation of potential impacts, and responses to all comments received on the draft EIS. Based on this information, the final EIS presents several recommendations regarding storm water management planning, point source and non-point source discharges, WWTP capacities, package treatment plants, and the protection of environmentally sensitive areas in the study area.

EPA will accept written comments on the final EIS for thirty (30) days from the date that the notice of availability of this final EIS is published in the Federal Register. Comments should be addressed to Chief, Environmental Impacts Branch, EPA-Region II.

If you have any questions concerning the above, or need any additional information, please contact Robert Hargrove, Chief, Environmental Impacts Branch, at (212) 264-1892.

Sincerely,

Constantine Sidamon-Eristoff
Regional Administrator

Enclosure

Final
Environmental Impact Statement on the 201 Facilities Plan
for the Upper Passaic River Basin (UPRB)
September 1991

Prepared by:
U.S. Environmental Protection Agency - Region II

Abstract: In accordance with the National Environmental Policy Act (NEPA) and the Environmental Protection Agency's (EPA) regulations implementing NEPA, a final environmental impact statement (EIS) has been prepared on the Upper Passaic River Basin (UPRB) 201 Facilities Plan. The final EIS responds to comments received on the 1981 draft EIS, which evaluated proposals to upgrade and expand various publicly-owned wastewater treatment plants (WWTPs) in the planning area. Additionally, the document incorporates the results of the Great Swamp Water Quality Study (GSWQS), which was undertaken to resolve certain issues which could not be addressed in the draft EIS. It also re-evaluates the impacts of these proposals, based upon the GSWQS's results and in consideration of the various WWTP improvements and regulatory changes which have occurred since 1981. Lastly, the final EIS presents recommendations with regard to non-point source pollution, stormwater management, protection of environmentally sensitive areas, and limiting the use of "package" WWTPs in the planning area.

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Approved by: [signature] 9/20/91

Constantine Sidamon-Eristoff, Regional Administrator — Date

FINAL
ENVIRONMENTAL IMPACT STATEMENT
ON THE
UPPER PASSAIC RIVER BASIN
201 FACILITIES PLAN

IN MORRIS, SOMERSET AND UNION COUNTIES
NEW JERSEY

PREPARED BY:
U.S. ENVIRONMENTAL PROTECTION AGENCY

WITH ASSISTANCE FROM:
GANNETT FLEMING ENVIRONMENTAL ENGINEERS, INC.
HARRISBURG, PA

IN ASSOCIATION WITH:
ECOLSCIENCES, INC.
ROCKAWAY, NJ

SEPTEMBER 1991

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Purpose and Need

This Environmental Impact Statement (EIS), which has been prepared as a decision-making tool, deals with the Upper Passaic River Basin (UPRB) 201 Facilities Plan (Killam, Dames & Moore, 1977). The plan proposed to upgrade and expand wastewater treatment plants (WWTPs) located in the UPRB sections of Morris, Somerset, and Union Counties, New Jersey. Municipalities wholly or partially within this area include Chatham Borough, Madison Borough, Watchung Borough, Chatham Township, Morris Township, Harding Township, Passaic Township, New Providence Borough, Berkeley Heights Township and Bernards Township (Figure ES-1).

In the late 1970s, the WWTPs within the UPRB 201 Planning Area, with a few exceptions, reached or were approaching design capacity. This condition resulted in the discharge of inadequately treated wastewater to the waters of the UPRB. The situation led to state-imposed bans on sewer extensions and new connections within some municipalities. Two of the municipalities, Berkeley Heights and Morris Townships, were under an Enforcement Compliance Schedule letter which was issued by the Environmental Protection Agency (EPA).

Several communities initiated and completed the design of additional wastewater treatment facilities. Since these communities were within a designated 201 planning area, they could not receive federal grant assistance until a Facilities Plan was approved by EPA and the New Jersey Department of Environmental Protection (NJDEP). In response to this requirement, representatives of the ten municipalities formed the Upper Passaic Wastewater Management Study Committee (UPWMSC) to administer this 201 facilities planning effort. The UPWMSC prepared a draft Facilities Plan that was issued in March 1977. The document was submitted to EPA and the NJDEP, but was not approved.

EPA identified major issues associated with the draft Facilities Plan and, on January 28, 1978, issued a notice of intent (NOI) to prepare an EIS on the UPRB 201 Facilities Plan. Among the issues identified at that time were:

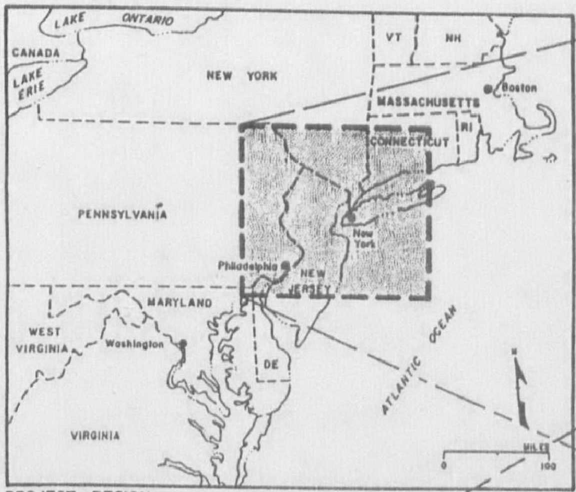
- secondary impacts associated with expansion and upgrading of WWTPs;
- impacts of the Chatham Township and Morris-Woodland WWTPs on the Great Swamp National Wildlife Refuge (GSNWR);
- expansion and construction of WWTPs within the flood hazard area;
- chlorine and ammonia toxicity associated with wastewater discharges in the Black Brook, Dead River, Loantaka Brook, and Passaic River; and
- public controversy.

On June 26, 1981, EPA issued a draft EIS on the UPRB 201 Facilities Plan, which evaluated various proposals to upgrade and expand several municipal wastewater treatment facilities. A public hearing was held at the Morris Township Municipal Building, in Convent Station, New Jersey, on August 20, 1981, in order to allow interested individuals, government agencies, and other organizations the opportunity to publicly comment on the draft EIS. During the initial and extended public comment period, which ran through September 4, 1981, written comments were accepted on the draft EIS.

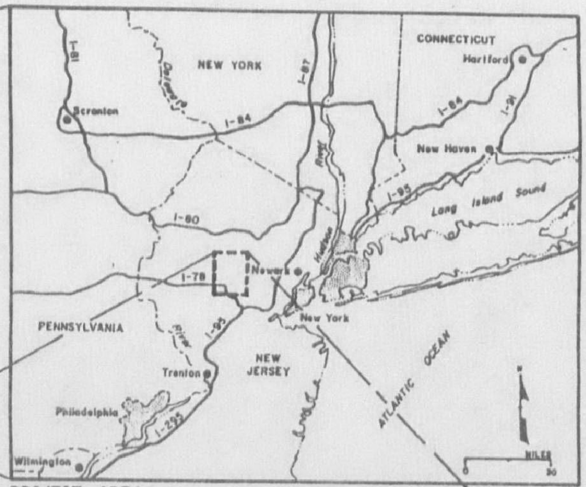
A major area of concern identified in the NOI and the draft EIS, and reaffirmed during the draft EIS comment period, was that wastewater effluent from the Morris-Woodland and Chatham Township WWTPs might supply excessive discharges of nitrogen and/or phosphorus to the GSNWR. In order to adequately address this issue, quantities of these nutrients reaching the GSNWR from non-point sources (i.e., from existing and future

GENERAL LOCATION

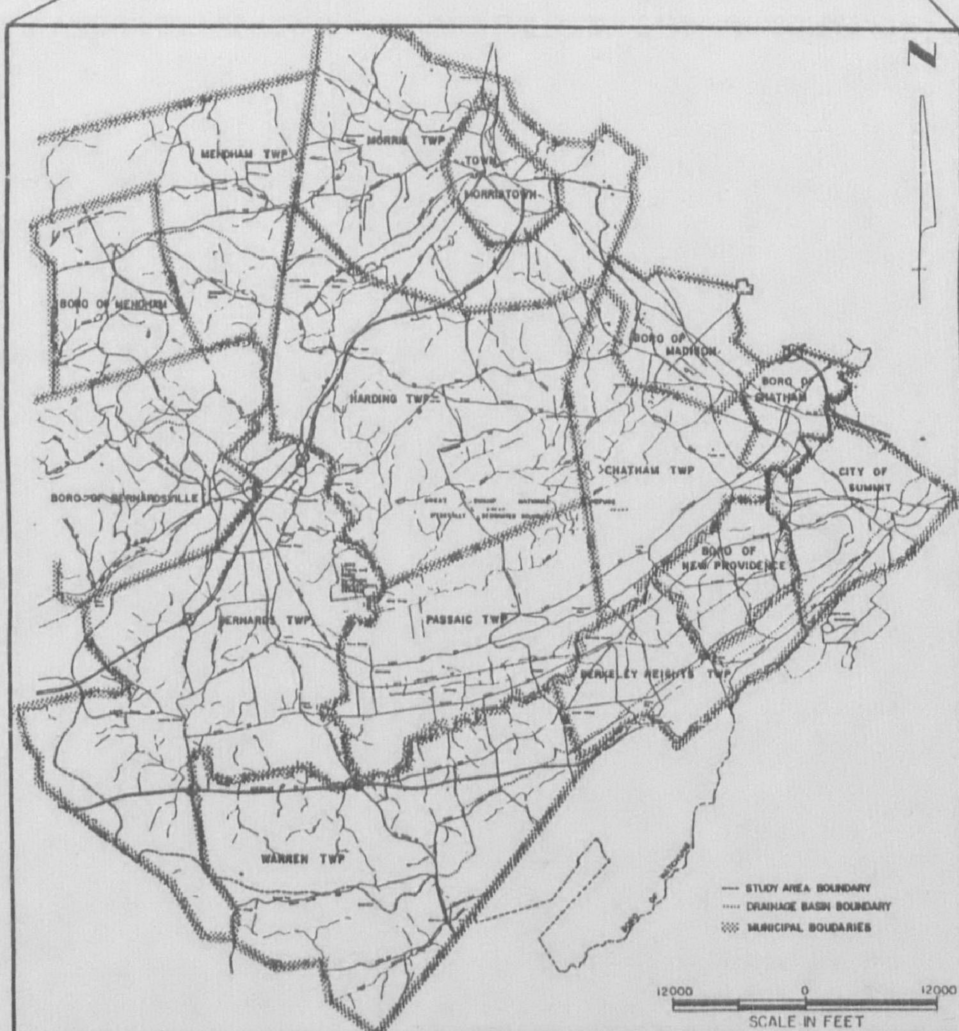
FIGURE ES-1



PROJECT REGION



PROJECT AREA



PROJECT LOCATION

development) also had to be considered. To evaluate the effects of point and non-point sources of nutrients to the GSNWR, EPA and NJDEP jointly conducted a water quality monitoring study (i.e. the Great Swamp Water Quality Study [GSWQS]). Subsequently, EPA and NJDEP issued a data report (Maguire Group, 1988), along with a computer modelling analysis report (Di Lorenzo, et al, 1988) on the GSWQS. Issuance of the final EIS was delayed pending completion of this study.

Since the draft EIS was issued, various changes have been made to the Clean Water Act regarding eligibility for federal funding. These changes shifted responsibility for management of programs that provide financial assistance for the construction of WWTPs from the federal government to state governments. EPA's Construction Grants Program was delegated to the State of New Jersey in phases between 1981 and 1983. Moreover, New Jersey established a revolving loan program in 1987 that was initially capitalized with "state-only" money derived from bond sales for the purpose of providing financial assistance for the construction of WWTPs. This program was subsequently augmented with federal funding in the form of capitalization grants, beginning in 1988. New Jersey includes this State Revolving Fund (SRF) with other "state only" funding programs in its Municipal Wastewater Assistance Program. EPA oversees New Jersey's administration of the SRF program, but is not involved with the specific details of individual projects.

This final EIS has been issued as a project summary document and, as such, augments the draft EIS. To this end, it reflects:

- changes in the mechanisms for funding of the WWTP construction;
- upgrades of wastewater treatment facilities since 1981;
- the analysis of the GSWQS reports and its implications on wastewater treatment;

- a re-evaluation of impacts associated with increased wastewater treatment capacity;
- an update of the environmental and socioeconomic inventories, where appropriate; and
- responses to all comments and their incorporation into the EIS process.

The overall format of the final EIS is shown on Table ES-1. The remaining portions of the executive summary highlight the key issues related to the projects discussed in the EIS.

WWTPs Preferred Alternatives

The WWTPs in the UPRB were evaluated in the draft EIS to determine the preferred method of wastewater management. At that time, the preferred alternatives included the expansion and upgrading of some plants and the discarding of others in favor of subregional wastewater treatment plants. Package treatment plants and on-lot systems were examined during the study, but package treatment plants were not recommended because of environmental concerns and operational and management considerations. On-lot systems were considered acceptable only in areas with low population densities, and acceptable soil and related environmental characteristics.

Since the issuance of the draft EIS, several factors have influenced a change in the preferred alternatives for some of the WWTPs, including:

- the decisions of some municipalities to proceed with wastewater facility improvements independent of EPA's Construction Grants Program;

TABLE ES-1
Final EIS Format

Executive Summary	Replaces draft EIS Executive Summary
Chapters 1-4	Same as draft EIS Chapters 1-4 (not reprinted in final EIS)
Chapter 5	Revisions to draft EIS
Chapter 6	Conclusions and Recommendations
Chapter 7	Responsiveness Summary
Appendices A-J	Same as draft EIS Appendices A-J (not reprinted in the final EIS)
Appendix K	Review of Great Swamp Water Quality Study
Appendix L	Stormwater Management for the Mitigation of Water Quality Degradation
Appendix M	Bernards Township Facilities Responsiveness Summary
Appendix N	Letters Received Concerning the draft EIS

- additional environmental data from the GSWQS; and

- public input as part of the EIS process.

Table ES-2 highlights the draft EIS and final EIS preferred and recommended alternatives, respectively, and the implementation status for each of the treatment plants evaluated in the study. Overall, changes in preferred alternatives between the draft EIS and final EIS have been minor. The most significant difference occurs in the Passaic and Warren Township facilities. Specifically, the draft EIS proposed that these facilities be merged into a single subregional facility. These townships proceeded independent of federal financial assistance and chose to upgrade their existing facilities rather than constructing a subregional facility.

Existing Environment in the Planning Area and Environmental Constraints to Development

The full description of the affected environment and a comprehensive constraints analysis are presented in the draft EIS for the UPRB 201 Facilities Plan. Chapter 5 of the final EIS provides descriptions of significant changes in features of the affected environment, as well as an update of environmental constraints to development in the UPRB since the issuance of the draft EIS.

Affected Environment in the Planning Area

Recent significant events that affect potential land use and protect natural resources in the UPRB are summarized under three major categories. These are water resources, critical areas, and land use.

From 1980 to 1990, major regulatory actions were implemented that provide more protection to water resources than was afforded previously, including EPA designation of the Buried Valley Aquifer Systems of the Central Passaic River Basin and the Unconsolidated Quaternary Aquifer of the Rockaway River Basin as Sole Source Aquifers

TABLE ES-2				
Final EIS Preferred Alternatives				
WWTP	Draft EIS Preferred Alternative	Final EIS Preferred Alternative	Implementation Status	Final EIS Recommended Flow Rates (mgs)[2]
Chatham Township	Upgrading existing facilities with the ability to add nutrient removal facilities in the future	Upgrade to Level 4 treatment, with nutrient removal	In Progress	0.75
Morris-Woodland	Upgrading existing facilities with the ability to add nutrient removal facilities in the future	Upgrade to Level 4 treatment, with nutrient removal	In Progress	2.0
New Jersey Department of Transportation - Harding Rest Stop	Continue existing operation	Make operational or design improvements to handle operational and vandalism problems	Not Scheduled	0.025
Berkeley Heights	Upgrading and expansion of existing facilities to Level 4 treatment with dechlorination	Expand and upgrade to Level 4 treatment with dechlorination	Complete[1]	3.5
Bernards Township	Upgrading and expansion of existing facilities to Level 4 treatment with dechlorination	Expand and upgrade to Level 4 treatment with dechlorination	Complete[1]	2.5
Madison-Chatham Joint Meeting	Upgrading to Level 4 treatment with dechlorination. The upgrade would reduce the treatment capacity 0.8 mgd	Upgrade to Level 4 treatment with dechlorination	Complete[1]	3.5[3]
New Providence Borough	Upgrading to Level 3 treatment	Upgrade to achieve consistent compliance with current Level 3 permit limits	Not Scheduled	1.5
Passaic Township	Replacement with a subregional WWTP that would treat the Warren Township and Passaic Township flows. The subregional WWTP would provide Level 4 treatment with dechlorination	Expand and upgrade to Level 4 treatment with dechlorination	In Progress	0.9
Warren Township Stage I-II	Elimination of the three WWTPs in favor of a subregional WWTP in Passaic Township	Expand and upgrade to Level 4 treatment with dechlorination	In Progress	0.47
Warren Township Stage IV	Elimination of the three WWTPs in favor of a subregional WWTP in Passaic Township	Expand and upgrade to Level 4 treatment with dechlorination	In Progress	0.8[4]
Warren Township Stage V	Elimination of the three WWTPs in favor of a subregional WWTP in Passaic Township	Construct a Level 4 WWTP with dechlorination	Complete[1]	0.38
Park Central	Elimination of the package WWTP with conveyance of flows to the Chatham Township WWTP	Upgrade to Level 4 treatment	In Progress	0.03
VA Medical Center	Upgrade existing facilities	Upgrade and provide dechlorination or alternate disinfection process	Upgrade is complete, dechlorination not yet scheduled	0.4

1 As of December 1990
2 Flow rates selected based on information developed during the EIS process and based on current NJDEP permitting actions.
3 Maximum monthly average flow = 5.0 mgd.
4 Currently at 0.45 mgd, expanding to 0.8 mgd.

under the Safe Drinking Water Act (SDWA). With respect to surface water quality, even though the Passaic River and most tributaries are classified as suitable for public potable water supply after required treatment, water quality is fair near Millington and Chatham, and declines to poor at Two Bridges.

In the 1980s, regulations at the state and local levels were implemented to provide stricter controls over activities in "critical areas." Such areas may be special habitats (e.g., wetlands, wildlife areas, or stands of native vegetation) or environmental features that require special planning and permitting. Major areas of regulation adopted over the past decade are as follows:

- The New Jersey Freshwater Wetlands Act requires that a permit be obtained from NJDEP for most activities that alter or disturb land or water in or around freshwater wetland areas, and for the discharge of dredged material into State Open Waters. Exemptions from applicability include activities permitted under the Act's "grandfather" clauses.

- The New Jersey Planning Act stipulates the preparation of the State Development and Redevelopment Plan to generate an organized assessment of the numerous growth changes affecting New Jersey.

- Local stormwater management, critical features, and environmental assessment ordinances and requirements, adopted by many New Jersey municipalities, restrict and regulate development.

- The Master Plan for the GSNWR emphasizes the preservation and protection of important freshwater wetland and upland habitats for resident and migratory wildlife species.

With respect to land use, existing and projected populations were re-examined. At least to 1988, the most current year for which data is available, no municipality has shown a trend in population that would invalidate the population projections presented in the draft EIS. The UPRB region continues to experience a very slight increase in population, with the greatest increase in Bernards Township. However, between 1980 and 1988, the populations of Morris Township, Morristown, and Madison Borough have stabilized, and both Bernardsville Borough and Chatham Borough have experienced a decline in population. Average household sizes continue to decline in the region. In fact, the documented decline is greater than projected in the draft EIS.

Environmental Constraints to Development

Potential environmental constraints have been identified and summarized as follows:

- Land Capacity: As of 1981, 36,260 acres of the UPRB were undeveloped, of which 21,247 acres were zoned for development. Of the developable acreage, 8,430 acres were excluded from development due to natural and imposed constraints, as described below.

    - Outdoor Recreation and Open Space Areas: About 11,180 acres were set aside and 1,310 acres were planned for parkland and open space resources. These areas are likely to remain undeveloped since: (1) a common objective of each municipal master plan is the preservation of all existing parkland; (2) such areas are designated for recreational uses by local zoning ordinances; and (3) almost half of the land is owned by the federal government as part of the national park and wildlife refuge systems.

- Steep Slopes: Approximately 1,920 acres of all residential, commercial and industrial zoned land were classified as steep slopes (15 percent slope or greater). Developers are less likely to build on parcels having excessive slopes due to construction and erosion problems which these sites pose; hence steep slopes are excluded from developable lands.

- Flood Prone Areas: Of the residential and industrial zoned undeveloped land in the basin, approximately 5,200 acres are located in flood prone areas. Federal and state laws direct the avoidance of floodplain development wherever a practicable alternative exists; moreover, developers tend to avoid floodplains due to economic risk. Therefore, flood prone areas are eliminated from developable lands.

- Wetlands: Wetlands are found throughout the UPRB, with a predominance in the GSNWR and the Black Brook addition to the GSNWR; these areas coincide with flood prone areas and parklands. Consequently, elimination of potential development acreages of wetland areas has already been taken into consideration. Futhermore, regulation of wetlands by federal and state agencies strongly discourages their development.

• Water Supply: Water supply is not a constraint to projected population growth and resultant future development. A combination of the minor expansion of water systems near water surplus areas and the development of private wells in areas of low density zoning should allow for adequate water supply to the UPRB without the need for developing further intrabasin transfers or reservoirs.

- Air Quality: Air quality is not an issue in terms of constraints to growth in that: (1) the UPRB is located in an attainment area with regard to total suspended particulates, sulfur dioxide, and carbon monoxide; and (2) further development of the UPRB for residential users is not considered a significant problem, except with regard to area-wide ozone levels. The latter is being addressed as a regional issue.

- Soils: Soils are predominantly unsuitable or only marginally suitable for septic systems, with the exception of Harding Township, Berkeley Heights, and New Providence, due to high water tables, proximity to bedrock, and low soil permeability. This factor may serve as a constraint to development if an area is not served by municipal or private sewage systems, or WWTP capacity is unavailable.

Environmental and zoning constraints have reduced the amount of net residential land available for new development by 41 percent. From 1980 to 1988, all the UPRB municipalities realized somewhat stabilized populations and residential development, except for Bernards Township which experienced an estimated 46 percent population increase. As of 1988, Bernards, along with Berkeley Heights, Chatham, Morris, Passaic, and Warren Townships, and Chatham, Madison, and New Providence Boroughs still had developable residential land for limited growth, but were nearing saturation. Harding Township had the most leeway for residential development; it only reached an estimated population of 3,633 or 52 percent of its constrained saturation.

Analysis and Interpretation of the GSWQS

The GSWQS was conducted jointly by EPA and NJDEP to evaluate present and future impacts of point and non-point source loadings in the Great Swamp watershed. The study determined that, under base flow conditions, the discharges of treated wastewater from the Morris-Woodland and Chatham Township WWTPs generated significantly elevated nutrient concentrations (orthophosphate, total phosphorus, and total soluble inorganic nitrogen) in their receiving waters, Loantaka Brook and Black Brook, respectively. The principal exception to these findings occurred on Loantaka Brook, where the difference in nitrate concentrations in the brook upstream and downstream of the Morris-Woodland WWTP discharge were negligible.

Comparison of loading estimates at the several Loantaka and Black Brook sampling locations indicated that some reaches of these brooks were apparently receiving substantial nutrient loadings from non-point sources. The upper reaches of Loantaka Brook appeared in particular to be affected by non-point source loadings in stormwater runoff flows. These non-point source influences, however, are not always evident in the concentration data alone. For example, storm flow concentrations of total phosphorus, orthophosphate, and total suspended solids at sampling locations in developed watersheds did not differ significantly from concentrations at sampling locations in undeveloped watersheds.

Impacts of Proposed Actions

There are two types of impacts that can result from the construction of the proposed WWTP improvements - primary impacts and secondary impacts. Primary impacts are directly related to construction activities or the operation of the wastewater treatment plants. Secondary impacts are related to development that is facilitated by the availability of wastewater treatment.

The upgrading of the WWTPs to Level 4 with nutrient removal will reduce nutrient loadings to the Passaic River, Passaic River tributaries, and the GSNWR. These reduced nutrient loadings will be of significant benefit to the surface waters of the UPRB.

The construction of the proposed facilities will not have significant adverse impacts on sensitive environmental areas. Where construction encroaches on wetlands or floodplains, such activities are reviewed and regulated by the NJDEP. Moreover, no sewer service will be provided to serve future development within wetlands or the 100-year floodplain in the service area, unless specifically approved by NJDEP.

Improvements in treatment level and/or reductions in infiltration/inflow (I/I) in the sewers may permit sewer service to be extended to additional users. However, new service will have to be approved by NJDEP. At this time no sewer extensions are planned; therefore, the proposed improvements to the existing facilities will not generate significant secondary impacts on land use patterns in the study area.

Increased non-point source pollution would be generated by additional development in the area. The impacts of the increased stormwater runoff would have to be mitigated by the implementation of local stormwater management plans.

Conclusions and Recommendations

The recommendations listed below are based on the extensive efforts conducted throughout the EIS process. It is the responsibility of the State of New Jersey, a county soil conservation district (SCD), or a municipality to implement these recommendations, as appropriate, to the extent of the state's, SCD's, or municipality's authority to do so.

- The data gathered in the GSWQS were sufficient to show the impact of the point source discharges from the Chatham Township and Morris-Woodland WWTPs on the GSNWR. Moreover, those data indicated that substantial non-point source loadings are entering certain reaches of brooks tributary to the GSNWR. Continued study on a scaled-down basis, such as that presented in the USFWS Master Plan for the GSNWR and in the Non-point Source

Pollution Project for the Great Swamp Watershed proposed through the U.S. Department of Agriculture, is recommended. Such continuing study can refine the identification and characterization of such non-point source influences, and evaluate various remedial alternatives.

- As WWTPs in the UPRB are upgraded, the point source loadings from these facilities will diminish, and non-point sources will exert greater influences on the overall loadings to the surface waters of the basin. Analysis of the GSWQS data has identified some stream reaches flowing into the GSNWR that appear to have substantial non-point source loadings. Stormwater management plans should be developed by each municipality in the UPRB, especially those within the Great Swamp sub-basin, to control non-point source pollution. Those plans should consider both water quantity and water quality issues. Guidance on the content of such stormwater management plans can be obtained from the NJDEP. Moreover, municipalities should consider establishing overall stormwater management goals for their most sensitive watersheds and stream corridors (see Appendix L.)

- Increased development in the UPRB will increase the hydraulic load of the streams tributary to the GSNWR. This increased hydraulic load may affect the water level of the swamp, which may in turn have secondary impacts on the area (e.g., flooding of basements). Insufficient data currently exists to determine the specific relationship between increased development, water levels, and secondary impacts. As the area comes under increased development pressure, it will become important to study this problem in more detail.

- Much of the UPRB is underlain by the Buried Valley Aquifer Systems, an important source of potable ground water in northern New Jersey. Recharge to these aquifer systems is relatively rapid and direct, making such ground water resources susceptible to contamination from the surface. Where prime ground water recharge areas can be reasonably delineated, municipalities should consider such areas in local zoning decisions to specify the types of development that would be compatible with these environmentally sensitive areas. The NJDEP and New Jersey Geological Survey can offer guidance and assistance to municipalities in their planning efforts.

- With the exception of Harding Township, Berkeley Heights Township, and New Providence Borough, the UPRB soils are predominantly unsuitable, or only marginally suitable, for septic systems, due to high-water tables, proximity to bedrock, and low soil permeability. In areas where conditions are unsuitable or septic systems are failing, an alternative wastewater disposal method must be employed. Most likely, these areas would be connected to an existing WWTP, but any action taken should be consistent with the State Development and Redevelopment Plan which is intended to assess and establish goals and strategies to address the numerous growth changes affecting the state.

- The draft EIS recommended using an environmental constraints analysis to determine appropriate capacities for the WWTPs for new development outside of environmentally constrained areas and by estimating reductions in the I/I component of the flow. The recommended capacities were revised in this final EIS to reflect current NJDEP permitting actions and updated information. The revised WWTP capacity recommendations are contained on Table ES-2.

- Some of the WWTPs operating within the UPRB experience substantial I/I. Where practical and cost-effective, these problems should be corrected.

- Regulation of wetlands and floodplains by NJDEP Division of Coastal Resources strongly discourages development of such environmentally sensitive areas. Therefore, sewer service should not be extended into wetlands and floodplains.

- Package treatment plants may encourage random development within the UPRB. Also, the treatment facilities within the basin are required to achieve high levels of treatment, including nutrient removal in some cases, which are often difficult to maintain with package plants. It would be more difficult for a municipality to operate many small package plants, or to oversee the operation of such plants if privately-owned or operated. Given these considerations, the use of package plants is not recommended in the UPRB.

- Development may lead to increased non-point source pollution and adverse impacts to, and losses of, environmentally sensitive areas. Development in the UPRB cannot be controlled by EPA; EPA recommends that development be controlled on a local level through zoning and comprehensive planning. Development should be consistent with the State Development and Redevelopment Plan.

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LIST OF ACRONYMS

ACE	United States Army Corps of Engineers
BMP	Best Management Practices
CEQ	Council on Environmental Quality
CWA	Clean Water Act
CWC	Commonwealth Water Company
DLI	United States Department of Labor and Industry
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
FIRM	Flood Insurance Rate Map
FNSI	Finding of No Significant Impact
FWPA	New Jersey Freshwater Wetlands Protection Act
GSNWR	Great Swamp National Wildlife Refuge
GSWQS	Great Swamp Water Quality Study
I/I	Infiltration and Inflow
NEPA	National Environmental Policy Act
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJPDES	New Jersey Pollution Discharge Elimination System
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NPS	Non-point Source
N.J.S.A.	New Jersey State Assembly

NWI	National Wetlands Inventory
ROD	Record of Decision
SCD	County Soil Conservation District
SCS	Soil Conservation Service
SPC	New Jersey State Planning Commission
SRF	State Revolving Fund
TBSA	Two Bridges Sewer Authority
UPRB	Upper Passaic River Basin
UPWMSC	Upper Passaic Wastewater Management Study Committee
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
VA	Veterans Administration
WQI	Water Quality Index
WWTP	Wastewater Treatment Plant

LIST OF UNIT ABBREVIATIONS

a	Acre
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
DO	Dissolved Oxygen
ha	Hectare
hu	Housing Unit
mgd	Million Gallons per Day
mg/l	Milligrams per Liter
NBOD	Nitrogenous Biochemical Oxygen Demand
NH_3-N	Ammonia Nitrogen
SS	Suspended Solids

CHAPTER 5

Revisions to the Draft Environmental Impact Statement

5.0 REVISIONS TO THE DRAFT EIS

This chapter identifies additions or revisions to the information presented in the draft EIS. These items were the result of comments raised during the review of the draft EIS, studies completed since the issuance of the draft EIS, particularly the GSWQS, environmental changes over the past ten years, and new or revised federal and state laws, regulations, and policies. Modifications are designated with bold print.

Purpose and Need

Page 1-2: Purpose and Need

The following paragraphs should be added at the bottom of the page:

In the early 1980s, various changes were made to the Clean Water Act regarding eligibility for federal funding. These changes shifted responsibility for management of programs that provide financial assistance for the construction of WWTPs from the federal government to state governments. EPA's Construction Grants Program was delegated to the State of New Jersey in phases between 1981 and 1983. Moreover, New Jersey established a revolving loan program in 1987, that was initially capitalized with "state-only" money derived from bond sales, for the purpose of providing financial assistance for the construction of wastewater treatment facilities. This program was subsequently capitalized with federal funding in the form of capitalization grants, beginning in 1988. New Jersey includes this State Revolving Fund (SRF) with other "state only" funding programs in its Municipal Wastewater Assistance Program. EPA oversees New Jersey's administration of the SRF program, but is not involved with the specific details of individual projects.

Alternatives and Summary of Existing Facilities

The following section should be substituted for all of Chapter 2:

2.1 Introduction

The draft EIS included a review of wastewater treatment alternatives for the communities in the UPRB, which covers all or portions of Morris, Somerset and Union Counties in New Jersey. The draft EIS recommended a preferred alternative for each of the communities included.

In this chapter, the alternatives presented in the draft EIS will be reviewed to determine whether the selection criteria are still valid and to assess the appropriateness of the preferred alternatives.

2.2 Advanced Treatment Level Criteria

The WWTPs in the UPRB were designed to provide secondary treatment. This level removes Biochemical Oxygen Demand (BOD) and suspended solids (SS) to an effluent concentration of 30 milligrams per liter (mg/l) or less but does relatively little to reduce the influent nitrogen and phosphorous concentrations. To address the removal of additional BOD and SS and to include nutrient removal, NJDEP established treatment level criteria corresponding to different classes of treatment. These treatment classes range from Class 1, which is slightly more stringent than secondary, to Class 5. NJDEP's criteria for each of these treatment classes is contained on Table 2-1.

TABLE 2-1

Treatment Level Criteria[1]

	BOD_5		$CBOD_u$		$NBOD_u$		NH_3-N		SS		DO
Class of Treatment	30-day Ave.	7-day Ave.	30-day Ave	7-day Ave.	30-day Ave.	7-day Ave.	30-day Ave.	7-day Ave.	30-day Ave.	7-day Ave.	7-day Ave.
Secondary	30	45	-	-	-	-	-	-	30	45	-
1	24	36	36	54	130	195	26	39	24	36	4
2	16	24	24	36	50	75	10	15	16	24	6
3	16	24	24	36	20	30	4	6	16	24	6
4	8	12	12	18	10	15	2	3	8	12	6
5	4	6	6	9	5	7.5	1	1.5	4	6	6

[1] All criteria in mg/l

Source: New Jersey Department of Environmental Protection

2.3 Wastewater Treatment Alternatives

The draft EIS examined several overall conceptual alternatives for the management and treatment of the existing and future wastewater flows generated in the UPRB. These alternatives included:

(1) No-Action - The existing facilities would continue to operate in their current status with no expansion or upgrading of the facilities.

(2) Upgrading and Expansion - All facilities would be upgraded to meet state and federal discharge standards and would be expanded to handle existing and future wastewater flows.

(3) Regional Facility - All wastewater would be collected and conveyed to a single treatment facility to be located near the existing Madison-Chatham WWTP. All existing treatment facilities would be abandoned.

(4) Subregional Facilities - Subregional facilities would be used to replace nearby treatment facilities.

(5) Package WWTPs - Package WWTPs would be used to handle flows generated from residential subdivisions or apartment complexes.

(6) On-Site Disposal - Wastewater generated from new or existing development would be handled by septic tanks with leaching fields or the Clivus Multrum system.

(7) GSNWR Alternatives - These are discussed in Section 2.3.1.

The no-action alternative was rejected because the existing WWTP discharges would not meet state and federal compliance standards and because new development in the area would put demands on the respective sewer systems. Also some communities had bans on sewer extensions and new connections which would continue to be enforced, regardless of whether expansion took place.

Upgrading and expanding the existing WWTPs is an acceptable alternative. It would enable the WWTPs to meet State and Federal discharge requirements and would allow the municipalities to effectively handle the wastewater generated from future growth.

The regional facility alternative was rejected because it would not be feasible or cost-effective to dismantle all the existing facilities and build a new one. Also, the environmental impacts of installing the conveyance system to transport the wastewater to the regional facility could be severe.

Subregional facilities would be an acceptable alternative, provided that the WWTPs that would be abandoned in favor of one centrally located WWTP are in close proximity and have similar discharge requirements. Although the construction of conveyance lines to the subregional facility may cause some negative environmental impacts as described above with the regional facility, the impacts are expected to be less severe because the replaced WWTPs would all be in close proximity to the subregional facility.

The package WWTPs alternative was rejected based on several considerations. First, the treatment facilities in the UPRB are required to achieve high levels of treatment, including nutrient removal, which are often difficult to maintain with package WWTPs. Also, it would be difficult for the municipalities to operate and maintain many small WWTPs or oversee the operation if the WWTPs were owned and operated by private entities. Package WWTPs would not be cost-effective when compared to the efficiencies and economies of a large municipal facility, especially given the fact that most communities within the basin already have collection systems in place. Finally, the use of package WWTPs may encourage random development.

The acceptability of the final alternative, on-site disposal, varies with the soil characteristics in the area. The majority of the soils on the developable lands within the UPRB are considered to have severe limitations for conventional leaching fields. For these areas, this alternative should be considered infeasible. In areas with low density, scattered development, and adequate soil conditions, on-lot systems would be preferred on the basis of cost and implementability.

Based on the results of the review of conceptual alternatives, the draft EIS presented specific options for wastewater treatment in the UPRB.

Plan K1 - Each of the existing WWTPs would be upgraded to a minimum of Level 4 except New Providence, which would provide Level 3 treatment.

Plan K2 - Same as Plan K1 except the Passaic Township and Warren Township Stages I-II, IV and V would be abandoned for a central WWTP located at the site of the Passaic Township WWTP.

Plan K3 - Same as K2 except the outfall location for the Bernards Township WWTP would be relocated.

A preferred alternative was selected for each WWTP based on cost, environmental, and implementation considerations. The preferred alternatives chosen in the 1981 draft EIS are presented in Section 2.3.2.

2.3.1 GSNWR Alternatives

Only three of the WWTPs included in the 201 Facilities Plan impact the GSNWR. They are the Chatham, Morris-Woodland, and New Jersey Department of Transportation (NJDOT)-Harding Rest Stop WWTPs. However, the NJDOT WWTP only discharges to surface waters during the winter months. The following alternatives, developed for dealing with the Chatham and Morris-Woodland WWTP's effluent, were presented in Chapter 2 of the draft EIS page 2-21.

- **Channelization of stream beds in those portions of Loantaka and Black Brooks within the GSNWR to allow flow to pass freely through the refuge carrying entrained nutrients.**
- **Development of an extensive sewer network to convey the WWTP effluents around the GSNWR for discharge directly to the Upper Passaic.**
- **Diversion of part or all of the Morris-Woodland and Chatham WWTPs effluent outside the GSNWR basin to the Passaic River as proposed in the 201 Facilities Plan.**
- **Seasonal treatment of nutrients at the Morris-Woodland and Chatham WWTPs.**
- **Year-round treatment of nutrients at the Morris-Woodland and Chatham WWTPs.**
- **Design of the Morris-Woodland and Chatham WWTPs so that nitrogen and/or phosphorous removal may be added later, if a subsequent study concludes that reduction of nutrients from the WWTPs is necessary to alleviate eutrophication.**

The first alternative, channelization of Loantaka and Black Brook, was deemed infeasible because of the Congressional mandate which established the GSNWR specifically prohibits outside interference or man-made activities in the wilderness area portion of the GSNWR.

The cost of building a sewer network to convey effluent around the GSNWR was determined to be extremely expensive and not cost-effective when compared to the other alternatives being considered. In addition, such construction could cause significant environmental impacts to the region encompassing the GSNWR.

Diversion of the flows for direct discharges either to the Passaic River or Whippany River was found to be incompatible with the GSNWR waterfowl management programs. The United State Fish and Wildlife Service (USFWS) expressed concern regarding diversion of the effluents because waterfowl management programs are dependent on a relatively constant supply of water, particularly during critical nesting periods. Also, a discharge to the Whippany River would result in a transfer of nutrients from one drainage basin to another. Local opposition to a discharge in the Whippany River could be strong.

A seasonal treatment of nutrients would result in the removal of nutrients in the warmer months during the growing season. However, the GSNWR would just act as a sink for nutrients during the winter months and vegetation would use these stored nutrients for growth in the summer. From both an environmental and cost-effective viewpoint, installing complex treatment technologies for seasonal nutrient removal was determined to be undesirable.

Year-round reduction of nitrogen and/or phosphorous was unjustified for the WWTPs at the time the draft EIS was prepared because there was insufficient evidence to warrant removal. Accordingly, the recommended alternative was to design the Chatham and Morris-Woodland WWTPs for enhanced BOD and SS removal with the ability to include nutrient removal processes, if desired, either at the time of construction or at some later date. The selection of this alternative was conditioned upon the undertaking of a study of the nutrient dynamics of the GSNWR.

In 1983, in accordance with the recommendations of the preferred alternative, EPA and NJDEP commissioned the GSWQS. This study encompassed many aspects of the water quality discharges into the GSNWR including the impacts of discharged nutrients from the WWTPs. A detailed analysis and interpretation of the GSWQS can be found in Appendix K.

The GSWQS determined that the WWTP discharges caused nutrient enrichment in the waters of the GSNWR, but this fact alone would not guarantee that increased algae growth would result. However, algal bioassays performed by Dr. F.B. Trama, in conjunction with the water quality study, demonstrated that the nutrient enrichment led to a higher standing crop of algal cells in in vitro tests of water from below the WWTPs.

These water quality study results indicated that an alteration of the preferred alternative is warranted. The recommended alternative in this final EIS now includes nutrient removal for the Morris-Woodland and Chatham WWTPs.

2.3.2 Draft EIS Preferred Alternatives

Table 2-2 describes the preferred alternatives presented in the 1981 draft EIS for each of the WWTPs in the UPRB. Given the changes that have occurred since the issuance of the draft EIS in 1981, namely the elimination of the EPA Construction Grants program, New Jersey's establishment of the SRF, and improvements to WWTPs already completed or under way, some of these preferred alternatives are no longer viable. The following sections describe the current status of the treatment facilities and the current recommended alternatives.

TABLE 2-2

Preferred Alternatives Presented in the 1981 Draft EIS

WWTP	Preferred Alternative
Chatham Township	Upgrading existing facilities with the ability to add nutrient removal facilities in the future
Morris-Woodland	Upgrading existing facilities with the ability to add nutrient removal facilities in the future
New Jersey DOT - Harding Rest Stop	Continue existing operation
Berkeley Heights	Upgrading and expansion of existing facilities to Level 4 treatment with dechlorination
Bernards Township	Upgrading and expansion of existing facilities to Level 4 treatment with dechlorination
Madison-Chatham Joint Meeting	Upgrading to Level 4 treatment with dechlorination. The upgrade would reduce the treatment capacity by 0.8 mgd
New Providence Borough	Upgrading to Level 3 treatment
Passaic Township	Replacement with a subregional WWTP that would treat the Warren Township and Passaic Township flows. The subregional WWTP would provide Level 4 treatment with dechlorination
Warren Township, Stage I & II, Stage IV and Stage V	Elimination of the three WWTPs in favor of a subregional WWTP in Passaic Township
Park Central	Elimination of the package WWTP with conveyance of flows to the Chatham Township WWTP
VA Medical Center	Upgrade existing facilities

Because of the concerns related to the potential impacts of the WWTP discharges to the GSNWR, the Morris-Woodland, Chatham, and New Jersey Department of Transportation Harding Rest Stop WWTPs are covered in greater detail. (See Section 2.4 below.)

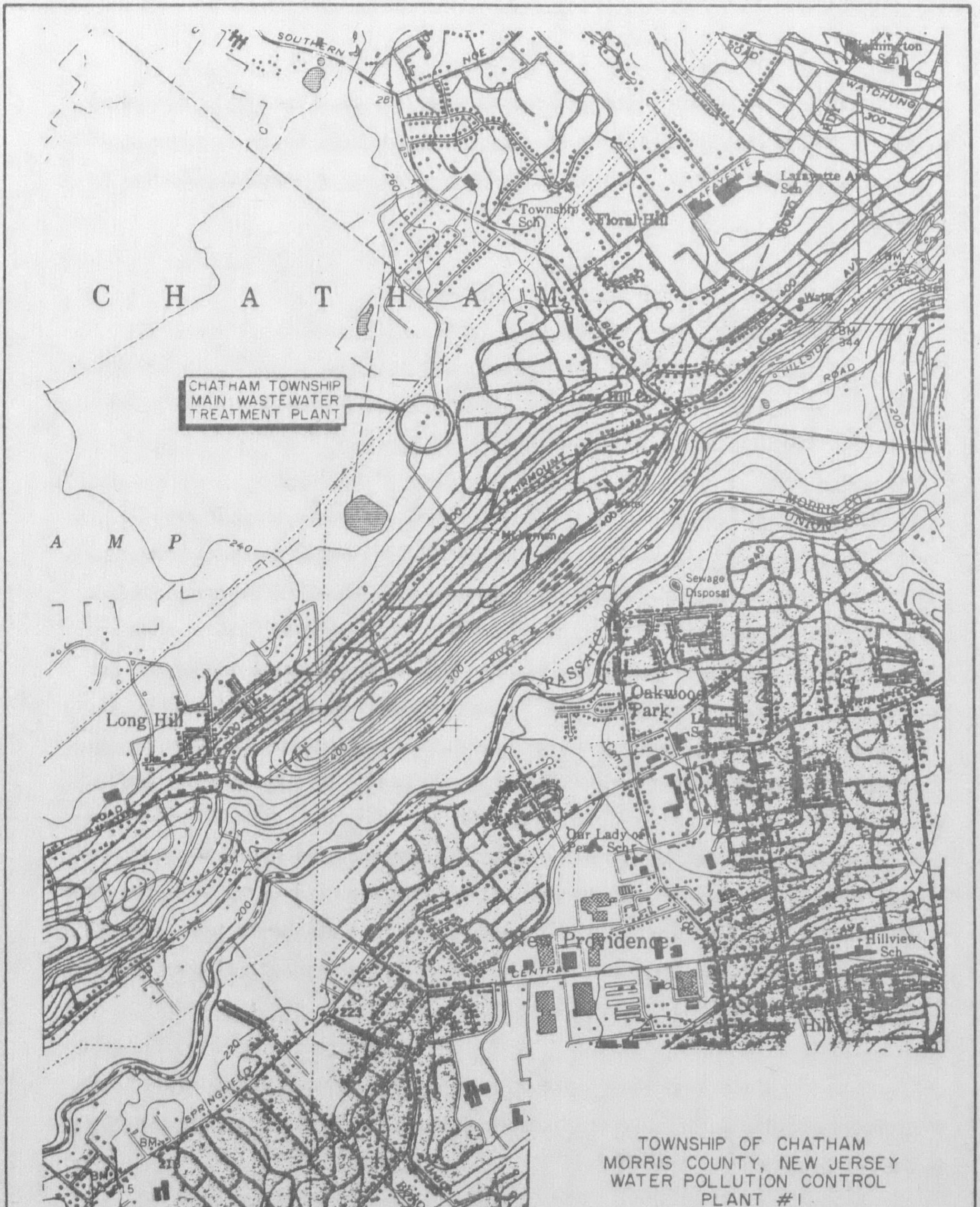
2.4 Status of Wastewater Treatment Facilities

2.4.1 Chatham Township

2.4.1.1 Existing Facilities

The Chatham Township sewer system and WWTP were constructed in 1966 and 1967 to serve all of Chatham Township and the WWTP is located on Tanglewood Road off of Fairmont Avenue (location maps shown in Figure 2-1). This WWTP was designed for an average daily flow of 0.75 million gallons per day (mgd) (existing facilities shown in Figure 2-2). The raw sewage flows into a concrete wet well that houses a comminutor and manually-cleaned bar screen bypass. After passing through comminution or screening, the wastewater is pumped to the primary clarifier. Prior to entering the clarifier, the wastewater passes through a cyclone degritter. Following primary clarification the wastewater flows through a high-rate trickling filter and biological solids produced here are removed in the secondary (or final) clarifier. The effluent from the final clarifier is disinfected in the two chlorine contact tanks and the effluent from these tanks flows to the stabilization basins. The final effluent from these basins is discharged to a Mosquito Commission Drainage Channel that flows to Black Brook, a tributary of the Upper Passaic River via the GSNWR.

Secondary sludge is recycled to the primary clarifier. Waste sludge is drawn from the primary clarifier and taken to the anaerobic digester. Digested sludge is transported to the Two Bridges Sewer Authority (TBSA) for incineration.



TOWNSHIP OF CHATHAM
MORRIS COUNTY, NEW JERSEY
WATER POLLUTION CONTROL
PLANT #1

LOCATION MAP

FIGURE 2–1

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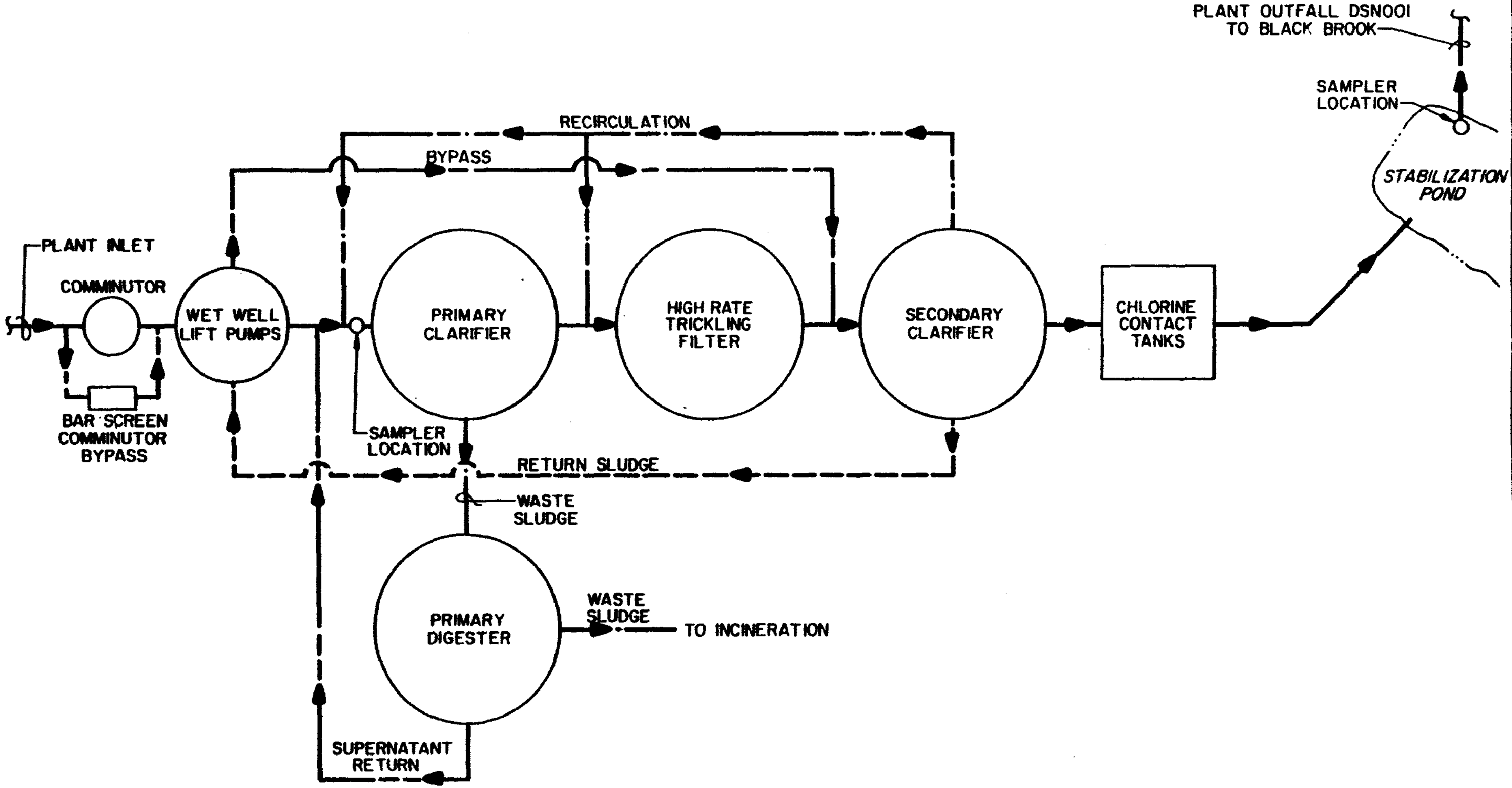

TOWNSHIP OF CHATHAM
MORRIS COUNTY, NEW JERSEY
WATER POLLUTION CONTROL
PLANT #1

EXISTING FACILITIES

FIGURE 2-2

The WWTP was designed to achieve secondary treatment standards (i.e., 30 mg/l of BOD_5 and 30 mg/l SS in the effluent). For the most part, the WWTP achieved these limits, but some NJDEP inspection visits revealed violations of effluent criteria such as BOD_5, SS, BOD_5 percent removal, and SS percent removal.

2.4.1.2 Upgraded Facilities

Because of the potential for the nutrients in the wastewater effluent to cause algal blooms in the GSNWR, NJDEP issued an administrative consent order on July 28, 1988 to upgrade the WWTP to class 4 treatment levels, including nutrient removal. To meet this mandate, Chatham Township decided to convert the treatment process to oxidation ditches, followed by secondary clarifiers, a continuous backwash filter, post aeration basins and ultraviolet disinfection. The waste sludge would flow to a gravity thickener and an anaerobic digester and, following digestion, would be transported to another facility for incineration. Figure 2-3 contains a schematic of the upgraded facility.

This conversion and upgrade would allow the treatment facility to achieve Class 4 treatment levels. In addition, it would also include mechanisms to achieve phosphorous reduction, and the use of ultraviolet disinfection would eliminate chlorine residuals, which were formally produced from chlorine disinfection and discharged into the receiving stream.

Part of the upgrade to Class 4 treatment was expansion of the existing capacity from 0.75 mgd to 1.0 mgd. The treatment units were designed to handle the increased flow. However, the NJPDES and construction permits, issued by NJDEP, do not currently allow this higher flow rate, and there is no guarantee that the higher flow rate will be permitted after the WWTP is constructed. If Chatham Township petitions NJDEP to obtain a permit for the higher flow and NJDEP agrees to consider a permit modification to allow increased flows, NJDEP has the authority to re-examine all of the permit parameters and make requirements for any parameter more stringent or add additional requirements to the permit.

