Appendix N — Natural Resources

A. CORRESPONDENCE FROM ENVIRONMENTAL AGENCIES

The attached correspondence is from the United States Fish & Wildlife Service (USFWS), The National Marine Fisheries Service (NMFS), and the New York State Department of Environmental Conservation (NYSDEC). These federal and state regulatory agencies are responsible for the protection of sensitive fish and wildlife species and habitat within the vicinity of the Project Area. Letters to these regulatory agencies were sent to verify the presence of special status species and habitat within and adjacent the Project Area. Response letters from these agencies include:

- USFWS Letter, dated 4/21/03, regarding the presence of special status species and habitats;
- NMFS Letter, dated 5/21/03, regarding the presence of special status species and habitats;
- USFWS Letter, dated 3/18/04, regarding the presence of special status species and habitats; and
- NYSDEC Natural Heritage Program Letter, dated 3/23/04, regarding the presence of special status species and habitats.

Additional coordination with New York City Department of Environmental Protection (NYCDEP) and New York City Department of Sanitation (DSNY) determined the feasibility of spoils removal by barge. The response letter from this coordination is as follows:

- DSNY Letter, dated 6/20/03, regarding the West 59th Street pier.

B. NORTH RIVER WPCP COMBINED SEWER SYSTEM MODELING REPORT

This section contains the “Impact of the Proposed Hudson Yards Rezoning and Redevelopment Project on the North River WPCP Combined Sewer System and the Hudson River” report. This report contains modeled wastewater flows, both With and Without the Proposed Action, to the North River WPCP, Combined Sewer Overflows within the North River drainage area, and the potential water quality impacts to the Hudson River and Harlem River.

A. Correspondence

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

April 21, 2003

Ms. Anjanette Nuñez
Assistant Planner
The Louis Berger Group, Inc.
20 Exchange Place, 22nd Floor
New York, NY 10005

Dear Ms. Nuñez:

This responds to your letter of April 2, 2003, requesting information on the presence of Federally listed or proposed endangered or threatened species in the vicinity of the proposed No. 7 Subway Extension - Far West Midtown Manhattan Rezoning in Manhattan, New York County, New York

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Therefore, no further Endangered Species Act coordination or consultation with the U.S. Fish and Wildlife Service (Service) is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally listed and proposed endangered and threatened species in New York* is available for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under other legislation.

Federally listed endangered and threatened marine species may be found near the project area. These species are under the jurisdiction of the National Marine Fisheries Service. You should contact Mr. Stanley Gorski, Habitat and Protected Resources Division, Area Coordinator, National Marine Fisheries Service, James J. Howard Marine Sciences Laboratory, 74 Magruder Road, Highlands, NJ 07732, for additional information (telephone: [732] 872-3037).

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate New York State Department of Environmental Conservation regional office(s),* and:

New York State Department of Environmental Conservation
New York Natural Heritage Program Information Services
625 Broadway
Albany, NY 12233
(518) 402-8935

Since wetlands may be present, you are advised that National Wetlands Inventory (NWI) maps may or may not be available for the project area. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Copies of specific NWI maps can be obtained from:

Cornell Institute for Resource Information Systems
302 Rice Hall
Cornell University
Ithaca, NY 14853
(607) 255-4864

Work in certain waters of the United States, including wetlands, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).*

If you require additional information or assistance please contact Michael Stoll at (607) 753-9334.

Sincerely,

Mark W. Clough
Acting For

David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://nyfo.fws.gov/es/esdesc.htm.

cc: NYSDEC, Long Island City, NY (Environmental Permits)
NYSDEC, Albany, NY (Natural Heritage Program)
NMFS, Highlands, NJ (Attn: S. Gorski)
NMFS, Milford, CT (Attn: M. Ludwig)
COE, New York, NY

U.S. Fish and Wildlife Service
New York Field Office
3817 Luker Road
Cortland, NY 13045

To provide a timely response to future requests for endangered species comments in New York, please include the following in future inquiries:

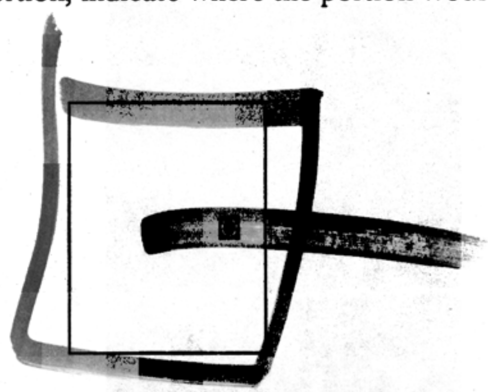
1. A concise brief description of the project/action.

2. Name of the hamlet/village/city/town/county where the project/action occurs.

3. The latitude and longitude of the project/action, i.e.: 42° 13' 28" / 76° 56' 30". If the project/action is linear, you may provide coordinates for both ends or just one nea[illegible] center.

4. A map showing the project/action location. Preferrably the map should be a U.S. Geological Survey quadrangle map (USGS Quad). You need only provide a copy of that portion where the project/action occurs. Please provide the name(s) of the USGS quadrangle.

   If providing only a portion, indicate where the portion would be located on the full quadrangle, i.e.



Providing the information above will assist us in responding to your needs.

If you require additional information please contact Michael Stoll at (607) 753-9334.

National Marine Fisheries Service
Habitat Conservation Division
Milford Field Office, 212 Rogers Avenue
Milford, Connecticut 06460

TO: Ms. Anjanette Nuñez
Assistant Planner
The Louis Berger Group
20 Exchange Place, 22nd Floor
New York, New York 10005

DATE: 21 May 2003

SUBJECT: Proposed No. 7 Subway Extension, Far West Midtown Manhattan Rezoning

Diane Rusanowsky
(Reviewing Biologist)

We have reviewed the information provided to us regarding the above subject project. We offer the following preliminary comments pursuant to the Endangered Species Act, the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act:

Endangered and Threatened Species

_______ There are no endangered or threatened species in the *immediate* project area.

__XX__ The following endangered or threatened species may be present in the Hudson River:

__XX__ shortnose sturgeon (*Acipenser brevirostrum*)

sea turtles: __XX__ loggerhead (*Caretta caretta*) __XX__ Kemp's ridley (*Lepidochelys kempii*)

__XX__ green (*Chelonia mydas*) __XX__ leatherback (*Dermochelys coriacea)*

Other: ____

Fish and Wildlife Coordination Act Species

__XX__ The following may be present in the project area: Anadromous and resident fish, forage and benthic species

Please contact the appropriate Regional Office of the New York State Department of Environmental Conservation to confirm the presence of anadromous or resident aquatic populations.
Habitat use by some species or life stages may be seasonal (e.g. over-wintering.)

Essential Fish Habitat

__XX__ The project area has been designated as Essential Fish Habitat (EFH) for one or more species. When details of the project are made available and permit applications have been made, conservation recommendations may be given. For a listing of EFH and further information, please go to our website at: http://www.nero.nmfs.gov/ro/doc/webintro.html . Based on the information provided to date, it is not possible to determine whether or not an EFH assessment will be necessary.

____ No EFH presently designated in the project area.

THE CITY OF NEW YORK Department of Sanitation

DANIEL KLEIN, Director
Office of Real Estate

51 Chambers Street, Room 815
New York, NY 10007
Telephone (212) 566-6262
788-7956
FAX (212)349-0610
dklein@dsny.nyc.gov

June 20, 2003

Mr. Doug Pearson
NYCT-Number 7 Extension Project
2 Broadway 5th Floor, Mailbox 519
New York, NY 10004

Dear Mr. Pearson:

The Department of Sanitation (DSNY) has reviewed your request concerning the possible transportation of rock spoils from the Number 7 Extension Project via our MTS system. This request cannot be accommodated by DSNY.

The West 59th Street MTS is currently being actively utilized by us. The remaining Manhattan MTS's at East 91st Street and West 135th Street are scheduled to be fully active by 2006, as we implement the City's long-term export plan. This plan relies heavily on using the MTS system for the transshipment of the City's municipal solid waste. The fully active MTS's will not have the necessary excess capacity to accommodate the additional traffic generated by your project or the slip space for mooring a dedicated barge to receive your rock spoils.

Please call me if you like to discuss this issue further.

Sincerely,

Daniel Klein

c: B. Sullivan

United States Department of the Interior

FISH AND WILDLIFE SERVICE
3817 Luker Road
Cortland, NY 13045

March 18, 2004

Mr. Doug Pierson
c/o The Louis Berger Group, Inc.
199 Water Street, 23rd Floor
New York, NY 10038

Dear Mr. Pierson:

This responds to your letter of March 3, 2004, requesting information on the presence of Federally listed or proposed endangered or threatened species in the vicinity of the proposed extension of the Number 7 Subway to Far West Midtown Manhattan (No. 7 Subway Extension – Far West Midtown Manhattan Rezoning Project), Manhattan Island, New York County, New York.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. In addition, no habitat in the project impact area is currently designated or proposed "critical habitat" in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.). Therefore, no further Endangered Species Act coordination or consultation with the U.S. Fish and Wildlife Service (Service) is required. Should project plans change, or if additional information on listed or proposed species or critical habitat becomes available, this determination may be reconsidered. The most recent compilation of Federally listed and proposed endangered and threatened species in New York* is available for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under other legislation.

Federally listed endangered and threatened marine species may be found near the project area. These species are under the jurisdiction of the National Oceanic and Atmospheric Administration/Fisheries (NOAA/F). You should contact Mr. Stanley Gorski, Habitat Conservation Division, Field Offices Supervisor, NOAA/F, James J. Howard Marine Sciences Laboratory, 74 Magruder Road, Highlands, NJ 07732, for additional information (telephone: [732] 872-3037).

For additional information on fish and wildlife resources or State-listed species, we suggest you contact the appropriate New York State Department of Environmental Conservation regional office(s),* and:

New York State Department of Environmental Conservation
New York Natural Heritage Program Information Services
625 Broadway
Albany, NY 12233-4757
(518) 402-8935

Since wetlands may be present, you are advised that National Wetlands Inventory (NWI) maps may or may not be available for the project area. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes. Copies of specific NWI maps can be obtained from:

Cornell Institute for Resource Information Systems
302 Rice Hall
Cornell University
Ithaca, NY 14853
(607) 255-4864

Work in certain waters of the United States, including wetlands, may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without recommending additional permit conditions, or recommend denial of the permit depending upon potential adverse impacts on fish and wildlife resources associated with project construction or implementation. The need for a Corps permit may be determined by contacting the appropriate Corps office(s).*

If you require additional information or assistance please contact Michael Stoll at (607) 753-9334.

Sincerely,

Mark W. Clough
Acting For
David A. Stilwell
Field Supervisor

*Additional information referred to above may be found on our website at: http://nyfo.fws.gov/es/esdesc.htm.

cc: NYSDEC, Long Island City, NY (Environmental Permits)
NYSDEC, Albany, NY (Natural Heritage Program)
NYSDEC, New Paltz, NY (Hudson River Fisheries Unit, Attn: K. Hatalla)
NOAA/F, Highlands, NJ (Attn: S. Gorski)
NOAA/F, Milford, CT (Attn: M. Ludwig)
COE, New York, NY

U.S. Fish and Wildlife Service
New York Field Office
3817 Luker Road
Cortland, NY 13045

To provide a timely response to future requests for endangered species comments in New York, please include the following in future inquiries:

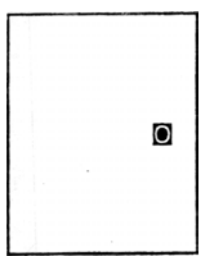
A concise brief description of the project/action.

2 Name of the hamlet/village/city/town/county where the project/action occurs.

3 The latitude and longitude of the project/action, i.e.: 42° 13' 28" / 76° 56' 30". If the project/action is linear, you may provide coordinates for both ends or just one near center.

4 A map showing the project/action location. Preferrably the map should be a U.S. Geological Survey quadrangle map (USGS Quad). You need only provide a copy of that portion where the project/action occurs. Please provide the name(s) of the USGS quadrangle.

If providing only a portion, indicate where the portion would be located on the full quadrangle, i.e.



Providing the information above will assist us in responding to your needs.

If you require additional information please contact Michael Stoll at (607) 753-9334.

New York State Department of Environmental Conservation
Division of Fish, Wildlife & Marine Resources
New York Natural Heritage Program
625 Broadway, Albany, New York 12233-4757
Phone: (518) 402-8935 • **FAX:** (518) 402-8925
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

March 23, 2004

G. Doug Pierson
Louis Berger Group
199 Water Street, 23rd floor
New York City, NY 10038

Dear Mr. Pierson:

In response to your recent request, we have reviewed the New York Natural Heritage Program databases with respect to an Environmental Assessment for the proposed Planning for the #7 Subway Extension, in addition, the MTA Corona Yards adjacent to Flushing Creek, both areas as indicated on the maps you provided, located in New York City.

> Enclosed is a report of rare or state-listed animals and plants, significant natural communities, and other significant habitats, which our databases indicate occur, or may occur, on your site or in the immediate vicinity of your site. The information contained in this report is considered <u>sensitive</u> and may not be released to the public without permission from the New York Natural Heritage Program.

Your project location is within, or adjacent to, a designated Significant Coastal Fish and Wildlife Habitat. This habitat is part of New York State's Coastal Management Program (CMP), which is administered by the NYS Department of State (DOS). Projects which may impact the habitat are reviewed by DOS for consistency with the CMP. For more information regarding this designated habitat and applicable consistency review requirements, please contact:

> Jeff Zappieri or Vance Barr - (518) 474-6000
> NYS Department of State
> Division of Coastal Resources and Waterfront Revitalization
> 41 State Street, Albany, NY 12231

The presence of rare species may result in your project requiring additional permits, permit conditions, or review. For further guidance, and for information regarding other permits that may be required under state law for regulated areas or activities (e.g., regulated wetlands), please contact the appropriate NYS DEC Regional Office, Division of Environmental Permits, at the enclosed address.

For most sites, comprehensive field surveys have not been conducted; the enclosed report only includes records from our databases. We cannot provide a definitive statement on the presence or absence of all rare or state-listed species or significant natural communities. This information should NOT be substituted for on-site surveys that may be required for environmental impact assessment.

Our databases are continually growing as records are added and updated. If this proposed project is still under development one year from now, we recommend that you contact us again so that we may update this response with the most current information.

Sincerely,

Charlene Houle jp

Charlene Houle
Information Services
NY Natural Heritage Program

Encs.

cc: Reg. 2, Wildlife Mgr.
Reg. 2, Fisheries Mgr.
Peter Nye, Endangered Species Unit, Albany
Shawn Keeler, Bureau of Fisheries, Albany

Natural Heritage Report on Rare Species and Ecological Communities

Prepared 12 March 2004 by NY Natural Heritage Program, NYS DEC, Albany, New York

This report contains SENSITIVE information that should be treated in a sensitive manner -- Please see cover letter. Refer to the Users' Guide for explanations of codes, ranks, and fields.
We do not always provide maps of locations of species most vulnerable to disturbance, nor of some records whose locations and/or extents are not precisely known or are too large to display.

* County ** Town Scientifc Name, COMMON NAME, & Group Name	NY Legal Status, Heritage Ranks, & Federal Status	EO Rank & Last Seen	Detailed Location	General Habitat and Quality	Office Use
* COLUMBIA, PUTNAM, RENSSELAER, ROCKLAND, ORANGE, NEW YORK, DU ** MOUNT PLEASANT, SAUGERTIES, BETHLEHEM, CITY OF RENSSELAER, CITY OF NEW YORK, FISHKILL, CITY OF NEW Y					
Acipenser brevirostrum SHORTNOSE STURGEON Fish	ENDANGERED G3 S1 LE		HUDSON RIVER The lower Hudson River from The Battery in New York City at its junction with Upper New York Bay, upstream to the Federal Dam in Troy and a portion of Schodack Creek.	A long tidal river representing the Lower Hudson River. The river constitutes the lower part of a 315 mile stream system. It is fed upstream by two large main channel streams, which provide 80% of the freshwater input, and numerous other smaller stre	4107368 BOF
* NEW YORK ** CITY OF NEW YORK					
Falco peregrinus PEREGRINE FALCON Bird	ENDANGERED G4 S3B,SZN (PS:LE)		MET LIFE BUILDING Go to the Met Life Building at 200 Park Avenue. The nest box is on the 57th floor on the south facade of the building, left of the sign.	For information on the population at this location and management considerations, please contact the NYS DEC Regional Wildlife Manager or NYS DEC Endangered Species Unit at 518-402-8859.	4007378 ESU

2 Records Processed

Significant Habitats

DATE 3/15/2004

REPORT ID #	NAME OF AREA	TYPE OF AREA	COUNTY	TOWN OR CITY	QUADRANGLE
SW 41-012	Whiteston Bridge to Little Neck Bay	Waterfowl Wintering Area	Queens	Queens - New York City	Flushing

USERS GUIDE TO NY NATURAL HERITAGE DATA

New York Natural Heritage Program, 625 Broadway, Albany, NY, 12233-4757 (518) 402-8935

NATURAL HERITAGE PROGRAM: The Natural Heritage Program is an ongoing, systematic, scientific inventory whose goal is to compile and maintain data on the rare plants and animals native to New York State, and significant ecological communities. The data provided in the report facilitate sound planning, conservation, and natural resource management and help to conserve the plants, animals and ecological communities that represent New York's natural heritage.

DATA SENSITIVITY: The data provided in the report are ecologically sensitive and should be treated in a sensitive manner. The report is for your in-house use and should not be released, distributed or incorporated in a public document without prior permission from the Natural Heritage Program.

NATURAL HERITAGE REPORTS (may contain any of the following types of data):

COUNTY NAME: County where the occurrence of a rare species or significant ecological community is located.
TOWN NAME: Town where the occurrence of a rare species or significant ecological community is located.
USGS 7 ½' TOPOGRAPHIC MAP: Name of 7.5 minute US Geological Survey (USGS) quadrangle map (scale 1:24,000).

SIZE (acres): Approximate acres occupied by the rare species or significant ecological community at this location. A blank indicates unknown size.
SCIENTIFIC NAME: Scientific name of the occurrence of a rare species or significant ecological community.
COMMON NAME: Common name of the occurrence of a rare species or significant ecological community.
ELEMENT TYPE: Type of element (i.e. plant, animal, significant ecological community, other, etc.)

LAST SEEN: Year rare species or significant ecological community last observed extant at this location.

EO RANK: Comparative evaluation summarizing the quality, condition, viability and defensibility of this occurrence. Use with LAST SEEN.
- A-E = Extant: A=excellent, B=good, C=fair, D=poor, E=extant but with insufficient data to assign a rank of A - D.
- F = Failed to find. Did not locate species, but habitat is still there and further field work is justified.
- H = Historical. Historical occurrence without any recent field information.
- X = Extirpated. Field/other data indicates element/habitat is destroyed and the element no longer exists at this location.
- ? = Unknown.
- Blank = Not assigned.

NEW YORK STATE STATUS (animals): Categories of Endangered and Threatened species are defined in New York State Environmental Conservation Law section 11-0535. Endangered, Threatened, and Special Concern species are listed in regulation 6NYCRR 182.5.

- E = Endangered Species: any species which meet one of the following criteria:
  1) Any native species in imminent danger of extirpation or extinction in New York.
  2) Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.
- T = Threatened Species: any species which meet one of the following criteria:
  1) Any native species likely to become an endangered species within the foreseeable future in NY.
  2) Any species listed as threatened by the U.S. Department of the Interior, as enumerated in the Code of the Federal Regulations 50 CFR 17.11.
- SC = Special Concern Species: those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York. Unlike the first two categories, species of special concern receive no additional legal protection under Environmental Conservation Law section 11-0535 (Endangered and Threatened Species).
- P = Protected Wildlife (defined in Environmental Conservation Law section 11-0103): wild game, protected wild birds, and endangered species of wildlife.
- U = Unprotected (defined in Environmental Conservation Law section 11-0103): the species may be taken at any time without limit; however a license to take may be required.
- G = Game (defined in Environmental Conservation Law section 11-0103): any of a variety of big game or small game species as stated in the Environmental Conservation Law; many normally have an open season for at least part of the year, and are protected at other times.

NEW YORK STATE STATUS (plants): The following categories are defined in regulation 6NYCRR part 193.3 and apply to NYS Environmental Conservation Law section 9-1503.

- E = Endangered Species: listed species are those with:
  1) 5 or fewer extant sites, or
  2) fewer than 1,000 individuals, or
  3) restricted to fewer than 4 U.S.G.S. 7 ½ minute topographical maps, or
  4) species listed as endangered by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.
- T = Threatened: listed species are those with:
  1) 6 to fewer than 20 extant sites, or
  2) 1,000 to fewer than 3,000 individuals, or
  3) restricted to not less than 4 or more than 7 U.S.G.S. 7 and ½ minute topographical maps, or
  4) listed as threatened by U.S. Department of Interior, as enumerated in Code of Federal Regulations 50 CFR 17.11.
- R = Rare: listed species have:
  1) 20 to 35 extant sites, or
  2) 3,000 to 5,000 individuals statewide.
- V = Exploitably vulnerable: listed species are likely to become threatened in the near future throughout all or a significant portion of their range within the state if causal factors continue unchecked.
- U = Unprotected; no state status.

continued on next page

NEW YORK STATE STATUS (communities): At this time there are no categories defined for communities.

FEDERAL STATUS (plants and animals): The categories of federal status are defined by the United States Department of the Interior as part of the 1974 Endangered Species Act (see Code of Federal Regulations 50 CFR 17). The species listed under this law are enumerated in the Federal Register vol. 50, no. 188, pp. 39526 - 39527.

(blank) = No Federal Endangered Species Act status.
LE = The element is formally listed as endangered.
LT = The element is formally listed as threatened.
E/SA = The element is treated as endangered because of similarity of appearance to other endangered species or subspecies.
PE = The element is proposed as endangered.
PT = The element is proposed as threatened.
C= The element is a candidate for listing.
(LE) = If the element is a full species, all subspecies or varieties are listed as endangered; if the element is a subspecies, the full species is listed as endangered.
(LE-LT) = The species is formally listed as endangered in part of its range, and as threatened in the other part; or, one or more subspecies or varieties is listed as endangered, and the others are listed as threatened.
(LT-C) = The species is formally listed as threatened in part of its range, and as a candidate for listing in the other part; or, one or more subspecies or varieties is listed as threatened, and the others are candidates for listing.
(LT-(T/SA)) = One or more subspecies or populations of the species is formally listed as threatened, and the others are treated as threatened because of similarity of appearance to the listed threatened subspecies or populations.
(PS) = Partial status: the species is listed in parts of its range and not in others; or, one or more subspecies or varieties is listed, while the others are not listed.

GLOBAL AND STATE RANKS (animals, plants, ecological communities and others): Each element has a global and state rank as determined by the NY Natural Heritage Program. These ranks carry no legal weight. The global rank reflects the rarity of the element throughout the world and the state rank reflects the rarity within New York State. Infraspecific taxa are also assigned a taxon rank to reflect the infraspecific taxon's rank throughout the world. ? = Indicates a question exists about the rank. Range ranks, e.g. S1S2, indicate not enough information is available to distinguish between two ranks.

GLOBAL RANK:

G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences), or very few remaining acres, or miles of stream) or especially vulnerable to extinction because of some factor of its biology.
G2 = Imperiled globally because of rarity (6 - 20 occurrences, or few remaining acres, or miles of stream) or very vulnerable to extinction throughout its range because of other factors.
G3 = Either rare and local throughout its range (21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range (e.g. a physiographic region), or vulnerable to extinction throughout its range because of other factors.
G4 = Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5 = Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
GH = Historically known, with the expectation that it might be rediscovered.
GX = Species believed to be extinct.

STATE RANK:

S1 = Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some factor of its biology making it especially vulnerable in New York State.
S2 = Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.
S3 = Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.
S4 = Apparently secure in New York State.
S5 = Demonstrably secure in New York State.
SH = Historically known from New York State, but not seen in the past 15 years.
SX = Apparently extirpated from New York State.
SZ = Present in New York State only as a transient migrant.

SxB and SxN, where Sx is one of the codes above, are used for migratory animals, and refer to the rarity within New York State of the breeding (B) populations and the non-breeding populations (N), respectively, of the species.

TAXON (T) RANK: The T-ranks (T1 - T5) are defined the same way as the Global ranks (G1 - G5), but the T-rank refers only to the rarity of the subspecific taxon.
T1 through T5 = See Global Rank definitions above.
Q = Indicates a question exists whether or not the taxon is a good taxonomic entity.

OFFICE USE: Information for use by the Natural Heritage Program.

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B. Sewer System Modeling Report

New York City
Department of Environmental Protection

PROPOSED NO. 7 SUBWAY EXTENSION AND HUDSON YARDS REZONING AND REDEVELOPMENT PROJECT -

ANALYSIS OF COMBINED SEWER OVERFLOWS AND FUTURE WATER QUALITY

October 27, 2004

By

HydroQual Environmental Engineers and Scientists, P.C.

In Association with

HydroQual, Inc.

HydroQual
Environmental
Engineers & Scientists

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SECTION 1

INTRODUCTION

The New York City Department of City Planning (DCP) and the Metropolitan Transit Authority (MTA) propose to promote the transit-oriented redevelopment of the Hudson Yards area, the general vicinity which is shown in Figure 1-1. The Proposed Action consisting of:

1. Adoption of zoning map and text amendments to the New York City Zoning Resolution and related land use actions (Zoning Amendments) to permit the development of the Hudson Yards as a mixed-use community with new commercial and residential uses, new open space, and a new Mid-block Park and Boulevard System between Tenth and Eleventh Avenues;

2. Construction and operation of an extension of the No. 7 Subway Line (No. 7 Subway Extension) to serve the Hudson Yards; and

3. Other public actions intended to foster such development and serve the City as a whole, including:

    - Expansion and modernization of the Jacob K. Javits Convention Center (Convention Center Expansion) including construction of approximately one million square feet of new exhibition space plus additional space for meeting rooms, banquet halls, and other facilities and the development of a new hotel with up to approximately 1,500 rooms;

    - A new Multi-Use Sports, Exhibition and Entertainment Facility (Multi-Use Facility) with approximately 30,000 square feet of permanent meeting room space and the capability to be converted into a number of different uses and configurations, including a stadium configuration with a seating capacity of up to approximately 75,000, an exposition configuration that includes approximately 180,000 square feet of exhibition space, or a plenary hall configuration that provides a maximum seating capacity of approximately 40,000; and

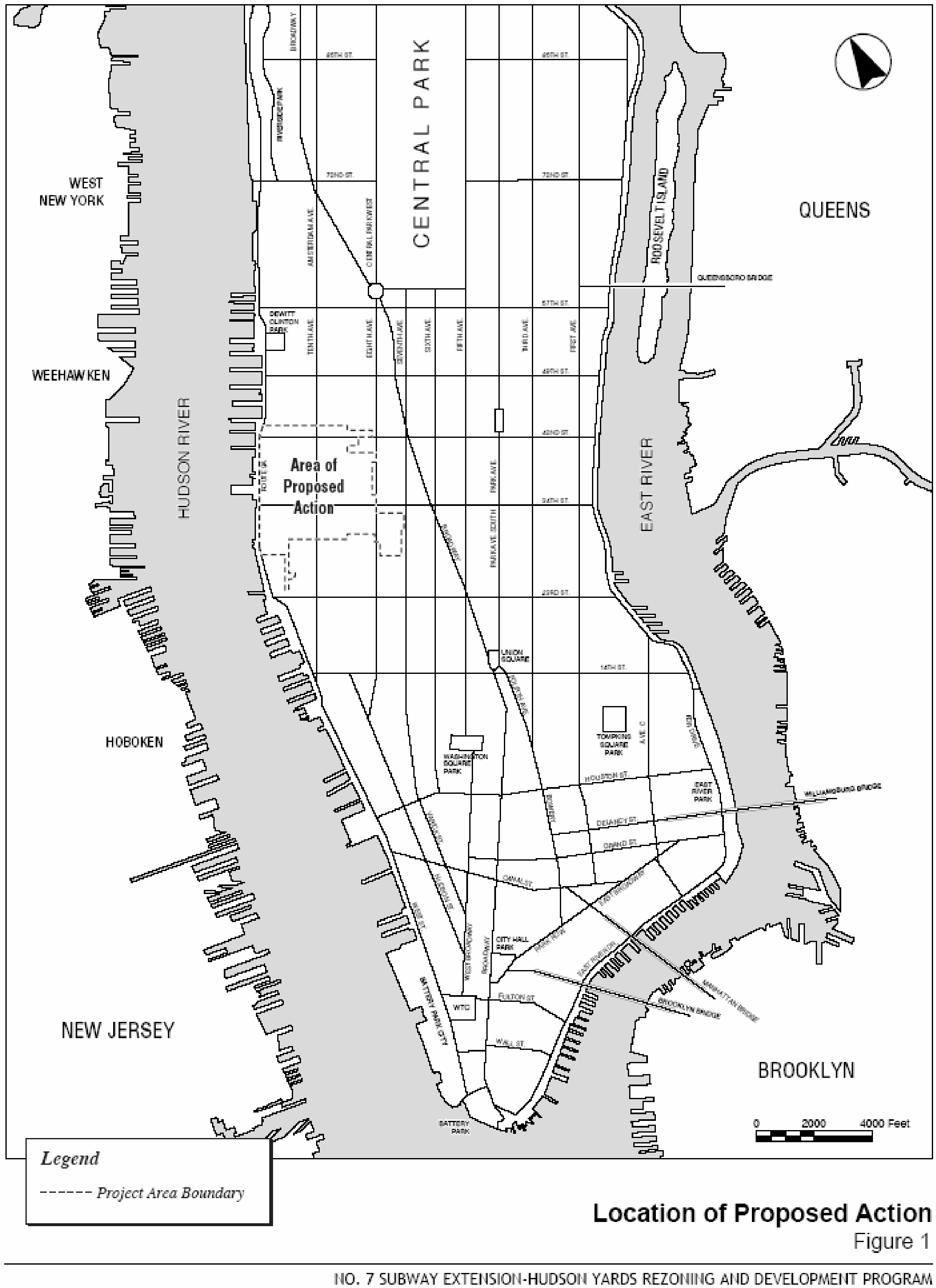


Figure 1-1. Location of Proposed Action (from DGEIS)

- Accommodations for other facilities, new or replacement transportation facilities for vehicle storage and other public purposes, including relocated facilities for the New York City Police Department (NYPD) Manhattan Vehicle Tow Pound and New York City Department of Sanitation (DSNY) Gansevoort facility, and a new 950-car public parking garage under the proposed Midblock Park and Boulevard System.

