

## **2. HISTORY / SUMMARY OF THE NYCDEP NITROGEN CONTROL ACTION PLAN**

Nitrogen discharges to the New York Harbor have been identified as a significant cause of hypoxia in the western Long Island Sound and portions of Jamaica Bay. As a result, nitrogen control requirements have been incorporated into the permits of the New York City wastewater treatment plants. This section of the document presents the nitrogen control permit requirements and outlines the nitrogen control actions implemented to date at the plants by the New York City Department of Environmental Protection (NYCDEP). A more detailed status and analysis of the nitrogen control actions are presented in the remaining sections of this document.

It is important to note that the New York City wastewater treatment plants were not designed for nitrogen removal. The NYCDEP has undertaken an aggressive and ambitious program to control nitrogen discharges, and is at the forefront of nitrogen removal technologies at wastewater treatment plants. The NYCDEP continues to place a high level of effort and resources into reducing nitrogen loads from the treatment plants, and over the years has included additional nitrogen control actions to achieve nitrogen permit limits.

### **2.1. Background**

The western Long Island Sound and portions of Jamaica Bay have been identified as waters affected by nitrogen loads and poor circulation, contributing to the occurrence of hypoxic events in the summer months. Initial concerns for nitrogen loads in the local waters can be traced back to 1985, when the Long Island Sound Study (LISS) identified nitrogen as the limiting nutrient in the waters, and therefore significantly responsible for the algal growth in the Long Island Sound. As a result, the 1988 SPDES permit specified that future TN limits will be imposed on plants discharging into the Upper East River upon completion of the LISS.

In the summer of 1987, excessive algal blooms (eutrophication) were observed in the Long Island Sound which resulted in extremely low dissolved oxygen levels in the bottom water habitats and caused adverse ecological effects. As a result, concerned groups (Sierra Club, Environmental Defense Fund, Interstate Sanitation Commission, and other organizations) wanted TN limits to be immediately incorporated into the SPDES permit and the NYSDEC was taken to court in accordance with Article 78. The nitrogen discharge issue was complicated because of the 1991 Ocean Dumping Ban which prevented the NYCDEP from disposing of its nitrogen rich sludge at sea and obligated NYCDEP to send its digested sludge to the newly constructed dewatering facilities. As a result, the sludge was now being sent to dewatering centrifuges where the digested sludge would be concentrated from 2% to 25% solids. The dewatered sludge was then sent on for land application and the remaining centrate stream was sent to the head of the plant. The dewatering facilities' centrate stream had a significant portion of soluble TN and was responsible for an increased TN load to the plant.

The legal hearing resulted in Nitrogen Control Requirements being incorporated into the SPDES permit. These requirements consisted of TN discharge limits being imposed on the Upper East River and Jamaica Bay WPCPs based on 1990 TN discharges prior to the start-up of sludge

dewatering facilities. The SPDES Nitrogen Control Requirements also mandated that Red Hook and Oakwood Beach WPCPs be retrofitted for Basic Step Feed BNR to negate the impact of the centrate stream on the TN being discharged from the plants. Other requirements consisted of operational changes to maximize TN removals at the WPCPs; increased nitrogen sampling & analysis; required NYCDEP to construct, operate and monitor a number of nitrogen removal pilot units; and obligated the NYCDEP to submit a NCAP, Phase 1&2 Pilot Study report, and a Feasibility Plan to the NYSDEC. The SPDES Nitrogen Control Requirements also had a re-opener clause that states additional TN removals may be necessary based on the findings of Phase 1 Pilot Work, LISS 3.0 Water Quality Model, and the final Comprehensive Conservation & Management Plan (CCMP).

## 2.2. SPDES Permit Nitrogen Requirements

The SPDES permits include total nitrogen discharge limits for eight NYC WPCPs, as shown in **Table 3** and **Table 4**. The four plants which discharge into the Upper East River (Bowery Bay, Hunts Point, Tallman Island, and Wards Island) have an aggregate total nitrogen effluent limit of 73,900 pounds per day for a 12-month rolling average and 88,600 pounds per day for a maximum monthly average. The four plants that discharge into Jamaica Bay (26<sup>th</sup> Ward, Coney Island, Jamaica, and Rockaway) have an aggregate total nitrogen effluent limit of 45,300 pounds per day for a 12-month rolling average and 54,600 pounds per day for a maximum monthly average. The aggregate limit is based on the nitrogen loads which were being discharged into the Long Island Sound and Jamaica Bay prior to sludge dewatering. The maximum monthly nitrogen permit limits were effective January 1, 1996, and the 12-month rolling average limits became effective January 1, 1997. The SPDES permit also required Red Hook WPCP and Oakwood Beach WPCP to be retrofitted for Basic Step Feed BNR.