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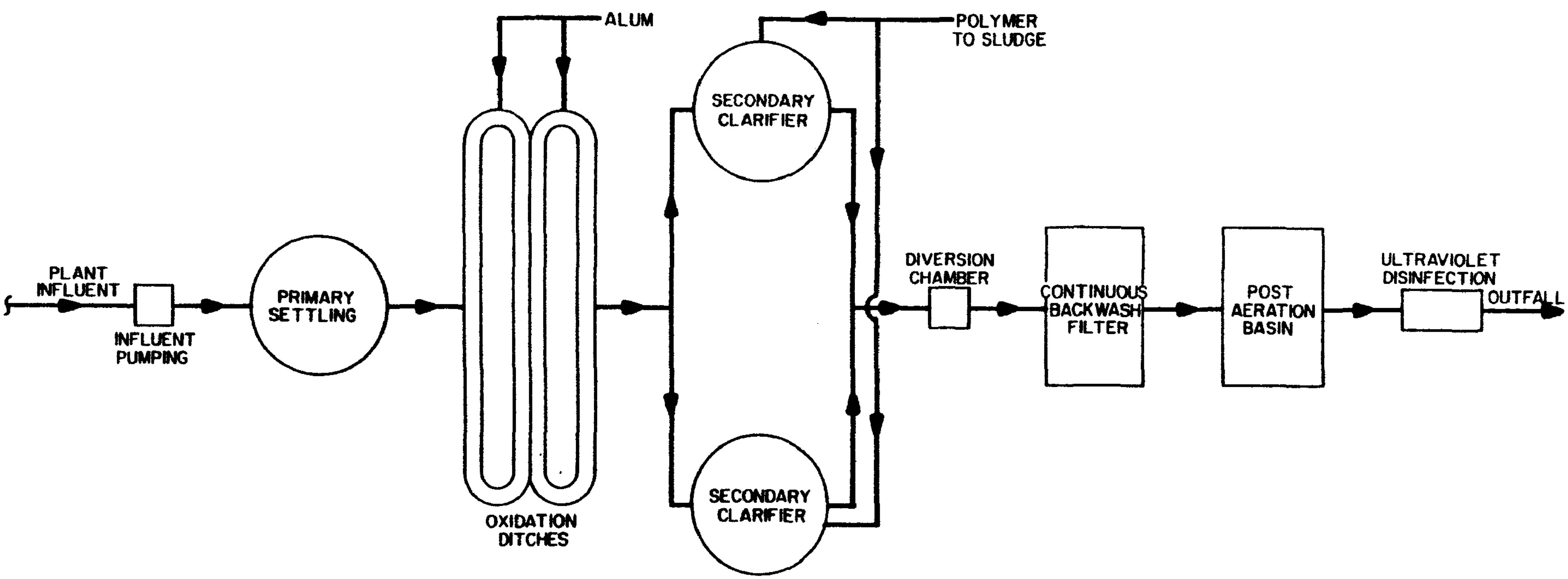

TOWNSHIP OF CHATHAM
MORRIS COUNTY, NEW JERSEY
WATER POLLUTION CONTROL
PLANT # I

PROPOSED FACILITIES

FIGURE 2-3

The question of whether or not Chatham Township will obtain a permit for additional flow involves the potential impacts from increased hydraulic loading to the GSNWR. Also, the related issues of increased development in the area induced by the presence of additional sewer capacity and increased non-point source pollution which could enter the GSNWR need to be considered in permit review.

2.4.1.3 Schedule of Completion

As part of the consent order issued to Chatham Township, a schedule for design, construction and operation was developed. The original schedule is outlined below:

	Deadline
Submit Application for Stage II Treatment Works Approval (TWA)	9/15/89
Advertise for Bids and Award Contract	4/15/90
Begin Construction	5/15/90
End Construction	10/15/91
Comply with final NJPDES Permit Limits	12/15/91

The original design would have required some units to be placed within the wetland areas around the WWTP property. These wetlands were classified as exceptional value and no construction can take place within a wetland of this category. The Chatham Township petition to have the wetlands reclassified was denied. Because the exceptional value classification remained, the WWTP upgrade had to be redesigned to relocate units so that a 75 foot buffer zone could be maintained around the wetlands. Because of the time involved in petitioning for wetland reclassification and the redesign necessitated by the decision not to reclassify, the project could not be completed according to the original schedule. NJDEP then modified the deadlines as follows:

	Deadline
Submit Application for Stage II TWA	7/15/90
Advertise for Bids and Award Contract	2/15/91
Begin Construction	3/15/91
End Construction	8/15/92
Comply with final NJPDES Permit Limits	10/15/92

The upgrade of the Chatham Township WWTP is now under construction and is scheduled to be completed prior to the compliance deadline.

2.4.2 Morris Township

2.4.2.1 Existing Facilities

Morris Township operates two WWTPs. The Morris-Woodland WWTP lies within the Passaic River drainage basin and the Morris-Butterworth WWTP lies within the Whippany River drainage basin. Because this final EIS deals with facilities in the UPRB only, the remainder of this section deals exclusively with the Morris-Woodland WWTP. The Morris-Woodland WWTP is located at the end of Florence Avenue off Woodland Avenue in Morristown (location map shown in Figure 2-4).

The original collection system and WWTP were constructed in 1960 to handle a design flow of 0.5 mgd. Morris Township expanded the WWTP in 1967 to a design average flow of 1.6 mgd, and maximum 30-day average flow of 2.0 mgd (existing facilities shown in Figure 2-5). The raw sewage enters a small pumping station which houses a comminutor, bar screen and three raw sewage pumps. The sewage is then pumped to the operation tanks, where it receives activated sludge treatment. The effluent from these tanks flows to the final clarifier. The overflow from the clarifier flows to a chlorine contact tank positioned around the base of the clarifier. Chlorine is added followed by sulfur dioxide to remove the chlorine residual. Following chlorination/dechlorination, the effluent flows down a cascade aeration system for reaeration prior to direct discharge to Loantaka

TOWNSHIP OF MORRIS
MORRIS COUNTY, NEW JERSEY
WOODLAND WASTEWATER
TREATMENT PLANT

LOCATION MAP

FIGURE 2-4

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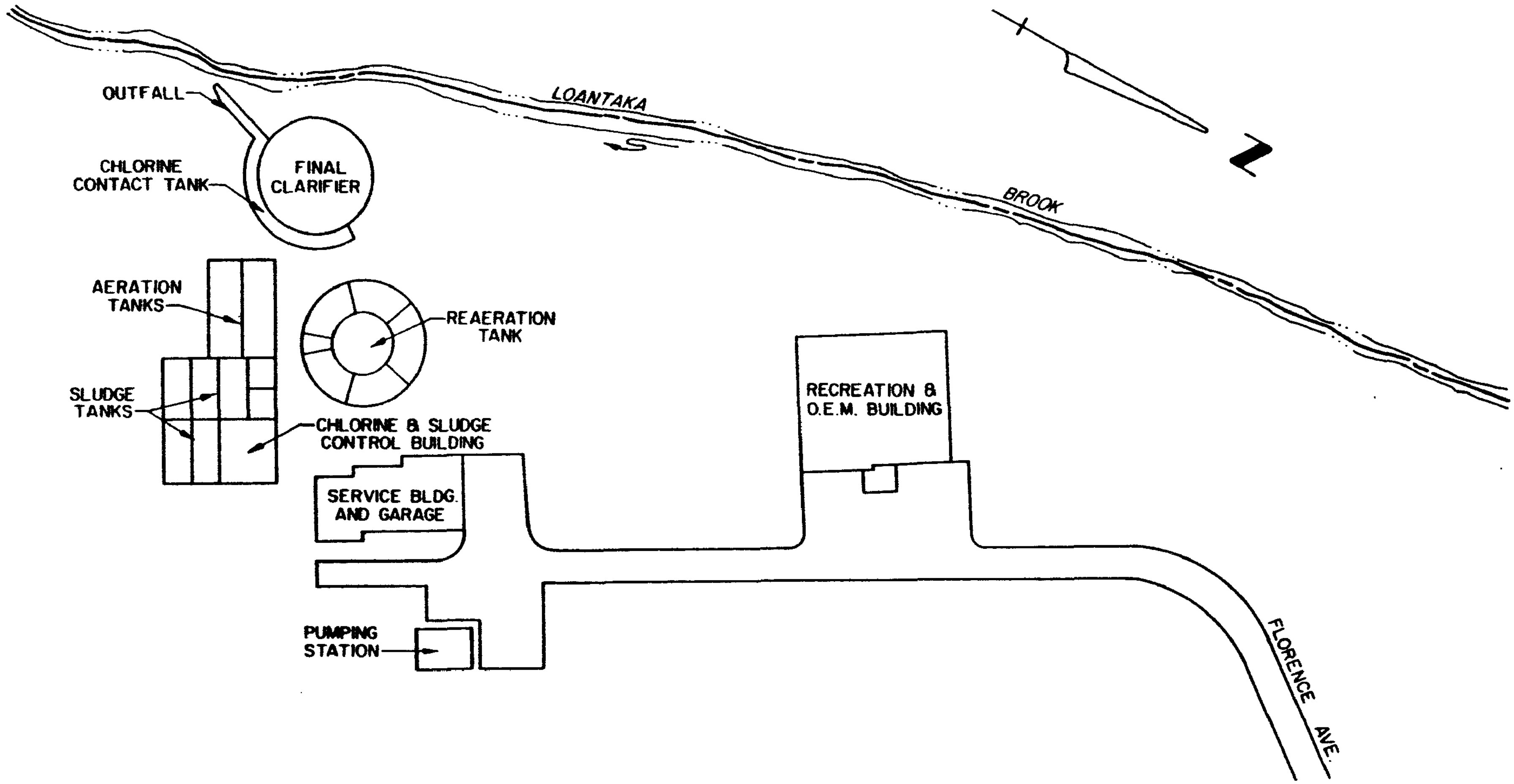

TOWNSHIP OF MORRIS
MORRIS COUNTY, NEW JERSEY
WOODLAND WASTEWATER
TREATMENT PLANT

EXISTING FACILITIES

FIGURE 2-5

Brook. Loantaka Brook then flows through Loantaka Pond prior to entering the Passaic River, via the GSNWR.

Sludge from the secondary clarifier is airlifted to the reaeration tank (formerly the contact stabilization basin). Some of this sludge is returned to the aeration tanks to maintain the solids, while the remainder is wasted to the "Purifax" unit, housed in the sludge handling and chlorination building. This unit doses the sludge with large amounts of chlorine to stabilize and disinfect the sludge. The chlorinated sludge is stored in the series of sludge storage tanks outside the building. The sludge thickens over time in these tanks and is pH adjusted before hauling to the TBSA for incineration. The liquid is decanted off the top of the sludge and recirculated back to the aeration basins.

The WWTP was designed to meet secondary treatment standards and, for the most part, achieves these effluent limits. However, some of the compliance inspections revealed effluent violations of various parameters, such as BOD percent removal and visible foam being discharged into Loantaka Brook. The most serious violations occurred in August of 1988 and July of 1990, when there were major fishkills in Loantaka Pond. In 1988, maintenance was being performed on the aeration basins and approximately 60 percent of the WWTP was out of service during this repair. Because of the bypass of some of the units, partially treated sewage (i.e., effluent with high BOD and suspended solids concentrations) was discharged to Loantaka Brook and subsequently entered Loantaka Pond. The high BOD wastewater removed oxygen from the pond, leaving insufficient oxygen for the fish. Consequently, 500 to 600 sunfish and some carp were killed.

In 1990, a power outage at the WWTP caused problems with the aeration system which, in turn, resulted in inadequately treated sewage entering Loantaka Brook and ultimately, Loantaka Pond. This discharge led to a fish kill of approximately 150 to 200 sunfish.

2.4.2.2 Upgraded Facilities

In 1988, NJDEP issued an administrative consent order to Morris Township to upgrade its Woodland WWTP to Class 4 treatment, including nutrient removal. This requirement was substantiated by the results of the GSWQS, which indicated that nutrients in the wastewater effluent had the potential to cause increased algal growth in the GSNWR. This administrative consent order also included a sewer ban which will be in effect until 1993, when the WWTP must meet final NJPDES effluent limits. The ban prohibits the extension of sewer service into non-sewered areas and the connection of dry sewer lines installed in newly developed and developing areas.

To meet the requirements of the consent order, Morris Township plans to convert the plant operation to a patented activated sludge process, identified as "A20". The existing raw sewage pumping station will be modified and incorporated into the new WWTP. The major treatment units of the WWTP will consist of two new parallel trains of A20 process reactors, followed by final clarification, gravity sand filtration, ultraviolet disinfection and post aeration, all provided by new facilities. A new chemical control building will be added to house process instrumentation and controls, blowers, recycle pumps, and alum and caustic chemical storage and feed equipment. A new outfall will be constructed slightly upstream of the existing outfall on Loantaka Brook. Figure 2-6 shows a schematic of the upgraded facilities.

The sludge generated at the new facility will be thickened only, using two new gravity belt thickeners. Polymer will be added to aid thickening. The new WWTP will include five storage tanks for raw and thickened sludge and the existing final clarifier will be converted and modified to serve as an emergency storage tank. As was the case with the existing WWTP, thickened sludge will be transported to TBSA for incineration.

In compliance with the requirements of the New Jersey Wastewater Treatment Financing Program, an environmental assessment of potential impacts was completed. On

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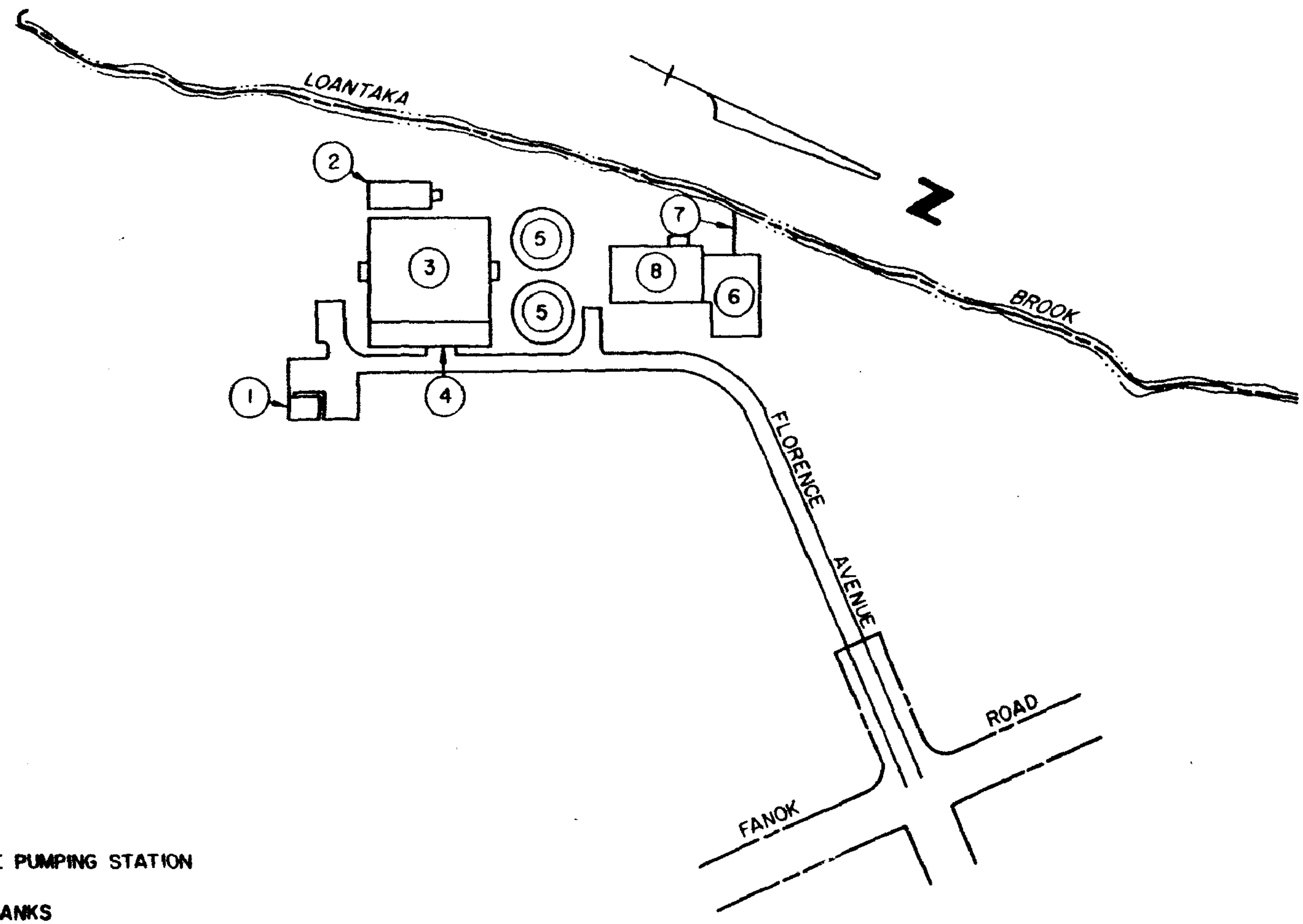
SOURCE: KILLAM ASSOCIATES
CONSULTING ENGINEERS



LEGEND

1. COMMINUTOR & RAW SEWAGE PUMPING STATION
2. A^2O ANAEROBIC & ANOXIC TANKS
3. A^2O OXIC TANKS
4. CONTROL BUILDING
5. FINAL SETTLING TANKS
6. GRAVITY SAND FILTER, UV DISINFECTION AND POST AERATION CASCADE
7. EFFLUENT OUTFALL
8. SLUDGE PROCESS FACILITY

TOWNSHIP OF MORRIS
MORRIS COUNTY, NEW JERSEY
WOODLAND WASTEWATER
TREATMENT PLANT

PROPOSED FACILITIES

FIGURE 2-6

July 2, 1990, NJDEP issued a Finding of No Significant Impact (FNSI) indicating that the proposed project would not cause any significant adverse environmental impacts and, in fact, would help improve the water quality of Loantaka Brook.

The designed facilities are intended to provide a maximum 30-day average flow rate of 2.5 mgd with a design average flow of 2.0 mgd. However, NJDEP issued its final permit to the facility in June 1990 (with expiration in July, 1995), permitting a maximum 30-day average flow of only 2.0 mgd. Morris Township will construct the facilities as designed and may at a later date petition NJDEP to increase the maximum monthly flow to 2.5 mgd. NJDEP may or may not grant this increase. Also, NJDEP reserves the right to modify the permit limits if the permit is reopened to incorporate a higher flow rate.

Increasing the Morris-Woodland WWTP's permitted flow rate involves the issues of direct hydraulic impacts to the GSNWR and secondary impacts, such as reduced infiltration and increased runoff, brought on by development and facilitated by increased sewer capacity.

2.4.2.3 Schedule of Completion

The consent order issued to Morris Township on May 2, 1988 contained the following schedule for design, construction and operation:

	Deadline
Submit Application for Stage II TWA	3/1/89
Advertise for Bids and Award Contract	10/1/89
Begin Construction	12/1/89
End Construction	12/1/90
Comply with final NJPDES Permit Limits	4/1/92

Morris Township felt it could not meet these deadlines and negotiated a revised schedule with NJDEP which was issued on July 1, 1988 in a revised consent order. The updated schedule is presented below:

	Deadline
Submit Application for Stage II TWA	3/1/90
Advertise for Bids and Award Contract	10/1/90
Begin Construction	12/1/90
End Construction	12/1/92
Comply with final NJPDES Permit Limits	3/1/93

The upgraded facilities at the Morris-Woodland WWTP are under construction.

2.4.3 New Jersey Department of Transportation - Harding Rest Stop

2.4.3.1 Existing Facilities

NJDOT constructed a WWTP at the Harding Township rest stop off the northbound lanes of I-287 (2,000 feet south of the Sand Spring Road overpass) in 1976. The WWTP went on-line in the spring of that year. This package WWTP was sized to handle 0.025 mgd of flow and uses the activated sludge process to achieve secondary effluent standards.

The raw sewage passes through a bar screen or comminutor and enters the aeration basin. Chemicals are added to promote phosphorous removal. The wastewater then enters a settling tank after which it flows to one of two rapid sand filters and the chlorine contact tank. The chlorinated wastewater effluent is disposed of in one of two ways. In the winter the effluent is discharged to a tributary of the Great Brook, which then passes through the

GSNWR before joining the Passaic River. In the summer (April 15 - October 15), the wastewater is collected in a holding tank and spray irrigated on the seven spray irrigation fields located next to the WWTP site. The dual discharge system was adopted to prevent discharges of nutrients to surface waters during the critical growing season. Figure 2-7 shows a schematic of the WWTP layout and existing facilities.

The sludge is removed from the settling tank and held in the aerated sludge holding tank. The waste sludge is then hauled to a landfill.

The WWTP has experienced operational problems and vandalism throughout the years. It was designed for a much higher flow than it currently realizes, so some of the equipment, such as chlorine dosing, does not operate properly. There have been persistent problems with cracking in the pipes of the spray fields caused by freezing conditions in the winter. Routinely, the spray fields have not been in operating order by April 15. Many violations of effluent limits have been reported from 1980 to 1989 and equipment has been stolen or vandalized.

2.4.3.2 Upgraded Facilities

Although the NJDOT package WWTP discharges to a stream that flows through a portion of the GSNWR, it is not recommended that this WWTP be upgraded at this time. The flow through the WWTP is very low and the WWTP is only permitted for an ultimate flow of 0.025 mgd. In addition, the WWTP does not discharge to surface waters during the growing season. However, the WWTP experiences some operational problems brought on by vandalism, weather, and the fact that the WWTP was originally designed for a much greater flow than it currently receives. It is recommended that some actions be taken to improve the performance of the WWTP on these bases. For example, downsizing some units or tightening security to discourage vandals may be appropriate.

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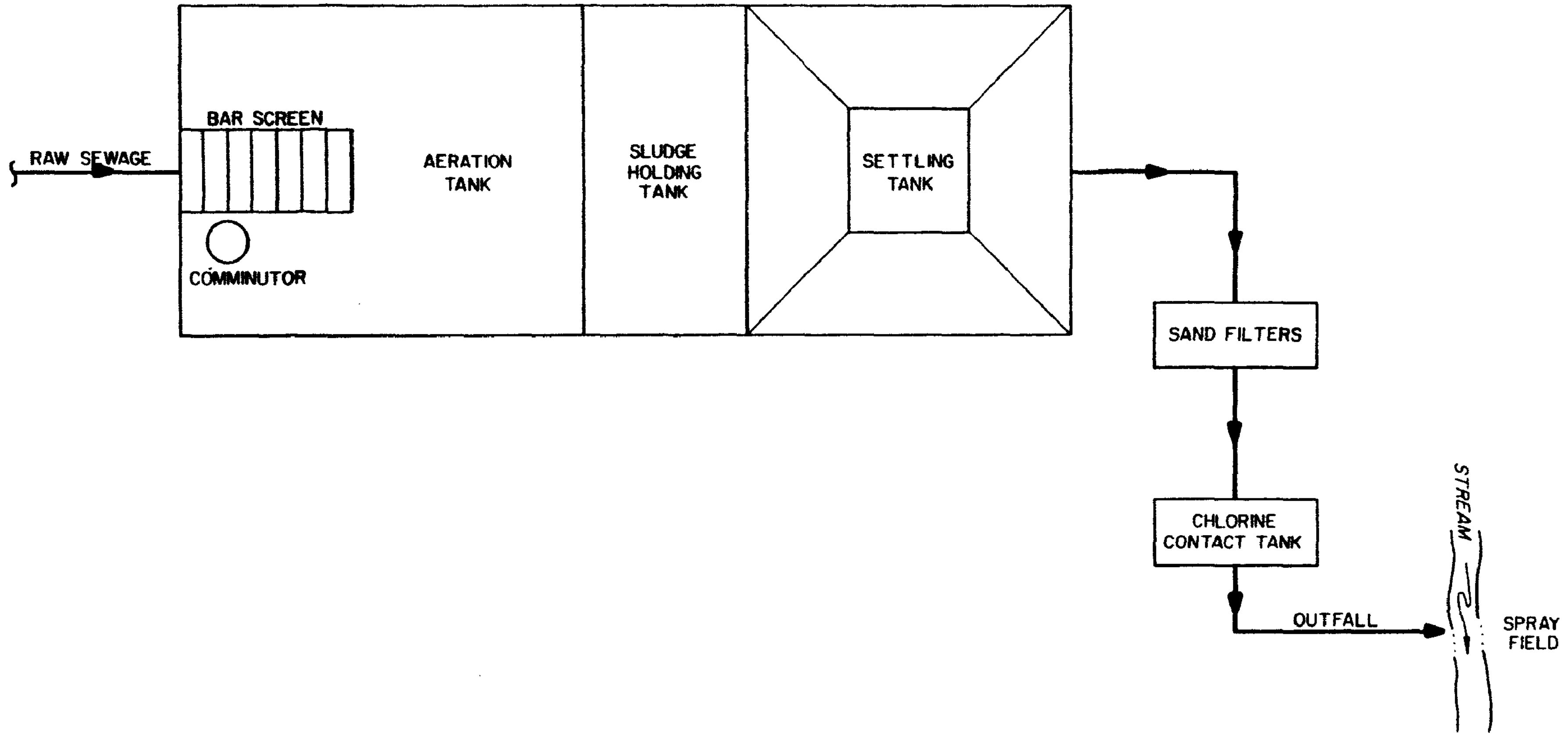

NEW JERSEY D.O.T.
HARDING REST STOP

EXISTING FACILITIES

FIGURE 2–7

2.4.4 Berkeley Heights Township

The collection system and WWTP for the Berkeley Heights Township were constructed in 1956 with a WWTP design capacity of 0.75 mgd. The WWTP was expanded in 1966 to a capacity of 1.5 mgd and upgraded to secondary treatment by adding a trickling filter.

The Township was issued a consent order requiring it to upgrade its sewage treatment facilities and banning additional sewer connections. In answer to this enforcement action, Berkeley Heights upgraded and expanded its treatment facility. The capacity was increased to 3.5 mgd and the WWTP was upgraded to Level 4 treatment. The upgraded WWTP went on-line in June 1990 and has met permit compliance conditions since that time. The Township is now awaiting acceptance of permit compliance from NJDEP. After NJDEP's approval, the sewer ban is expected to be lifted.

Sludge generated at the facility is transported as wet sludge to Parsippany-Troy Hills for incineration. The treated wastewater effluent is discharged to the Passaic River.

2.4.5 Bernards Township

The collection system to serve Bernards Township was constructed in 1959 and expanded through 1969. The treatment facility, the Harrison Brook Sewage WWTP, was constructed between 1963 and 1966 with a design capacity of 0.55 mgd and partially expanded in 1967 to a capacity of 1.2 mgd. During the 1967 expansion, not all units were expanded.

Recently, the WWTP was upgraded and expanded to a capacity of 2.50 mgd at Level 4 treatment. The new WWTP employs oxidation ditches and polishing lagoons to achieve effluent limitations. Sludge is aerobically digested, dried on sand drying beds and land applied. The WWTP uses chlorination for disinfection purposes followed by dechlorination. The effluent is discharged to the Dead River.

The upgraded/expanded WWTP went on-line in June 1984 and has achieved compliance since that date.

2.4.6 Madison-Chatham Joint Meeting

The Boroughs of Madison and Chatham as a joint venture constructed the Madison-Chatham Joint Meeting Water Pollution Control Facility in 1910. The 1910 WWTP used Imhoff tanks but these were replaced in 1929 by an activated sludge secondary WWTP. In 1950, primary treatment and sludge digestion facilities were added. The WWTP was further expanded in 1971 to a design capacity of 4.0 mgd.

The existing Madison-Chatham Joint Meeting WWTP has an average annual design permitted flow of 3.5 mgd with a maximum monthly average flow of 5.0 mgd. The treatment level has been upgraded to Level 4 treatment which is achieved through the process of activated sludge and a stabilization lagoon. Sludge generated at the facility is digested and dried with a belt press or sand drying beds. Dried sludge is hauled off-site and land applied. The wastewater effluent is dechlorinated prior to discharge to the Passaic River.

The construction at the Joint Meeting WWTP is complete and the WWTP is meeting permit compliance.

2.4.7 New Providence Borough

The WWTP that serves the Borough of New Providence was built in 1927 as an infiltration/inflow (I/I) treatment facility. The sewer system in the Borough transported wastewater to the Joint Meeting Regional WWTP at Elizabeth, via the City of Summit sanitary sewer system. During peak flow periods, when the pump station capacity (1.5 mgd) was exceeded, the overflow was diverted to the New Providence WWTP which originally consisted of a primary clarifier, chlorinator and discharge to the Passaic River. The WWTP's capacity was then 0.3 mgd. The WWTP was expanded and upgraded between 1968 and 1970 to secondary treatment by adding two trickling filters. The capacity with the filters in parallel is 6.5 mgd and with the filters in series is 2.8 mgd. Under normal conditions, the majority of flow is transported to the regional facility with only enough flow diverted to the New Providence WWTP to maintain biological growth on the trickling filters.

The WWTP continues to operate as a trickling filter WWTP in the mode stated above. The permitted capacity is 1.5 mgd at Level 3 treatment. The WWTP has difficulty achieving its effluent limitations, particularly for nitrogenous biochemical oxygen demand (NBOD).

The treated effluent is discharged to the Passaic River. Sludge is transported along with up to 1.5 mgd of primary clarifier effluent to the City of Summit sewer system for transfer to the Elizabeth Joint Meeting's interceptor.

No construction is currently scheduled except to convert the chlorination system to ultraviolet (UV) disinfection to comply with the permit limitation for chlorine residual.

2.4.8 Passaic Township

The Passaic Township-Stirling WWTP was constructed in 1930, had a design capacity of 0.4 mgd and operated as a conventional trickling filter WWTP. Sludge digesters were added in the 1950s and the addition of an oxidation lagoon in 1975 increased the design capacity to 0.65 mgd.

The WWTP is currently undergoing an upgrade and expansion. The trickling filter will be eliminated and replaced by oxidation ditches to provide Level 4 treatment and a permitted capacity of 0.9 mgd. The construction has been delayed beyond its original completion date and is now scheduled for completion in early Spring 1992. Sludge disposal will be handled in the same manner, by transportation as wet sludge, to Two Bridges WWTP for incineration. However, the new WWTP will include ultraviolet disinfection to replace the chlorination now practiced. The disinfected effluent is discharged to the Passaic River.

2.4.9 Warren Township

The Warren Township Sewer Authority district is divided into four (4) service areas. Areas I and II are treated by one facility while Areas III, IV and V are treated by separate facilities. All but the Stage III WWTP are included within the UPRB.

2.4.9.1 Warren Township Stage I-II WWTP

The Warren Township Stage I-II WWTP was constructed in 1968 and used the process of contact stabilization, a modification of the activated sludge process, to achieve effluent limitations. The design capacity was 0.3 mgd.

The Stage I-II WWTP received an administrative consent order to upgrade to Level 4 treatment. The WWTP will have an expanded permitted capacity of 0.47 mgd and will use activated sludge with one stage nitrification and sand filters to achieve effluent limits. The new WWTP will include dechlorination facilities. Liquid sludge will continue to be trucked to the Somerset-Raritan WWTP for incineration.

The construction is currently about 90 percent complete and the WWTP is in compliance with the interim effluent limits specified in the consent order. The treatment effluent is discharged to the Passaic River.

2.4.9.2 Warren Township Stage IV WWTP

The Stage IV WWTP was constructed in 1965 with a design capacity of 0.3 mgd and used the contact stabilization process mentioned above for the Stage I-II WWTP. The WWTP's capacity was expanded in 1977 to 0.45 mgd with the addition of an aerated lagoon.

The Stage IV WWTP is being expanded and upgraded to Level 4 treatment to a design capacity of 0.80 mgd. The new WWTP will employ oxidation channels and sand filters to achieve Level 4 limits and use ultraviolet disinfection to comply with chlorine residual limits. Liquid sludge is transported to the Somerset-Raritan WWTP for incineration. Treated effluent is discharged to Pound Brook, a tributary to the Dead River.

The WWTP expansion/upgrade is approximately 50 percent complete and the WWTP is currently in compliance with interim effluent limits specified in the WWTP's administrative consent order.

2.4.9.3 Warren Township Stage V

The Warren Township Stage V WWTP was constructed in the early 1980's and uses oxidation ditches and sand filters to achieve Level 4 treatment limits. Liquid sludge is transported to the Somerset-Raritan WWTP for incineration. The WWTP is in compliance with effluent limits and discharges treated effluent to the Dead River. The WWTP uses chlorination and a dechlorination system is proposed to be added in the near future.

2.4.10 Park Central

The Park Central WWTP was constructed as a package WWTP to serve the Cardinal Hill apartment complex located in Chatham Township. The WWTP employed contact stabilization to treat up to 30,000 gpd and discharged the final effluent to the Passaic River. The draft EIS considered the elimination of the Park Central WWTP with generated flows being conveyed to the Chatham Township WWTP. However, the WWTP has not been abandoned.

The Park Central WWTP was issued a consent order by NJDEP to upgrade its facilities to Level 4 treatment. The upgrade will include the addition of a sludge digester and holding tank, sand filters, an equalization basin, UV disinfection, and new instrumentation. The digested sludge will be disposed of in the same manner as currently practiced -- transportation to Parsippany-Troy Hills for incineration. The terms of the consent order required construction to be completed by May 1, 1991 and full compliance to be achieved by July 1, 1991. The construction of the plant is essentially complete at this time and it is fully operational. Permit compliance was expected to be achieved by the July 1, 1991 deadline.

2.4.11 Veterans Administration Medical Center

The Veterans Administration (VA) Medical Center operates a WWTP in the Lyons section of Bernards Township. This WWTP was built in the 1930s and operated as a rapid sand filter WWTP to achieve secondary treatment.

The draft EIS preferred alternatives would have involved the elimination of this WWTP and would have conveyed the VA wastewater to a subregional facility for treatment. However, prior to the completion of the draft EIS, NJDEP approved an upgrade to the WWTP and alternatives for the VA WWTP were eliminated from further consideration. The VA WWTP accepts waste from the VA Medical Center only.

The current WWTP is an extended aeration WWTP with a permitted capacity of 0.4 mgd, average flow and 1.0 mgd, 24-hour maximum flow. The old rapid sand filter WWTP is idle and awaiting demolition. Liquid sludge is transported off-site for incineration. Treated effluent is disinfected with chlorine and discharged to an unnamed tributary to the Harrison Brook, a tributary to the Dead River. The WWTP cannot meet its chlorine residual limits, so the disinfection process may be converted to UV disinfection.

The VA WWTP has been on-line since August 1986 and has no further construction or expansion plans.

2.5 Project Funding

WWTP construction and modification in the UPRB were funded through federal, state, local and private funding sources. Federal funds were issued through EPA's Construction Grants Program. This program was delegated to the State of New Jersey in phases from 1981 to 1983. In 1987, New Jersey established a revolving loan program, initially capitalized with State-only money derived from bond sales, for the purpose of providing financial assistance for the construction of WWTPs. This program was subsequently capitalized with federal funding in the form of capitalization grants, beginning in 1988. New Jersey has consolidated the SRF and State-only funding sources into one program entitled the Municipal Wastewater Assistance Program. Local funding may come from bond issues, user fees, connection fees or other sources. Table 2-3 lists the WWTPs in the UPRB and any federal and state funding which they received.

TABLE 2-3

Federal and State Project Funding [1]

WWTP	Federal or State Funding Program [2]	Amount	Year
Chatham Township	None		
Morris Township	SRF	$14,703,510	1989
Berkeley Heights	NJL	16,122,000	1987
Bernards Township	CG	13,577,213	1981
Madison-Chatham Joint	SRF	17,997,672	1988
Meeting	None		
New Providence Borough	SRF	8,702,128	1989-1990
Passaic Township	None		
Warren Township			
Stage I-II	SRF	5,640,185	1989-1990
Stage IV	None		
Stage V	None		
Park Central	NA		
VA Medical Center	NA		

[1] Source = NJDEP

[2] CG = Construction Grants, SRF = State Revolving Fund, NJL = New Jersey Loan Program, NA = Not Applicable

2.6 Final EIS Recommended Alternatives

Given the changes that have occurred since the draft EIS was prepared, some of the draft EIS alternatives are no longer valid. The updated recommended alternatives are presented in Table 2-4. These alternatives reflect the actions that have occurred or actions that are currently in progress, with the exceptions of the New Providence Borough and NJDOT facilities. All of the WWTPs, with the exception of the New Providence Borough, VA Medical Center, and NJDOT WWTPs, have been required to upgrade to Level 4 treatment. Many have also undertaken expansions in addition to the upgrades.

TABLE 2-4

Summary of Final EIS Recommended Alternatives

WWTP	Final EIS Recommended Alternative
Chatham Township[2]	Upgrade to Level 4, with nutrient removal
Morris-Woodland[2]	Upgrade to Level 4, with nutrient removal
New Jersey DOT - Harding Rest Stop[3]	Improve operation to consistently meet permit limits
Berkeley Heights[1]	Expand and upgrade to Level 4
Bernards Township[1]	Expand and upgrade to Level 4
Madison-Chatham Joint Meeting[1]	Upgrade to Level 4
New Providence Borough[3]	Upgrade to achieve consistent compliance with current permit limits
Passaic Township[2]	Expand and upgrade to Level 4
Warren Township Stage I-II[2]	Expand and upgrade to Level 4
Warren Township Stage IV[2]	Expand and upgrade to Level 4
Warren Township Stage V[1]	Construct a Level 4 WWTP
Park Central[2]	Upgrade to Level 4
VA Medical Center	Upgrade[1] and provide dechlorination or alternate disinfection process.[3]

[1] Complete (as of November 1990)

[2] In Progress

[3] Not Currently Scheduled

New Providence Borough's WWTP has not been upgraded to Level 4 and has consistent problems meeting its Level 3 permit limits for NBOD and carbonaceous biochemical oxygen demand (CBOD) (NJDEP, 1990). This final EIS recommends that the WWTP be modified so that it can consistently meet its current limits or upgraded to level 4, if appropriate. This recommendation is consistent with NJDEP compliance and enforcement goals.

The draft EIS recommended the construction of several interceptors that would have been needed if the preferred alternatives in the draft EIS recommending sub-regional WWTPs were implemented. These interceptors were not built and, given the current situation, are not needed, nor are they recommended in this final EIS.

Existing Environment in the Planning Area and Environmental Constraints to Development

Page 3-5: WATER RESOURCES - Water Quality - Upper Passaic River

The following paragraphs and table should be added at the bottom of the page, prior to the section on Loantaka Brook:

The NJDEP monitors water quality at three locations within the UPRB, all on the Passaic River: near Millington, near Chatham, and at Two Bridges (NJDEP, 1988). The first two of these monitoring stations are within the UPRB 201 Facilities Plan study area.

Data on water quality are used by NJDEP to compute a Water Quality Index (WQI) that ranges from 0 to 100, with lower values indicating better water quality. For example, an index value of 20 is equivalent to the level of water quality criteria. The indices for each water quality variable are derived from severity curves that plot the water quality variable versus a pollution assessment value. This methodology is a modification of a water quality index suggested by Brown, et al. (1970) and supported by the National Sanitation

Foundation. The NJDEP water quality index profile (1983-1987) for the Passaic River at Millington and Chatham locations is shown below:

TABLE 2-5
Water Quality Index Profile

Average WQI	Millington	Chatham
Temperature	2	3
Oxygen	45	28
pH	3	2
Bacteria	22	36
Nutrients	22	36
Solids	6	12
Ammonia	0	7
Metals	6	7
Overall Average	35	44
Overall Condition	Fair	Fair

Water Quality Index Description

0-10	Excellent
11-25	Good
26-60	Fair
61-80	Poor
81-100	Very Poor

The NJDEP narrative description of water quality within the basin indicates that water quality is fair near Millington and Chatham, but declines to poor water quality at Two Bridges. The criteria showing the least desirable index values are oxygen, bacteria, and nutrients. Near Millington and Chatham, the Passaic River is nutrient-enriched, as evidenced by total phosphorus and total inorganic nitrogen concentrations. Phosphorus averages 0.16 and 0.38 mg/l near Millington and Chatham, respectively. Water quality

conditions decline near Millington in the late spring to early summer season, possibly as a result of non-point source influences. Near Chatham, water quality conditions decline during summer months, likely as a result of point source influences.

Page 3-12: WATER RESOURCES

The following section should be inserted after the second paragraph:

GSNWR Water Quality Study

Comments received by EPA during the public comment/hearing period of EPA's draft EIS for the UPRB 201 Facilities Plan repeatedly raised the issue of potential impacts to water quality in the GSNWR resulting from discharges from WWTPs to streams traversing the GSNWR, as well as water quality impacts that might be generated by additions of nutrients from non-point sources. The GSWQS was developed by EPA and NJDEP in response to these areas of concern, and was designed to provide information regarding possible degradation of surface and/or subsurface water quality, and to assess the possibility of accelerated eutrophication of existing bodies of water within the GSNWR.

A preliminary scope for the GSWQS was developed in 1980 by a task force of academic and governmental water quality and wetland experts. In 1982, the NJDEP refined the scope of the study. Project implementation began in late 1983; intensive field sampling began in March 1984 and continued through September 1985. Some sampling efforts (e.g., monitoring of storm events) continued until April 1987.

The data collection effort for the GSWQS included precipitation monitoring, ground water monitoring, and surface water monitoring. Surface water monitoring included both automatic and grab sampling of base flows and storm flows. Fifteen locations within or proximate to the GSNWR were sampled by grab on a monthly basis for twenty months; grab samples included base flow (no rainfall influence) and storm flow (rainfall-influenced) samples.

Detailed descriptions of the GSWQS program elements, statistical analyses of the GSWQS data base, and discussions of specific findings derived from the GSWQS are presented in Appendix K of this final EIS. Other GSWQS reports present particular aspects or applications of the study data; a full listing of the GSWQS data is presented in the Maguire Group data report (1988), a discussion of algal bioassay results using water from GSNWR sampling locations is presented in the Trama report (1987), and a discussion of hydrological modeling results using GSWQS data is presented in the Najarian report (1988).

The GSWQS generated water quality information with significant diagnostic and prognostic utility. The overall objective of the study was to evaluate present and future impacts of point and non-point source loadings of nutrients to the GSNWR; the data analyses reported in Appendix K and in the three reports cited above have disclosed interesting and useful findings that quantify existing nutrient loadings and predict changes in such loadings in future years.

The principal findings of the GSWQS are summarized as follows:

- Effects of Point Source Discharges On Base Flow Nutrient Concentrations: Under base flow conditions, the discharges of treated wastewater from the Morris-Woodland and Chatham Township WWTP caused statistically significant elevations in nutrient concentrations (orthophosphate, nitrate, total phosphorus, and total soluble inorganic nitrogen) in their receiving waters, Loantaka Brook and Black Brook, respectively. The principal exception to this finding was in Loantaka Brook, where nitrate concentrations in the brook upstream of the Morris-Woodland WWTP discharge were not statistically different from nitrate concentrations in the brook immediately below the WWTP discharge. Algal bioassays reported by Trama (1987) demonstrated that the increased nutrient concentrations associated with the WWTP discharges promoted increased algal growth in laboratory cultures.

- **Effects of Point Source Discharges On Storm Flow Nutrient Concentrations:** Under storm flow conditions, the discharges of treated wastewater from the Morris-Woodland and Chatham Township WWTP continued to cause statistically significant elevations in nutrient concentrations (orthophosphate, total phosphorus, and total soluble inorganic nitrogen) in their receiving waters. As was the case with base flow data, nitrate concentrations downstream of the Morris-Woodland WWTP discharge were *not statistically different* from nitrate concentrations immediately above the discharge.

- **Influence of GSNWR on Water Quality:** The influence of the GSNWR on base flow water quality in Great Brook and Black Brook is significant and beneficial. In general, base flow concentrations of nutrients in the brooks at the end of the GSNWR are equal to or less than concentrations of those nutrients at the control locations upstream of the study area (i.e., upstream of both the GSNWR and the WWTPs). The same findings hold for storm flow grab data.

- **Non-Point Source Influences on Water Quality:** Analyses designed to test the influences of non-point source runoff on water quality in the Loantaka and Black Brooks yield ambiguous results. Storm flow concentrations of total phosphorus, orthophosphate, and total suspended solids are not different between locations in more developed watersheds (sampling stations 100 and 200) and locations in less developed watersheds (sampling stations 170 and 270). Nitrogenous compounds, however, *do show significant elevations* at sampling locations in the more developed watersheds. Moreover, the loading estimates for total nitrogen, total phosphorus, BOD_5, and suspended solids show orders of magnitude increases between Stations 105 and 110 on Loantaka Brook. Such increases cannot be directly attributed to the Morris-Woodland WWTP, but rather appear to be the result of loadings occurring in the reach between Stations 105 and 110. Other sampling locations

apparently influenced by non-point source loadings include Station 100 and 120 (Loantaka Brook), Station 170 (Primrose Brook), and Station 270 (Middle Brook).

- **Future Trends in Water Quality and Quantity: Projected increases in the development of undeveloped lands will, according to hydrological modeling, increase the non-point source (stormwater) loadings of streams tributary to the GSNWR, while reducing base flows available to dilute loadings from the WWTP's discharging to those streams. Offsetting in part these adverse trends in water quality are the proposed upgrades of the Morris-Woodland and Chatham Township WWTP's to Level 4 treatment. Hydraulic loadings of streams tributary to the GSNWR will increase as a greater percentage of the watershed is developed as residential or commercial properties. Watershed planning should integrate stormwater management measures to reduce potential hydraulic and constituent loading to the GSNWR from non-point sources.**

Page 3-17: WATER RESOURCES - Water Quality

The following section should be inserted after the second paragraph.

Point Source Pollution

Upon issuance of the UPRB 201 Facilities Plan in 1977, chlorine and ammonia toxicity were serious problems with respect to surface waters, particularly in the Great Swamp Sub-basin. However, since then, NJDEP has required that ten of the WWTPs within the UPRB be upgraded to Level 4 treatment, including dechlorination.

Page 3-20: WATER RESOURCES - Ground water - Sole Source Aquifer

The following paragraphs should be substituted for the paragraph at the bottom of the page:

On May 8, 1980, EPA designated the Buried Valley Aquifer Systems of southeast Morris and western Essex Counties as a Sole Source Aquifer (Draft EIS Figure 3-6). This designation stipulates that all federally assisted projects constructed in the Rockaway River Basin Area are subject to review to ensure that these projects are designed and constructed without a significant hazard to public health. Two communities within the UPRB, Madison and Chatham Boroughs, are wholly dependent on this aquifer system for their water supply. In addition, the Commonwealth Water Company (CWC) derives more than one half of its water from well fields which tap aquifer systems located outside the study area.

On January 12, 1983, EPA issued a final determination stating that the Unconsolidated Quaternary Aquifer, in the Rockaway River Area, New Jersey, was a Sole Source Aquifer. This determination extended the Sole Source Aquifer designation to another major component of the ground water resources of northern New Jersey.

Page 3-23: WATER RESOURCES - Water Supply - Sole Source Aquifer

The following should be inserted after the first paragraph:

The Buried Valley Aquifer Systems are especially important to the GSNWR because of the GSNWR's high evapotranspiration rate in the summer when both surface and ground water storage are significantly depleted. Reducing the recharge of the aquifer by allowing more impervious cover within the watershed overlying the aquifer threatens both the Buried Valley Aquifer Systems and the GSNWR. New development may reduce the amount of recharge and increase the amount of withdrawal.

Page 3-25: ECOSYSTEMS - Aquatic

Immediately under Aquatic, the following section should be inserted:

Wetlands

In 1978, passage of the Clean Water Act (CWA) gave the U.S. Army Corps of Engineers (ACE) sole regulatory authority over freshwater wetland areas. Nine years later, in 1987, the State of New Jersey passed the Freshwater Wetlands Protection Act (FWPA) (N.J.S.A. 13:9B-1 et. seq.), requiring a permit from the NJDEP for most activities which alter or disturb land or water in or around freshwater wetland areas, and for the discharge of dredged material into State Open Waters. Exemptions from applicability include activities permitted under the Act's "grandfather" clauses.

The requirements of the FWPA are more restrictive than those of the CWA administered by the ACE and overseen by EPA. Therefore, compliance with the FWPA effectively ensures compliance with the CWA, without obviating the need for an ACE permit. However, the ACE and NJDEP have officially agreed that wetland delineations made or confirmed by the NJDEP are acceptable to the ACE. These determinations are used in part to determine the applicability of the "nationwide permit" which allows the placement of fill in wetlands less than one acre in size. The intended result is that if the NJDEP confirms that less than one acre of wetland is to be filled, and the developer abides by the conditions and best management practices (BMPs) included in the nationwide permit, no contact with the ACE is required. Effective July 1, 1988, individuals proposing to engage in a regulated activity in a freshwater wetland or State Open Water must obtain one or more of the following permits from the NJDEP Division of Coastal Resources: a Statewide General Permit, an Individual Freshwater Wetlands Permit, an Open Water Fill Permit, or a Water Quality Certification.

Areas up to 50 feet and 150 feet adjacent to wetlands of intermediate and exceptional

resource value, respectively, are termed "transition" areas. Effective July 1, 1989, individuals proposing to engage in regulated activities in transition areas must obtain a transition area waiver from the NJDEP.

Page 3-25: ECOSYSTEMS - Aquatic

After the section on wetlands and prior to the sentence "Trout are the most sensitive . . .," a sub-heading entitled **Wildlife** should be inserted.

Page 3-29: ECOSYSTEMS - Threatened and Endangered Species

The following paragraph should be inserted after the third paragraph:

More recently, in 1990, the NJDEP Natural Heritage Program published a list of rare species and natural communities. The following table includes the threatened and endangered species of the area within the Great Swamp Sub-basin.

TABLE 2-6
Rare Species and Natural Communities in the Great Swamp Sub-basin

Quadrangle Name	Common Name	Federal Status	State Status
Bernardsville	Blue-spotted salamander	-	Endangered
	Henslow's sparrow	-	Endangered
	Grasshopper sparrow	-	Threatened/Endangered
	Great blue heron	-	Threatened
	Willow-leaved aster	-	Endangered
	Wood turtle	-	Threatened
	Bog turtle	Rare	Endangered
	Bobolink	-	Threatened
	Longtail salamander	-	Threatened
	Red-headed woodpecker	-	Threatened
	Downy phlox	-	Endangered
	Barred owl	-	Threatened
Chatham	Blue-spotted salamander	-	Endangered
	Great blue heron	-	Threatened
	Variable sedge	May be listed in future	Endangered
	Sedge wren	-	Endangered
	Wood turtle	-	Threatened
	Bog turtle	Rare	Endangered
	Longtail salamander	-	Threatened
	Featherfoil	-	Endangered
	Red-headed woodpecker	-	Threatened
	Virginia bunchflower	-	Endangered
	Long-awned smoke grass	-	Endangered
	Downy phlox	-	Endangered
	Southern arrow head	-	Endangered
	Lace-lip ladies' tresses	-	Endangered
	Puff-sheathed dropseed	-	Endangered
	Barred owl	-	Threatened
	Narrow-leaved tinker's-weed	-	Endangered
	Canada violet	-	Endangered
Morristown	Cooper's hawk	-	Endangered
	Blue-spotted salamander	-	Endangered
	Grasshopper sparrow	-	Threatened/Declining
	Bog rosemary	-	Endangered
	Redbud	-	Endangered
	Sedge wren	-	Endangered
	Wood turtle	-	Threatened
	Bog turtle	Rare	Endangered
	Longtail salamander	-	Threatened
	Virginia bunchflower	-	Endangered
	Three birds orchid	-	Endangered
		-	
Mendham	American bittern	-	Threatened
	Wood turtle	-	Threatened
	Bog turtle	Rare	Endangered
	Swamp pink	Threatened	Endangered

Source: NJDEP, Natural Heritage Program, 1990.

Page 3-43: LAND USE - Residential

The following paragraphs should be inserted in place of the first two paragraphs of this section:

Of the total 16,860 net hectares (ha) (41,660 net acres) zoned for residential purposes in the UPRB, approximately half have been developed (Draft EIS Table 3-15). (A net hectare is a gross hectare less the area required for streets.) Similarly, of the total 11,150 acres zoned residential in the Great Swamp Sub-basin, about 5,615 acres or 50 percent have been developed. Basinwide, approximately 90 percent of the 29,095 existing housing units (hu) in 1975 were one- and two-family homes and the majority of the remaining units constituted two- and three-story garden apartments and townhouses. The largest residential concentrations are in the UPRB's eastern sector.

Over two decades, the character of housing in terms of density and type of construction has not changed considerably. Between 1968 and 1978, approximately 97 percent of all housing units constructed in the UPRB have been single-family homes (NJDLI, 1976-1977); nearly all new housing units constructed since 1977 in the Great Swamp Sub-basin have also been single-family homes. Because of the requirements for relatively large minimum size building lots under zoning in the UPRB area, development densities have historically equalled densities permitted under each municipality's zoning regulations. The highest average densities, roughly 6.2 to 11.4 hu/ha (2.5 to 4.6 hu/a), are found in the eastern portion of the UPRB (Table 3-16). Average densities in the remaining sections of the area are significantly less.

Page 3-43: LAND USE - Commercial

The following sentence should be inserted after the first sentence of the first paragraph:

Within the Great Swamp Sub-basin, approximately 47 percent of the total 473 acres of commercially zoned land was developed by 1980.

Page 3-44: LAND USE - Industrial

The following should be inserted as the second paragraph under this section:

As of 1980, industrial development in the Great Swamp Sub-basin, consisting predominantly of industrial office and research laboratory facilities, occupied approximately 49 acres. This figure constituted about 100 percent of the area's industrially zoned land.

Page 3-44: LAND USE - Transportation and Utilities

The following should be substituted for the paragraph in this section:

The entire street network, including interstate highways 78 and 287 accounts for about seven percent or 1,990 ha (4,940 a) of the UPRB's total land; about 43 percent of this acreage or 856 ha (2,114 a) is in the Great Swamp Sub-basin. Land within railroad and utility corridors amounts to an additional 230 ha (560 a).

Page 3-47: LAND USE

The following sections should be inserted at the bottom of the page:

The Preliminary State Development and Redevelopment Plan

The State Planning Act (N.J.S.A. 52:18A-16 et al.) became law January 2, 1986. This Act stipulated the preparation of the State Development and Redevelopment Plan (the Plan) by the New Jersey State Planning Commission (SPC). A preliminary three-volume description of the guidelines, strategies and goals of the Plan was issued in 1988. The process outlined in the Plan has not been completed and remains in the preliminary stage.

The purpose of the Plan is to develop an organized assessment of the numerous growth changes affecting the state. As New Jersey becomes more populated, social, economic, and environmental changes have created the need for goals and strategies to be implemented within the next five to ten years.

The Preliminary Plan is developed on a "tier system" that is based on levels of government needed to maintain public service efficiency and environmental quality goals. The preliminary New Jersey growth management system has seven tiers. The tiers were developed based on sewerage availability, and proximity to high quality watersheds and potable watersheds. Four of the tiers include urban and suburban areas that have basic public services, or plans for them. Three of the tiers include suburban and rural areas without these services, and without plans for providing them within the planning period.

At the present time, the Plan is in the final stages of the cross-acceptance program. This cross-acceptance process is a statewide involvement in the Plan whereby municipalities share with their respective counties their recommendations and objections to the Preliminary Plan. Errors in mapping of tier boundaries are identified according to delineation criteria set forth in the Plan. Each county is to submit a written report to the state identifying preferred tier boundaries and designations and how such areas conform with Plan strategies and policies. It is this cross-acceptance stage which Union, Somerset and Morris Counties are presently completing.

In addition to the current cross-acceptance negotiations, the SPC has expressed the possibility of changing the Tier designations to Policy Areas, and avoiding Tier lines which may be arbitrary or subjective. An interim Cross-Acceptance State Planning Report addressing these issues will be published by the SPC in 1991.

USFWS Master Plan for GSNWR

The USFWS administers the GSNWR, a wetland tract that dominates the central portion of the UPRB. In 1987, the USFWS issued a final EIS on the Master Plan for the GSNWR, discussing alternatives and recommended management plans for the refuge.