The DCP proposes to rezone Hudson Yards to permit medium- to high-density development and a broader range of land uses than currently allowed, including office, residential, open space, and other uses. Concurrently, MTA proposes to extend the No. 7 Subway from its current terminus at Times Square into the Hudson Yards area. These two elements of the Proposed Action -- the No. 7 Subway Extension and the Zoning Amendments -- are interdependent, in that the investment to construct, operate, and maintain the proposed No. 7 Subway Extension would not be made if not for the development accommodated by the proposed Zoning Amendments. In addition, the level of redevelopment and mix of land uses that would be permitted by the proposed rezoning could not be supported unless the subway service were extended into Hudson Yards. Major public uses such as the Multi-Use Facility and Convention Center Expansion are proposed for Hudson Yards.

The Hudson Yards Project Area is within a neighborhood generally located between Manhattan's Chelsea and Clinton neighborhoods. The Project Area encompasses the area bounded by West 43rd Street on the north, Seventh and Eighth Avenues on the eastern boundary (eastern boundary varies), West 30th and West 24th Streets on the southern boundary (southern boundary varies), and Eleventh Avenue and Twelfth Avenue on the western boundary (western boundary varies).

The Rezoning Area is bounded to the north by West 43rd Street, Seventh and Eighth Avenues on the eastern boundary (eastern boundary varies), West 30th and West 28th Streets on the southern (southern boundary varies), and Eleventh Avenue on the western boundary. This area has not been fully developed due to a number of factors, including the limited range of densities and uses permitted under current zoning, lack of subway service in the area, and the large amount of open, transportation-related infrastructure in the area. The keys to redevelopment of Hudson Yards are to change the existing manufacturing zoning to allow for a broader range and density of uses and to provide additional transit with sufficient capacity and connections to other transportation facilities to efficiently and effectively serve the area.

The Proposed Actions have the potential to impact both infrastructure in Manhattan in the North River Water Pollution Control Plant (WPCP) sewer service area and water quality in the Hudson River adjacent to Manhattan. HydroQual has completed a detailed analysis of the additional pollutant loadings and potential impacts on the water quality of the Hudson River resulting from the Hudson Yards Proposed Action, as described in the sections of this report. The analyses described in the following sections were dependent on the estimation of the additional Combined Sewer Overflows (CSO) that could occur as a result of the Proposed Action. Representatives of the Department of Environmental Protection (DEP) and other consultants provided information relevant to that assessment. An overview of the individual work elements within the tasks that were conducted to develop the information are provided herein. Specifics of the work elements involved in the estimation of the CSO overflows are described in the following sections.

The impact assumptions made herein generally rely on making conservative assumptions so that worst-case conditions can be assessed. Therefore, in conducting these analyses, the choice was made to overestimate any impacts to ensure that potential impacts on water quality are captured, and that actual effects would be less than those presented in this report. Stated another way, making conservative assumptions provides for a margin of safety when the project is assessed.

SECTION 2

SEWER SYSTEM

This section of the report describes the sewer system in the area of the Proposed Action. The section also describes the sewer system in the North River Water Pollution Control Plant (WPCP) service area to which the sewage from the Project Area flows. Also described in this section is a hydraulic model that has been constructed of the major elements in the sewer system to enable estimates to be made of the amount and frequency of overflows induced by rainfall events.

2.1 NORTH RIVER WPCP

Sewage at the area of the Proposed Action is treated at the North River WPCP, which is located on a platform over the Hudson River in Manhattan, at 135th Street and 12th Avenue. The North River WPCP treats dry weather and wet weather flows from the combined sewer service area. The plant has a design capacity of 170 million gallons per day (MGD) for treating dry weather sanitary sewage. The WPCP has a total capacity of 340 MGD (twice design capacity) allowing for the treatment of peak dry weather flows and some wet weather flow. The WPCP provides secondary treatment to the wastewater entering the facility.

The New York State Department of Environmental Conservation State Pollution Discharge Elimination System (SPDES) permit for the North River WPCP is permit number NY-0026247. This permit defines the treatment, monitoring and regulatory requirements for the WPCP. The WPCP has been permitted to operate under the authorization of the NYSDEC since its' construction in 1986. Treated sewage is discharge into the Hudson River in accordance with the SPDES permit through a submerged outfall located adjacent to the WPCP. This outfall is designed to provide for dilution of the treated effluent after it is discharged into the Hudson River.

In fiscal year 2003, the North River WPCP discharged treated wastewater to the Hudson River. The treated effluent averaged a daily flow of 132 MGD including both wet and dry weather periods. Table 2-1 includes a summary of the fiscal year 2003 effluent discharge. The SPDES permit requires that the WPCP comply with effluent CBOD-5 (25 mg/l max – 30 day average, 85 % removal 30-day average, 35,000 lbs/day – 30 day average), total suspended solids (TSS) (30 mg/l max 30-day average, 85% removal – 30-day average, 43,000 lbs/day), pH,

Table 2-1. North River WPCP Effluent Limits

Parameter	Enforceable Effluent Limitations				
	Type	Limitation	Units	Limitation	Units
Flow, Total	12 month rolling average	170	MGD		
Flow, Total	Monthly average	Monitor	MGD		
$CBOD_5$	Monthly average	25	mg/l	35000	lbs/day
$CBOD_5$	7 day arithmetic mean	40	mg/l	57000	lbs/day
BOD_5	6 consecutive hour avg.	50	mg/l		
Dissolved Oxygen	Daily Minimum	Monitor	mg/l		
Solids, Suspended	Monthly average	30	mg/l	43000	lbs/day
Solids, Suspended	7 day arithmetic mean	45	mg/l	64000	lbs/day
Solids, Suspended	Daily Maximum	50	mg/l		
Solids, Suspended	6 consecutive hour avg.	50	mg/l		
pH	Range	6.0 - 9.0	SU		
Nitrogen, Total (as N)	Monthly average	Monitor	mg/l	Monitor	lbs/day
Nitrogen, Ammonia (as NH_3)	Monthly average	Monitor	mg/l	Monitor	lbs/day
Nitrogen, TKN (as N)	Monthly average	Monitor	mg/l	Monitor	lbs/day
Nitrite (as N)	Monthly average	Monitor	mg/l	Monitor	lbs/day
Nitrate (as N)	Monthly average	Monitor	mg/l	Monitor	lbs/day
Phosphorus, Total (as P)	Monthly average	Monitor	mg/l		
Soluble Orthophosphate (as P)	Monthly average	Monitor	mg/l		
Temperature	Daily Maximum	Monitor	°C		
Chlorides	Monthly average	Monitor	mg/l		
Cyanide, Total	Daily Maximum			85	lb/day
Mercury, Total	Daily Maximum			1.1	lb/day
Arsenic, Total	Daily Maximum	Monitor	ug/l		
Priority Pollutant Scan		Monitor	ug/l		
Effluent Disinfection required: [X] All Year [ ] Seasonal from ___________ to					
Coliform, Fecal	30 day geometric mean	200	No./100		
Coliform, Fecal	7 day geometric mean	400	No./100		
Coliform, Fecal	6 hour geometric mean	800	No./100		
Coliform, Fecal	Instantaneous Maximum	2400	No./100		
Chlorine, Total Residual	Daily Maximum	2.0	mg/l		

chlorine residual and fecal coliform (200 /100 ml – 30-day max.) limits. Additional effluent limitations are summarized in Table 2-1.

This table indicates that the maximum 2003 monthly North River WPCP effluent flow was 149 MGD, well below the allowable effluent flow of a monthly average of 170 MGD. biochemical oxygen demand (BOD), TSS and fecal coliform bacteria were all monitored to be well within compliance with the permit limits for 2003. Each of these parameters is shown in Table 2-2 to be much lower than the required by the SPDES permit even in the worst month of the year.

Also shown in this table are the effluent conditions assumed for the worst-case impact analysis that follows. For this analysis, effluent concentrations were assumed to be each to the maximum observed concentration for the 2003 period. Effluent flows for future periods are developed as described in Section 2.5. Effluent concentrations for the future conditions reflect 2003 performance levels.

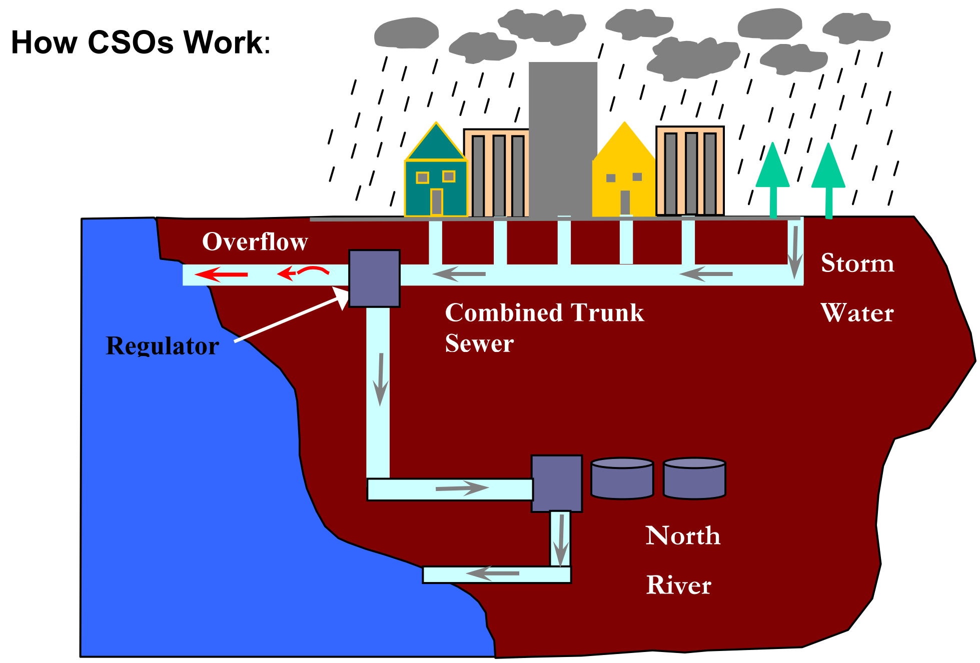
2.2 CONFIGURATION OF SEWER SYSTEM

The sewer system in the Hudson Yards area is part of a combined sewer system connected to the North River WPCP. A combined sewer system conveys sanitary sewage to the WPCP in dry weather and a combination of storm water and sanitary sewage in wet weather. When this combined wet weather flow exceeds the ability of the WPCP to treat it, some fraction will overflow into the Hudson River. The overflow will be a combination of storm water and sanitary sewage. Generally, storm water will contain lower concentrations of pollutants than sanitary sewage. Therefore, the concentration of pollutants in combined sewage will be lower that than of sanitary sewage.

Table 2-2. Summary of North River WPCP Existing and Projected Future Effluent Discharges for 2010 and 2025 With and Without Proposed Action

Parameter	Units	Existing Conditions Fiscal Year 2003		2010 No Build		2025 No Build		2010 Build		2025 Build		Current SPDES Effluent
		Average Effluent[2]	Maximum Month[2,3]	Average Effluent	Maximum Month	Average Effluent	Maximum Month	Average Effluent	Maximum Month	Average Effluent	Maximum Month	Permit Limit[4]
Average Daily Flow	mgd	132	149	135.5	152.5	142.9	159.9	137	154	150	167	170
$CBOD_5$	mg/L	16.7	25	16.7	22	16.7	22	16.7	22	16.7	22	25
$CBOD_5$	lbs/day	18,358	30,067	18,844	27,646	19,874	29,190	19,053	27,959	20,861	30,671	35,445
$CBOD_5$ Removal	%	88.4	93	--	--	--	--	--	--	--	--	85
Suspended Solids	mg/L	15.7	22	15.7	22	15.7	22	15.7	22	15.7	22	30
Suspended Solids	lbs/day	17,256	27,339	17,714	24,328	18,681	25,687	17,910	24,604	19,609	26,991	43,000
Suspended Solids Removal	%	89.5	94	--	--	--	--	--	--	--	--	85
Fecal Coliform	MPN/100ml	47	70	47	70	47	70	47	70	47	70	200
Organic Nitrogen-N	lbs/day	4,250	7,704	4,363	6,804	4,601	7,187	4,411	6,882	4,829	7,555	-
Ammonia-N	lbs/day	16,825	22,616	17,271	20,886	18,214	22,010	17,462	21,114	19,119	26,088	-
TKN-N	lbs/day	21,075	27,836	21,633	25,246	22,815	26,605	21,873	25,522	23,948	27,909	-
Nitrate-N	lbs/day	133	248	137	219	144	232	138	222	151	244	-
Nitrite-N	lbs/day	83	124	85	115	89	121	86	116	94	127	-
Total Phosphorus-P	lbs/day	3,509	5,480	3,602	4,379	3,799	4,624	3,642	4,429	3,988	4,858	-
PO_4-P	lbs/day	2,465	3,368	2,530	3,246	2,668	3,413	2,558	3,280	2,801	3,205	-
Copper	lbs/day	20.7	38.7	21.3	34.4	22.5	36.3	21.5	34.8	23.6	38.2	-
Zinc	lbs/day	54.1	111	55.5	96	58.5	102	56.1	97.1	61.4	107	-
Lead	lbs/day	2.1	3.2	2.1	2.8	2.2	3	2.1	2.8	2.3	3.2	-

(1) 30-day average.
(2) Data from "Operating Data, Fiscal Year 2003," NYCDEP - Bureau of Wastewater Treatment, Process Engineering Section.
(3) Worst month WPCP effluent values may not have occurred in the same month for multiple parameters.
(4) Limits set forth in Draft North River WPCP SPDES Permit No. NY-0026247; February, 2004.



2.2.1 North WPCP Service Area

The North River WPCP sewer system serves to convey dry weather sewage and storm runoff from an area of Manhattan extending from about 14th Street north to the tip of Manhattan and from the west side of Central Park (Broadway) to the Hudson River. The North River drainage area is served by a combined sewer system with 178 miles of sewers. The oldest sewers in the study area were built before 1850 and they constitute about 4 percent of the system. The remainder of the system is broken down as follows: 19 percent were built between 1850 and 1875; 33 percent were built between 1876 and 1900; 25 percent were built between 1901 and 1925; 18 percent were built between 1926 and 1950 and the remaining 1 percent was built after 1951. The smaller size sewers are generally circular and the largest are generally boxes. There are other shapes including flat top egg sewers, U bottom sewers and basket handle sewers. Larger sewers are generally constructed of concrete while smaller ones are brick or vitrified clay.

Two main interceptors; the north and south interceptors serve the North River WPCP. A schematic of the sewer system is shown in Figure 2-1 and the locations of the regulators are shown in Figure 2-2. The north interceptor begins along the northwestern portion of Manhattan at West 201 Street. It extends northerly to near the tip of Manhattan. It then extends westerly to the western shoreline of Manhattan and then continues southerly parallel to the Hudson River until it terminates at the WPCP. The interceptor ranges in size from 42 inches to 9 feet. The

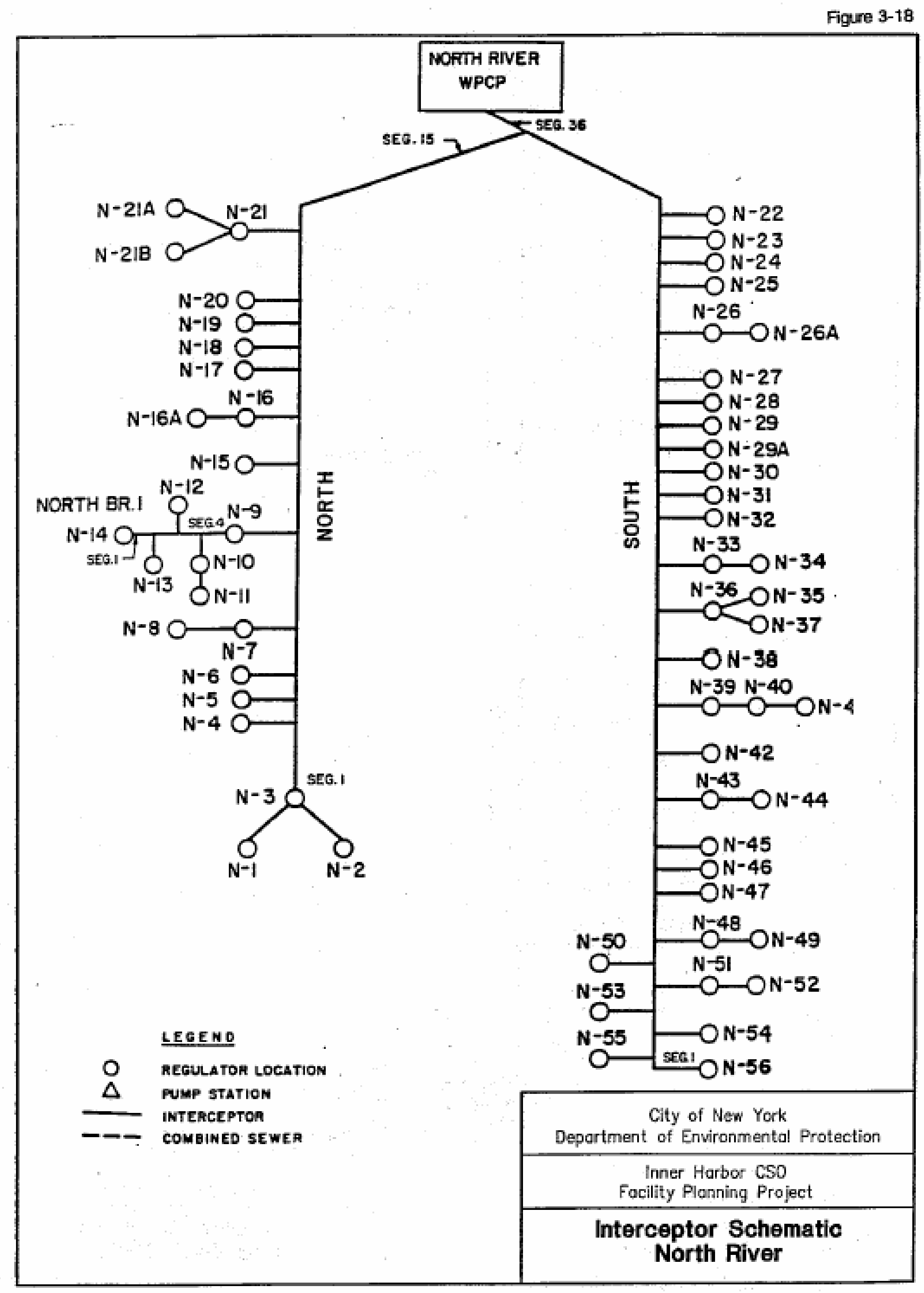


Figure 2-1. Schematic of North River Interceptors and Regulators (From Inner Harbor CSO Facility Planning Project)

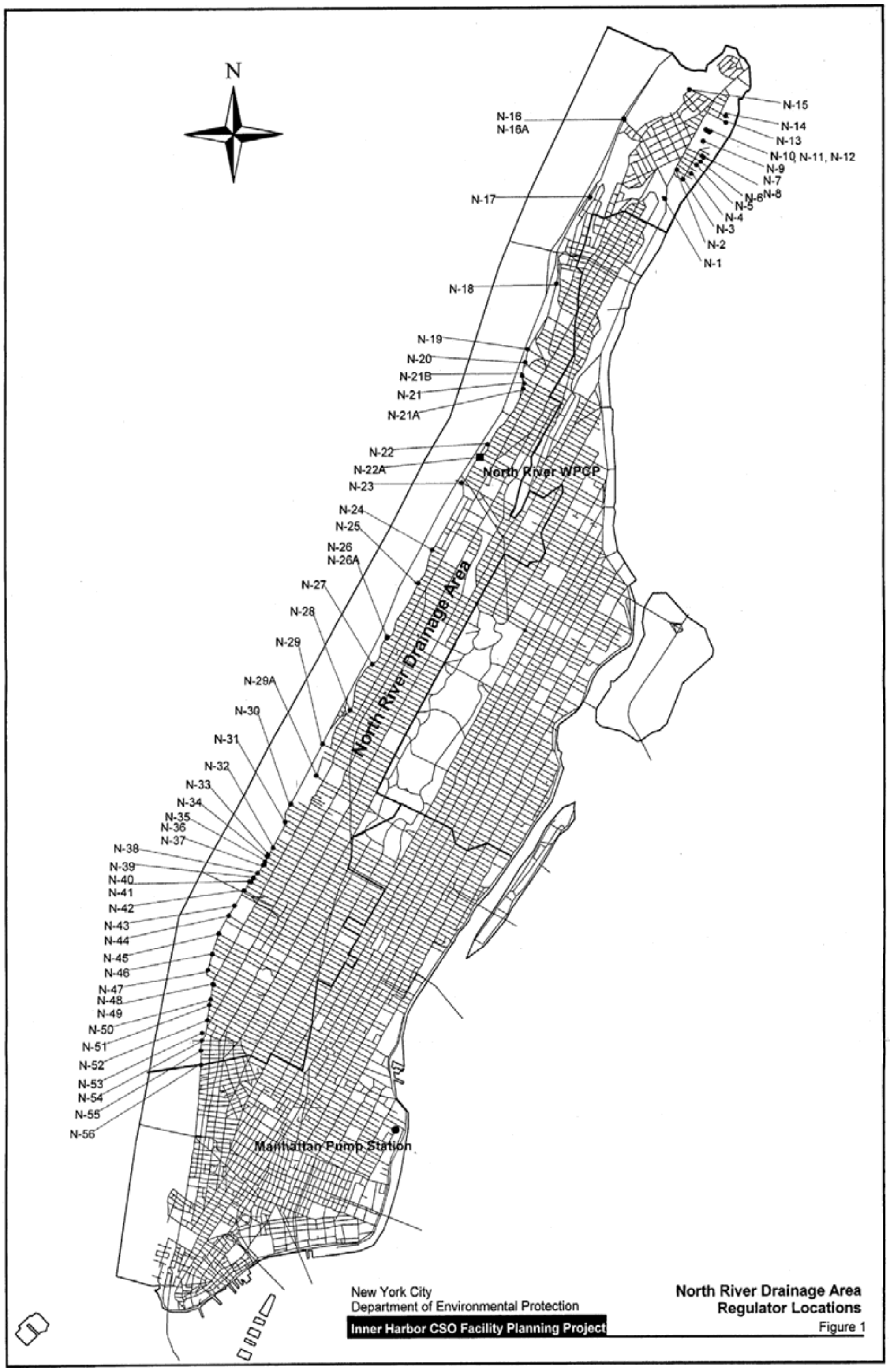


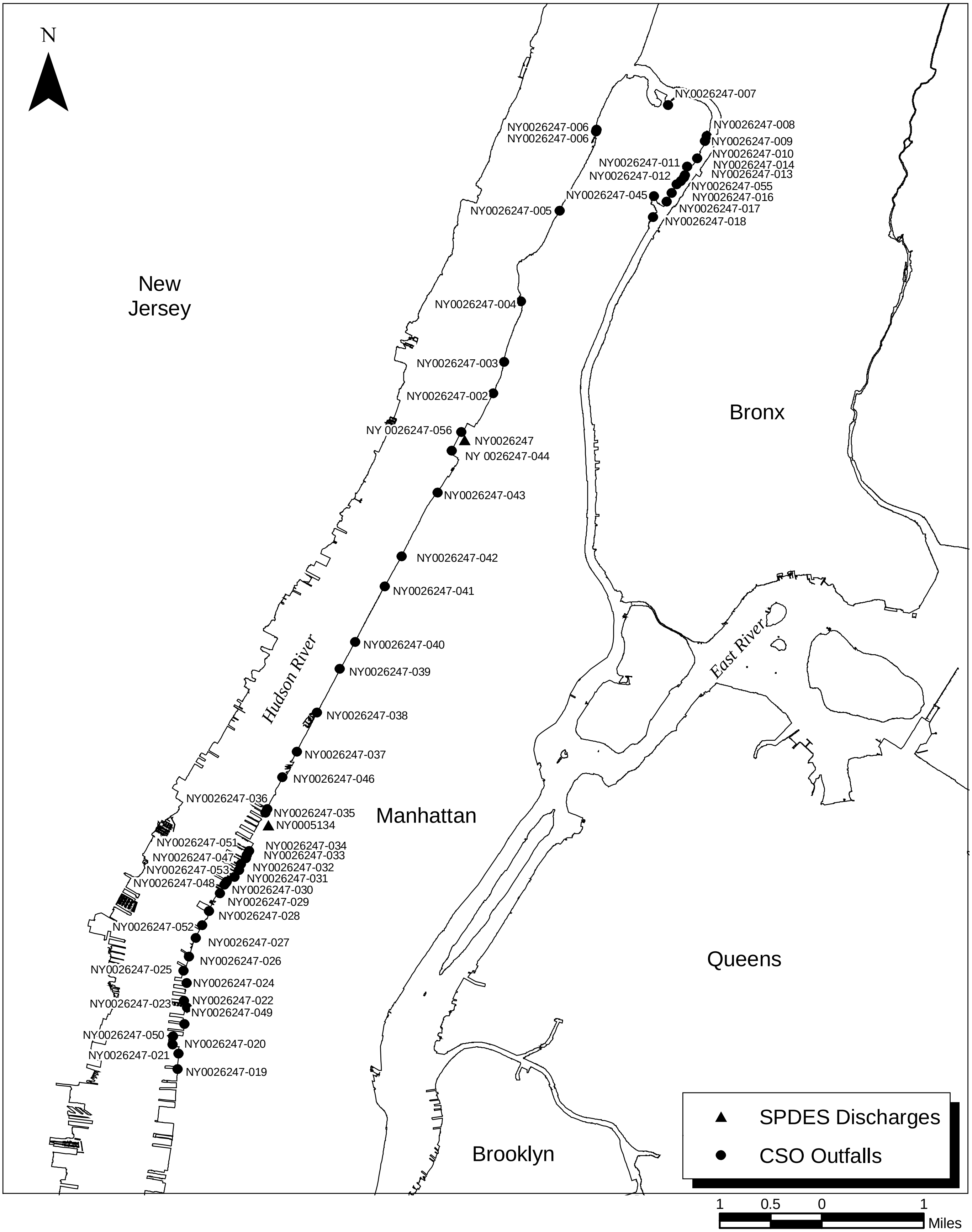
Figure 2-2. Location of North River Regulators (From Inner Harbor CSO Facility Planning Project)

southern interceptor begins at Bank Street, near West 11th Street. It runs northerly parallel to the Hudson River until it terminates at the WPCP. The interceptor ranges in size from 18 inches to 16 feet.

The drainage area tributary to North River WPCP is about 5,000 acres. Sanitary flow and a portion of the runoff from about 4,500 acres of combined drainage area discharge into the North and South Interceptors. Sanitary flow from the remaining 500-acres of drainage area also reaches the interceptor sewers, but the runoff from this area drains directly into the Hudson and Harlem Rivers.

