EXECUTIVE SUMMARY

ES-1 BACKGROUND

The present State Pollutant Discharge Elimination System (SPDES) discharge permits for New York City's Wastewater Pollution Control Plants (WPCPs) contain certain provisions relative to the reduction of nitrogen as summarized below:

- Aggregate effluent nitrogen loading limits for Upper East River and Jamaica Bay WPCPs.
- The preparation of a Nitrogen Control Action Plan, in the event aggregate limits are not met.
- The requirement to initiate nitrogen removal retrofits at certain WPCPs.
- Pilot research related to nitrogen removal and other related operational issues.
- The preparation of a summary report entitled *The Nitrogen Control Feasibility Plan.*

The New York City Department of Environmental Protection (NYCDEP) has been implementing the programs needed to address each of the above issues since the SPDES requirements were established. In total, these programs go beyond the specifics of the SPDES permits in their scope of activities; the experimental and full-scale testing undertaken has been extremely comprehensive in scope and relatively costly to undertake. Nonetheless, the City can justify its investment in technology development on the basis of savings in the very large capital program it will have to implement to meet projected nitrogen control levels.

ES-2 NITROGEN CONTROL FEASIBILITY PLAN

This document is the Nitrogen Control Feasibility Plan.

ES-2.1 Objective of the Nitrogen Control Feasibility Plan

The Nitrogen Control Feasibility Plan (NCFP) is a summary document which incorporates the information gathered from all of the ongoing pilot and operations related projects. The principal objective of the NCFP is to identify the feasibility of removing nitrogen from each of the fourteen WPCPs.

Technologies such as suspended and attached growth processes with and without separate centrate treatment have been evaluated to identify the capability of each WPCP to remove nitrogen. The cost associated with each technology option has also been estimated.

ES-2.2 Methodology Used

The results presented in the NCFP are projections of process performance based on the modeling done for each of the fourteen WPCPs. The models were calibrated utilizing data obtained from the programs listed below.

- Full scale experimentation of nitrogen removal at the Tallman Island WPCP.
- Pilot scale experimentation conducted under the PO-55 program. This experimentation has been performed in accordance with a protocol which has been reviewed and approved by an external Nitrogen Technical Advisory Committee.
- Influent wastewater data obtained from an ongoing wastewater characterization program.

All of the data and analysis utilized for the development of the NCFP are included in this report and are summarized in Appendix A. This data represents several years of study. The research and study program, however, is still on-going. The information on technologies presented herein represents the best knowledge to date. Ongoing work will generate more data and refine the findings that have been developed. All new data and findings will be presented as they become available.

ES-2.3 Nitrogen Technical Advisory Committee

The Nitrogen Technical Advisory Committee (NTAC) is an independent group of world-renowned experts. The NTAC has provided input on every aspect of experimentation. The NTAC meets with the NYCDEP regularly to review program status and make recommendations for additional studies that may be appropriate. The NTAC will prepare a separate report to summarize their findings and present their comments on the NCFP. The members of the NTAC are presented below:

- James L. Barnard, Ph.D., P.E. – Black & Veatch
- Bruce A. Bell, Ph.D., P.E., D.E.E. – Carpenter Environmental Associates
- Glen T. Daigger, Ph.D., P.E., D.E.E. – CH2M Hill
- Jeffrey P. Featherstone - Delaware River Basin Commission
- Denny S. Parker, Ph.D., P.E., D.E.E. – Brown and Caldwell
- Clifford W. Randall, Ph.D., P.E. – Virginia Polytechnic Institute and State University
- H. David Stensel, Ph.D., P.E., D.E.E. – University of Washington

ES-2.4 Focus of the NCFP

The experimentation relative to nitrogen removal is ongoing. The results that have been obtained to date are the focus of the NCFP. The NCFP presents process performance projections for both suspended and attached growth processes. Performance of separate centrate treatment is also included. In particular, the NCFP provides projections based on the experiments that have proceeded the farthest as listed below.

- Performance of the suspended growth step-feed BNR process.
- Performance of separate centrate treatment.
  - Physical/Chemical process performance
  - Biological processes – nitrification performance.
- Performance of attached growth processes primarily in the nitrification mode.
- Preliminary design criteria and facility costs.

Experimentation is still ongoing. Final data on wastewater characterization are being developed. Data from all seasons are needed for the attached growth processes and additional time is necessary for certain experiments to reach steady state conditions. As further data and analysis become available updates will be issued.