The USFWS final EIS addresses a comprehensive land use plan, setting forth long-term (10 to 20 year) objectives for resource management and public use of the refuge. Four alternatives were evaluated: (1) a no-action alternative continuing the current management practices and levels of public use; (2) the recommended alternative emphasizing wetland and upland habitat improvement; (3) a public use alternative expanding options for public access and wildlife education; and (4) a wildlife management alternative restricting access to the refuge and intensifying wildlife management activities, particularly for woodcock and waterfowl.

The recommended alternative emphasizes the preservation and protection of important freshwater wetland and upland habitats for resident and migratory wildlife species. Refuge management would emphasize habitat improvement and protection, environmental education and interpretation, and a range of wildlife-oriented recreational activities. Among the specific management plans identified under the recommended alternative were studies to further the understanding of the hydrology of the GSNWR and to design a water management program that would maximize wetland habitat diversity while minimizing flooding of non-refuge lands.

Three large pools are maintained within the GSNWR by water control structures. The recommended alternative would add to this the installation of ditch plugs in the Black Brook Acquisition Area, thus permitting the restoration of natural wetland habitat in depressions that had been previously drained. Restored water levels would not exceed those of historical natural water levels and would not cause flooding of non-refuge lands. Water quality monitoring would be continued to expand understanding of the determinants of water quality changes in the GSNWR watershed.

Local Stormwater Management, Critical Features, and EIS Ordinances and Requirements

In the 1980s, many New Jersey municipalities developed and implemented ordinances that restrict development in critical areas. Property developers are required to identify wetlands, floodplains, steep slopes, hydric soils and other constraining features on site plans; in some cases, the density of development is determined on prorated net acreage remaining after subtraction of critical area acreages. Stormwater management requirements are often strictly regulated at the municipal level; the New Jersey Department of Environmental Protection has promoted the development of sound municipal stormwater management ordinances by establishing a grant program to sponsor the development of such ordinances, and by providing a generic ordinance to guide municipalities in the development of such guidelines. Finally, many New Jersey municipalities have adopted ordinances regulating the preparation and contents of EISs that must accompany applications for site development. The following table presents a matrix indicating the types of local ordinances or requirements currently observed by municipalities in the UPRB 201 Facilities Plan study area.

Page 3-50: POPULATION - Population Ceilings - (1) Average Household Size

The following paragraph should be added to the end of the first paragraph at the top of the page:

Since the late 1970s, average household sizes continued to decline in the region. The documented decline is greater than projected in draft EIS Table 3-18. For example, the mean household size in 1980 and 1987 for Bernards Township was 3.14 and 2.97, respectively, whereas the draft EIS-projected figures for 1975 and 1990 were 3.50 and 3.43, respectively. Similarly, the median household size in 1980 for Berkeley Heights was 3.20, representing a decline of 0.13 more than the 1990 projection in the draft EIS.

Page 3-53: ECONOMICS - Employment and Income

The following sentence should be added to the end of the third paragraph:

By 1980, median household incomes for Chatham, Harding and Morris Townships had risen to $40,594, $39,121, and $40,000, respectively--an average 100 percent increase since 1970.

Page 3-54: ECONOMICS - Public Services

The following should be substituted for the third paragraph:

Several municipalities have experienced declining school enrollment and have reduced facilities. Consequently, increases in enrollment could be absorbed with little or no additional expenditures.

The only municipalities planning for school expansion are Chatham Township, as well as Bernards and Passaic townships. In 1987, the schools of Chatham Township regionalized and merged with the schools of Chatham Borough. As a result of this merger, the schools of Chatham Township currently (December 1990) are at capacity. The school district is presently building additions to accommodate the students acquired during the merger, even though they sold one school building after the merger. The current census figures are projected to show a decline within the next five years. Therefore, the school district believes the new additions will be more than adequate for the foreseeable future.

TABLE 2-7 Matrix of Municipal Ordinances or Provisions Promoting Sound Environmental Management Practices			
Location	Stormwater	Critical Areas	EIS
Berkeley Heights	Yes	Yes	Yes
Bernards Township	Yes	Yes	No
Bernardsville Borough	No	No	No
Chatham Borough	(a)	Yes	No
Chatham Township	Yes	Yes	Yes
Harding Township	Yes	Yes	Yes
Madison Borough	Yes	No	Yes
Mendham Borough	Yes	Yes	Yes
Mendham Township	(b)	Yes	Yes
Morris Township	Yes	Yes	Yes
Morristown	(b)	Yes	Yes
New Providence	Yes	No	No
Passaic Township	No	Yes	No
Summit	Yes	No	Yes
Warren Township	Yes	Yes	Yes

Note: Information in matrix was obtained by telephone calls to municipal officials

(a) Ordinance in adoption process
(b) Morris County Stormwater Management Technical Guide in process of completion

Page 3-55: LAND CAPACITY CONSTRAINTS - Effects on the Supply of Land - Flood Prone Areas

The following paragraphs should be substituted for this section:

Approximately 1,900 ha (4,700 a) of undeveloped residentially zoned land in the UPRB are situated in flood prone areas. Additionally 200 ha (500 a) of industrially zoned undeveloped land also lie in designated floodplains.

Within the Great Swamp Sub-basin, approximately 4,700 acres, or 22 percent, of Harding and Morris Townships are considered flood prone. Nearly 33 percent falls within the 100 year flood boundary while an additional three percent falls within the 500 year flood boundary. The GSNWR comprises most of this flood prone area. The following table shows both the 100 year and the 500 year flood prone areas for these townships. Acreages and percentages were based on the Flood Insurance Rate Maps (FIRM). (FIRM maps were not available for Chatham Township.)

A May 1977 Federal Executive Order (11988) directed the avoidance of floodplain development wherever there is a practicable alternative. Further, because of the serious flood hazard associated with these areas, as well as the additional floodproofing costs related to structural and grading modifications, mortgage lending institutions and builders are more likely to favor investment in and development of sites outside the floodplains. Therefore, the flood prone areas have been excluded from the developable lands of the UPRB (Draft EIS Table 3-20).

Page 3-58: LAND CAPACITY CONSTRAINTS - Effects on the Supply of Land - Wetlands

The following should be substituted for this section:

The ACE and EPA jointly define wetlands as: "Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." Wetlands are excluded from development in this analysis because of their environmental sensitivity. In the UPRB, wetlands are predominantly found within the GSNWR and the along the Black Brook addition to the GSNWR. These areas coincide with flood prone and parkland areas (Draft EIS Figures 3-1, 3-9). Consequently, elimination of potential development acreages within these areas has already been included in the analysis.

TABLE 2-8 Flood Acreages for Great Swamp Sub-basin[1]						
Township	Stream	100 Year Flood		500 Year Flood		Total Percent
		Acres	Percent	Acres	Percent	
Morris[2]	Great Brook	12	<1	26	<1	<1
Morris	Whippany River/ Watnong Brook	12	<1	3	<1	<1
Morris	Whippany River	124	4	7	<1	4
Morris	Loantaka Brook	14	<1	1	<1	<1
Harding	Loantaka Brook	37	<1	0	<1	<1
Harding	Great Swamp	3,852	30	6	<1	30
Harding	Primrose Brook	2	<1	20	<1	<1
Harding	Silver Brook	78	<1	24	<1	<1
Harding	Primrose Brook/ Passaic River	237	2	89	<1	3
Harding	Silver Brook/ Great Brook	202	2	29	<1	2
TOTAL ACRES AND PERCENT OF FLOODPLAINS		5332	33	412	3	40

Total Acreage of Morris and Harding Townships - 15,960

Percent of Morris and Harding Townships that is floodplain - 36%

Source: Flood Insurance Rate Map, Morris Township, 1981.
Flood Insurance Rate Map, Harding Township, 1982.

[1] Flood Insurance Rate Map for Chatham Township unavailable.

[2] Only includes Morris County served by Morris-Woodland WWTP.

Wetlands within the Great Swamp Sub-basin have been divided into five separate categories. These categories are forested, emergent, scrub shrub, open water, and riparian (stream banks). Wetlands in these five categories comprise approximately 7,300 acres or 33 percent of the Great Swamp Sub-basin as indicated in the table below.

TABLE 2-9
Wetland Acres in Great Swamp Sub-basin

Quadrangle	Forested	Emergent	Scrub Shrub	Open Water	Riparian
Mendham and Morristown	745	26	49	67	4
Bernardsville	958	208	60	33	0
Chatham	4,119	365	622	64	2
Total	5,822	599	731	164	6
Percent of Great Swamp Sub-basin	26	3	3	<1	<1

Sources: U.S. Fish and Wildlife Service NWI Map, Morristown, 1976.

U.S. Fish and Wildlife Service NWI Map, Mendham, 1976.

U.S. Fish and Wildlife Service NWI Map, Bernardsville, 1976.

U.S. Fish and Wildlife Service NWI Map, Chatham, 1976.

Page 3-58: LAND CAPACITY CONSTRAINTS - Effects on the Supply of Land

The following section should be inserted immediately after the section on Wetlands:

Hydric Soils

Hydric soils in New Jersey are divided into three groups, each group with slightly different criteria. The following table lists the three groups and their definitions:

TABLE 2-10 Hydric Soils	
Group	**Definition**
1	Soils that nearly always display consistent hydric conditions.
2	Soils displaying consistent hydric conditions in most places, but additional verification is needed.
3	Soils displaying hydric conditions in few places and additional verification is needed.

Source: NJDEP, New Jersey Hydric Soils, 1987.

Hydric soils within the UPRB are primarily located within the GSNWR or along stream banks. Hydric soils as a separate entity usually are not a constraining factor, however, if hydric soils are found in conjunction with hydrophytic vegetation or wetlands hydrology, then the area may be determined to be a wetland. Field verification is needed to accurately determine whether hydric soils are found in the wetland. The presence of hydric soils by itself on a site does not necessarily identify and delineate an area as a wetland or preclude development. Therefore, hydric soils are not considered a constraining factor in this report.

Page 3-61: LAND USE PLAN CONSTRAINTS - Effects on Supply of Land

The following should be added onto the first sentence of the third paragraph in this section:

. . .for public use, **such as the federally-owned 4,600 acre GSNWR.**

Page 3-66: LAND USE PLAN CONSTRAINTS - Current Litigation

The following should be inserted in place of the second paragraph of this section:

Since the court ruling, the New Jersey Fair Share Housing Act of 1985 (N.J.S.A. 52:27D-301) was adopted. It requires each municipality to submit a housing plan to the state which provides for the municipality's fair share of regional low and moderate income housing needs.

Status of the litigation, with respect to the UPRB municipalities, is as follows:

- **The Chatham Township suit was settled in 1983, but the township was sued again by a developer in 1985 for exclusionary zoning. Settlement was achieved in 1986 through submission of a housing plan to the state and adoption of inclusionary zoning.**

- **The Harding Township and Madison Borough suits were dropped in 1983, since they were not considered priority areas for expansion of low and moderate income housing. Since then, both municipalities submitted housing plans to the state.**

- **The Morris Township suit was settled in 1984 through adoption of inclusionary zoning and development of 535 low and moderate income housing units.**

- **The Passaic Township suit was dropped since a housing plan was submitted to the state; the plan was approved in 1988 and subsequently implemented.**

It is recognized that each community is responsible for guiding its growth and development by means of a local zoning ordinance and master plan. As part of this process, consideration should be given to possible additional water and sewer demands created by low and moderate income housing developments. The EPA policy to protect environmentally critical areas is intended to encourage a restriction on development in those areas. It is not, however, a policy judgment or, or support for, the present zoning in non-critical areas.

Page 3-71: WATER SUPPLY CONSTRAINTS - Safe Yield/Ground Water Recharge

The following phrase should be inserted in the last sentence of this section:

By controlling the development of large expanses of impervious surfaces, the recharge capabilities of the residual soils overlying the Brunswick Formation will be preserved, and it is expected that the aquifers, **including the Buried Valley Aquifer Systems,** will be sufficient to meet self-supply water needs (Draft EIS Table 3-26).

Page 3-75: IMPLICATIONS FOR FUTURE POPULATION GROWTH - 5. Soils

The second sentence should be revised as follows:

The UPRB soils are predominantly unsuitable or only marginally suitable for septic systems, with the exception of **Harding Township,** Berkeley Heights and New Providence, due to high water tables, proximity to bedrock, and low soil permeability.

Page 3-80: PHASING FUTURE POPULATION GROWTH - Population Projections

The following paragraphs should be added after the last sentence:

Since 1981, additional population data have been generated for the municipalities in the UPRB and are included for comparison to examine the accuracy of the EIS Year 2000 Constrained Population (Draft EIS Table 3-29).

The region continued to experience a very slight increase in population, with the greatest increase in Bernards Township. However, between 1980 and 1988, the populations of Morris Township, Morristown, and Madison have stabilized, and both Bernardsville and Chatham Borough have experienced a decline in population.

In 1986, the Passaic River Coalition report on the Buried Valley Aquifer Systems provided population estimates for these municipalities for the year 2000. The most recent demographic data are 1988 provisional population estimates provided by the New Jersey Department of Labor and Industry. The 1980 Census population counts, the 1988 provisional estimates, the EIS Year 2000 population projections (where available), and the Passaic River Coalition Year 2000 population projections are shown in the following table. At least to the year 1988, no municipality has shown a trend in population change that would invalidate the population projections presented and used in the UPRB 201 Facilities Plan and presented in Table 3-29 of the draft EIS.

TABLE 2-11
Matrix of Population Counts, Estimates, and Projections for UPRB Municipalities

Location	1980 Census (a)	1988 Estimate (b)	2000 Projected (c)	2000 Projected (d)
Berkeley Heights Township	12,549	12,644	13,216	13,100
Bernards Township	12,920	18,830	17,820	21,000
Bernardsville Borough	6,715	6,466	NA	7,900
Chatham Borough	8,537	8,101	9,150	9,880
Chatham Township	8,883	9,323	10,920	11,960
Harding Township	3,236	3,633	NA	4,680
Madison Borough	15,357	15,353	15,890	16,054
Mendham Borough	4,899	5,163	NA	7,332
Mendham Township	4,488	4,566	NA	7,280
Morris Township *	18,486	19,629	21,138	24,552
Morristown	16,614	16,517	NA	17,160
New Providence Borough	12,426	12,065	12,960	12,100
Passaic Township	7,275	7,706	9,840	9,360
Summit	21,071	20,643	NA	23,800
Warren Township	9,805	10,552	9,579	14,800
TOTAL	163,261	171,191	NA	184,920

(a) 1980 census information (New Jersey Department of Labor, 1989)

(b) 1988 provisional estimates (New Jersey Department of Labor, 1989)

(c) Projected Year 2000 populations used for wastewater flow analysis (includes persons in group quarters) (EPA, 1981)

(d) Projected Year 2000 populations in Buried Valley Aquifer Systems (Passaic River Coalition, 1986)

NA Projection not included

* Morris Township EPA estimate extrapolated from 40 to 100% of municipality

Environmental Impacts of Feasible Alternatives

Page 4-5: SHORT TERM IMPACTS - Surface Water Quality

The following should be substituted for the third paragraph of this section:

Erosion may be minimized or avoided by strict adherence to a soil erosion and sedimentation control plan which is typically enforced by the municipality and the County Soil Conservation District (SCD). Control measures may include installing water diversion structures, diversion ditches, hay bales and sedimentation basins, netting, mulching, seeding or sodding to provide temporary protection, particularly on soil stockpiles, preserving existing vegetation, and promptly restoring disturbed areas.

Page 4-6: SHORT TERM IMPACTS - Surface Water Quality

The following should be added after the last paragraph of this section:

During construction, all of the existing treatment facilities will remain operational. No inadequately treated wastewater will be discharged to the surface waters of the basin.

Page 4-6: SHORT TERM IMPACTS - Short Term Impacts

The following should be inserted prior to the section on Terrestrial and Aquatic Ecosystems:

Ground Water Quality and Supply

Construction of the facilities to upgrade water treatment may require dewatering of excavated areas. This will cause a localized and temporary depression of ground water, potentially affecting the stability of structures adjacent to the construction area. If dewatering is deemed necessary, the stability of adjacent structures will be determined and monitored. Control structures (e.g., settling basins) will be used to remove sediment from pumped ground water prior to the water being discharged. This will minimize adverse

impacts resulting from siltation of nearby surface waters and/or wetlands. Ground water levels will return to normal following completion of construction activities.

Page 4-8: SHORT TERM IMPACTS - Terrestrial and Aquatic Ecosystems

The following should be inserted prior to the last paragraph of this section:

The proposed construction at the Morris-Woodland WWTP will be located principally on upland areas within the existing WWTP site. Approximately 0.25 acres of wetland will be filled to provide space sufficient to accommodate the proposed construction. Due to the limited amount of available space, it is not possible to construct the proposed facilities without encroaching on a portion of the wetland areas on the site. The wetlands peripheral to the 0.25 acres to be filled will be protected from construction-related impacts by soil erosion and sedimentation control measures. The NJDEP Division of Coastal Resources has determined that a permit for this activity is not required.

The Morris-Woodland WWTP site and surrounding area has been identified as potential habitat for the wood turtle (Clemmys insculpta), a species listed as threatened in New Jersey. To prevent individual turtles from being damaged by construction activities, a silt fence will be used to enclose the entire construction area. Further, the entire construction zone will be surveyed weekly between March 15 and November 15 for the presence of turtles. NJDEP will be notified of any turtle(s) found in the construction area and direct the appropriate actions to relocate them.

The wetlands surrounding the Chatham Township WWTP site may provide habitat for the blue-spotted salamander (Ambystoma laterale). The salamander will not be impacted because no structures will be placed in the wetlands. There will also be a 75 foot buffer zone around the wetland, and construction areas will be clearly delineated and fenced to keep construction activity out of the wetlands.

Page 4-8: SHORT TERM IMPACTS

The following should be inserted prior to the section on Cultural Resources:

Floodplains

Several structures and outfalls will be placed in the 100-year floodplain. The NJDEP Division of Coastal Resources has issued stream encroachment permits for this activity. Included in the permit are requirements for facility design to protect property and provide for public safety in the event of flooding.

Page 4-14: LONG TERM PRIMARY IMPACTS - Surface Water Quality

The following should replace the first paragraph:

The use of alternative disinfection processes, such as UV disinfection, or dechlorination facilities at the WWTPs within the UPRB will greatly reduce adverse impacts caused by the discharge of chlorine residual into receiving streams. These facilities are currently on-line at the Berkeley Heights, Bernards Township, Madison-Chatham Joint Meeting, and Warren Township Stage I-II and IV WWTPs. These facilities are scheduled to be included at the Chatham Township, Morris-Woodland, New Providence Borough, Passaic Township, Warren Township Stage V, Park Central, and VA Medical Center WWTPs in the future.

Page 4-14: LONG TERM PRIMARY IMPACTS - Surface Water Quality

The third paragraph should be replaced with the following:

The water quality in Loantaka Pond will be enhanced by the removal of phosphorous and oxygen-demanding materials when the upgraded facilities at the Morris-Woodland

WWTP come on-line.

Page 4-14: LONG TERM PRIMARY IMPACTS - Surface Water Quality

The following should be inserted after the third paragraph:

Adherence to the effluent limitations will have a beneficial impact on water quality in Loantaka Brook, Black Brook and the Passaic River. The bases for these projected improvements are the data from the GSWQS, through which the influences of the Morris-Woodland and Chatham Township WWTPs on surface water quality in their receiving waters were quantified.

Page 4-14: LONG TERM PRIMARY IMPACTS

The following should be inserted prior to the section on Flooding:

Ground Water Quality

With the exception of the NJDOT-Harding Rest Stop WWTP, the operation of the WWTPs as planned or upgraded will have no significant long-term impacts to the ground water resources of the area. The continued operation of the NJDOT WWTP will impact ground water resources in the summer months (April 15 - October 15) when the spray irrigation fields are in operation. However, the quantity of effluent treated is very low and it is treated to secondary standards with some nutrient removal, so the impacts of this operation are expected to be minimal.

4-21: LONG TERM SECONDARY IMPACTS - Surface Water Resources

The following should be substituted for this section:

Population growth and associated land development can cause an increase in the amount of stormwater runoff and thus affect water quality in two ways:

- Increased stormwater runoff may lead to more flooding by causing rapid and higher total rises in receiving surface water levels than would normally be experienced with similar storms under pre-development conditions. The expected change in flood flows for several critical locations in the UPRB are shown in draft EIS Table 4-6.

- Greater stormwater runoff can also cause an increase in non-point source (NPS) pollution loading of suspended solids, nitrogen and phosphorus, as well as pesticides, fertilizers, toxic metals, oil and grease and other pollutants from developed areas to surface water resources. The expected increase in suspended solids, nitrogen and phosphorus to the GSNWR and the Upper Passaic River is shown in draft EIS Table 4-7. This analysis is based on the projected increase in impervious surface area.

The decrease in stormwater infiltration resulting from increased stormwater runoff also prevents stormwater from recharging the ground water resources and soils, and reduces the vegetative cover effectiveness from "naturally treating" the runoff. This natural treatment includes uptake of nutrients by WWTPs and removal of pollutants in the ground by mechanisms such as absorption and interception by the soils.

In the Northeast New Jersey Water Quality Management Plan (NJDEP, 1976), the major documented sources of NPS pollution were the residential sector for suspended solids, and organic soils and swamps for oxygen demanding materials (BOD). Phosphorus and nitrogen for the total Upper Passaic basin (an area larger than the UPRB) originated principally from point sources, with 90 percent of the phosphorus and 87 percent of the nitrogen loads coming from point sources.

The implementation of stormwater management techniques can prevent NPS pollution to varying degrees. Of particular importance are techniques to prevent degradation of the study area's water quality that are also referred to as BMPs. A BMP is defined as a practice, or combination of practices, that is determined to be the most effective practicable means of preventing or reducing the amount of pollution generated by non-point sources to a level compatible with water quality goals.

Historically, the regulation and implementation of stormwater management, including the use of BMPs, has been the responsibility of state and local governments. Section I of Appendix L summarizes the regulations promulgated by the State of New Jersey to address stormwater management. The Morris County SCD should be consulted regarding proper control of erosion and soil loss. The SCD should also be consulted when control measures are planned.

Because of the concern over the declining water quality in the GSNWR, much attention has been given to the stormwater-related NPS pollution in the Great Swamp Sub-basin including the potential impact of increased development in the upstream watershed areas. In order to evaluate these effects, a study of the nutrient dynamics of the GSNWR was proposed to examine the need for nutrient removal at the Morris-Woodland and Chatham Township WWTPs and the feasibility of controls on NPS nutrients coming into the GSNWR (see Appendix E).

Though studies to date have not been conclusive, in general, the UPRB has been considered a non-point source of pollution that contributes to the degraded water quality in downstream receiving waters. Of particular concern are nutrients and fecal coliform bacteria being transported by stormwater runoff. The most recent water quality project to be proposed for the Great Swamp Sub-basin is an improvement project to be authorized for funding through the U.S. Department of Agriculture. Included in the objectives of this proposed project is the determination of the sources, amounts, and rates of NPS pollution

and the development of a watershed management plan to reduce, prevent, and remedy the problems through a cost-sharing program.

Section II of Appendix L includes a summary of stormwater management practices recommended for mitigating the potential impacts of increased stormwater runoff resulting from increased development in a watershed. These practices should be considered for implementation in the UPRB as part of management plans and municipal ordinances as per state regulations. If the proposed improvement project concerning NPS pollution is funded, its findings should be incorporated into both existing and new local stormwater management plans and ordinances.

Page 4-24: LONG TERM SECONDARY IMPACTS - Aquatic Ecosystems

The following should be added on the end of the paragraph:

More specifically, wetlands of the GSNWR will benefit from the operation of the upgraded treatment facilities due to the removal of nutrients that could otherwise lead to excessive algal growth in the GSNWR.

Page 4-25: LONG TERM SECONDARY IMPACTS - Land Use

The first paragraph of this section should be re-structured as follows:

The provision of wastewater treatment facilities is not anticipated to result in long-term areawide growth patterns which differ significantly from those likely to occur without the facilities. **However, if these facilities are expanded and permitted beyond their currently permitted capacities, as could occur with Chatham Township and Morris-Woodland WWTPs, some land use conversion may take place. To control development, the affected municipalities should use local zoning to specify the type of development desired in a given area.**

Page 4-25: LONG TERM SECONDARY IMPACTS - Land Use

The following should be inserted at the bottom of the page:

These long-term, secondary impacts relate to growth impacts such as increased development, increased impervious area, and increased real estate values. With the elimination of interceptor construction from the preferred alternative, the secondary impacts are reduced.

Page 4-26: LONG TERM SECONDARY IMPACTS - Protection of Sensitive Areas

The following should be substituted for this section:

Environmentally sensitive areas (e.g., floodplains, wetlands) in the UPRB were identified in Chapter 3 of the draft EIS. It is EPA's policy that these areas be protected to the maximum extent possible. This protection can be afforded by restricting the types and magnitudes of actions that will be permitted in these areas; by stipulating the types of management measures that are required to control potential environmental impacts in and around these areas; or by subjecting these areas to more rigorous analysis and review of all major proposed actions. Additional methods include:

- **Zoning and community master plans: Zoning and land use planning is controlled at the local level. Communities can rezone environmentally sensitive areas to preclude or restrict development. To accommodate future population growth, communities can implement transfer of development rights to allow for higher density development in non-sensitive areas.**

- **Sizing and location of facilities: The facilities proposed have been located so as to minimize the impact to any sensitive areas. In addition, in order to**

improve water quality in the UPRB and to help protect the GSNWR, sewer service should not be extended into areas designated as environmentally constrained (Draft EIS Figure 3-9).

Further, no sewer service will be provided to serve future development within wetlands or the 100-year floodplain in the UPRB, unless specifically approved by the New Jersey Department of Environmental Protection.

Recent regulations have greatly increased the protection of sensitive areas in the UPRB. As a result, the proposed upgrades of the WWTPs can be implemented without significant secondary impacts on wetlands, floodplains, or other environmentally sensitive areas.

List of Preparers

The following names should be added to the list of preparers:

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CHAPTER 6

Conclusions and Recommendations

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Prior to delegation of the Construction Grants Program to the State of New Jersey, EPA applied special conditions as appropriate to the grants issued under the program. The recommendations made in this EIS will be reviewed by the NJDEP and incorporated into the State Water Management Plan currently being developed. In addition, the recommendations will be considered when issuing NJPDES permits, and awarding state grants and loans. This chapter outlines the recommendations that EPA believes are most important for the protection of the environment of the UPRB.

6.2 Conclusions and Recommendations

The recommendations listed below are based on the extensive efforts conducted throughout the EIS process. It is the responsibility of the State of New Jersey, a county soil conservation district (SCD), or a municipality to implement these recommendations, as appropriate, to the extent of the state's, SCD's, or municipality's authority to do so.

- The data gathered in the GSWQS were sufficient to show the impact of the point source discharges from the Chatham Township and Morris-Woodland WWTPs on the GSNWR. The status of the WWTPs operating within the UPRB has been reviewed as part of this final EIS. The recommendations with regard to the WWTPs can be found on Table ES-2. Moreover, those data indicated that substantial non-point source loadings are entering certain reaches of brooks tributary to the GSNWR. Continued study on a scaled-down basis, such as that presented in the USFWS Master Plan for the GSNWR and in the Non-point Source Pollution Project for the Great Swamp Watershed proposed through the U.S. Department of Agriculture, is recommended; such continuing study can refine the identification and characterization of such non-point source influences, and evaluate various remedial alternatives.

- As WWTPs in the UPRB are upgraded, the point source loadings from these facilities will diminish, and non-point sources will exert greater influences on the overall loadings to the surface waters of the basin. Analysis of the GSWQS data has identified some stream reaches flowing into the GSNWR that appear to have substantial non-point source loadings. Stormwater management plans should be developed by each municipality in the UPRB, especially those within the Great Swamp sub-basin, to control non-point source pollution. Those plans should consider both water quantity and water quality issues. Guidance on the content of such stormwater management plans can be obtained from the NJDEP. Moreover, municipalities should consider establishing overall stormwater management goals for their most sensitive watersheds and stream corridors (see Appendix L.)

- Increased development in the UPRB will increase the hydraulic load of the streams tributary to the GSNWR. This increased hydraulic load may affect the water level of the swamp, which may in turn have secondary impacts on the area (e.g., flooding of basements). Insufficient data currently exists to determine the specific relationship between increased development, water levels, and secondary impacts. As the area comes under increased development pressure, it will become important to study this problem in more detail.

- Much of the UPRB is underlain by the Buried Valley Aquifer Systems, an important source of potable ground water in northern New Jersey. Recharge to these aquifer systems is relatively rapid and direct, making such ground water resources susceptible to contamination from the surface. Where prime ground water recharge areas can be reasonably delineated, municipalities should consider such areas in local zoning decisions to specify the types of development that would be compatible with these environmentally sensitive areas. The NJDEP and New Jersey Geological Survey can offer guidance and assistance to municipalities in their planning efforts.

- With the exception of Harding Township, Berkeley Heights Township, and New Providence Borough, the UPRB soils are predominantly unsuitable, or only marginally suitable, for septic systems, due to high water tables, proximity to bedrock, and low soil permeability. In areas where conditions are unsuitable or septic systems are failing, an alternative wastewater disposal method must be employed. Most likely, these areas would be connected to an existing WWTP, but any action taken should be consistent with the State Development and Redevelopment Plan which is intended to assess and establish goals and strategies to address the numerous growth changes affecting the state.

- The draft EIS recommended using constraints analysis to determine appropriate capacities for the WWTPs by accounting for development outside of environmentally constrained areas and by estimating reductions in the I/I component of the flow. The recommended capacities were revised in this final EIS to reflect current NJDEP permitting actions and updated information. The revised WWTP capacity recommendations are contained on Table ES-2.

- Some of the WWTPs operating within the UPRB experience substantial I/I. Where practical and cost-effective, these problems should be corrected.

- Regulation of wetlands and floodplains by NJDEP Division of Coastal Resources strongly discourages development of such environmentally sensitive areas. Therefore, sewer service should not be extended into wetlands and floodplains.

- Package treatment plants may encourage random development within the UPRB. Also, the treatment facilities within the basin are required to achieve high levels of treatment, including nutrient removal in some cases, which are often difficult to maintain with package plants. It would be more difficult for a municipality to operate many small package plants or oversee the operation of such plants if privately-owned or operated. Given these considerations, the use of package plants is not recommended in the UPRB.

- Development may lead to increased non-point source pollution and adverse impacts to and losses of environmentally sensitive areas. Development in the UPRB cannot be controlled by EPA; EPA recommends that development be controlled on a local level through zoning and comprehensive planning. Development should be consistent with the State Development and Redevelopment Plan.

CHAPTER 7

Responsiveness Summary

7.0 RESPONSIVENESS SUMMARY

7.1 Introduction

The draft EIS on the UPRB 201 Facilities Plan was issued in 1981. The notification of the issuance was published in the Federal Register on June 26, 1981. The draft EIS presented an in-depth description of wastewater treatment alternatives, the affected environment and the environmental impacts associated with the proposed alternatives.

A public hearing was held at the Morris Township Municipal Building, in Convent Station, New Jersey on August 20, 1981 in order to allow interested individuals, governmental agencies, and other organizations the opportunity to comment on the draft EIS. In addition, written comments were accepted during the comment period that followed issuance of the draft EIS; the formal comment period closed on September 4, 1981.

This final EIS was prepared to address the comments received on the draft EIS and to incorporate them into the EIS process. This responsiveness summary is organized into three sections: (1) Responses to Comments Regarding Bernards Township, (2) Response to Comments from the Public Hearing, and (3) Responses to Written Comments Received. The responsiveness summary addresses comments requiring a direct response and comments requiring significant text modification. Comments identifying typographical errors or factual mistakes are reflected in the text; no specific response is presented in the responsiveness summary in those cases. If necessary, comments were edited to make them more concise and understandable, but the intent of the comment was maintained.

7.2 Responses to Comments Regarding Bernards Township

The Bernards Township sewage facilities were included within the scope of the draft EIS. However, Bernards Township requested that its project be segmented out of the EIS, so that the project could proceed independent of the EIS process. Bernards Township made this request because: (1) the Township was under a court order to provide sewage treatment for high density housing, (2) the Township felt that construction grants for the project would not be available beyond September 30, 1981, and (3) the Township agreed with the population and flow projections and the level of treatment proposed in the draft EIS. With this in mind, the draft EIS stated that Bernards Township would be permitted to proceed to construction of its wastewater treatment facilities independent of the EIS process, provided that there was no significant public controversy.

Numerous comments regarding the Bernards Township project were raised during the public comment period of the draft EIS. They included:

- need for sewers;
- further analysis of alternatives;
- impacts to environmentally sensitive areas (i.e., wetlands, floodplains, prime agricultural lands, cultural resources, and sole source aquifers);
- impacts to the water table;
- excessive costs;
- public participation;
- EPA subsidizing development; and
- easement acquisition procedures.

Based on its review of the comments, EPA determined that the issues had been satisfactorily addressed in the draft EIS. However, on November 3, 1981, EPA issued a responsiveness summary (see Appendix M) that addressed the specific comments received on the Bernards Township portion of the project. EPA issued a grant for the Bernards Township project and allowed it to proceed to construction, following the close of the draft EIS comment period. For a discussion of the Bernards Township wastewater treatment facilities, see Chapter 5, Section 2.4.5.

7.3 Responses to Comments from the Public Hearing

A public hearing on the draft EIS was held on August 20, 1981 at the Morris Township Municipal Building, in Convent Station, New Jersey. Representatives from the EPA opened the meeting by discussing the background of the project and presenting the format of the hearing. Substantive comments raised at the hearing and EPA's responses are presented in this section. (Comments #2 and #4 were made at the public hearing but were not reflected in any written submittals.) The individual making the comment is identified.

Mr. Robert H. Fox, P.E.
Harding Township

Comment #1: **Harding Township's only significant objection to the recommendations of the report is that another study to determine the need for nitrogen and phosphorus removal at the Woodland Avenue treatment plant in Morris Township would result in unnecessary delay. The damage to private property and generally to the environment of the area far outweighs the cost of nutrient removal.**

Response: Although the Northeastern New Jersey 208 Plan established that the Morris-Woodland WWTP should have Level 4 treatment with phosphorous removal, the draft EIS determined that there was insufficient information to determine that the treatment plant effluent itself was the cause of excessive algae growth in the Loantaka Brook and GSNWR. There are other causes of eutrophication and a clear link between algal growth and treatment plant effluent needed to be established before recommending a costly upgrade to include nutrient removal. In order to address this issue, EPA and the NJDEP jointly completed the GSWQS.

The results of the GSWQS show that nutrients in the effluents of the Chatham and Morris-Woodland WWTPs can lead to algal growth in the GSNWR. Accordingly, the Morris-Woodland and Chatham WWTPs have been issued new NJPDES permits that require Level 4 treatment, including nutrient removal. The Morris-Woodland WWTP was issued a permit to construct an upgraded facility. Construction began December 1990; full permit compliance will be achieved by March 1993. The Chatham Township WWTP was also issued a permit to construct and construction has begun on this plant. Full permit compliance is expected to be achieved by October 1992.

Comment #2: **The water quality study should not be limited to just the impacts on the GSNWR. It should be expanded to include the effects on the streams. The streams flow through private properties bordering the GSNWR and there has been significant serious damage to the properties as a result of the excessive aquatic vegetation that has been facilitated by nutrient loadings in the stream.**

Response: The spatial arrangement of sampling locations used in the GSWQS included locations on Great Brook, Loantaka Brook, Black Brook, Primrose Brook, and the discharge channel from the Chatham Township WWTP. These stations are upstream of the GSNWR proper, and have been used to characterize point source and non-point source effects on water quality in the streams flowing through private landholdings bordering the GSNWR.

Comment #3: **Another study is not needed to determine impacts of wastewater effluent or water quality. Nutrient removal should be part of the upgrading of the Morris Township plant from the very start.**

Response: See Response to Comment #1.

Comment #4: **Would a privately funded package plant be governed by these proposals that prohibit development in wetlands or in floodplains? Does EPA have any control over that? If developers wanted a package plant in a wetlands area, would they eventually have to contact EPA? Is EPA willing to spell out in the final Environmental Impact Statement that there will be no package treatment plants approved for wetlands, floodplains, or for residential treatment; this is not clear in the present text.**

Response: On page 2-16 and 2-17 of the draft EIS, package treatment plants were eliminated as a feasible alternative for wastewater management in the UPRB. The constraints analysis in the draft EIS indicated that the existing treatment facilities could accommodate the wastewater generated currently and by future development in areas that are not environmentally constrained. Therefore, EPA recommended that no package plants be constructed to treat wastewater flows. No new information developed as part of this final EIS alters this recommendation. While EPA exercises no regulatory authority over privately-funded plants, the provisions in the draft EIS would be considered by NJDEP in permitting such a plant. Both privately- and publicly-funded plants would come under the same provisions. EPA has also included a recommendation that no package plants should be located in floodplains or wetlands and that no additional package plants be used for residential or industrial wastewater treatment.

If a developer were to propose construction of a package treatment plant in a wetland or floodplain, he/she would be required to contact a variety of state and federal agencies and get appropriate permits.

Mrs. Ella Filippone
Passaic River Coalition

Comment #5: **The Passaic River Coalition, as well as the Passaic Valley Ground Water Protection Committee request that prime aquifer recharge areas be included as critical areas in the Upper Passaic Facilities Plan. Primary recharge areas do exist in the Upper Passaic River Basin which contains part of the terminal moraine.**

Response: Prime aquifer recharge areas were not specifically included as environmentally sensitive lands because the areas are not adequately delineated, moreover, many of these areas were already considered environmentally sensitive as floodplains and wetlands for the purposes of the draft EIS. Accordingly, EPA does not believe that a separate environmental constraints category for prime aquifer recharge areas is warranted at this time.

Comment #6: **EPA should develop guidelines for each facility so that the impact on environmentally sensitive lands is kept to an absolute minimum. In addition, the EPA must provide the municipalities in the Upper Passaic River Basin with a clear working definition of wetlands, prime recharge areas, and floodways.**

Response: Municipalities may find "working definitions" of wetlands in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation, 1989) and of floodplains in Technical Manual for Stream Encroachment (NJDEP, 1988). Guidance on prime aquifer areas can be obtained from the New Jersey Geological Survey and from NJDEP Division of Water Resources. Because appropriate federal and state definitions of these resources already exist, there is no need to redefine these resources in this final EIS.

Comment #7: **EPA should provide guidance with regard to non-point source pollution from new developments so that improvements gained through the upgrading of sewage treatment plants remain a positive benefit.**

Response: Local municipalities have the responsibility of developing and implementing adequate stormwater management plans to address non-point source pollution. However, in Appendix L of this document, EPA has provided preliminary guidance for developing stormwater management plans in the UPRB.

Comment #8: **The Passaic River Coalition supports the upgrading and improvement of the treatment facilities, but strongly recommends that precise checks and balances be added to ensure that the activities recommended do not initiate extensive new development and new degradation.**

Response: The upgrading of existing WWTPs is directed at reducing nutrient loads to the receiving waters of the UPRB; the upgrading does not explicitly propose new capacity at such upgraded facilities. The activities recommended will not, therefore, serve independently to promote new development within the basin. Moreover, EPA's constraints analysis presented in Chapter 3 of the draft EIS, calculated the necessary treatment plant capacities based on restrictions on development in environmentally sensitive areas. EPA believes that this constraints analysis, as modified by this final EIS, is still valid for the UPRB. Accordingly, although EPA cannot control development by restricting treatment plant flows, EPA recommends that NJDEP and the local municipalities adhere to the constraints analysis in the draft EIS when planning future WWTPs in the UPRB.

Mr. Edward A. Taratko, Jr. (presented by Mr. Allan C. Herbert)
Upper Passaic River Basin Wastewater Management Committee

Comment #9: **In the instances where the EIS projections are less than the existing treatment plant capacity, the plant capacity should be maintained at the present level so that the existing treatment facilities can be utilized to their maximum potential. This situation occurs specifically in the Madison-Chatham Joint Meeting plant where a reduction in capacity from 4.0 mgd to 3.2 mgd is recommended, as well as in the Morris Township-Woodland Plant where a reduction in capacity from 2.0 mgd to 1.8 mgd is recommended.**

Response: The draft EIS recommended a flow of 1.8 mgd for the Morris-Woodland WWTP and a flow of 3.2 mgd for the Madison-Chatham Joint Meeting WWTP, assuming a significant reduction in the infiltration/inflow (I/I) component of the flows. A reduction in the I/I of the magnitude EPA was anticipating was not realized; therefore, NJDEP issued a permit to the Morris-Woodland WWTP for 2.0 mgd and to the Madison-Chatham Joint Meeting for an average flow of 3.5 mgd and a maximum monthly flow of 5.0 mgd.

Comment #10: **The recommendations of the EIS further indicate that the Chatham Township and Morris Township plants should be upgraded to Level 4 treatment with provision for possible nutrient removal in the future following the recommended studies. It is not apparent how the cost-effectiveness analysis in the EIS could be completed without the established levels of treatment for these treatment plants.**

Response: Although the actual scenarios for wastewater treatment were not known at the time of issuance of the EIS, the costs for all alternatives were developed using the most acceptable information available. The costs were presented in Chapter 2 of the draft EIS.

Following the issuance of the draft EIS, the GSWQS was completed. This study showed that nutrients from the two plants were impacting the GSNWR. The higher costs of nutrient removal can be justified to prevent adverse environmental impacts. Consequently, the recommended alternative in this final EIS is to upgrade to Level 4 treatment with nutrient removal and dechlorination. This concept is currently being implemented for the Morris-Woodland and Chatham Township WWTPs.

Comment #11: **It is apparent that the original issue of water quality and quantity and the subsequent impact of the GSNWR has been inadequately addressed in the EIS and does not satisfy the original project scope. The imposition of additional studies upon the upstream municipalities or the Upper Passaic River Basin Wastewater Management Committee would result in additional local costs to address issues which were to**

be addressed and concluded within the framework of the EIS.

Response: The reports detailing the results of the GSWQS were issued in late 1987 and early 1988. These studies were conducted and funded jointly by the EPA and NJDEP. No local funding was required for these projects. See Response to comment #1.

Comment #12: **The Upper Passaic River Basin Wastewater Management Committee questions the imposition of Level 4 treatment for all of the treatment facilities within the Upper Passaic Basin. The Environmental Impact Statement does not provide an independent analysis of this requirement but instead refers to the 303e basin plan and waste load allocations.**

Further, the seven treatment areas should be segmented. The design and construction of advanced secondary treatment facilities should be permitted immediately on an individual project basis, while the justification of Level 4 treatment, dechlorination, or nutrient removal is determined.

Response: In December of 1981, the EPA Advanced Treatment Task Force issued a Summary of Findings on the Advanced Treatment Facilities proposed for the UPRB. Its report concluded that nitrification during warm weather months was needed for the Madison-Chatham, Berkeley Heights, Passaic Township, Morris Township, and Bernards Township wastewater treatment plants to significantly improve the dissolved oxygen concentration of the Upper Passaic River, Loantaka Brook, and the Dead River. The report also recommended dechlorination for all treatment plants in the UPRB. The Task Force concluded that the New Providence treatment plant did not need to be upgraded to Level

4 because the existing level of treatment was adequate at this plant. With regard to Chatham Township, the Task Force recommended that the upgrading of the Chatham Township plant be delayed until completion of the GSWQS.

The GSWQS was completed and the results of the study indicated that both the Chatham Township and Morris Township plants contributed nutrients to the GSNWR that could promote excess algal growth. Based on these results, NJDEP required the Chatham and Morris Township plants to be upgraded to Level 4 treatment with nutrient removal.

Regarding the segmenting of the plants, the draft EIS recommended that some plants be consolidated in a single subregional facility; however, given the lack of federal funding for such a project, no plants were abandoned and no subregional facilities were constructed. Instead, all of the facilities were treated separately by the permitting agency and all but the New Providence and the VA Medical Center facilities were upgraded to Level 4. Accordingly, segmentation of the project occurred and some facilities were allowed to proceed independent of the EIS process.

Mrs. Abigail Fair
Great Swamp Watershed Association

Comment #13: **The following recommendations are especially vital: (1) that funded sewage projects will not serve development in sensitive areas and will not overstress area resources; (2) that a study of quality and magnitude of stream flows in the GSNWR Basin be implemented; (3) that industrial package plants should not be approved until a water**

quality study is completed; and (4) that zoning regulations for the Upper Passaic Basin and the surrounding municipalities be modified to protect the environmentally sensitive lands from indiscriminate development.

Response: EPA acknowledges this comment and has moved forward with the implementation of some of these recommendations. A list of recommendations is included in this final EIS in Chapter 6. The GSWQS has been completed and an analysis of the results is included as Appendix K of this document.

Comment #14: **The Association finds the draft EIS sets forth very conservative critical area delineations. For instance, since accurate wetland mapping was not a part of this EIS process, many existing wetlands are not delineated. This means that the constrained population figures arrived at are very generous and should be considered as absolute maximums.**

Response: The draft EIS used the U.S. Fish and Wildlife Service National Wetland Inventory (NWI) maps to delineate wetland boundaries. Given the nature of this study, EPA believes that this is an appropriate approach to identifying wetlands. Nevertheless, as development occurs, wetland delineations will have to be prepared by the developer in accordance with federal and state regulations to determine exact wetland boundaries.

Comment #15: **The Watershed Association urges that the water quality and stream flow study for the GSNWR Basin be implemented immediately under the aegis of EPA.**

Response: Detailed descriptions of the GSWQS program elements, statistical analyses of the GSWQS data base, and discussions of specific findings deriving from the GSWQS are presented in Appendix K of this final EIS. Other GSWQS reports present particular aspects or applications of the study data; a full listing of the GSWQS data is presented in the Maguire Group data report (1988), a discussion of algal bioassay results using water from GSNWR sampling locations is presented in the Trama report (1987), and a discussion of hydrological modeling results using GSWQS data is presented in the Najarian report (1988).

Comment #16: **The Association recommends that approval of residential package treatment plants, as well as industrial package plants, be delayed until the water quality study is complete. The increasing volume of water coming into the GSNWR Basin combined with serious non-point source pollution will be compounded by residential and commercial development made possible by package plants.**

Response: See Response to Comment #4.

Comment #17: **Page 2-4 - Township of Chatham. The draft EIS states that package plants were eliminated and sewage rerouted to the Township plant. Park Central (see page 2-7) is a package plant that processes sewage from Cardinal Hill Apartments on River Road in Chatham Township. It has not been connected to Township sewers. This plant's 30,000 gallons of effluent a day (Tables 2-1 and 2-2) would bring the Township's total daily gallonage to 0.83 million gallons per day and should be taken into consideration if expansion of the Township plant is undertaken.**

Response: As indicated in the draft EIS, the Park Central package plant has never been considered in the evaluation of Chatham Township and neither the plant flows nor the population served have been considered in the constraints analysis. The Park Central package treatment plant remains in operation and is privately owned and operated. There are no plans for abandonment of the Park Central facility with flows being directed to the Chatham plant. In fact, the plant is currently undergoing an upgrade to Level 4 treatment that will be completed in 1991. (See Chapter 5, Section 2.4.10). Because this plant's flows will not be diverted to the Chatham plant, no consideration of these flows is necessary with regard to expanding the Chatham plant's capacity.

Comment #18: **The following corrections should be made before the EIS is made final:**

1. page 3-2 - Acres of floodplains and wetlands delineated in Figures 3-1 and discussed on page 3-58 are not accurate. Wetlands in the GSNWR Basin are much more extensive according to the National Wetlands Inventory and the Morris County Soil Conservation District maps. Also see page 3-23.

2. page 3-37 - The draft EIS discussion of growth trends in the UPRB neglects to mention the very significant amount of commercial development occurring in Morris Township and in Madison. This development will create serious impacts, particularly in non-point run-off, because of the unusual amount of traffic being generated and the subsequent need to expand secondary roads as well as access to Route 287. The estimates for changes in impervious surface area found on page 4-20, Table 4-5, do not appear to take proposed road widening and extensive parking areas into consideration.

Response: 1. See Response to Comment #14.

2. As stated on page 3-44 of the draft EIS, the impervious surface area estimates included the entire street network, including Routes 287 and 78. The estimates indicated that seven percent of the land was impervious. This estimation method is appropriate for a study of this nature. The presence of additional impervious surfaces in the form of increased development, additional parking, and road widening will have an impact on non-point source pollution on a local level. However, through the development and implementation of stormwater management plans (such as presented in Appendix L), local municipalities can achieve some control over the quantity and quality of stormwater runoff.

Mrs. Elizabeth Corsetto (Presented by Mrs. Helen Fenske)
Association of New Jersey Environmental Commissions/
New Jersey Conservation Foundation

Comment #19: **It is absolutely necessary that the final plan retain the following recommendations:**

1. **That a water quality study be undertaken to determine the effects of point and non-point nutrient loadings on the GSNWR. EPA has the money set aside for this study, and it should commence immediately.**

2. **That nitrogen and phosphorous removal be implemented at the Morris and Chatham Township plants, if the above study indicates a need for such removal to protect the GSNWR.**

3. **That no industrial package treatment plants be approved until the water quality study is completed.**

4. **That if non-point sources are found to be a significant contributor to the pollution of the GSNWR, that the GSNWR Basin will be designated a General Permit Program Area.**

5. **That zoning regulations in municipalities in the Upper Passaic Basin be modified to protect environmentally sensitive lands.**

6. **That sewer service under this plan will not be extended into environmentally sensitive areas, such as floodplains, wetlands, steep slopes and prime agricultural lands.**

Response: EPA acknowledges this comment and has taken steps as appropriate to incorporate these recommendations into the EIS. Chapter 6 includes a list of recommendations.

Mrs. Helen Fenske
Great Swamp Watershed Association & New Jersey Conservation Foundation

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Comment #20: **Will the GSNWR Water Quality Study be conducted according to EPA guidelines? Will the EPA be monitoring the study?**

Response: Yes. See Response to Comment #15.

Diane Nelson
Boonton

Comment #21: **If a municipality obtains Step 2 Construction Grant funding that contains a grant condition prohibiting sewer connections in environmentally sensitive areas (e.g., floodplains, wetlands) and no**

Step 3 grant is obtained, are the grant conditions specified in the Step 2 grant still valid or can the municipality ignore those conditions because they did not receive money for actual construction?

Response: EPA considers the signing of a grant award document to be a contract between EPA and the grantee and, therefore, all conditions in the grant award apply. Accordingly, if a municipality accepts a Step 2 design grant, they accept all of the grant conditions that were contained therein. The conditions apply for a period of 50 years and are not contingent upon receiving Step 3 construction monies.

7.4 Responses to Written Comments Received

The following section highlights and responds to comments received in writing during the comment period following the issuance of the draft EIS. The comments have been included here as direct quotes, wherever possible, and in other cases the comments were paraphrased, while retaining the nature and tone of the comments. To review the exact context and phrasing of the comments, copies of the complete comments are included in Appendix N. The comment numbers listed in this section have also been placed next to the specific comment in the letters to aid in the identification of the comments from each letter.

United States Department of the Interior
William Patterson
Regional Environmental Officer
September 8, 1981

Comment #22: **The draft statement does not address mineral resources and it is difficult to evaluate potential minerals involvement related to siting of the proposed alternatives.**

Response: The final EIS presents the alternative of upgrading existing facilities to Level 4 treatment with nutrient removal as the recommended alternative. Under this alternative, existing sites will undergo some facility expansion, but no new sites will be developed. Thus, potential mineral involvement is negligible.

Comment #23: **In the section entitled Controlling Development in Environmentally Sensitive Areas (Page xi), the fourth paragraph states "In order to protect environmentally sensitive areas from development sewer service should not be extended into areas designated as environmentally constrained in Figure 3-9. In addition US EPA Step 2 and Step 3 grants to the municipalities should contain conditions to prohibit future development in floodplains and wetlands from connecting to any system receiving grants" (our emphasis). It is our view that to control development in these environmentally sensitive areas, the word should must be replaced with must. As written, this paragraph is merely a recommendation, not an absolute prohibition against sewer hookups in wetlands and floodplains.**

Response: Given EPA's current role in funding and permitting wastewater treatment facilities, EPA can only make recommendations regarding these matters. However, for those municipalities that received EPA Construction Grants in the UPRB (e.g., Bernards Township), the grants contain prohibitions against sewer hook-ups in environmentally sensitive areas.

Comment #24: **There was no mention in the draft statement about the possible need for a permit from the U.S. Army Corps of Engineers to conduct fill activities in project implementation. Such permits may be required**

for interceptors crossing streams and wetlands (page 4-6 through 4-8). The Fish and Wildlife Service, pursuant to the Fish and Wildlife Coordination Act (16 U.S. C. 661 et seq.), may provide additional and separate evaluation if project implementation requires a permit from the U.S. Army Corps of Engineers under Section 404 of P.L. 52-500, unless the method of authorization is general or nationwide permits.

It would appear that the Fish and Wildlife Service, as a minimum, will probably recommend that the U.S. Army Corps of Engineers, when issuing a permit, require features to reduce turbidity and sedimentation during project construction. Technical assistance concerning measures to avoid, reduce, or offset anticipated project-caused losses of fish and wildlife may be obtained by contacting the Field Supervisor, Ecological Services, Fish and Wildlife Service, 315 South Allen, Suite 322, State College, Pennsylvania 16801 (FTS 727-4601).

Response: EPA acknowledges this comment. Local municipalities are responsible for obtaining all permits and approvals required for construction/operation of the WWTPs' expansions and upgrades from the appropriate state and federal agencies.

U.S. Department of Agriculture
Plater T. Campbell
State Conservationist
July 31, 1981

Comment #25: 1. **Page 3-2 - The statement that the areas shown on Figure 3-1 represent locations where the probability of flooding during any particular year is approximately 1.0 percent is incorrect. The**

outer fringe of this area has a 1.0 percent probability of flooding, while the inner portions have progressively higher probabilities.

2. **Page 3-4 - We would suggest that the first two sentences of the second paragraph be rewritten as follows - "The United States Department of Agriculture, Soil Conservation Service (USDA-SCS) has determined that, based on general characteristics, some of the land in Morris and Somerset Counties is prime farmland. This determination is based on an assessment of the suitability of the soils for agriculture based on the degree of slope, available water capacity, pH, and seasonal high water table as well as the existing land use."**

3. **Page 3-43 - The section on land use does not mention agricultural land although other parts of the statement allude to its existence in the project area. It is disturbing to see agricultural land classified as vacant land zoned for residential, commercial or industrial use.**

Response: EPA acknowledges these comments.

New Jersey Department of the Public Advocate
Michael Bryce, Assistant Deputy
August 28, 1981

Comment #26: **On page 2-73 under the subheading "Environmental Constraints," the following sentences have been added to the earlier draft - "The potential for eutrophication is high and elevated algae growth levels have been recorded in localized areas (NJDEP, 1974). In addition**

there may be accelerated growth of rooted aquatic plants under low flow conditions in the GSNWR."