Wet weather flow is directed into the WPCP through regulators that redirect wet and dry weather flows. In total, there are 62 regulating structures in the North River WPCP service area. These regulators redirect wet weather flows to 52 outfalls (Figure 2-3) most of which discharge excess wet weather flow. Also shown in Figure 2-3 are the locations of two SPDES permit discharges (North River WPCP and industrial discharge) to the Hudson River, which are not CSOs. The locations of the regulators are listed in Table 2-3, which is abstracted from the current SPDES permits. These regulators direct all dry weather sewage into the north and south braches of the North River interceptor, which transport these sewage flows to the WPCP. These regulators in wet weather direct combined sewage into the interceptor for transport to and treatment at the WPCP. Regulators in the North River service area were designed to allow more than twice the design flow of 170 MGD into the branch interceptors.

Analyses conducted herein and summarized in section 2.4 indicate that in total the North River regulators have the capacity to allow about 740 MGD into the interceptor, which is a factor of 4.35 times the design flow of 170 MGD. This is the amount of flow that could be diverted by the regulators providing that there was an unlimited capacity at the treatment facility to treat that flow. This is not the case, as the WPCP has a maximum capacity of 340 MGD. Although the regulators are designed to direct more than 4 times the design dry weather flow of the WPCP into the interceptor, the WPCP is only capable of treating a maximum flow of 340 MGD, twice the design flow of 170 MGD. For this and other reasons, the regulators may not direct the maximum flows into the interceptor for treatment at the North River WPCP. However, excess flow that is directed into the interceptor is stored in the interceptor which has a capacity to store over 20 million gallons (MG) of combined sewage and then allow it to flow into the North River WPCP for treatment at the end of each storm.



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Location of North River

CSOs and Permitted Discharges

Figure 2-3

CSOs and NPDES

October 2004

Table 2-3. Combined Sewer Outfalls Locations (From SPDES Permit)

Outfall	Latitude	Longitude	Location	Size	Waterbody	Comments	Class
002	40,50,01	73,57,00	W. 152nd St. (Reg #N-20,-21,-21A,-21B)	60" DIA	Hudson River		I
003	40,50,07	73,56,56	W. 158th St. (Reg #N-19)	48" DIA	Hudson River		I
004	40,50,14	73,56,49	W. 171st St. (Reg #N-18)	10'6" x 6'	Hudson River	Telemetered	I
005	40,51,15	73,56,25	W. 190th St. (Reg #N-17)	16" DIA	Hudson River		I
006	40,52,10	73,55,46	Dyckman St. (Reg #N-16)	DBL 7' x 5'	Hudson River		I
007	40,52,31	73,54,50	W. 218th St. (Reg #N-15)	4' x 2'4"	Harlem River		I
008	40,52,12	73,54,26	W. 216th St. (Reg #N-14)	4' x 5'	Harlem River		I
009	40,52,09	73,54,26	W. 215th St. (Reg #N-13)	2'4" x 3'6"	Harlem River		I
010	40,52,02	73,54,32	W. 211th St. (Reg #N-10,-11,-12)	4'1" x 4'6"	Harlem River		I
011	40,52,01	73,54,33	W. 209th St. (Reg #N-9)	48" DIA	Harlem River		I
012	40,51,55	73,54,49	W. 207th St. (south side) (Reg #N-7)	2'4" x 3'6"	Harlem River		I
013	40,51,49	73,54,44	W. 206th St. (Reg #N-6)	2'4" x 3'6"	Harlem River		I
014	40,51,47	73,54,46	W. 205th St. (Reg #N-5)	48" DIA	Harlem River		I
016	40,51,43	73,54,49	W. 203rd St. (Reg #N-4)	2'4" x 3'6"	Harlem River		I
017	40,51,39	73,54,53	W. 201st St. (Reg #N-3)	4' x 6'	Harlem River	Telemetered	I
018	40,51,31	73,55,00	Highbridge Park (Reg #N-1)	48" DIA	Harlem River		I
019	40,44,09	74,00,35	Bank St. (Reg #N-56)	48" DIA	HudsonRiver		I
020	40,44,16	74,00,34	Jane St. (Reg #N-55)	48" DIA	Hudson River		I
021	40,44,25	74,00,40	Gansevoort St. (Reg #N-54)	48" DIA	Hudson River		I
022	40,44,41	74,00,30	s/o W. 17th St. (Reg #N-51)	54" DIA (to bulkhead)	Hudson River		I
023	40,44,42	74,00,36	W. 18th St (Reg #N-50)	5'x4'6"	Hudson River	Telemetered	I
024	40,44,57	74,00,31	W. 21st St. (Reg #N-48,-49)	48" DIA	Hudson River		I
025	40,45,03	74,00,34	W. 23rd St. (Reg #N-47)	6'6" x 5'6"	Hudson River		I
026	40,45,11	74,00,32	n/o W. 26th St. (Reg #N-46)	6'3" x 5'7"	Hudson River		I
027	40,45,20	74,00,26	W. 30th St. (Reg #N-45)	48" DIA	Hudson River	Telemetered	I
028	40,45,36	74,00,15	W. 36th St. (Reg #N-43)	48" DIA	Hudson River		I

Table 2-3. Combined Sewer Outfalls Locations (From SPDES Permit) (Continued)

Outfall	Latitude	Longitude	Location	Size	Waterbody	Comments	Class
029	40,45,48	74,00,07	W. 40th St. (Reg #N-42)	30" DIA	Hudson River		I
030	40,45,54	73,59,59	W. 43rd St. (Reg #N-39)	54" DIA	Hudson River		I
031	40,45,58	73,59,53	W. 44th St. (Reg #N-38)	54" DIA	Hudson River		I
032	40,46,02	73,59,49	W. 46th St. (Reg #N-37)	48" DIA	Hudson River		I
033	40,46,07	73,59,47	W. 48th St. (Reg #N-34, -33)	2'8" x 4'	Hudson River	Telemetered	I
034	40,46,10	73,59,43	W. 50th St. (Reg #N-32)	48" DIA	Hudson River		I
035	40,46,26	73,59,35	W. 56th St. (Reg #N-31)	54" DIA	Hudson River		I
036	40,46,34	73,59,33	W. 59th St. (Reg #N-30)	48" DIA	Hudson River		I
037	40,46,59	73,59,18	W. 72nd St. (Reg #N-29)	DBL 3' x 4'	Hudson River		I
038	40,47,13	73,59,02	W. 80th St. (Reg #N-28)	10'6" x 6'	Hudson River	Telemetered	I
039	40,47,41	73,58,43	W. 91st St. (Reg #N-27)	5'5" x 4'	Hudson River		I
040	40,47,53	73,58,33	W. 96th St. (Reg #N-26, -26A)	10' x 6'	Hudson River	Telemetered	I
041	40,48,04	73,58,24	W 108th St. (Reg #N-25)	4' x 4'	Hudson River		I
042	40,48,22	73,58,13	W. 115th St. (Reg #N-24)	4'6" x 4'	Hudson River		I
043	40,49,09	73,57,38	St. Clairs Place (Reg #N-23)	DBL 8'8" x 7'6"	Hudson River	Telemetered	I
044	40,49,26	73,57,47	W. 138th St (Reg. #N-22)	42" DIA	Hudson River		I
045	40,51,35	73,54,56	Academy St. (Reg #N-2)	DBL 7' x 6'	Harlem River		I
046	40,46,49	73,59,25	W. 66th St. (Reg #N-29A)	5'6" x 5'	Hudson River	Telemetered	I
047	40,45,45	73,59,55	W. 47th St (Reg. #N-35)	2'8" x 4'	Hudson River (E)		I
048	40,45,52	74,00,02	W. 42nd St. (Reg #N-40)	DBL 8' x 2'	Hudson River		I
049	40,44,36	74,00,35	W. 14th St. (Reg #N-52)	6' x 4'6"	Hudson River		I
050	40,44,30	74,00,36	Bloomfield St. (Reg #N-53)	2'4" x 3'6"	Hudson River		I
051	40,46,08	73,59,47	W. 49th St.	DBL 12' x 6'	Hudson River		I
052	40,45,32	74,00,16	W. 34th St. (Reg #N-44)	4'9" x 4'6"	Hudson River (E)		I
055	40,51,47	73,54,57	W. 207th St. (Reg #8)	36"	Harlem River		I
056	40,49,34	73,57,31	W. 142nd St. (Reg. #22A)	60"	Harlem River		I

As the maximum flow treated by the WPCP is about 340 MGD, the peak wet weather flow treated at the facility is on the order of 218 MGD. This was computed as the difference between the maximum WPCP flow of 340 MGD and the dry weather sewage flow of 122 MGD. During the peak period of the day when the dry weather sewage could be about 30% higher that 122 MGD, the peak wet weather flow treated would be reduced to about 180 MGD. As the drainage area for the combined sewer is about 4500 acres and it has a impervious factor of 0.75 or greater, the peak amount of rainfall that receives treatment is about 0.1 inches per hour. This is calculated as:

$$I_{treated} = 218 \text{ MGD}/(4500 \text{ acres} \times 0.75 \times 0.645) = 0.1 \text{ inches per hour}$$

SPDES permit requirements have been redefined in the recently issued 2003 permits to include a number of new provisions that pertain directly to CSOs. Some of these provisions that are relevant to the impacts of the proposed Project include:

- A provision for 14 technology based CSO controls.
- A first time provision requiring the City to develop a Long Term CSO Control Plan

Although, the United States Environmental Protection Agency (EPA) CSO Policy set out in 1994 a provision for developing a long term control plan (LTCP) for CSO, it was only made a requirement of the City in the recent 2003 draft SPDES permits.

The daily average dry weather sanitary sewage flow treated at the North River plant in 2003 was 122 MGD. The total daily average flow including both dry weather and wet weather flows was about 132 MGD in 2003. This difference of about 10 MGD is associated with days when wet weather flow was being taken into the WPCP and the daily average flow was elevated well beyond the dry day flow of 122 MGD. The flow received and being treated at the North River WPCP is below the SPDES allowable 12-month rolling average maximum flow of 170 MGD.

A rough estimate of the annual amount of wet weather flow treated at the WPCP can be obtained from the existing treatment plant records by multiplying the 10 MGD flow differential flow between the dry sewage flow of 122 MGD and the average flow of 132 MGD by 365 days. This estimate would indicate that the WPCP treats about 3.7 BG a year of wet weather flow. Further, estimates made in the Annual Report on Best Management Practices (BMP) for CSOs delivered to New York State Department of Environmental Conservation (NYSDEC) as a

SPDES permit requirement in April of 2004, indicated that the WPCP captures and treats between 90 and 95 percent of the combined sewage present in the sewer system in a given year. This level of CSO control is beyond the EPA CSO Policy *presumptive approach* recommendation to provide a minimum of primary treatment to at least 85 percent of the annual combined sewage generated within a combined sewer service area. The EPA CSO Policy assumes that if that level of combined sewage receives treatment CSO impacts on water quality will be minimized.

2.2.2 Hudson Yards Area

Combined sewers serve the Hudson Yards Project Area similar to the rest of the North River WPCP drainage area. Combined sewers and regulators located within or just adjacent to the Project Area (Figure 2-4) are listed in Table 2-4.

Table 2-4. Regulator/Outfalls In or Adjacent to Project Area

SPDES Outfall Number	SPDES Outfall Location and Connected Regulator Structures
026	n/o W. 26th St. (Reg #N-46)
027	W. 30th St. (Reg #N-45)
028	W. 36th St. (Reg #N-43)
029	W. 40th St. (Reg #N-42)
030	W. 43rd St. (Reg #N-39)
032	W. 42nd St. (Reg #N-37)
033	W. 48th St. (Reg #N-34, -33)
047	W. 47th St. (Reg #N-35)
048	W. 42nd St. (Reg #N-40)
052	W. 34th St. (Reg #N-44)

These combined sewer outfalls and regulators convey sewage into the south branch of the North River interceptor and combined sewer overflows to the Hudson River in accordance with the SPDES permit requirements discussed above.

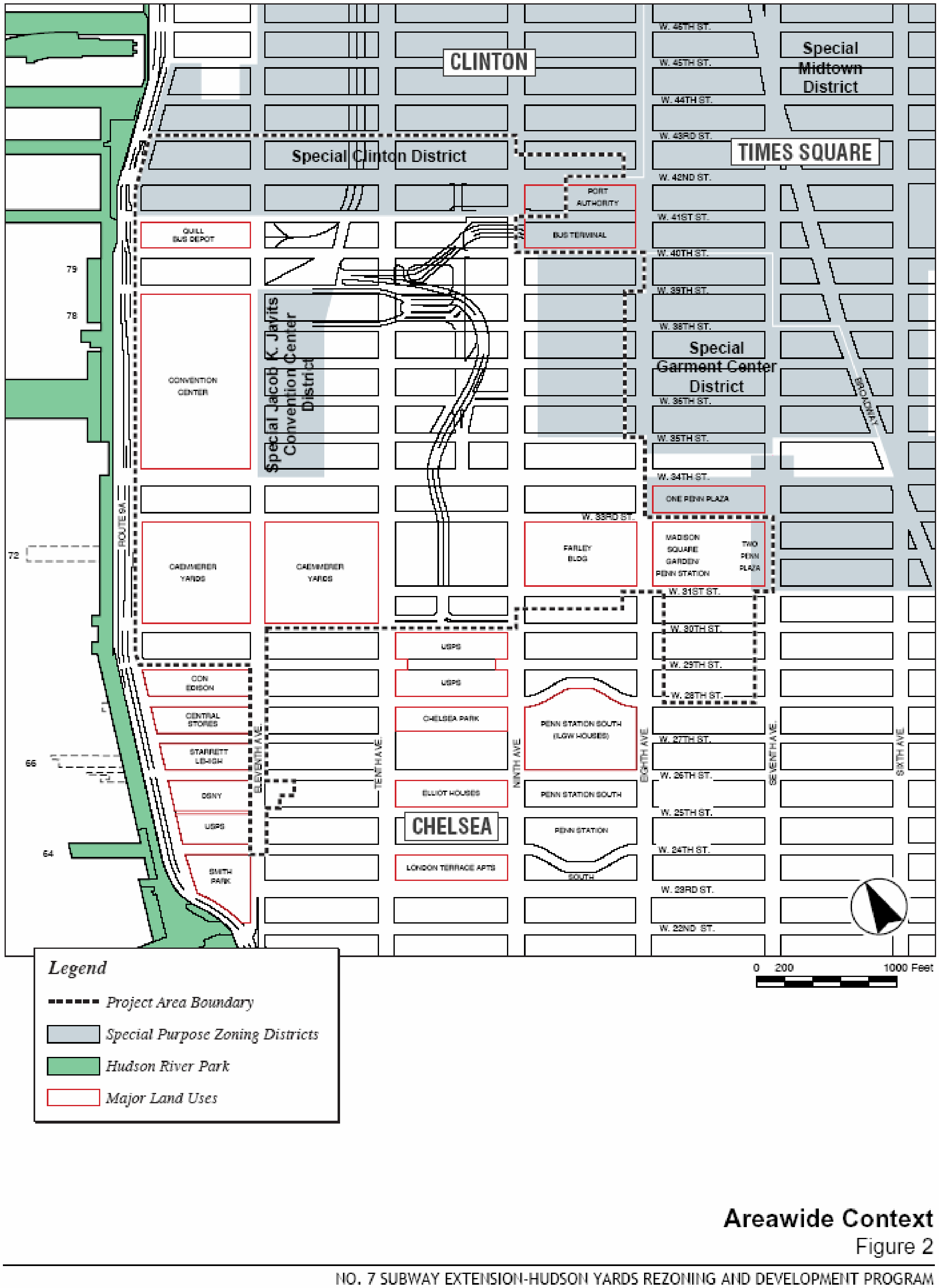


Figure 2-4. Boundaries of Proposed Project Area

2.2.3 Regulatory Requirements

As previously described, the outfalls in the Hudson Yards area as well as those in the entire North River WPCP drainage area are combined sewer overflow outfalls. The New York State Department of Environmental Conservation State Pollution Discharge Elimination System (SPDES) permits these outfalls to discharge combined sewage during wet weather periods for the North River WPCP (NY-0026247). This permit lists the regulatory requirements that control the discharge of wet weather flows.

Outfalls in the North River WPCP area are required to comply with a number of NYS DEC technology-based requirements. There are a total of 14 BMP requirements required in the permit. These include the following:

(1) CSO Maintenance and Inspection Program
(2) Maximum Use of Collection System for Storage
(3) Maximize Flow to WPCP
(4) Wet Weather Operating Plan
(5) Prohibition of Dry Weather Overflow
(6) Industrial Pretreatment
(7) Control of Floatable and Settleable Solids
    a. Catch Basin Repair and Maintenance
    b. Catch Basin Retrofitting
    c. Booming, Skimming and Netting
    d. Institutional, Regulatory, and Public Education
(8) Combined Sewer System Replacement
(9) Combined Sewer/Extension
(10) Sewer Connection & Extension Prohibitions
(11) Septage and Hauled Waste
(12) Control of Run-off
(13) Public Notification
(14) Annual Report

The City's compliance with these 14 CSO technology based requirements is documented in a report that was first submitted to the DEC in April of 2004. BMP #14 requires DEP to report on their BMPs annually thereafter.

In addition to the SPDES permit, the outfalls within this area must comply with the requirements of an Order on Consent signed in 1992 and modified in 1996 (DEC case # R2-3351-90-12). The City and the State DEC have recently negotiated a modification and update to the Order on Consent (DEC case # CO2-200001-7-8). This order has recently been developed and public noticed but remains a draft until adoption by the State. The new Order requires the City to conduct certain planning studies in the North River WPCP area (Inner Harbor area) and to provide construction of a number of CSO improvement projects in the area. These improvement projects require that a number of regulators be reconstructed to provide control of combined sewage flows. The Order on Consent requirements, as detailed in the appendix to the Order, specific to the North River drainage area are summarized below.

III. Inner Harbor CSO	
A. Facility Plan Development	
1. Submit Modified Facility Plan Report	Completed
2. Submit Additional Modified Facility Plan Report	February 2004
B. Comprehensive Watershed Planning	
1. Submit Approvable Gowanus Canal Waterbody / Watershed Facility Plan Report	June 2007
C. Regulator Improvements - Fixed Orifices	
1. Initiate Final Design	March 2000
2. Final Design Completion Including CPM Analysis	September 2002
3. Notice to Proceed to Construction	February 2003
4. Construction Completion	April 2006
D. Regulator Improvements - Automation	
1. Initiate Final Design	February 2005
2. Final Design Completion Including CPM Analysis	November 2006
3. Notice to Proceed to Construction	November 2007
4. Construction Completion	June 2010
E. In-Line Storage[1]	
1. Initiate Final Design	July 2005
2. Final Design Completion Including CPM Analysis	November 2006
3. Notice to Proceed to Construction	August 2007
4. Construction Completion	August 2010
F. Submit Approvable Drainage Basin Specific LTCP for Gowanus Canal	January 2008

1. Construction of proposed in-line storage facility is contingent upon the success of the ongoing Hunts Point in-line Storage Prototype Facility as well as site specific sewer system hydraulic calculations to be reviewed and approved by NYCDEP's Bureau of Water and Sewer Operations.

Aspects of CSO control required in the Consent Order for the Project Area and the North River drainage area as indicated in C and D in the table above is for reconstruction of regulators to have fixed orifices or to have some level of automation. There are other requirements in the Order as abstracted above for the Inner Harbor area (Gowanus Canal) that are not relevant to the Hudson Yards impact analyses. These requirements are outlined in the Modified Facility Plan for the Inner Harbor drainage area. Milestones listed above in the graphic have been complied with and DEP is on schedule with implementation of these CSO controls.

The table below summarizes changes being made to the regulators in the North River drainage area.

Table 2
North River WPCP Regulators

Regulator	1993 Condition	Original Plan	Modified Plan	Regulator	1993 Condition	Original Plan	Modified Plan	Regulator	1993 Condition	Original Plan	Modified Plan
N-1	MAN	No Action	Fixed Orifice	N-21	HYD	Fixed Orifice	Fixed Orifice	N-37	TG	No Action	No Action
N-2	TG	No Action	No Action	N-21A	DC	No Action	No Action	N-38	HYD	Fixed Orifice	Fixed Orifice
N-3	HYD	Automation	Automation	N-21B	DC	No Action	No Action	N-39	HYD	Vortex	Fixed Orifice
N-4	MAN	No Action	Fixed Orifice	N-22	HYD	Fixed Orifice	Fixed Orifice	N-40	DC/TG	No Action	No Action
N-5	MAN	No Action	Fixed Orifice	N-22A	HYD	-	Fixed Orifice	N-41	TG	No Action	No Action
N-6	MAN	No Action	Fixed Orifice	N-23	HYD	Automation	Automation	N-42	HYD	Fixed Orifice	Fixed Orifice
N-7	MAN	No Action	Fixed Orifice	N-24	HYD	Vortex	Fixed Orifice	N-43	HYD	Vortex	Fixed Orifice
N-8	DC/TG	No Action	No Action	N-25	HYD	Vortex	Fixed Orifice	N-44	TG	No Action	No Action
N-9	HYD	Vortex	Fixed Orifice	N-26	HYD	Automation	Automation	N-45	HYD	Automation	Automation
N-10	DC	No Action	No Action	N-26A	DC/TG	No Action	No Action	N-46	HYD	Vortex	Fixed Orifice
N-11	TG	No Action	No Action	N-27	HYD	Fixed Orifice	Fixed Orifice	N-47	HYD	Vortex	Fixed Orifice
N-12	DC/TG	No Action	No Action	N-28	HYD	Automation	Automation	N-48	HYD	Vortex	Fixed Orifice
N-13	DC/TG	No Action	No Action	N-29	HYD	Vortex	Fixed Orifice	N-49	DC/TG	No Action	No Action
N-14	DC/TG	No Action	No Action	N-29A	HYD	Automation	Automation	N-50	HYD	Automation	Automation
N-15	HYD	Fixed Orifice	Fixed Orifice	N-30	HYD	Vortex	Fixed Orifice	N-51	HYD	Vortex	Fixed Orifice
N-16	HYD	Vortex	Fixed Orifice	N-31	HYD	Fixed Orifice	Fixed Orifice	N-52	TG	No Action	No Action
N-16A	TG	No Action	No Action	N-32	HYD	Fixed Orifice	Fixed Orifice	N-53	DC/TG	No Action	No Action
N-17	MAN	No Action	Fixed Orifice	N-33	HYD	Automation	Automation	N-54	HYD	Fixed Orifice	Fixed Orifice
N-18	HYD	Automation	Automation	N-34	TG	No Action	No Action	N-55	HYD	Vortex	Fixed Orifice
N-19	HYD	Vortex	Fixed Orifice	N-35	TG	No Action	No Action	N-56	HYD	Fixed Orifice	Fixed Orifice
N-20	HYD	Fixed Orifice	Fixed Orifice	N-36	HYD	Vortex	Fixed Orifice				

As indicated in the table above, which was abstracted from the Modified Facility Plan Report dated April 2003, CSO controls to be implemented will improve regulator orifices or will provide for automation of the regulators to improve the ability to better control and optimize the wet weather flow diverted to the North River WPCP so that additional wet weather flow can be treated to help reduce CSOs. A total of 42 regulators are being rebuilt as part of the CSO control program for the North River WPCP service area. Automation is being provided at 9 regulators. Two of the regulators listed in Table 2-4 as being in or adjacent to the Proposed Action are scheduled for automation.

Although it is not called for in the Modified Facility Plan for the area, the DEP is in the process of developing a City-Wide Supervisory Control And Data Acquisition system (SCADA) to provide data acquisition and control of the sewer system. This system, although not yet designed for the North River WPCP sewer system will consist of in-system flow and water level sensors and computerized control of the 9 automated regulators. The purpose of this SCADA system is to provide for better control of the sewer system so that the amount of CSO treated at the WPCP can be maximized.

Inline storage called for in the North River drainage area in the Modified Facility Plan will utilize the oversized North River interceptor for storage of CSO and will not require construction of inflatable dams or other structures within the sewer system. The interceptor transporting 340 MGD of flow to the WPCP will only be about half full with combined sewage. Through operation of control gates at the WPCP and regulator controls, flow added to the interceptor at a rate greater than 340 MGD will be stored within in the interceptor. This excess capacity in the interceptor will result in storage of over 20 MG of combined sewage for treatment at the North River WPCP after the rainfall ends. This control practice was described in the Wet Weather Operating Plan (WPCP) that defines how the WPCP operators should control the pumps and gates to ensure the maximum use of the interceptor to store excess combined sewage.

The information shown above from the April 2003 Modified Facility Plan summarizes updates to an Inner Harbor CSO Facility Plan submitted to the NYSDEC in January of 1993. This January 2003 Facility Plan provided extensive water quality sampling and water quality modeling to document the impacts of CSOs on the waters of New York Harbor, specifically the Hudson River adjacent to Manhattan. This report demonstrated that CSOs do not significantly contribute to dissolved oxygen and coliform problems in the open waters of the Hudson River, Lower East River and Upper New York Bay. Based on these conclusions, the Facility Plan recommended regulator improvements and inline interceptor storage for the North River WPCP drainage area as part of a technology based control strategy to maintain the sewer system and to maximize CSO flows to the WPCP.

2.3 DESCRIPTION OF THE MODELING FRAMEWORK

Combined sewage that overflows from the sewer system to protect the WPCP from being inundated in wet weather is not readily documented by direct measurements. The number of outfalls in the system and the complexity of making flow measurements in sewer systems impacted by tides make direct measurement of overflow an expensive and in-exact science. An alternative to measurement of the overflows is calculation of the overflow volumes using engineering equations. As indicated in the preceding sections of this report, the sewer system is complex and does not readily lend itself to application of the engineering calculations relating rainfall to combined sewer overflow. Another alternative is to apply a computer model that contains all of the necessary equations.

The computer model selected to calculate overflows from the North River WPCP sewer system for this impact analysis was a modern sewer system model know as the InfoWorks computer model. InfoWorks is a detailed hydraulic model used to determine runoff flows, water surface elevations and flows within sewers for evaluation of sewer conditions, for estimation of CSO overflows, and for developing loadings to receiving water quality models. InfoWorks has been applied to a variety of complex wet weather analyses including CSO and stormwater assessments. InfoWorks is being applied to the entire NYC combined sewer system as part of the Long Term CSO Plan Development activities currently being undertaken at the DEP. The model uses hourly rainfall data to calculate hourly WPCP flow, and CSO and/or stormwater discharges.

The model has many individual components that have been refined over the past 20 years. Although InfoWorks is not a direct descendent of an earlier hydraulic modeling program sponsored by EPA known as the Storm Water Management Model (SWMM model) it could be considered a more modern version of the 30-year old EPA sponsored program. The following sections describe some of the components of the model.

Surface runoff computations – This section of the program computes the amount of overland runoff for individual drainage areas. Generally, a runoff area would be a small regulator drainage area. For large regulator drainage areas, there would be many sub-catchment areas draining to the regulator. This element of the program accounts for depression storage, infiltration, impervious surfaces, sheet flow across land surfaces, curb and gutter flow to central collection points. This module converts rainfall to surface runoff.

InfoWorks uses a rationale type approach to estimate runoff (i.e., Q = CIA) from drainage areas incorporating such features as time and condition dependant infiltration/percolation into the runoff coefficient ("C"). Hourly runoff ("Q") is calculated by multiplying hourly precipitation ("I") values within the drainage area ("A") by the runoff coefficients ("C") for the tributary drainage areas. For impervious areas, the runoff coefficient dictates that all precipitation runs off surfaces except for a small amount that is collected in surface depressions.

Sewer transport – This section of the model accepts runoff flows at nodes (manholes), adds in dry weather sewage flows and creates combined sewage within individual pipes. Flows are then transmitted along the pipes using the Mannings equation, when not impacted by backwater or other transient affects. Flows in excess of pipe capacity are not transferred through the pipes as they are stored in the node immediately upstream the pipe and released once capacity becomes available in the pipes. When backwaters or other transients occur, the model improves on the Mannings analysis in that actual pipe and regulator hydraulics equations (full St. Venant's equations) are included so that backwater curves, hydraulic grade-lines, sewer surcharging, and regulator hydraulics are calculated on finer spatial and temporal scales. This type of hydraulic model has undergone over 30 years of development since the days of the SWMM model and has had hundreds of applications around the world. These computer models require extensive experience and effort for model set-up and application.

The InfoWorks model is commercially available and supported. It incorporates all of the features of the EPA SWMM model, with addition of many graphical user interfaces (GUIs) that assist the user in setting up model inputs and viewing model outputs. The model contains a utility to compare model output with observed flow data.