**Table 3**  
**Upper East River (BB, HP, TI, WI) Total Nitrogen Permit Limits**

Total Nitrogen Limit	Baseline Limit	Effective Date
Aggregate 12-Month Rolling Average Limit	73,900 lbs/day	January 1, 1997
Maximum Monthly Limit	88,600 lbs/day	January 1, 1996

**Table 4**  
**Jamaica Bay (26W, CI, Ja, Rk) Total Nitrogen Permit Limits**

Total Nitrogen Limit	Baseline Limit	Effective Date
Aggregate 12-Month Rolling Average Limit	45,300 lbs/day	January 1, 1997
Maximum Monthly Limit	54,600 lbs/day	January 1, 1996

According to Section X-B.3 of the SPDES permit, the NYCDEP was required to submit a Nitrogen Control Action Plan (NCAP) to the NYSDEC by June 30, 1994. The NCAP shall address measures to be taken by the NYCDEP to achieve the specified effluent limits for TN, which may include:

- population waste load projections
- planned, approved, or contracted sewer service extensions or connections
- treatment of treatment plant side streams
- separate treatment to accommodate new waste loads
- nitrogen load tradeoffs with other point source loads
- sewer connection or extension restrictions
- water conservation

The NCAP shall also include a schedule of implementation, estimated costs of the specified actions, and a contingency plan. In the event of a significant non-compliance, the NYCDEP will submit a revised NCAP which will specify additional nitrogen control actions that will be implemented to ensure compliance with the TN permit limits. A significant non-compliance is defined in the SPDES permit as follows:

*For Exceedence of the 12 Month Rolling Average Baseline Limit:*  
*2 of 6 consecutive reported values > 1.4 x 12 Month Rolling Average Limit*  
*and/or*  
*6 consecutive reported values > 12 Month Rolling Average Limit*

*For Maximum Monthly Average Baseline Limit:*  
*1 of 6 consecutive reported value > 1.2 Maximum Monthly Average Limit*  
*and/or*  
*2 of 6 consecutive reported values > Maximum Monthly Average Limit*

The SPDES permits also require that the NYCDEP construct, operate, and monitor pilot nitrogen removal equipment and methods to demonstrate their nitrogen removal effectiveness. The pilot work requirements are presented in **Table 5** and **Table 6**. The findings of these pilot studies are to be incorporated into the Phase 1&2 reports and the Nitrogen Control Feasibility Plan which must be submitted to the NYSDEC.

**Table 5**  
**SPDES Permit Phase I Pilot Work**

<b>Pilot Work</b>	<b>Description</b>
Chemically Enhanced Thickening	Enhance Gravity Thickening at Bowery Bay and Jamaica with Polymer Addition
Fixed Media	Evaluate the Effects of Fixed Media on BNR
Internal Recycle	Evaluate the Effects of Internal Recycle on BNR

**Table 6**  
**SPDES Permit Phase II Pilot Work**

<b>Pilot Work</b>	<b>Description</b>
Centrate Treatment	Install Physical/Chemical Pilot Unit to Remove Nitrogen From Centrate Stream
Thickening Centrifuge	Test Centrifugal Thickener at One Treatment Plant
Research Studies	CCNY to Conduct Research Studies Pertaining to Nitrogen Removal, Froth Control, and Final Tank Settling
Other Pilot Work	Install Two Package BNR Units and 1 MGD Biofilter

The NYCDEP also entered into a side agreement with the NYSDEC, which required the establishment of a Nitrogen Technical Advisory Committee (TAC). The TAC is responsible for overseeing the NYCDEP's Nitrogen Program which includes reviewing materials provided by the NYCDEP, providing recommendations on the design and operation of the above pilot units, advising the NYCDEP on the scope of work and monitoring procedures associated with the pilot units, interpreting the results of these pilot studies, and participate in the development of a Nitrogen Control Feasibility Plan.

In addition, the SPDES permit required NYCDEP to implement operational changes to maximize TN removals at the existing plants (June 1993) and required the NYCDEP to modify its sampling and analysis procedures to enable the plants to perform nitrogen mass balances (June 1994). As a result, the sludge age was increased at selected treatment plants to increase TN removals such as 26<sup>th</sup> Ward (4/93-10/93), Coney Island (1/94-5/94), Red Hook (10/93-10/94), Tallman Island (6/93-5/93), and Bowery Bay (1/94-3/96). Other treatment plants were unable to increase the sludge age due to mechanical and process limitations. However, many of the treatment plants selected to increase their sludge age encountered frothing problems and related process upsets which forced them to reduce the sludge age. These frothing problems necessitated that froth control systems be incorporated into the design and construction of the Basic Step Feed BNR retrofits. Some of the mechanical limitations have been corrected in-house and the remainder of the these problems will be addressed in future plant upgrades. The NYCDEP also modified its sampling and analysis procedures as was required in the SPDES permit prior to June 1994.