Is there is any documentation for the inclusion of these sentences? Or if, (especially the point about rooted aquatic plants) this is just conjecture?

Response: The sentences referred to were in an earlier draft copy of the document. The document was modified as appropriate for the draft EIS that was ultimately issued by EPA.

With regard to the statements identified, EPA was referring to an NJDEP Study. With respect to rooted aquatics, the statement is conjecture, but field observations confirm the statement.

Comment #27: **Under the title "Engineering Criteria" the principal engineering criteria has been changed from "Process Efficiency" to "Compliance with effluent quality constraints." What does this change mean and is there any policy briefing EPA might have explaining the reasons for this change?**

Response: The terminology has similar meaning; no difference in meaning was intended or implied.

Comment #28: **There are areas that could use package treatment plants that are not necessarily adjacent to sewerage collection networks. Also, it is stated that: "In unsewered areas such as Harding Township, zoning densities are too low for this method of wastewater treatment to be used effectively." Zoning densities should not be considered an environmental reason not to use package plants.**

Response: EPA is not restricted to discussions of environmental impacts only. A detailed EIS on a 201 Facilities Plan includes additional concerns such as engineering considerations, implementability, reliability, cost, and management concerns. See Response to Comment #4.

Comment #29 **EPA has not taken into consideration its own position that 201 Construction Grants will only service existing populations.**

Response: The construction grants program was revised such that EPA would fund facilities to serve only existing development, not growth. However, local municipalities were not prevented from constructing facilities to handle future growth providing they could obtain a permit for the discharge of the additional flow and provided this additional capacity was paid for by local funding sources. Since the issuance of the draft EIS, EPA delegated its construction grants program to NNDEP. Moreover, New Jersey established a revolving loan program in 1987 to provide financial assistance for the construction of wastewater treatment facilities which was initially capitalized with state-only money derived from bond sales. EPA then issued a series of capitalization grants, starting in 1988, to capitalize this program. New Jersey includes this SRF with other "state only" funding programs in its Municipal Wastewater Assistance Program. To receive funding, projects go through a process similar to the former construction grants program. Through this program, NJDEP must decide how much capacity to fund at the plants.

Comment #30: **EPA has suggested a ban on "industrial package plants" only until after the GSNWR report is completed. Yet for residential package plants EPA suggests that they should not be used in the UPRB at all. The EIS section on package plants, therefore, should be deleted until:**

A) they are studied further by EPA; B) the GSNWR study is completed; and C) EPA changes its position that 201 monies will only cover construction for existing populations.

Response: See Response to Comment #4.

Comment #31: **What documentation does EPA have that these "package plants" are not cost-effective? Assuming package plants develop in areas that will not be served by sewer lines, comparing their cost-effectiveness to that of municipal plants is like comparing apples and oranges.**

Response: The cost-effectiveness of package treatment plants was discussed on page 2-17 of the draft EIS. The statement in the draft EIS was not intended to imply that package treatment plants cannot be used as cost-effective alternatives for wastewater treatment in some situations. However, in the majority of the UPRB, the municipalities are served by wastewater treatment plants and have extensive collection networks already in place. Given these circumstances, it is more cost-effective and environmentally acceptable for new development to link into the existing service system than to construct package treatment plants. In addition, see Response to Comment #4.

Comment #32: **On page 3-32 under title "Air Quality", why was table E-2 removed? Why was the statement that Northern New Jersey is a Class II (PSD) area removed? Also, why was the paragraph on PSD increments removed on page 3-35 (formerly 3-46) just before the "Energy" section?**

Response: This information was included in an earlier draft version of the document. It was removed prior to publication of the final version of the document because the information was not germane to the project.

Comment #33: **The last line on page 3-36 should be deleted or further documentation be supplied for its inclusion.**

Response: An appropriate reference (the Morris County Planning Board, 1978) is supplied on page 3-36 of the draft EIS. No further documentation is required.

Comment #34: **On page 3-37, at the bottom, two sentences were deleted from the earlier draft: "The maximum density in this area is 2 housing units/ha (5 unit/a). An additional 56 townhouses are under construction on a 4.5 ha (11a) plot adjacent to Rt. 202 just south of Bernards Twp. (Horensky, SCPB, December 17, 1978)." Why were they deleted?**

Response: These figures were reflected in the overall constraints analysis. The sentences were not needed in the draft EIS that was ultimately issued by EPA.

Comment #35: **On page 3-47 in the second paragraph there are two sentences: "Other communities in the UPRB are substantially developed. Due to the established character and the lack of vacant developable land, the potential new growth is severely restricted in these areas." Please supply the documentation for these sentences. In addition, the next sentence should be deleted. The question of surrounding uses goes to "zoning" not to the "environment."**

Response: As indicated by the discussions on pages 3-46 and 3-47 of the draft EIS, this information came from the master plans developed for the communities in the UPRB. These are suitable references for this information. This information was included to ensure completeness of the document and because it is germane to the project.

<u>Comment #36</u>: **On page 3-61 under "Effects on Supply of Land" there is a recommendation that does not logically follow. Because 1310 acres are proposed for recreational land in 3 communities and a <u>portion</u> (How much?) of those reserved areas coincides with environmentally constrained" lands, then <u>all</u> of this land should be subtracted from total vacant land area (i.e. presumably because some land is constrained, all of it should be deducted from available land)? This is not in fact a logical conclusion. Again EPA is determining what lands should be subtracted from the present available supply without having an "environmental constraint" reason for suggesting so. This new section on page 3-61 should be rewritten to coincide with the logical scope of the EIS.**

<u>Response</u>: The analysis referenced on page 3-61 of the draft EIS recognizes and incorporates the proposed land use plans of the three municipalities cited into the land supply estimates shown in Tables 3-22 and 3-23; this is appropriate in projecting realistic land availability in future years. Moreover, the analysis uses the conservative assumption that environmentally constrained areas will not be those areas reserved for public use. The analysis is not subtracting the lands proposed for reservation from the total developable land because some portion of those lands is constrained by specific environmental considerations (e.g., steep slopes, flooding), but rather because those lands are proposed to be removed by municipal action from the total developable land and reserved for specific and limited uses. Such refinements to the constraints analysis are realistic adjustments for probable future actions.

Comment #37: **Page 3-75 under "Soils" should contain the same 3 towns listed under "Soil Constraints" on page 3-74.**

Response: The document has been revised to reflect this change.

Comment #38: **The first paragraph on page 3-79 should be deleted unless EPA is going to use the "construction permits measurement of growth" for all the other towns in the UPRB. This is an unrealistic and totally unwarranted departure from the methods used in the rest of the EIS.**

Response: The use of the construction permits measurement of growth was appropriate; its use was explained in the context of the document.

Township of Harding
Robert H. Fox, P.E.
Harding Township Engineer
May 19, 1977

Comment #39: **Of greatest concern to Harding Township is the fact that the plan does not include a definite provision for phosphate removal at Morris Township's Woodland Avenue Sewage Treatment Plant. A design process which results in effluent concentrations of 0.5 mg/l of phosphorous may or may not be sufficient to eliminate the problem of eutrophication.**

Response: The receiving waters of the upper reaches of the GSNWR act efficiently to reduce phosphorus available in the water column below input concentrations. Analysis of the GSWQS data by Najarian (1988) indicated that even if all phosphorus were removed from the wastewater effluents upstream of the GSNWR, there would still be significant input levels of phosphorus available to support plant growth, as well as phosphorus available from in situ releases of previously stored phosphorus. Nutrient loading estimates reported in this final EIS (Appendix K) tentatively identified significant non-point source phosphorus loadings in the Loantaka Brook watershed. Because of these other phosphorus inputs, removal of phosphorus below the 1.0 mg/1 level is not warranted at this time. Should non-point source controls (e.g., stormwater management measures) become significantly more effective in future years, reduction of nutrient concentrations in point source discharges may be deemed desirable and cost-effective.

The Morris-Woodland WWTP was issued a consent order to upgrade to Level 4 treatment including nutrient removal. The NJPDES permit that was issued to the Morris-Woodland WWTP contains a final effluent limit of 1.0 mg/L for phosphorous. (See Chapter 5, Section 2.4.2.2 for a description of the upgraded facilities.)

Comment #40: **The construction of an outfall which would discharge all or a portion of the plant effluent downstream from Loantaka Pond is unacceptable to Harding Township. From this point the nutrients would flow downstream through the slow-moving reaches of the brook bordering the GSNWR. It is in these reaches where the high nutrient loading causes the growth of dense aquatic vegetation and clogging of the brook which results in sediment deposition and flooding of adjacent properties. Such condition cannot be permitted to continue.**

Response: As stated on page 2-49 of the draft EIS, redirecting the Morris-Woodland plant outfall was never considered a viable option by EPA.

Borough of New Providence, NJ
William W. Fitter
Engineering Administrator
September 2, 1981

Comment #41: **There is a lack of information concerning the effect on Passaic River water quality of the requirement of Level 3 treatment for New Providence. There is no indication that independent sampling of the river was performed to provide justification that if the Borough were to expand its facility a significant improvement in water quality would be achieved. Further, there is no record that Wapora Inc. made use of any or all of the available local data in their study. Until there is more definitive information than that contained in the draft report, it is difficult to justify the expenditure of funds to construct, operate and maintain an expanded facility which would also necessitate the loss of municipal park and recreational lands.**

Response: The operation of the New Providence Borough treatment plant is unique in the UPRB because this plant serves as an infiltration/inflow (I/I) treatment facility. During periods of heavy rain, the collection system receives significantly higher flows because of I/I inputs to the system. When flows exceed the capacity of the pump station that transports flows from the Borough to the Joint Meeting Regional Treatment Plant at Elizabethville via the City of Summit Sewer System, the excess flows are diverted to the New Providence treatment facility. During times of normal flow, wastewater from the Borough is treated at the Elizabethville facility with only a small diversion of flow to the New Providence facility. This diversion is used to maintain biological growth on the trickling filters.

Based on available information and the operation of the New Providence plant as described above, Level 3 treatment was considered appropriate for the plant. However, the New Providence plant has a history of violations of the Level 3 nitrogenous biochemical oxygen demand (NBOD) and carbonaceous biochemical oxygen demand (CBOD) permit limits. Accordingly, the final EIS recommends that the plant be modified, either through its operation or through the construction of alternate or additional units, to consistently meet its Level 3 permit limits. This recommendation is consistent with enforcement actions currently being taken by NJDEP.

Comment #42: **In the consideration of the water quality of the Passaic River, no mention is made in the report of the effect of cleaning and clearing of the river to improve its flow characteristics and to reduce areas of natural pollution, which have a direct effect on the water quality of the New Providence site.**

Response: Regardless of whether any dredging operations occur in the reaches of the Passaic River near the New Providence plant, the discharge of the effluent from the New Providence plant will have an impact on Passaic River water quality. EPA and NJDEP agreed that Level 3 treatment is appropriate for this plant. This recommendation must necessarily be independent from considerations of any dredging actions which may or may not occur on the Passaic River because EPA does not have direct control over these operations.

Pluymers, Williamson and Barbieri Associates
William Pluymers, P.E.
August 14, 1981

Comment #43: **While, theoretically, Alternative PT-2 has many advantages, in reality it has some disadvantages for Passaic Township. Therefore, it is suggested that Alternative PT-1 be considered the prime alternative rather than PT-2. If this is unacceptable, both alternatives should be both considered viable and at least have equal status.**

Response: Alternative PT-2, a subregional facility for Passaic and Warren Townships, was a viable alternative at the time the draft EIS was prepared. However, because construction grants were not used for this project, the Townships chose to continue the independent operation of their treatment plants. Both Townships have upgraded their facilities. The recommended alternative in the final EIS has been modified to reflect the realities of the current situation in the UPRB. The recommended alternative for Passaic Township in this final EIS is PT-1, expanding and upgrading to Level 4 treatment with dechlorination. This recommendation is contained in Table 2-4 of this final EIS.

Comment #44: **In the description of the existing facility, the Passaic Township plant is presented as having a capacity of 0.6 mgd. This should be corrected to 0.65 mgd. Further, the average flow per capita of 120 gpcd is rather high; we feel it should be 100 gpcd.**

Response: The flow rate was incorrectly identified as 0.6 mgd; it has been corrected in the final EIS in Chapter 5.

As stated on page A-1 of the draft EIS, the information sources of the 201 plan, the 208 plan, I/I data from the communities, and discussions with NJDEP and EPA were used to determine the flow rates. Based on these sources, a per capita flow rate of 120 gpcd was used.

Township of Warren
Ronald H. Willans
Warren Township Authority Chairman
September 3, 1981

Comment #45: **The Warren Township Sewerage Authority has stated its intention to concur with the regionalization of its treatment facilities with Passaic Township as proposed in the 201 Facilities Plan and the EIS study of that plan. However, there is a reluctance by Passaic Township to join Warren Township in a regional facility. Also, the location should not be set by the study.**

Response: See Response to comment #43.

Comment #46: **The Stage V treatment plant in Warren, which is a Level 4 treatment facility, was erroneously stated as being in the floodplain. This facility is located entirely outside of the floodplain.**

Response: The document has been revised to reflect this comment.

Elson T. Killam Associates, Inc.
Kenneth L. Zippler
August 12, 1981

Comment #47: **Killam Associates and the Madison-Chatham Joint Meeting feel that the EIS has underestimated the flows which will be generated in the Madison-Chatham Joint Meeting tributary area in upcoming years.**

A reduction in plant capacity of 3.2 mgd could pose significant problems to the Joint Meeting in accepting flows from already approved developments as well as future developments.

Response: The draft EIS anticipated a greater I/I flow reduction than actually occurred and, therefore, the draft EIS flows estimates were lower than the NJPDES permitted values. Based on this, the Madison-Chatham Joint Meeting plant has been issued an NJPDES permit to discharge an annual average flow of 3.5 mgd with a monthly maximum average flow of 5.0 mgd.

William Kramer
August 22, 1981

Comment #48: **In reference to Recommendation 9 (p. ix), it is stated that industrial package treatment plants should not be approved until completion of the non-point source water quality study. What is your definition of "industrial" package plants? Does an "industrial" package plant differ from a package plant that treats only domestic waste (e.g. a package plant for an office building or research lab)? It appears to me that package plants represent a way of bypassing the 201 Facilities plans. Any type of package plant would tend to encourage development in areas that are not currently served by a sewage treatment system, and could result in negative environmental impacts on area wetlands.**

Response: An industrial package plant would treat process wastewater, not strictly domestic wastewater or mostly domestic wastewater, such as a residential package plant. See response to Comment #4 regarding EPA's position on package WWTPs in the UPRB.

Harding Township Environmental Commission
Sally Dudley
August 20, 1981

Comment #49: **The prohibition of package treatment plants for development in the wetlands and floodplains of the UPRB should be clearly stated in the final EIS as it is only implied in the current draft. Such a prohibition, along with the prohibition against sewer connections to developments in floodplains and wetlands should help protect the integrity of the GSNWR.**

Response: See Response to Comment #4.

Citizens Concerned About the Future of the Dodge Estate
Paul Hammann
August 28, 1981

Comment #50: **The Madison-Chatham Joint Meeting plant is completely overloaded following even a 1" rainfall due to severe extraneous inflow problems. Normal rainfall produces more than a 9 mgd output and over 13 mgd has been recorded during heavy rainfall when special instrumentation was installed. During these rainfall periods raw sewage flows from manholes onto the streets.**

Response: The Madison-Chatham Joint Meeting Plant is only permitted for a maximum monthly flow average of 5.0 mgd. Through issuance of the NJPDES permit, NJDEP has indicated that this reflects an appropriate level of I/I for this facility.

Comment #51: **Chatham Township was on the verge of granting Schering-Plough an amendment to their zoning law based on waste disposal that had as one option a septic system either forcing sewage into the ground or by gravity after dispersal over an area of about an acre. The imminent danger to the Buried Valley Aquifer is frightening and some means must be quickly found to prevent such things from happening.**

Response: The Buried Valley Aquifer has been designated a Sole Source Aquifer. Accordingly, as required by Section 1424(e) of the SDWA, no federal funds can be used to fund projects that could cause harm to the water quality of the sole source aquifer. The project presented in the EIS complies with Section 1424(e) of the SDWA.

EPA believes that the protection of the Buried Valley Aquifer is critical, and recommends that NJDEP and local municipalities take the necessary steps, to the extent of their authority to do so, to protect water quality when considering privately funded projects that may impact the aquifer.

Comment #52: **Clear directives should be given for the GSNWR area that will specify what treatment plants can and cannot do. Capacity values must be set. A maximum peak value for the Joint Meeting is urgent. These specifications must then be enforced.**

Response: The actions that treatment plants can and cannot take are specified in the NJPDES permits issued to each plant, in grant conditions (in cases where the treatment plants received construction grants), and applicable state and federal regulations. Recommendations for capacities and treatment levels for the WWTPs are presented in this final EIS. NJDEP has used all appropriate information in determining treatment plant capacities and included these values in the NJPDES permits.

Apgar Associates
Robert H. Fox, P.E.
Harding Township Engineer
September 3, 1981

Comment #53: **The draft should be amended to include the following:**

1. **Require Level 5 treatment at the Morris Township-Woodland plant without further delay.**

2. **Require sand filtration at the Woodland Avenue plant to protect the stream during plant upsets. This would also help to assure good plant operation which would be necessary to prevent filter clogging.**

3. **Require phosphate and nitrate removal processes at the Woodland Avenue plant without further delay.**

4. **Amend the scope of the water quality (nutrient) study in the GSNWR watershed to include the impact of nutrients on the streams and private properties in the vicinity of the GSNWR.**

5. **Clearly prohibit the construction of small (package type) treatment plants that would discharge into the streams that flow into the GSNWR.**

Response: 1. The results of the GSWQS justified the upgrading of the Morris-Woodland plant to Level 4 treatment with nutrient removal and dechlorination (or alternative disinfection process). This plant is currently under construction for the upgraded facilities. (See Chapter 5, Section 2.4.2.2). Because of the input of other pollutant sources to the GSNWR, namely non-point source pollution, the imposition of Level 5 treatment on the Morris-Woodland WWTP is not justified. The additional increment of benefit to go from Level 4 to Level 5 does not outweigh the extra costs at this time. However, as conditions change in the future and as nonpoint source pollution is controlled, Level 5 treatment may be warranted. This judgment would be made by NJDEP.

2. The upgraded facilities at the Morris-Woodland plant will include gravity sand filtration.

3. The upgraded facility will include nutrient removal.

4. See Response to Comment #2.

5. See Response to Comment #4.

Schering-Plough Corporation
Scott C. Gordon
Manager, Corporate Environmental Engineering
September 3, 1981

Comment #54: **The recommendation for downgrading the existing design capacity of the Madison-Chatham Joint Meeting should be reconsidered since**

some of the methodology and assumptions used may not be valid. The method used for this projection was a land-use model which was developed using available vacant land as a dependent variable. Since both Madison and Chatham Boroughs have very little vacant land, this type of model seems inappropriate.

Response: This EIS employed basic constraints analysis techniques that involved overlaying existing zoning with environmentally sensitive lands and eliminating treatment capacity for constrained aras. This methodology is appropriate for a study of this type.

Comment #55: **Several important factors should be carefully investigated before concluding that an additional study is necessary. There is a considerable amount of monitoring data and other environmental studies already available on the GSNWR. It appears that some of these studies may not have been adequately considered in the draft EIS.**

The field sampling program conducted by EPA in 1978 and reported in the draft EIS should be more fully discussed and compared with other studies.

The supportive monitoring data cited in Appendix C of the draft EIS on Tables C-4 through C-12 omits useful information such as the type and frequency of sample, the time of year, and in some cases, the unit of measurement. There also appears to be missing data.

There is an important oversight that is easily forgotten when comparing and interpreting monitoring data. This oversight is variable stream flows.

Response: The studies preceding the GSNWR were fully evaluated during the preparation of the draft EIS. Those data, though useful in characterizing existing conditions in some of the Basin's surface waters, were not designed with specific issues such as point source and non-point source loading quantification, wasteload allocation, or hydrological modeling guiding the study design and data collection. The GSWQS was designed specifically with such issues central to the data collection; moreover, the GSWQS data base provides full documentation of sample type, frequency, date, measurement unit; the GSWQS data base also provides flow rate measurements at all sampling locations.

Comment #56: **One important area that was neglected in the draft EIS was the establishment of a clear benchmark from which to judge and compare available data. The draft EIS appears to accept the NJDEP's Water Quality Criteria classification for fresh water streams as the criteria for evaluation of the GSNWR. No foundation was laid to demonstrate that these are appropriate criteria.**

Response: The analysis of the GSWQS emphasized comparison of data among and between monitoring locations rather than comparison of data with absolute standards. These relative comparisons point out significant differences and potential impacts without reliance on absolute standards for obtaining these conclusions.

Comment #57: **Recommendations regarding the proposed nutrient study and related waste treatment issues are as follows:**

1. **Regardless of the proposed nutrient study, the Morris Township and Chatham Township WWTPs should be upgraded**

to Level 4 with full nutrient and chlorine removal. Alternate disinfection methods should be evaluated and adequate sludge handling and disposal facilities should be provided.

2. **Regardless of the proposed nutrient study, privately owned waste treatment plants capable of achieving Level 4 plus nutrient removal should be permitted in developable areas that are not served by a municipal system provided they are not located in wetlands or floodplains.**

3. **The nutrient study, if still justified, should be conducted in three phases; design, testing and evaluation. The design phase is the most critical and important. This should involve a clear understanding of all the identifiable objectives and the tasks required to complete each objective.**

<u>Response</u>:

1. See Response to Comment #1. Also, the upgraded Chatham and Morris-Woodland WWTPs will be using ultraviolet disinfection, not chlorination. Both plants will continue to transport sludge to Two Bridges Sewer Authority for incineration.

2. See Response to Comment #4.

3. This study was conducted in these phases. A preliminary scope for the GSWQS was developed in 1980 by a task force of academic and governmental water quality and wetland experts. In 1982, EPA and NJDEP (again in consultation with water quality and wetlands experts) refined the scope of the study. Project implementation began in late 1983; intensive field

sampling began in March 1984 and continued through September 1985. Some sampling efforts (e.g., monitoring of storm events) continued until April 1987. The data evaluation phase of the study was conducted as part of this final EIS. (See Appendix K).

Comment #58: **A pumping station should be investigated to handle not only the waste treatment plant discharge but possibly a portion of Loantaka Brook during high water conditions.**

Response: The idea of a pumping station was investigated in the draft EIS and rejected because it was not considered a cost-effective option.

Comment #59: **As stated in the draft EIS, the Congressional mandate for designated Wilderness Areas specifically prohibits outside interferences or man-made activities. Presumably, the discharges from the Chatham Township and Morris Township treatment plants would be considered a man-made influence since they flow into the GSNWR?**

Response: The Congressional mandate for designated wilderness areas would apply to direct discharges to the GSNWR. However, EPA does not believe that the operation of the Morris-Woodland and Chatham WWTPs, located outside of the GSNWR, which discharge treated effluent to streams that ultimately enter the GSNWR, constitutes an act prohibited by the Wilderness Act.

Comment #60: **The U.S. Fish and Wildlife Service has expressed a great concern regarding the diversion of the waste treatment plant effluents from the GSNWR because waterfowl management programs are dependent on a relatively constant supply of water particularly during critical**

nesting periods. It is not only desirable to have these areas managed but it is essential to control both man-made and natural forces in order to preserve the uniqueness of the GSNWR.

Response: Where man-made facilities (e.g., WWTPs, stormwater collection systems) intercept natural drainage patterns and/or affect stream flows, the most desirable solution would be to restore "normal" flow volumes with clean water (e.g., clean discharges). The recommended alternative, the upgrading of existing treatment facilities to provide cleaner discharges, is consistent with this type of solution.

Comment #61: **One man-made activity discussed in the draft EIS that may adversely affect receiving waters such as the GSNWR or the Passaic River, is the use of chlorine for disinfection of waste treatment plant effluents. Alternative means of disinfection are available and contrary to the draft EIS, the costs are competitive with chlorine. One of the best methods for disinfection is ozonation. The use of ozone is now cost-effective with chlorine because of recent advances in solid state electronics and improvements in electrode design.**

Response: At the time the draft EIS was prepared, chlorination was NJDEP's preferred method of disinfection. Since that time, advances in alternative disinfection processes and new information regarding the impacts of chlorine on receiving streams has made alternative disinfection processes desirable in the UPRB. NJDEP has applied chlorine residual limits to the treatment plants in the UPRB and many have either installed dechlorination equipment or replaced chlorination with an alternative disinfection process, such as ultraviolet disinfection. The plants without such processes either in use already or under construction appear to be heading toward implementation of this technology in the near future. At this time, ozonation is considered a viable treatment option; however, none of the treatment plants have chosen to employ this technology.

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APPENDICES

APPENDIX K

Review of Great Swamp Water Quality Study

APPENDIX K:
REVIEW OF GREAT SWAMP WATER QUALITY STUDY

Prepared by:

United States Environmental Protection Agency

With Assistance From:

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In Association With:

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September 1991

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I. INTRODUCTION

A. General Background

In 1977, the Upper Passaic Wastewater Management Study Committee issued a Draft 201 Facilities Plan setting forth a proposal to upgrade and expand wastewater treatment plants (WWTPs) located in the Upper Passaic River Basin (UPRB) sections of Morris, Somerset, and Union Counties, New Jersey. A 201 Facilities Plan is a long-range planning document that sets forth guidance for the construction and/or modification of wastewater treatment facilities in a specific region, usually a large watershed area. Municipalities wholly or partially included within the planning area addressed in the 1977 Draft 201 Facilities Plan for the Upper Passaic River Basin are Chatham Borough, Madison Borough, New Providence Borough, Watchung Borough, Berkeley Heights Township, Bernards Township, Chatham Township, Harding Township, Morris Township, and Passaic Township (Figure 1).

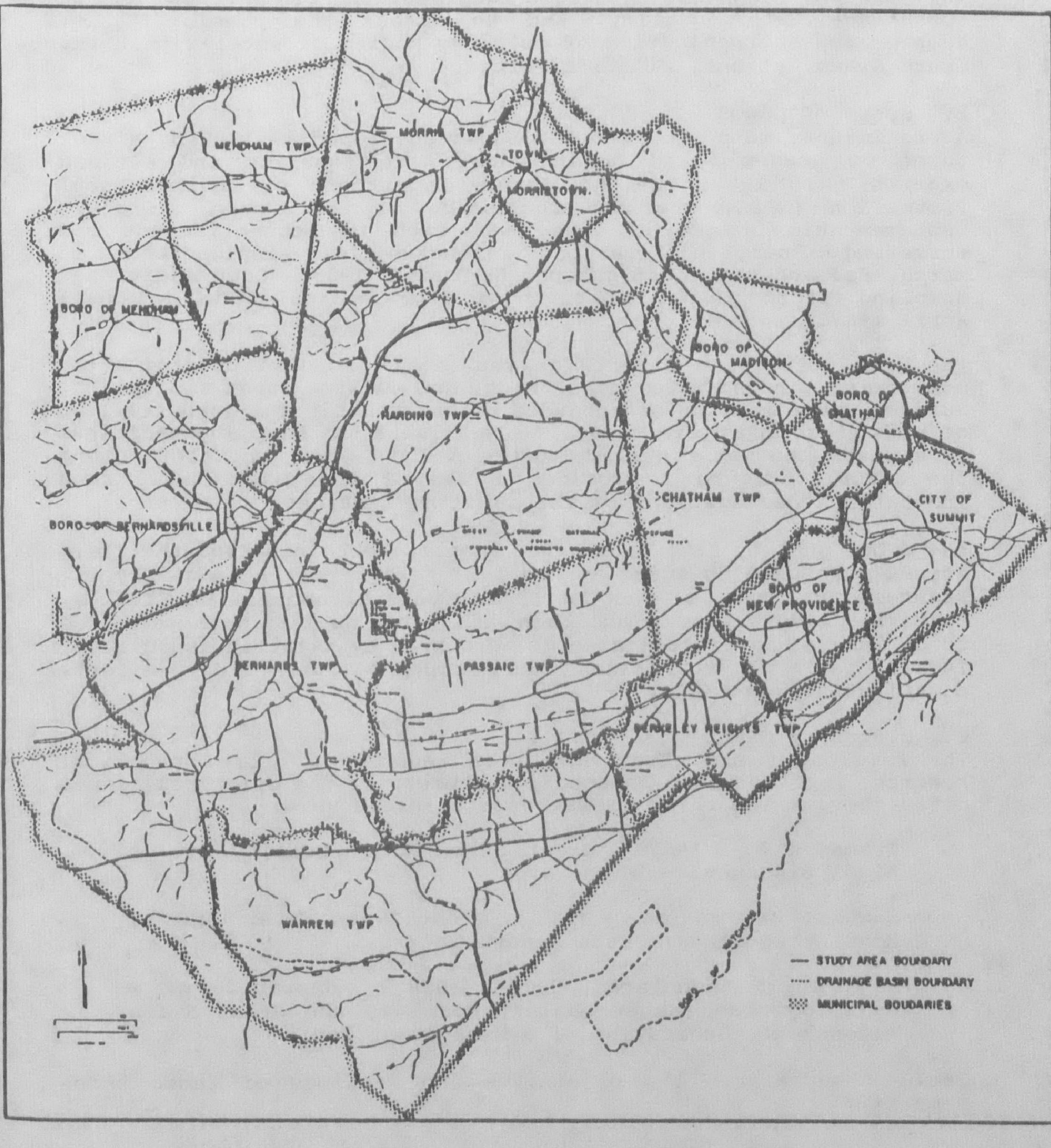
In 1978, the Environmental Protection Agency (EPA) identified major environmental issues associated with the draft Facilities Plan and issued a notice of intent (NOI) to prepare an environmental impact statement (EIS) on the Plan. Among the major issues identified at that time were (EPA, 1981):

- secondary impacts associated with expansion and upgrading of WWTPs;
- impacts of the Chatham Township and Morris-Woodland WWTPs on the Great Swamp National Wildlife Refuge (GSNWR)
- expansion and construction of WWTPs within the flood hazard area;
- chlorine and ammonia toxicity associated with the wastewater discharges in the Black Brook, Dead River, Loantaka Brook, and Passaic River; and
- public controversy.

The draft EIS on the UPRB 201 Facilities Plan was issued by EPA in June, 1981. A public hearing was held on August 20, 1981 to discuss the 201 Plan and its draft EIS; additionally, written comments on the draft EIS were solicited according to NEPA guidelines.

Comments received during the public hearing and comments received in writing repeatedly raised the issue of potential impacts to water quality in the GSNWR resulting from discharges from wastewater treatment plants (WWTPs) to streams traversing that swamp, as well as water quality impacts that might be generated by additions of nutrients from non-point sources.

FIGURE 1
Municipalities Included in UPRB 201 Facilities Plan



The Great Swamp Water Quality Study (GSWQS) was developed in response to these areas of concern, and was designed to provide information regarding possible degradation of surface and/or subsurface water quality, and to assess the possibility of accelerated eutrophication of existing bodies of water within the Great Swamp National Wildlife Refuge.

B. Scope of GSWQS

A preliminary scope for the GSWQS was developed in 1980 by a task force of academic and governmental water quality and wetland experts. In 1982, the New Jersey Department of Environmental Protection (NJDEP) refined the scope of the study. Project implementation began in late 1983 with the establishment and surveying of sampling locations; intensive field sampling began in March 1984 and continued through September 1985. Some additional sampling efforts (e.g., monitoring of storm events) continued until April 1987.

The data collection effort for the GSWQS included precipitation monitoring, ground water monitoring, and surface water monitoring. Surface water monitoring included both automatic and grab sampling of base flows and storm flows. Table 1 lists the sampling locations from which the water quality and flow data were generated during the GSWQS. Figure 2 provides a map of the Great Swamp area indicating the locations of the sampling stations.

The water quality data (and water samples) obtained from the field effort were used to guide an Algal Bioassay Program headed by Dr. Francesco B. Trama of the Center for Coastal and Marine Studies, Rutgers, University. In addition, the water quality data were used to calibrate a hydrological model prepared by Najarian Associates, Inc. Table 2 summarizes the scope of the study efforts constituting the GSWQS.

C. Status of GSWQS

The results of the study have been reported in three technical reports, each focusing on specific subsets of the principal issues cited above. The three GSWQS reports issued were:

Trama, F.B. 1987. Great Swamp Water Quality Study: Algal Bioassay.

Maguire Group, Inc. 1988. Great Swamp Water Quality Monitoring Study: Data Report.

Najarian & Associates, Inc. 1988. Adaptation of a Hydrologic and Water Quality Model to the Great Swamp Watershed: Generation of a Management Tool.

Table 3 summarizes the objectives and findings of these three reports.

TABLE 1
Locations of GSWQS Surface Water Sampling Stations

Station No.	Location
100	Loantaka Brook above Morris-Woodland WWTP
105	Loantaka Brook, 100' below Morris-Woodland WWTP
110	Loantaka Brook at Green Village Road
120	Great Brook at Woodland Road
160	Great Brook on Dike Road (GSNWR)
170	Primrose Brook near Katz' weir
180	Loantaka/Great Brook at Pleasant Plains Road
200	Black Brook at Southern Boulevard Bridge
215	Drainage ditch below outfall of Chatham WWTP
220	Drainage ditch at GSNWR boundary
240	Black Brook at New Vernon Road Bridge
270	Middle Brook at Pleasant Plains Road
280	Black Brook at Pleasant Plains Road
340	Passaic River at Osborne Pond spillway
320	Passaic River at USGS Millington Gage

FIGURE 2
Locations of GSWQS Sampling Stations

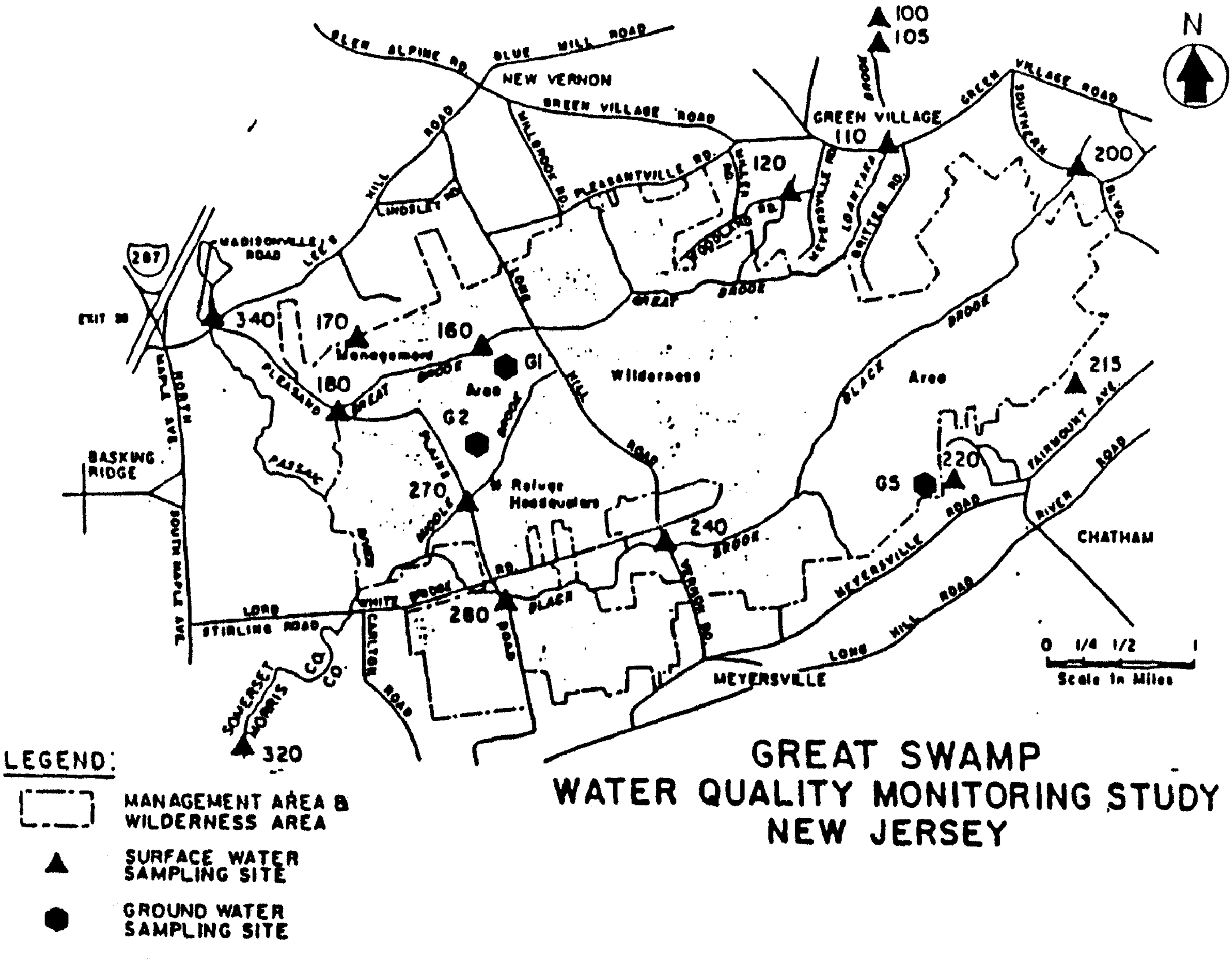


TABLE 2
Summary of GSWQS Sampling Efforts

Site No.	Base Grab	Storm Grab	Intensive Storm	Bioassay	Flow
100	X	X	X	X	X
105	X	X		X	X
110	X	X	X		X
120	X	X	X	X	X
160	X	X	X		X
170	X	X	X	X	X
180	X	X	X	X	X
200	X	X			X
215	X	X		X	X
220	X	X			X
240	X	X			X
270	X	X			X
280	X	X		X	X
320	X	X	X	X	X
340	X	X	X	X	X

TABLE 3
Summary of Existing GSWQS Reports

REPORT: Great Swamp Water Quality Monitoring Study: Data Report.
DATE: January, 1988
AUTHOR: Maguire Group, Inc.

<u>Objectives of Study</u>:

1) to evaluate the effects of nutrient loading on the Great Swamp National Wildlife Refuge (GSNWR) from point sources (the Morris-Woodland and Chatham WWTPs);

2) to evaluate the effects of nutrient loadings from non-point sources;

3) to provide data to the NJDEP for their modeling analyses; and

4) to provide data for use in establishing wastewater treatment facility wasteload allocations.

<u>Findings</u>: Report details scope and methodology, lists all water quality data, and graphs flow data. No other data evaluation is presented in the report. These data, however, provided the basis for the algal bioassays and hydrological modeling studies cited below.

TABLE 3
Summary of Existing GSWQS Reports
(page 2 of 3)

REPORT: Great Swamp Water Quality Study: Algal Bioassays
DATE: December 1987
AUTHOR: F.B. Trama, Department of Biological Sciences and Center for Coastal and Environmental Studies, Rutgers University, New Brunswick, New Jersey.

Objectives of Study: use of algal bioassays on a seasonal and flow basis to determine the limiting nutrients and eutrophication potential for GSNWR surface waters. Specifically, to:
1) identify the growth-limiting constituents (e.g., N, P, or trace elements);
2) determine availability of the growth-limiting nutrients; and
3) quantify a biological response to changes in nutrient levels.

Findings:
1) water from Stations 100, 120, 170, and 340 are phosphorus-limited with respect to algal growth potential. These streams have a moderate amount of available phosphorus and an adequate supply of inorganic nitrogen to support plant growth.

2) the Passaic River below Osborne Pond (Station 340) is low in available phosphorus and nitrogen, but Station 100 has consistently high concentrations of nitrate-nitrogen.

3) Great Brook (Station 180) and Black Brook (Station 280) are both regarded as nitrogen-limited as they travel through the wetlands of the GSNWR. This is more evident for Black Brook than it is for Great Brook. They both carry a high concentration of phosphorus that presumably arises via the sewage treatment plant effluents. The Black Brook system (Station 280) shows a significantly higher concentration of phosphorus than does Black Brook (Station 180).

3) sewage effluent (Stations 105 and 215) is a rich source for phosphorus and inorganic nitrogen, These effluents as sampled, however, are always nitrogen-limited.

4) the net effect of stream waters entering the Passaic River in the vicinity of GSNWR (Station 320) is an increase in the concentration of phosphorus; little, if any, change in nitrate-nitrogen occurs. The Passaic River at Station 320 varies from nitrogen- to phosphorus-limited depending on quality and quantity of inflows from the upstream region.

Recommendations:
1) the source of the high nitrate concentrations at Station 100 should be identified, if possible.

TABLE 3
Summary of Existing GSWQS Reports
(page 3 of 3)

REPORT: Adaptation of a Hydrologic and Water Quality Model to the Great Swamp Watershed: Generation of a Management Tool.
DATE: January 1988
AUTHORS: J.L. DiLorenzo, H.S. Litwack, T.O. Najarian, and G.O. Marino. Najarian & Associates, Inc. Eatontown, New Jersey.

Objectives of Study:

1) determination of the long-term nutrient budget of the Great Swamp Watershed;

2) development of a technically defensible management tool that is capable of predicting long-term impacts of changes in land use within the Great Swamp Watershed; and

3) assessment of the impacts of the sewage treatment plants within the watershed on the water quality conditions in the Great Swamp.

Findings:

1) under present (1984-85) conditions, the GSNWR acts as an important sink for nutrients originating in the Great Swamp Watershed;

2) the deposition of such nutrients and pollutants within the GSNWR is likely to increase appreciably as a result of realistic projections for the increase in developed acreages within the watershed by the year 2000; the loss of pervious surface accompanying such development will reduce base flows and increase quantities of surface runoff.

3) the model developed provides the means for assessing the extent and duration of water quality impacts from WWTPs on the dissolved oxygen (DO) regime and nutrient fluxes in the streams of the refuge area.

D. Scope of This Review

Background information gathering for this review of the GSWQS included a detailed examination of the three reports cited in Table 3, as well as a review of the 201 Facilities Plan and the subsequent draft EIS. Other information sources used included the annual water quality data published by USGS for New Jersey rivers and streams, technical papers detailing the potential impacts of wastewater discharge into wetland ecosystems, watershed and aquifer studies for the UPRB, draft and final EISs issued by the USFWS for the GSNWR, and Findings of No Significant Impact (FNSIs) issued by the NJDEP for three regional WWTP upgrades.

The quantitative analyses detailed in this appendix have been designed to provide statistically valid statements concerning the temporal and spatial changes in water quality across the study area - the Upper Passaic River Basin. The types of questions "asked" of the GSWQS data base in this report pertain to particular concerns that have been raised by agencies, organizations, and individuals about the present and future state of the Great Swamp. The set of analyses does not exhaust the information that can eventually be gleaned from the water quality study; the data collection effort was extensive, and some aspects of the data base have not been evaluated in detail in this review. This review focuses on nutrient loadings (forms of nitrogen and phosphorus) being added to the Great Swamp and Passaic River by point and non-point loadings from the Upper Passaic River Basin.

II. ANALYTICAL APPROACH TO REVIEW OF GSWQS

A. Issues Resolved in Earlier GSWQS Reports

The summaries of the GSWQS reports on hydrological modeling (Najarian, 1987) and algal bioassays (Trama, 1988) offered in Table 3 include references to specific findings, conclusions, and recommendations set forth in those reports. EPA has reviewed those findings, and concurs with them as stated by the original investigators. However, the GSWQS Data Report (Maguire Group, 1988) contains only raw data and ancillary information (e.g., sampling and quality assurance protocols) and has no interpretation section. Thus, several of the significant questions raised by commentors on the draft EIS need to be evaluated in terms of the data collected by the GSWQS.

The principal applications of the data collected by the Maguire Group were:

1) to evaluate the effects of nutrient loading on the GSNWR from point sources (the Morris-Woodland and Chatham WWTPs);

2) to evaluate the effects of nutrient loadings from non-point sources;

3) to provide data to the NJDEP for their modeling analyses; and

4) provide data for use in establishing WWTP wasteload allocations.

Objective 1 above was evaluated in part in the Trama report on algal bioassays; as noted in Table 1, the Trama report concluded that "sewage effluent (Stations 105 and 215) is a rich source for phosphorus and inorganic nitrogen, These effluents as sampled, however, "are always nitrogen-limited"(Trama, 1987).

Objective 2 - the non-point source issue - was partially evaluated by algal bioassays; the Trama report presents algal bioassay results from water obtained during both base-flow and storm-flow sampling intervals. This review presents additional analyses evaluating the magnitudes and general locations of significant non-point source loadings.

Objective 3 above was satisfactorily met; the data provided to NJDEP and its contractor permitted the development of an analytic model that "provides the means for assessing the extent and duration of water quality impacts from WWTPs on the dissolved oxygen (DO) regime and nutrient fluxes in the streams of the refuge area" (Najarian & Associates, 1988).

Objective 4 - the evaluation of wasteload allocations - has been resolved in part by the modeling results described in the Najarian report. The hydrological/water quality modeling demonstrated that reduction in waste loadings from the WWTPs discharging to the Great Swamp could achieve lowered levels of nutrients, although the reductions achieved by Level 4 treatment were not likely to generate water quality that would meet NJDEP standards for all parameters.

B. Quantitative Methods Used in Review

The changes in water quality over the study area can be quantitatively assessed by comparing grab samples from various combinations of upstream and downstream station sets. The sampling dates for these data sets are the same; all grab samples were taken within the space of one or two hours. The principal difference, then, between any two data sets is the sampling location and the influences on water quality introduced at or upstream of that sampling location. Thus, the differences in water quality variables between two stations can be statistically examined with a paired t-test.

A t-test of paired values begins with the statement of a testable (or "falsifiable") hypothesis termed the null hypothesis. The null hypothesis - the hypothesis accepted or rejected based on the outcome of the statistical test - is generally framed as assuming that the mean difference between the paired values is zero, implying that the means compared are not significantly different and that the values obtained in sampling two locations come from the same large distribution of possible values. The t-statistic derived in the test is either greater or less than the statistical probability established before the test is performed; commonly, a probability of 5 percent is used. From this t-statistic, the probability that the magnitude of the mean difference could happen by chance can be computed. If the probability of occurrence of the mean difference is greater than or equal to 5 percent (in decimal proportions, 0.05), then the mean difference is not significant and the null hypothesis is not discarded. If the probability of occurrence of the mean difference is less than 5 percent, then the mean difference is significant and the null hypothesis is discarded (Steele and Torrie, 1960).

Where statistical comparison of water quality data from several sampling locations is desired, the differences between the means of several data sets can be evaluated using a multiple range test. In this review, the Newman-Keuls multiple range test is used to identify groups of sampling locations whose mean values for a particular water quality parameter are statistically different or not different. The form of the analysis is similar to the paired t-test; in the multiple range test, the number of comparisons is greatly expanded (Steel and Torrie, 1960).

The water quality values of primary concern are biogenic nutrients - nitrogen and phosphorus. These nutrients can occur in aquatic systems as inorganic ions (e.g., orthophosphate, nitrate, and ammonium), as particulate inorganic forms (e.g., phosphate complexes), and as elements or compounds incorporated into organic molecules. Nitrate and orthophosphate are immediately available as plant nutrients; the particulate inorganic and/or organic forms of these nutrients can become available after certain chemical reactions (e.g., hydrolysis of complexes, oxidation of organics, oxidation of ammonium to nitrate).

The GSWQS analyzed samples for two forms of phosphorus: orthophosphate (PO4) and total phosphorus (TP). Nitrogen was analyzed as four forms: nitrate (NO3), ammonia (NH4), total filterable Kjeldahl nitrogen (FTKN) and total unfilterable Kjeldahl nitrogen (UTKN). The statistical analyses of the GSWQS data reported here focus on analysis of orthophosphate, total phosphorus, nitrate, and total soluble inorganic nitrogen (the sum of ammonia and nitrate concentrations) - this latter value was used by Trama as a predictor of plant growth responses in the algal bioassay studies.

The chapter that follows examines over 20 different hypotheses about the relationships between and among sampling stations. The very large size of the GSWQS data base allows hundreds of potential hypotheses to be tested; the key to extracting information of biological significance is to relate a testable hypothesis to the form of the database and to the general water quality under assessment. The hypotheses discussed in Chapter 5 are directly relevant to the objectives of the GSWQS as summarized in the Chapter I of this review.

III. STATISTICAL ANALYSES OF GRAB SAMPLE DATA

A. Influence of WWTPs on Water Quality Under Base Flow Conditions
A principal issue raised in comments about the UPRB 201 Facilities Plan was the magnitude of the impact of WWTP discharges on water quality in Loantaka Brook, Great Brook, and Black Brook. These Passaic River tributaries originate outside of the Great Swamp, receive discharges of treated wastewater from municipal WWTPs, and convey these additional loadings through the Great Swamp.

The array of sampling stations in the GSWQS was arranged so that the influence of discharges from the Morris-Woodland and Chatham WWTPs could be quantitatively assessed. Specifically, Stations 100 and 105 are located on Loantaka Brook above and below the Morris-Woodland WWTP, respectively. These two stations bracket the discharge from that plant, and can be compared to isolate the effects of that WWTP on water quality in Loantaka Brook. The locations of stations on Black Brook are not so conveniently situated; although Station 200 provides a sampling location upstream of the Chatham WWTP, there is no direct correlate of Station 110 on Black Brook. Station 210 is a location that directly samples the discharge of the Chatham WWTP from a ditch that connects to Black Brook; there is no station that samples the brook after mixing of the WWTP discharge with ambient flows.

Keeping in mind the difference in station patterns between the Loantaka Brook/Great Brook and the Black Brook subsystems, the influences of the two WWTPs can be assessed by comparing grab samples from the upstream and downstream sets of stations. The sampling dates for these data sets are the same; all grab samples were taken within the space of one or two hours. Thus, the differences between mean water quality variables between two stations can be statistically examined with t-test statistics. As discussed above, pairs of stations can be compared using the paired t-test; more than two stations can be compared using multiple range comparisons.

1. Loantaka Brook/Great Brook Subsystem Comparisons
Table 4 presents a graphic illustration of the similarities and differences among mean phosphate, nitrate, total phosphorus, and total soluble inorganic nitrogen concentrations in base flow grab samples at the Loantaka Brook/Great Brook stations. Mean nutrient concentrations at stations underlined by the same line are not statistically different from each other; mean nutrient concentrations at stations underlined by different lines are statistically different. For phosphate and total phosphorus, stations 100, 120, 160, 170, 180, and 340 (the Passaic River at the Great Brook confluence) have similar base flow mean concentrations. Station 105 has mean concentrations for these nutrients higher than all other stations, while Station 110 has intermediate

Table 4
Multiple Range Comparison of Base Flow Nutrient Concentrations in the Loantaka Brook/Great Brook (Series 100) Subsystem Stations*

A. Comparison of Mean Orthophosphate at Series 100 Stations

Station Number

	120	170	100	180	160	340	110	105
Population 1	-----	-----	-----	-----	-----	-----		
Population 2							-----	
Population 3								-----

B. Comparison of Mean Nitrate at Series 100 Stations

Station Number

	180	160	170	340	120	100	105	110
Population 1							-----	-----
Population 2	-----	-----	-----	-----	-----			
Population 3						-----		

C. Comparison of Mean Total Phosphorus at Series 100 Stations

Station Number

	120	170	340	100	180	160	110	105
Population 1	-----	-----	-----	-----	-----	-----		
Population 2							-----	
Population 3								-----

D. Comparison of Mean Total Inorganic Nitrogen at Series 100 Stations

Station Number

	180	160	170	340	120	100	110	105
Population 1	-----	-----	-----	-----	-----			
Population 2						-----		
Population 3							-----	
Population 4								-----

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

concentrations significantly different from both Station 105 and from the downstream set. Mean total soluble inorganic nitrogen concentrations at stations 100, 105, and 110 were statistically different from each other and from the downstream stations; mean concentrations at this group of stations were significantly higher than mean total soluble inorganic nitrogen concentrations at the downstream stations. Nitrate concentrations were similar at stations 105 and 110; both these stations and Station 100 had nitrate concentrations significantly higher than downstream stations. This particular finding will be discussed further in sections below.

While multiple range testing permits simultaneous comparison of a relatively large group of sampling locations, paired t-testing offers the opportunity to test specific null hypotheses and discern finer differences in sample means, should such differences exist. Table 5 compares the paired base flow grab sample data for nitrate (NO3) and phosphate (PO4) ions at stations 100 and 110. As the table indicates, base flow grab sample nitrate concentrations at Station 110 are not statistically different from those at Station 100. There is, however, a statistically significant difference in base flow phosphate ion concentrations at Station 100 and Station 110; the phosphate ion concentrations are higher at Station 110 than they are at Station 100.

Table 6 compares paired base flow grab sample data for total soluble inorganic nitrogen (TSIN) and total phosphorus (TP) at stations 100 and 110. In both cases, the data sets are significantly different, and in both cases, the mean for Station 110 is higher than is the mean at Station 100.

The results of the preceding multiple range tests and paired t-tests indicate that the Morris-Woodland WWTP discharge significantly elevated concentrations of phosphate, total soluble inorganic nitrogen, and total phosphorus into Loantaka Brook. These are, in fact, the results generally anticipated; a treatment plant discharge without tertiary nutrient removal is likely to elevate nutrient levels in receiving waters. The counter-intuitive finding in these data was that the mean nitrate levels in Loantaka Brook were statistically the same above and below the Morris-Woodland WWTP. The implication here is that the non-point source loadings to Loantaka Brook might be sufficiently elevated to mask any affect of the Morris-Woodland WWTP on nitrate concentrations.