This model also contains a utility to view a section through a pipe. It displays the hydraulic grade line in the pipe at a point in the simulation. It also displays the invert and crown of the combined sewer and the street grade.

InfoWorks comes from a suite of models that are commercially available from the Wallingrord Software. This model has essentially the same features as the original EPA SWMM model but is much more advanced and comes with a user friendly GUI that is ArcView GIS based. The model is one of among a variety of high-end computer models developed for use on desktop PC computers by European research/consulting organizations.

InfoWorks has all of the features that exist in the EPA model but is not based directly on the EPA SWMM model. This model is based on many of the same basic energy and momentum equations of flow. However, it does use different solution techniques and has a number of enhancements over the EPA SWMM model including the following:

- Enhanced ArcView based graphical user interface with ability to calculate certain input items from the data base (e.g., percent imperviousness).
- Enhanced ability to evaluate Real Time Control Operations including the ability to interface with radar based precipitation data such as NEXRAD.

2.4 APPLICATION OF MODEL TO EXISTING SYSTEM

The sewer system hydraulic model (InfoWorks) described above was used herein to calculate the amount of combined sewage discharged from the North River and Hudson Yards area combined sewers. The volume of CSO was calculated based on available precipitation data from the National Weather Service Central Park rain gage using InfoWorks, a commercial compute based mathematical that simulates flows in sewers and is available from Wallingford Software, Inc.

A simple rainfall-runoff models (RAINMAN) for the entire North River drainage area was available for use here-in that provided a detailed summary of the regulator drainage areas. Similarly, a detailed InfoWorks hydraulic model of the two interceptor sewers, including the treatment plant that provided details of the interceptors and regulators was also available for use in this impact assessment. These details included the interceptor sewers; drop shafts that convey flows from branch interceptors to the interceptor sewers, and the regulators. However, the detailed model did not contain the regulator drainage areas.

At the onset of the EIS update process, a determination was made that this detailed InfoWorks hydraulic model and the simple RAINMAN model of the drainage surfaces could be combined to provide a comprehensive InfoWorks hydraulic model of the North River sewer system to use in this EIS impact analysis

Following sections describe the model review and update, calibration, and model application to future conditions.

2.4.1 Model Review and Update

The Bureau of Water and Sewer Operations (BWSO) of DEP provided as-built and construction drawings of the north and south interceptor sewers, branch interceptors, and the regulators within the North River drainage area. All of these drawings were reviewed to confirm, and update as appropriate, the regulator configurations, invert elevations of diversion weirs and of branch interceptors, and the interceptor sewers. In addition, the infiltration/inflow drawings and regulator improvement program reports developed by the DEP were reviewed to supplement information on the sewer connections within individual regulator tributary areas and regulator chambers.

One or more sewer segments upstream of each regulator was included in the model, in addition to the regulator and interceptor configurations. The regulator drainage areas encompassing the Project Area were characterized in detail by including several sewer segments, and delineating the corresponding runoff-contributing areas to individual manholes included in the model. The Bureau of Wastewater Treatment (BWT) also provided construction drawings of the North River treatment plant, including the dimensions of wet well and influent gates that control inflows to the wet well. The wet well of the WPCP and the pumps were included in the model to assure that plant pumping was properly calculated.

Figure 2-5 shows a schematic of regulator connections to the interceptor sewers, and the model includes all the 61 regulators and 52 permitted combined sewer outfalls within the North River drainage area. This figure is a detailed representation of the sewer network in the Project Area as it is schematized in the InfoWorks model.

2.4.2 Model Calibration and Verification

Before application, any computer model must be calibrated to verify that it is reliably simulating the real world. Calibration of a hydraulic model requires reliable in-system and/or overflow data under a range of storm conditions. HydroQual compiled data from various sources to support model calibration, which included:

Flow data is compiled by BWT of DEP in the North River WPCP service area as part of inflow/infiltration characterization. Shown in Figure 2-6, there are the 10 locations within the system where flow data was monitored by BWT from 1993 to December 2003. There were six locations in regulator drainage areas (NR6A, NR6B, NR6C, NR9, NR12, and NR13) and four locations in the North and South interceptor sewers (NR4, NR5, NR50, and NR48). Water depth data area also compiled by BWT at seven regulators (NR18, NR26A, NR28, NR3, NR33, NR45, and NR50).

Based on a review of the available information, data from April to November 2003 were chosen for model calibration. A range of precipitation events occurred within this period, and flow data was available at 5-15 minute intervals at most of the 10 locations. Precipitation data, from the National Weather Service rain gauge at Central Park, was reviewed to identify a range of wet weather events suitable for calibration and verification of the hydraulic model. There were 25+ events separated by an inter-event time of 4 hours or more. Nine events, listed in Table 2-5, were chosen based on the range of precipitation volumes and peak/average intensities, and also the completeness of concurrent flow/water depth data. Five of these events were used for calibrating the hydrologic and hydraulic model parameters, and the remaining four were used to verify the model performance without adjusting the parameters. Events #1, #2, #5, #6, and #9. were used in the model calibration process.

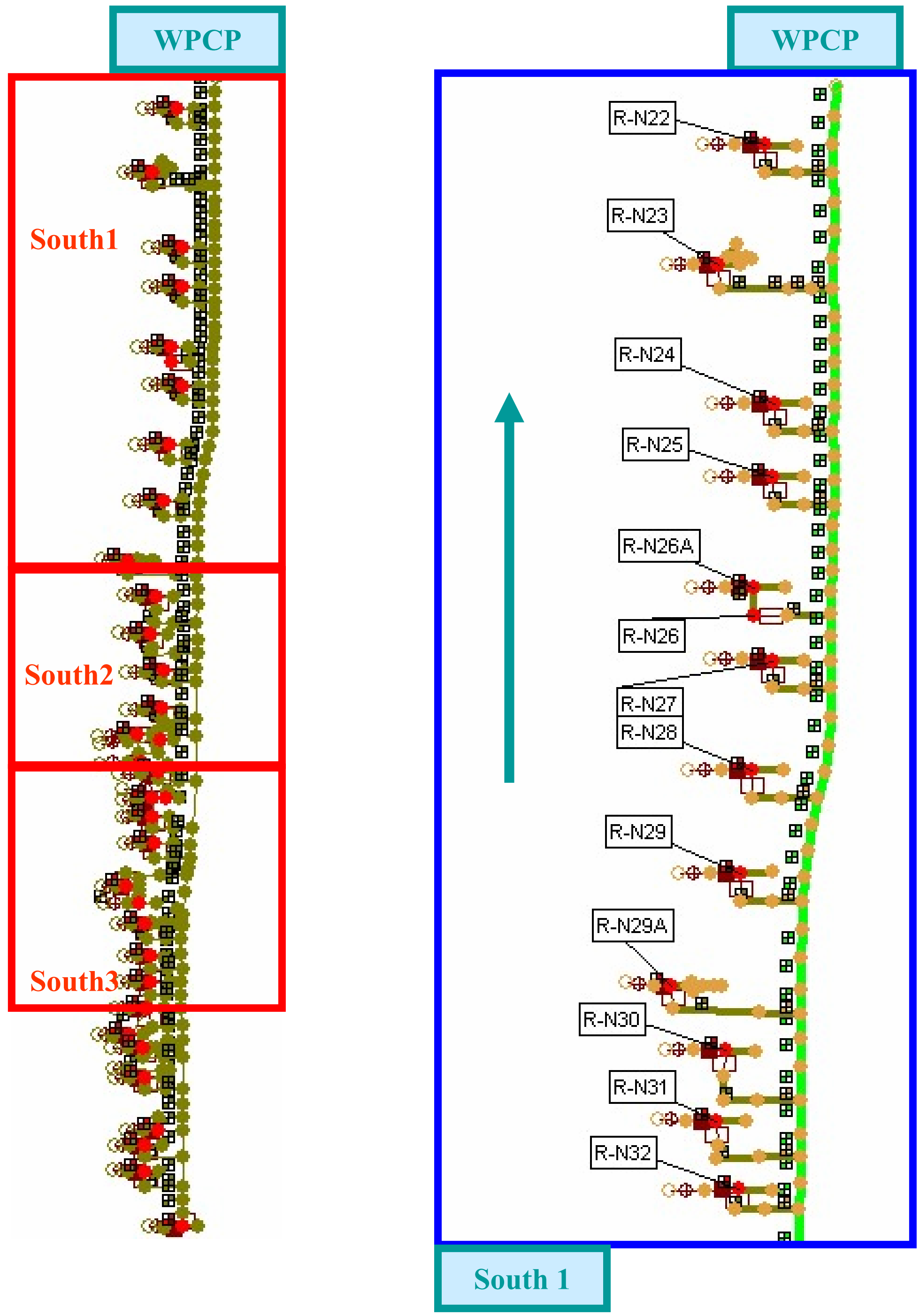


Figure 2-5. Schematic of North River InfoWorks Model

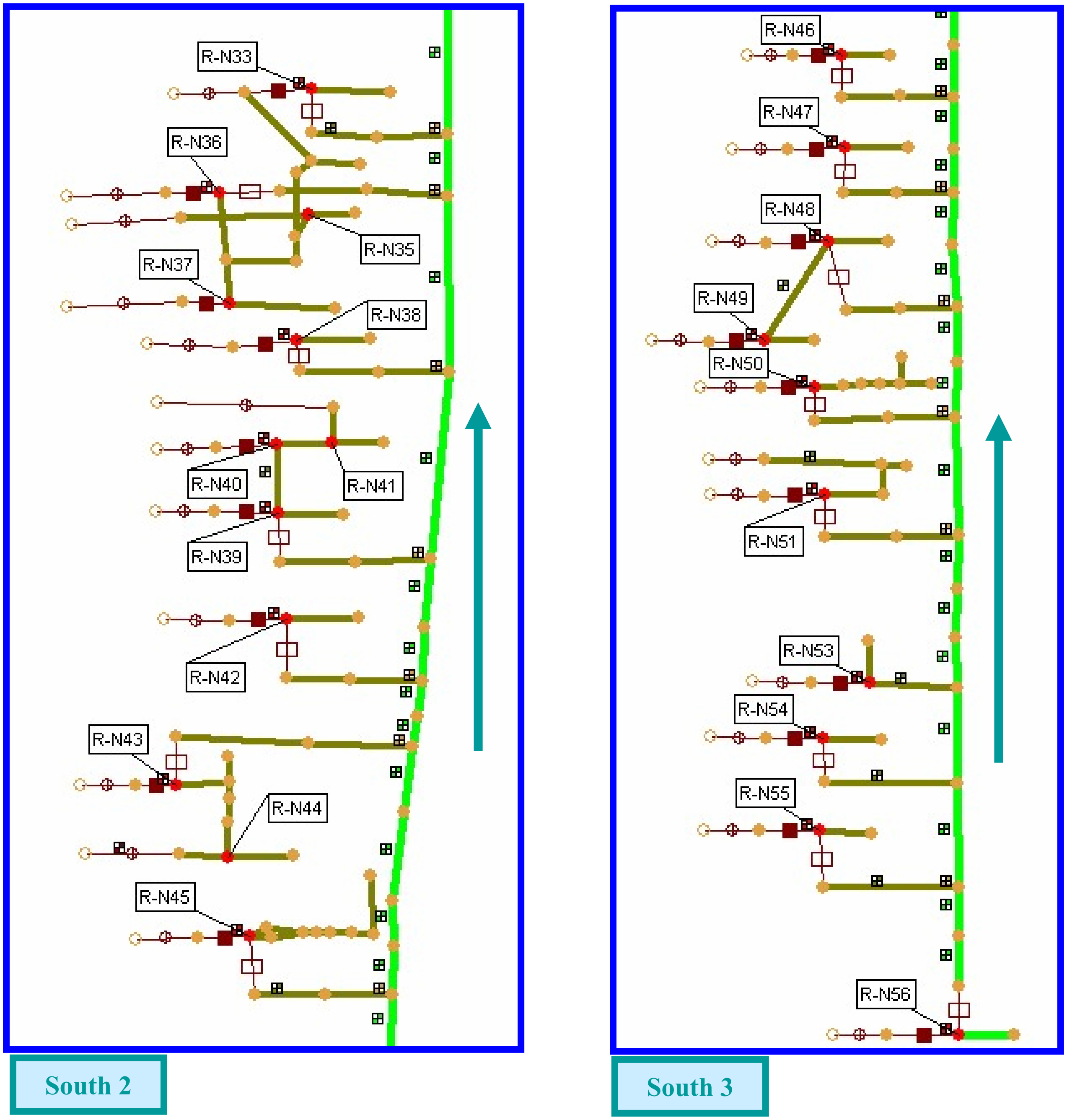


Figure 2-5. Schematic of North River InfoWorks Model (Continued)

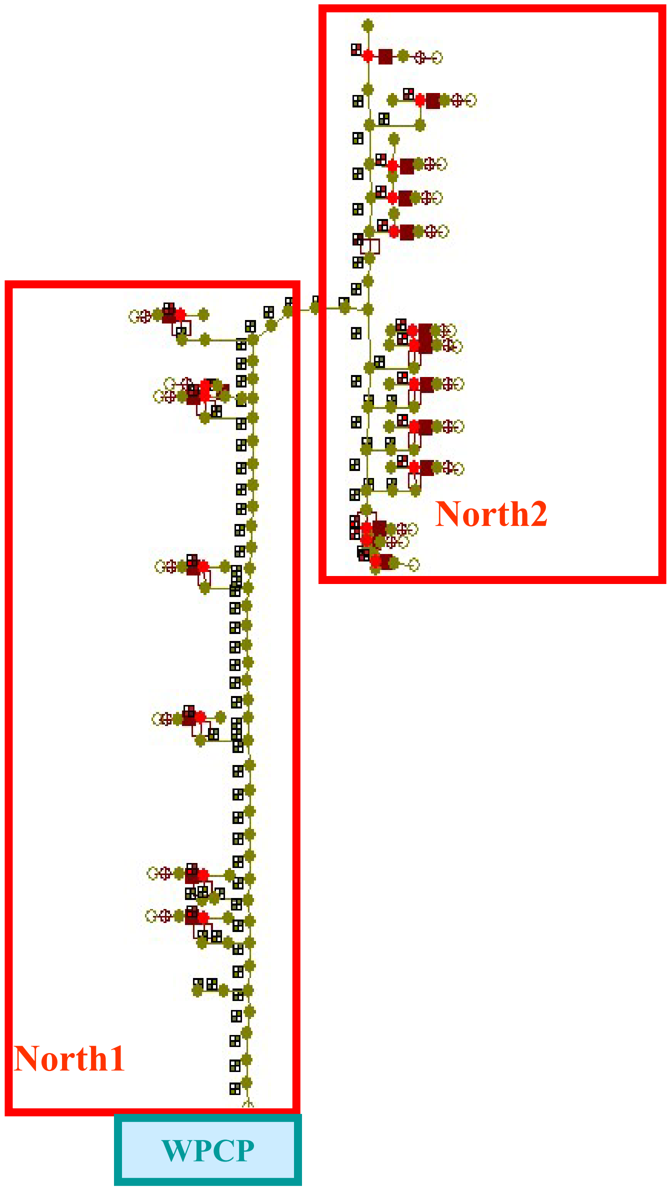


Figure 2-5. Schematic of North River InfoWorks Model (Continued)

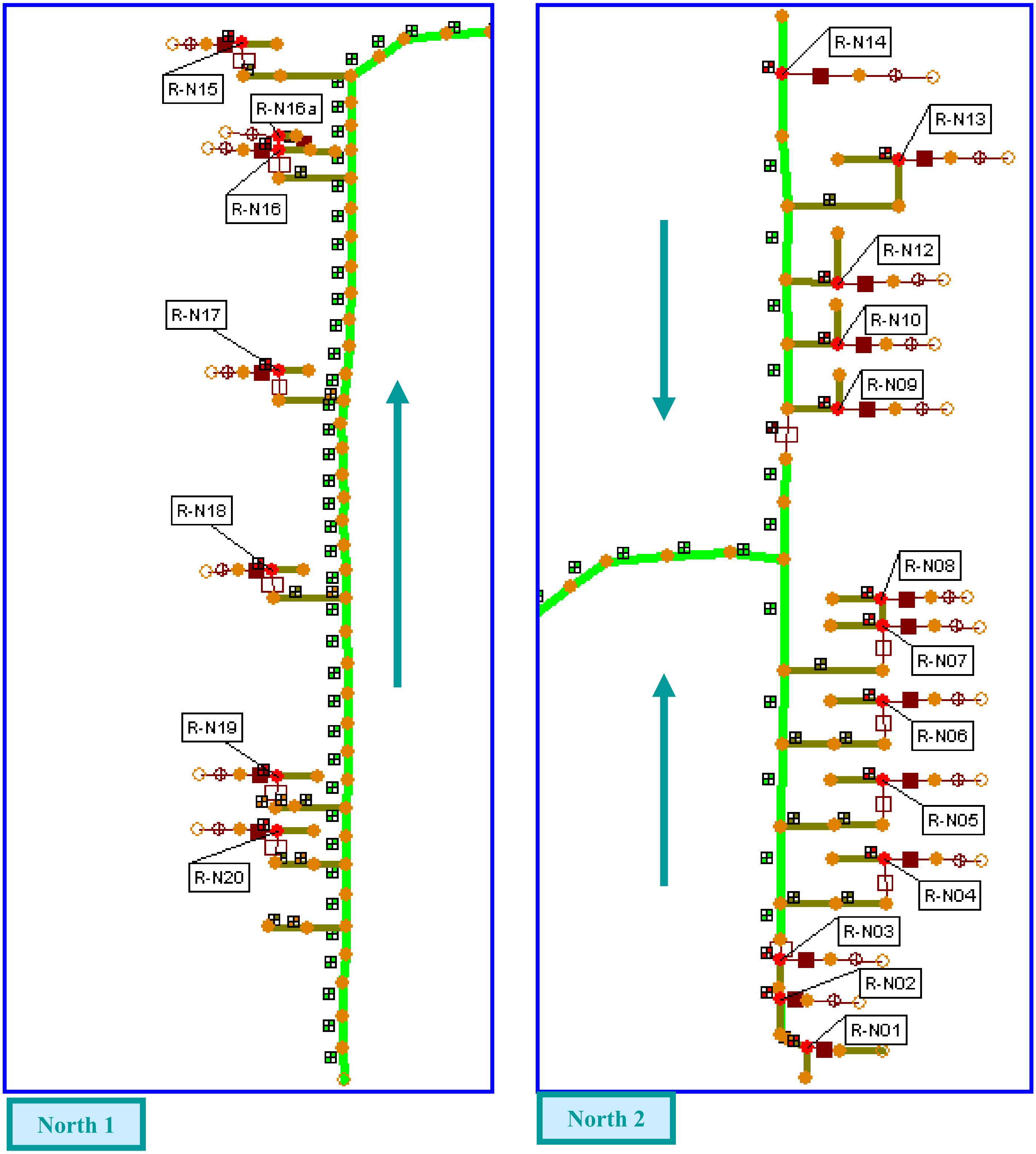


Figure 2-5. Schematic of North River InfoWorks Model (Continued)

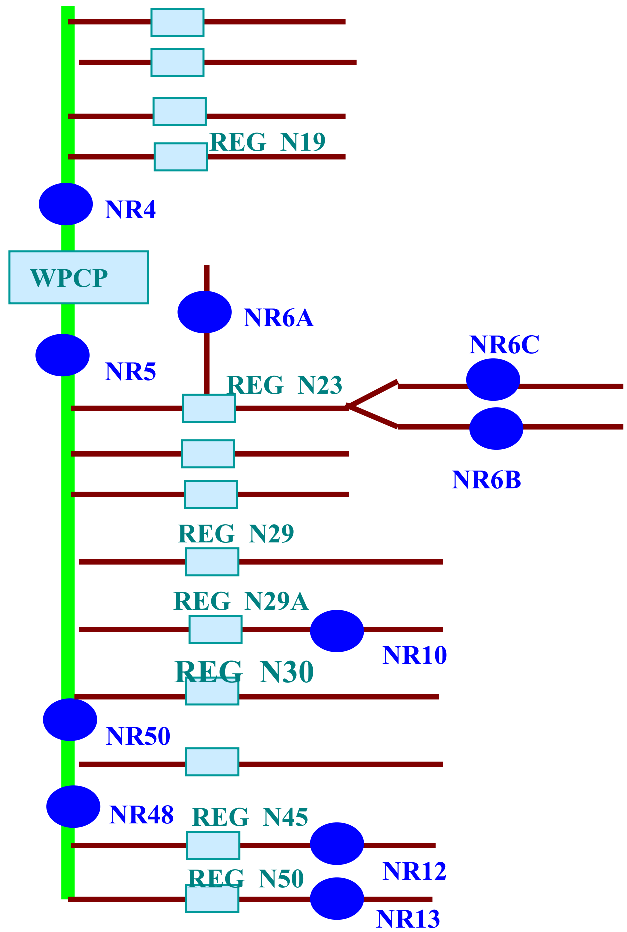


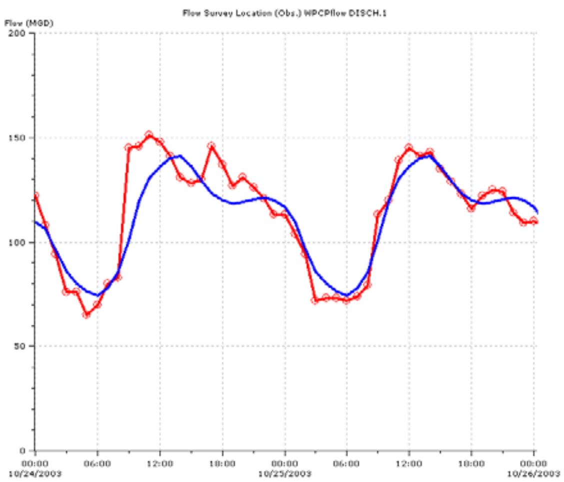
Figure 2-6. Locations of BWT Flow Monitors in the Regulators/Interceptors

Table 2-5. Summary of Rainfall Events Used in Model Calibration/Verification

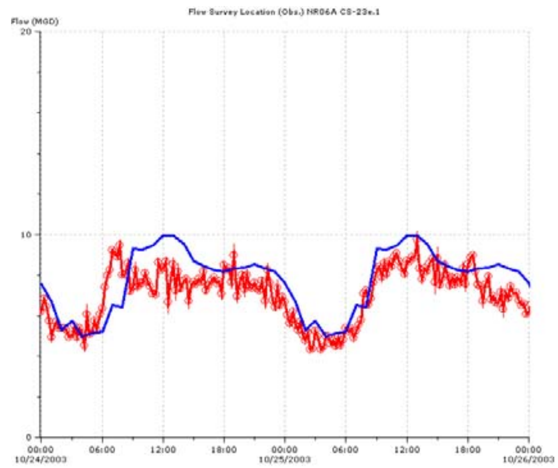
Events	Start Time	End Time	Volume (In)	Ave. Intensity (in/hr)	Max Intensity (in/hr)
#1	4/25, 11 PM	4/26, 9 PM	0.57	0.03	0.16
#2	6/3, 5 PM	6/5, 0 AM	2.67	0.13	0.66
#3	6/7, 9 AM	6/7, 8 PM	0.89	0.08	0.18
#4	6/18, 1 AM	6/18, 11 AM	0.86	0.09	0.22
#5	9/18, 11 PM	9/19, 5 AM	0.59	0.10	0.18
#6	9/23, 1 AM	9/23, 1 PM	1.19	0.10	0.34
#7	10/14, 10 PM	10/15, 5 AM	0.87	0.12	0.44
#8	10/26, 11 PM	10/27, 10 PM	1.93	0.12	0.47
#9	11/19, 5 AM	11/20, 9 AM	2.38	0.39	0.62

Most of the outfalls in the North River drainage area are submerged at some point in the tidal cycle; therefore, representation of the tidal influence on these outfalls was critical to characterize the actual sewer system performance. Tide data compiled at Battery station by the National Oceanic and Atmospheric Administration (NOAA) was used to set the tides at each of the outfall tide gages impacted by the Hudson River tides. Tidal correction factors were used to develop estimates of the tidal variations near each of the combined sewer outfalls, which were then explicitly included in the hydraulic model.

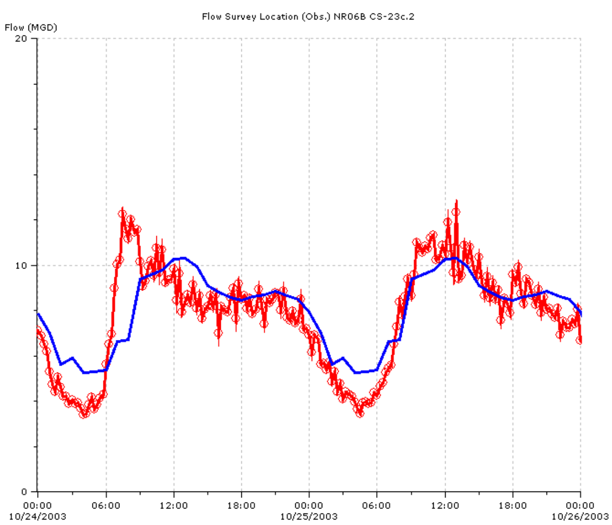
Limited historic data was available on the typical dry weather flows contributed by individual regulator drainage areas into the interceptor sewers. Therefore, the 2000 census data was used to develop initial dry weather flow estimates based on the population distribution. The flow data at the ten BWT locations were then used to confirm and redistribute dry weather flows contributed by the individual regulator drainage areas. Eight dry weather events were chosen from the April-November 2003 period to achieve this dry weather flow calibration. Shown in Figure 2-7 are examples of dry weather flow calibration achieved at the treatment plant and selected regulator/ interceptor flow monitoring locations. The monitored and modeled flows correlated very well for all of the eight dry weather flow events.