### **2.3. NYCDEP Nitrogen Control Actions**

The Nitrogen Control Action Plan was submitted to the NYSDEC in June 1994. In addition to addressing the items required by the SPDES permits, the NCAP document identified unexpected events which would place the NYCDEP in significant non-compliance with the permit limits at the effective dates. In the NCAP document, it was stated that there was an unidentified increase in the influent nitrogen load to Wards Island WPCP and Hunts Point WPCPs, which needed further investigation. More importantly, the NCAP document informed the NYSDEC that the Upper East River WPCPs would not be able to comply with the SPDES TN permit limits because of severe frothing problems at the WPCPs and Wards Island WPCP's inability to increase the sludge

age due to return sludge problems and process limitations. As a result, NYCDEP incorporated froth control systems into the nitrogen program and corrected the mechanical limitations at the Wards Island and Hunts Point WPCPs. The NYCDEP also decided to retrofit 26<sup>th</sup> Ward WPCP and Bowery Bay WPCP for Basic Step Feed BNR to ensure that NYCDEP complies with the SPDES TN permit limits. Also in the NCAP document, the NYCDEP requested that NYSDEC consider a nitrogen tradeoff in the Upper East River for additional nitrogen removals achieved at Red Hook WPCP, for which the NYSDEC did not give credit. Though the NYCDEP had developed nitrogen control actions to achieve the effluent limits, the actions could not be implemented before January 1996. As a result, the NYCDEP proposed to submit a semiannual report before a non-compliance was encountered, to address the status of the NYCDEP's nitrogen control actions, analyze plant performance, investigate additional nitrogen control technologies that could quickly be implemented, and inquire into increased TN loads at the WPCPs. The NYCDEP submitted the first semiannual report on May 9, 1995 and has submitted five semiannual reports since then on the following dates March 19, 1996; May 13, 1996; December 23, 1996; May 20, 1997; and December 31, 1998.

It is important to note that the NYC WPCPs were not designed for nitrogen removal. The four Upper East River WPCPs and one Jamaica Bay WPCP have been retrofitted with modifications for Basic Step Feed BNR with the exception of a froth control system. The Red Hook and Oakwood Beach WPCPs were also retrofitted for Basic Step Feed BNR with the exception of a froth control system. There have been and are still many unforeseen delays and limitations at the WPCPs in implementing BNR reliably to meet nitrogen discharge permit limits consistently. The NYCDEP has undertaken an aggressive and ambitious program to control nitrogen discharges, and as shown in the recent data has been reducing its nitrogen discharges. The NYCDEP has placed a high level of effort and resources into reducing nitrogen loads from the WPCPs, and over the years has revised the Nitrogen Control Action Plan to include additional nitrogen control actions in order to achieve nitrogen permit limits. However, the current SPDES permit nitrogen requirements mandate reliable and consistent BNR performance, for which the WPCPs were not originally designed.

A summary of the NYCDEP's semiannual reports are presented in the following **Table 7** and **Table 8**. There have been unforeseen delays associated with retrofitting the WPCPs for Basic Step Feed BNR operation. Though the Basic Step Feed BNR retrofits have been completed, delays in the froth control systems have been preventing the NYCDEP from satisfactorily implementing Basic Step Feed BNR and increasing the sludge age. The NYCDEP had a number of unexpected problems with the froth control systems such as equipment problems, contractors falling behind schedule, contractual disagreements, and contractors defaulting. It should be noted that neither the NYCDEP nor the contractors have had any previous experience designing and constructing chlorine spray hoods and as a result NYCDEP had to develop an innovative design. The NYCDEP is trying to expedite all contracts, and have even been operating without a froth control system where possible, in its best attempt to implement the nitrogen control actions.

A summary of the semiannual reports and corresponding nitrogen control actions are outlined in the following tables. A detailed status and evaluation of the nitrogen control actions and of the SPDES permit Phase I and II Pilot Work is presented in the following sections of this document.