2. Black Brook Subsystem Comparisons

Table 7 presents a graphic illustration of the similarities and differences among mean nutrient concentrations at stations in the Black Brook subsystem, as determined in a multiple range test. Station 215 consistently shows significantly elevated nutrient levels; Station 220 generally shows a similar relationship, except for nitrate concentrations that are statistically similar to most downstream stations. Stations 240 and 280, both locations in the

TABLE 5

Null Hypothesis #1: The mean differences in nitrate and orthophosphate ion concentrations in base flow grab samples from Loantaka Brook sampling stations above (Sta. 100) and below (Sta. 105) the Morris-Woodland WWTP are equal to zero (sample values are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Base Flow Grab Samples Station 100 NO3	Station 100 PO4	Station 105 NO3	Station 105 PO4
02-Mar-84	1.86	0.038	4.46	2.410
20-Mar-84	1.37	0.050	4.50	2.000
23-Apr-84	1.50	0.050	3.86	2.600
18-May-84	1.49	0.050	1.45	3.000
12-Jun-84	2.13	0.050	0.44	2.040
16-Jul-84	0.82	0.084	1.24	1.430
16-Aug-84	2.82	0.120	1.98	2.500
19-Sep-84	2.94	0.324	2.40	3.260
17-Oct-84	2.30	0.012	2.96	3.700
16-Nov-84	2.26	0.015	0.87	3.340
18-Dec-84	1.39	0.010	2.20	2.980
14-Jan-85	1.38	0.010	8.00	2.650
21-Feb-85	1.30	0.010	5.90	2.170
21-Mar-85	0.85	0.010	2.33	2.600
09-Apr-85	2.10	0.010	0.64	3.050
16-May-85	2.99	0.067	1.55	2.880
24-Jun-85	1.48	0.045	0.57	2.900
08-Jul-85	1.85	0.025	4.19	3.680
13-Aug-85	2.11	0.035	3.52	3.300
17-Sep-85	2.06	0.047	1.52	2.880
MEAN	1.85	0.053	2.73	2.769
STD.DEV.	0.63	0.070	1.97	0.576

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0927, a value greater than 0.05. Thus, the NO3 data columns above ARE NOT statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 6

Null Hypothesis #2: The mean differences in Total Soluble Inorganic Nitrogen (TSIN) and Total Phosphate (TP) concentrations in base flow grab samples from Loantaka Brook sampling stations above (Sta. 100) and below (Sta. 105) the Morris-Woodland WWTP are equal to zero (sample values are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 100		Station 105	
Collection Date	TSIN	TP	TSIN	TP
02-Mar-84	2.36	0.040	12.26	2.920
20-Mar-84	1.91	0.050	10.80	2.070
23-Apr-84	1.85	0.050	9.27	2.580
18-May-84	1.81	0.186	7.05	3.460
12-Jun-84	2.36	0.050	8.44	2.150
16-Jul-84	1.09	0.140	3.94	1.640
16-Aug-84	3.03	0.176	7.48	2.900
19-Sep-84	2.99	0.348	13.20	3.520
17-Oct-84	2.35	0.032	11.76	4.160
16-Nov-84	2.78	0.038	11.87	3.520
18-Dec-84	1.75	0.022	8.20	3.080
14-Jan-85	1.91	0.022	13.80	3.100
21-Feb-85	1.69	0.028	12.10	2.710
21-Mar-85	1.32	0.015	8.83	3.050
09-Apr-85	2.37	0.015	12.84	3.300
16-May-85	3.23	0.082	9.15	3.050
24-Jun-85	1.81	0.142	8.16	3.220
08-Jul-85	2.04	0.070	6.89	4.160
13-Aug-85	2.18	0.054	7.70	3.390
17-Sep-85	2.21	0.035	3.71	2.930
MEAN	2.15	0.080	9.37	3.046
STD.DEV.	0.56	0.082	2.90	0.625

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.0000, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.0000, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

TABLE 7
Multiple Range Comparison of Base Flow Nutrient Concentrations in the Black Brook (Series 200) Subsystem Stations*

A. Comparison of Mean Orthophosphate at Series 200 Stations

	Station Number 200	270	320	280	240	220	215
Population 1				-----	-----		
Population 2	-----	-----	-----				
Population 3						-----	
Population 4							-----

B. Comparison of Mean Nitrate at Series 200 Stations

	Station Number 270	320	280	240	200	220	215
Population 1		-----	-----	-----	-----	-----	
Population 2	-----	-----	-----	-----	-----		
Population 3							-----

C. Comparison of Mean Total Phosphorus at Series 200 Stations

	Station Number 200	320	270	280	240	220	215
Population 1				-----	-----		
Population 2	-----	-----	-----				
Population 3						-----	
Population 4							-----

D. Comparison of Mean Total Soluble Inorganic Nitrogen at Series 200 Stations

	Station Number 270	320	200	280	240	220	215
Population 1	-----	-----	-----	-----	-----		
Population 2						-----	
Population 3							-----

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

GSNWR, show intermediate levels of orthophosphate and total phosphorus that are statistically different from other stations and/or sets of stations.

Tables 8 and 9 summarize the results of paired t-tests on base flow grab sample values for NO3, PO4, TSIN, and TP at Stations 200 and 215. As noted above, Station 200, located upstream of the GSNWR and the Chatham WWTP, is the control station for Black Brook; i.e., water quality at Station 200 is independent of discharges from the Chatham WWTP (although dependent on other sources in the upper watershed of Black Brook). Station 215 is located on the drainage ditch that conveys the Chatham WWTP discharge to Black Brook (Station 215 does not sample the discharge after mixing with Black Brook waters). The paired t-tests shown in the tables demonstrate that the mean concentrations of NO3, PO4, TSIN, and TP are all significantly higher at Station 215 than at Station 200. Thus, the Chatham WWTP discharge is adding biogenic nutrients at concentrations significantly higher than background concentrations in Black Brook.

3. <u>Between Subsystems Comparisons</u>

Table 10 compares base flow grab sample data for NO3 and PO4 at stations 100 and 200. As demonstrated earlier (Table 5), mean base flow NO3 concentrations did not differ significantly at stations 100 and 110, implying that the NO3 contributions from the watershed were relatively high. This last paired t-test demonstrates that the NO3 concentrations at the Loantaka Brook control station (Station 100) were significantly higher than those of the Black Brook control station (Station 200). Phosphate concentrations were similar at these two locations. The water quality at both of these stations reflects point and non-point influences in the watershed, and the difference in mean NO3 concentrations between the stations indicates that watershed loadings of NO3 are substantial in the Loantaka Brook drainage area upstream of the Morris-Woodland WWTP.

4. <u>Discussion</u>

Under base flow conditions, the discharges of treated wastewater from the Morris-Woodland and Chatham treatment plants generate statistically significant increases in nutrient concentrations (orthophosphate, nitrate, total phosphorus, and total soluble inorganic nitrogen) in their receiving waters, Loantaka Brook and Black Brook, respectively. The principal exception to this finding is in Loantaka Brook, where base flow nitrate concentrations in the brook upstream of the Morris-Woodland WWTP discharge are not statistically different from nitrate concentrations in the brook immediately below the discharge. Algal bioassays have demonstrated that these increased nutrient concentrations promote increased algal growth in laboratory cultures.

TABLE 8

Null Hypothesis #3: The mean differences in Nitrate and Orthophosphate Ion Concentrations in base flow grab samples from the Black Brook sampling stations above (Sta. 200) and in the effluent of the Chatham WWTP are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 200		Station 215	
Collection Date	NO3	PO4	NO3	PO4
02-Mar-84	1.20	0.043	2.40	2.260
20-Mar-84	1.26	0.050	2.30	2.330
23-Apr-84	1.11	0.062	2.49	2.080
18-May-84	0.89	0.066	3.65	2.920
12-Jun-84	0.56	0.091	3.40	3.260
16-Jul-84	0.25	0.104	2.55	1.640
16-Aug-84	0.64	0.024	3.02	3.200
19-Sep-84	0.89	0.010	3.14	4.540
17-Oct-84	0.52	0.010	1.46	4.740
16-Nov-84	1.27	0.042	2.32	3.660
18-Dec-84	0.95	0.025	1.52	3.680
14-Jan-85	2.66	0.015	1.28	3.840
21-Feb-85	1.20	0.025	0.63	3.270
21-Mar-85	1.33	0.022	0.50	3.520
09-Apr-85	0.70	0.010	0.45	4.200
16-May-85	0.18	0.015	0.83	4.180
24-Jun-85	0.26	0.101	1.38	4.620
08-Jul-85	0.28	0.015	3.26	3.860
13-Aug-85	0.47	0.038	2.88	4.600
17-Sep-85	0.45	0.015	4.24	4.420
MEAN	0.85	0.039	2.19	3.541
STD.DEV.	0.57	0.031	1.12	0.920

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0004, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 9

Null Hypothesis #4: The mean differences in Total Soluble Inorganic Nitrogen and Total Phosphorus concentrations in base flow grab samples from the Black Brook sampling stations above (Sta. 200) and in the effluent of the Chatham WWTP (Sta. 215) are equal to zero (samples are drawn from the same distribution)

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 200		Station 215	
Collection Date	TSIN	TP	TSIN	TP
02-Mar-84	1.70	0.050	14.00	2.700
20-Mar-84	1.31	0.050	12.30	2.220
23-Apr-84	1.16	0.054	14.49	2.700
18-May-84	0.94	0.108	14.85	3.560
12-Jun-84	0.61	0.098	18.60	4.260
16-Jul-84	0.30	0.106	10.25	2.000
16-Aug-84	0.69	0.088	15.02	4.020
19-Sep-84	0.94	0.086	22.14	4.840
17-Oct-84	0.57	0.046	18.06	4.840
16-Nov-84	1.85	0.064	18.92	3.780
18-Dec-84	1.29	0.045	11.72	3.930
14-Jan-85	2.84	0.033	18.88	4.180
21-Feb-85	1.69	0.045	14.63	3.760
21-Mar-85	1.50	0.030	20.60	4.180
09-Apr-85	0.73	0.062	20.45	4.670
16-May-85	0.29	0.062	20.43	4.330
24-Jun-85	0.55	0.165	17.18	4.690
08-Jul-85	0.31	0.089	18.26	4.520
13-Aug-85	0.83	0.076	12.88	4.670
17-Sep-85	0.49	0.109	14.23	4.640
MEAN	1.03	0.073	16.39	3.925
STD.DEV.	0.65	0.033	3.39	0.872

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.0000, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.0000, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

TABLE 10

Null Hypothesis #5: The mean differences in Nitrate and Orthophosphate ion concentrations in base flow grab samples from the Loantaka Brook sampling station above the Morris-Woodland WWTP (Sta. 100) and those from Black Brook above the Chatham Township WWTP (Sta. 200) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 100		Station 200	
Collection Date	NO3	PO4	NO3	PO4
02-Mar-84	1.86	0.038	1.20	0.043
20-Mar-84	1.37	0.050	1.26	0.050
23-Apr-84	1.50	0.050	1.11	0.062
18-May-84	1.49	0.050	0.89	0.066
12-Jun-84	2.13	0.050	0.56	0.091
16-Jul-84	0.82	0.084	0.25	0.104
16-Aug-84	2.82	0.120	0.64	0.024
19-Sep-84	2.94	0.324	0.89	0.010
17-Oct-84	2.30	0.012	0.52	0.010
16-Nov-84	2.26	0.015	1.27	0.042
18-Dec-84	1.39	0.010	0.95	0.025
14-Jan-85	1.38	0.010	2.66	0.015
21-Feb-85	1.30	0.010	1.20	0.025
21-Mar-85	0.85	0.010	1.33	0.022
09-Apr-85	2.10	0.010	0.70	0.010
16-May-85	2.99	0.067	0.18	0.015
24-Jun-85	1.48	0.045	0.26	0.101
08-Jul-85	1.85	0.025	0.28	0.015
13-Aug-85	2.11	0.035	0.47	0.038
17-Sep-85	2.06	0.047	0.45	0.015
MEAN	1.85	0.053	0.85	0.039
STD.DEV.	0.63	0.070	0.57	0.031

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0002, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.2160, a value greater than 0.05. Thus, the PO4 data columns above ARE NOT statistically different.

B. Influence of Great Swamp on Base Flow Water Quality

The sampling conducted during the GSWQS was designed to provide data from the Loantaka Brook/Great Brook system and Black Brook at both ends of their respective drainages through the GSNWR. On Loantaka Brook, Station 110 provides data from water quality in Loantaka Brook before the brook enters the GSNWR; Station 180 provides equivalent data at the point where Great Brook exits the GSNWR (Loantaka is tributary to Great Brook southwest of the Morris-Woodland WWTP). Similarly, Station 240 provides data for Black Brook at the point where this brook exits the wilderness area and enters the management area (at this point, it has received the discharge from the Chatham WWTP), while Station 280 provides data for Black Brook at the point where the brook exists the GSNWR. These paired sampling stations permit a comparison of nutrient levels before and after these streams traverse substantial tracts of wetlands. The technical literature on wetlands (e.g., Reddy and Smith, 1987, Hammer, 1989, Kadlec and Bevis, 1990) indicates generally that wetlands serve as a overall sink for nutrients (e.g., nitrogen and phosphorus); the GSWQS provides data to test this hypothesis in the specific context of the Great Swamp.

1. Loantaka/Great Brook Subsystem Comparisons

Tables 11 and 12 present paired t-test analyses for base flow grab sample nutrient concentrations at Loantaka Brook /Great Brook stations 110 and 180. Mean concentrations of NO3, PO4, TSIN, and TP are all significantly lower at station 180 than at Station 110, indicating that, under base flow conditions, the swamp is generally serving as a sink for biogenic nutrients entering the swamp in Loantaka Brook.

2. Black Brook Subsystem Comparisons

Tables 13 and 14 present similar paired t-tests for Black Brook stations 240 and 280. Here, the base flow mean concentrations of NO3, PO4, and TSIN are not significantly different; mean concentrations of these biogenic nutrients remain the same between those two stations. Only TP concentrations show a significant difference, with mean TP concentrations at Station 240 being significantly higher than those at Station 280. This would indicate that a limited amount of nutrient removal is occurring in the Great Swamp system between stations 240 and 280. Note here that the spatial separation between stations 240 and 280 is substantially less than the separation between stations 110 and 180 in the Loantaka Brook/Great Brook comparisons made earlier; thus, there is less opportunity for cycling and or removal of nutrients.

3. Between Subsystems Comparisons

Tables 15 and 16 compare base flow nutrient concentrations between the two streams at their respective exits from the GSNWR. Mean NO3, PO4, TSIN and TP concentrations are all significantly higher at Station 280 than at Station 180; Black Brook subsystem is apparently exporting higher base flow concentrations of nutrients to the Passaic River than is the Great Brook subsystem.

TABLE 11

Null Hypothesis #6: The mean differences in Nitrate and Orthophosphate ion concentrations in base flow grab samples from the Loantaka Brook sampling station below the Morris-Woodland WWTP (Sta. 110) and those from Great Brook just before its Passaic River confluence (Sta. 180) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 110		Station 180	
Collection Date	NO3	PO4	NO3	PO4
02-Mar-84	1.80	0.543	0.29	0.038
20-Mar-84	1.88	0.494	0.08	0.050
23-Apr-84	2.60	0.519	0.05	0.050
18-May-84	3.45	0.660	0.05	0.050
12-Jun-84	3.20	0.504	0.05	0.272
16-Jul-84	2.37	0.670	0.05	0.296
16-Aug-84	1.61	1.200	1.32	0.124
19-Sep-84	3.65	1.960	0.05	0.048
17-Oct-84	1.78	2.450	0.05	0.048
16-Nov-84	1.44	1.670	0.07	0.025
18-Dec-84	5.80	1.200	0.05	0.020
14-Jan-85	5.50	1.240	0.50	0.020
21-Feb-85	2.30	0.678	0.16	0.030
21-Mar-85	4.10	1.290	0.38	0.020
09-Apr-85	1.67	1.490	0.12	0.025
16-May-85	2.77	2.140	0.45	0.124
24-Jun-85	2.98	1.060	0.46	0.109
08-Jul-85	2.88	1.810	0.32	0.101
13-Aug-85	2.68	1.900	0.75	0.100
17-Sep-85	2.82	1.510	0.27	0.045
MEAN	2.86	1.249	0.28	0.080
STD.DEV.	1.20	0.607	0.32	0.078

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0000, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 12

Null Hypothesis #7: The mean differences in Total Soluble Inorganic Nitrate and Phosphorus concentrations in base flow grab samples from the Loantaka Brook sampling station below the Morris-Woodland WWTP (Sta. 110) and those from Great Brook just before its Passaic River confluence (Sta. 180) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 110		Station 180	
Collection Date	TSIN	TP	TSIN	TP
02-Mar-84	3.60	0.760	0.34	0.048
20-Mar-84	3.13	0.478	0.13	0.050
23-Apr-84	3.48	0.588	0.10	0.050
18-May-84	4.70	0.900	0.10	0.050
12-Jun-84	3.25	0.608	0.10	0.298
16-Jul-84	2.42	1.540	0.10	0.278
16-Aug-84	1.93	1.430	1.37	0.410
19-Sep-84	9.40	2.300	0.10	0.078
17-Oct-84	9.28	2.700	0.08	0.076
16-Nov-84	7.04	1.880	0.11	0.047
18-Dec-84	8.45	1.440	0.08	0.035
14-Jan-85	9.60	1.490	0.56	0.033
21-Feb-85	4.90	0.904	0.20	0.050
21-Mar-85	7.90	1.600	0.42	0.030
09-Apr-85	5.85	1.720	0.15	0.052
16-May-85	6.97	2.260	0.48	0.228
24-Jun-85	3.63	1.200	0.49	0.144
08-Jul-85	3.55	2.060	0.35	0.218
13-Aug-85	2.99	1.980	0.78	0.196
17-Sep-85	4.61	1.570	0.36	0.040
MEAN	5.33	1.470	0.32	0.121
STD.DEV.	2.52	0.625	0.32	0.111

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.0000, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired TP values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 13

Null Hypothesis #8: The mean differences in Nitrate and Orthophosphate ion concentrations in base flow grab samples from the Black Brook sampling station upstream of the GSNWR management area (Sta. 240) and Black Brook just before its Passaic River confluence (Sta. 280) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 240		Station 280	
Collection Date	NO3	PO4	NO3	PO4
02-Mar-84	0.49	0.136	0.47	0.126
20-Mar-84	0.32	0.146	0.30	0.124
23-Apr-84	0.41	0.212	0.39	0.222
18-May-84	0.18	0.288	0.30	0.254
12-Jun-84	0.05	0.828	0.05	1.200
16-Jul-84	0.05	0.476	0.05	0.544
16-Aug-84	1.72	0.432	1.58	0.434
19-Sep-84	0.45	0.664	0.48	0.462
17-Oct-84	0.88	1.550	0.12	1.000
16-Nov-84	0.62	0.154	0.56	0.149
18-Dec-84	0.36	0.177	0.45	0.154
14-Jan-85	1.30	0.399	0.18	0.318
21-Feb-85	0.13	0.045	0.34	0.139
21-Mar-85	0.90	0.315	0.95	0.268
09-Apr-85	0.95	0.624	0.95	0.636
16-May-85	1.02	0.990	1.25	1.490
24-Jun-85	1.05	0.852	1.05	0.616
08-Jul-85	0.74	0.905	0.99	0.885
13-Aug-85	1.43	1.340	1.57	1.130
17-Sep-85	0.35	0.579	0.55	0.509
MEAN	0.67	0.556	0.63	0.533
STD.DEV.	0.48	0.417	0.47	0.408

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.585, a value greater than 0.05. Thus, the NO3 data columns above ARE NOT statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.638, a value greater than 0.05. Thus, the PO4 data columns above ARE NOT statistically different.

TABLE 14

Null Hypothesis #9: The mean differences in Total Soluble Inorganic Nitrate and Total Phosphorus concentrations in base flow grab samples from the Black Brook sampling station upstream of the GSNWR management area (Sta. 240) and Black Brook just before its Passaic River confluence (Sta. 280) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Base Flow Grab Samples Station 240 TSIN	Station 240 TP	Station 280 TSIN	Station 280 TP
02-Mar-84	0.54	0.164	0.52	0.154
20-Mar-84	0.37	0.158	0.35	0.136
23-Apr-84	0.46	0.270	0.44	0.230
18-May-84	0.23	0.318	0.35	0.288
12-Jun-84	0.56	1.790	0.48	1.420
16-Jul-84	0.25	0.620	0.23	0.672
16-Aug-84	2.61	0.604	2.20	0.584
19-Sep-84	1.53	0.756	0.70	0.540
17-Oct-84	1.01	1.730	0.69	1.090
16-Nov-84	0.67	0.200	0.62	0.186
18-Dec-84	0.48	0.218	0.49	0.184
14-Jan-85	4.30	0.446	2.49	0.342
21-Feb-85	0.65	0.162	1.29	0.181
21-Mar-85	1.16	0.374	1.02	0.300
09-Apr-85	0.98	0.732	0.98	0.704
16-May-85	4.12	1.230	4.45	1.600
24-Jun-85	1.80	1.240	1.46	0.710
08-Jul-85	3.14	1.330	2.59	1.150
13-Aug-85	3.51	1.440	2.75	1.190
17-Sep-85	1.00	0.582	0.81	0.499
MEAN	1.47	0.718	1.25	0.608
STD.DEV.	1.33	0.545	1.10	0.455

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.063, a value greater than 0.05. Thus, the TSIN data columns above ARE NOT statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.035, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 15

Null Hypothesis #10: The mean differences in Nitrate and Orthophosphate ion concentrations in base flow grab samples from the Great Brook sampling station just above its confluence with the Passaic River (Sta. 180) and Black Brook just before its Passaic River confluence (Sta. 280) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data From 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Base Flow Grab Samples Station 180 NO3	Station 180 PO4	Station 280 NO3	Station 280 PO4
02-Mar-84	0.29	0.038	0.47	0.126
20-Mar-84	0.08	0.050	0.30	0.124
23-Apr-84	0.05	0.050	0.39	0.222
18-May-84	0.05	0.050	0.30	0.254
12-Jun-84	0.05	0.272	0.05	1.200
16-Jul-84	0.05	0.296	0.05	0.544
16-Aug-84	1.32	0.124	1.58	0.434
19-Sep-84	0.05	0.048	0.48	0.462
17-Oct-84	0.05	0.048	0.12	1.000
16-Nov-84	0.07	0.025	0.56	0.149
18-Dec-84	0.05	0.020	0.45	0.154
14-Jan-85	0.50	0.020	0.18	0.318
21-Feb-85	0.16	0.030	0.34	0.139
21-Mar-85	0.38	0.020	0.95	0.268
09-Apr-85	0.12	0.025	0.95	0.636
16-May-85	0.45	0.124	1.25	1.490
24-Jun-85	0.46	0.109	1.05	0.616
08-Jul-85	0.32	0.101	0.99	0.885
13-Aug-85	0.75	0.100	1.57	1.130
17-Sep-85	0.27	0.045	0.55	0.509
MEAN	0.28	0.080	0.63	0.533
STD.DEV.	0.32	0.078	0.47	0.408

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0001, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 16

Null Hypothesis #11: The mean differences in Total Soluble Inorganic Nitrate and Total Phosphorus concentrations in base flow grab samples from the Great Brook sampling station just above its confluence with the Passaic River (Sta. 180) and Black Brook just before its Passaic River confluence (Sta. 280) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Base Flow Grab Samples Station 180 TSIN	Station 180 TP	Station 280 TSIN	Station 280 TP
02-Mar-84	0.34	0.048	0.52	0.154
20-Mar-84	0.13	0.050	0.35	0.136
23-Apr-84	0.10	0.050	0.44	0.230
18-May-84	0.10	0.050	0.35	0.288
12-Jun-84	0.10	0.298	0.48	1.420
16-Jul-84	0.10	0.278	0.23	0.672
16-Aug-84	1.37	0.410	2.20	0.584
19-Sep-84	0.10	0.078	0.70	0.540
17-Oct-84	0.08	0.076	0.69	1.090
16-Nov-84	0.11	0.047	0.62	0.186
18-Dec-84	0.08	0.035	0.49	0.184
14-Jan-85	0.56	0.033	2.49	0.342
21-Feb-85	0.20	0.050	1.29	0.181
21-Mar-85	0.42	0.030	1.02	0.300
09-Apr-85	0.15	0.052	0.98	0.704
16-May-85	0.48	0.228	4.45	1.600
24-Jun-85	0.49	0.144	1.46	0.710
08-Jul-85	0.35	0.218	2.59	1.150
13-Aug-85	0.78	0.196	2.75	1.190
17-Sep-85	0.36	0.040	0.81	0.499
MEAN	0.32	0.121	1.25	0.608
STD.DEV.	0.32	0.111	1.10	0.455

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.0001, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.0001, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

4. Discussion

The analyses of base flow data described in the preceding sections confirm and expand upon the findings presented in the GSWQS reports issued earlier. There are significant differences in mean nutrient concentrations between and among sampling locations; these significant differences reflect the non-point source loadings from the watersheds, the point source loadings of the Morris-Woodland and Chatham WWTPs, and the nutrient fluxes affected by processes within the Great Swamp. Conversely, there are extensive similarities in water quality data from certain sets of sampling locations; these similarities are of equal importance in evaluating nutrient dynamics in the Great Swamp ecosystem.

The point source loadings of the WWTPs are clearly discernible in the base flow grab sample data bases. Figures 3 and 4 make this point in a graphical summation of the mean concentrations of nutrients in base flow grab sample data. In almost all comparisons between stations, nutrient concentrations increase downstream of the WWTP discharges, indicative of point source nutrient loading from these WWTPs. The mean nutrient concentrations, however, decline relatively quickly at sampling locations further downstream of the WWTP discharges; this finding indicates that nutrients are being removed by some combination of physical, chemical, or biological mechanisms operating in the Great Swamp ecosystem.

The notable exception to the generalization stated above is the high level of nitrate in Loantaka Brook above the Morris-Woodland WWTP. The mean base flow grab sample nitrate concentration at Station 100 was 1.85 mg/l, a mean not significantly different (in a paired t-test) from the mean nitrate concentration of 2.73 mg/l at Station 105. However, the nitrate concentrations at Station 110 were not significantly correlated with either the Station 100 nitrate concentrations or the Station 105 nitrate concentrations, nor were they significantly related to a multiple regression on Station 100 and 105 nitrate values. Thus, the mean nitrate concentration of 2.86 mg/l at Station 110 does not appear to be determined by any simple factor, but rather by a complex of watershed influences.

The recovery of Loantaka Brook (i.e., the lowering of nutrient levels downstream of the Morris-Woodland WWTP) is markedly apparent, as is the similarity in nutrient concentrations at sampling locations below Station 100 in the Loantaka/Great Brook subsystem. In the multiple range test, the set of stations including stations 120, 160, 170, 180, and 340 had means not significantly different for PO4, TP, NO3, and TSIN. This finding confirms the role of the Great Swamp as a nutrient sink, and also indicates that there are no significant differences in nutrient concentrations among these latter five sampling locations (as measured in the Newman-Keuls multiple range test).

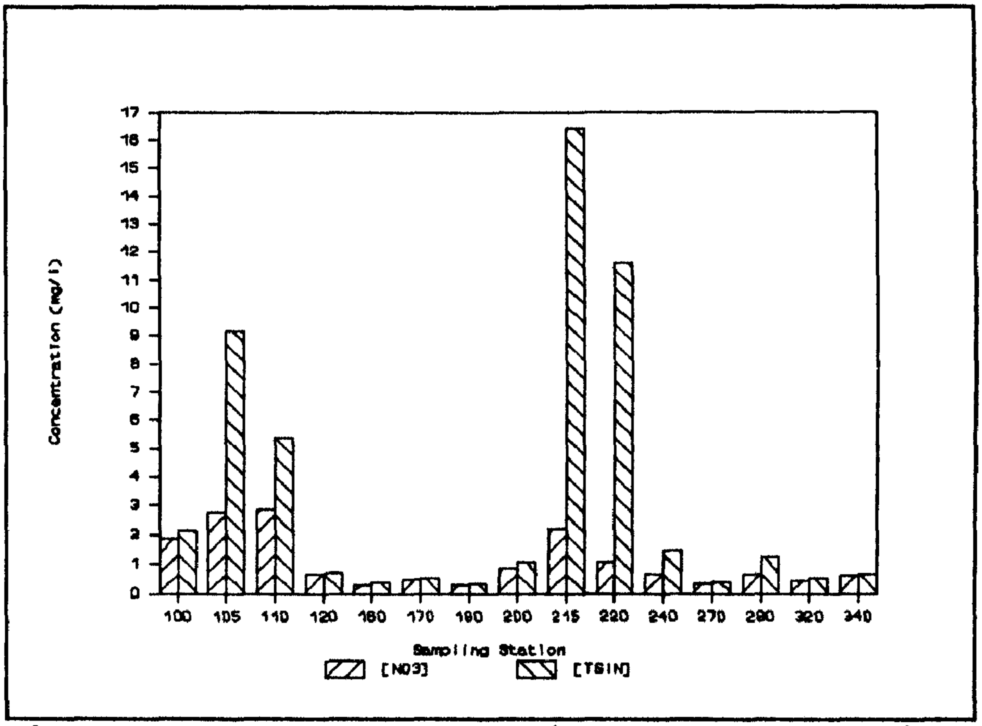


Figure 3. Mean Base Flow Nitrogen Concentrations by Sampling Station

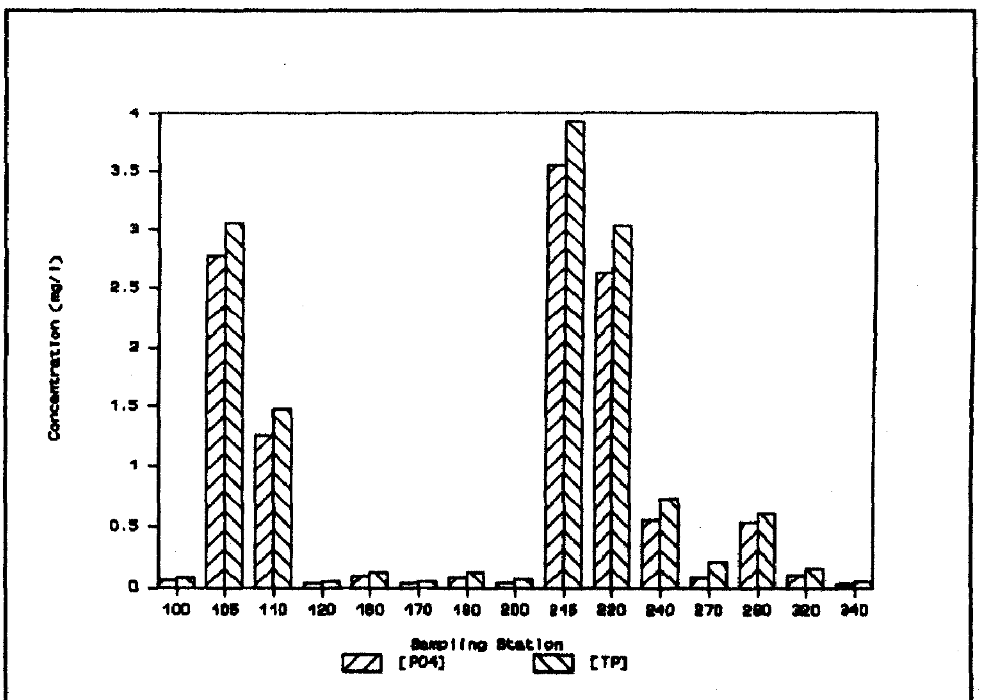


Figure 4. Mean Base Flow Phosphorus Concentrations by Sampling Station

Declines in nutrient levels in the Black Brook subsystem are also apparent, although the declines show a somewhat more complex pattern than do concentrations in the Loantaka Brook/Great Brook subsystem. In the Black Brook subsystem, stations 215 and 220, points along the ditch receiving the Chatham WWTP discharge, consistently had higher nutrient concentrations (for all nutrient forms evaluated) than the control station (Station 200) and the downstream locations. Stations 240 and 280 generally had intermediate nutrient concentrations, while stations 200, 270, and 320 had similar low concentrations for all nutrient forms evaluated.

Nitrate concentrations again yielded a complex picture; Station 215 had significantly higher nitrate concentrations than any other location in the Great Brook subsystem, but nitrate concentrations at stations 200 and 220 were statistically similar to concentrations in downstream locations. The similarity of nitrate concentrations at Station 200 to concentrations at locations downstream of the Chatham WWTP discharge (e.g., Station 240) could be indicative of elevated non-point source loadings upstream of Station 200 in the Black Brook watershed. However, in this context it should be pointed out that the mean nitrate concentration at Station 200 (0.85 mg/l) is significantly lower than the mean nitrate concentration at Station 100 (1.85 mg/l). Whatever non-point influences are affecting nitrate concentrations at these two control locations are more pronounced at Loantaka Brook than at Black Brook.

Based on these statistical analyses, it is clear that the influence of the Great Swamp on base flow water quality in Great Brook and Black Brook is significant and beneficial. In general, base flow concentrations of nutrients in the brooks at the end of the swamp are equal to or less than concentrations of those nutrients at the control locations upstream of the study areas (i.e., upstream of both the swamp and the wastewater treatment plants). The lower reaches of the Loantaka Brook/Great Brook system produce a greater degree of reduction in nutrient concentrations than do the lower reaches of the Black Brook system.

C. Influence of WWTPs on Water Quality Under Storm Flow Conditions

Within the design of the GSWQS, grab sampling at 15 stream locations was conducted during storm events as well as during base flow periods. The storm flow grab sample data were taken at several locations on each brook within the GSNWR, permitting comparison of water quality both within and between drainage subsystems. The analytical and statistical approaches for the tests described in this section are the same as for the base flow assessments; only the data bases differ. In general, 13 sets of samples are complete across all stations and provide the basis for the multiple range statistical comparisons. For some tests, there may be 14 or 15 data points for comparison in paired t-tests; for this reason, the means compared in the paired t-tests and multiple range tests for storm flow data may be slightly different.

1. Loantaka Brook/Great Brook Subsystem Comparisons

Table 17 presents a graphical illustration of the similarities and differences discerned by a multiple range test among mean nutrient concentrations in 13 grab samples from storm flows taken at stations in the Loantaka Brook/Great Brook subsystem (plus Station 340, the Passaic River station just upstream of the Great Brook confluence). The basic relationship among stations is that of similarity among the sampling stations downstream of Station 110 and of dissimilarity between stations 105 and 100 and from the downriver set of six stations. Only in mean nitrate concentration does the pattern differ; here, station 100 is grouped as similar to stations 105 and 110, while the downriver set of five stations form two overlapping sets with statistically similar concentrations.

Tables 18 and 19 summarize paired t-tests for storm flow grab sample data (NO3, PO4, TSIN, TP) from Stations 100 and 105. Recall that Station 100 is on Loantaka Brook above the Morris-Woodland WWTP discharge, while Station 110 is below the discharge. Mean PO4, TSIN, and TP concentrations were significantly higher in storm flow grab samples at Station 105 than at Station 100; mean NO3 concentrations were not significantly different at these locations.

2. Black Brook Subsystem Comparisons

Table 20 presents a graphical illustration of the similarities and differences discerned by a multiple range test among mean nutrient concentrations in 13 grab samples from storm flows taken at stations in the Black Brook subsystem (plus Station 320, the Passaic River station just downstream of the Black Brook confluence). The basic relationship for phosphorus levels among stations is that of similarity among the downriver set of five stations, with Station 215 and Station 210 different from this downriver set and from each other. In terms of nitrate concentrations, Station 220 is similar to the downriver set rather than being in its own 'population." Figures 5 and 6 illustrate the changes in nitrogen and phosphorus concentrations in storm flows at all sampling locations.

Table 17
Multiple Range Comparison of Storm Flow Nutrient Concentrations in the Loantaka Brook/Great Brook (Series 100) Subsystem Stations*

A. Comparison of Mean Orthophosphate at Series 100 Stations

	Station Number							
	100	120	340	160	170	180	110	105
Population 1	-----	-----	-----	-----	-----	-----		
Population 2							-----	
Population 3								-----

B. Comparison of Mean Nitrate at Series 100 Stations

	Station Number							
	340	180	160	170	120	100	105	110
Population 1						-----	-----	-----
Population 2		-----	-----	-----	-----			
Population 3	-----	-----	-----	-----				

C. Comparison of Mean Total Phosphorus at Series 100 Stations

	Station Number							
	120	340	100	170	160	180	110	105
Population 1	-----	-----	-----	-----	-----	-----		
Population 2							-----	
Population 3								-----

D. Comparison of Mean Total Soluble Inorganic Nitrogen at Series 100 Stations

	Station Number							
	160	170	340	120	180	100	110	105
Population 1	-----	-----	-----	-----	-----	-----		
Population 2							-----	
Population 3								-----

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

TABLE 18

Null Hypothesis #12: The mean differences in Nitrate and Orthophosphate ion concentrations in storm flow grab samples from the Loantaka Brook sampling station above (Sta. 100) and below (Sta. 105) the Morris-Woodland WWTP are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 14 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 100		Station 105	
Collection Date	NO3	PO4	NO3	PO4
14-Mar-84	0.47	0.050	1.25	0.556
06-Apr-84	1.34	0.050	1.73	0.540
17-Apr-84	1.24	0.050	2.27	1.540
23-Aug-84	1.97	0.076	0.66	2.680
05-Sep-84	1.98	0.032	0.34	2.100
02-Oct-84	1.49	0.020	0.64	2.460
30-Oct-84	1.42	0.010	0.84	2.340
30-Nov-84	1.37	0.020	0.42	2.870
28-Dec-84	1.80	0.010	5.00	2.200
12-Mar-85	0.95	0.015	1.80	1.130
03-May-85	1.25	0.042	1.25	0.010
26-Jul-85	1.17	0.194	0.86	2.380
26-Aug-85	1.57	0.096	3.20	2.280
03-Oct-85	0.70	0.060	0.47	1.300
MEAN	1.34	0.052	1.48	1.742
STD.DEV.	0.44	0.048	1.30	0.900

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.744, a value greater than 0.05. Thus, the NO3 data columns above ARE NOT statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 19

Null Hypothesis #13: The mean differences in Total Soluble Inorganic Nitrate and Total Phosphorus concentrations in storm flow grab samples from the Loantaka Brook sampling station above (Sta. 100) and below (Sta. 105) the Morris-Woodland WWTP are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 14 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 100		Station 105	
Collection Date	TSIN	TP	TSIN	TP
14-Mar-84	0.60	0.166	2.88	0.880
06-Apr-84	1.91	0.035	3.68	0.730
17-Apr-84	1.92	0.050	10.07	1.800
23-Aug-84	2.18	0.110	9.36	2.800
05-Sep-84	2.23	0.080	7.44	2.210
02-Oct-84	1.62	0.064	9.94	2.860
30-Oct-84	1.69	0.062	12.84	2.680
30-Nov-84	1.67	0.030	15.02	3.270
28-Dec-84	2.44	0.042	9.50	2.680
12-Mar-85	1.20	0.062	7.00	1.260
03-May-85	1.38	0.198	2.85	0.600
26-Jul-85	1.26	0.218	6.86	2.580
26-Aug-85	1.96	0.220	7.08	2.800
03-Oct-85	1.05	0.170	5.47	2.510
MEAN	1.65	0.108	7.86	2.119
STD.DEV.	0.51	0.071	3.57	0.895

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.000, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.000, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

TABLE 20
Multiple Range Comparison of Storm Flow Nutrient Concentrations in the Black Brook (Series 200) Subsystem Stations*

A. Comparison of Mean Orthophosphate at Series 200 Stations

	Station Number						
	320	200	270	280	240	220	215
Population 1					-----	-----	
Population 2	-----	-----	-----	-----	-----		
Population 3							-----

B. Comparison of Mean Nitrate at Series 200 Stations

	Station Number						
	270	320	240	280	220	200	215
Population 1	-----	-----	-----	-----	-----	-----	
Population 2							-----

C. Comparison of Mean Total Phosphorus at Series 200 Stations

	Station Number						
	200	320	270	280	240	220	215
Population 1	-----	-----	-----	-----	-----		
Population 2						-----	
Population 3							-----

D. Comparison of Mean Total Soluble Inorganic Nitrogen at Series 200 Stations

	Station Number						
	270	320	200	280	240	220	215
Population 1	-----	-----	-----	-----	-----		
Population 2						-----	
Population 3							-----

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

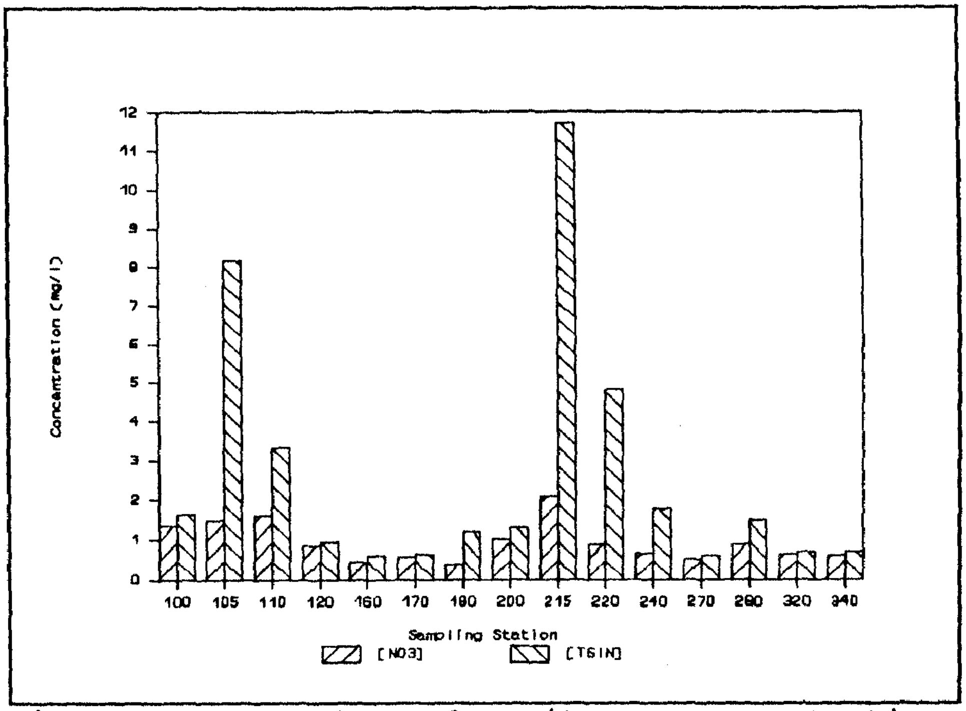


Figure 5. Mean Storm Flow Nitrogen Concentrations by Sampling Station

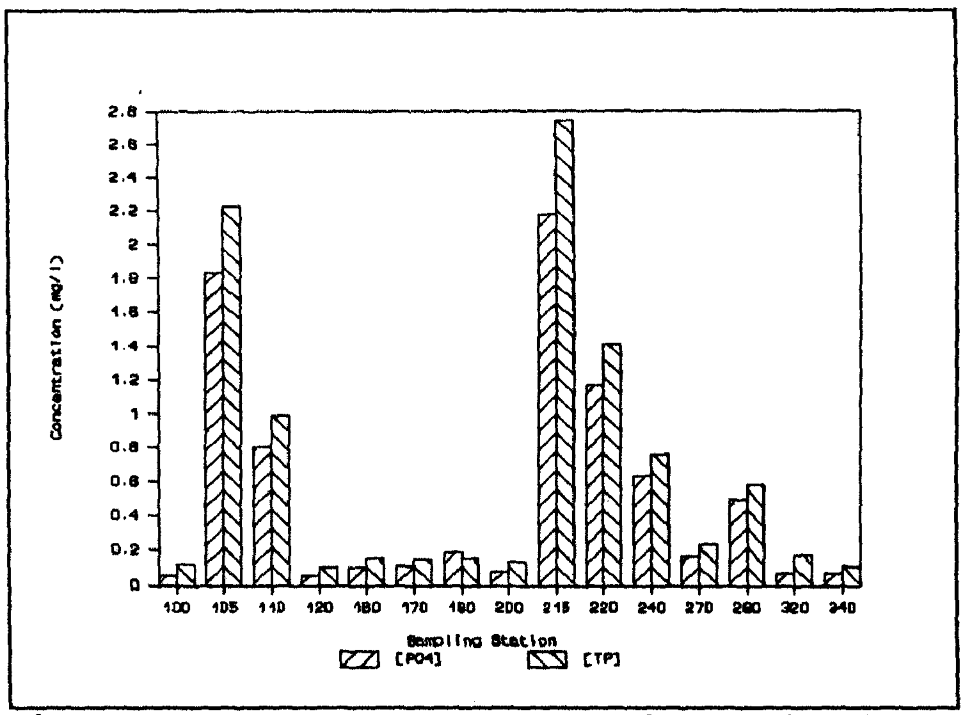


Figure 6. Mean Storm Flow Phosphorus Concentrations by Sampling Station

Tables 21 and 22 summarize paired t-tests for storm flow grab data from Stations 200 and 215. Recall that Station 200 is on Black Brook before that brook enters the GSNWR, while Station 215 is on the drainage ditch receiving the discharge from the Chatham WWTP. Mean NO3, PO4, TSIN, and TP concentrations are all significantly higher at Station 215 than at Station 200.

3. Between Subsystem Comparisons

Table 23 summarizes the paired t-test comparing NO3 and PO4 concentrations in storm flow grab samples at Stations 100 and 200. Mean PO4 concentrations are not significantly different. Mean NO3 concentrations, however, are significantly higher at Station 100 than at Station 200. This difference mirrors the finding described earlier with respect to base flow NO3 concentrations at these two stations, that the NO3 concentrations in Loantaka Brook at Station 100 appear to be elevated prior to the brook receiving the discharge of the Morris-Woodland WWTP. Table 24 compares storm flow grab sample concentrations of TSIN and TP at stations 100 and 200; here, only the mean concentrations of TSIN are statistically different between these stations.

4. Discussion

Neither the Morris-Woodland nor the Chatham Township WWTP receives and discharges stormwater by design; thus, the quality of the discharges from these facilities should be relatively independent of rainfall events. Conversely, non-point source runoff from watershed areas should transiently elevate concentrations of nutrients and contaminants in surface waters receiving such surface runoff. The statistical tests described above indicate that both the Morris-Woodland and Chatham Township WWTP discharges elevate nutrient concentrations in their respective receiving streams under storm flow conditions as well as under base flow conditions. This effect was graphically illustrated in Figures 5 and 6.

TABLE 21

Null Hypothesis #14: The mean differences in Nitrate and Orthophosphate Ion Concentrations in storm flow grab samples from the Black Brook sampling stations above (Sta. 200) and in the effluent of the Chatham WWTP (Sta. 215) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 15 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Storm Flow Grab Samples Station 200 NO3	Station 200 PO4	Station 215 NO3	Station 215 PO4
14-Mar-84	0.56	0.050	1.48	0.950
06-Apr-84	0.77	0.050	2.41	0.530
17-Apr-84	0.88	0.076	1.04	0.435
31-May-84	0.40	0.050	1.82	0.494
23-Aug-84	0.54	0.010	1.63	3.300
05-Sep-84	1.06	0.032	7.00	4.480
02-Oct-84	0.97	0.012	2.30	4.040
30-Oct-84	0.63	0.036	1.72	3.780
30-Nov-84	1.07	0.033	1.30	2.600
28-Dec-84	2.02	0.015	1.02	2.820
12-Mar-85	1.30	0.020	0.75	1.090
03-May-85	0.80	0.018	1.38	0.768
26-Jul-85	0.96	0.515	2.69	2.400
26-Aug-85	1.37	0.100	3.68	0.595
03-Oct-85	0.93	0.073	1.10	1.000
MEAN	0.95	0.074	2.16	2.024
STD.DEV.	0.42	0.130	1.59	1.482

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.000, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.000, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 22

Null Hypothesis #15: The mean differences in Total Soluble Inorganic Nitrogen and Total Phosphorus concentrations in storm flow grab samples from the Black Brook sampling stations above (Sta. 200) and in the effluent of the Chatham WWTP (Sta. 215) are equal to zero (samples are drawn from the same distribution)

Data For Hypothesis Testing: TSIN and TP grab sample data from 15 sampling dates.

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 200		Station 215	
Collection Date	TSIN	TP	TSIN	TP
14-Mar-84	0.61	0.050	5.58	1.040
06-Apr-84	0.82	0.047	5.33	0.630
17-Apr-84	1.00	0.070	9.64	0.460
31-May-84	0.45	0.062	3.54	0.648
23-Aug-84	0.59	0.070	17.63	3.460
05-Sep-84	1.53	0.104	15.20	4.780
02-Oct-84	1.11	0.080	19.90	4.980
30-Oct-84	1.15	0.132	20.52	4.400
30-Nov-84	1.37	0.072	13.90	2.850
28-Dec-84	2.50	0.040	13.82	3.250
12-Mar-85	1.88	0.028	8.05	1.100
03-May-85	0.88	0.100	5.58	0.980
26-Jul-85	1.03	0.520	8.59	2.730
26-Aug-85	1.64	0.300	10.61	2.860
03-Oct-85	1.23	0.110	3.20	2.760
MEAN	1.18	0.124	11.28	2.563
STD.DEV.	0.56	0.132	5.61	1.572

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.000, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.000, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

TABLE 23

Null Hypothesis #16a: The mean differences in Nitrate and Orthophosphate ion concentrations in storm flow grab samples from the Loantaka Brook sampling station above the Morris-Woodland WWTP (Sta. 100) and those from Black Brook above the Chatham Township WWTP (Sta. 200) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 14 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 100		Station 200	
Collection Date	NO3	PO4	NO3	PO4
14-Mar-84	0.47	0.050	0.56	0.050
06-Apr-84	1.34	0.050	0.77	0.050
17-Apr-84	1.24	0.050	0.88	0.076
23-Aug-84	1.97	0.076	0.54	0.010
05-Sep-84	1.98	0.032	1.06	0.032
02-Oct-84	1.49	0.020	0.97	0.012
30-Oct-84	1.42	0.010	0.63	0.036
30-Nov-84	1.37	0.020	1.07	0.033
28-Dec-84	1.80	0.010	2.02	0.015
12-Mar-85	0.95	0.015	1.30	0.020
03-May-85	1.25	0.042	0.80	0.018
26-Jul-85	1.17	0.194	0.96	0.515
26-Aug-85	1.57	0.096	1.37	0.100
03-Oct-85	0.70	0.060	0.93	0.073
MEAN	1.34	0.052	0.99	0.076
STD.DEV.	0.44	0.048	0.40	0.134

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0206, a value less than 0.05. Thus, the NO3 data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.3608, a value greater than 0.05. Thus, the PO4 data columns above ARE NOT statistically different.

TABLE 24

Null Hypothesis #16b: The mean differences in Total Soluble Inorganic Nitrogen and Total Phosphorus concentrations in storm flow grab samples from the Loantaka Brook sampling station above the Morris-Woodland WWTP (Sta. 100) and those from Black Brook above the Chatham Township WWTP (Sta. 200) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 14 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 100		Station 200	
Collection Date	TSIN	TP	TSIN	TP
14-Mar-84	0.60	0.166	0.61	0.050
06-Apr-84	1.91	0.035	0.82	0.047
17-Apr-84	1.92	0.050	1.00	0.070
23-Aug-84	2.18	0.110	0.59	0.070
05-Sep-84	2.23	0.080	1.53	0.104
02-Oct-84	1.62	0.064	1.11	0.080
30-Oct-84	1.69	0.062	1.15	0.132
30-Nov-84	1.67	0.030	1.37	0.072
28-Dec-84	2.44	0.042	2.50	0.040
12-Mar-85	1.20	0.062	1.88	0.028
03-May-85	1.38	0.198	0.88	0.100
26-Jul-85	1.26	0.218	1.03	0.520
26-Aug-85	1.96	0.220	1.64	0.300
03-Oct-85	1.05	0.170	1.23	0.110
MEAN	1.65	0.108	1.24	0.123
STD.DEV.	0.51	0.071	0.52	0.159

Statistical Results (NO3): The probability that the mean difference between paired TSIN values is zero is 0.044, a value less than 0.05. Thus, the TSIN data columns above ARE statistically different.

Statistical Results (PO4): The probability that the mean difference between paired TP values is zero is 0.704, a value greater than 0.05. Thus, the TP data columns above ARE NOT statistically different.

D. Influences of Great Swamp Discharges on Passaic River Water Quality

The GSWQS included two stations on the Passaic River that bracketed the stream discharges from the Great Swamp into the river. Station 340 was located upstream of the GSNWR near the Osborne Pond Dam Spillway. Station 320 was located downstream of the GSNWR at the USGS Millington gauge house just south of the South Maple Avenue Bridge. (Note that the spatial pattern of these two stations is the reverse of their numerical order). Grab samples (both base and storm flows) and intensive storm samples were collected at these two Passaic River stations on the same days that grab samples were collected on the Great Brook and Black Brook station sets.

Tables 25 and 26 compare base flow grab sample concentrations of biogenic nutrients in the Passaic River at Stations 340 and 320. Tables 27 and 28 provide the same comparison for storm flow data.

The base flow comparisons demonstrate that mean nitrate and mean total soluble inorganic nitrogen concentrations are statistically similar at these two Passaic River stations; the Great Swamp tributaries do not elevate nitrogen levels significantly in the Passaic River. However, both the mean orthophosphate and total phosphorus concentrations below the Great Swamp discharges are statistically higher than concentrations above the Great Swamp discharges; the discharges from the Great Swamp are apparently elevating phosphorus levels in the Passaic River.

The storm flow comparisons discern no statistical difference in mean concentrations of any biogenic nutrient in the Passaic River above and below the Great Swamp discharges to the river. Although the storm concentrations in the Great Swamp discharges are themselves elevated over base flow conditions, Passaic River concentrations of nutrients appear to be sufficiently elevated from other influences to mask any effect of the Great Swamp discharges.

TABLE 25

Null Hypothesis #17: The mean differences in Nitrate and Orthophosphate ion concentrations in base flow grab samples from the Passaic River sampling station above the Great Swamp stream discharges (Sta. 340) and those from the Passaic River below the Great Swamp discharges (Sta. 320) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Base Flow Grab Samples			
	Station 340		Station 320	
Collection Date	NO3	PO4	NO3	PO4
02-Mar-84	0.93	0.016	0.46	0.038
20-Mar-84	0.95	0.050	0.25	0.050
23-Apr-84	0.65	0.050	0.19	0.070
18-May-84	0.44	0.050	0.18	0.075
12-Jun-84	0.40	0.050	0.29	0.278
16-Jul-84	0.50	0.056	0.08	0.300
16-Aug-84	0.65	0.012	1.30	0.130
19-Sep-84	0.30	0.024	0.27	0.050
17-Oct-84	0.05	0.020	0.05	0.050
16-Nov-84	0.61	0.025	0.31	0.060
18-Dec-84	0.55	0.012	0.05	0.035
14-Jan-85	1.19	0.010	0.66	0.038
21-Feb-85	1.00	0.012	0.50	0.050
21-Mar-85	0.65	0.015	0.38	0.045
09-Apr-85	0.50	0.010	0.36	0.032
16-May-85	0.41	0.010	0.76	0.196
24-Jun-85	0.66	0.033	0.72	0.157
08-Jul-85	0.52	0.022	0.54	0.119
13-Aug-85	0.52	0.028	0.67	0.154
17-Sep-85	0.20	0.010	0.73	0.082
MEAN	0.58	0.026	0.44	0.100
STD.DEV.	0.27	0.016	0.31	0.080

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.0906, a value greater than 0.05. Thus, the NO3 data columns above ARE NOT statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.0002, a value less than 0.05. Thus, the PO4 data columns above ARE statistically different.