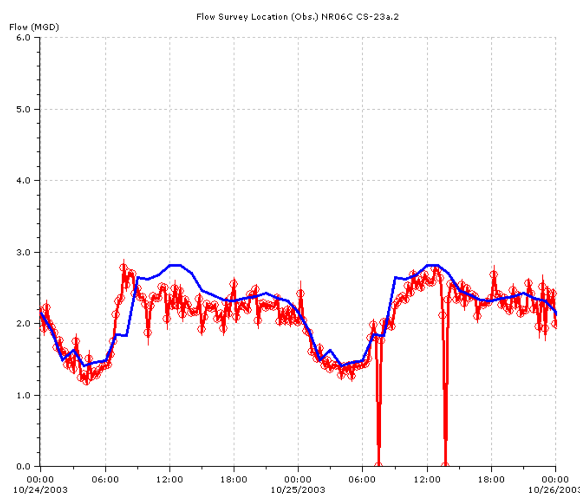
	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	65.000	151.000	228.453
...2003evt8_dwf_revDiurnal>CPK2003	74.431	141.107	224.487



	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	4.317	9.741	14.145
...2003evt8_dwf_revDiurnal>CPK2003	4.967	9.933	15.540



	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	3.376	12.330	15.576
...2003evt8_dwf_revDiurnal>CPK2003	5.235	10.304	16.119



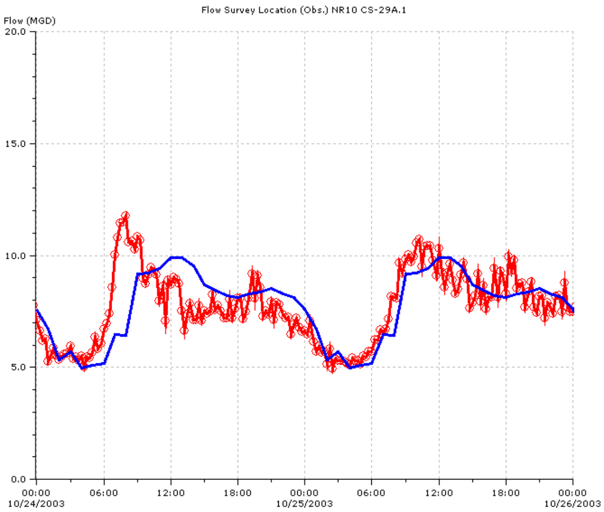
	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	0.000	2.775	4.142
...2003evt8_dwf_revDiurnal>CPK2003	1.408	2.816	4.406

Figure 2-7. Calibration of Model for Dry Weather Flow (October 24, 2003)

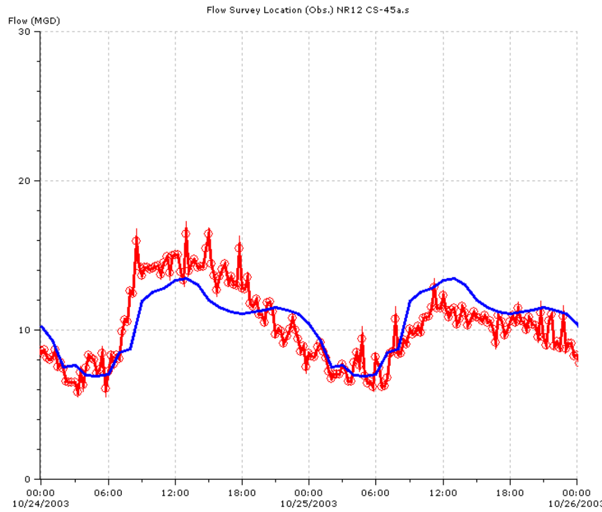
Blue line – model ***Red line – observed data***

Upper Left – WPCP ***Upper Right – Meter 6A***

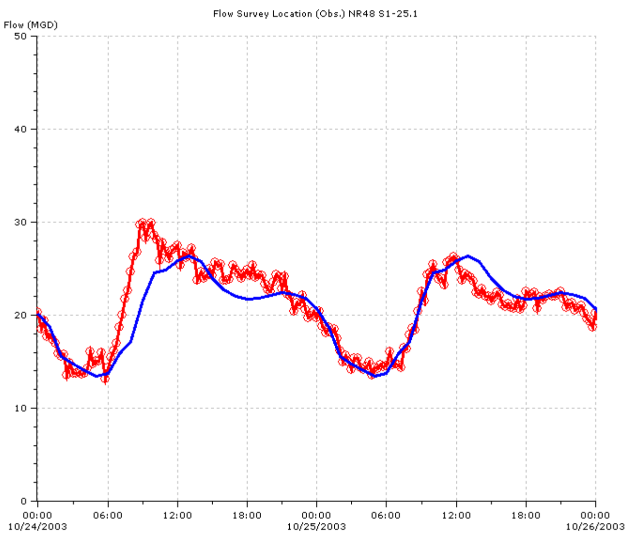
Lower Left – Meter 6B ***Lower Right – Meter 6C***



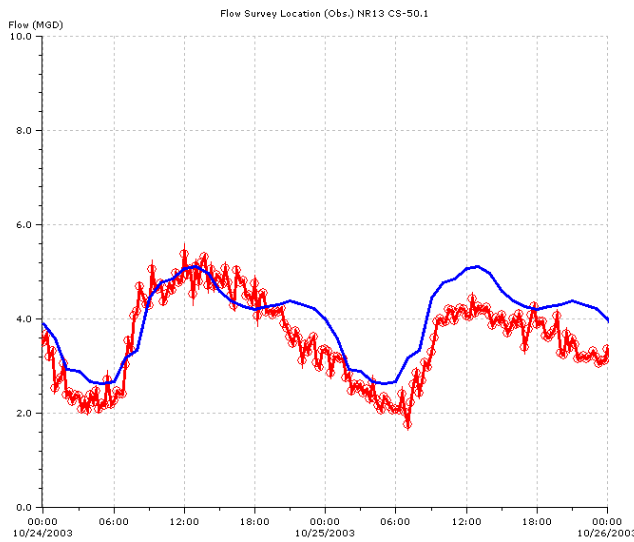
	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	4.920	11.740	15.478
...2003evt8_dwf_revDiurnal>CPK2003	4.987	9.906	15.498



	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	5.793	16.440	20.697
...2003evt8_dwf_revDiurnal>CPK2003	6.901	13.466	21.067



	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	13.110	29.850	42.208
...2003evt8_dwf_revDiurnal>CPK2003	13.409	26.343	41.208



	Flow (MGD)		
	Min	Max	Volume (US Mgal)
Obs.	1.751	5.369	7.158
...2003evt8_dwf_revDiurnal>CPK2003	2.616	5.120	8.010

Figure 2-7. Calibration of Model for Dry Weather Flow
(October 24, 2003 - Continued)

Blue line – model ***Red line – observed data***

Upper Left – Meter 10 ***Upper Right – Meter 12***

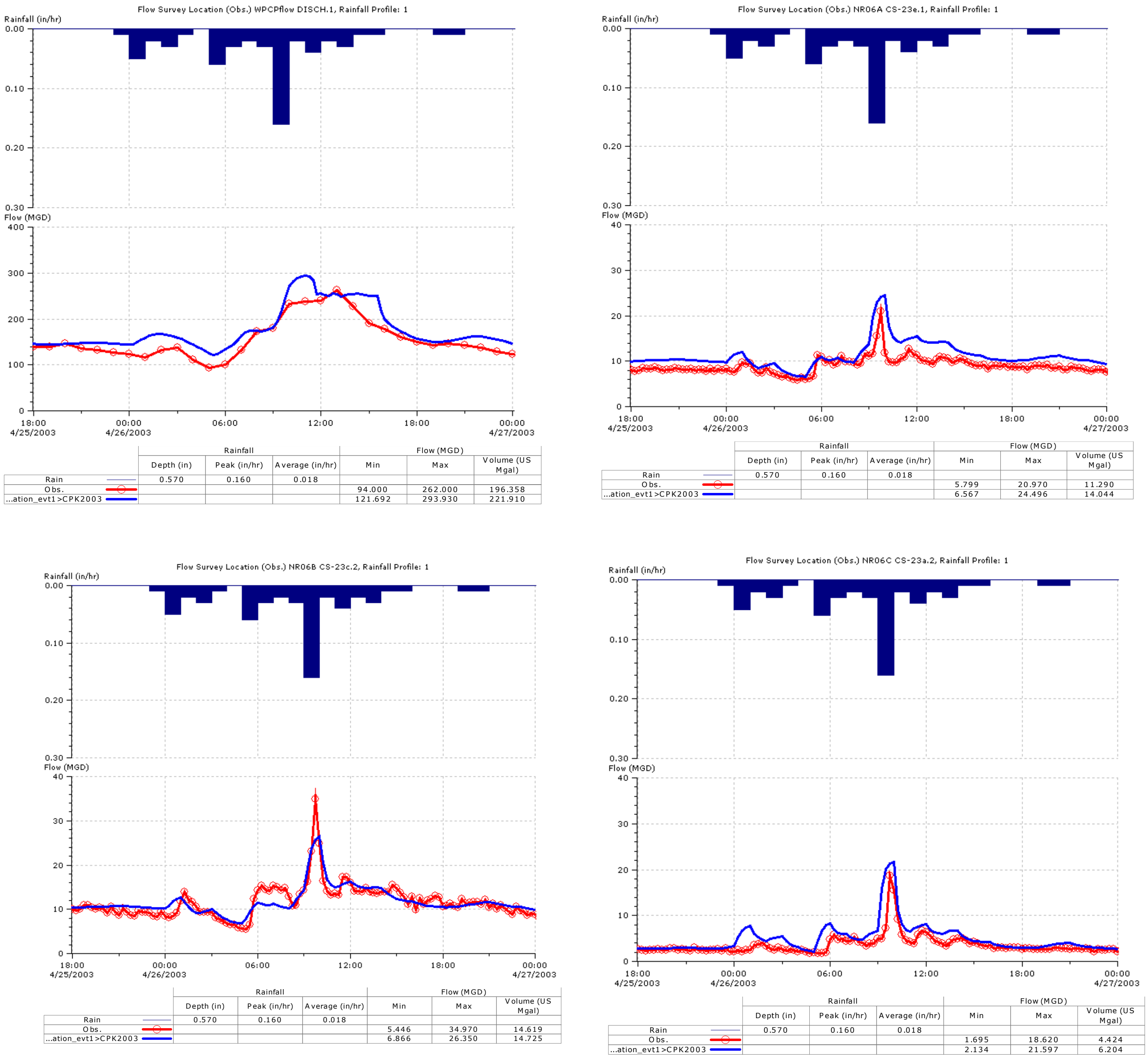
Lower Left – Meter 48 ***Lower Right – Meter 13***

Calibration of the model for wet weather conditions consisted of reviewing the appropriate hydrologic and hydraulic model parameters and making adjustments as necessary. The hydrologic parameters such as depression storage, evapotranspiration, infiltration, overland flow width, and surface roughness were adjusted to achieve the runoff volume balance. Surface slopes for drainage areas tributary to individual manholes in the system were obtained from the surface contours and the spot elevation data developed by the DEP. The percent imperviousness factors were assumed based on the land use types within each drainage area.

Flow data at individual regulator drainage areas were used to adjust the hydrologic model parameters, since these flows would not be influenced by potential backwater effects in the interceptor sewers. These hydrologic parameter sets were then extended to other regulator drainage areas based on the similarity in land uses and proximity to those regulator drainage areas where flow data were available.

The operation of treatment plant influent gates largely determines the performance of the sewer system during wet weather periods. Based on detailed discussions with the plant operators, it was understood that the wet well had a small storage volume, and the WPCP isolation gates were used to prevent flooding in the plant when the wet well water level reached an elevation of –20 feet. An operation rule curve was developed accounting for the wet well water level variations and associated pumping and gate closure positions to represent the dynamic operation of the treatment plant during wet weather periods. Ideally, the wet well water level was maintained between –35 and –38 feet.

The North River interceptor sewers were designed to accommodate peak flows of up to 440 MGD when flowing at about 60% of the full depth. Consequently, significant inline storage is realized when the plant inflows are throttled using the influent isolation gates. Since this causes backwater effects in the interceptor sewers, both flow and water level data at the interceptor monitoring locations were used to calibrate the model for the five wet weather periods. The treatment plant operation rule curve was adjusted until the monitored and modeled plant inflows correlated very well. Figure 2-8 shows a comparison of the monitored and modeled flow data at the treatment plant and at selected monitoring locations in the regulators/ interceptors.



	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				94.000	262.000	196.358
...ation_evt1>CPK2003				121.692	293.930	221.910

	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				5.799	20.970	11.290
...ation_evt1>CPK2003				6.567	24.496	14.044

	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				5.446	34.970	14.619
...ation_evt1>CPK2003				6.866	26.350	14.725

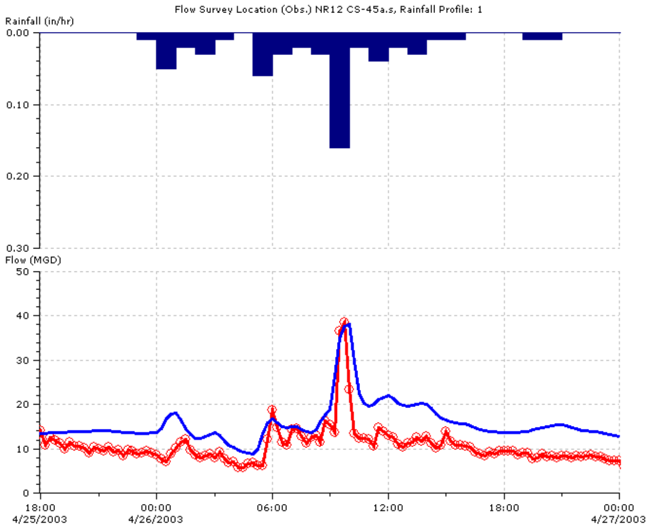
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				1.695	18.620	4.424
...ation_evt1>CPK2003				2.134	21.597	6.204

Figure 2-8. Calibration of Model for Wet Weather Flow (April 25, 2003)

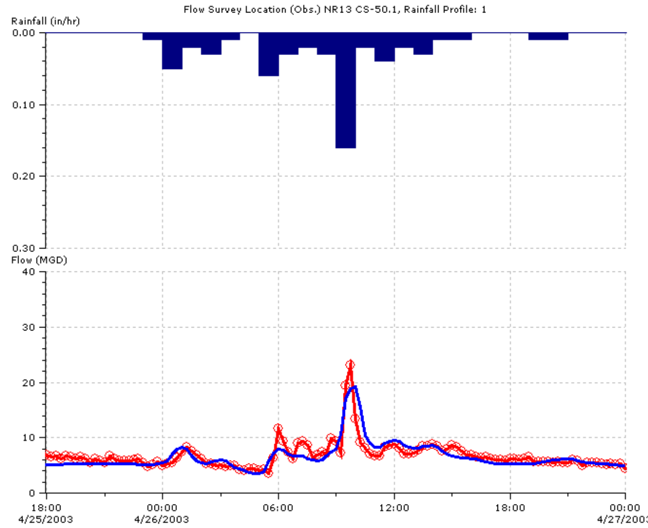
Blue line – mode ***Red line – observed data***

Upper Left – WPCP ***Upper Right – Meter 6A***

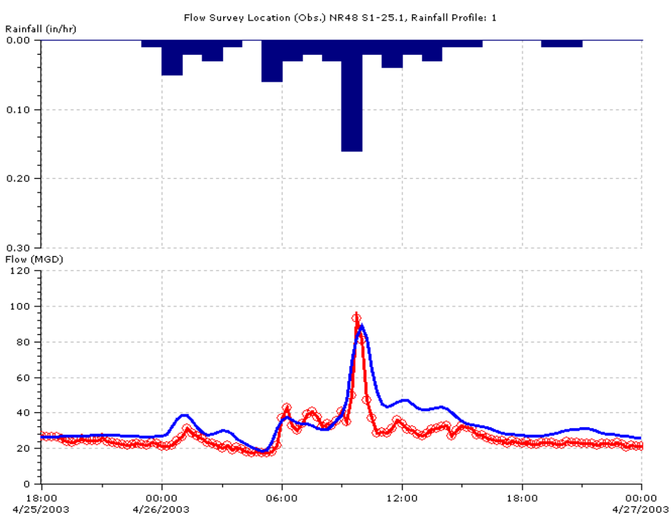
Lower Left – Meter 6B ***Lower Right – Meter 6C***



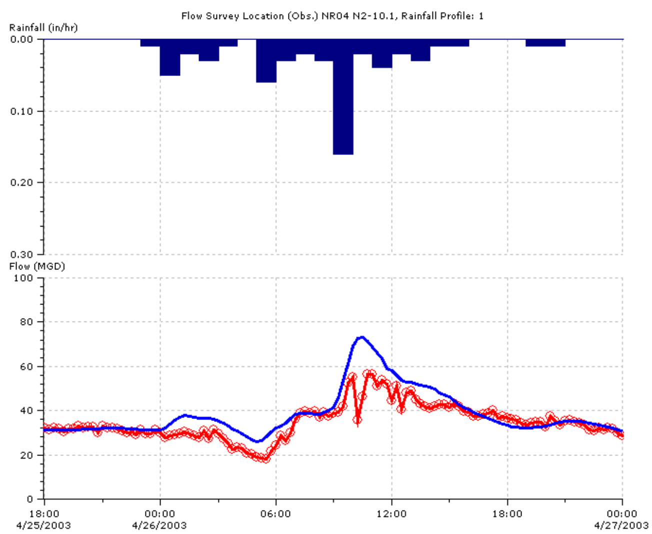
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				5.765	38.460	13.385
...ation_evt1>CPK2003				8.885	38.103	19.757



	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				3.537	23.060	8.465
...ation_evt1>CPK2003				3.480	19.236	8.231



	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				17.440	93.030	34.357
...ation_evt1>CPK2003				18.698	88.631	41.688



	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.570	0.160	0.018			
Obs.				18.210	56.230	43.670
...ation_evt1>CPK2003				25.930	73.113	48.404

Figure 2-8. Calibration of Model for Wet Weather Flow (April 25, 2003 - continued)

Blue line – model ***Red line – observed data***

Upper Left – Meter 12 ***Upper Right – Meter 13***

Lower Left – Meter 48 ***Lower Right – Meter 04***

An independent set of wet weather events was used to verify the model performance. During this process, the calibrated model was used to simulate four wet weather events without adjusting any hydrologic and hydraulic model parameters. Events #3, #4, #7, and #8 were used to verify the model. The modeled and monitored flows at 10 locations and also at the treatment plant correlated well for these four events.

2.5 FUTURE CONDITIONS ANALYSES

This section of the report summarizes the analyses conducted using the calibrated sewer system hydraulic model to estimate the changes in combined sewer overflows associated with the proposed Project.

2.5.1 Sewage Flows

Future No Build dry weather sewage flows for the North River WPCP drainage area were developed using best engineering judgment in lieu of trying to estimate sewage flows from proposed rezoning actions, which are currently unknown. The Hudson Yards DGEIS examined additional WPCP flows for future No Build and Future with the Project only within the Hudson Yards study area. This was expanded on herein to take into account additional flow contributions from the entire North River WPCP service area.

In order to prepare the analysis for the 2010 and 2025 planning horizons, the approach followed to address additional flows within the North River WPCP drainage area was to the use information available in the DEP's "New York City Water Demand and Wastewater Flow Projections - August 1998" report. This report was developed by the DEP as a tool to use for future infrastructure planning activities. This approach is a reasonable approach that addresses new and proposed developments and rezoning within the drainage area through overall population projections and other factors that impact wastewater generation. The "low end" projections from this August 1998 report were used within this impact analysis, as these are reasonable based upon the current flows being handled by the WPCP. The "high end" flow projections provided in the DEP report are well beyond current flow levels and were not considered representative of current conditions. For example, the current North River WPCP 2003 annual flow is 132 MGD. The low end flow that was interpolated from this report was 145 MGD while the high end flow was 165 MGD. As indicated above, the low end projections were used since they more accurately reflect existing conditions.

The calculation presented below was utilized for the analysis of the effects of the North River WPCP on the Hudson River, the modeling of the sewer system, and the projection of CSO events and their potential impacts on water quality.

The approach is as follows:

Existing Conditions - Existing DEP treatment process flow data for fiscal year 2003 (the most recent available) for the North River WPCP were used to develop current sewage flows. The 365-day average flow, which includes wet weather events that are handled by the WPCP was reported by DEP as 132 MGD. The flow reported by DEP as the dry weather sanitary sewage flow (w/o wet weather flows) was 122 MGD.

Future No Build

2010 - The 2010 flow was extrapolated flow based upon the projected 2015 flow of 151.6 MGD and the 2005 flow of 144.7 MGD using the low end flow projection in the DEP report. This results in a projected flow for 2010 of approximately 135.5 MGD 365 day average flow as detailed below and 125.5 MGD dry weather sanitary sewage flow.

1. 151.6 MGD (projected 2015 low end flow) -144.7 MGD (projected 2005 low end flow) = 6.9 MGD/10 years x 5 = 3.45 MGD (the incremental delta from 2005 to 2010), say 3.5 MGD

2. 132 MGD (2003 DEP, 365 day average flow) + 3.5 MGD (incremental change) = 135.5 MGD = 365-day sewage flow

3. 122 MGD (2003 DEP, dry day sanitary sewage flow) + 3.5 MGD (incremental change) = 15.5 MGD

4. 2010 No Build WPCP flow would, therefore, be 135.5 MGD or 125.5 MGD dry weather sanitary sewage flow

It was assumed that the calculated 0.2 MGD 2010 No Build increase in the Hudson Yards DGEIS (Table 16-8) was included in this number since it is well within the overall projected increase of 3.5 MGD calculated above.

2025 - The calculated incremental change in the WPCP flows based upon the 2025 flow of 155.6 MGD and the 2005 flow of 144.7 MGD using the low end flow projection in the DEP report. This results in a projected flow for 2025 of approximately 142.9 MGD as the 365-day average flow and 132.9 MGD as the dry day sanitary sewage flow.

1. 155.6 MGD (projected 2025 low end flow) -144.7 MGD (projected 2005 low end flow) = 10.9 MGD (the incremental delta from 2005 to 2025)

2. 132 MGD (2003 DEP, 365 day average flow) + 11.0 MGD (incremental change) = 142.9 MGD = 365-day flow

3. 122 MGD (2003 DEP, 365 day average flow) + 10.9 MGD (incremental change) = 132.9 MGD = dry weather flow

4. 2025 No Build WPCP flow would, therefore, be 143.9 MGD as a 365-day average flow and 133.9 as the dry day sanitary sewage flow

It was assumed that the calculated 0.4 MGD 2025 No Build increase in the Hudson Yards DGEIS (Table 16-8) was included in this number since it is well within the projected 10.9 MGD increase shown above.

Future With Project

2010 – This future condition added the 2010 incremental change of 1.5 MGD due to the Hudson Yards project, as calculated in the DGEIS (Table 16-8 of DGEIS), to the 2010 No Build WPCP flows.

1. 135.5 MGD (2010 No Build 365- day average WPCP flow) + 1.5 MGD (2010 incremental change) = 137.0 MGD = 365-day flow

2. 125.5 MGD (2010 No Build dry day sanitary sewage WPCP flow) + 1.5 MGD (2010 incremental change) = 127.0 MGD = dry weather flow

2025 – This future condition added the 2025 incremental change of 7.1 MGD due to the Hudson Yards project, as calculated in the DGEIS (Table 16-8 of DGEIS), to the 2025 No Build WPCP flows.

1. 142.9 MGD (2025 No Build 365-day average WPCP flow) + 7.1 MGD (2025 incremental change) = 150.0 MGD

2. 132.9 MGD (2025 No Build dry day sanitary sewage WPCP flow) + 7.1 MGD (2025 incremental change) = 140.0 MGD

As described above two sets of flows were developed for the analyses. These flows are summarized in Table 2-6.

Table 2-6. Dry and Total Sewage Flows for Future Conditions

Condition	Dry Weather Sanitary Flow (MGD)	365-day Average Sewage Flow (MGD)
Current (2003)	122	132
Future 2010	125.5	135.5
Future 2010 w/Proposed Action	127	137
Future 2025	132.9	142.9
Future 2025 w/Proposed Action	140	150

These two flows (dry weather sanitary and 365-day) represent key information for use in the analyses, which follows. The dry weather sanitary flow represents the domestic and industrial sewage present or project to be in the sewer system in non-rain periods. It is this ***flow that was used as base flow in the calculation of combined sewer overflows in the InfoWorks model***. This model then imposes the amount of rainfall-induced runoff that enters the combined sewer system to compute the flow to the North River WPCP in wet weather and the amount of CSO. Simply put, the dry weather flow represents the daily average inflow to and overflow from the North River WPCP in dry periods.

The 365-day average flow represents the total flow processed at the North River WPCP on a daily average basis. This flow is calculated by dividing the total flow treated at the WPCP by 365. This flow would represent the average effluent flow leaving the WPCP during wet and dry periods and is the flow that was used ***to assess the impact of the North River WPCP on Hudson River water quality***.

2.5.2 Modifications to Sewer System Model to Accommodate Hudson Yards Changes

In the future, the Hudson Yards and other projects that promote growth within the North River WPCP drainage area will, as previous described, add sewage flows to the sewer system. Depending on the individual projects there may need to be changes to the trunk sewers in the local streets. There may also need to be changes to the regulators that divert sewage to a maximum of twice the dry weather flow to the WPCP and CSOs to New York Harbor. In certain instances, where large scale changes are being made in the character of the area, there may need to be changes made to the City's Sewer Drainage Plan.

The Hudson Yards project may require some improvements within the sewers, regulators, and/or drainage plan. DEP is preparing an Amended Drainage Plan for the rezoning area that includes upgrades to sewers that will accommodate the full build-out allowed under the proposed re-zoning. The conceptual amended drainage plan would include upgrades to the project area combined sewers. In addition, DEP is currently in the process of studying the feasibility of capturing storm water runoff and conveying this flow directly to the Hudson River by a separate storm sewer system (high level storm sewer system) within three sub-drainage areas in the re-zoning area. This would reduce storm water flows to the combined sewer system if implemented. Also, the DEP has indicated that they will modify, as required, regulators receiving flows from the rezoning area to divert two times the proposed dry weather flow to the interceptor and the WPCP in order to avoid additional CSOs in the future with this project for storms where the North River WPCPs maximum capacity is not fully utilized.

The results of those analyses were not completed in time to be used within this impact evaluation. In addition, as described in the previous section, additional flows are projected within the drainage area from a variety of future un-identified projects or as a result of water use patterns. Analyses would be conducted by DEP to identify sewer system improvements and necessary drainage plan amendments at the time these projects are proposed. No other drainage plan amendments were considered in conducting this evaluation.

In order to complete the impact assessment, in the absence of site specific drainage plan amendments, analyses were conducted to determine whether adjustments needed to be made in the sewer system hydraulic model. In order to properly conduct the impact analysis under future flows, it was necessary to:

- Assure that future base flows used in the hydraulic model would not calculate dry weather sewage overflows.

- Assure that the regulators in the model were capable of passing twice the design dry weather flow toward the WPCP in the future.

Figure 2-9 shows a typical North River WPCP sewer system regulator structure. This device is located at point in the sewer system where larger combined trunk sewers located in the streets reach the most downstream point in the sewer system before the Hudson River.

In reality, there are many combined trunk sewers and many regulators in the North River WPCP drainage area not just the single one show in this schematic. The purpose of the regulator is to control the amount of flow going to the WPCP in wet weather so as to not overwhelm the facility and flood it out. The graphic shows the key elements in each regulator.

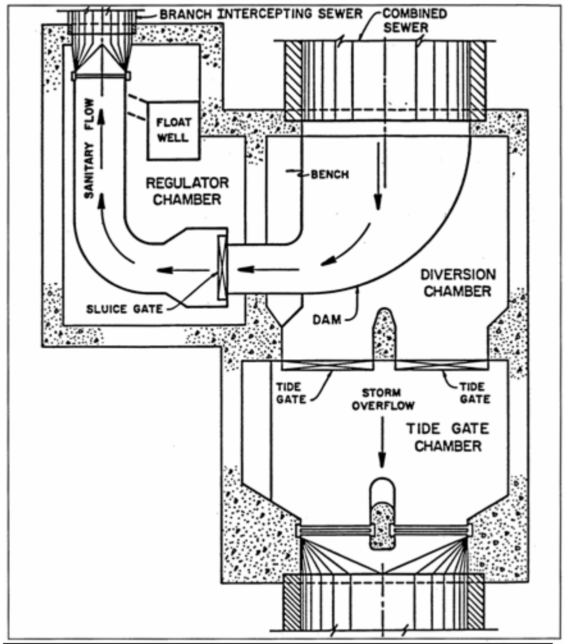


Figure 2-9. Typical NYC Regulator

The key elements in the regulator that control the fate of flow are the diversion chamber dam (weir), the sluice gate (orifice) and the branch interceptor. The diversion dam (weir) is a concrete step over, which water must flow before it can exit into the Hudson River. As long as the water level is lower than the weir (dry weather condition), combined sewage will be diverted through the sluice gate (orifice) to the branch interceptor, then to the interceptor and finally into the North River WPCP. If the flow in the sewer exceeds the capacity of the sluice gate (orifice), the branch interceptor or the interceptor or is higher than the diversion dam (weir), then it will be discharged as an overflow (wet weather condition).

DEP is examining all of these aspects of the system for the regulators within the Project Area. This analysis could result in a plan to improve the regulators within the Project Area so that additional combined sewage would be directed to the North River WPCP.

Non-Project Area Regulators - An analysis was conducted to determine whether the InfoWorks computer model of the sewer system would need to have any of the key elements of the regulators improved to accommodate future flows to allow the impact analyses to be conducted for the FGEIS. This analysis consisted of running the model under different rainfall intensities until the water level just reached the top of the diversion dam. At that point in time, the amount of flow entering the branch interceptor was recorded. The model was executed in this mode for each regulator without having the regulator overflow to the harbor, until the amount of flow that could pass into the branch interceptor, and subsequently to the north or south interceptor, was determined.

Next, the amount of dry weather sanitary sewage flow present at that location was determined for current and future conditions. These flows were developed for the InfoWorks modeling analysis to be reflective of current conditioning and do not represent more conservative flows used in DEP's hydraulic calculations that are conducted in assessing potential drainage plan modifications. These numbers were compared to the estimated maximum capacity of the regulator.

The results of these analyses are shown in Table 2-7. Indicated in this table are the regulator names and numbers (column 1), the estimated capacity of each regulator (column 3), the dry weather sanitary flow allocated to each regulator when the North River WPCP is treating 170 MGD or twice that flow - 340 MGD (column 4a & 4b), the dry weather sanitary sewage flow estimated to be present at each regulator in the future (2025) with the proposed project (column 5a) and twice that capacity (column 5b). Column 2 represents a drainage area Identification (ID) used in the model, which is the land surface connected to the adjacent regulator.

In conducting this analysis, it was assumed that the total flow entering the interceptor through all the branch interceptors would flow freely out the end of the interceptor. In reality this is not the case since the North River WPCP has a limited capacity. The analysis was, however, conducted as described above to assure that there would be no dry weather overflows calculated within the model and to assure that the regulators would pass two times the dry weather flow for the future conditions.