- Optimization of the step-feed BNR processes.
  - Complete wastewater characterization work.
  - Complete evaluation of nitrifier growth rates.
  - Verify modeling and pilot plant results using additional data.
  - Complete evaluation of supplemental alkalinity.
  - Optimize carbon addition.
  - Optimize secondary clarifiers.

- Separate centrate treatment.
  - Assessment of centrate treatment economics.
  - Operational considerations from the physical chemical treatment.
  - Results for denitrification through biological means.
  - Further evaluate need for centrate flow for alternatives where equalization treatment is not provided.

- Attached growth nitrification and denitrification process optimization.

- Economic analysis for "Outlier" WPCPs

- Higher nitrification rates may eliminate need for additional aeration tanks at North River, Owls Head, Jamaica and Coney Island.

- Newtown Creek WPCP (different from other WPCPs because no PSTs and low

HRT.)

ES-3 RESULTS FOR WPCPs AND FACILITY COST ESTIMATES

The NCFP identifies certain feasible technologies for the removal of TN from the effluent of the City's fourteen WPCPs. Each WPCP is somewhat different, so configuration and facility costs vary. The step-feed BNR process, separate centrate treatment, and biologically active filtration are all viable alternatives for consideration. The identification of these technologies does not represent a commitment by the NYCDEP to initiate upgrades at any of the WPCPs. The actual implementation of BNR upgrades is subject to discussion that will take place with the New York State Department of Environmental Conservation (NYSDEC) relative to future SPDES requirements and regulatory legal procedures that must be followed prior to adopting SPDES permit requirements.

The most feasible technology to implement maximum nitrogen removal on a retrofit basis is the step-feed BNR retrofit. In addition the concept of flow reductions through demand side water conservation in selected drainage basis is a management tool that is feasible to enhance nitrogen removal. Capital, O&M and present worth cost estimates for the recommended retrofit alternative are shown in Table ES-1. It should be noted no retrofit technologies were identified that would result in a significant increase in nitrogen removal at Newtown Creek.

Table ES-1. Cost Estimates for Retrofit Process to Achieve Maximum TN Removal

WPCP	Capital ($M)	O&M ($M/yr)	Present Worth ($M)
Tallman Island	27	5	143
Wards Island	79	34	816
Bowery Bay	52	19	468
Hunts Point	48	14	352
26th Ward	48	13	333
Jamaica	26	7	176
Coney Island	30	7	178
Rockaway	12	2	64
Red Hook	18	6	158
Newtown Creek	N/A	N/A	N/A
North River	35	9	237
Owls Head	30	7.7	198
Port Richmond	17	8.4	198
Oakwood Beach	18	9	203

The most feasible technology to implement nitrogen removals to a limit of 9 mg/L TN is also step-feed BNR. At WPCPs where carbon is required, the dosage may be optimized as need to

meet the 9 mg/L limit. Capital, O&M and present worth cost estimates for the recommended alternatives to meet 9 mg/L TN are shown in Table ES-2.

Table ES-2. Cost Estimates for Recommended Alternative to Meet Effluent TN of 9 mg/L

WPCP	Capital ($M)	O&M ($M/yr)	Present Worth ($M)
Tallman Island	27	5	143
Wards Island	79	27	655
Bowery Bay	147	12	320
Hunts Point	48	15	365
26th Ward	48	9	239
Jamaica	26	7	176
Coney Island	30	7	178
Rockaway	5	1	20
Red Hook	18	4	104
Newtown Creek	396	37	1210
North River	35	9	237
Owls Head	30	7.7	198
Port Richmond	17	8.4	198
Oakwood Beach	18	6	155

The most feasible technology to implement nitrogen removal to the limits of 4 mg/L TN is step-feed BNR followed by a supplemental denitrification step. Separate centrate treatment may also be required at certain WPCPs. Capital, O&M and present worth cost estimates for the recommended alternatives to meet 4 mg/L TN are shown in Table ES-3.

Table ES-3. Cost Estimates for Recommended Alternative to Meet Effluent TN of 4 mg/L			
WPCP	**Capital ($M)**	**O&M ($M/yr)**	**Present Worth ($M)**
Tallman Island	78	8	245
Wards Island	236	32	912
Bowery Bay	146	16	489
Hunts Point	178	20	605
26th Ward	111	10	327
Jamaica	118	10	334
Coney Island	250	14	533
Rockaway	48	4	128
Red Hook	64	6	186
Newtown Creek	527	49	1527
North River	200	16	533
Owls Head	200	13	461
Port Richmond	63	6	183
Oakwood Beach	51	7	204

Present worth costs estimated are illustrated in Figure ES-1. The "all WPCPs" cost curves include upgrading all fourteen WPCPs for nitrogen removal. The Upper East River (UER) curves include the costs for upgrading Tallman Island, Wards Island, Hunts Point, and Bowery Bay WPCPs. The Jamaica Bay (JB) curves include the costs for upgrading 26th Ward, Jamaica, Coney Island and Rockaway WPCPs.