TABLE 26

Null Hypothesis #18: The mean differences in Total Soluble Inorganic Nitrate and Total Phosphorus concentrations in base flow grab samples from the Passaic River sampling station above the Great Swamp stream discharges (Sta. 340) and those from the Passaic River below the Great Swamp discharges (Sta. 320) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 20 sampling dates

Statistical Test: Paired t-Test; p = 0.05

Collection Date	Base Flow Grab Samples Station 340 TSIN	Station 340 TP	Station 320 TSIN	Station 320 TP
02-Mar-84	0.98	0.027	0.51	0.078
20-Mar-84	1.00	0.050	0.30	0.050
23-Apr-84	0.70	0.050	0.24	0.080
18-May-84	0.49	0.050	0.23	0.090
12-Jun-84	0.45	0.050	0.34	0.318
16-Jul-84	0.55	0.158	0.13	0.382
16-Aug-84	0.70	0.046	1.41	0.264
19-Sep-84	0.35	0.038	0.32	0.112
17-Oct-84	0.09	0.062	0.08	0.086
16-Nov-84	0.69	0.030	0.35	0.079
18-Dec-84	0.59	0.028	0.09	0.057
14-Jan-85	1.23	0.018	0.83	0.054
21-Feb-85	1.07	0.020	0.66	0.064
21-Mar-85	0.68	0.018	0.43	0.060
09-Apr-85	0.53	0.012	0.39	0.100
16-May-85	0.45	0.033	0.94	0.347
24-Jun-85	0.80	0.057	0.79	0.240
08-Jul-85	0.64	0.076	0.64	0.218
13-Aug-85	0.59	0.060	0.77	0.216
17-Sep-85	0.25	0.012	0.82	0.084
MEAN	0.64	0.045	0.51	0.149
STD.DEV.	0.28	0.032	0.34	0.109

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.1474, a value greater than 0.05. Thus, the TSIN data columns above ARE NOT statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.0001, a value less than 0.05. Thus, the TP data columns above ARE statistically different.

TABLE 27

Null Hypothesis #19: The mean differences in Nitrate and Orthophosphate ion concentrations in storm flow grab samples from the Passaic River sampling station above the Great Swamp stream discharges (Sta. 340) and those from the Passaic River below the Great Swamp discharges (Sta. 320) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: NO3 and PO4 grab sample data from 15 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 340		Station 320	
Collection Date	NO3	PO4	NO3	PO4
14-Mar-84	1.00	0.050	0.60	0.050
06-Apr-84	0.89	0.050	0.26	0.050
17-Apr-84	0.81	0.050	0.45	0.068
31-May-84	0.54	0.050	0.19	0.082
23-Aug-84	0.60	0.018	1.12	0.079
05-Sep-84	0.41	0.014	0.20	0.050
02-Oct-84	0.27	0.020	0.13	0.042
30-Oct-84	0.22	0.028	0.13	0.118
30-Nov-84	0.68	0.020	0.45	0.052
28-Dec-84	0.95	0.010	0.52	0.035
12-Mar-85	0.18	0.020	0.75	0.035
03-May-85	0.95	0.010	1.35	0.042
26-Jul-85	0.74	0.620	0.08	0.074
26-Aug-85	0.58	0.028	1.13	0.060
03-Oct-85	0.45	0.030	1.20	0.160
MEAN	0.62	0.068	0.57	0.066
STD.DEV.	0.27	0.153	0.44	0.034

Statistical Results (NO3): The probability that the mean difference between paired NO3 values is zero is 0.7045, a value greater than 0.05. Thus, the NO3 data columns above ARE NOT statistically different.

Statistical Results (PO4): The probability that the mean difference between paired PO4 values is zero is 0.9725, a value greater than 0.05. Thus, the PO4 data columns above ARE NOT statistically different.

TABLE 28

Null Hypothesis #20: The mean differences in Total Soluble Inorganic Nitrogen and Total Phosphorus concentrations in storm flow grab samples from the Passaic River sampling station above the Great Swamp stream discharges (Sta. 340) and those from the Passaic River below the Great Swamp discharges (Sta. 320) are equal to zero (samples are drawn from the same distribution).

Data For Hypothesis Testing: TSIN and TP grab sample data from 15 sampling dates

Statistical Test: Paired t-Test; p = 0.05

	Storm Flow Grab Samples			
	Station 340		Station 320	
Collection Date	TSIN	TP	TSIN	TP
14-Mar-84	1.05	0.078	0.65	0.066
06-Apr-84	0.94	0.052	0.31	0.045
17-Apr-84	0.86	0.050	0.50	0.098
31-May-84	0.59	0.050	0.24	0.134
23-Aug-84	0.65	0.046	1.17	0.130
05-Sep-84	0.46	0.050	0.25	0.107
02-Oct-84	0.30	0.034	0.16	0.086
30-Oct-84	0.36	0.068	0.16	0.180
30-Nov-84	0.80	0.038	0.49	0.067
28-Dec-84	0.99	0.022	0.56	0.066
12-Mar-85	0.21	0.030	0.81	0.038
03-May-85	1.00	0.047	1.45	0.169
26-Jul-85	0.83	0.740	0.16	0.132
26-Aug-85	0.64	0.120	1.22	0.220
03-Oct-85	0.70	0.060	1.45	0.880
MEAN	0.69	0.099	0.64	0.161
STD.DEV.	0.27	0.179	0.47	0.206

Statistical Results (TSIN): The probability that the mean difference between paired TSIN values is zero is 0.6784, a value greater than 0.05. Thus, the TSIN data columns above ARE NOT statistically different.

Statistical Results (TP): The probability that the mean difference between paired TP values is zero is 0.3932, a value greater than 0.05. Thus, the TP data columns above ARE NOT statistically different.

E. Influence of General Land Use Patterns on Great Swamp Water Quality

The pattern of land use within the Great Swamp watershed can exert a significant influence on water quality of the streams traversing the swamp system. Many studies have demonstrated that development of land within a watershed impacts both the quality and quantity of surface water runoff. Erosion and transport of surface contaminants increase loading of sediments, nutrients, and contaminants in stormwater runoff. Without stormwater management, storm hydrographs show higher peaks, aggravating localized flooding. Compounding these problems are the reduced baseflows that result from the decrease in pervious surfaces that promote the infiltration of rainfall into the soil.

The statistical analyses summarized in previous sections represent comparisons of data (as concentrations) from sampling stations that bracket major point sources of water-borne contaminants (i.e., the WWTPs). Some inferences can also be drawn about the relative influence of non-point sources (e.g., stormwater runoff); the strongly elevated nitrate concentrations at Station 100 (base flow data) and the moderately elevated phosphorus concentrations at stations 240 and 280 (base flow data) were identified in those spatial comparisons. The data from the Great Swamp Water Quality Study do provide opportunity for some additional hypothesis testing pertinent to non-point source water quality effects (again, using concentration data) in the Upper Passaic River Basin; these tests are described below.

In the design of the GSWQS, stations 100 and 200 were established as reference or control stations to provide water quality information before the discharges of the Morris-Woodland and Chatham WWTP, respectively, affected water quality. Two other sampling locations were established to monitor tributaries to Great Brook and Black Brook, respectively. Station 170 is on Primrose Brook, which drains a relatively undeveloped area, while Station 270 is on Middle Brook, which originates within the Great Swamp (Najarian, 1988). Both base flow and storm flow grab sample data are available for these locations.

Based on the spatial arrangement of these four locations, one could postulate that Station 100 would be most significantly influenced by non-point source runoff from developed areas, while Station 270 on Middle Brook would be least affected by such anthropogenic processes. Station 170 on Primrose Brook might be expected to be less influenced by watershed development, as would Station 200 on Black Brook. The null hypothesis for all statistical testing will be that the mean difference between paired data is equal to zero; where the null hypothesis is rejected, significant differences are identified. These significant differences can be evaluated for correspondence with the relative degree of anthropogenic influence in each stream's watershed.

1. Base Flow Conditions

The base flow grab sample data matrix for stations 100,170, 200, and 270 is complete for ten water quality variables: specific conductance, ammonia, nitrate, total filterable Kjeldahl nitrogen, total unfilterable Kjeldahl nitrogen, total phosphorus, orthophosphate, 5-day biochemical oxygen demand, total suspended solids, and total dissolved solids. An eleventh variable, total soluble inorganic nitrogen, can be derived from the sum of ammonia and nitrate concentrations (Trama, 1987). These data cover 20 sampling dates (March 1984 through September 1985) by roughly one-month intervals. Multiple range Newman-Keuls comparisons were calculated for each of these eleven variables; the graphical summaries of the multiple range tests are shown in Table 29.

For the base flow grab sample comparisons, only one variable - orthophosphate - showed no significant differences among the four locations; the null hypothesis was not rejected. The other ten variables showed one or more significant differences in the four-station comparisons. The most common pattern of significant differences was a split of the stations into three dissimilar groups, with stations 170 and 270 in one group and stations 100 and 200 set off as different from this group and each other. This pattern was shown for five variables: specific conductance, ammonia, nitrate, total soluble inorganic nitrogen, and total dissolved solids. For BOD and total suspended solids, stations 100, 170 and 270 grouped as similar, with Station 200 dissimilar to (and higher than) this group. For total phosphorus, stations 100, 170, and 200 grouped as similar, with Station 270 dissimilar and higher than the three-station group. For total Kjeldahl nitrogen (both filterable and unfilterable), stations 100, 200 and 270 grouped as similar, with Station 170 dissimilar and lower than the three-station group.

These base flow grab sample comparisons indicate a trend toward nitrogen levels higher in Loantaka and Black Brooks than in Primrose and Middle Brooks. The increase in dissolved solids and specific conductance (related variables that measure the dissolved ionic or colligative properties of the water sample) may be due in part to the increase in forms of dissolved nitrogen. However, other variables whose concentrations are considered related to watershed development - TSS, BOD, and TP - show patterns different from that for forms of nitrogen. For these variables, stations 170 and 270, taken from tributaries less subject to anthropogenic influences, show mean base flow concentrations equal to or higher than mean concentrations at locations in the streams draining developed watersheds. This finding is not consistent with strong non-point residential/commercial influences at Loantaka and Black Brooks, at least not in a manner typically described in the technical literature.

TABLE 29

Multiple Range Comparisons of Base Flow Grab Sample Means at WWTP-Independent Stations*

Specific Conductance

	Sta.170	Sta.270	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Ammonia (NH4)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Nitrate (NO3)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Total Soluble Inorganic Nitrogen (TSIN)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Filterable Total Kjeldahl Nitrogen (FTKN)

	Sta.170	Sta.270	Sta.100	Sta.200
Pop. 1		--------	--------	--------
Pop. 2	--------			

Unfilterable Total Kjeldahl Nitrogen (UTKN)

	Sta.170	Sta.100	Sta.270	Sta.200
Pop. 1		--------	--------	--------
Pop. 2	--------			

TABLE 29 (cont.)

Multiple Range Comparisons of Base Flow Grab Sample Means at WWTP-Independent Stations*

Total Phosphorus (TP)

	Sta.170	Sta.200	Sta.100	Sta.270
Pop. 1	--------	--------	--------	
Pop. 2				--------

Orthophosphate (PO4)

	Sta.170	Sta.200	Sta.100	Sta.270
Pop. 1	--------	--------	--------	--------

Biochemical Oxygen Demand (BOD)

	Sta.170	Sta.100	Sta.270	Sta.200
Pop. 1	--------	--------	--------	
Pop. 2				--------

Total Suspended Solids (TSS)

	Sta.270	Sta.100	Sta.170	Sta.200
Pop. 1	--------	--------	--------	
Pop. 2				--------

Total Dissolved Solids (TDS)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

2. Storm Flow Conditions

The storm flow grab sample data base for the GSWQS is complete for the same variables as was the base flow data base; however, only 13 dates can be used to compile a data matrix that has no missing values. The multiple range comparisons discussed in this subsection thus compare eleven water quality variables taken on thirteen sampling dates. Table 30 presents the graphical results of the Newman-Keuls multiple range comparisons of the storm flow grab data.

These comparisons show no significant differences among the four sampling locations for three variables: total phosphorus, orthophosphate, and total suspended solids. The most common grouping pattern is the station 100-200/station 170-270 split (also the most common pattern for the base flow analyses previously described); this patterns of grouping was shown for ammonia, total soluble inorganic nitrogen, and total dissolved solids. Two other patterns were repeated; for conductance and nitrate, a station 170-270/station 200/station 100 three-way split was seen, while for unfilterable total Kjeldahl nitrogen and BOD, a station 270-170-100/station 200 split was seen.

3. Discussion

Storm flow samples should reflect non-point source inputs to the streams from their respective watersheds. The results of EPA's National Urban Runoff Program (NURP) demonstrated that concentrations of various nutrients and contaminants were generally higher in stormwater from developed areas than in stormwater from undeveloped areas (EPA, 1983). The lack of significant differences in storm flow TSS, TP and PO4 concentrations among the GSWQS stations compared statistically does not support a conclusion that the developed areas of the Loantaka Brook and Black Brook watersheds influence these water quality parameters to a greater extent than do the undeveloped areas of these watersheds. The concentration differences in forms of nitrogen, with Loantaka and Black Brooks showing significantly higher concentrations than Primrose and Middle Brooks, is a pattern seen throughout the water quality data base. Thus, these concentration data do not show compelling evidence of significant non-point source influence from the upper watersheds of Loantaka and Black brooks, particularly for non-nitrogen-based stormwater constituents.

It should be noted that the NURP study cited above found no correlation between concentrations of nutrients/contaminants in stormwater and stormwater runoff volumes. The volume of stormwater runoff is an important influence in determining how much material is carried in runoff; if runoff volumes from several areas are substantially different, concentration data alone may not provide an adequate basis for comparison of the influences of the various areas on downstream water bodies. This aspect of stormwater runoff evaluation - the comparison of loadings rather than concentrations - is discussed in Section F below.

TABLE 30

Multiple Range Comparisons of Storm Flow Grab Sample Means*

Specific Conductance

	Sta.170	Sta.270	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Ammonia (NH4)

	Sta.170	Sta.270	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	--------

Nitrate (NO3)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	
Pop. 3				--------

Total Soluble Inorganic Nitrogen (TSIN)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	--------	--------		
Pop. 2			--------	--------

Filterable Total Kjeldahl Nitrogen (FTKN)

	Sta.170	Sta.100	Sta.270	Sta.200
Pop. 1		--------	--------	
Pop. 2	--------			
Pop. 3				--------

Unfilterable Total Kjeldahl Nitrogen (UTKN)

	Sta.170	Sta.100	Sta.270	Sta.200
Pop. 1	--------	--------	--------	
Pop. 2				--------

TABLE 30 (cont.)

Multiple Range Comparisons of Storm Flow Grab Sample Means*

Total Phosphorus (TP)

	Sta.100	Sta.200	Sta.170	Sta.270
Pop. 1	---------	---------	---------	---------

Orthophosphate (PO4)

	Sta.100	Sta.200	Sta.170	Sta.270
Pop. 1	---------	---------	---------	---------

Biochemical Oxygen Demand (BOD)

	Sta.270	Sta.170	Sta.100	Sta.200
Pop. 1	---------	---------	---------	
Pop. 2				---------

Total Suspended Solids (TSS)

	Sta.270	Sta.100	Sta.170	Sta.200
Pop. 1	---------	---------	---------	---------

Total Dissolved Solids (TDS)

	Sta.270	Sta.170	Sta.200	Sta.100
Pop. 1	---------	---------		
Pop. 2			---------	---------

* This is a graphical representation of the Newman-Keuls multiple comparisons test. At the 0.05 level of significance, the means of any two stations underscored by the same line are not significantly different. Means increase from left to right.

F. Estimation of Point and Non-Point Source Loadings in GSWQS Sampling Area

The analyses detailed in the sections above compared concentrations of nutrients in the waters of streams at various points in the Great Swamp watershed. Concentrations are important in representing the transient availability of nutrients to aquatic organisms, and in representing the changes in the quality of water from point to point in the watershed. However, when comparing the total amounts of material being transported by or through a stream system at various points, loadings must be estimated. The loading of a particular water-borne constituent is estimated by multiplying concentration by flow rate, yielding a mass of material being transported in a stream per unit time.

Loadings of total nitrogen (all forms of nitrogen measured), total phosphorus, total suspended solids, and BOD5 were computed using the flow rates (in cubic feet per second) and concentration data reported in the GSWQS data report (Maguire Group, Inc.; 1988). These specific constituents were selected because they are commonly used in evaluating stormwater runoff effects on receiving waters (Wanielista, 1978; Hordon, 1989). The computations were transformed to the unit of milligrams per second (mg/sec), representing the flux of material past a point in the stream. These results can be readily transformed to other units to extrapolate to longer time periods. Table 31 lists the loading estimates for base flow conditions at all locations regularly sampled; Table 32 presents similar information for storm flow conditions.

1. Estimated Loadings From Morris-Woodland and Chatham WWTPs

Under base flow conditions, the average total nitrogen load (all forms of nitrogen measured) in Loantaka Brook at Station 100 was estimated at 101 milligrams per second (mg/sec). The average total nitrogen load in Loantaka Brook at Station 105, below the Morris-Woodland WWTP, was estimated at 1058 mg/sec, a one order of magnitude increase principally attributable to the WWTP discharge. Total phosphorus loadings in Loantaka Brook increased by 1.6 orders of magnitude below the WWTP discharge (3 mg/sec to 126 mg/sec), again attributable to the WWTP discharge.

Using storm flow grab sample data, the total nitrogen load in Loantaka Brook increased by approximately 0.8 orders of magnitude (195 mg/sec to 1319 mg/sec) below the Morris-Woodland WWTP discharge, while the total phosphorus load increased by about 1.1 orders of magnitude (10 mg/sec to 123 mg/sec). Loadings from point source discharges should not be affected by stormwater runoff to the same degree as are non-point source discharges, and this generalization is seen in the comparative loading increases estimated here.

TABLE 31

Great Swamp Loading Estimates (mg/sec)*
Base Flow Conditions

Station	Total Nitrogen	Total Phosphorus	BOD5	Suspended Solids
100	101	3	62	167
105	1058	126	165	331
110	2364	246	1016	1802
120	279	10	379	925
160	560	45	867	1842
170	448	20	717	1846
180	953	99	1711	3098
200	515	11	664	1564
215	5986	460	3103	2867
220	6330	575	1776	2482
240	742	107	788	1238
270	61	6	91	160
280	2075	289	1498	2227
340	2475	96	3644	5238
320	2683	252	3737	14310

* Estimated by averaging products of flow rate x concentration for each sampling location and date

TABLE 32

Great Swamp Loading Estimates (mg/sec)*
Storm Flow Conditions

Station	Total Nitrogen	Total Phosphorus	BOD5	Suspended Solids
100	195	10	290	5764
105	1319	123	320	1618
110	17016	1541	25551	357914
120	551	31	1124	7973
160	1266	79	1840	6613
170	846	119	1750	16418
180	2604	141	3502	8656
200	930	14	914	3452
215	7572	508	3441	6390
220	5668	592	4446	19062
240	1295	144	776	996
270	245	20	341	484
280	2798	401	2070	3721
340	3556	283	6390	18309
320	5222	591	8864	77521

* Estimated by averaging products of flow rate x concentration for each sampling location and date

In the Black Brook subsystem under base flow conditions, the total nitrogen loading at Station 215 (below the Chatham Township WWTP discharge) is approximately 1.1 orders of magnitude greater than total nitrogen loading at Station 200 (515 vs 5986 mg/sec), above the WWTP discharge. The total phosphorus loading below the WWTP discharge is 1.6 orders of magnitude greater than that estimated for Station 200 (11 vs 460 mg/sec). Under storm flow conditions, these relationships are estimated to be 0.9 and 1.6 orders of magnitude difference for total nitrogen and total phosphorus, respectively. Again, the overall influence of the WWTP discharge is slightly diminished under storm flow conditions.

These loading rate comparisons corroborate the findings reported from comparisons of nutrient concentrations; during the period of study, the Morris-Woodland and Chatham Township WWTP discharges were contributing significantly to the nutrient loadings in the streams entering the Great Swamp.

2. Estimated Loading Influences of Non-Point Sources

Tables 31 and 32, discussed in the preceding section with respect to point source loading estimates, also provide some insight into the reaches of Loantaka and Black Brooks substantially affected by non-point source loadings. To examine the tables for such insights, two trends must be assumed to be at work. First, if a point source discharge dominates loadings to a stream, then the loading estimates should peak at the sampling location just below the point source discharge, and diminish at sampling locations further downstream from the discharge. Second, if the point source discharge is from a WWTP that does not directly receive stormwater flows (except incidently through infiltration), then the point source loadings should not change substantially between base and storm flow samplings.

Examination of Table 31 with these generalized trends in mind discloses deviations from these expected trends. Most conspicuously, base flow loading estimates in Loantaka Brook increase between Stations 105 and 110, even though Station 105 is the station specifically sited to quantify the influence of the Morris-Woodland WWTP. Table 32, presenting storm flow estimated loadings, indicates even more substantial increases in loadings of total nitrogen, total phosphorus, BOD5, and suspended solids between Stations 105 and 110.

The estimates from Black Brook sampling locations show the more paradigmatic trend, with loading increases evident at Station 215, below the Chatham Township WWTP, and approximately the same loadings at Station 220, farther downstream on the discharge channel.

The data in Tables 31 and 32 can be transformed into percentage increases between base and storm flow loading estimates. Where stormwater runoff (non-point) influences are most extreme, these increases should be greatest; where the increase is negligible, non-point sources are not influential. These percentage increases are shown in Table 33 for each constituent evaluated; the last column lists the geometric mean of the increases in each constituent (the geometric mean is used here because of the extremely wide variation in the percentage increase values). The geometric mean increase in storm flow loadings over base flow loadings is most pronounced for Station 110 (1986%), principally due to the increase in suspended solids during storm flows. Other locations showing substantial increases include Stations 100 (430%), Station 170 (265%), Station 270 (244%), and Station 120 (239%). These are predominantly sampling sites in the Loantaka Brook subsystem. The Great Swamp sampling locations with the lowest geometric mean loading increases in storm flow loadings over base flow loadings include Station 215 (25%), Station 280 (43%), Station 200 (56%), Station 180 (109%), and Station 105 (116%). This latter group includes the sampling locations below the Morris-Woodland and Chatham Township WWTPs and the sampling locations at the end of both Loantaka and Black Brooks. These comparisons confirm that the WWTP discharge loadings are relatively independent of precipitation events (the anticipated finding); they also indicate that the discharges from the Great Swamp to the Passaic River are only moderately influenced by precipitation events.

3. Discussion

The loading estimates introduced above clearly demonstrate the significant effect of the Morris-Woodland and Chatham Township point discharges on the total amounts of suspended solids, biodegradable organics, total nitrogen, and total phosphorus carried by surface waters receiving those point source discharges. Upgrading of those facilities to Level 4 treatment with nutrient removal will certainly reduce those point source loadings substantially.

The loading estimates also indicated that surface waters draining to the Great Swamp, particularly those waters in the Loantaka Brook subsystem, are influenced by non-point source loadings. Water samples from the location at Green Village Road (Station 110) showed the most conspicuously elevated loadings of common stormwater constituents; however, a similar increase, though not so pronounced, is seen on Primrose and Middle Brooks. The latter locations drain less-developed watersheds than does Loantaka Brook proper. The Black Brook subsystem shows generally less influence of non-point source loading than does the Loantaka Brook subsystem.

Loading estimates for the GSWQS sampling locations closest to the Passaic River do not show substantial increases in storm flow loadings over base flow loadings. These comparisons appear to indicate that the transport of water-borne materials from the Great Swamp to the Passaic River is somehow "damped" from extreme storm influences.

Table 33

Geometric Mean Percentage Increase in Common Non-Point Source Constituents With Storm Flows

Station	Geom. Mean Increase*
110	1986%
100	430%
170	265%
270	244%
120	239%
240	179%
320	167%
220	131%
160	129%
105	116%
340	112%
180	109%
200	56%
280	43%
215	25%

* Geometric mean increase in common stormwater constituents (values in Table 32 divided by values in Table 31), expressed as percentage increase

IV. STATISTICAL ANALYSES OF AUTOMATED SAMPLING DATA

The GSWQS scope of sampling included the sampling of storm events at certain stream locations using automated equipment. This type of monitoring/sampling equipment was installed at six locations: Stations 100, 120, 160, 170, 340, and 320. Sampling was automatically triggered when a certain pre-set volume of water had passed the sampling device. The water quality data generated by this automated sampling program provides a data base with a much finer degree of resolution than does the grab sampling data base.

During the course of the GSWQS, three storm events were sampled at Stations 120, 160, 170, and 320; two storms were sampled at Stations 100, 110, and 340. In some cases, two or three stations were sampled during the same storm; in other cases, only a single location was sampled in any particular storm. Table 31 lists the storm events and stations sampled by the automated water samplers.

A. Flow-Weighted Nutrient Loadings During Storm Flows

Flow-weighting describes the mathematical procedure used to generate a meaningful average value for nutrient concentrations in a highly variable flow regime. The computation involves multiplying the flow value times the concentration value for each sampling time, summing these products, and dividing by the sum of the flow values. This yields a weighted average that adjusts the mean for higher or lower flow intervals in the data set. Geometrically, the weighted mean represents the centroid of the data set - the theoretical center of an array of data points graphed with flow on the X-axis and concentration on the Y-axis. Table 32 lists flow-weighted concentrations of biogenic nutrients in storm flow data sets collected by automated water samplers (where the flow data was not reported or was incomplete, the simple mean of the nutrient concentrations is reported and the row marked with an asterisk).

B. Temporal Trends in Stormwater Nutrient Loadings

Stormwater runoff from the watershed of a stream or river typically transports suspended solids, biodegradable organic compounds, nutrients, soluble ions, and a variety of contaminants to the receiving water. These stormwater runoff constituents are those that accumulate at the land surface or in soil layers easily leached by surface runoff. Because precipitation essentially rinses the land surface of the watershed, concentrations of runoff-borne constituents are typically most concentrated in the first phases of runoff from a significant storm. This is the "first flush" effect characterized by Wanielista (1978) and many other investigators of runoff quality. In a watershed of relatively simple hydraulics, the expectation would be that concentrations of nutrients and other stormwater constituents would peak in the early phases of the runoff hydrograph and, for this reason, Wanielista suggests the use of a "pollutograph" or "loadograph" to model this variation in concentrations of stormwater constituents.

TABLE 34

Summary of GSWQS Intensive Storm Sampling Effort

Site No.	Date	Sampling Interval	Samples
320	05/02/85	0.75 hr	23
340	06/05/85	1 hr	12
320	09/24/85	2 hrs	18
320	09/27/85	2 hrs	23
120	04/15/86	2 hrs	12
120	04/17/86	1.5 hrs	6
120	05/20/86	4 hrs	14
160	05/20/86	4 hrs	17
170	05/20/86	4 hrs	17
120	06/11/86	3.25 hrs	12
160	06/11/86	3.25 hrs	12
170	06/11/86	3.25	8
170	07/01/86	3 hrs	12
340	07/01/86	3 hrs	12
100	03/30/87	1.5 hrs	21
110	03/30/87	1.5 hrs	21
100	04/03/87	1.5 hrs	19
110	04/03/87	1.5 hrs	19

TABLE 35

Flow-weighted Nutrient Concentrations During Storm Events

Station	Start Date	Mean Flow (cfs)	NO3 (mg/l)	PO4 (mg/l)	TSIN (mg/l)	TP (mg/l)
Sta. 120	04/15/86	9.0*	0.45*	0.046*	0.64*	0.082*
Sta. 120	04/17/86	NA*	0.07*	0.042*	0.25*	0.061*
Sta. 120	05/20/86	7.6	0.52	0.010	0.55	0.093
Sta. 120	06/11/86	8.8	0.66	0.061	0.72	0.150
Sta. 160	05/20/86	7.1*	0.07*	0.044*	0.10*	0.341*
Sta. 160	06/11/86	12.4*	0.06*	0.035*	0.07*	0.141*
Sta. 170	05/20/86	19.2	0.38	0.010	0.53	0.054
Sta. 170	06/11/86	27.9	0.46	0.056	0.56	0.141
Sta. 170	07/11/86	21.8	0.41	0.10	0.47	0.115
Sta. 340	06/05/85	56.3	0.82	0.013	1.75	0.048
Sta. 340	07/01.86	44.4	0.62	0.016	0.73	0.126
Sta. 320	05/02/85	34.4	0.60	0.086	0.71	0.148
Sta. 320	09/24/85	13.0	1.37	0.176	1.53	0.171
Sta. 320	09/27/85	349.7	0.85	0.055	1.00	0.013

* Flow data incomplete or missing - concentrations are unweighted means

The automated sampling programs conducted in the GSWQS provide water quality data that can be used to track the time course of loadings at various points monitored during the study (see Table 31). The sampling intervals during these storm monitoring studies varied between 0.75 and 4.0 hours; the intervals were consistent within any single storm event. Figures 5 and 6 represent temporal patterns in nitrate and orthophosphate concentrations at stations 100 and 110 during a rainfall event; the horizontal axis lists data by time interval, while the vertical axis indicates concentration of the nutrient ion.

In the initial phases of the rainfall, nitrate is elevated at both stations, and shows a gradual decline during the course of the storm. This would be anticipated as the first flush passes through the section of stream being monitored and subsequent runoff flows carry more dilute concentrations of the ions. Note, however, that the nitrate concentrations at Station 100 begin to rise near the end of the sampling period; there is no accompanying rise in the nitrate concentrations measured at Station 110.

Orthophosphate ion concentrations show a more paradigmatic pattern; concentrations are elevated at the onset of runoff, and decline over the course of the storm. Concentrations of orthophosphate are generally higher at Station 110 than at Station 100.

The storm sampled on March 30, 1987 was followed by another storm commencing April 3, 1987. Automated water quality was carried out at stations 100 and 110 during this second storm. Because the two monitored storms were separated by a relatively short period of time - the last sample of the initial storm and the first sample of the second storm were separated by about 62 hours - the expectation would be that the first flush effects of the second storm would be reduced. Stormwater loading models generally take into account the length of the period antecedent to a rainfall, assuming that the accumulation of chemicals susceptible to stormwater transport is a function of the length of the dry interval preceding a rainfall (e.g., McElroy et al., 1976).

Figures 7 and 8 portray nitrate and orthophosphate concentrations at stations 100 and 110 through the time course of the two storm events. The separation of data along the horizontal axis reflects the interval between sampling of the two storms. The most striking aspect of the nutrient concentrations, both nitrate and orthophosphate, is the magnitude of the concentrations of these nutrients in the initial phases of the second storm nutrient concentrations are as great or greater than those in the first flush of the first storm. The time interval has not permitted significant amounts of these nutrients to be deposited or re-dispersed in the watershed; thus, the elevated nutrient levels do not directly reflect loadings from residential, commercial, or agricultural operations. The two most evident explanations are 1) nutrients accumulated by the first storm in or near waterbodies

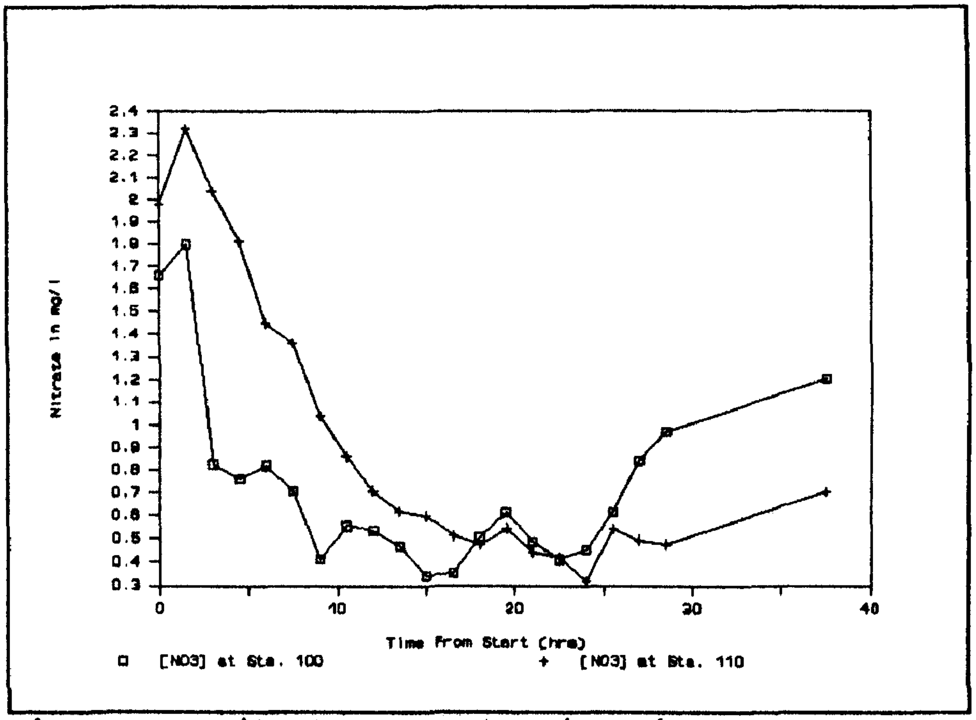


Figure 7. Nitrate Concentrations in Storm Flows at Stations 100 and 110.

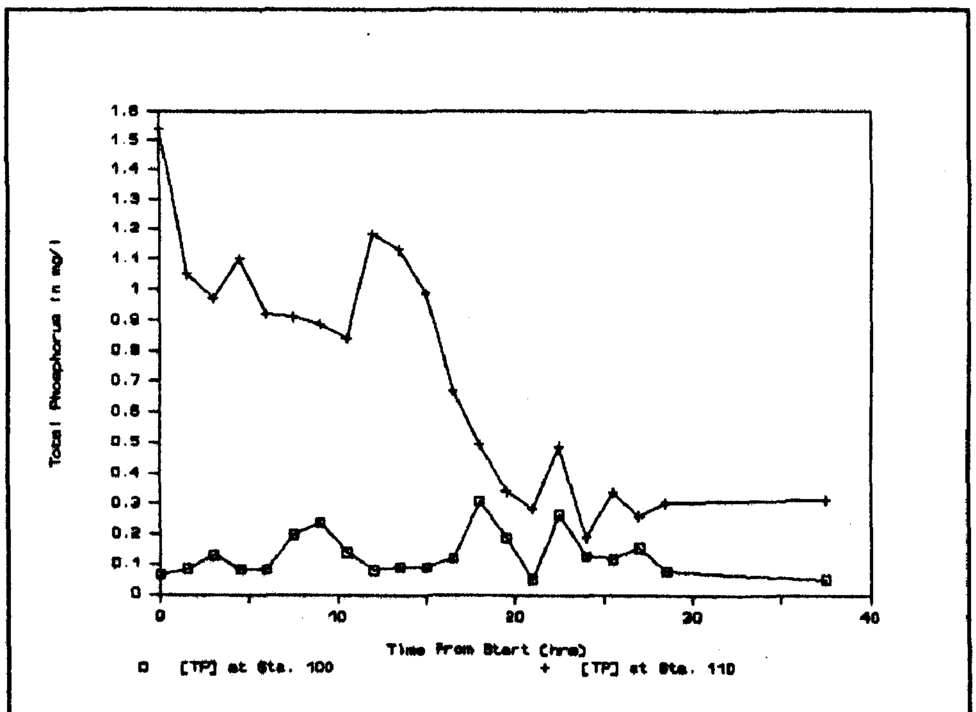


Figure 8. Total Phosphorus Concentrations in Storm Flows at Stations 100 and 110.

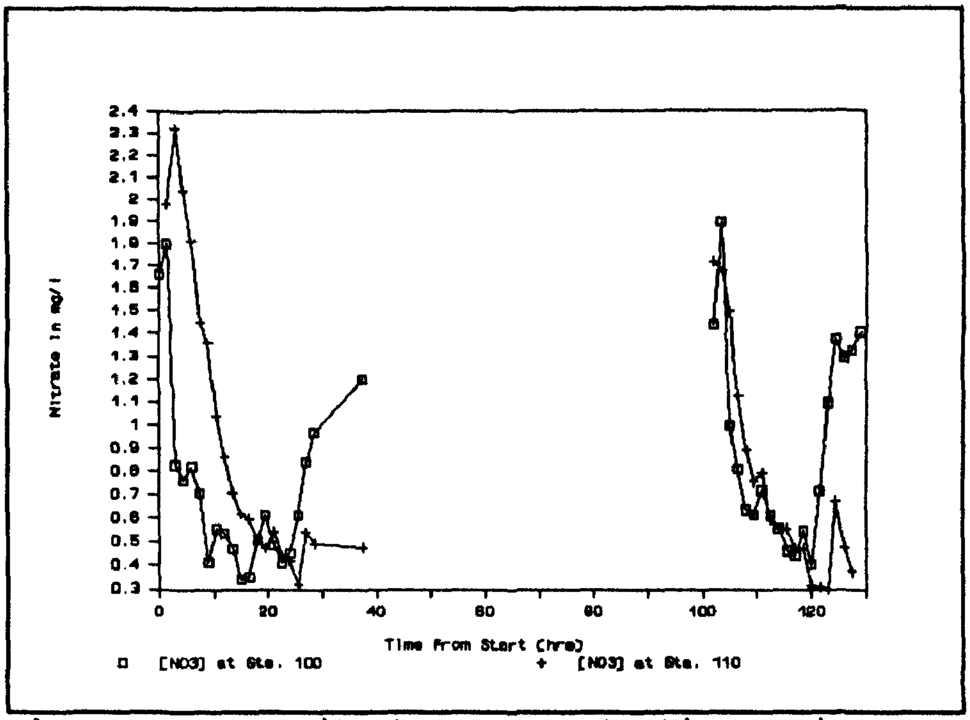


Figure 9. Nitrate Concentrations in Two Consecutive Storms at Stations 100 and 110.

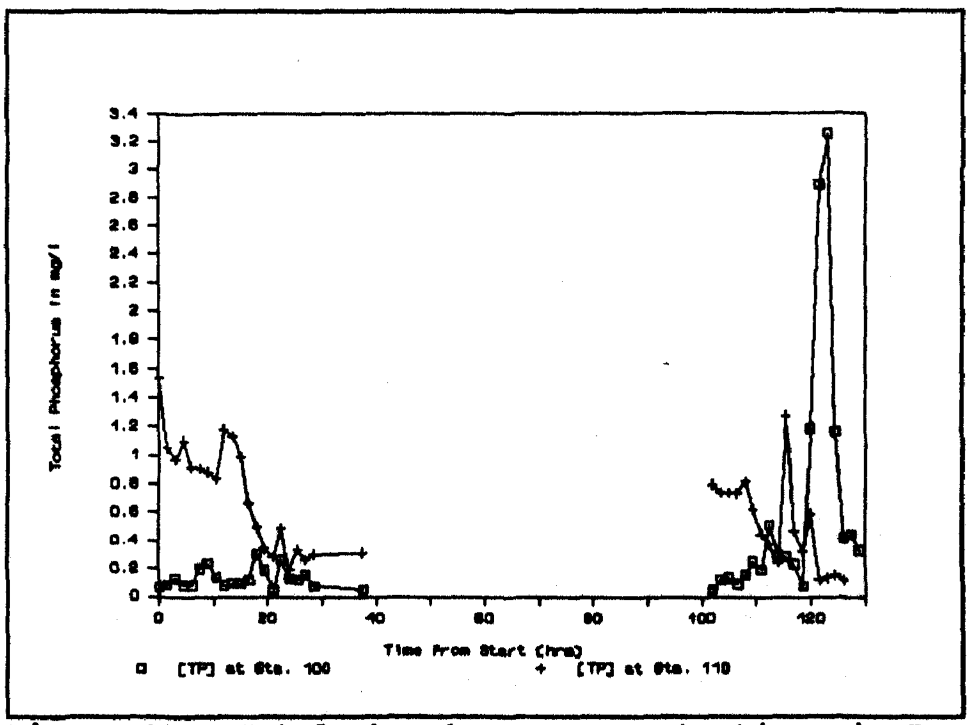


Figure 10. Total phosphorus Concentrations in Two Consecutive Storms at Stations 100 and 110.

upstream of the sampling stations,or 2) significant loadings from groundwater (e.g., water percolating through the soil and being added to the stream by lateral flow. The data are insufficient to provide an answer to the anomalies in the concentrations patterns; however; the data are consistent with the findings reported earlier concerning high levels of nitrate in base flows in Loantaka Brook above the Morris-Woodland WWTP.

V. INTERPRETATION OF GSWQS ANALYTICAL FINDINGS

The 1986-1987 water quality data obtained in the Great Swamp Water Quality Study document the statistically significant elevations in biogenic nutrients generated by discharges from the Morris-Woodland and Chatham WWTPs. The data also document the operation of the Great Swamp as a sink for these added nutrients.

A. Influence of WWTPs on Water Quality and Plant Growth Under Base Flow Conditions

The enrichment of the waters of the Great Swamp with nutrients from WWTPs, as demonstrated in this review, does not by itself guarantee that such water quality changes will be translated into algal growth. However, the algal bioassays conducted in conjunction with the water quality determinations (Trama, 1987) demonstrated that the nutrient enrichment does lead to a higher standing crop of algal cells in *in vitro* tests of water from below the treatment plants. Thus, the concern over the potential for eutrophication due to the wastewater loads has been demonstrated to have a firm basis in experimental results.

At this point, it is pertinent to update the status of the WWTPs discharging into the surface waters of the Great Swamp area (Passaic River and tributaries). The Chatham Township and Morris-Woodland facilities have proposed to upgrade their wastewater treatment capabilities to Level 4. The New Jersey Department of Environmental Protection (NJDEP) has issued a Finding of No Significant Impact (FNSI) for the Morris-Woodland plant (NJDEP, 1990). Thus, there are concrete actions proposed for wastewater facilities that will individually and collectively reduce nutrient loading to the waters of the Great Swamp and the Passaic River.

It is also worthy of note here that the hydrological model derived by Najarian and Associates (Najarian, 1988) predicted that, even if the model were modified to simulate 100 percent removal of constituents from the Morris-Woodland and Chatham plant discharges, the phosphorus concentrations at Station 180 would remain above the State standard of 0.1 mg/l total phosphorus. The reason for this is apparently the ability of the swamp ecosystem to export phosphorus accumulated in the biomass of the system. Thus, according to the modeling studies of nutrient budgets in the Great Swamp watershed, the proposed upgrades of the WWTPs mentioned above will certainly reduce loadings to the Great Swamp ecosystem, but will not restore loadings to "pristine" conditions. The development of the Great Swamp's watershed areas, Loantaka Brook watershed in particular, has apparently had, and will continue to have, a significant effect on water quality of the Great Swamp.

B. Influence of Land Use Patterns and Non-Point Source Loadings on Great Swamp Water Quality

The pattern of land use within the Great Swamp watershed can exert a significant influence on water quality of the streams traversing the swamp system. Many studies have demonstrated that development of land within a watershed causes increased loading of sediments, nutrients, and contaminants in stormwater runoff. Compounding this problem are the reduced baseflows that result from the decrease in pervious surfaces that promote the infiltration of rainfall into the soil (Wanielista, 1978; Najarian, 1988).

The statistical comparisons of base and storm flow concentrations of common stormwater-borne constituents discussed in a previous section do not fully confirm this generalization for tributaries of the Great Swamp. Water samples from Loantaka Brook (Station 100) and Black Brook (Station 200), both of which drain areas with moderate to high development, do not show the expected elevations in concentrations of phosphorus and suspended solids when compared with water samples from streams draining watersheds with little or no development differences (Station 170 on Primrose Brook and Station 270 on Middle Brook). Concentrations of various forms of nitrogen do show significantly higher concentrations in the streams draining "developed" watersheds than in those draining "undeveloped" watersheds, but these differences alone do not constitute a demonstration of significant non-point source influences.

The loading estimates (concentrations x flows) indicated that surface waters draining to the Great Swamp, particularly those waters in the Loantaka Brook subsystem, are influenced by non-point source loadings. Water samples from the location at Green Village Road (Station 110) showed the most conspicuously elevated loadings of common stormwater constituents during storm events; however, a similar increase, though not so pronounced, is seen on Primrose and Middle Brooks. The latter locations drain less-developed watersheds than does Loantaka Brook proper. The Black Brook subsystem shows generally less influence of non-point source loading than does the Loantaka Brook subsystem.

C. Influence of Great Swamp Discharges on Passaic River Water Quality

The discharges from the Great Swamp tend to increase the concentration of phosphorus in the Passaic River. That finding was reported by Trama (1987) from the algal bioassay data, and is confirmed in the statistical analyses reported in earlier chapters of this review. Trama noted that the Passaic River in the vicinity of Station 320 (near the Millington gage) varies from a nitrogen-limited condition to a phosphorus condition depending on the quality and quantity of flows from the upstream regions. Thus, the effect of these additions of phosphorus from the Great Swamp may or may not promote additional growth of aquatic plants, depending on the transient nutrient limitation condition prevailing in the waters of the Passaic River.

Loading estimates for the GSWQS sampling locations closest to the Passaic River do not show substantial increases in storm flow loadings over base flow loadings. These comparisons appear to indicate that the transport of water-borne materials from the Great Swamp to the Passaic River is somehow "damped" from extreme storm influences.

D. Future Conditions and Water Quantity/Quality Trends

The hydrological model derived by Najarian and Associates predicted that, for the watersheds that would most likely be developed by the year 2000 (e.g., Loantaka Brook subbasin), storm flow volumes would increase by factors of 2-2.5, while base flows would diminish by factors of 0.6-0.8. Water quality under base flow conditions would be affected more by WWTP effluents because there would be less base flow to dilute such loadings; also, the higher stormwater flows would reduce detention times for water in the wetlands, thus lowering the efficiency of nutrient removals. Clearly, the conversion of undeveloped land to developed land will adversely affect water quality under all types of flow regimes.

The increase in the impervious coverage of the watersheds draining to the Great Swamp is likely to increase the "flashiness" of flooding in that system. As noted above, the storm flow volumes in the Loantaka Brook subbasin are predicted to increase by a factor of 2-2.5, leading to increased flooding of areas historically on the margins of flood hazard areas. Local municipalities now mandate stormwater management measures for all significant developments; however, the interaction of these site-specific stormwater management systems (e.g., detention basins) can aggravate downstream flooding impacts if the site-specific systems are not integrated (at least by design, if not by actual management) into a regional system.

VI. SUMMARY

The Great Swamp Water Quality Study (GSWQS) conducted by EPA and its consultants has generated water quality information with significant diagnostic and prognostic utility; that is, the data have provided a sound basis for quantifying point and non-point source influences and impacts that existed during the time of the study, and have also provided information necessary for modeling potential impacts of land use changes on the Great Swamp in future years.

The overall objective of the study was to evaluate present and future impacts of point and non-point source loadings of nutrients to the Great Swamp; the data analyses reported in this review and the three reports preceding this review have disclosed numerous interesting and useful findings that quantify nutrient concentrations and loadings, identify specific stream reaches significantly affected by point and/or non-point source influences, and predict specific changes in such loadings in future years.

The GSWQS data have showed that, under base flow (dry) conditions, the discharges of treated wastewater from the Morris-Woodland and Chatham WWTPs generated statistically significant elevations in nutrient concentrations (orthophosphate, nitrate, total phosphorus, and total soluble inorganic nitrogen) in their receiving waters, Loantaka Brook and Black Brook, respectively. The principal exception to this finding was in Loantaka Brook, where nitrate concentrations in the brook upstream of the Morris-Woodland WWTP discharge were not statistically different from nitrate concentrations in the brook immediately below the discharge.

Algal bioassays using water from various surface water reaches of the study area have demonstrated that most of the stream reaches of the Great Swamp watershed are phosphorus-limited; nitrogen limitations occurs in stream reaches receiving discharges from WWTPs. The increased concentrations of nutrients, particularly phosphorus, resulting from the WWTP discharges promote increased algal growth in laboratory cultures.

The influence of the Great Swamp on base flow water quality in Great Brook and Black Brook is clearly beneficial. In general, base flow concentrations of nutrients in the brooks at the end of the swamp are equal to or less than concentrations of those nutrients at the control locations upstream of the study areas (i.e., upstream of both the swamp and the wastewater treatment plants); the swamp ecosystem is apparently serving as a nutrient sink. Moreover, the nutrient loads in waters leaving the swamp and entering the Passaic River are not elevated during storm events; again, the swamp ecosystem appears to be buffering what might otherwise be significant storm-related discharges to the Passaic River.

The influences of non-point source runoff on water quality in the Loantaka and Black brooks not always clearly discernible in the GSWQS data base; analyses comparing concentration data sometimes show different results than do analyses comparing loading estimates. Storm flow concentrations of total phosphorus, orthophosphate, and total suspended solids are not different between locations in more developed watersheds (sampling stations 100 and 200) and locations in less developed watersheds (sampling stations 170 and 270). Forms of nitrogen, however, do show significant elevations at sampling locations in the more developed watersheds. Estimated loadings (concentrations x flows) do show substantial increases in storm flow loadings of common runoff constituents (e.g., suspended solids, biodegradable organics, nitrogen, and phosphorus) in Loantaka Brook, Primrose Brook, and Middle Brook.

Projected increases in the development of presently undeveloped lands in the Great Swamp watershed will increase the non-point source (stormwater) loadings of streams tributary to the Great Swamp, while reducing base flows available to dilute loadings from the WWTPs discharging to those streams. Offsetting in part these predicted adverse trends in water quality are the proposed upgrades of the Morris-Woodland and Township WWTPs to Level 4 treatment with nutrient removal. Hydraulic loading of streams flowing into the Great Swamp will increase as a greater percentage of the watershed is developed as residential or commercial properties. Watershed planning should integrate stormwater management measures to reduce potential hydraulic and nutrient loading to the Great Swamp from non-point sources.

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APPENDIX L

Stormwater Management for the Mitigation of Water Quality Degradation

APPENDIX L

STORMWATER MANAGEMENT FOR THE MITIGATION OF WATER QUALITY DEGRADATION

I. New Jersey State Regulations

In New Jersey, stormwater management regulations, as prepared by the Department of Environmental Protection (NJDEP), Division of Water Resources, implement the provisions of the New Jersey Storm Water Management Act, P.L. 1981, c.32, which amends and supplements the Municipal Land Use Law, N.J.S.A. 40:55D-1, et seq. Stormwater management is also addressed in the rules of the New Jersey Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-34 et seq.

In general, the NJDEP's stormwater management regulations dictate the procedures for the preparation and content of a management plan and the implementing municipal ordinance. A management plan is to comprise two phases: a Phase I targeted at preventive measures to be applied to the site plan and subdivision review process; and a Phase II which provides for the long term comprehensive planning of alternative preventive stormwater management measures in conjunction with remedial stormwater management measures. Part of Phase II is the development of a system of nonstructural and/or structural stormwater management programs to mitigate flooding and non-point source pollution. The need for expanded protection of environmentally critical areas, including floodplains and wetlands, is also to be reviewed.

The stormwater control standards specified in the regulations are for general use as minimums to be applied to predefined major developments. Major development, as used in the regulations, refers to development as defined in the Municipal Land Use Law. In addition, the development activity must either be (1) a site or subdivision plan that will ultimately cover one or more acres of land with additional impervious surfaces or (2) any construction used for feeding and holding areas for specified numbers of animal units;

pipelines, storage, or distribution systems for petroleum products or chemicals; storage, distribution or treatment facilities for liquid waste (other than individual on-site sewage disposal systems); solid waste storage, disposition, incineration or landfill; quarries, mines or borrow pits; land application of sludge or effluents; and storage, distribution or treatment facilities for radioactive waste.

The specified stormwater control standards include the following:

- Stormwater runoff volumes and rates are to be controlled so that post-development peak runoff values do not exceed pre-development rates for a 2-year, 10-year, and 100-year storm event.

- Detention basins to be used for water quality control, in addition to flood control, should be designed to increase the detention time by using lower release rates so as to encourage sedimentation (removal of suspended solids and attached pollutants).

- New development, including construction of detention basins (excluding on-stream basins), should be avoided in floodplains.

- Alternatives to retention basins for runoff quantity and quality control are to be allowed. These measures include infiltration techniques, land use management, and consideration of waiving or amending local municipal requirements for impervious cover for specified property uses.

II. Recommended Stormwater Management Practices

Stormwater management control techniques can generally be classified by the runoff attribute controlled and/or the philosophical approach of control. The four categories associated with controlling various runoff attributes are described below. These are:

- Runoff Volume Control - Control techniques designed to prevent a certain amount of the total rainfall from becoming surface runoff by providing an opportunity for the rainfall to infiltrate into the ground. Rainfall infiltration into the ground can be encouraged by increasing the soils' infiltration rates, increasing surface retention or detention storage (allows more time for infiltration), and increasing the interception of rainfall by growing plants.

- Runoff Peak Rate Control - Control techniques designed to regulate the peak flow rate of runoff by increasing the hydraulic resistance of the surface, decreasing the land slope, increasing the length of flow path, or providing temporary storage and outlet control of runoff that would otherwise leave the site at an unacceptably high flow rate.

- Erosion Control - Control techniques designed to minimize accelerated soil erosion and corresponding downstream sedimentation. Accelerated erosion is defined as that erosion caused by land disturbance, such as construction development and agricultural activities. This is erosion other than that resulting from natural geological processes such as wind, rain, temperature fluctuations, frost action, etc. The excessive sediment produced covers aquatic plants and fish spawning areas. It also carries pollutants such as nutrients, pesticides, and other oxygen demanding material that are attached to sediment particles. Examples of typical erosion control techniques include bank stabilization, critical area planting, contour farming, terracing, and strip cropping.

- Pollution Source Controls - Control techniques, particularly Best Management Practices (BMPs), designed to minimize the accumulation of pollutants on the land surface, in the soils, and in the atmosphere prior to rainstorms. In controlling pollution at the "source", these techniques control potential pollution of downstream receiving waters during and following the rainstorm events. Pollution source controls are generally supplementary to the other control techniques because by themselves they usually do not provide sufficient stormwater control to meet regulatory requirements for control of flow volumes and peaks. Examples of typical pollution source controls include filter strip, sediment basin, street cleaning, wetland preservation, and agricultural waste storage structure.

The four means of control commonly used are presented below:

- Structural - Control techniques consisting of physical facilities designed, constructed, and installed for the exclusive function of storm runoff abatement, including erosion and sediment runoff control.

- Nonstructural - Control techniques consisting of land use management techniques geared towards minimizing storm runoff impacts through control of the type and extent of new development and of land disturbance activities in general.

- On-Site - Techniques designed to control runoff at its source (i.e., the development or land disturbance site).

- Off-Site - Control techniques located downstream of the development or land disturbance site that are designed to intercept runoff or divert it to another control facility.

The following paragraphs describe stormwater management facilities and practices that can be used to control downstream flooding and water quality degradation. These descriptions are for guidance only and do not replace the need for a detailed management plan and an implementing ordinance for the municipalities of the Upper Passaic River

Basin. Table L-1 is a list of performance estimates for the practices described. This table was prepared to provide insight into the potential control performance for selected practices. The actual performance of any stormwater management practice is dependent on the specific design, operation, and maintenance of the facility, as well as the characteristics of the storm runoff to be controlled. The selection of a particular practice for application should be based on physical suitability (size of runoff area, soil type, slope of terrain, etc.), type of control and pollutant removal desired, and its implementation and operation features (simplicity and cost of installation, maintenance needs, flexibility of use in both existing and new development, etc.).