The information contained in this table shows that for all regulators, except regulator 21, the calculated maximum theoretical capacity (column 3) of all regulators exceeds the estimated flow allocation when the WPCP is treating its maximum flow of 340 MGD (column 4). The table also shows that twice the design flow for the future with the

Table 2-7. Hydraulic Model Regulator Capacities

Subcatchment ID	Regulator	Calculated Regulator Capacity (MGD)	Regulator 2xDDWF	Regulator Sub-total	Regulator 2025 FB DWF (MGD)	Regulator 2X2025 FB DWF (MGD)
CS-01	N1	21.20	0.33	17.47	6.93	13.85
CS-03	N3		17.14			
CS-04	N4	1.80	0.13		0.05	0.10
CS-05	N5	2.50	0.38		0.15	0.30
CS-06	N6	no overflow	0.02		0.03	0.06
CS-07	N7	2.00	0.02	0.05		
CS-08	N8		0.02			
CS-09	N9	7.30	0.25	3.25	1.29	2.57
CS-10	N10/11		1.31			
CS-12	N12		0.93			
CS-13	N13		0.02			
CS-14	N14		0.74			
CS-15	N15	4.00	1.09		0.43	0.87
CS-16	N16/16A	27.00	17.46		6.92	13.84
CS-17	N17	3.85	0.02		0.01	0.02
CS-18	N18	35.90	11.37		4.51	9.01
CS-19	N19	26.20	10.91		4.32	8.65
CS-20	N20	5.00	1.35		0.53	1.07
CS-21	N21	6.20	10.02		3.97	7.95
CS-22	N22	5.32	3.22		1.28	2.55
CS-23a	N23	79.15	54.82		21.73	43.47
CS-24	N24	9.02	3.55		1.41	2.81
CS-25	N25	11.65	5.17		2.05	4.10
CS-26A	N26/26A	68.18	24.18		9.59	19.17
CS-27	N27	no overflow	0.87		0.35	0.69
CS-28	N28	62.54	23.00		9.12	18.23
CS-29	N29	no overflow	9.24		3.66	7.33
CS-29Ab	N29A	29.80	23.56		9.34	18.68
CS-30	N30	8.45	4.05		1.61	3.21
CS-31	N31	4.60	0.46		0.18	0.36
CS-32	N32	3.30	0.48		0.19	0.38
CS-33	N33	140.62	47.74		18.93	37.85
CS-35	N35//36/37	no overflow	0.81		0.32	0.64
CS-38	N38	3.02	0.26		0.10	0.21
CS-39	N39	3.93	0.10	1.45	0.06	0.11
CS-40	N40/41		1.35		0.78	1.56
CS-42	N42	3.16	0.07		0.04	0.08
CS-43b	N43/44	7.04	0.93		0.53	1.04
CS-45a	N45	66.09	32.02		18.47	36.95
CS-46	N46	7.48	3.51		1.39	2.78
CS-47	N47	8.69	3.04		1.21	2.41
CS-48	N48	8.56	1.53	2.52	0.61	1.22
CS-49	N49		0.98		0.39	0.78
CS-50	N-50	38.14	12.17		4.83	9.65
CS-51	N51	12.90	0.91	3.95	0.36	0.72
CS-52	N52		3.04		1.21	2.41
CS-53	N53	no overflow	0.00		0.00	0.00
CS-54	N54	2.13	0.56		0.22	0.44
CS-55	N55	6.22	3.04		1.21	2.41
CS-56	N56	2.66	1.83		0.72	1.45

project (column 6) is lower than the computed maximum capacity (column 3) for all of the regulators.

The overall conclusion from this evaluation is that a slight adjustment was required in the model to regulator 21. It is possible that this modification is only required in the model and will not actually be required to the system. Much more detailed field investigations and hydraulic calculations would be required before a recommendation would be made to adjust regulator 21. However, each of the other regulators, as they were configured within the model, would have the hydraulic capacity to allow more than twice the dry weather sanitary sewage flow into the interceptor for the future conditions (2025) and would not create dry weather overflows. In fact the analyses show that in total the regulators have the capacity to transport as much as 4 times the dry weather flow under free flow conditions. This being the case it was possible to conduct the analysis of the impacts of the project on the combined sewer system without making any other modifications to the model structures. Changes that may be made by the DEP in accordance with any future drainage plan modifications would presumably reduce CSO overflows.

Project Area Regulators - The DEP determined that regulators within the Project Area could be modified to allow additional dry weather flows and combined sewage flows to be effectively transported into the interceptor and to the WPCP for treatment. The concept would be to improve internal elements so that they would direct more flow from the Project Area into the interceptor, thereby minimizing potential future increases in CSO associated with the Project. This would allow Project Area combined sewage to be fully treated at the North River WPCP for wet periods when the WPCP would not be receiving 340 MGD from the remainder of the service area. At the time that this impact analysis was conducted, DEP had not yet completed the drainage plan calculations to determine changes required to sewers in the project area. Further, DEP was in the process of examining the regulators to determine how they could raise the overflow weir and/or expand the capacity of the branch interceptors to assure that two times dry weather flow could be diverted into the interceptor in order to avoid additional CSOs in the future with the project for storms when the North River WPCP capacity is fully utilized. As no specific design changes were available at the time this report was developed, the regulators in the model were not modified in this impact analysis.

It should be noted that the sewer system is dynamic and complex and it should not be assumed based on this analysis, that the amount of flow passed by any individual regulator would reflect the conditions shown in Table 2.7. The capacity listed in this table reflects a free flowing condition, which is not present in reality since the North River WPCP operates to control the maximum total flow entering the system to 340 MGD. Therefore, the actual flow entering the north and south interceptors from any individual regulator will be less than the maximum capacity show in Table 2.7 and are dependant on a number of factors including the relative elevation of the diversion weir, the size of the branch interceptor, the proximity to the WPCP and other features that come into play when the system operates in a dynamic mode during wet weather.

2.5.3 Future CSO Volumes and Flows

The results of the model simulations was used to estimate:

- The annual overflow volumes for CSOs in the North River WPCP drainage area and the Project Area for current conditions and for future conditions with and without the Proposed Action for two analysis years (2010 and 2025).

- The annual pollutant loadings from CSOs in the North River WPCP drainage area and the Project Area for current conditions and for future conditions with and without the Proposed Action for two analysis years (2010 and 2025).

The sewer system hydraulic model was used to calculate the amount of combined sewage present within the sewer of the North River WPCP service area during a 1-year simulation period. An entire year was chosen as the simulation for a number of reasons, as outlined below.

- A full 12-month simulation allows for an evaluation to be made over a variety of storm conditions including small, medium and large events.

- Certain DEP discharge permit reporting requirements revolve around 12-month reporting of combined sewer overflows.

- A full year simulation allows for assessment of storms that overlap each other providing additional stresses on the infrastructure and on the environment.

In conducting this 1-year simulation, calendar year 1988 rainfall were selected for the rainfall sequence as:

- this rainfall pattern has been shown to represent typical long term average rainfall conditions for the NYC area,

- this rainfall pattern is being used for other water quality impact evaluations by local regulatory personnel in developing of total maximum daily loads (TMDLs) for New York Harbor, and

- this rainfall pattern contains a fairly wet July that serves to create additional stressors on both the sewers and on water quality.

Table 2-8. Summary of 1988 Rainfall Statistics

Annual Rainfall Statistic	1988 JFK	1988 Central Park	Long-Term Average (1970-1999)
Total Volume (in)	40.7	44.67	39.2
Return Period (yrs)	2.4	1.9	1.9
Intensity (in/hr)	0.067	0.062	0.055
Return Period (yrs)	10.3	2.6	1.9
Number of Storms	100	94	112
Return Period (yrs)	1.1	1.0	1.9
Storm Duration (hrs)	6.1	7.07	6.1
Return Period (yrs)	2.1	4.9	1.9

Rainfall data from the Central Park National Weather Service rain gauge records show that the 1988 rainfalls had the characteristics summarized in Table 2-8 in relation to the long-term averages for the area.

This rainfall pattern was imposed on the sewer system model to compute the CSO overflows and the wet weather flow to the North River WPCP. For the purpose of this analysis the North River WPCP influent raw sewage pumping was set as in the model calibration analyses to a maximum pumping rate of 340 MGD.

For the future condition with the proposed Hudson Yards project, a number of actions have been proposed that could possibly result in some changes in runoff from the connected drainage area. These changes are described in the following text boxes abstracted from the DGEIS.

> In the 2010 Future With the Proposed Action, the amount of pervious or absorptive surfaces would change compared to the existing condition (the area is currently almost entirely covered with impervious surfaces). By 2010, there would be approximately 871,200 square feet of open space or impervious cover on the Convention Center roof and 156,816 square feet (approximately 3.6 acres) for the full block public open space between West 33rd and West 34th Streets from Eleventh to Twelfth Avenues. In addition, the stormwater retention and recycling systems of the Multi-Use Facility would be in operation.

> In the 2025 Future With the Proposed Action, the amount of impervious surfaces would decrease from existing levels, due to the development of approximately 871,200 square feet of open space or impervious cover on the Convention Center roof; approximately 3.6 acres for the full block public open space between West 33rd and West 34th Streets from Eleventh to Twelfth Avenues; approximately 8 acres of public open space constructed by the City within the Midblock Park and Boulevard System and on Block 675 (West 29th to West 30th Streets, Eleventh to Twelfth Avenues); and approximately 7.5 acres of public open space on the eastern portion of Caemmerer Yard. In addition, the stormwater retention and recycling systems of the Multi-Use Facility could be in operation. As a result, it is anticipated that the stormwater discharge to the sewer system would be reduced in the 2025 Future With the Proposed Action.

Based on this information, changes in use of the land areas tributary to the sewer system in the Project Area will convert a portion of the existing impervious surfaces into pervious surfaces of partially impervious surfaces. This would result in a reduction in the amount of runoff from these areas during rainfall periods. For the purpose of this analysis, the following assumptions were made.

- The Caermmerer Yard (located between W. 33rd and W. 30th Streets and Tenth and Twelfth Avenues) surface runoff is currently directed through a storm sewer directly to the Hudson River. When that analysis was conducted it was not clear that the runoff from the Caemmeron Yards was routed through a storm sewer to the Hudson River. Therefore, for this analysis it was assumed that the Yards were diverting runoff to the combined sewers. This amounts to a worst case assumption of the surface runoff from two 16-acre (+/-) lots being directed into the combined sewer system.

  In the future, a portion of the Yards will be devoted to the multiuse facility. This facility will have its own 150,000-gallon storm water storage and retention tank. that will contain all but about 2 rainfall events a year. The overflows not contained will be routed through the Caermmerer Yards storm sewer and not into the CSO system. About one-half of the remainder of the Yards will be converted to open space. It was assumed herein for all future analyses that the storm water from that area will be connected to the combined sewer after accounting for some rainfall attenuation and that the stormwater from the multi-use facility would be directed to the combined sewer system, again a worst case analysis.

- As noted in the text boxes above, a portion of the redeveloped area will be turned into open space or will have green rooftops for storm water retention. For the purpose of this analysis, these areas (66 acres) were assumed to retain the first 0.25 inches of rainfall completely. After this retention, the ensuing runoff was directed to the CSO system without any retardation factors.

The InfoWorks model was executed for a few different scenarios to calculate changes in combined sewer overflow volumes and frequency as a result of the increases in the base sanitary sewage flows. The results of these analyses are shown in Table 2-9. This table indicates that increases in the base sanitary flow to the WPCP would result in some increase in combined sewer overflows throughout the North River WPCP drainage area. This overflow occurs because the WPCP is only capable of treating a peak wet weather flow of 340 MGD. For the current conditions, with the base sanitary dry weather flow at 122 MGD, the WPCP will treat a peak wet weather flow of 218 MGD (340 MGD minus 122 MGD). Any combined sewage present in wet weather beyond a flow of 218 MGD would be discharged into New York Harbor.

For the 2010 future condition without the project, the dry weather sanitary sewage flow is expected to be 125.5 MGD. This would result in the WPCP treating a peak wet weather sewage flow in the future of 214.5 MGD beyond the 125.5 MGD. The treated peak flow of 214.5 MGD would be less than the presently treated peak flow of 218 MGD. Therefore, for a given storm event, larger dry weather sewage flows would result in less CSO being treated at the WPCP and more being discharged into New York Harbor.

For the 2025 future condition without the project, the dry weather sanitary sewage flow is expected to be 132.9 MGD. This would result in the WPCP treating a peak wet weather sewage flow in the future of 207.1 MGD beyond the 132.9 MGD. The treated peak flow of 207.1 MGD would be less than the presently treated peak flow of 218 MGD. Therefore, for a given storm event, larger dry weather sewage flows would result in less CSO being treated at the WPCP and more being discharged into New York Harbor.

Table 2-9. Summary of Combined Sewer Overflow Volumes – Annual Basis

	Outfall	Regulator	Existing w/1988 Rainfall		2010_w/o Project		2010_with Project		2025_w/o Project		2025_with Project	
			Overflow Volume (MG)	# Overflow Events	Overflow Volume (MG)	# Overflow Events	Overflow Volume	# Overflow Events	Overflow Volume (MG)	# Overflow Events	Overflow Volume	# Overflow Events
Project Area Outfalls	026	N-46	24.4	20	25.1	20	25.3	20	26.5	20	27.7	21
	027	N-45	86.9	14	90.1	14	93.5	14	96.1	14	102.1	15
	028	N-43	14.2	15	14.7	15	14.9	15	15.5	15	16.3	16
	029	N-42	6.9	13	7.0	13	7.1	13	7.5	13	7.9	14
	030	N-39,40	2.9	10	3.1	10	3.2	10	3.4	11	3.6	11
	032	N36,37	1.9	9	2.0	10	2.0	9	2.2	9	2.3	10
	033	N-33	17.2	13	17.8	13	18.1	13	19.3	13	20.9	13
	047	N-35	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	048	N-41	4.4	11	4.5	11	4.7	11	4.8	12	5.1	12
	052	N-44	1.9	8	1.9	8	2.0	8	2.0	8	2.1	9
	Total Annual Overflow (MG) - Project Area		**160.7**		**166.3**		**170.8**		**177.4**		**188.1**	
Outfalls Outside the Project Area	018	N-1	0.1	1	0.1	1	0.1	1	0.1	1	0.1	1
	045	N-2	10.3	13	10.6	13	10.7	13	11.3	13	11.9	13
	017	N-3	49.0	19	50.3	21	50.6	21	53.5	22	56.5	22
	016	N-4	2.5	9	2.6	9	2.6	9	2.8	9	3.0	9
	014	N-5	3.4	10	3.5	11	3.6	11	3.8	11	4.0	12
	013	N-6	1.1	5	1.1	5	1.1	5	1.2	5	1.3	5
	012	N-7	1.5	6	1.6	6	1.6	6	1.7	6	1.8	8
	055	N-8	1.5	6	1.6	6	1.6	6	1.7	6	1.8	6
	011	N-9	2.3	11	2.3	11	2.4	11	2.5	12	2.6	12
	010	N-10,11,12	12.1	14	12.3	14	12.4	14	13.0	14	13.5	15
	009	N-13	2.5	10	2.5	11	2.5	11	2.6	11	2.7	11
	008	N-14	24.0	32	24.2	32	24.3	32	24.8	32	25.3	32
	007	N-15	0.8	5	0.9	5	0.9	5	0.9	5	1.0	5
	006	N-16	64.9	21	66.6	21	67.0	21	70.7	22	74.3	24
	005	N-17	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	004	N-18	3.6	6	3.6	7	3.6	7	3.7	7	3.8	7
	003	N-19	5.1	12	5.2	12	5.2	12	5.6	13	6.0	12
	002	N-20,21,21A,21B	58.0	56	59.4	57	59.4	57	63.3	56	66.6	60
	044	N-22	0.7	2	0.7	2	0.7	2	0.7	2	0.8	2
	043	N-23	115.2	19	118.8	19	119.7	19	127.1	19	134.2	20
	042	N-24	2.5	9	2.5	9	2.5	9	2.6	9	2.7	9
	041	N-25	1.5	6	1.5	6	1.5	6	1.6	6	1.6	6
	040	N-26,26A	24.6	13	25.5	13	25.8	13	27.5	13	29.2	13
	039	N-27	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	038	N-28	2.4	6	2.4	6	2.4	6	2.5	6	2.5	6
	046	N-29A	5.5	10	5.6	10	5.6	10	6.0	10	6.3	11
	037	N-29	0.7	2	0.7	2	0.7	2	0.7	2	0.7	2
	036	N-30	17.1	15	17.6	15	17.8	15	18.9	15	20.0	17
	035	N-31	8.5	14	8.7	14	8.8	14	9.2	14	9.6	15
	034	N-32	8.2	14	8.5	14	8.5	14	9.0	14	9.4	15
	031	N-38	4.9	12	5.1	12	5.2	12	5.5	12	5.8	12
	025	N-47	18.4	14	19.0	14	19.3	14	20.3	15	21.5	17
	024	N-48,49	17.2	14	17.7	14	17.9	14	18.9	14	19.9	15
	023	N-50	44.7	14	46.4	14	47.1	14	49.9	14	52.9	16
	022	N-51	13.3	14	13.8	14	14.0	14	14.9	14	15.7	14
	049	N-52	19.6	38	20.0	27	20.1	27	21.0	27	21.8	29
	050	N-53	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0
	021	N-54	6.1	13	6.3	14	6.4	14	6.7	14	7.0	14
	020	N-55	15.6	16	16.0	16	16.2	16	16.9	17	17.8	18
	019	N-56	5.5	14	5.7	14	5.8	14	6.1	14	6.5	14
	Total Annual Overflow (MG) - Non-Project Area		**574.7**		**591.2**		**595.6**		**629.3**		**661.9**	
	Total Overflow Volume (MG) North River WPCP Drainage area		**735.5**		**757.5**		**766.4**		**806.7**		**850.0**	
	Increase in Annual CSO (MG) from non-Project Growth				**22.1**		**0.0**		**71.2**		**0.0**	
	Increase in Annual CSO (MG) from the Project				**0.0**		**8.9**		**0.0**		**43.4**	

Table 2-10. Summary of Combined Sewer Overflow Volumes – Event Basis

	Outfall	Regulator		Existing w/1988 Rainfall		2010_w/o Project			2010_with Project			2025_w/o Project		2025_with Project	
			Overflow Volume (MG)	Overflow/Event Volume (MG)	# Overflow Events	Overflow/Event Volume (MG)	# Overflow Events	Overflow Volume	Overflow/Event Volume (MG)	# Overflow Events	Overflow Volume	Overflow/Event Volume (MG)	# Overflow Events	Overflow/Event Volume (MG)	# Overflow Events
Project Area Outfalls	026	N-46	24.4	1.2	20	1.3	20	25.3	1.3	20	26.5	1.3	20	1.3	21
	027	N-45	86.9	6.2	14	6.4	14	93.5	6.7	14	96.1	6.9	14	6.8	15
	028	N-43	14.2	0.9	15	1.0	15	14.9	1.0	15	15.5	1.0	15	1.0	16
	029	N-42	6.9	0.5	13	0.5	13	7.1	0.5	13	7.5	0.6	13	0.6	14
	030	N-39,40	2.9	0.3	10	0.3	10	3.2	0.3	10	3.4	0.3	11	0.3	11
	032	N36,37	1.9	0.2	9	0.2	9	2.0	0.2	9	2.2	0.2	9	0.3	9
	033	N-33	17.2	1.3	13	1.4	13	18.1	1.4	13	19.3	1.5	13	1.6	13
	047	N-35	0.0	0.0	0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0
	048	N-41	4.4	0.4	11	0.4	11	4.7	0.4	11	4.8	0.4	12	0.4	12
	052	N-44	1.9	0.2	8	0.2	8	2.0	0.2	8	2.0	0.3	8	0.2	9
			160.7	**11.4**		**11.8**		**170.8**	**12.1**		**177.4**	**12.5**		**12.6**	
Outfalls Outside Project Area	018	N-1	0.1	0.1	1	0.1	1	0.1	0.1	1	0.1	0.1	1	0.1	1
	045	N-2	10.3	0.8	13	0.8	13	10.7	0.8	13	11.3	0.9	13	0.9	13
	017	N-3	49.0	2.6	19	2.4	21	50.6	2.4	21	53.5	2.4	22	2.6	22
	016	N-4	2.5	0.3	9	0.3	9	2.6	0.3	9	2.8	0.3	9	0.3	9
	014	N-5	3.4	0.3	10	0.3	11	3.6	0.3	11	3.8	0.3	11	0.3	12
	013	N-6	1.1	0.2	5	0.2	5	1.1	0.2	5	1.2	0.2	5	0.3	5
	012	N-7	1.5	0.3	6	0.3	6	1.6	0.3	6	1.7	0.3	6	0.3	8
	055	N-8	1.5	0.3	6	0.3	6	1.6	0.3	6	1.7	0.3	6	0.3	6
	011	N-9	2.3	0.2	11	0.2	11	2.4	0.2	11	2.5	0.2	12	0.2	12
	010	N-10,11,12	12.1	0.9	14	0.9	14	12.4	0.9	14	13.0	0.9	14	0.9	15
	009	N-13	2.5	0.3	10	0.2	11	2.5	0.2	11	2.6	0.2	11	0.2	11
	008	N-14	24.0	0.8	32	0.8	32	24.3	0.8	32	24.8	0.8	32	0.8	32
	007	N-15	0.8	0.2	5	0.2	5	0.9	0.2	5	0.9	0.2	5	0.2	5
	006	N-16	64.9	3.1	21	3.2	21	67.0	3.2	21	70.7	3.2	22	3.2	24
	005	N-17	0.0		0		0	0.0		0	0.0		0		0
	004	N-18	3.6	0.6	6	0.5	7	3.6	0.5	7	3.7	0.5	7	0.5	7
	003	N-19	5.1	0.4	12	0.4	12	5.2	0.4	12	5.6	0.4	13	0.5	12
	002	N-20,21,21A,21B	58.0	1.0	56	1.0	57	59.4	1.0	57	63.3	1.1	56	1.1	60
	044	N-22	0.7	0.3	2	0.4	2	0.7	0.4	2	0.7	0.4	2	0.4	2
	043	N-23	115.2	6.1	19	6.3	19	119.7	6.3	19	127.1	6.7	19	6.7	20
	042	N-24	2.5	0.3	9	0.3	9	2.5	0.3	9	2.6	0.3	9	0.3	9
	041	N-25	1.5	0.3	6	0.3	6	1.5	0.3	6	1.6	0.3	6	0.3	6
	040	N-26,26A	24.6	1.9	13	2.0	13	25.8	2.0	13	27.5	2.1	13	2.2	13
	039	N-27	0.0		0		0	0.0		0	0.0		0		0
	038	N-28	2.4	0.4	6	0.4	6	2.4	0.4	6	2.5	0.4	6	0.4	6
	046	N-29A	5.5	0.5	10	0.6	10	5.6	0.6	10	6.0	0.6	10	0.6	11
	037	N-29	0.7	0.3	2	0.3	2	0.7	0.3	2	0.7	0.3	2	0.4	2
	036	N-30	17.1	1.1	15	1.2	15	17.8	1.2	15	18.9	1.3	15	1.2	17
	035	N-31	8.5	0.6	14	0.6	14	8.8	0.6	14	9.2	0.7	14	0.7	15
	034	N-32	8.2	0.6	14	0.6	14	8.5	0.6	14	9.0	0.6	14	0.6	15
	031	N-38	4.9	0.4	12	0.4	12	5.2	0.4	12	5.5	0.5	12	0.5	12
	025	N-47	18.4	1.3	14	1.4	14	19.3	1.4	14	20.3	1.4	15	1.3	17
	024	N-48,49	17.2	1.2	14	1.3	14	17.9	1.3	14	18.9	1.4	14	1.3	15
	023	N-50	44.7	3.2	14	3.3	14	47.1	3.4	14	49.9	3.6	14	3.5	16
	022	N-51	13.3	1.0	14	1.0	14	14.0	1.0	14	14.9	1.1	14	1.1	14
	049	N-52	19.6	0.5	38	0.7	27	20.1	0.7	27	21.0	0.8	27	0.8	29
	050	N-53	0.1		0		0	0.1		0	0.1		0		0
	021	N-54	6.1	0.5	13	0.5	14	6.4	0.5	14	6.7	0.5	14	0.5	14
	020	N-55	15.6	1.0	16	1.0	16	16.2	1.0	16	16.9	1.0	17	1.0	18
	019	N-56	5.5	0.4	14	0.4	14	5.8	0.4	14	6.1	0.4	14	0.5	14
	Total Annual Overflow (MG) - Non-Project Area		**574.7**	**34.1**		**34.8**		**595.6**	**35.1**		**629.3**	**36.6**		**37.0**	
	Total Overflow Volume (MG) North River WPCP Drainage area		**735.5**	**45.4**		**46.6**		**766.4**	**47.2**		**806.7**	**49.1**		**49.6**	
	Increase in Annual CSO (MG) from non-Project Growth					**1.2**			**0.0**		**71.2**	**1.9**		**0.0**	
	Increase in Annual CSO (MG) from the Project					**0.0**		**8.9**	**0.6**			**0.0**		**0.5**	

Table 2-10 provides a summary of the average volume of combined sewage overflowing during a typical storm event from each outfall in the North River WPCP service area. It is calculated as the total annual overflow volume divided by the number of overflow occurrences at that location.

The results of Tables 2-9 and 2-10 are summarized in Tables 2-11 through 2-14 in a more consolidated format. It should be noted that minor differences in numbers reported herein are related to round off and truncation errors.

Table 2-11 shows that conservative projections of anticipated growth within the North River drainage area by 2010 would cause an additional increase in annual CSO overflow volumes of about 3.0 percent throughout the drainage area with some variance depending on the location of the outfalls.

Table 2-11. Overflow Statistics for 2010 Without Proposed Action

	Existing Conditions – Overflow Volume (MG)	2010 CSO Overflow Volume (MG) – No project	Increase in CSO (MG)	Change in CSO %	Increase in CSO (MG/Event)
Entire North River WPCP area	735.5	757.5	22.1	3.0	1.2
Outfalls within Project Area	160.7	166.3	5.6	3.5	0.4
Outfalls Outside Project Area	574.7	591.2	16.5	2.9	0.7

Table 2-12 summarizes the anticipated impacts of the Project in the year 2010.

Table 2-12. Overflow Statistics for 2010 With Proposed Action

	2010 CSO Overflow Volume (MG) – No project	2010 CSO Overflow Volume (MG) – With project	Increase in CSO (MG)	Change in CSO %	Increase in CSO (MG/Event)
Entire North River WPCP area	757.5	766.4	8.9	1.1	0.6
Outfalls within Project Area	166.3	170.8	4.5	2.7	0.3
Outfalls Outside Project Area	591.2	595.6	4.4	0.7	0.3

Table 2-12 shows that conservative projections of anticipated growth within the North River drainage area by 2010 with the project would cause an additional increase in annual CSO overflow volumes of about 1.1 percent throughout the drainage area with some variance depending on the location of the outfalls.

The results for the future year 2025 are summarized in Table 2-13.

Table 2-13. Overflow Statistics for 2025 Without Proposed Action

	Existing Conditions – Overflow Volume (MG)	2025 CSO Overflow Volume (MG) – No project	Increase in CSO (MG)	Change in CSO %	Increase in CSO (MG/Event)
Entire North River WPCP area	735.5	806.7	71.2	9.7	3.7
Outfalls within Project Area	160.7	177.4	16.7	10.4	1.1
Outfalls Outside Project Area	574.7	629.3	54.6	9.5	2.5

Table 2-13 shows that conservative projections of anticipated growth within the North River drainage area by 2025 would cause an additional increase in annual CSO overflow volumes by about 9.7 percent throughout the drainage area with some variance depending on the location of the outfalls.

Table 2-14 summarizes the anticipated impacts of the project in the year 2025.

Table 2-14. Overflow Statistics for 2025 With Proposed Action

	2025 CSO Overflow Volume (MG) – No project	2025 CSO Overflow Volume (MG) – With project	Increase in CSO (MG)	Change in CSO %	Increase in CSO (MG/Event)
Entire North River WPCP area	806.7	850.3	50.2	6.3	0.5
Outfalls within Project Area	177.4	190.6	16.7	9.6	0.1
Outfalls Outside Project Area	629.3	659.6	33.3	5.3	0.4

Table 2-14 shows that conservative projections of anticipated growth within the North River drainage area by 2025 with the Project would cause an additional increase in annual CSO overflow volumes by about 6.3 percent throughout the drainage area with some variance depending on the location of the outfalls.

Overall, the Project is estimated to increase combined sewer overflows in 2010 by about 1.1 percent and in 2025 by about 6.3 percent in the North River WPCP drainage area. These results should be considered conservation and a high-end estimate for the following reasons.

- Drainage Plan changes anticipated by DEP to modify the sewer system, or other potential changes being assessed to regulator structures in the Project Area, are not included in these estimates of future overflows. Regulator changes to raise weirs or increase branch interceptor capacity could reduce CSO for times when the peak North River WPCP flow of 340 MGD has not been reached and is not a limiting factor.