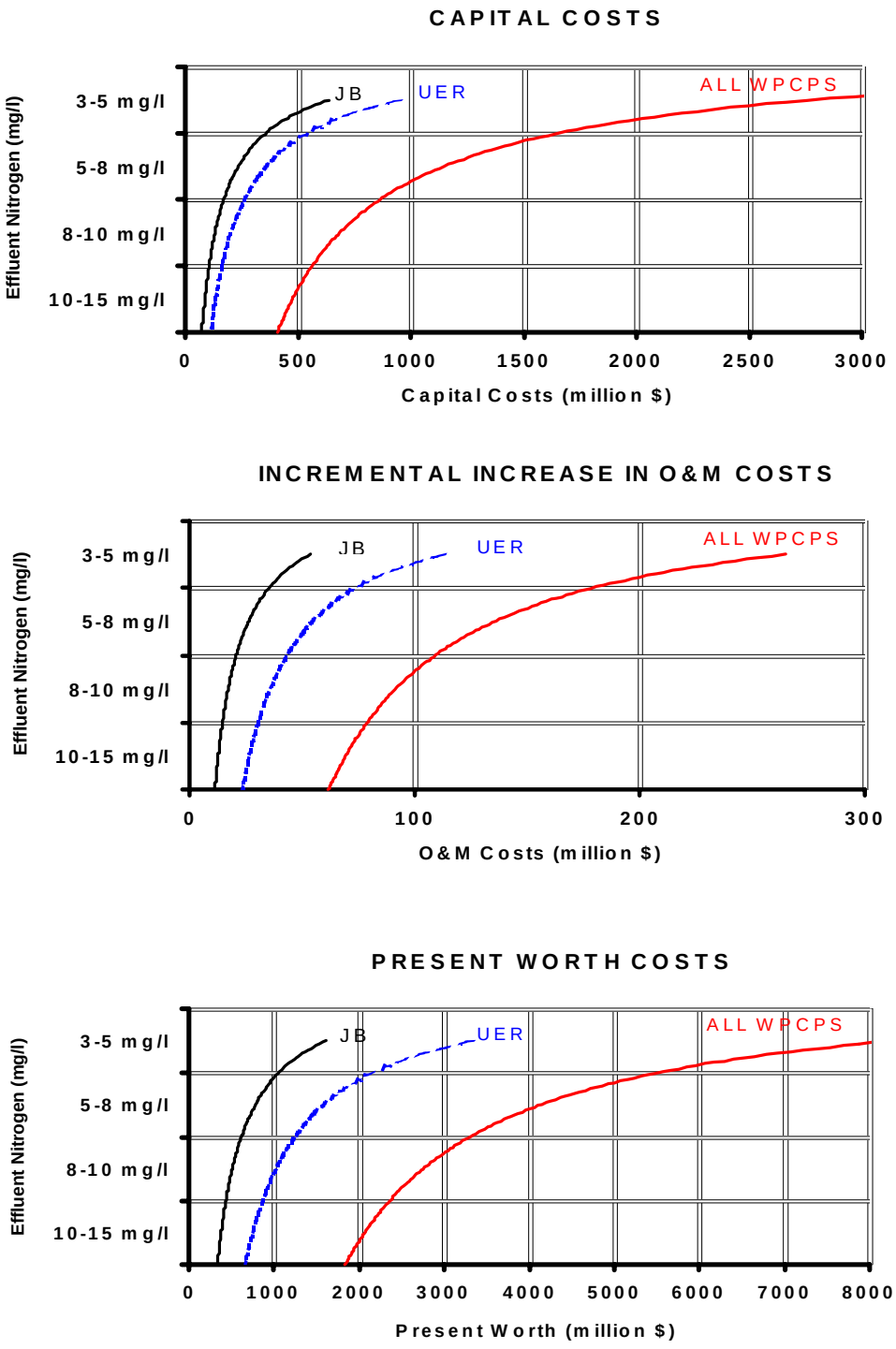

Figure ES-1. Costs for BNR Modifications at New York City's WPCPs