Impoundments

Conventional stormwater management practices often involve the use of impoundment facilities. Impoundment facilities are structural devices that detain stormwater runoff and release it at a controlled rate. There are two types of impoundments. Detention basins are "dry" impoundments that temporarily store runoff and release it to downstream surface water channels. Retention basins are "wet", impoundments that provide "permanent" storage and release runoff water through infiltration and evaporation. Impoundments can be designed for individual site control or to control runoff from multiple development sites or watershed areas. In areas where the anticipated non-point source pollutant load is expected to be particularly heavy, multiple ponds designed to perform in tandem, may be more effective in controlling water quality. Under these circumstances, an upper pond may serve as a settling basin that releases higher quality water into a lower pond.

Infiltration Pits and Trenches

Infiltration pits and trenches collect stormwater runoff from impervious areas for temporary storage and subsequent infiltration into the soil. Permeable soils are necessary to ensure a reasonable rate of infiltration. Also, the water table should be sufficiently lower than the depth of the facility so that the facility will always be above the groundwater. Application is usually limited to relatively small sources of runoff, such as roof drains and small paved areas.

Land Surface Controls and Zoning

Land surface controls and zoning can be used to naturally encourage precipitation to infiltrate the soil and reduce the runoff volume. In addition, runoff can be controlled to inhibit local flooding and pollution of downstream channels. Specific techniques include grading slopes to less than two percent, restricting the amount of impervious surface coverage at an industrial, commercial, institutional, or high density residential development sites, and using special vegetative cover. Zoning can be used to control the number of dwelling units or building square footage for a given site to discourage over-development. This practice could also include encouragement of cluster land use development and open space acquisition.

Porous and Grid/Modular Pavement

This management practice includes the use of either porous asphalt pavement or concrete grid and modular pavement. The most suitable application for these pavement materials are low-volume traffic areas such as:

- parking lots, especially fringe or overflow parking areas;
- emergency stopping and parking lanes;
- on-street parking aprons in residential neighborhoods;
- recreational vehicle camping area parking pads;
- private road, easement service roads and fire lanes;
- industrial storage yards and loading zones;
- driveways for residential and light commercial use; and
- bike paths, walkways, patios and swimming pool aprons.

Seepage Areas

Grassed areas can be used for managing storm runoff by employing their natural capacity for reducing runoff velocities, infiltrating runoff flows, and filtering runoff contaminants. This practice is applicable to new development of low to moderate density, where the percentage of impervious cover is relatively small. Seepage areas are small, grass-covered areas that infiltrate the water and allow particulate contaminants to settle out of the runoff water. The grass also tends to absorb some of the soluble pollutants. Seepage areas maybe created by excavating shallow depressions in the land surface or by constructing a system of dikes or berms to pond water over permeable soils.

Channel Modification

Channel modification includes any action which affects the physical prevention or reduction of local flooding. Channelization is the process of converting sinuous channels to linear ditches and enlarging and reshaping the stream bed into a nearly trapezoidal cross-sectional area. To facilitate land drainage, stream bed material may be removed to increase the gradient of the channel.

Cistern Storage

This management practice involves the collection and storage of storm runoff in a storage tank or chamber to control peak runoff rates. Sedimentation occurring in the tank and water reuse can also provide some source pollution and runoff volume control.

A cistern can serve solely as a stormwater detention device with a continuous controlled flow release; as a holding tank that disposes of runoff via facilities such as infiltration pits/trenches and seepage areas; or as holding tank that collects water for later uses such as lawn watering, fire protection, and irrigation.

Floodplain Management

This management practice incorporates land use planning to control flood corridor development and stream channel modification. Controlling development in flood corridors protects against backwater effects that result when the flood-carrying capacities of watercourses are exceeded due to clogging and encroachment of development.

Environmentally sensitive wetlands and woodlands tend to be found adjacent to water courses. Wetlands, which are poorly drained soils, absorb, store, and improve the quality of runoff. Wetland preservation is presented as a separate practice to control source pollution. Woodlands often form greenways ideally suited to provide flood damage control.

Parking Lot Storage

Impervious parking areas can be designed to act as temporary impoundments during rainstorms to control the rate of runoff. parking lot drainage systems can be designed to temporarily detain stormwater in specifically designated areas, generally at the perimeter of parking areas, and release it at a controlled rate using specially designed or modified storm drain inlet structures.

Rooftop Detention

Rooftop detention involves the temporary ponding and gradual release of stormwater falling directly onto flat roof surfaces by incorporating controlled-flow roof drains into building designs. This is achieved through the use of small perforated weirs or collars placed around the inlets of roof downdrain pipes. The purpose of rooftop detention is to reduce the rooftop discharge rate to reduce the impact on receiving stormwater facilities.

Bank Stabilization

Bank stabilization techniques involve grade stabilization structures to control erosion on banks or slopes of streams, creeks, and road swales that can be sediment-producing, highly erodible or severely eroded with little or no established vegetation. Grade stabilization structures are used to strengthen the floor and side slopes of natural or artificial channels.

Conservation Tillage

Conservation tillage applies to crop tillage methods used to control or reduce the amount of erosion from crop fields resulting from storm runoff by retaining water, increasing infiltration, or slowing the runoff velocity.

The most common conservation tillage practice for the northeastern United States is termed no-tillage or zero tillage. It involves soil preparation and planting that are done in one operation with specialized farm equipment. This results in limited soil disturbance and leaves most crop residues on the soil surface.

Other conservation tillage practices, e.g. ridge planting, strip tillage, plow planting, etc., are less common than no-tillage. Typically they required specialized soil and cropping conditions to be practical. Some of the conservation tillage methods may also decrease runoff volume by allowing significant amounts of runoff to infiltrate into the soil. This ability is dependent on the amount of soil compaction in the undisturbed areas of the field and the amount of crop residues exposed. High soil compaction inhibits infiltration, whereas exposed crop residues absorb the water and retain it on site until it evaporates or is transpired by plants.

Contour Farming

Contour farming is the practice of farming sloping cultivated land in such a way that plowing, preparing land, planting, and cultivating are done on the contour. The primary purpose of this practice is to control erosion. Because erosion control reduces sedimentation, the secondary purpose of this practice is control of source pollution. Informal contour farming, such as cropping across rather than up and down a hill slope, can be easily applied.

Cover Cropping

Cover cropping involves planting and growing of cover and green manure crops. Cover and green manure crops are crops of close-growing grasses, legumes (clover), or small grain planted in a fallow field and plowed into the ground before the next row of crop is planted. this technique is used to control erosion during periods when the major crops do not furnish cover.

The cover crop can be seeded after harvesting the major crop by light plowing, or it can be seeded prior to cultivation of the major crop without additional seedbed preparation. Cover crops are most beneficial to farm practices that leave bare soil following harvesting, e.g. corn silage production.

Critical Area Planting

Critical area planting involves planting vegetation on critical areas to stabilize the soil and promote stormwater infiltration, thereby reducing damage from sediment erosion and excessive runoff to downstream areas. Critical areas can be sediment-producing, highly erodible or severely eroded areas where vegetation is difficult to establish with usual seeding or planting methods.

Diversion

A diversion is any channel designed and constructed to intercept excessive and/or concentrated runoff from cropland, pastureland, or farmsteads (including feedlots and eroding gullies), or conservation practices such as terraces or strip cropping fields. The intercepted flow is then conveyed (diverted) to a disposal site and/or facility such as an infiltration pit, impoundment, or wetland. Intercepted runoff could also be made available for use on nearby sites. The primary purpose of a diversion is to reduce erosion and subsequent soil loss potential. A secondary purpose could be to prevent unpolluted surface runoff from entering, and thereby diluting, contaminated areas such as waste storage ponds.

Farmland Management

Farmland management incorporates several practices, all of which discourage accelerated erosion at the farm site. These practices include using proper planting and management techniques for pasture and hayland to control erosion from the areas. Another farmland management practice is the development and protection of springs used as water supply sources on farms to distribute grazing to several locations rather than concentrating it in one area.

Fencing

Fencing controls streambank erosion by preventing both the physical destruction of the bank and the denuding of streambank vegetation from grazing animals.

Storm Sewers

Storm sewer systems include curbs and gutters, conveyance facilities, pipelines, storage facilities and flow regulators. Conveyance consists of collecting the stormwater and transporting it, via underground pipes, to a storage facility, to an overflow/bypass device or directly into a receiving stream. The primary control purpose of storm sewers is to protect the land from erosion by replacing overloaded and inadequate roadside swales. A second purpose is to eliminate local flooding.

Strip cropping

In general, *strip cropping* is the seeding and growing of crops in a systematic arrangement of strips or banks across the "general" slope of the terrain or on the contour. The crops are arranged so that a strip of grass or close-growing crop is alternated with a clean-tilled production crop or a fallow row. The primary purpose of this technique is to control erosion caused by storm runoff flowing down the slope. The function of this crop arrangement is similar to that of the filter strip which is used for more urbanized areas (refer to discussion of filter strips provided later in this section). Grassed waterways/diversions or outlets should be established on the slopes at points where storm runoff accumulates to provide safe disposal of the excess water.

Terracing

A terrace is an earth embankment, ridge or channel constructed across a slope at a suitable location to intercept runoff water and control erosion. Generally terraces are considered supporting practices to use in conjunction with contouring, strip cropping and reduced tillage methods (particularly on long slopes and slopes where these practices may not be effective enough alone). Terracing has been amply shown to be highly effective in trapping sediment and reducing erosion. The effectiveness of terracing is not as effective for reducing the loss of nutrients from the soil from surface runoff, however, and subsurface nitrogen losses may increase.

Agricultural Waste Storage Structure

Agricultural waste storage structures can be either an above-ground fabricated structure or an excavated pond. These facilities are designed to temporarily store nontoxic agricultural wastes including animal waste to reduce contamination of natural watercourses by source pollution control of liquid and solid wastes. This involves providing temporary storage for the agricultural wastes and not allowing them to remain on the land surface where they can infiltrate and/or wash away to surface watercourses. Wastes can be disposed of by controlled application to cropland. Animal wastes supply soils with nutrients, improve soil tilth, reduce runoff rates, and increase soil infiltration rates. A Nutrient Management Plan can be developed to maximize the use of nutrients produced on the farm.

Filter Strips

This practice uses vegetated areas for intercepting storm runoff to reduce the runoff velocities and filter out the runoff contaminants. Although filter strips are similar to grass waterways used in strip cropping, they are used primarily for urban developments. Successful application of filter strips to urban developments requires consideration of natural drainage patterns, steepness of slopes, soil conditions, selection of proper grass cover, and proper maintenance. The filter strips should be established at the perimeter of disturbed or impervious areas to intercept sheet flows of surface runoff. These grass buffer strips will slow runoff flow to settle particulate contaminants and encourage infiltration.

Sediment Basin

A sediment basin, sometimes referred to as a debris basin, is an earth embankment or ridge generally constructed across the slope or across minor watercourses and have subsurface outlets. The basin does not control erosion but rather traps sediment near the land disturbance and prevents it from entering downstream watercourses.

Street Cleaning

Street cleaning involves sweeping, vacuuming, flushing, or otherwise cleaning of streets (including curbs and gutters), parking lots, and other paved vehicular traffic areas. The primary purpose is to control source pollution by removing dry-weather accumulations of pollutants including oil and grease, general litter, sediment including gravel and silt/sand, and fallen leaves.

Wetland Preservation

The potential of using natural or artificially created wetland areas as a source pollution control technique is a relatively new idea. Performance capabilities and design principles and parameters have not yet been identified and quantified. However, it has been found that implementation of this technique should include the need for maintenance harvesting to prevent constituent recycling.

In general, wetland vegetation provides sediment trapping, prevention of sediment resuspension and removal of soluble and sediment-associated nutrients. Additionally, wetlands slow the velocity of runoff, which reduces the likelihood of downstream erosion of the streambank.

Artificial wetlands are normally created as part of a detention pond. An inlet-controlled slotted standpipe can be used as a control device for creating a shallow wetland in the lower stage of an extended detention pond. This device regulates water levels within the lower stage and maintains target detention times even when partially clogged.

The preservation and protection of natural wetlands for a control technique is desirable because it retains or enhances existing drainage patterns so that the natural hydrologic characteristics of an area are maintained as much as possible. Also, most wetlands serve as an aquatic and wildlife habitat.

TABLE L-1

Stormwater Management Practices
Performance Estimates

Type of Control[1]

Control Practice	Runoff Peak Rate	Runoff Volume	Erosion	Sediment	Phosphorus	Nitrogen
VOLUME CONTROLS						
Infiltration Pits and Trenches	90%	90%	30-60%	30-60%	40%	60%
Land Surface Control and Zoning	UK	UK	UK	UK	UK	UK
Porous Pavement (Asphalt)	100%	>60%	UK	UK	40%	60%
Porous Pavement (Concrete)	75%	30-60%	UK	UK	30-60%	30-60%
Seepage Areas	30-60%	30-60%	30-60%	30-60%	30-60%	30-60%
PEAK RATE CONTROLS						
Channel Modification	30-60%	N	V	N	N	N
Cistern Storage	>60%	V	<30%	25-70%	30-60%	30%
Floodplain Management	UK	UK	UK	N	N	N
Impoundment (Dry Detention)	>60%	N	<30%	<30%	10%	20%
Impoundment (Wet Detention)	>60%	>60%	<30%	60%	30%	30-65%
Parking Lot Storage	>60%	N	<30%	30-60%	30-60%	<30%
Rooftop Detention	>60%	V	<30%	N	N	N
EROSION CONTROLS						
Bank Stabilization	<30%	<30%	>60%	>60%	>60%	<30%
Conservation Tillage,						
General	30-60%	30-60%	60-90%	>60%	30-60%	30-60%
No-Till	30-60%	30-60%	80-98%	>60%	>60%	30-60%
Contour Plowing	30-60%	30-60%	50%	15-55%	30-60%	30-60%
Cover Cropping,						
Alone	<30%	<30%	30-60%	50-60%	30-60%	<30%
With Conservation Tillage	30-60%	30-60%	>60%	95%	>60%	30-60%
Critical Area Planting	30-60%	30-60%	>60%	>60%	>60%	30-60%
Diversion	<30%	<30%	30-60%	30-60%	30-60%	<30%
Farmland Management	30-60%	30-60%	>60%	>60%	>60%	30-60%
Fencing	N	N	>60%	>60%	60-80%	30-60%

TABLE L-1 (Cont'd.)

Stormwater Management Practices
Performance Estimates

Type of Control[1]

Control Practice	Runoff Peak Rate	Runoff Volume	Erosion	Sediment	Phosphorus	Nitrogen
EROSION CONTROLS (Cont'd.)						
Storm Sewers (Without Treatment)	>60%	N	N	N	N	N
Stripcropping - Contour	30-60%	30-60%	75%	>60%	>60%	30-60%
Terracing	30-60%	30-60%	50-98% Avg. 80%	>60%	>60%	30-60%
SOURCE POLLUTION CONTROLS						
Agricultural Waste Storage Structure	>60%	>60%	N	>60%	>60%	>60%
Filter Strips	30-60%	<30%	30-60%	85%	>60%	<30%
Sediment Basin	N	<30%	30-60%	>60%	>60%	<30%
Street Cleaning						
Mechanical Sweepers	N	N	N	50%	30-60%	<30%
Vacuum Sweepers	N	N	N	95%	30-60%	<30%
Wetland Preservation	30-60%	30-60%	<30%	75%	50%	25-85%

(1) 1N - not applicable or negligible preventive effect or reduction capability.
V - variable preventive effect or reduction capability where performance is exclusively dependent on application.
UK - unknown preventive effect or reduction capability.

References

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APPENDIX M

Bernards Township Facilities Responsiveness Summary

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

0 3 NOV 1981

To All Government Agencies, Public Groups and Citizens:

On August 20, 1981, the Environmental Protection Agency (EPA) held a public hearing at the Morris Township Municipal Building, Convent Station, New Jersey on the draft environmental impact statement (EIS) on the Upper Passiac River Basin 201 Facilities Plan. The purpose of the hearing was to receive public comment on the issues addressed on the draft EIS.

Comments were received at the public hearing and subsequent comment period objecting to the Bernards Township sewerage facilities proposed in the draft EIS. However, EPA believes that the majority of the comments have been addressed in the draft EIS. The remainder have been evaluated since the comment period by EPA and Bernards Township. The enclosed responsiveness summary has been prepared in order to answer questions raised during the comment period concerning the Bernards Township project.

Because of internal funding limitations and the possibility that the township would lose approximately $700,000 in additional grant funds due to the expiration of funding authorization for innovative and alternative technology projects, EPA issued a grant to construct the Bernards Township sewerage facilities on September 30, 1981.

Public comment received on the draft EIS not related to the Bernards Township project will be addressed in the final EIS. You will be notified upon availability of the final EIS. Thank you for your interest in this project.

Sincerely yours,

Richard T. Dewling, Ph.D.
Acting Regional Administrator

Enclosure

Responsiveness Summary

Project Name: Bernards Township Sewage Treatment Plant Upgrading and Expansion and Interceptor System, Somerset County, New Jersey

Project Number: C-34-382-01

Applicant: Bernards Township Sewerage Authority

The Bernards Township project is included in the scope of an environmental impact statement (EIS) that the Environmental Protection Agency (EPA) is preparing on the Upper Passaic River Basin 201 Facilities Plan. In July 1980 and again in April 1981, the applicant requested that EPA segment its project out of the EIS so it could proceed independent of the EIS process. This request was made for three reasons: (1) the township was under a court order to provide sewage treatment for high density housing; (2) the applicant felt that because of the position of this project on the New Jersey Priority List, construction grants for the project would not be available beyond September 30, 1981; and (3) the applicant agreed with the population and flow projections and the level of treatment being proposed in the EIS. To both requests, EPA indicated that it would consider the segmentation after issuing a draft EIS and holding a public hearing on the draft providing there was no significant public controversy associated with the segmentation.

The draft EIS was issued on June 8, 1981. The EIS indicated that EPA intended to segment the project out of the EIS if there was no significant public controversy. At the public hearing held August 20, 1981 at the Morris Township Municipal Building, Convent Station, New Jersey, several comments were received opposing the proposed interceptor system. In addition, approximately 75 letters were received following the public hearing, objecting to the interceptor system. EPA believes that many of the issues raised in these comments have been addressed in the draft EIS. The remainder have been evaluated since the public hearing by EPA and the applicant. Furthermore, delay of the grant would have caused the township to lose approximately $700,000 in additional grant funds due to the expiration of funding authorization for innovative and alternative technology projects. Therefore, EPA decided to award a grant for the construction of this project on September 30, 1981.

The comments received fell into a number of well defined categories. To avoid repetition EPA has grouped the comments and responded accordingly.

Issues raised during the comment period:

- Lack of need for sewers
- Inadequate analysis of alternatives
- Impacts to environmentally sensitive areas (i.e., wetlands, floodplains, prime agricultural lands, cultural resources and sole source aquifers)
- Impacts to the water table
- Excessive costs
- Public participation
- EPA subsidizing development
- Easement acquisition procedures

Lack of need for sewers

Many commenters have indicated that they feel there is no need for sewers in the area. The soils in the area are rated by the Soil Conservation Service as having severe limitations for the use of on-site systems. In addition, the Bernards Township Health Officer has indicated that the septic systems in the area are malfunctioning and that sewers are needed. Given this information and the lack of substantial evidence to the contrary, EPA concluded that sewers are needed in this area.

Inadequate analysis of alternatives

Several comments were received indicating that alternatives to sewering were not analyzed. In addition, several commenters felt that a septic management program would work in this area. Following the public hearing, the township health officer and the applicant's consultant evaluated alternatives to sewering for this area. The conclusion of these studies was that sewers were the most cost-effective and environmentally sound alternative for treating the wastewater generated in the study area.

Impacts to environmentally sensitive areas

Many commenters expressed concern over the potential impact the interceptor would have on environmentally sensitive areas. Environmentally sensitive areas potentially affected and possible mitigation measures are discussed below.

Wetlands and Floodplains - The interceptor and treatment plant were sized to exclude capacity for these areas and EPA intends to affix special conditions to the grant for the project prohibiting new sewer hookups from undeveloped wetlands and floodplains. In addition, the main portion of off-road easement was inspected by EPA, U.S. Fish and Wildlife Service, and the New Jersey Department of Environmental Protection (NJDEP) on September 14, 1981; no wetlands were encountered. The interceptor will be aligned through portions of floodplain. However, adverse impacts to these areas will be minimized by strict adherence to environmental specifications included in the construction plans and specifications.

Prime Agricultural Lands - Impacts of sewer construction on prime agricultural lands will be mitigated through proper construction techniques (i.e., soil erosion and sediment controls and limiting easement widths). Major portions of candidate prime agricultural lands (defined by soil type, importance, and extent of active farming) in the Upper Passaic study area are developed or are protected by other environmental constraint designations. In addition, there are currently minimal local controls to limit development of agricultural lands in the study area. Prime agricultural lands were not included as an environment constraint in the EIS. However, EPA will support any local controls to protect prime agricultural lands.

Cultural Resources - As was stated at the public hearing and in the draft EIS, additional cultural resource work had to be done for the project. The cultural resource survey was completed and it indicates that no cultural resources on or eligible for listing on the National Register of Historic places were encountered in the impact corridor of the project.

Sole Source Aquifer - Approximately one-half of the recharge zone of the Buried Valley Sole Source Aquifer underlies the Upper Passaic study area. Designation of an area as a sole source aquifer recharge zone gives the EPA Regional Administrator the authority to review all federally funded projects within the designated area to determine potential impacts to groundwater quality. The potential impacts of the project have been reviewed and have been determined to be beneficial to the aquifer. This is because the proposed sewer programs will improve surface water quality and, therefore, the quality of recharging waters will improve. In addition, the quality of local pockets of groundwater should improve because of the elimination of improperly treated leachate from malfunctioning septic systems.

Impacts to the water table

One commenter expressed concern over the project's impacts to the water table in Bernards Township. In areas that require dewatering for construction, the water table will be temporarily lowered. However, water levels will quickly return to normal after dewatering ceases. A potential indirect impact of the project may be a reduction in the amount of groundwater recharge because water that is presently discharged into the ground from septic systems will eventually be transported to the Bernards Township treatment plant for ultimate discharge to the Dead River. However, there are adequate existing water resources in the study area to meet the demands of the design population of the project. In addition, as stated above, the overall impact to the groundwater is expected to be beneficial because of the improvement in its quality. The improvement in quality is expected to far outweigh any adverse impacts associated with groundwater reduction.

Excessive costs

Many commenters were concerned that the user costs and hookup costs associated with the project may be excessive. The user costs associated with the regional project are expected to be approximately $120/year. In addition, there will be an incremental increase in this cost due to the proposed collection system which was not covered by the current grant. However, the sum of these costs is not expected to exceed the 1.75% of median income. This is the guideline recommended by EPA for assessing the economic burden of sewer facilities on the public. In addition, if the grant for the treatment plant would have been delayed, the township would have lost approximately $700,000 in grant funds because of the expiration of funding authorization for innovative and alternative technology projects. It is likely that this would have resulted in an additional increase in the user costs associated with the project.

Costs associated with connecting to the sewer system will be borne by the individual homeowner. These costs are a one-time cost and are expected to be in the range of $10 to $15 per linear foot. There are some options (e.g., joint connections by whole blocks) to reduce these costs. These costs will be analyzed further and explained during the planning of the proposed collection system. However, they are not expected to cause undue economic hardship on the individual user.

Public participation

The apparent lack of public participation during the planning of the interceptor system was cited as a concern by several commenters. The interceptor system was proposed in the draft facilities plan for the Upper Passaic study area on which the EIS was prepared. The preparation of the EIS began with the issuance of a Notice of Intent on January 26, 1978. A citizens advisory committee (CAC) was developed in the beginning of the EIS process. During the preparation of the EIS, three public meetings and six CAC meetings were held to solicit public comment on the wastewater treatment plan proposed for the Upper Passaic River Basin. A review of the minutes of these meetings (Appendix I in the draft EIS) indicates that few, if any, comments were received during this time objecting to the Bernards Interceptor System. At the public hearing and during the subsequent comment period, objections were raised by approximately 75 parties. This responsiveness summary is intended to answer the concerns raised by those parties.

In addition, if Bernards Township intends to apply for federal funding for the proposed collection system that will contribute flow to the interceptor system, an additional public hearing will be held to obtain public input on that aspect of its facilities plan.

EPA subsidizing development

A few commenters objected to the project because they believed it was contrary to an EPA policy requiring no growth. Current EPA regulations call for designing facilities for a 20-year life. This requires the planning and construction of facilities to correct existing wastewater treatment problems plus a nominal additional capacity to treat wastewater generated by reasonable growth providing environmentally senstive areas are protected. In most cases the design population is the approved 208 population. In the case of Bernards Township, the project population was reduced based on existing zoning to eliminate further encroachment on environmentally critical areas (i.e., floodplains, wetlands, and steep slopes). This resulted in a reduction of the 208 population projection by approximately 600 persons. Therefore, EPA believes that this project will not subsidize unacceptable population growth in Bernards Township.

Easement acquisition proceedings

Some commenters expressed concern over the proceedings intiated by Bernards Township to acquire the easements required for construction of the interceptor. EPA requires that all easements necessary for the construction of a project be acquired prior to the award of a Step 3 grant for construction. While it is unfortunate that more time could not be allocated by the township to allow for the acquisition of the easements EPA finds that the requirements for real property acquisition were met in this case.

APPENDIX N

Letters Received Concerning the DEIS

APGAR ASSOCIATES

ENGINEERS · LAND SURVEYORS · PLANNERS

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THADDEUS F. HOLMAN, L.S.

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SUBDIVISION AND SITE PLANS
WATER AND SEWER SYSTEMS
ENVIRONMENTAL STUDIES AND REPORTS
SOIL AND FOUNDATION ENGINEERING
DRAINAGE AND FLOOD STUDIES
STREETS, HIGHWAYS AND BRIDGES
MUNICIPAL ENGINEERING · PLANNING
DAMS AND HYDRAULIC STRUCTURES

August 20, 1981

Mr. Edward A. Taratko, Chairman
Upper Passaic River Basin
Wastewater Management Committee
Post Office Box 90
50 Woodland Avenue
Convent Station, New Jersey 07961

Re: Environmental Impact Statement, Draft, June 1981

Dear Mr. Taratko:

As Harding Township's representative to the Wastewater Management Committee, I would like to express our support of the Draft Environmental Impact Statement. It appears that after many years of study we have finally reached the point where needed facilities for wastewater treatment can be designed and constructed. Although the individual interests and desires of each member community may not be fully met by the recommendations of the report, we believe the Upper Passaic River Basin will greatly benefit if most of its recommendations are adopted.

Our only significant objection to the recommendations of the report is the delay that would result from another study to determine the need for nitrogen and phosphorous removal at the Woodland Avenue Treatment Plant in Morris Township. It is well established that effluent from that plant has had unusually high nutrient levels for many years. Reference is made to a report entitled "Surface Water Resources of the Great Swamp Watershed" by Guillander, et al (University of Pennsylvania), 1975 as well as recent stream water sampling reports of the U. S. Fish and Wildlife Service.

The high nutrient level of the effluent has significantly contributed to the accelerated growth of rooted aquatic vegetation in Loantaka Brook. The vegetation clogs the brook, reduces the flow, and causes sediment buildup reducing the depth of the channel. During the past ten years the channel depth has been reduced by about 50% in the low-lying area of Harding Township bordering the Great Swamp. Residential lands that were once used for lawns can no longer be mowed because of the high water table. What was once an attractive portion of residential lots is now a soggy mess of weeds. Flood levels that were once reached every ten or fifteen years are now reached several times a year. Trees that for many years lined the banks of the brook are now dead. 1

Therefore, Harding Township strongly objects to further delays in the construction of nutrient removal facilities at the Woodland Avenue plant in Morris Township. While further study may be required to determine the effects of the nutrients on

the National Wildlife Refuge, the effects of nutrients on the growth of vegetation that clogs Loantaka Brook as it flows through private property in Harding can be readily observed. The damage to private property and generally to the environment of the area far outweighs the cost of nutrient removal.

With this one modification to the recommendations of the study, Harding Township endorses and approves the draft Environmental Impact Statement.

Very truly yours,

Robert H. Fox, P.E.
Harding Township Engineer

RHF/nh
cc: U. S. Environmental Protection Agency
N. J. Department of Environmental Protection
Harding Township Committee
Harding Township Environmental Commission
Mayor W. Thomas Margetts

Harding Township Environmental Commission

P. O. BOX 300 • NEW VERNON, NEW JERSEY 07976

August 20, 1981

Chief
Environmental Impacts Branch
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

Dear Sir:

The Harding Township Environmental Commission supports the general provisions and recommendations of the Environmental Impact Statement for the 201 Facilities Plan of the Upper Passaic River Basin. The EIS reflects a recognition of the need to protect the area's precious and unique natural resource, the Great Swamp National Wildlife Refuge.

For example, the population projections are sound because they recognize the limits of development that can be supported by the environementally sensitive areas in the basin.

The recommendation to prohibit the extension of sewer service to floodplains and wetlands is an excellent way to preserve the vital functions performed by these areas. Construction grants should be conditioned to preclude any sewer hookups to residences, businesses, or industries proposed for wetlands or floodplains.

We are, however, concerned that yet another study is proposed before certain improvements in the Morris and Chatham Township plants will be funded. I am referring to the proposed nutrient dynamics study which would determine the magnitude and sources of stream flows and nutrient loads to the Great Swamp and their effects on the Swamp. At least for the Morris Township plant and Loantaka Brook, we know today that there is a heavy nutrient load. Studies done for this EIS show high levels of pollutants in Loantaka Brook and Loantaka Pond below the Morris Township plant. Studies by the Harding Township Engineer over the last ten years or so have also shown high levels of nutrients in Loantaka Brook.

These pollutants are affecting the Great Swamp and neighboring private property owners. The pollutants encourage algae growth. The algae traps sediment. The sediment reduces the size of the stream channel. Result: rising water levels in and around the Swamp. The Swamp is losing irreplaciable animal habitats. Homeowners are losing irreplaceable backyards..

Let's not waste any more time or money. We don't need another study. Nutrient removal should be part of the upgrading of the Morris Township plant from the very start. We know it's needed. We don't need another study to tell us so. 3

Sincerely,

RE: STATEMENT - ENVIRONMENTAL IMPACT STATEMENT ON THE UPPER PASSAIC RIVER BASIN 201 FACILITIES PLAN. MORRIS TOWNSHIP, AUGUST 20, 1981

PRESENTED BY: Ella F. Filippone, Executive Administrator, Passaic River Coalition

The Passaic River Coalition is a watershed association concerned with water resources management in the Passaic River Basin. Our headquarters are located at 246 Madisonville Road, Basking Ridge, New Jersey in the high headwaters of the Passaic River and within a brief distance from the Great Swamp Wildlife Refuge. The Passaic River Coalition has been in existence since 1969 and has participated in deliberations of the Upper Passaic 201 Facilities plan since its inception in 1974-75. We have attended every meeting on this program except those to which we were not invited.

On many occasions we have presented our concerns to the New Jersey DEP, the U. S. EPA, the consultants and municipal officials. After considerable input, we welcomed the receipt of the Draft Environmental Impact Statement on the Upper Passaic River Basin. as we anticipated the document which would finally move forward the improvement of sewage treatment plants much needed in the region.

We anticipated coming to this hearing to praise WAPORA, instead we find ourselves in a position to be extremely critical, a grave disappointment after all the efforts put into this program. The Environmental Impact Statement justifies the proposals of 1977 which were questioned by the public, although the statement attempts to make various recommendations regarding critical lands and land use. Assumptions and omissions negate some of these forward moving efforts. There has never been any question that the sewage treatment plants in the Upper Passaic River Basin must be up-graded, and in some cases expanded; however, the clear definition of the secondary impacts of these activities has not been brought forward. The EIS leans heavily on decisions made in the master plans of the municipalities. Certain decisions regarding zoning have been extremely controversial in the Upper Passaic, and the EIS does not demonstrate public opposition to changes in zoning such as mass opposition of the citizens of Bernards Township to the PRN zone.

Because of this lack of recommendation, the recommended Bernards Township interceptor line will stimulate growth in the Dead River Basin, which is contrary to all the principles being advocated by the EPA and others in the federal government regarding wetlands.

The EIS has made substantial progress with regard to its concerns for the Great Swamp Wildlife Refuge. The recommendation to undertake a study of water quality impacts from receiving streams follows through on a recommendation we presented four years ago. We are extremely pleased to note, that although not as extensively as we had recommended, the EIS strongly recommends a research project to determine water quality impacts on the Great Swamp. This recommendation should be pursued immediately.

The Bernards Township alignments alternatives should all be rejected. The recommended route is highly controversial and lacks public support, and more than that, will impact the wetlands of the Dead River, initiating extensive new development which will toally destroy within a period of time the ecological integrity of the Dead River.

There has been no public discussion within Bernards Township regarding the routing of this interceptor; there has been no consideration of placing the interceptor along more environmentally sound routes. The need for the interceptor is being questioned by contrary citizens in the township. We, at the Passaic River Coalition, have been inundated with telephone calls regarding this interceptor because of the crisis being developed within the community to have the interceptor developed. Placing the interceptor through the wetlands of the Dead River will clearly enable Commonwealth of Basking Ridge to build 1220 housing units on land in the confluence of the Passaic and Dead Rivers which, in our opinion, is a wetland. The court decision on this property clearly stated "that the Department of Environmental Protection and the Environmental Protection Agency can and will appropriately and adequately protect the water quality of the river and the zoning is not needed for that purpose."

We strongly recommend that the decision to approve the Bernards Township interceptor be set aside so that the public has an opportunity to evaluate and comment on the project. As the interceptor is now recommended, we object and respectfully request that the Department of the Interior, Fish and Wildlife Division, evaluate the wetlands status of the route to verify our findings.

The EIS, contrary to requests presented at Citizens Advisory Committee meetings, also provides a brush stroke over the Buried Valley Aquifer in all of the municipalities in this facilities plan or in the designated sole source aquifer area.

5 The PRC as well as the Passaic Valley Ground Water Protection Committee requested that prime aquifer recharge areas be included as critical areas in the Upper Passaic Facilities Plan. This kind of evaluation had been done for the Rockaway River, thus establishing the precedent. According to our technical person, the primary recharge areas do exist in the Upper Passaic River Basin which contains part of the terminal moraine. The EIS does not in any clear cut manner address the impact of the growth, initiated by the treatment plant improvements on ground water, stated in its water supply element - it hazily discusses the importation of water from other sources. The water supply element further continues to lean on Osborne Pond as a source of drinking water. Plans for the abandonment began in the mid-70's and were completed by 1979. We find it irresponsible that the consultant did not obtain the timetable from Commonwealth Water Company so that accurate water supply figures could be included in the report. From the inception of the deliberations on this planning effort, the PRC has forecast a water supply deficit. Numerically, for the region, there is a surplus, but that surplus is not in the service area where the greatest growth is being experienced. The water purveyors that have a surplus do not serve the growth centers; thus, water supply must be considered a constraint to growth in this facilities plan.

The Passaic River Coalition supports improvements to water quality in the
6 Passaic River Basin as a primary goal under the Clean Water Act. We would recommend that EPA development guidelines for each facility so that the impact on environmentally

sensitive lands is kept at an absolute minimum. EPA must provide the municipalities in the Upper Passaic with a clear definition of wetlands, prime recharge areas and floodways. EPA should guide these municipalities through their planning boards in assuring that water quality improvement and "anti degradation policy" be pursued in all their deliberations. EPA should provide guidance with regard to non-point source pollution factors from new developmentss so that improvements gained through the upgrading of sewage treatment plants remains a positive benefit. EPA should establish 7
a program for the Upper Passaic which seeks to justify for EPA-Washington the need for a Level IV treatment.

Finally, we strongly recommend that since questions by the public exist on the Bernards Township Facilities Plan that it be removed from the Upper Passaic group and be permitted to function as an independent facility with its own public participation program so that the citizens of Bernards Township, and especially those who are presently agrieved, have an opportunity for input and evaluation. The Upper Passaic is one of the most important ecological parts of the system which suffers from degradation. The guardianship of the Great Swamp and the many wetlands in these upper reaches must be firmly established as a responsibility, not only of the concerned citizens, but of the municipalities and county governments dealing with land use.

We support the upgrading and improvement of the treatment facilities, but strongly recommend that precise checks and balances be added to insure that the 8
activities recommended do not initiate extensive new development.

TOWNSHIP OF MORRIS

P. O. BOX 90
50 WOODLAND AVENUE
CONVENT STATION, NEW JERSEY 07961
(201) 539-4880

EDWARD A. TARATKO, P.E.
TOWNSHIP ADMINISTRATOR

August 20, 1981

Chief, Environmental Impacts Branch
U. S. EPA
Region II

Re: Environmental Impact Statement
on the Upper Passaic River Basin
201 Facilities Plan

Gentlemen:

The Upper Passaic River Basin Wastewater Management Committee completed the final draft 201 Facilities Plan on the Upper Passaic River Basin in March, 1977. A public hearing on this plan was held on May 20, 1977, at which time comments were received from the public and various concerned agencies within the study area. This plan, which was approved by the Upper Passaic River Basin Wastewater Management Committee, has therefore been utilized as a basis for comparison with the Environmental Impact Statement.

A comparison of recommendations included under the draft Facility Plan and the draft Environmental Impact Statement have been shown on the enclosed Table A. As can be seen on this tabulation, the total projected wastewater flow considered in the draft Facility Plan amounted to 20.3 MGD (million gallons per day) while under the draft Environmental Impact Statement the total wastewater flow which would be conveyed to centralized treatment facilities has been reduced to 17.6 MGD. Thus, the Environmental Impact Statement provides approximately 13% less capacity for wastewater flows

generated within the watershed in an apparent response to the concerns ex-
pressed over population projections in the Facility Plan and potential second-
ary impacts of the recommended alternative. This reduction of approximately
2.7 MGD in total basin treatment capacity has been concentrated in the com-
munities of Morris Township, Chatham Township, Bernards Township and the
Madison/Chatham Joint Meeting. Moreover, in the Madison/Chatham Joint Meeting
and the Morris Township treatment facilities the EIS recommends a reduction in
the present plant capacity which would be accomplished by reducing the capacity
of the advanced wastewater treatment facilities, thereby limiting the entire
design capacity of the plant.

We recognize that the proposed plant capacities under either study are based
on estimates of population growth, per capita wastewater contributions and
allowances for commercial and industrial development. Although it is somewhat
difficult to justify the differences in estimating procedures which result in
the reduced wastewater projections in the EIS, it is ludicrous to reduce exist-
ing plant capacity which has been financed through the taxpayer dollars by the
imposition of subsequent in-plant bottlenecks, which could seriously affect
treatment efficiency and reliability. It should be noted that the existing
plant capacities had been previously approved by the regulatory agencies prior
to their construction and based upon this, commitment of flows in excess of
the proposed EIS reduced plant capacities, have been granted in some instances.
We would, therefore, suggest that in the instances where the EIS projections
are less than the existing treatment plant capacity that the plant capacity
be maintained at the present level and thereby utilize the existing treatment
facilities to their maximum potential. This situation occurs specifically 9
in the Madison/Chatham Joint Meeting where a reduction in capacity
from 4.0 MGD to 3.2 MGD is recommended as well as the Morris Township

Woodland Treatment Plant where a reduction in capacity from 2.0 MGD to 1.8
MGD is recommended.

The Notice of Intent to prepare an Environmental Impact Statement on the 201
Facility Plan for the Upper Passaic River Basin included the issue of impacts
on the Great Swamp National Wildlife Refuge due to the quantity and quality
of wastewater effluent from the Chatham Township Treatment Plant and the
Morris Township Woodland Treatment Plant. The Notice of Intent indicated
that further evaluation of the impacts would be addressed in the Environmental
Impact Statement. The conclusions of the draft EIS are quite similar to the
statement in the Notice of Intent in that additional studies are still being
required for the upstream areas draining to the Great Swamp. Since the origi-
nal issue is apparently still not resolved within the EIS, it would appear
that the original scope of work has not been satisfied. However, the recom-
mendations of the EIS further indicate that the Chatham Township and Morris
10 Township plants should be upgraded to Level 4 treatment with provision for
possible nutrient removal in the future following the recommended studies. It
is not apparent how the cost effective analysis in the EIS could be completed
without the levels of treatment established for these treatment plants.

However, it is apparent that the original issue of water quality and quantity
and the subsequent impact on the Great Swamp has been inadequately addressed
in the Environmental Impact Statement and does not satisfy the original project
11 scope. The imposition of additional studies upon the upstream municipalities
or the Upper Passaic River Basin Wastewater Management Committee would result
in additional local costs to address issues which were to be addressed and
concluded within the framework of the EIS.

We, furthermore, question the imposition of Level 4 treatment (Level 3 treatment for New Providence) for all of the treatment facilities within the Upper Passaic Basin. The EIS does not provide an independent analysis of this requirement but instead refers to the 303e basin plan and waste load allocations. 12

It is our understanding that during the development of the scope of work for the EIS, the regulatory agencies agreed to conduct further sampling, analyses and evaluations of the need for nitrification within the Upper Passaic Basin. There is no evidence within the EIS that this work was completed to justify the requirement for nitrification facilities at each of the individual plants and this increased level of treatment will impose a serious financial burden upon all of the municipalities served by these treatment facilities. Following the initiation of the EIS by EPA, the NJDEP was advised by letter dated March 21, 1978, that "one of the factors which is vital to the timely completion of such an EIS is the availability of waste load allocations from the NJDEP. These allocations are necessary for the EIS consultants evaluation of the affects of proposed wastewater treatment works on the study area." The preparation of these waste load allocations is not referenced in the EIS and the waste load allocations have been based on the prior 303e basin study.

Due to the substantial financial investments that will be required by the implementation of Step 4 treatment levels, it would appear imperative to have a detailed evaluation and compilation of the allowable waste load allocations.

SUMMARY

Although the original projection for the completion of the EIS was based on a 12 month study period, almost 4 years have elapsed since the date of the original Notice of Intent by EPA dated January 27, 1978. The water quality of the

Passaic River has not improved during this period, some municipalities are still under the building bans imposed many years ago, and the cost of construction has escalated substantially. Furthermore, potential revisions to the funding of wastewater treatment projects could increase the cost to the municipalities by a substantial amount. Although the Upper Passaic Committee concurs with the treatment facility configuration within the study area since this is compatible with the 201 Facility Plan, we strongly urge a re-evaluation of the need for Level 4 treatment as well as the need for additional studies and possible nutrient removal facilities in the extreme headwaters of the Basin, upstream of the Great Swamp. It is our understanding that the need for Level 4 treatment would be addressed independently in the EIS as well as the completion of any necessary studies to determine the level of treatment in the extreme headwater area.

In order to expedite the necessary projects within the study area, we would further recommend that the 7 treatment areas be segmented. The design and construction of advanced secondary treatment facilities should be permitted immediately on an individual project basis, while the justification of Level 4 treatment, dechlorination or nutrient removal is determined.

Respectfully submitted,

Edward A. Taratko, Jr., Chairman
Upper Passaic River Basin Wastewater
Management Committee

cc: Members - UPRBWM Committee

Enc.

TABLE A

COMPARISON OF RECOMMENDATIONS
UNDER THE DRAFT FACILITY PLAN
AND THE ENVIRONMENTAL IMPACT STATEMENT

PLANT LOCATION	FACILITY PLAN (1977)	ENVIRONMENTAL IMPACT STATEMENT (1981)
Berkeley Heights	Expand to 3.1 MGD with Level 4 treatment.	Expand to 3.2 MGD with Level 4 treatment and dechlorination.
Bernards Township	Expand to 3.0 MGD with Level 4 treatment (possible Stage II expansion to 4.9 MGD to serve contiguous communities).	Expand to 2.5 MGD with Level 4 treatment and dechlorination.
Chatham Township	Expand to 1.9 MGD with Level 4 treatment.	Expand to 1.0 MGD with Level 4 treatment (possible nutrient removal following additional studies).
Madison-Chatham Joint Meeting	Maintain capacity at 4.0 MGD. Upgrade treatment to Level 4.	Upgrade to Level 4 treatment with dechlorination. Reduce total plant capacity from 4.0 MGD to 3.2 MGD.
Morris Township	Expand to 2.5 MGD with Level 4 treatment.	Upgrade to Level 4 treatment (possible nutrient removal following additional studies). Reduce total plant capacity from 2.0 MGD to 1.8 MGD.
New Providence	Maintain capacity at 2.8 MGD. Upgrade treatment to Level 3.	Upgrade to Level 3 treatment.
Passaic Township (incl. Warren Twp.)	Expand to 3.0 MGD with Level 4 treatment.	Expand to 3.1 MGD with Level 4 treatment and dechlorination. Eliminate 3 Warren Twp. plants and convey wastewater to Passaic Twp. for treatment.

GREAT SWAMP WATERSHED ASSOCIATION
P.O. Box 82
Green Village Post Office
Green Village, New Jersey 07936

Public He[illegible]

September 2, 1981

Mr. Steve Arella
Environmental Impacts Branch
U.S. EPA Region II
26 Federal Plaza
New York, N.Y. 10278

Dear Mr. Arella:

The following is a statement made by the Great Swamp Watershed Association at the hearing on the draft EIS for the 201 Upper Passaic River Basin Facilities Plan on August 20, 1981.

The Association wishes to commend EPA, Region II, for its responsiveness to the many issues raised about primary and secondary impacts of sewage expansion in this Basin.

The Association endorses the recommendations made in this draft EIS. The following recommendations are especially vital:

- a study of the quality and magnitude of stream flows in the Great Swamp Basin be implemented. [illegible]
- [illegible] industrial package plants should not be approved until the water quality study is completed. 13
- [illegible] funded sewage projects will not serve development in sensitive areas and grant conditions to this effect are imposed.
- zoning regulations for the UPRB municipalities should be modified to protect environmentally sensitive lands from indiscriminate development.

The Association finds the draft EIS sets forth very conservative critical area delineations. For instance, since accurate wetland mapping was not a part of this EIS process, many existing wetlands are not delineated. This means that the constrained population figures arrived at are very generous and should be considered as absolute maximums. 14

The Watershed Association urges that the Water Quality and Stream Flow study for the Great Swamp Basin be implemented immediately under the egis of EPA. Funds have been set aside for this project, so it should now have top priority in order to move water management in the Basin from a planning stage to implementation. 15

The Association recommends that approval of residential package treatment plants, as well as industrial package plants be delayed until the water quality study is complete. The increasing volume of water coming into the Great Swamp Basin combined with serious non-point source pollution will be compounded by residential and commercial development made possible by package plants. 16

GREAT SWAMP WATERSHED ASSOCIATION
P.O. Box 82
Green Village Post Office
Green Village, New Jersey 07936

We support the Passaic River Coalition's serious concern over impacts of sewage interceptors in the Dead River sub-basin and on all of Bernards Township.

We respectfully submit the following additional comments for the record of the draft EIS hearing.

The Association fully endorses the recommendations made by EPA at the Public Hearing on August 20, 1981, namely, that no package treatment plant should be approved in this Basin until the water quality study of the Great Swamp Basin is completed. The results of the study should then be used to set up guidelines for development. The Association feels that any sewer expansion whether publicly or privately funded, should comply with EPA's recommendations in the draft EIS, including criteria for a General Discharge Permit. Several pending development applications that would utilize package plants and be built in sensitive areas of the Basin are currently under local review. Approval of these proposals without an evaluation of their primary and secondary impacts would violate the recommendations set forth in both the 208 Water Quality Plan and in the draft EIS for the UPRB 201.

The following corrections should be made before the EIS is made final:

17 - Page 2-4 - Township of Chatham. The DEIS states that package plants were eliminated and sewage rerouted to the Township plant. Park Central (see page 2-7) is a package plant that processes sewage from Cardinal Hill Apartments on River Road in Chatham Township. It has not been connected to Township sewers. This plants 30,000 gallons of effluent a day (Tables 2-1 and 2-2) would bring the Township;s total daily gallonage to .83 million gallons per day and should be taken into consideration if expansion of the Township plant is undertaken.

18 - page 3-2 - Areas of floodplains and wetlands delineated in Figure 3-1 and and discussed on page 3-58 are not accurate. Wetlands in the Great Swamp Basin are much more extensive according to the National Wetlands Inventory and the Morris County Soil Conservation District maps. See also page 3-23.

- page 3-37 - The DEIS discussion of growth trends in the UPRB neglects to mention the very significant amount of commercial development occurring in Morris Township and in Madison. This development will create serious impacts, particularly in non-point run-off, because of the unusual amount of traffic being generated and the subsequent need to expand secondary roads as well as access to Route 287. The estimates for changes in impervious surface area found on page 4-20, Table 4-5, do not appear to take proposed road widening and extensive parking areas into consideration.

Sincerely yours,
Abigail Fair, Chairman

cc: Dr. Richard Dewling, EPA
Mr. Robert Hargrove, EPA
Mr. William J. Muszynski, EPA
Mr. Paul Arbesman, DEP
Mr. Arnold Schiffman, DEP
Dr. Marwan Sadat, DEP
Mr. Richard Salkie, DEP

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Project Review
15 State Street
Boston, Massachusetts 02109

ER-81/1296

September 8, 1981

Dr. Richard T. Dewling
Acting Regional Administrator
Environmental Protection Agency
26 Federal Plaza
New York, New York 10278

Dear Dr. Dewling:

The Department of the Interior has reviewed the June 1981 draft environmental statement on the Upper Passaic River Basin 201 Facilities Plan, Somerset, Morris and Union Counties, New Jersey. The following comments are offered for your consideration in preparation of the final statement.

GENERAL COMMENTS

In general, the draft statement adequately describes the proposed project's impacts on fish and wildlife resources. If carried out as proposed, water quality entering the Great Swamp National Wildlife Refuge should be significantly improved.

The draft statement does not address mineral resources and it is difficult to evaluate potential minerals involvement related to siting of the proposed alternatives. 22

For clarity, it would be appropriate in our view to illustrate and label the positions of all the discussed alternatives on appropriate figures.

DETAILED COMMENTS

Pages 2-48 and 2-49

The description of alternative B-3 states that the segment between the Maple Avenue pump station and Haas Road will run south along Pond Hill Road to the top of the ridge, and that the Lower Passaic Interceptor and Parkland Interceptor are additional and future phases of this alternative. Interceptor alternative B-3 as depicted on figure 2-2 (between pages 2-46 and 2-47), however, is about 1,000 feet west of Pond Hill Road. The Lower Passaic and the Parkland Interceptors are not depicted on figure 2-2, and the streets along which they would run are not labeled.

Figure 2-2 shows that interceptor alternative B-3 is in close proximity to a quarry site. The final statement should note the present status of the quarry shown in Figure 2-2 and should indicate what effect, if any, project rights-of-way will have on the quarry.

Page 2-54:

The draft statement is unclear as to which portions of the implementation plan are to be constructed within presently held rights-of-way, and which portions of the plan shall require right-of-way acquisition. This is particularly significant with regard to alternatives WP-3 and B-3 of the implementation plan.

SUMMARY COMMENTS

23 In the section entitled Controlling Development in Environmentally Sensitive Areas (page xi), the fourth paragraph states "In order to protect environmentally sensitive areas from development sewer service should not be extended into areas designated as environmentally constrained in Figure 3-9. In addition US EPA Step 2 and Step 3 grants to the municipalities should contain conditions to prohibit future development in floodplains and wetlands from connecting to any system receiving grants" (our emphasis). It is our view that to control development in these environmentally sensitive areas, we recommend the word should be replaced with must. As written, this paragraph is merely a recommendation, not an absolute prohibition against sewer hookups in wetlands and floodplains.

24 The draft statement adequately describes the existing fish and wildlife resources and evaluates general project construction impacts. However, our review detected no mention in the draft statement about the possible need for a permit from the U.S. Army Corps of Engineers to conduct fill activities in project implementation. Such permits may be required for interceptors crossing streams and wetlands (page 4-6 through 4-8). Accordingly, unless the method of authorization is by general or nationwide permits, the comments on the statement do not in any way preclude additional and separate evaluation and comments by the Fish and Wildlife Service, pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.), if project implementation requires a permit from the U.S. Army Corps of Engineers under Section 404 of P.L. 52-500.

In review of the application(s) for such a permit(s), unless the activities fall under general or nationwide permits, the Fish and Wildlife Service may concur, with or without stipulations, or object to the proposed work depending on project effects on fish and wildlife resources which may be identified and evident at that time. It would appear that the Fish and Wildlife Service, as a minimum, will probably recommend that the U.S. Army Corps of Engineers, when issuing a permit, require features to reduce turbidity and sedimentation during project construction.

Technical assistance concerning measures to avoid, reduce, or offset anticipated project-caused losses of fish and wildlife may be obtained by contacting the Field Supervisor, Ecological Services, Fish and Wildlife Service, 315 South Allen, Suite 322, State College, Pennsylvania 16801 (FTS 727-4601).

Sincerely,

William Patterson
Regional Environmental Officer

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
1370 Hamilton Street, P. O. Box 219, Somerset, New Jersey 08873

July 31, 1981

Chief, Environmental Impacts Branch
U.S. Environmental Protection Agency, Region II
26 Federal Plaza
New York, New York 10278

Dear Sir:

We have reviewed the Draft Environmental Impact Statement for the Upper Passaic River Basin 201 Facilities Plan and have the following comments to make:

25

1. Page 3-2 - The statement that the areas shown on Figure 3-1 represent locations where the probability of flooding during any particular year is approximately 1.0 percent is incorrect. The outer fringe of this area has a 1.0 percent probability of flooding, while the inner portions have progressively higher probabilities.

2. Page 3-4 - We would suggest that the first two sentences of the second paragraph be rewritten as follows - "The United States Department of Agriculture, Soil Conservation Service (USDA-SCS) has determined that, based on general characteristics, some of the land in Morris and Somerset Counties is prime farmland. This determination is based on an assessment of the suitability of the soils for agriculture based on the degree of slope, available water capacity, pH, and seasonal high water table as well as the existing land use."

3. Page 3-43 - The section on land use does not mention agricultural land although other parts of the statement allude to its existence in the project area. It is disturbing to see agricultural land classified as vacant land zoned for residential, commercial or industrial use.

We appreciate the opportunity to review and comment on this project.

Sincerely,

PLATER T. CAMPBELL
State Conservationist

State of New Jersey

DEPARTMENT OF THE PUBLIC ADVOCATE
DIVISION OF PUBLIC INTEREST ADVOCACY

STANLEY C. VAN NESS
PUBLIC ADVOCATE

CN 850
TRENTON, NEW JERSEY 08625

CARL S. BISGAIER
DIRECTOR
TEL: 609-292-1693

August 28, 1981

Mr. Robert Hargrove
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

Dear Mr. Hargrove:

We are writing to make the following comments on the latest Upper Passaic Environmental Impact Statement:

1) On page 2-73 under the subheading "Environmental Constraints," the following sentences have been added to the earlier draft - "The potential for eutrophication is high and elevated algae growth levels have been recorded in localized areas (NJDEP 1974). In addition 26
there may be accelerated growth of rooted aquatic plants under low flow conditions in the GSNWR."