- Fairly conservative assumptions were made relative to the amount of rainfall retained on the green roofs and open areas. Recent testing data indicates that the amount of rain retained on green roofs could be 0.5 to 1.0 inches, both being far greater than the 0.25 inches assumed in the analyses.

- Another conservative assumption made here-in was that the Caemmeron Yards runoff is routed into the combined sewers not into the storm sewer and directly to the Hudson River.

These potential changes were not included so that if any bias exists it would be to over-calculate CSO overflows so the water quality impacts calculated in section 3 of this report would not be underestimated.

The modeling analyses conducted (Tables 2-9 and 2-10) provides an estimate of the frequency of combined sewer overflows from outfalls within the Project Area and outside the Project Area but within the North River WPCP drainage area. This table shows that the combined sewers are calculated to overflow from a low of zero times a year to a high of 56 times a year. It appears that the average or typical overflow frequency appears to be between 10 and 15 times a year.

The frequency of CSOs events within the project and within the North River area is summarized in Table 2-15.

Table 2-15. Summary of CSO Overflow Frequency Within The North River WPCP Area

	Range in 2010 CSO Overflow Frequency (#/yr) - No project	Range in 2010 CSO Overflow Frequency (#/yr) – With project	Range in 2025 CSO Overflow Frequency (#/yr) - No project	Range in 2025 CSO Overflow Frequency (#/yr) – With project
Outfalls within Project Area	0 to 20	0 to 20	0 to 20	0 to 21
Outfalls Outside Project Area	0 to 57	0 to 57	0 to 56	0 to 60

Overall, the modeling analysis indicates that there is only a very slight increase in the number of times individual CSOs overflow from the combined sewer system associated with the

Project. None of the outfall areas are calculated to have an increase in overflow frequency associated with the Project for the 2010 future scenario.

For the future 2025 year, five of the ten outfalls in or adjacent to the Project Area are calculated to have an increase of one additional overflow occurrence a year. For 2025, a select few outfalls outside the Project Area will have a higher increase in the number of overflow occurrences each year, with the highest being 4 additional overflow occurrences at one outfall. Thirty-one of the outfalls are calculated, for 2025, to have no increase in the number of overflow occurrences associated with the Project. Thirteen outfalls are calculated, for 2025, to have one additional overflow occurrence in a typical year associated with the Project. Six outfalls are calculated to have two additional overflow occurrences in a typical year associated with the Project for the future year 2025.

In summary, these analyses estimate that in 2025 without the project, the North River CSOs will overflow about 2.3 percent more frequently then they do now because of the increased base flow in the sewers. The project would result in an additional increase of about 4.7 percent in overflow occurrences. For the purpose of clarification, an overflow occurrence is defined herein to be a single overflow event at a single CSO outfall location.

2.5.4 CSO Overflow Quality

The water quality impact analyses, described in Section 3, required estimation of the total mass of pollutants that would be discharged from the CSOs not just the volume of overflow. As indicated in earlier sections of this report, CSO overflows are a combination of sanitary sewage and storm water. During a rainfall event the runoff from streets and other impervious surfaces picks up pollutants that are deposited on those surfaces. When the street runoff enters the combined sewer system, it is mixed with the more concentrated sanitary sewage to form combined sewage. This mixture is what is discharged to the Hudson River when the North River WPCP cannot treat all of the flow directed towards it.

Street runoff (storm water) tends to have lower concentrations of pollutants than does sanitary sewage. Therefore, during large rainfall events overflows have concentrations that more resemble storm water than sanitary sewage since during these larger storms there is a larger volume of runoff in the combined sewage than there is sanitary wastewater. Concentrations of pollutants would be higher during smaller rainfall events because the pollutants are less diluted when overflows do occur within the North River area on an infrequent basis, there would be a tendency for the combined sewage quality to be more reflective of weaker storm water since it is the larger events that cause overflows and the smaller events with the stronger combined sewage are routed to the WPCP. It is the product of concentration and sewage volume that form the mass of pollutants for use in the water quality impact analyses.

The mass of CSO pollutants that would be discharged in the simulation periods were calculated by tracking the fraction of storm water and fraction of sanitary sewage in each outfall during each hour of overflow during each simulation period. A concentration was then applied for each pollutant to the fraction of sanitary or fraction of storm water in the overflow.

Concentrations applied to sanitary sewage and to storm water are listed below in Table 2-16.

Table 2-16. Concentrations of Sanitary Waste and Stormwater Used to Calculate CSO Mass Loadings

Water Quality Constituent	Sanitary Waste Concentration (mg/l)	Stormwater Concentration (mg/l)	Typical CSO Concentration (mg/l)
Total Suspended Solids - TSS	150	27	39.3
CBOD-5	-	-	29
Total Nitrogen - TN	26.1	2.4	4.8
Total Phosphorus - TP	4.75	0.36	0.8
Total Coliform Bacteria – units = No./100ml	15,000,000	200,000	1,680,000
Zinc – units = ug/l	420	154	180
Lead – units = ug/l	66	28	32
Copper – units = ug/l	220	35	54

Sanitary sewage concentrations of CBOD-5, total nitrogen, and total phosphorus were defined based on 2003 annual average influent raw sewage measurements for North River WPCP. Concentrations of metals in the sanitary wastewater was taken as a worst month 2003 raw sewage concentration to assure a worst case analysis was being conducted. As DEP does not routinely measure raw sewage influent concentrations of total coliform bacteria, a raw sewage concentration was assigned based on previous analyses conducted. Stormwater concentrations were assigned based on storm water quality measurements made by DEP during numerous CSO facility planning studies over the past 20 years.

Also shown in the far right column of Table 2-16 is an estimate of the CSO concentration of various constituents assuming, that at a certain point during an overflow event, 90 percent of the CSO consists of storm water and 10 percent consists of sanitary sewage. This calculation emulates the way CSO concentrations were estimated for the mass loading analyses. Application of this process in the water quality impact analyses described in Section 3 varied for practical reasons but was consistent in results with this approach.

Water quality impact calculations, as described in Section 3, use the actual mass of combined sewage entering New York Harbor for each hour of the simulation periods. A summary of CSO pollutant mass loadings resulting from the changes in the base sanitary sewage flow to the increased flows described above is provided in Table 2-17.

Table 2-17. Incremental Changes in Average CSO Event Mass Discharges

		Changes From the Current Conditions			
Water Quality Constituent	**2003 Conditions**	**2010 Without Project**	**2010 With Project**	**2025 Without Project**	**2025 With Project**
Total Suspended Solids - TSS	5,697	150	212	484	778
BOD-5	3,416	90	126	290	466
Total Nitrogen - TN	767	20.2	28.5	65.3	104.8
Total Phosphorus - TP	132	3.5	4.9	11.2	18.1
Total Coliform Bacteria	-	2.6%	3.7%	8.5%	13.6%
Zinc	23.6	0.6	0.9	2.0	3.2
Lead	4.1	0.1	0.2	0.3	0.6
Copper	7.9	0.2	0.3	0.7	1.1

Note: Numbers represent pounds of each constituent per event except for coliform bacteria.

The calculated loadings of each pollutant during each event tend to be relatively small compared to other discharged mass loadings to the Hudson River. For example, as shown in Table 2-2, the average TSS load currently discharged from the North River WPCP is 17,236 pounds per day, while the incremental change in CSO mass loading during a typical event would be 778 pounds per event (2025 w/project). Similarly, the WPCP discharges 21,291 pounds a day of total nitrogen (organic nitrogen + ammonia + nitrate + nitrite) while a typical CSO event is estimated to discharge 104.8 pounds.

2.5.5 Impacts of Conservative Assumptions on CSO Overflows

A number of assumptions were made as part of these analyses to assure that worst-case impacts on water quality were being evaluated. These assumptions tended favor a higher estimate of the volume of combined sewage that could be overflowing from the North River WPCP service area and presumably from the Project Area. These assumptions follow.

1. Caemmerer Yard – The fate of storm water from the rail yards was unknown when the model of the sewer system was being constructed. Information that was readily available did not show whether storm water from this area was being discharged into the Hudson River or was entering the combined sewer system. Therefore for the existing conditions assessment of the volume of combined sewer overflow, this area was set-up so that runoff flows entered the combined sewer system. This assumption would tend of over-estimate the amount of combined sewage generated. In all future conditions analysis this was also the case except for areas where open space was planned. For planned open space areas, runoff was treated as detailed in #2 below. No credit was taken here-in for any planned runoff collection or recycling systems planed for the multi-use facility.

2. Green Roof and Open Areas – The Proposed Actions include the use of green rooftops and open spaces to reduce runoff from previously impervious areas. For the purpose of this analysis, it was assumed that a total of about 66 acres of impervious surfaces would become green open spaces, parks or green roof tops and therefore absorb a certain amount of rainfall. As no information was available on the design of these rooftops or the performance in the New York City environment, an assumption was made that these spaces would absorb the first 0.25 inches of rainfall. Rainfall amounts after the first 0.25 inches would runoff these areas as if they were 100 percent impervious.

   Information obtained from Earth Pledge shows that a green roof could reduce annual runoff by 50 percent. The information also shows that retention of the first 0.5 inches of rainfall is reasonable. In addition, the peak flow rate of runoff from a green roof could be reduced by 50 percent and there could be a delay in the time that it takes for runoff flows to start. This delay can vary but could be up to a few hours.

All of these factors, if considered in the analyses would result in reductions of runoff entering the combined sewer system and presumably in the amount of combined sewage generated from the area.

3. SCADA System - New York City is automating regulators in the North River drainage area and is implementing a SCADA system in the City to control the regulators. These actions are being taken to better manage the combined sewer collection system and to enhance the amount of wet weather sewage processed at the WPCPs. No credit was taken for this action in estimating the volume of combined sewage overflowing from the sewer system.

   To comply with the newly negotiated CSO Consent Order and outlined on page 2-17, DEP plans to have the regulator modifications completed in 2010.

   Ideally the SCADA system will supply information on the combined sewage in the collection system to WPCP plant personnel so that they will be better able to manage wet weather flow and maximize the amount of time the WPCPs are able to operate at their maximum design capacity. In other words, the system should increase the amount of time the North River WPCP operates at or near 340 MGD. This would tend to reduce CSO flows that would normally have been discharged untreated. This increase treatment of combined sewage was not accounted for in future condition assessments.

4. Drainage Plan Improvements – As indicated in earlier sections, DEP conducted hydraulic calculations to assess any improvements in the combined sewers that would be necessitated by the Hudson Yards Proposed Action. These calculations resulted in recommendations to replace or improve elements of the collection system.

   DEP is also examining other improvements that would have the potential to reduce CSO overflows through the system including modifications to the regulators to raise the diversion weir heights or to open up orifices and branch interceptors. Another change being investigated is the construction of high level storm sewers in streets. These storm sewers would transport runoff flow directly to the Hudson River keeping it out of the combined system and thereby reducing combined sewer overflows.

These types of modifications would result in transport of additional wet weather flow to the WPCP for times when the WPCP has not yet reached its maximum treatment capacity. Changes in regulators could be made to any of the 62 regulators in the collection system, providing they do not negatively impact upstream sewers and providing they do in fact serve to transfer additional flow to the WPCP. DEP has committed to make changes to regulator structures in the area of the proposed action so that the action will not result in additional overflows from the project area when the WPC is operating below its' design capacity. DEP had not proposed any formal changes to any of the 62 regulators at the time this report was developed. Therefore, no credit was taken for this potential reduction in the estimates of CSO overflows. Similar changes could also be made outside of the Project Area as well to help reduce future overflows.

In summary, the DEP is preparing an Amended Drainage Plan for the rezoning area that includes upgrades to sewers that would accommodate the full build-out allowed under the proposed rezoning. The conceptual drainage plan is expected to include upgrades to the project area combined sewers. Additionally, DEP is currently in the process of studying the feasibility of capturing storm water runoff and conveying this flow directly to the Hudson River by a separate storm sewer system (high level storm sewer system) within three sub-drainage areas in the rezoning area. This would reduce the storm water flows to the combined sewer system if implemented. Also, the City shall modify, as required, the regulators receiving flow from the rezoning area to divert two times the proposed dry weather flow to the interceptor and the WPCP in order to avoid additional CSOs in the future in the project area for storms when the North River Plant's maximum capacity is not utilized.

Since no formal design change were prepared at the time these analyses were conducted, the assumption made herein was to not make any changes in the sewer system model. This assumption was a worst case assumption that would result in an overstatement of future CSOs and the associated water quality impacts. The implications of these assumptions included:

- An overestimate of the amount of street runoff entering the combined sewer system where DEP would provide separate storm sewers.
- An overestimate of the amount of CSO volume lost from the system where DEP would raise weirs within regulators.

Overall, these assumptions with those noted above are conservative in that they tend to overestimate the potential for future volumes of CSOs. Naturally such an overestimate would represent worst case conditions since it would also tend to overestimate the water quality impacts of the proposed project.

SECTION 3

HUDSON RIVER WATER QUALITY

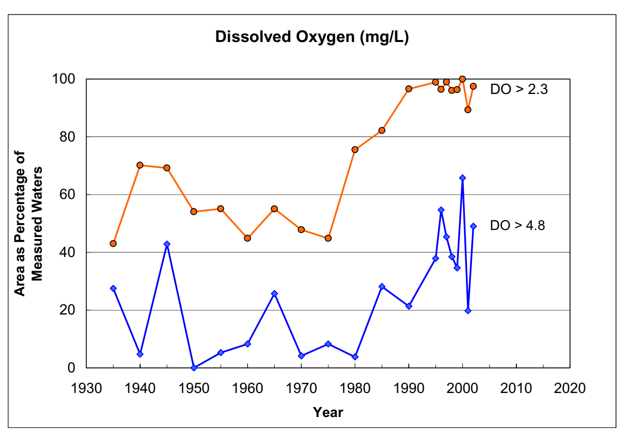
Readily available information was compiled to complete analyses of the impact of additional sewage flow associated with the Proposed Action on water quality in the Hudson River. Information was compiled for inclusion in the FGEIS on water quality concentrations of such constituents such as total suspended solids, dissolved oxygen, total nitrogen, total phosphorus and a few different metals and bacteria. This data was mostly compiled from the Hudson River and a nearby location in the Harlem River based on ambient water quality monitoring data collected by the DEP Harbor Survey Section of the Bureau of Wastewater Treatment (BWT) and others. This information was reviewed to assess the existing water quality near the area of the Proposed Action.

In addition, analyses were conducted to project the impacts of changes in pollutant loadings on water quality. These analyses relied on the use of a water quality model of New York Harbor. This modeling calculation allowed estimations to be made of impacts of the Proposed Action on water quality including any potential changes in dissolved oxygen (DO), total coliform bacteria, total suspended solids, total nitrogen, total phosphorus, copper, lead and zinc.

3.1 EXISTING WATER QUALITY DATA

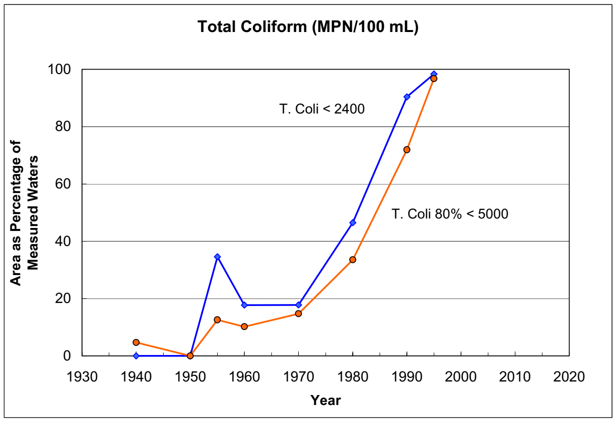
Water quality in the Hudson River is impacted by many factors including both wastewater treatment plant discharges and combined sewer overflows from both the New York and the New Jersey sides of the Hudson River. NYSDEC classifies the Hudson River in the area of the proposed action as Class I requiring dissolved oxygen concentrations to be greater than 4.0 mg/L at all times, total coliform bacteria to have a 30-day geometric mean of less than 10,000/100 ML and a fecal coliform 30-day geometric mean of 2,000/100 ML.

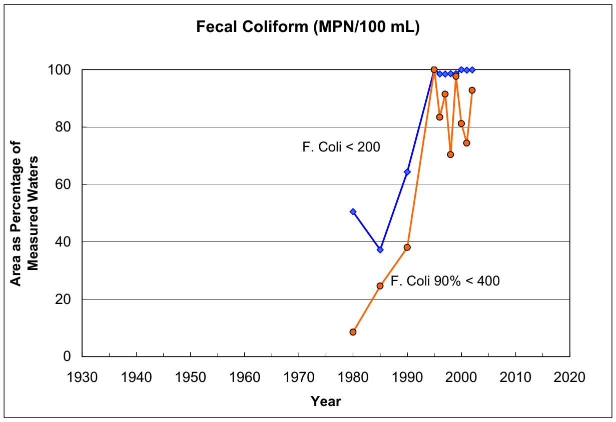
3.1.1 New York Harbor Water Quality – Far Field



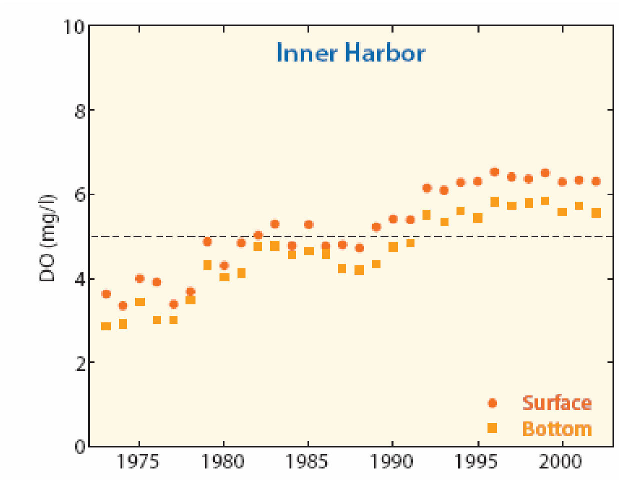
There have been continuous improvements in New York Harbor water quality over the past few decades associated with improvements in sewage treatment and best management practices applied to the combined sewage system. These graphics show that dissolved oxygen concentrations in New York Harbor have improved to the point that most of the harbor provides an aquatic habitat that is satisfactory for fish survival (D.O. >2.3 mg/l, USEPA, Marine D.O. Criteria). In addition, water quality has reached the point where more than 50 percent of the harbor waters are satisfactory for fish propagation (D.O. > 4.8 mg/l, USEPA, Marine D.O. Criteria).

In addition, sanitary water quality has improved to the point that almost 100 percent of the harbor waters are in compliance with NYSDEC total coliform SB bathing standards (bathing criteria - geometric mean less than 2,400 MPN/100 mL – blue line and 80 % of samples are less than 5,000 MPN/100 mL – orange line). Sanitary water quality as measured by fecal coliform bacteria shows similar results, with nearly all areas close to or in full compliance with SB bathing standards (bathing criteria - median less than 200 MPN/100 mL – blue line) (see Figure at right top - orange line) (see Figure at right bottom). Most remaining problems in the harbor are associated with confined tributaries that are near large CSO outfalls.

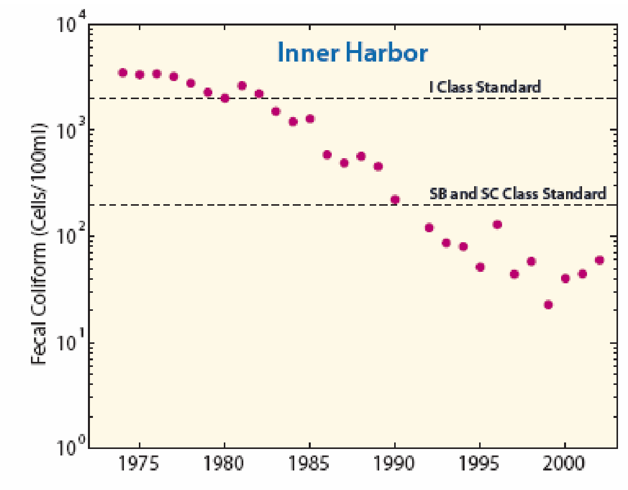




Dissolved oxygen concentrations in the area of the Harbor adjacent to Manhattan also show a general increasing trend (see Figure left). Summer average dissolved oxygen concentrations have increased in both the surface and bottom waters. Recently, summer average concentrations appear to have stabilized with bottom water concentrations averaging over 5 mg/l and surface concentrations over 6 mg/l.



Near Manhattan summer average coliform bacteria concentrations have also declined steadily over the past few decades. Similar to the dissolved oxygen data, summer average bacteria levels also appear to have leveled off, although there appears to be some recent fluctuations. Summer average fecal coliform concentrations near Manhattan are less than 100 per 100/ml.



As water quality has improved over time, the NYSDEC has moved away from listing the Hudson River as an impaired water because of dissolved oxygen or coliform bacteria levels. NYSDEC has not listed the Hudson as being impaired for aquatic life or recreational uses on either the 2002 or the recently released 2004 303(d) list. The relevant section of the NYSDEC 2004 303(d) list is shown in Figure 3-1.

The State of New Jersey has recently indicated on their 2004 integrated listing that the Hudson aquatic life and recreation uses are attained based on the Interstate Environmental Commission (IEC) sampling data for dissolved oxygen and fecal coliform bacteria. Relevant sections of the New Jersey's consolidated listing (www.state.NJ.US/DEP/wmm/sgwqt/water/integratedlist/integratedlist2004.html) are shown in the following graphics.

Station	Waterbody	SW Class	Years	FC SWQS (geomean/100ml)	FC (Top) Geomean (per 100ml)	Sample Number	FC (bottom) Geomean (per 100ml)	Sample Number	FC Assessment
KI	Kill Van Kull	SE2/SE3	1997-2001	770/1500	48	68	25	42	Attain
K2	Kill Van Kull	SE3	1997-2001	1500	45	62	9	41	Attain
K3	Arthur Kill	SE3	1997-2001	1500	11	63	110	39	Attain
K4	Arthur Kill	SE3	1997-2001	1500	55	67	53	41	Attain
K5	Arthur Kill	SE2	1997-2001	770	19	68	8	42	Attain
K5A	Raritan Bay	SE1	1997-2001	200(400)	10 (2%)	63	6 (0%)	40	Attain
K6	Raritan Bay	SE1	1997-2001	200(400)	2 (0%)	63	3 (0%)	40	Attain
N1	Hudson River	SE1	1997-2001	200(400)	29 (8%)	66	25 (3%)	36	Attain
N2	Hudson River	SE1/SE2	1997-2001	200(400)/770	34 (8%)	40	33(0%)	36	Attain
N3	Hudson River	SE2	1997-2001	770	47	40	46	35	Attain
N3A	Hudson River	SE2	1997-2001	770	48	41	42	35	Attain
N3B	Hudson River	SE2	1997-2001	770	46	67	37	36	Attain
N4	Hudson River	SE2	1997-2001	770	71	66	42	36	Attain
N5	Hudson River	SE2	1997-2001	770	45	66	17	37	Attain
N6	Hudson River	SE2	1997-2001	770	44	66	0	37	Attain
Location A –	Hackensack River, Secaucus	SE2	summer 2001	770	105	18			Attain
Location B –	Hudson River, Weehawken	SE2	summer 2001	770	115	18			Attain
Location C –	Upper NY Bay, Jersey City	SE2	summer 2001	770	16	18			Attain
Location D –	Newark Bay Hudson County Park;	SE3	summer 2001	1500	52	18			Attain
Location E –	Upper NY Bay, Jersey City	SE2	summer 2001	770	47	13			Attain

Assessment Results for Fecal Coliform in the NY-NJ Harbor Estuary

New York State — **Final 2004 Section 303(d) List** — **September 24, 2004**

Water Index Number	Waterbody Name (WI/PWL ID)	County	Type	Class	Cause/Pollutant	Source	Year
Part 1 - Individual Waterbody Segments with Impairment (con't)							
	Lower Hudson River Drainage Basin (con't)						
H-171-P848-	Esopus Creek, Upp (1307-0007) [6]	Ulster	River	A(T)	Silt/Sediment	Streambank Erosion	1998
H-202-P8f	* Sleepy Hollow Lake (1301-0059)	Greene	Lake	A	Silt/Sediment	Streambank Erosion	2002
H-204- 2- 7-P24	Kinderhook Lake (1310-0002)	Columbia	Lake	B	Phosphorus	Agric, On-site WTS	2002
H-235-11-P377	Snyders Lake (1301-0043)	Rensselaer	Lake	B	Phosphorus	Oxygen Dem/Sed.	2002
	Hackensack/Ramapo River Drainage Basin						
NJ-P1026	* Greenwood Lake (1501-0001)	Orange	Lake	B	Phosphorus	On-site WTS, Urban	2002
	Atlantic Ocean/Long Island Sound Drainage Basin						
(MW1.1) LB/GB-253	Coney Island Creek (1701-0008)	Kings	Estuary	I	D.O./Oxygen Demand	Urban/CSO, OWTS	1998
					Pathogens	Urban/CSO, OWTS	2002
(MW1.2) SI (portion 1)	* Arthur Kill, Class I, and minor tribs (1701-0010)	Richmond	Estuary	I	Floatables [7]	Urban/Storm/CSO	2002
(MW1.2) SI (portion 3)	* Newark Bay (1701-0183)	Richmond	Estuary	SD	Floatables [7]	Urban/Storm/CSO	2002
(MW1.2) SI (portion 4)	* Kill Van Kull (1701-0184)	Richmond	Estuary	SD	Floatables [7]	Urban/Storm/CSO	2002
(MW1.2) SI.P1039	Bradys Pond/Grassmere Lake (1701-0357)	Richmond	Lake	B	Phosphorus	On-site WTS, Urban	2002
(MW1.3) UB-EB- 1	Gowanus Canal (1701-0011)	Kings	Estuary	SD	D.O./Oxygen Demand	Urban/Storm/CSO	1998
(MW2.1) ER-LI- 4	**Newtown Creek and tidal tribs (1702-0002)**	Queens	Estuary	SD	**D.O./Oxygen Demand**	Urban/Storm/CSO	2004
(MW2.3) ER-1-5-P1043	Van Cortlandt Lake (1702-0008)	Bronx	Lake	B	Phosphorus	Urban Runoff	2002
(MW2.4) ER-3	Bronx River, Lower (1702-0006)	Bronx	Estuary	I	Pathogens	Urban/Storm/CSO	1998
					Oxygen Demand	Urban/Storm/CSO	2004
(MW2.4) ER-3	Bronx River, Middle, and tribs (1702-0106)	Bronx	River	B	Pathogens	Urban/Storm/CSO	2002
(MW2.4) ER-3	Bronx River, Upper, and tribs (1702-0107)	Westchester	River	C	D.O./Oxygen Demand	Urb/Storm Runoff	2002
					Pathogens	Urb/Storm Runoff	2004
(MW2.5) ER/LIS-LNB	Little Neck Bay (1702-0029)	Queens	Estuary	SB	Pathogens	Urban/Storm/CSO	1998
(MW2.5) ER-LI-12	**Flushing Creek/Bay (1702-0005)**	Queens	Estuary	I	**D.O./Oxygen Demand**	Urban/Storm/CSO	2004
(MW2.5) ER/LIS-LNB-19 thru 20	**Alley Creek/Little Neck Bay Trib (1702-0009)**	Queens	Estuary	I>SC	**Oxygen Demand**	Urban/Storm/CSO	2004
(MW3.1) LIS (portion 2a)	* Larchmont Harbor (1702-0116)	Westchester	Estuary	SB	Floatables	Urb/Storm, Municipl	2002
					Pathogens	Urb/Storm, Municipl	2002
(MW3.2) LIS- 2	**Hutchinson River, Lower, and tribs (1702-0003)**	Bronx	Estuary	SB	**D.O./Oxygen Demand**	Urban/Storm/CSO	2004
(MW3.2) LIS- 2	Hutchinson River, Middle, and tribs (1702-0074)	Westchester	River	B	Oil/Grease	Urb/Storm, Industr	2002
					D.O./Oxygen Demand	Urb/Storm, Industr	2002
					Pathogens	Urb/Storm, Industr	2002

Figure 3-1. NYSDEC 2004 Section 303(d) List for Section of New York Harbor Showing Water Bodies with Impairments for the Indicated Constituents

New Jersey has also listed the waters of the Hudson on sublists 1 and 2 for dissolved oxygen, fecal coliform bacteria as well as for copper, lead and nickel indicating attainment. Relevant sections of the New Jersey 2004 Integrated List of Waterbodies are shown on Figure 3-2A.