**Table 7**  
**Summary of Nitrogen Control Action Plans**  
**Upper East River**

<b>Nitrogen Control Actions to be Implemented</b>	<b>Wards Island</b>	<b>Hunts Point</b>	<b>Tallman Island</b>	<b>Bowery Bay</b>
Original Nitrogen Control Action Plan June 30, 1994	No Action	Basic Step Feed BNR Retrofit ( <i>January 1996</i> )	Basic Step Feed BNR Retrofit ( <i>January 1996</i> )	High Sludge Age ( <i>January 1996</i> )
1st Semi-Annual Report May 5, 1995	Separate Centrate Treatment ( <i>February 1996</i> ) & High Sludge Age ( <i>July 1996</i> )	Basic Step Feed BNR Retrofit ( <i>July 1996</i> ) & Separate Centrate Treatment ( <i>Present</i> )	Basic Step Feed BNR Retrofit ( <i>January 1996</i> )	Basic Step Feed BNR Retrofit ( <i>January 1997</i> )
2nd Semi-Annual Report March 19, 1996	Separate Centrate Treatment ( <i>February 1996</i> ) & High Sludge Age ( <i>July 1996</i> )	Basic Step Feed BNR Retrofit ( <i>July 1996</i> ) & Separate Centrate Treatment ( <i>Jan 1996</i> )	Basic Step Feed BNR Retrofit ( <i>January 1996</i> )	Basic Step Feed BNR Retrofit ( <i>January 1997</i> )
3rd Semi-Annual Report May 13, 1996	Separate Centrate Treatment ( <i>October 1996</i> ) & High Sludge Age ( <i>June 1997</i> )	Basic Step Feed BNR Retrofit ( <i>September 1997</i> ) & Separate Centrate Treatment ( <i>Present</i> )	Basic Step Feed BNR Retrofit ( <i>October 1996</i> )	Basic Step Feed BNR Retrofit ( <i>Dec 1997</i> )
4th Semi-Annual Report December 23, 1996	Separate Centrate Treatment ( <i>November 1996</i> ) & High Sludge Age ( <i>July 1997</i> )	Basic Step Feed BNR Retrofit ( <i>October 1997</i> ) & Separate Centrate Treatment ( <i>Present</i> )	Basic Step Feed BNR Retrofit ( <i>April 1997</i> )	Basic Step Feed BNR Retrofit ( <i>January 1998</i> )
5th Semi-Annual Report May 20, 1997	Separate Centrate Treatment ( <i>Present</i> ) & High Sludge Age ( <i>January 1998</i> )	Basic Step Feed BNR Retrofit ( <i>January 1999</i> ) & Separate Centrate Treatment ( <i>Present</i> )	Basic Step Feed BNR Retrofit ( <i>April 1997</i> )	Basic Step Feed BNR Retrofit ( <i>January 1999</i> )
6th Semi-Annual Report	Separate Centrate Treatment ( <i>Present</i> ) High Sludge Age in Batteries A-D ( <i>March 1999</i> ) & Step Basic Step Feed BNR in Battery E ( <i>January 1998</i> )	* Basic Step Feed BNR Retrofit ( <i>December 1999</i> ) & Separate Centrate Treatment ( <i>Present</i> )	Basic Step Feed BNR Retrofit ( <i>April 1997</i> )	Basic Step Feed BNR Retrofit ( <i>Dec 1999</i> )

\* Hunts Point & Bowery Bay WPCPs have attempted to implement Basic Step Feed BNR without a froth control system.

**Table 8**  
**Summary of Nitrogen Control Action Plan**  
**Jamaica Bay**

<b>Nitrogen Control Actions to be Implemented</b>	<b>26th Ward</b>	<b>Coney Island</b>	<b>Jamaica</b>	<b>Rockaway</b>
Original Nitrogen Control Action Plan June 30, 1994	<i>High Sludge Age (January 1996)</i>	No Action	No Action	No Action
1st Semi-Annual Report May 5, 1995	<i>Basic Step Feed BNR Retrofit (January 1997)</i>	No Action	No Action	No Action
2nd Semi-Annual Report March 19, 1996	<i>Basic Step Feed BNR Retrofit (January 1997) &amp; Separate Centrate Treatment (June 1995)</i>	No Action	No Action	No Action
3rd Semi-Annual Report May 13, 1996	<i>Basic Step Feed BNR Retrofit (December 1997) &amp; Separate Centrate Treatment (Present)</i>	No Action	No Action	No Action
4th Semi-Annual Report December 23, 1996	<i>Basic Step Feed BNR Retrofit (January 1998) &amp; Separate Centrate Treatment (Discontinued)</i>	No Action	No Action	No Action
5th Semi-Annual Report May 20, 1997	<i>Basic Step Feed BNR Retrofit (July 1999) &amp; Separate Centrate Treatment (September 1997)</i>	No Action	No Action	No Action
6th Semi-Annual Report	<i>Basic Step Feed BNR Retrofit (April 2000) Separate Centrate Treatment (March 1998) Discontinue Exporting Owls Head WPCP's Sludge to 26<sup>th</sup> Ward WPCP (December 2000)</i>	No Action	No Action	No Action