Our question is whether there is any documentation for the inclusion of these sentences? Or if, [especially the point about rooted plants] this is just conjecture?

2) Under the title "Engineering Criteria" the principal engineering criteria has been changed from "Process Efficiency" to "Compliance with effluent quality constraints." We would like to know what this 27
change means and would like to see any policy briefing your office might have explaining the reasons for this change.

3) Under "Analysis of Conceptual Alternatives - No Action" on page 2-14, 2-15 - We believe the last sentence in the first paragraph on page 2-15 ["This could lead. . ."] should be more properly placed after the last sentence in the last paragraph on page 2-14.

4) On page 2-16 and 2-17 we note the new section on "Package Treatment Plants." This section should be deleted in its present form. First of all, the section does not address package treatment plants in an environmental sense. Mostly it talks about "agency management problem,"

"cost-effectiveness" and collaterally "secondary growth." If the scope of the EIS is "environmental constraints" then EPA may have stepped beyond that scope in this section by discussing cost-effectiveness,* serious management problems, and vague unexplained secondary impacts.

28 In addition there is outright misinformation in this section. Areas that could employ package treatment plants are not necessarily adjacent to sewerage collection networks. Also, on page 2-17 it says: "In unsewered areas such as Harding Township, zoning densities are too low for this method of wastewater treatment to be used effectively." That sentence should be deleted completely because first of all it in no way discusses the "environmental problem" of package plants. Zoning densities throughout the Upper Passaic region are frequently just as low as Harding Township, and yet that is not an <u>environmental</u> reason to suggest the nonuse of such plants.

29 In addition, EPA has not taken into consideration their own (newly proposed) position that 201 construction will only service existing populations. Under the EPA proposal the 201 constraints would not be able to service any population growth in the Upper Passaic region (which EPA acknowledges will occur on page 3-81). Under those circumstances EPA must review alternative systems to meet this growth or else it is creating an EIS that is not dealing with reality.

30 It's also interesting to note that EPA has suggested a ban on "industrial package plants" only until after the GSNWR report is completed. Yet for residential package plants EPA suggests that they should not be used in the UPRB at all. The recent trichloroethylene contamination of acquifers in New Jersey should illustrate the incongruity of EPA's position. The EIS section on package plants, therefore, should be deleted until: A) they are studied further by EPA; B) the GSNWR study is completed; and C) EPA changes its position that 201 monies will only cover construction for existing populations.

Unless EPA does this they are in fact making a non-environmental judgment on the use of non-critical lands that is contrary to the EIS statement on page 3-66.

31 * What documentation does EPA have that these "package plants" are not cost effective? DEP has information showing that there are cost-effective package plants already operating in Morris County. Without some sort of documentation, this cost-effectiveness statement is nothing more than speculation. Assuming package plants develop in areas that will not be served by sewer lines, comparing their cost-effectiveness to that of municipal plants is like comparing apples and oranges.

5) On page 3-8 under the title "Loantaka Brook" - the third paragraph is rambling and misleading. The DO standard was met for 1978. That should be stated first and then EPA can discuss any minimal problems it encountered in the study. The way it's presently worded suggests that "really the standard wasn't met in 1978."

6) On page 3-32 under title "Air Quality," why was table E-2 removed? Why was the statement that Northern New Jersey is a Class II (PSD) area removed? Also, why was the paragraph on PSD increments removed on page 3-35 (formerly 3-46) (just before the "Energy" section? 32

7) In line with our earlier comments, we believe the last line on page 3-36 should be deleted or further documentation be supplied for its inclusion. 33

8) On page 3-37, at the bottom, two sentences were deleted from the earlier draft: "The maximum density in this area is 2 housing units/ha (5 unit/a). An additional 56 townhouses are under construction on a 4.5 ha (11a) plot adjacent to Rt. 202 just souh of Bernards Twp. (Horensky, SCPB, December 17, 1978)." Why were they deleted? 34

9) On page 3-47 in the second paragraph there are two sentences: "Other communities in the UPRB are substantially developed. Due to the established character and the lack of vacant developable land, the potential new growth is severly restricted in these areas." Please supply the documentation for these sentences. In addition the next sentence should be deleted. The question of surrounding uses goes to "zoning" not to the "environment." 35

10) On page 3-61 under "Effects on Supply of Land" there is a recommendation that does not logically follow. Because 1310 acres are proposed for recreational land in 3 communities and a portion (How much?) of those reserved areas coincide with environmentally constrained" lands, then all of this land should be subtracted from total vacant land area (i.e. presumably because some land is constrained, all of it should be deducted from available land)? This is not in fact a logical conclusion. Again EPA is determining what lands should be subtracted from the present available supply without having an "environmental constraint" reason for suggesting so. We would recommend that this new section on page 3-61 be rewritten to coincide with the logical scope of the EIS. 36

11) Page 3-75 under "Soils" should contain the same 3 towns listed under "Soil Constraints" on page 3-74. 37

N-12

38 12) The first paragraph on page 3-79 should be deleted unless EPA is going to use the "construction permits measurement of growth" for all the other towns in the UPRB. This is an unrealistic and totally unwarranted departure from the methods used in the rest of the EIS.

I would like to set up a time when we can discuss the above comments.

Very truly yours,

MICHAEL BRYCE
Assistant Deputy Public Advocate

MB/cst

TOWNSHIP OF HARDING

MORRIS COUNTY, N.J.

MAILING ADDRESS
P O BOX 23, MADISON, N J 07940

May 19, 1977

Mr. Edward A. Taratko, Jr., Chairman
Upper Passaic River Wastewater Management Committee
Post Office Box 90
50 Woodland Avenue
Convent Station, New Jersey 07961

Dear Mr. Taratko:

We have reviewed the Final Draft, 201-Facilities Plan of the Upper Passaic River Basin dated March 1977 prepared by Elson T. Killam Associates and Dames & Moore. Of greatest concern to Harding Township is the fact that the plan does not include a definite provision for phosphate removal at Morris Township's Woodland Avenue Sewage Treatment Plant.

39

We understand that Morris Township is conducting, or is about to conduct, an independent stream sampling and monitoring program to determine phosphorous levels in Loantaka Brook upstream from the plant outfall. If these levels are already sufficient to cause a eutrophication problem in Loantaka Pond, then facilities for phosphorous removal would not be included in the proposed plant modifications. We do not believe this is consistent with good planning to improve the water quality in this stream.

We acknowledge that nutrient levels in the stream above the outfall are rather high. Tests on water samples that we have obtained, indicate phosphorous concentrations between 0.13 and 0.57 milligrams per liter. Although it has been suggested that the source of the phosphorous is upstream farms, particularly horse farms, this is not supported by the results of our stream monitoring work. On two occasions during the summer of 1976 we sampled the stream and found above-normal phosphorous levels. On both occasions the stream was not significantly influenced by stormwater runoff. The stream flow resulted primarily from groundwater sources. In soil, phosphates precipitate rapidly to insoluable forms. Thus, phosphates do not travel through soil; they are entirely removed from percolating water. Therefore, it is very unlikely that the high phosphorous levels in the stream can be attributed to upstream farms. Most of the phosphorous is probably resulting from septic system overflows and other small point sources. As these sources could be located and then either eliminated or controlled, the phosphorous level in the stream could be reduced to normal levels.

Phosphorous loadings from the plant effluent appear to vary from about 10 to 18 milligrams per liter. Considering an average daily flow of about 0.5 MGD and the fact that the stream flow is very low during the summer months, the discharge from the plant must be considered as a major point source of phosphate pollution. Because of this, and because other point nutrient sources can be either eliminated or controlled, we are strongly opposed to the adoption of a plan which does not include definite provisions for phosphate removal.

Alternates (a) or (b) as shown on page 10-21 of the Final Draft are totally unacceptable to Harding Township. These provide for the construction of an outfall which would discharge all or a portion of the plant effluent downstream from Loantaka Pond. From this
40 point the nutrients would flow downstream through the slow-moving reaches of the brook bordering the Great Swamp. It is in these reaches where the high nutrient loading causes the growth of dense aquatic vegetation and clogging of the brook which results in sediment deposition and flooding of adjacent properties. Such conditions cannot be permitted to continue.

A design process which results in effluent concentrations of 0.5 mg/l of phosphorous may or may not be sufficient to eliminate the problem of eutrophication. If it is necessary to provide for a more sophisticated process than conventional chemical coagulation, then such provision should be made. Equipment is readily available which has the capability to remove phosphate levels to less than 0.5 mg/l. Such equipment may also provide the additional benefit of nitrogen removal.

In conclusion, we urge that the Plan should not be adopted by the Committee or approved by the New Jersey Department of Environmental Protection or the United States Environmental Protection Agency without an amendment containing definite provisions for sufficient phosphorous removal at the Woodland Avenue Plant to eliminate the problems of eutrofication. The effects of excessive nutrient levels must not only be considered in Loantaka Pond, but in the low velocity reaches of the Brook downstream as it flows through Harding Township.

Very truly yours,

Robert H. Fox, P.E.
Harding Township Engineer
Member, Upper Passaic River Basin
Wastewater Management Committee

RHF/nh
cc: N.J. Dept. of Environmental Protection
United States Environmental Protection Agency
Elson T. Killam Associates, Inc.
Dames and Moore

N-14

Borough of New Providence, N. J.

William W. Fitter
Engineering Administrator

September 2, 1981

Chief, Environmental Impacts Branch
U.S.E.P.A. - Region II
26 Federal Plaza
New York, New York 10278

Subject: Environmental Impact Statement on Upper Passaic River Basin
201 Facilities Plan

Gentlemen:

We have reviewed the draft copy of the above study and find that the study in its present form does not adequately answer a number of questions concerning upgrading of the Borough's Waste Water Treatment Plant.

First and foremost is the lack of information concerning the effect on water quality of the Passaic River by the requirement of Level 3 treatment for New Providence. There is no indication that independent sampling of the river was performed to provide justification that if the Borough were to expand its facility a significant improvement in water quality would be achieved. Further, there is no record that Wapora Inc. made use of any or all of the available local data in their study. 41

In the consideration of the water quality of the Passaic River, no mention is made in the report of the effect of cleaning and clearing of the river to improve its flow characteristics and to reduce areas of natural pollution, which have a direct effect on the water quality of the New Providence site. 42

Until we can receive more definitive information than that contained in the draft report, it is difficult to justify the expenditure of funds to construct, operate and maintain an expanded facility which would also necessitate the loss of municipal park and recreational lands. We would ask that this letter be made a part of the official record to emphasize our concerns and that these concerns be addressed in the final report. 41

Yours truly,

William W. Fitter
Engineering Administrator

WWF:ds

ADDRESS: PARK PLACE, NEW PROVIDENCE, NEW JERSEY
Phone 201 [illegible]

TOWNSHIP OF PASSAIC

COUNTY OF MORRIS

MILLINGTON, STIRLING, GILLETTE, MEYERSVILLE, HOMESTEAD PARK

PETER H. PELISSIER
ADMINISTRATOR/CLERK
1802 LONG HILL ROAD
MILLINGTON, NEW JERSEY 07946
647-8550

September 2, 1981

Chief,
Environmental Impacts Branch,
EPA-Region II
United States Environmental Protection Agency
26 Federal Plaza,
New York, New York 10278

Dear Chief:

The Governing Body of the Township of Passaic has requested our Township Engineering firm of Pluymers, Williamson and Barbieri Associates to review the Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan.

Enclosed is a copy of a letter dated August 14, 1981 from William Pluymers for the above firm which is being submitted for consideration in accordance with the September 4, 1981 deadline to receive comments relating to the above EIS statement on the 201 Facilities Plan.

Passaic Township concurs with the enclosed recommendations as submitted by Mr. Pluymers and requests they be made part of the Township's formal comments regarding Alternative PT-1 and Alternative PT-2.

Very truly yours,

Peter H. Pelissier,
Administrator/Clerk

PHP:jg
Enclosures
cc: Township Committee
William Pluymers, P.E.
LeRoy H. Mattson,
Township Attorney

Certified Mail No. 913475

PLUYMERS, WILLIAMSON AND BARBIERI ASSOCIATES

ENGINEERS • LAND PLANNERS • LAND SURVEYORS

William Pluymers P.E., P.P.
D. Gregg Williamson P.E., L.S.
Joseph F. Barbieri L.S., P.P.

August 14, 1981

Mr. Peter Pelissier
Administrator/Clerk
Township of Passaic
1802 Long Hill Road
Millington, N. J. 07946

Re: Passaic Township S.T.P.
Our Project No. 1040

Dear Mr. Pelissier:

As requested, we have reviewed the draft of the Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan. The Statement has studied the various treatment facilities in the Basin and arrived at two alternates for Passaic Township. These alternates are similar to those presented in the earlier 201 Facilities Plan, however, there is a change in emphasis. Alternative PT-1 is the expansion and upgrading to Level 4 with dechlorination. Alternative PT-2 is the expansion to treat Passaic Township and Warren Township flows to Level 4 with dechlorination. The earlier study emphasized Alternative PT-2 as the recommended plan and the new study again recommends PT-2 as having the least environmental impact and being cost effective and feasible.

While, theoretically, Alternative PT-2 has many advantages, in reality it has some disadvantages. The primary disadvantage is the relationship between Passaic Township and Warren. It is not the type of relationship, but the fact that the municipalities have no formal relationship. In view of the history of this relationship, the present economic atmosphere and the direction each municipality is taking in regards to sanitary facilities 43
Alternative PT-2 places a hardship on Passaic Township. This results primarily from the fact that the location of the treatment facility would be in Passaic Township. Any expansion of the Passaic Township Stirling Plant must consider future Warren participation. Further, Warren is experiencing growth and with this growth new sanitary facilities. It may not be realistic to expect most of these to be abandoned for treatment at the Stirling Plant site. This becomes even more unrealistic considering the Federal givernment's attitude on aid.

On Table 4-4 is a cost summary which shows a much greater cost for Passaic Township for Alternative PT-2. In view of the present situation on federal aid PT-2 seems unrealistic. A copy of Table 4-4 is attached for your reference and, as you can see, the cost is about four times greater for PT-2 versus PT-1. A future breakdown of costs is given in attached Table B-7. Based on these Tables, the cost for PT-2 is greater. Our review did not reveal any explanation of the selection of PT-2 on a cost basis. The Town-

ship should request an explanation of justification for the greater cost to the Township under PT-2.

Therefore, it is suggested that Alternative PT-1 be considered the prime alternative rather than PT-2. If this is unacceptable, both alternatives should be both considered viable and at least have equal status.

Environmentally, the PT-2 would have a greater impact. The routes of the interceptor sewers would affect a large area which could be left undisturbed. As noted on page 4-1, these would impact the flood plain in Warren. It is noted that the Passaic Plant is in the flood plain. A larger plant, as required under PT-2, would have a greater impact. The present plant can be expanded with minimal impact on the flood plain.

44 In addition to the above, we found some factual errors. The study lists us as consultants to New Providence, and by separate letter we advised them of the mistake. In the description of the existing facility, the plant is presented as having a capacity of 0.6 mgd. This should be corrected to 0.65 mgd. Further, the average flow per capita of 120 gpcd is rather high; we feel it should be 100 gpcd.

Due to a prior commitment, I can not attend the August 20, 1981 hearing on this matter. Also, you should be aware that September 4, 1981 is the deadline for filing written comment.

Very truly yours,

William F. Pluymers

William Pluymers, P.E.
For the Firm

WP:blp
Encl.

Township of Warren
SEWERAGE AUTHORITY
46 Mountain Boulevard
Warren, New Jersey 07060
(201) 753-8000

September 3, 1981

Chief Environmental Impacts Branch
United States Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

Dear Sir:

The Warren Township Sewerage Authority has the following comments with regards to the Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan:

1. The Warren Township Sewerage Authority is and has previously stated in the past its intention to concur with the regionalization of its treatment facilties with Passaic Township as proposed in the 201 Facilities Plan and the EIS study of that plan. 45

2. The implementation of the proposed regional treatment plant may not be achievable since there appears to be a publicly stated reluctance by Passaic Township to join Warren Township in a regional facility.

3. The proposed regional facility may have to include as an integral part, not only an interceptor, but also a pumping station for the connection of existing sewer lines to the treatment facility.

4. The location of the treatment plant should not be fixed by this study and would be determined by a cost - benefit analysis including the items illustrated above in 3.

5. Since the Warren Township Sewerage Authority is singularly being asked to abandon its treatment facilities for the environmental benefit of the total of the Upper Passaic Basin, that portion of the treatment capacity of the regional facility attributable to the existing capacity of the Warren Township treatment plants should be reimbursed at 100% of elligible cost.

46 6. The Stage Five treatment plant in Warren, which is a level four (4) treatment facility, was erroneously stated as being *in the flood plain.* This facility is entirely located outside of the flood plain.

Very truly yours,

Ronald H. Willens,
Authority Chairman

RHW:es
cc: R. Hargrove, USEPA
Township Committee
Upper Passaic Basin Manager, NJDEP
S. Kaltnecker, Killam

Elson T. Killam Associates, Inc.

27 Bleeker Street, Millburn, New Jersey 07041 — Environmental and Hydraulic Engineers

• Telephone: (201) [illegible] • Telex: [illegible] ETK ASSOC [illegible]

Kenneth L. Zippler, P.E.
Executive Vice President

August 12, 1981

Chief, Environmental Impacts Branch
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

Re: Draft Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan

Gentlemen:

The purpose of this letter is to convey the concerns of this office and the Madison-Chatham Joint Meeting regarding the portions of the Draft Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan (June, 1981) which pertain to the Madison-Chatham Joint Meeting sewage treatment facilities.

As you know, the Draft Environmental Impact Statement (EIS) recommends that the Madison-Chatham Joint Meeting treatment plant be upgraded to Level 4 treatment (nitrification with dechlorination) and reduce the facility's design capacity from its present 4.0 million gallons per day (MGD) to 3.2 MGD. The EIS states that several factors will allow the Madison-Chatham Joint Meeting to accept this decrease in design capacity without any adverse effects on its members, the Boroughs of Madison and Chatham. These factors are: 1) declining populations and flows between now and the year 2000 (see Table 2-6 and Appendix page A-3 of the EIS), and 2) a reduction of wet weather infiltration from present average levels of 0.755 MGD to 0.42 MGD (see EIS, Appendix A).

The first concern raised by the 3.2 MGD figure put forward by the EIS is what it would actually mean supposing that the Madison-Chatham Joint Meeting facilities were upgraded to Level 4 treatment. Would 3.2 MGD represent the annual average flow which could be accepted by the treatment facilities or would it represent a maximum 6-month or maximum monthly average flow? Clearly, limiting the maximum monthly flow at the Madison-Chatham Joint Meeting treatment plant to 3.2 MGD would result in a yearly average flow well below 3.2 MGD. On the other hand, allowing a yearly average flow of 3.2 MGD would result in some average monthly flows being well above the 3.2 MGD rate. It would be difficult to assess the full impact of the 3.2 MGD design capacity put forward by the EIS until it is clear just how the figure would be incorporated into the National Pollution Discharge Elimination System (NPDES) Permit for the treatment plant.

This office and the Joint Meeting are also concerned about the viability of the 3.2 MGD design capacity itself, even if used as an annual average flow rate. For instance, both Table 2-6 and Appendix A presume a reduction in wet weather infiltration of 0.355 MGD. Even if a program to reduce infiltration in the Madison-Chatham Joint Meeting system were funded, it is not certain that such a large reduction (45%) would be realized. In fact, along with approving a grant to cover the cost of a Phase II-A Sewer System Evaluation Survey for the Madison-Chatham Joint Meeting Service area, the Environmental Protection Agency recently rejected an application which requested funding to undertake a study to initiate an infiltration reduction program, thus casting doubt as to whether or not such a study would ever be undertaken in the future.

An analysis of recent flows at the Madison-Chatham Joint Meeting Sewage Treatment Plant casts further suspicion on the 3.2 MGD design flow presented in the EIS. The following table presents the flows at the treatment plant tabulated monthly for the years 1972 through 1977:

MADISON-CHATHAM SEWAGE TREATMENT PLANT
(AVERAGE SEWAGE FLOW IN MGD)

	1972	1973	1974	1975	1976	1977
January	2.47	3.13	3.04	3.07	3.30	2.60
February	2.75	3.21	2.63	3.10	3.09	2.94
March	3.49	3.07	2.82	2.92	3.02	3.63
April	2.63	3.83	3.28	2.66	3.04	3.10
May	3.12	2.65	2.42	3.03	2.78	2.52
June	3.24	2.48	2.28	2.96	2.56	2.64
July	2.53	2.49	2.06	3.58	2.48	2.39
August	2.14	2.44	2.14	2.37	2.43	2.40
September	2.24	2.32	2.70	3.42	2.49	2.64
October	2.44	2.53	2.45	3.00	2.85	2.77
November	2.42	2.34	2.19	2.98	2.63	3.33
December	3.39	3.32	2.70	2.77	2.64	3.75
Yearly Avg.	2.73	2.81	2.55	2.98	2.77	2.89
Wet Weather Average (Dec.-May)	2.98	3.20	2.82	2.93	2.98	3.09

Examination of the table demonstrates that the monthly average flows in March, June and December of 1972, February, April and December of 1973, April of 1974, July and September of 1975, January of 1976, and March, November and December of 1977 all exceeded the 3.2 MGD plant capacity designated by the EIS. The EIS does point out that the 3.2 MGD is based upon a wet weather infiltration flow of 0.42 MGD, which represents a reduction of 0.355 MGD from the present estimated wet weather infiltration flow rate of 0.755 MGD. It is by no means certain that further infiltration and inflow work would in fact reduce infiltration by nearly 50 percent as assumed by the EIS. However, even assuming that infiltration could be reduced to such an extent, the 3.2 MGD capacity proposed by the EIS would have been exceeded during April of 1973, July of 1975, and March and December of 1977.

Of further concern to the Madison-Chatham Joint Meeting are the projected future flows contained in the EIS. Using the flows presented in the preceding table one finds that for the six years for which data is presented, yearly flow at the Joint Meeting Treatment Plant averaged 2.8 MGD. Wet weather flows over the same period averaged 3.0 MGD. Using the annual average flow as a base, it is apparent that the EIS design capacity of 3.2 MGD allows for a growth of only 400,000 gallons in future flows. Both Madison Borough and Chatham Borough presently have approved residential and commercial developments which will contribute an additional 0.33 MGD of flow to the Joint Meeting treatment plant. With the addition of these flows to the present flows, only 70,000 gallons per day remains for future growth from this date on, assuming no reduction in present infiltration rates. The allowance made by the EIS for a reduction in infiltration of 0.355 MGD would offset the increase in flow due to the confirmed development which is occurring in Madison and Chatham Boroughs. However, there is no guarantee as to whether or not such a reduction can be obtained and, in fact, the Joint Meeting has been rejected for a Federal Grant to further investigate and attempt to reduce the infiltration in the system. This would prelude any further development in either Madison or Chatham Boroughs.

Further along these lines, the EIS has forecasted an actual drop in population for the Madison-Chatham Joint Meeting tributary area between now and the year 2000 (see Appendix A). While this forecast was complimented by the results of the 1980 census, which recorded significant declines in population for both Madison and Chatham Boroughs, it should be realized that neither the Census nor the EIS figures took into account residential development which has already been approved by both Boroughs which is expected to add over 1000 people to the Madison-Chatham Joint Meeting tributary area. In addition, the EIS forecast of declining populations in the Madison-Chatham Joint Meeting tributary area is directly opposite to estimates by the Borough of Madison and the Borough of Chatham. The

EIS projects the population for the Madison-Chatham Joint Meeting tributary area to be nearly 25,000 by the year 2000. However, combined estimates by the Boroughs of Madison and Chatham place the year 2000 population at approximately 30,000 people.

Finally, the allowance made by the EIS for commercial and industrial flows within the Madison-Chatham Joint Meeting tributary area of 200,000 gallons per day (see EIS, Table 2-6) has already been exceeded by existing development plus flows which the Joint Meeting has already agreed to accept from future developments--most notably the 300-acre Giralda Farms property being developed by the PIC Realty Corporation. Therefore, if the treatment plant's design capacity were reduced to 3.2 MGD, neither the Borough of Madison nor the Borough of Chatham would be able to accept any additional commercial or industrial flows without jeopardizing existing flow agreements.

Further compounding this problem is the fact that the Schering-Plough Corporation has asked the Madison-Chatham Joint Meeting to accept flows from its proposed research laboratories which will be built on the Chatham Township portion of the Giralda Farms property. Flows from the research laboratory are projected to reach nearly 200,000 gallons per day by the year 2000 and, if accepted by the Joint Meeting, would double the commercial and industrial flow allotment for the Madison-Chatham Joint Meeting.

47 In conclusion, it is the feeling of this office and the Madison-Chatham Joint Meeting that the EIS has underestimated the flows which will be generated in the Madison-Chatham Joint Meeting tributary area in upcoming years. It is felt that the following table contains a more realistic projection of flows between now and the year 2000 and that a reduction in plant capacity of 3.2 MGD could pose significant problems to the Joint Meeting in accepting flows from already approved developments as well as future developments:

Present Estimated Average Yearly Flow (1977)	2.89 MGD
Confirmed Development - Madison Borough(1)	0.23
Confirmed Development - Chatham Borough(1)	0.10
Allowance for Ultimate Development(2)	
Madison - 3255 people @ 120 g/c	0.39

Elson T. Killam Associates Inc.

Chief, Environmental
Impacts Branch -5- August 12, 1981

Allowance for Ultimate Development(2)

Chatham - 1718 people @ 120 g/c		0.21 MGD
	TOTAL	3.82 MGD
Schering Plough Research Laboratories (Chatham Township)		0.19 MGD
	TOTAL	4.01 MGD

(1) Developments already approved by municipal planning boards.

(2) Based upon a total Madison-Chatham Joint Meeting tributary population of 29,900 people by the year 2000.

Clearly, no matter how they are resolved, the matters discussed above are of great significance to the Madison-Chatham Joint Meeting. The reduction in capacity of the Joint Meeting treatment plant proposed by the EIS is so large that the Joint Meeting is in the position of having to delay decisions on requests by developers for the Joint Meeting to accept additional flows. As the Joint Meeting currently has several such requests pending before it, most notably a request by the Schering-Plough Corporation for the Joint Meeting to accept flows from their proposed research laboratories, it would be most desirable to have a definite answer on what capacity will be assigned to the Madison-Chatham Joint Meeting treatment plant and how that capacity will appear on the treatment plant's NPDES permit--i.e., average monthly, annual average, etc.

If you should have any questions concerning the above or if we may provide any further information in regards to this matter, please contact us.

Very truly yours,

ELSON T. KILLAM ASSOCIATES, INC.

Kenneth L. Zippler

KLZ:cli

William H. Kramer
Hydrogeologist
78 May Drive
Chatham, New Jersey 07928
(201) 377-2675

August 22, 1981

Chief
Environmental Impacts Branch
US EPA
Region II
26 Federal Plaza
New York, NY 10278

Dear Sir:

I am a resident of Chatham Township, NJ and I am concerned about the rapid pace of development in the area and its effect on the Great Swamp National Wildlife Refuge and other wetlands.

48 In reference to Recommendation 9 (p. ix), you mention that industrial package treatment plants should not be approved until completion of the non-point source water quality study. What is your definition of "industrial" package plants? Does an "industrial" package plant differ from a package plant that treats only domestic waste (e.g. a package plant for an office building or research lab)? In the past several months, I have seen several proposals in Chatham Township for office and research lab developments that include onsite treatment and disposal of wastes as an alternative to hooking up to a public sewage treatment system. It appears to me that package plants represent a way of bypassing the 201 facilities plans. Any type of package plant would tend to encourage development in areas that are not currently served by a sewage treatment system, and could result in negative environmental impacts on area wetlands.

I would urge you to include any type of package plant under Recommendation 9 and to seriously consider the effects that package plants will have on the rate of development in the area, and how they might be used to bypass growth restrictions that are part of the 201 facilities plan.

I would greatly appreciate your comments and look forward to hearing from you in the near future.

Sincerely yours,

William H. Kramer

Harding Township Environmental Commission
P. O. BOX 300 • NEW VERNON, NEW JERSEY 07976

August 26, 1981

Robert Hargrove
Environmental Protection Agency
Region II
26 Federal Plaza
New York, N. Y. 10278

Dear Bob:

I was delighted to hear you say last week at the public hearing on the EIS for the Upper Passaic River Basin 201 Facilities Plan that EPA will not allow package treatment plants to serve any development (residential, commercial or industrial) in the wetlands and floodplains of the Upper Passaic.

I hope this prohibition will be clearly stated in the final EIS as it is only implied in the current draft. Such a prohibition, along with the prohibition against sewer connections to developments in floodplains and wetlands should help protect the integrity of the Great Swamp. 49

Thank you for your consideration.

Sincerely,

Sally Dudley

SD:nd

cc: Richard Dewling
Dr. Marwan Sadat

Citizens Concerned
About the Future of
The Dodge Estate
146 Loantaka Way, Madison, N.J. 07940
A Non-profit Association

August 28, 1981

Mr. Robert Hargrove
New Jersey/Puerto Rico Section
Environmental Impacts Branch, Region II
26 Federal Plaza
New York, N. Y. 10278

Dear Mr. Hargrove:

This will supplement my verbal comments at the EPA EIS public hearing at Morris Township hall on August 20, 1981. Citizens Concerned---Dodge Estate is an incorporated association that has been in existence over 5 years monitoring the development of the Dodge Estate. We address all impacts on the environment including water, sewage, runoff of storm water; density and traffic. We expect to continue this activity as building site plan applications come in for the Madison portion. We have followed closely the Schering-Plough application in Chatham Township which has just been withdrawn. We will also follow closely future developments in Chatham Township on the Estate.

Focusing on the EIS, our main concerns have been:

1. Water quality of the storm water runoff. While not a treatment plant output it does affect Loantaka Brook and its tributary and the Great Swamp. PIC Realty of Prudential has constantly violated local and state requirements placed on them. While remedial action was taken after shut down by officials, pollution continues which a recent survey and photographic documentation clearly shows.

50 2. 140,000 gallons/day of additional sewage from the Madison portion of the tract alone will enter the Madison sewage system and then to the Madison-Chatham Joint Meeting plant. This plant is in complete overload following even a 1" rainfall due to severe extraneous inflow problems. This has been the case for many years but no solution has been found so far. Testing is about to get under way in another attempt to locate the inflow. Schering-Plough was to add an additional 192,000 gallons/day and a study was made by the Joint Meeting to see how this could be accomodated. There has to be a limit placed on the absolute peak output of this plant. Normal rainfall produces more than a 9 MGD output. Over 13 MGD has been recorded during heavy rainfall when special instrumentation was installed. During these rainfall periods raw sewage

flows from manholes onto the streets. Many manhole covers are sealed and bolted. The Joint Meeting plant has a 4 MGD output rating.

3. Chatham Township was on the verge of granting to Schering-Plough an amendment to their zoning law based on waste disposal that had as one option a septic system either forcing sewage into the ground or by gravity after dispersal over an area of about an acre. The imminent danger to the Buried Valley Acquifer is frightening and some means must be quickly found to prevent such things from happening. Only timely action by concerned residents kept the amendment from being passed. It is now to be rewritten and resubmitted in order to attract other developers. 51

__Commentary__

Action is required now to develop guidelines that municipalities can use and would be forced to use. Even when clear specifications are written developers violate them with ease. A good example is the storm water runoff quality. A good monitoring system is set up, but the violations go on and on.

A limit must be set for the Joint Meeting plant. We wish to bring three items to attention. (See below)* The report(ref. 1) clearly shows the complete overloading due to extraneous inflow. The "gobbledegook" of average daily flow, monthly average flow and yearly flow(see ref. 3) has to be clarified. An absolute peak value has to be established so that raw sewage is not distributed over the flood plain after every rainfall. A firm Joint Meeting plant output value must be established so that Madison and Chatham can treat new development requests properly. In many cases developments might have to be rejected because of capacity limits. The urgency for these clarified limits is great.

The Schering-Plough proposals and the action by Chatham Township officials is frightening. Even though the ordinance amendment is now withdrawn it shows what potential dangers exist under existing regulations. Reference 2 has as one plan a 400,000 gallon holding tank to be discharged alternately with the 100,000 holding tank on the Madison portion of the estate. How ridiculous can we get. All this because the Joint Meeting is severely overloaded to begin with during rainfall.

__Recommendations__

We urge that clear directives be given for the Great Swamp area that will specify what treatment plants can and can not do. Capacity values must be set. A maximum peak value for the Joint Meeting is urgent. These specifications must then be enforced. 52

We affirm your decision not to allow additional package treatment plants.

* References are listed on the last page.

We cannot comment on other parts of the EIS that we are not familiar with such as the Dead River area.

Sincerely,

Paul Hammann

Copies to:

Mr. Arnold Shiffman
Dir. Div. of Water
Resources DEP

Mr. Paul Arbesman
Assist. Comm. DEP

Dr. Marwan Sadat
Div. Water Resc. DEP

Mr. George Caparole
Div. Water Resc. DEP

REFERENCES

1. "Infiltration/Inflow Analysis, Phase I", Elson T. Killam Associates, Inc. August 1979, Milburn, N. J.

2. "Report Upon Impact of Sewage Generated By Proposed Schering-Plough Research Facilities on Madison Borough and Madison-Chatham Joint Meeting Systems" Elson Killiam Associates, Inc. July 1981. Milburn, N. J. 07041

3. Letter to Chief, Environmental Impacts Branch, U. S. Environmental Protection Agency, Region II, 26 Federal Plaza, New York, N. Y., August 12, 1981. Re: Draft Environmental Impact Statement on the Upper Passaic River Basin 201 Facilities Plan from Elson T. Killam Associates, Inc., Milburn, N. J. 07041

APGAR ASSOCIATES
ENGINEERS • LAND SURVEYORS • PLANNERS

ROBERT H. FOX, P.E.
THADDEUS F. HOLMAN, L.S.

ERNEST C. HIESENER, P.E.
WAYNE F. HOLMAN, L.S.

P. O. BOX 298
DEMUN PLACE
FAR HILLS, NEW JERSEY 07931
201-234-0416

SUBDIVISION AND SITE PLANS
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DAMS AND HYDRAULIC STRUCTURES

September 3, 1981

Mr. Stephen Arella
Chief, Environmental Impacts Branch
Environmental Protection Agency - Region II
26 Federal Plaza, Room 400
New York, New York 10278

Re: Environmental Impact Statement
Upper Passaic River Basin 201 Facilities Plan

N-22

Dear Mr. Arella:

I serve as Harding Township's representative on the Upper Passaic Wastewater Management Study Committee. I would like to express our general support of the draft Environmental Impact Statement and the alternatives recommended. We do request, however, that a higher level of treatment be required at Morris Township's Woodland Avenue treatment plant. During the summer and fall seasons, the plant effluent represents most, if not all, of the flow in Loantaka Brook. The brook has a very small drainage area, a flat gradient, and its bottom is covered with fine sediment from upstream development. These conditions are obviously not conducive to generating or supporting high dissolved oxygen levels. We therefore request that Level 5 treatment with nutrient removal be required at the Morris Township plant. It is essential that sand filtration be required to produce a higher quality effluent as well as to protect the brook from pollution during plant up-sets which occur from time to time.

There is ample evidence that nutrients from the Morris Township plant have had a serious detrimental impact on Loantaka Brook. Tests on water samples which we have taken downstream of the plant indicate total phosphorous concentrations of 18.7 mg/l and total nitrogen levels of 3.9 mg/l. Similar concentrations have been measured by the U. S. Fish and Wildlife Service. The high nutrient level has significantly contributed to the accelerated growth of rooted aquatic vegetation in Loantaka Brook. The vegetation clogs the brook, reduces the flow, and causes sediment buildup, reducing the depth of the channel. During the past ten years the channel depth has been reduced by about 50% in the low-lying area of Harding Township bordering the Great Swamp. Residential lands that were once used for lawns can no longer be mowed because of the high water table. Areas that were once an attractive portion of residential lots are now a soggy mess of weeds. Flood levels that were once reached every ten or fifteen years are now reached several times a year. Trees that for many years lined the banks of the brook are now dead.

This condition is becoming worse every year. Further delay of the construction of nutrient removal facilities for another study to be completed is totally unnecessary. In 1977 Morris Township advised the Upper Passaic Wastewater Management Committee that it was conducting, or about to conduct, an independent stream sampling and monitoring program to determine phosphorous levels in Loantaka Brook. To the best of my knowledge the results of this study have never been released. A copy of my May 19, 1977 letter to Committee Chairman Taratko concerning the effects of the high nutrient load on the stream is attached. Prior to the construction of the treatment plant, Loantaka Brook flowed freely - unclogged by thick aquatic vegetation. There has been testimony substantiating this on several occasions. What better evidence can be obtained to prove that the treatment plant is the nutrient source that is primarily responsible for the damage to the stream? Although it has been suggested that the source of phosphorous is upstream farms, this is not supported by the results of our stream monitoring or that of the Fish and Wildlife Service. This subject is further discussed in the third paragraph of my May 19, 1977 letter to Mr. Taratko. It is also significant to note that there are only a few farms remaining in the watershed, and that this potential source of nutrients most likely will not exist in a few years.

Although a statement was made at the public hearing that the construction of small (package) treatment plants would not be permitted in the Great Swamp basin, this is not clearly set forth in the EIS. As discharge of effluent from small treatment plants would seriously impact these waters, a strong statement prohibiting them should appear on page xi, Controlling Development in Environmentally Sensitive Areas. A section discussing this should also be included toward the end of Chapter 3 where discussions of other constraints appear.

In summary, we ask that the draft be amended to include the following:

1. Require Level 5 treatment at the Morris Township Woodland Avenue plant without further delay.

2. Require sand filtration at the Woodland Avenue plant to protect the stream during plant upsets. This would also help to assure good plant operation which would be necessary to prevent filter
53 clogging.

3. Require phosphate and nitrate removal processes at the Woodland Avenue plant without further delay.

4. Amend the scope of the water quality (nutrient) study in the Great Swamp watershed to include the impact of nutrients on the streams and private properties in the vicinity of the Great Swamp.

5. Clearly prohibit the construction of small (package type) treatment plants that would discharge into the streams that flow into the Great Swamp.

Mr. Stephen Arella
Re: Environmental Impact Statement

Page 3
September 3, 1981

We appreciate the opportunity to comment on the draft Environmental Impact Statement, and ask that the final report be amended to include the recommendations outlined above.

Very truly yours

Robert H. Fox, P.E.
Harding Township Engineer

RHF/nh
att.
cc: W. Thomas Margetta, Mayor
Environmental Commission
Planning Board

Schering-Plough

Schering-Plough Corporation
Kenilworth, New Jersey 07033
Telephone 201-558-4000
Telex 138316

September 3, 1981

Certified Mail

Chief, Environmental Impacts Branch
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, NY 10278

Gentlemen:

Subject: Comments on the Draft Environmental Impact Statement on The Upper Passaic River Basin 201 Facilities Plan

Schering-Plough Corporation requests that the following written comments be entered into the Public Hearing Record concerning the subject draft Environmental Impact Statement (EIS). The stated purpose of this Hearing is to bring together all pertinent information on the issues and to provide public participation. Written comments were requested on or before September 4, 1981.

Schering-Plough Corporation (Schering) is an international pharmaceutical company engaged in the discovery, development, manufacture and distribution of a broad line of health care products. The Corporate Headquarters of Schering is located in New Jersey as well as major research and manufacturing facilities. Because of the rapid growth and needs in the health care area, Schering is planning to construct new facilities that are within the area covered by the draft EIS. The specific area of concern is what is known as Giralda Farms (formerly the old Dodge estate) that is located in a portion of Madison and Chatham Township. The location is shown on the map provided in Attachment A.

After reviewing the draft EIS, we would like to direct our comments to the following three major areas:

1. Proposal to downgrade the capacity of the Madison-Chatham Joint Meeting Waste Treatment Plant from 4.0 MGD to 3.2 MGD.
2. Proposal to do an additional nutrient study on the Great Swamp.
3. Options for upgrading the Chatham Township Waste Treatment Plant.

1. <u>Proposal to downgrade the capacity of the Madison-Chatham Joint Meeting Waste Treatment Plant from 4.0 MGD to 3.2 MGD.</u>

   We believe that the recommendation for downgrading the existing design capacity of the Joint Meeting should be reconsidered since some of the methodology and assumptions used, in our opinion, may not be valid. Based on the land-use model and new population estimates described in the draft EIS, the Joint Meeting flow for the year 2000 was projected to be only 3.2 MGD. This projected flow seems unrealistically low since the present average flow is 2.9 MGD and "confirmed development" already approved by the Madison and Chatham Borough Planning Boards will add an additional 0.334 MGD. The flow of 3.2 MGD recommended in the draft EIS for the year 2000 will consequently already be exceeded within the next few years.

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The method used for this projection was a land-use model which was developed using available vacant land as a dependent variable. Since both Madison and Chatham Boroughs have very little vacant land, this type of model seems inappropriate.

There is also an error noted in Figure 3-9 of the draft EIS entitled "Developable Land". The entire Madison portion of Giralda Farms (the old Dodge estate) is incorrectly shown as already developed. This 200 acre track is currently being developed as an executive office park but there has been no construction other than site improvements to date. This track lies in Madison immediately south of Route 24 (Madison Avenue) between Treadwell Avenue and Loantaka Way - see map in Attachment A.

In reviewing past 201, 303(e) and 208 basin planning studies, a number of comprehensive population estimates and flow projections have already been made. Ironically, the populations that should have been the easiest to project in the draft EIS (Chatham and Madison Boroughs) because of their higher degree of completed development, were actually the communities in the study area that showed the greatest divergence with previous studies. The draft EIS study, for example, showed a projected population for the Madison-Chatham area to be 25% less than the 208 study.

A comparison of past studies and what we believe to be a more realistic projection of population and flows for Madison and Chatham is presented in Attachment B. This Attachment is a recent study completed by Elson T. Killam Associates entitled "Report Upon Impact of Sewerage Generated by Proposed Schering-Plough Research Facilities on Madison Borough and Madison-Chatham Joint Meeting Sewage Systems". The population projected to the year 2000 in this report is 29,980 compared to 25,040 in the draft EIS. The capacity of the Joint Meeting is also projected by Killam to be 3.82 MGD by the year 2000 compared to 3.2 MGD in the draft EIS.

Schering requests that the population and flow projections presented in the draft EIS be reviewed to reflect the projections made in the Killam report. Allowing for a contingency factor of at least 10%, it is our recommendation that the projected flow for the Joint Meeting be set at a level no lower than its design capacity which is an average annual flow of 4.0 MGD. The projected flow would be as follows:

- Present estimated average yearly flow ....2.89 MGD
- Confirmed development - Madison Borough 0.23
- Confirmed development - Chatham Borough 0.10
- Ultimate development - Madison 0.39
  (3255 people @ 120 g/c)
- Ultimate development - Chatham 0.21
  (1718 people @ 120 g/c)
- Contingency 0.38
- Allowance for future inflow reduction ....(0.20)

Total 4.00 MGD

There also appears to be an inadequate accounting for the type of commercial and institutional development found in both Madison and Chatham which are unique from other communities in the surrounding study area. Both Madison and Chatham, for example, have well developed main downtown business districts with a large variety of shopping, light manufacturing, office and other business and service concerns. There are also many facilities that are used by the surrounding communities such as Drew and Fairleigh Dickinson Universities, libraries, railroad stations, restaurants, racket clubs and the areawide Madison YMCA. The two Universities, for example, have a combined enrollment of over 5,000 students of which more than half (2700) are full time resident students.

There is one final point that should be clarified in the draft EIS concerning flows. There are many different and sometimes confusing ways to calculate flows e.g., daily average, monthly average, 30-day average, maximum daily, ... etc. What is important is that a consistent method be used. Table 2-1 in the draft EIS, for example, uses "average daily" and "design capacity" in MGD but Table 2-7 refers to the same values as "peak monthly average flows".

A good discussion related to this issue is included in Attachment B in a letter dated May 21, 1981 prepared by Elson T. Killam Associates for the Joint Meeting and submitted to the New Jersey Department of Environmental Protection. This letter specifically requests the NJDEP to advise the Joint Meeting as to the remaining capacity of the Madison-Chatham Joint Meeting Treatment Plant.

2. Proposal to do an additional nutrient study on the Great Swamp.

Based on the information presented in the draft EIS, the need for the proposed nutrient study is not clearly demonstrated. It is concluded, without much factual support, that nutrients entering *Loantaka Pond* may be adversely affecting the Great Swamp and that there may be accelerated growth of rooted aquatic plants under low flow conditions. There is a general lack of evidence cited indicating what has been the adverse impacts on the Great Swamp. 55

Several important factors that should be carefully investigated before concluding that an additional study is needed. First of all, there is a considerable amount of monitoring data and other environmental studies already available on the Great Swamp. It appears that some of these studies may not have been adequately considered in the draft EIS. Several of these studies contain a considerable amount of water quality data, in particular;

1. U.S. Fish and Wildlife Service, Environmental Assessment - Proposed Black Brook Addition to the Great Swamp National Wildlife Refuge, Northeast Region Office, Newton, Massachusetts, July 1977.

2. Guillaudeu, D.A., Moye, E.M., and Syz, S.B., Surface Water Resources of The Great Swamp Watershed - an Environmental Basis for Planning Growth, Masters Thesis for Regional Planning, Department of Landscape Architecture and Regional Planning, University of Pennsylvania, January 1975.

3. Great Swamp National Wildlife Refuge, Water Quality Study, 1980.

The most recent Great Swamp Water Quality Study cited above, for example, contains a wealth of useful current monitoring data. A copy of this study is provided in Attachment C. This study summarized the results from 16 monitoring stations sampled twice per month, 4 stations sampled once per month and 6 stations sampled quarterly. There were 10 parameters analyzed including dissolved oxygen and nutrients. The results for each parameter are plotted and compared to the NJDEP Surface Water Quality Standards (These Standards, incidently, were revised in March 1981).

The field sampling program conducted by the EPA in 1978 and reported in the draft EIS, should be more fully discussed and compared with other studies. During the late summer and fall, when most of the field study was made, nutrient concentrations and BOD are generally expected to be naturally higher and the dissolved oxygen lower. During this time of the year, much of the plant life in freshwater wetlands dies. Nutrient levels increase as plants decompose because the nutrients which were once taken-up by the plants are no longer assimilated. Conditions of lower flow further increase the exposure of dead matter to the atmosphere, accelerating the decomposition process.

The supportive monitoring data cited in Appendix C of the draft EIS on Tables C-4 through C-12 omits useful information such as the type and frequency of sample, the time of year and in some cases the unit of measurement. There also appears to be missing data. Dissolved oxygen levels, for example, at the Millington Station for July and August are mentioned on page 3-5 of the draft EIS text and referred to Tables C-4, C-5 and C-6 of Appendix C. These Tables, however, do not contain this data.

There is an important oversite that is easily forgotten when comparing and interpreting monitoring data. This oversite is variable stream flows. In most cases the flows through the Great Swamp are highly variable. Both Loantaka Brook and Black Brook, for example, can vary by several orders of magnitude. During low flows, in fact, both Brooks would be dry beds if it were not for the Chatham Township and Morris Township waste treatment plant discharges. These discharges are stated to be 0.8 MGD and 1.0 MGD respectively. During wet weather, the flows of Loantaka Brook and Black Brook are stated to be as high as 580 MGD and 100 MGD respectively. There can quite obviously be very little valid comparison and correlation of monitoring data unless flow data is also known.

One important area that was neglected in the draft EIS was the establishment of a clear benchmark from which to judge and compare available data.
The draft EIS appears to accept the NJDEP's Water Quality Criteria classi- 56
fication for fresh water streams as the criteria for evaluating the Great

Swamp. No foundation was laid to demonstrate that this is an appropriate criteria. There was no attempt made, for example, to define what dissolved oxygen and nutrient levels would be desirable in the Great Swamp. Nutrients are essential for plant growth and the growth of microscopic organisms that originate the basic food chain progression. In the extreme case, if there were no nutrients, there would be no plant and animal life and hence, no swamp.

To further illustrate this important point, the draft EIS states that excessive nutrients may be causing adverse growth patterns in the Great Swamp. What are considered 'normal' growth patterns? What are 'normal' nutrient levels found in other swamps? What are 'normal' dissolved oxygen levels and what is considered to be 'normal' seasonal variations in water quality for a swamp supporting a desirable diversity of plant and animal life?

The draft EIS states that the potential for eutrophication in the Great Swamp is high. What degree of eutrophication is considered 'normal' or acceptable for the Great Swamp? It is known, for example, that there is a naturally occurring ecological progression for a water body as follows*:

Open water (lake, pond) - Marsh - Swamp - Dry land (forest, bog)

This transitory process occurs through the natural geological and biological process of eutrophication. If the Great Swamp is to be preserved as a swamp, should these natural processes be controlled as well as man-made influences?

* Ursin, Michael J., Life in and Around Fresh Water Wetlands, Thomas Y. Crowell Co., New York, 1975.

Our recommendations regarding the proposed nutrient study and related waste treatment issues are as follows:

- Regardless of the proposed nutrient study, the Morris Township and Chatham Township waste treatment plants should be upgraded to level 4 with full nutrient and chlorine removal. Alternate disinfection methods should be evaluated and adequate sludge handling and disposal facilities should be provided.

- Regardless of the proposed nutrient study, privately owned waste treatment plants capable of achieving level 4 plus nutrient removal should be permitted in developable areas that are not served by a municipal system provided they are not located in wetlands or flood plains. 57

- The nutrient study, if still justified, should be conducted in three phases; design, testing and evaluation. The design phase is the most critical and important. This should involve a clear understanding of all the identifiable objectives and the tasks required to complete each objective.

3. Options for the Chatham Township Water Treatment Plant

There is one alternate briefly discussed in the draft EIS for upgrading the Chatham Waste Treatment Plant that we believe should be re-evaluated in greater detail. This alternate is to divert the flow from the waste treatment plant directly into the Passaic River rather than allowing it to go into the Great Swamp via Black Brook.

This alternate was briefly evaluated but unfortunately was dropped from further consideration because of costs. In our opinion, this alternate makes the most sense because it solves the most problems. Besides minimizing the need to upgrade the treatment plant, this alternate would reduce nutrient and oxygen demand loadings on the Swamp, reduce flooding and provide the Swamp Management with a means of controlling extremely variable water levels that can affect wildlife management programs.

58 We recommend that a pumping station be investigated to handle not only the waste treatment plant discharge but possibly a portion of Loantaka Brook during high water conditions. An overflow channel could possibly be provided to allow a portion of Loantaka Brook to go into the proposed pumping station or into Black Brook. The pumping station would be controlled by the Great Swamp Management and would permit them to maintain adequate water levels during dry weather and to reduce flooding during wet weather.

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There is one issue that should be clarified concerning the management of the Great Swamp in general but specifically the large easternly portions that have been designated as Wilderness Areas. As stated in the draft EIS, the Congressional mandate for designated Wilderness Areas specifically prohibits outside interferences or man-made activities. Presumably, the discharges from the Chatham Township and Morris Township treatment plants would be considered a man-made influence since they flow into the Swamp?

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As indicated in the draft EIS, the U.S. Fish and Wildlife Service, which manages the Great Swamp, has expressed a great concern regarding the diversion of the waste treatment plant effluents from the Swamp because waterfowl management programs are dependent on a relatively constant supply of water particularly during critical nesting periods. If the Congressional mandate is taken in the strictest sense, the very law that was created to protect wetlands and wilderness areas could also be their demise. If taken to the extreme, there could actually be very few, if any, Swamp management programs allowed. Virtually everything would constitute a man-made activity and thus be prohibited? As previously discussed, it is not only desirable to have these areas managed but it is essential to control both man-made and natural forces in order to preserve the uniqueness of the Swamp.

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One man-made activity discussed in the draft EIS that may adversely affect receiving waters such as the Great Swamp or the Passaic River, is the use of chlorine for disinfection of waste treatment plant effluents. It is unfortunate that chlorination is still almost exclusively used. Alternative means of disinfection are available and contrary to the draft EIS, the costs are competitive with chlorine. The use of ultraviolet light or ozone, for example, may not be as effective on poorly treated effluents but is very effective when used on more highly treated effluents. Since many waste treatment plants are now being upgraded to provide better treatment, these alternate means of disinfection should be considered.

A major problem associated with using chlorine is that in order to insure an effective bacteria kill, the required dosage level also kills the beneficial types of higher life organisms such as protozoans which are natural predators. Since chlorine does not break-down readily in fresh water, the residual chlorine continues to kill or inhibit these beneficial organisms long after leaving the waste treatment plants. This subject is discussed in many literature references such as the one cited below.*

* Berk, S.G., and Botts, J.A., Effect of Chlorinated Coliforms on Protozoan Population Growth, J. Water Pollution Control Federation, Volume 53, Number 3, March 1981.

One of the best methods for disinfection is ozonation. The use of ozone is now cost effective with chlorine because of recent advances in solid state electronics and improvements in electrode design. Ozone generators, for example, can now produce ozone concentrations of 2% using air whereas previously this concentration was only possible with oxygen. Ozone is the most powerful oxidant and leaves no harmful residual. Any excess ozone decomposes to oxygen in a short period of time which even further enhances water quality.

It is incorrectly stated in the draft EIS, that ozonation is a developing technology. An extensive 20 month study program, for example, was recently completed at Marlborough, Massachusetts under the sponsorship of the EPA.* This study successfully demonstrated the reliability of using ozone for disinfecting municipal wastewater in terms of disinfection performance, process control, instrumentation and equipment reliability.

* Stover, E.L., Jarnis, R.N., and Long, J.P., High-Level Ozone Disinfection of Municipal Wastewater Effluents, EPA-600/2-81-040, NTIS, PB81-172272, March, 1981.

It is also incorrectly stated in the draft EIS that the energy consumption is significantly greater for ozone compared to chlorine. The comparison made is not done on the same basis. Since chlorine is stable and easily

liquified, it can be produced in large plants and conveniently packaged and shipped to end users in various size cylinders. Ozone, on the other hand, is not stable and consequently must be generated on-site at the point of use. Both chlorine and ozone are produced electrolytically. In the case of chlorine however, the energy consumed in production are reflected in the purchase price. In the case of ozone, on-site energy costs are higher because it must be manufactured at the point of use. A fair comparison of total energy consumption and costs, therefore, must be done on a common basis to reflect the total energy consumed in each case.

We appreciate the opportunity to participate in this Hearing and trust that you will give serious consideration to our comments.

Sincerely,

SCHERING-PLOUGH CORPORATION

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