Assessment Results for Dissolved Oxygen in the NY-NJ Harbor Estuary

Station	Waterbody	SW Class	SWQS (not less than)	SWQS (24 hr avg.)	Years	DO: % violations Surface	DO: % violations Bottom	AL Use Attainment
KI	Kill Van Kull	SE2/SE3	4/3 mg/l	NA	1997-2001	0	0	Attain
K2	Kill Van Kull	SE3	4mg/l	NA	1997-2001	0	0	Attain
K3	Arthur Kill	SE3	4mg/l	NA	1997-2001	0	0	Attain
K4	Arthur Kill	SE3	4mg/l	NA	1997-2001	0	0	Attain
K5	Arthur Kill	SE2	3mg/l	NA	1997-2001	2	9	Attain
K5A	Raritan Bay	SE1	4mg/l	5mg/l	1997-2001	2	7	Attain
K6	Raritan Bay	SE1	4mg/l	5mg/l	1997-2001	0	0	Attain
N1	Hudson River	SE1	4mg/l	5mg/l	1997-2001	0	3	Attain
N2	Hudson River	SE1/SE2	4mg/l	5mg/l	1997-2001	0	2	Attain
N3	Hudson River	SE2	3mg/l	NA	1997-2001	0	0	Attain
N3A	Hudson River	SE2	3mg/l	NA	1997-2001	0	2	Attain
N3B	Hudson River	SE2	3mg/l	NA	1997-2001	1	1	Attain
N4	Hudson River	SE2	3mg/l	NA	1997-2001	0	6	Attain
N5	Hudson River	SE2	3mg/l	NA	1997-2001	0	3	Attain
N6	Hudson River	SE2	3mg/l	NA	1997-2001	0	1	Attain

However, New Jersey also lists sections of the Hudson River on their sublist 3 (Figure 3-2B) indicating that additional information is required to determine whether the uses are fully attained. Specifically, NJDEP is concerned here about fecal coliform bacteria impacting near shore uses and that data on near shore coliform levels is lacking.

3.1.2 Hudson River Water Quality – Near Field

The North River WPCP discharges into the Hudson River. In addition, CSOs located within the overall North River WPCP drainage area discharge to the Hudson River and northern portions of the Harlem River. The Hudson River has been classified by the NYSDEC as a Class I water, which indicates water suitable for secondary contact recreation (i.e., fishing and boating).

NYCDEP maintains two sampling stations, N-3B and N-4, in the Hudson River for conventional pollutants and additional water quality data as part of its annual harbor survey. Station N-3B is located at West 125th Street and station N-4 is located at West 42nd Street. In addition, during 1991 as part of a U.S. Environmental Protection Agency (USEPA) study, data concerning ambient concentrations of several heavy metals were collected from stations throughout the harbor complex including the Hudson River. USEPA stations within the Hudson River include H2 at West 42nd Street, H3 at West 125th Street and H4 at Spuyten Duyvil. The

Wtrshd Region	WMA	Station Name/Waterbody	Site ID	Parameters	Data Source
Northeast	06	Hilltop Left and Right	Hilltop Left and Right	Fecal Coliform	Twp of Pequannock
Atlantic Coast	14	Hobb Lake-14	Great Times Camp	Fecal Coliform	Camden Co HD
Northeast	04	Hohokus Brook at Old Mill Rd in Franklln Lakes	AN0283	Benthic Macroinvertebrates	NJDEP AMNET
Northwest	01	Holiday Lake-01	Holiday Lakes	Fecal Coliform	Sussex Co HD
Raritan	08	Holland Brook at Holland Brook Rd in ReadIngton	AN0342	Benthic Macroinvertebrates	NJDEP AMNET
Raritan	08	Holland Brook at South Branch Rd in Branchburg	EWQ0343	Phosphorus, Temperature, Dissolved Oxygen, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	EWQ
Atlantic Coast	12	Hollow Brook at Route 35 in Neptune Twnshp	10	Phosphorus, Nitrate	Monmouth Co HD
Lower Delaware	19	Holly Lake-19	Holly Lake Association	Fecal Coliform	Burlington Co HD
Northwest	01	Honey Run at Rt 519 in Hope	AN0046	Benthic Macroinvertebrates	NJDEP AMNET
Northwest	01	Honey Run near Hope	01445900	Phosphorus, Temperature, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
Atlantic Coast	13	Horicon Lake-13	Lake Horicon Beach - North and South	Fecal Coliform	Ocean Co HD
Raritan	08	Horseshoe Lake-08	Horseshoe Lake 1 and Lake 2	Fecal Coliform	Roxbury Twp Board of Health
Atlantic Coast	15	Hospitality Branch at Blue Bell Rd near Cecil	01411035	Phosphorus, Temperature, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
Atlantic Coast	15	Hospitality Branch near Cecil	01411050	Phosphorus, Fecal Coliform, Dissolved Oxygen, Nitrate, Dissolved Solids, Unionized Ammonia	NJDEP/USGS Data
Lower Delaware	17	Hudson Lake-17	Sportsman Club	Fecal Coliform	Salem Co HD
Northeast	05	Hudson River	N1, N2, N3, N3A, N3B, N4, N5, N6	Fecal Coliform, Dissolved Oxygen	IEC
Northeast	05	Hudson River - NYC & Battery	HR1, HR2	Copper, Lead, Nickel	EPA, HEP (GLEC), NJDEP Fish Tissue Monitoring
Northeast	05	Hudson River at G.W. Bridge	HR4	Copper, Lead, Nickel	EPA, HEP (GLEC), NJDEP Fish Tissue Monitoring
Northeast	05	Hudson River near Yonkers	HR7	Copper, Lead, Nickel	EPA, HEP (GLEC), NJDEP Fish Tissue Monitoring
Northeast	05	Hudson River- NYC Area	Hudson River- NYC Area	Copper, Lead, Nickel	EPA, HEP (GLEC), NJDEP Fish Tissue Monitoring
Lower Delaware	18	Hurff Lake	Hurff Lake	Fecal Coliform	Gloucester Co HD
Atlantic Coast	12	Husky Brook at South St in Eatontown	33	Phosphorus, Nitrate	Monmouth Co HD
Northwest	01	Iliff Lake-01	Lake Iliff	Fecal Coliform	Sussex Co HD
Raritan	08	India Brook at Calais Rd BR#733 in Randolph	AN0344A	Benthic Macroinvertebrates	NJDEP AMNET
Raritan	08	India Brook at Mountalnside Rd in Mendham	AN0345	Benthic Macroinvertebrates	NJDEP AMNET
Raritan	08	India Brook Unknown Trib at Calais Rd in Randolph	AN0344	Benthic Macroinvertebrates	NJDEP AMNET

Figure 3-2a. New Jersey DEP 2004 Integrated List for Section of New York Harbor Showing Attainment of Uses for the Indicated Constituents

Sublist	Wtrshd Region	WMA	Station Name/Waterbody	Site ID	Parameters
3	Atlantic Coast	15	Hospitality Branch at Blue Bell Rd in Monroe	AN0627	Benthic Macroinvertebrates
3	Atlantic Coast	15	Hospitality Branch at Rt 538 in Monroe	AN0628	Benthic Macroinvertebrates
3	Atlantic Coast	15	Hospitality Branch at Rt 54 in Folsom	AN0633	Benthic Macroinvertebrates
3	Atlantic Coast	15	Hospitality Branch near Cecil	01411050	Temperature, Total Suspended Solids
3	Atlantic Coast	14	Hospitality Brook below Route 563	WHOSPITA	Pineland Biological Community
3	Lower Delaware	17	Hudson Branch at Vineland	17-HUD-1	Cadmium, Copper, Mercury, Nickel, Selenium, Silver, thallium, Zinc
3	Northeast	05	Hudson River	N1, N2, N3, N3A, N3B, N4, N5, N6	Fecal Coliform
3	Raritan	07	Hudson River	Weehawken (Location B)	Fecal Coliform
3	Atlantic Coast	12	Husky Brook at South St In Eatontown	33	pH, Total Suspended Solids
3	Atlantic Coast	12	Husky Brook at South St in Eatontown	MB-33	Benthic Macroinvertebrates
3	Atlantic Coast	14	Impoundment on Horse Pond Stream (Lake 1616-14)	BHOBUTTR2	Pineland Biological Community
3	Atlantic Coast	14	Indian Cabin Creek above Landing Creek	LINCABIN	Pineland Biological Community
3	Atlantic Coast	14	Indian Cabin Creek at EHC Lk outlet in Egg Harbor	AN0594	Benthic Macroinvertebrates
3	Atlantic Coast	14	Indian Cabin Creek at Fifth Ave in Mullica	AN0593	Benthic Macroinvertebrates
3	Atlantic Coast	14	Indian Mills Brook at Indian Mills	01409449	Phosphorus, Fecal Coliform
3	Atlantic Coast	14	Indian Mills Brook impoundment above Old Schoolhouse Rd (Lake 1685-14)	BINSCHOO	Pineland Biological Community
3	Atlantic Coast	14	Indian Mills Pond-14	Indian Mills Pond, BMULAKED	Phosphorus
3	Lower Delaware	19	Indian Run at Birmingham Rd in Pemberton	EWQ0151A	Phosphorus, pH, Total Suspended Solids
3	Lower Delaware	17	Indian Run at Cedar Ln Rd in Upper Pittsgrove	AN0746	Benthic Macroinvertebrates
3	Lower Delaware	17	Iona Lake-17	Iona Lake	Phosphorus
3	Raritan	09	Ireland Brook at Patricks Corners	01404470	Phosphorus, Fecal Coliform, Total Suspended Solids
3	Raritan	09	Iresick Brook at Rt 527 in Old Bridge	AN0452	Benthic Macroinvertebrates
3	Lower Delaware	20	Ivanhoe Brook at Millers Mill Rd in Upper Freehold	AN0123	Benthic Macroinvertebrates
3	Atlantic Coast	15	Jack Pudding Branch at Cologne Ave. in Hamilton	AN0640B	Benthic Macroinvertebrates
3	Lower Delaware	19	Jacks Run at Range Rd in New Hanover	AN0149B, NJARANGE	Pineland Biological Community
3	Northwest	01	Jacksonburg Creek near Blairstown	01443600	pH, Temperature
3	Northwest	01	Jacksonburg Creek near Millbrook	01443550	Fecal Coliform, pH, Temperature
3	Northwest	11	Jacobs Creek above Rt 29	DRBCNJ0003	Phosphorus, Nitrate, Unionized Ammonia
3	Northwest	11	Jacobs Creek at Bear Tavern	01462739	Phosphorus, pH
3	Lower Delaware	19	Jade Run at Rt 206 in Vincentown	01465847	Nitrate
3	Atlantic Coast	13	Jakes Branch at Double Trouble Rd in South Toms River	AN0543	Benthic Macroinvertebrates
3	Atlantic Coast	13	Jakes Branch at Dover Rd in Berkeley	AN0542	Benthic Macroinvertebrates
3	Atlantic Coast	13	Jakes Branch at Dover Rd near Double Trouble	01408702	Dissolved Oxygen, pH
3	Atlantic Coast	12	Jumping Brook at Essex Rd in Tinton Falls	AN0479	Benthic Macroinvertebrates
3	Atlantic Coast	12	Jumping Brook at Green Grove	01407720	Dissolved Oxygen, Dissolved Solids, Total Suspended Solids
3	Atlantic Coast	13	Kettle Creek at New Hampshire Ave in Lakewood	AN0515	Benthic Macroinvertebrates

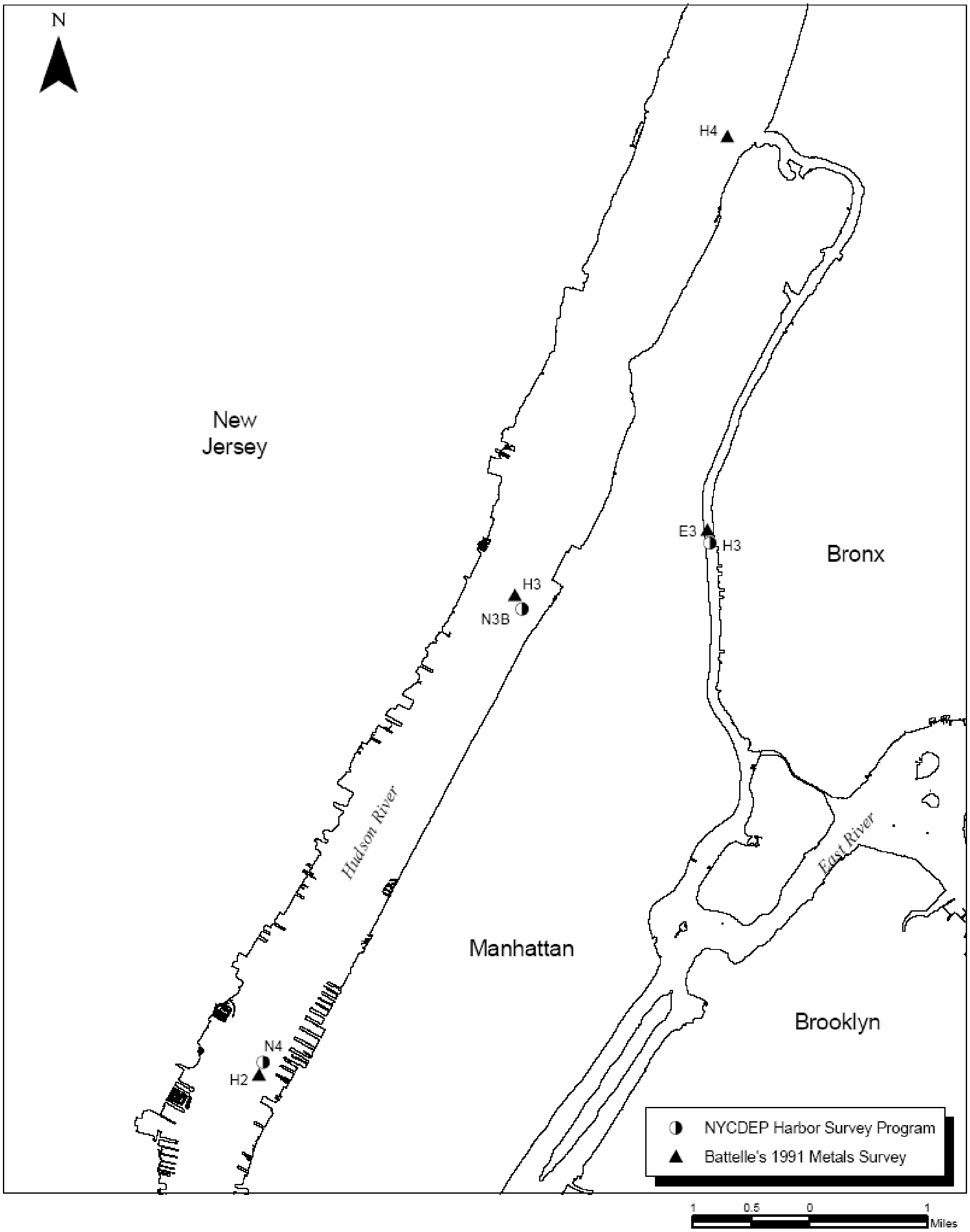
Figure 3-2b. New Jersey DEP 2004 Integrated List for Section of New York Harbor Showing Attainment of Uses for the Indicated Constituents

locations of these Hudson River water quality stations are shown on Figure 3-3. Water quality data for the Hudson River are presented in Table 3-1. The Harbor Survey data in Table 3-1 represents average concentrations for sampling conducted during 2003, the most recent data available, unless otherwise specifically noted. The USEPA 1991 metals data are presented in Table 3-1. The NYSDEC Class I water quality standards are also presented for comparison.

The water quality data indicate that all of the water quality parameters reported were in compliance with NYSDEC water quality Class I standards and guidance values with the exception of mercury at the surface and bottom for stations H2-T, H2-B, H-3T, H-3B, H-4T, and H-4B. For the summer period, dissolved oxygen concentrations were also measured to be in compliance with the minimum requirements. Both surface and bottom level dissolved oxygen concentrations for the summer of 2003 were observed to be greater than the minimum required water quality standard of 4.0 mg/l.

As indicated in Section 3.1.1, dissolved oxygen and bacteria concentrations have been improving over the past few decades. Recent dissolved oxygen data collected at station N3B and NY in the Hudson River shown in Figure 3-4 and reported on in Table 3-1 for 2003 show some year-to-year variability. In 1988 and again in 2003, dissolved oxygen concentrations in both the surface and bottom waters were in compliance with the NYSDEC minimum requirement of 4 mg/L. Samples found below this minimum requirement were observed in the summers of 1999, 2000, 2001 and 2002. However, it should be noted that these samples were apparently infrequent, and based on NYSDEC and New Jersey Department of Environmental Protection (NJDEP) conclusions probably do not impair aquatic life uses.

The Harlem River is a NYSDEC Class I water, which means that it is suitable for secondary contact recreation (fishing and boating). NYCDEP maintains one sampling station, H-3, in the Harlem River for conventional pollutants and additional water quality data as part of its annual harbor survey. In addition, during 1991, data concerning ambient concentrations of several heavy metals were collected from stations throughout the harbor complex including the Harlem River by USEPA. These stations are shown on Figure 3-3. Water quality data are presented in Table 3-2. The Harbor Survey data in Table 3-2 represents average concentrations for sampling conducted during 2003, the most recent data available, unless otherwise specifically noted. Metals data for station E-3 from 1991 are also presented in Table 3-2. The NYSDEC Class I water quality standards are also presented for comparison.



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Hudson Yards

Water Quality Monitoring Stations

Figure 3-3

Water Quality Stations

October 2004

Table 3-1. Hudson River Water Quality and Metals Data

Parameter	Units	Average Concentration								
		Station N-3B[1]	Station N-4[2]	Station H-2T[3]	Station H-2B[4]	Station H-3T[5]	Station H-3B[6]	Station H-4T[7]	Station H-4B[8]	NYS Class I Standards
Dissolved Oxygen (surface/minimum)	mg/L	8.69[9]/5.51[10]	8.37[9]/5.71[10]	--	--	--	--	--	--	4.0
Dissolved Oxygen (bottom/minimum)	mg/L	6.95[9]/4.69[10]	6.69[9]/4.37[10]	--	--	--	--	--	--	4.0
BOD (surface)	mg/L	2.0[11]	1.9[11]	--	--	--	--	--	--	--
BOD (bottom)	mg/L	2.7[11]	2.6[11]	--	--	--	--	--	--	--
Total Coliform (surface)	MPN/100 ml	838[12]	1495[12]	--	--	--	--	--	--	10,000
Total Coliform (bottom)	MPN/100 ml	1411[12]	1316[12]	--	--	--	--	--	--	10,000
Fecal Coliform (top)	MF	94	85	--	--	--	--	--	--	2,000
Fecal Coliform (bottom)	MF	35	46	--	--	--	--	--	--	2,000
Total Suspended Solids (surface)	mg/L	13.12	12.7	--	--	--	--	--	--	--
Total Suspended Solids (bottom)	mg/L	71.23	42.53	--	--	--	--	--	--	--
Arsenic	µg/L	--	--	--	--	--	--	--	--	36 [13,14]
Cadmium	µg/L	--	--	0.08[13]	0.07[13]	0.06[13]	0.07[13]	0.07[13]	0.08[13]	7.7[13,14]
Chromium	µg/L	--	--	--	--	--	--	--	--	--
Copper	µg/L	--	--	2.14[13]	1.78[13]	2.00[13]	1.91[13]	1.67[13]	1.86[13]	5.6[14,15]
Lead	µg/L	--	--	0.16[13]	0.18[13]	0.13[13]	0.16[13]	0.15[13]	0.21[13]	8.0[13,14]
Mercury	µg/L	--	--	0.0053[13]	0.0033[13]	0.0027[13]	0.0033[13]	0.0068[13]	0.0064[13]	0.0026[13,14]
Nickel	µg/L	--	--	1.37[13]	1.39[13]	0.98[13]	1.03[13]	0.82[13]	1.14[13]	8.2[13,14]
Silver	µg/L	--	--	0.0133[13]	0.0121[13]	.0106[13]	0.0135[13]	0.0178[13]	0.0182[13]	--
Zinc	µg/L	--	--	7.23[13]	7.19[13]	3.76[13]	5.23[13]	5.82[13]	4.89[13]	66[13,14]
Cyanide	µg/L	--	--	--	--	--	--	--	--	1.0[14]
NH_3-N	mg/L	0.21	0.24	--	--	--	--	--	--	--
(NO_3 + NO_2)	mg/L	0.52	0.47	--	--	--	--	--	--	--
Total Phosphorous	mg/L	0.12	0.12	--	--	--	--	--	--	--
Chlorophyll-a	µg/L	6.6	6.3	--	--	--	--	--	--	--

Notes:

(1) Average concentrations for 2003 NYCDEP Harbor Survey station N-3B, West 125th Street

(2) Average concentrations for 2003 NYCDEP Harbor Survey station N-4, West 42nd Street

(3) Average concentrations for 1991 USEPA Station H-2T, located on the surface at West 42nd Street

(4) Average concentrations for 1991 USEPA Station H-2B, located on the bottom at West 42nd Street

(5) Average concentrations for 1991 USEPA Station H-3T, located on the surface at West 125th Street

(6) Average concentrations for 1991 USEPA Station H-3B, located on the bottom at West 125th Street

(7) Average concentrations for 1991 USEPA Station H4-T, located on the surface at Spuyten Duyvil

(8) Average concentrations for 1991 USEPA Station H4-B, located on the bottom at Spuyten Duyvil

(9) Represents average between January and December 2003

(10) Minimum between June 1, 2003 and September 30, 2003

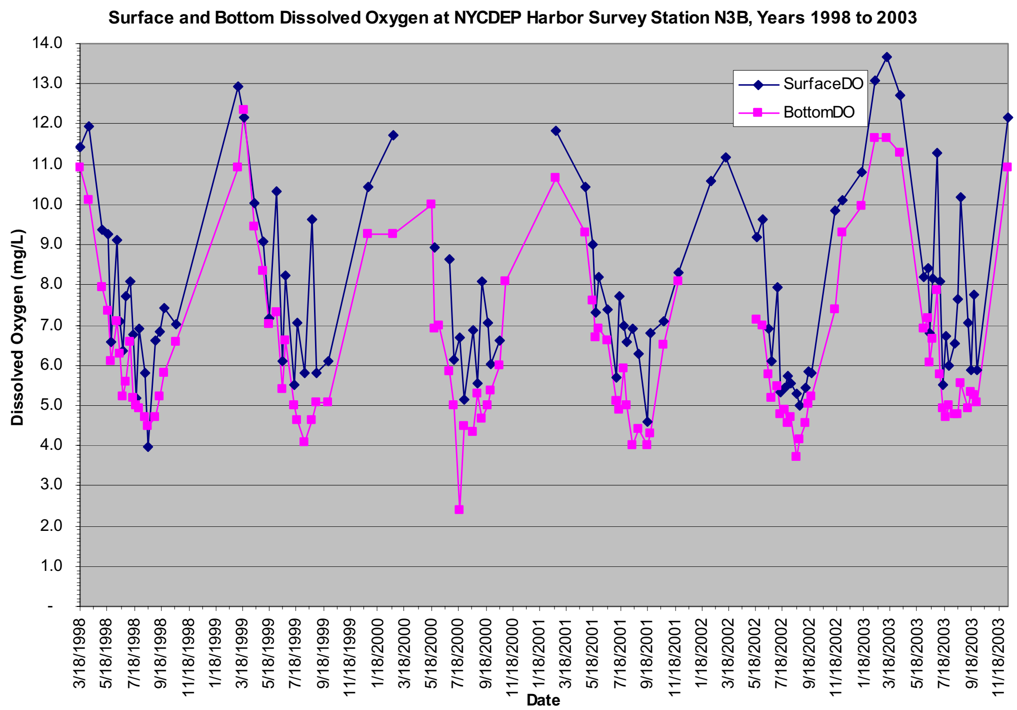
(11) Latest available data 1997

(12) Latest available data 1996

(13) Guidance values and data are for dissolved metals

(14) NYSDEC Guidance Value (NYSDEC TOGS 1.1.1, June 1998, errata January 1999 and addendum April 2000)

(15) Site specific chronic and acute criteria for dissolved copper in New York/New Jersey Harbor



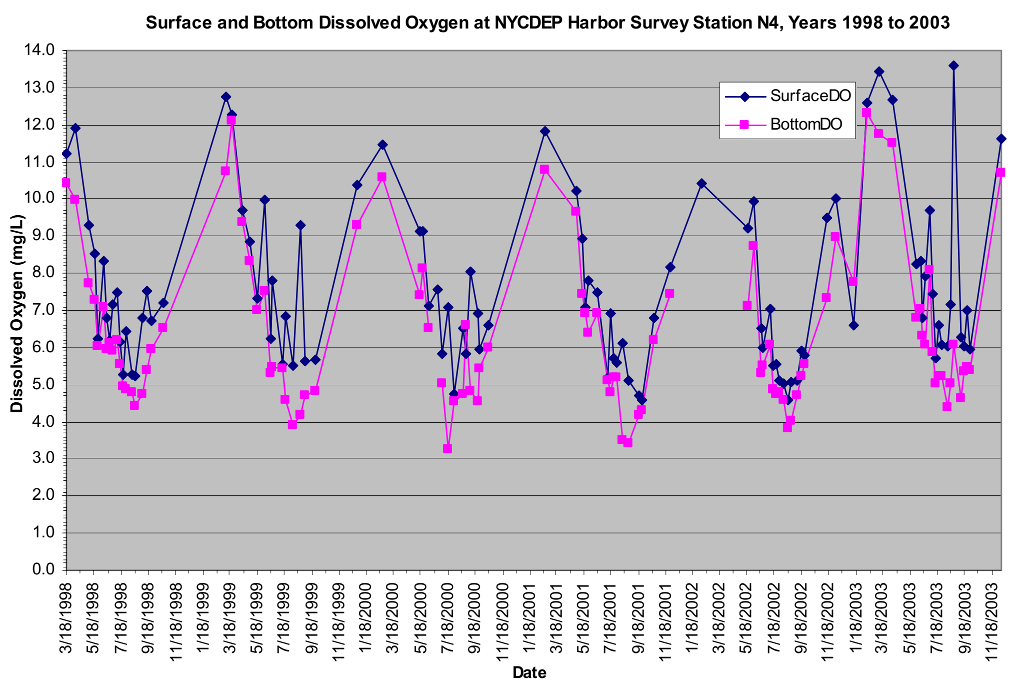


Figure 3-4. Dissolved Oxygen Data at Hudson River Stations N4 and N3B

Table 3-2. Harlem River Water Quality and Metals Data

Parameter	Units	Average Concentration Station H3[1]	Station E3[2]	NYS Class I Standards
Dissolved Oxygen (surface/minimum)	mg/L	7.03[3]/4.34[4]	--	4.0
Dissolved Oxygen (bottom/minimum)	mg/L	6.98[3]/4.28[4]	--	4.0
BOD (surface)	mg/L	2.3[5]	--	--
BOD (bottom)	mg/L	2.1[5]	--	--
Total Coliform (surface)	MPN/100 ml	1355[6]	--	10,000
Total Coliform (bottom)	MPN/100 ml	1244[6]	--	10,000
Fecal Coliform (top)	MF	305	--	2,000
Fecal Coliform (bottom)	MF	52[7]	--	2,000
Total Suspended Solids (surface)	mg/L	18.55	--	--
Total Suspended Solids (bottom)	mg/L	20.95	--	--
Arsenic	µg/L	--	--	36 [8,9]
Cadmium	µg/L	--	0.085[8]	7.7[8,9]
Chromium	µg/L	--	--	--
Copper	µg/L	--	2.63[8]	5.6[9,10]
Lead	µg/L	--	0.265[8]	8.0[8,9]
Mercury	µg/L	--	0.0036[8]	0.0026[8,9]
Nickel	µg/L	--	1.96[8]	8.2[8,9]
Silver	µg/L	--	0.0025[8]	--
Zinc	µg/L	--	10.04[8]	66[8,9]
Cyanide	µg/L	--	--	1.0[9]
NH_3-N	mg/L	0.306	--	--
(NO_3 + NO_2)	mg/L	0.497	--	--
Total Phosphorous	mg/L	0.162	--	--
Chlorophyll-a	µg/L	3.1	--	--

Notes:

(1) Average concentrations for 2003 NYCDEP Harbor Survey Station H-3, East 155th Street

(2) Average concentrations for 1991 USEPA Station E-3, East 155th Street

(3) Represents average between January and December 2003

(4) Minimum between June 1, 2003 and September 30, 2003

(5) Latest available data 1997

(6) Latest available data 1996

(7) Latest available data 1999

(8) Guidance values and data are for dissolved metals

(9) NYSDEC Guidance Value (NYSDEC TOGS 1.1.1, updated June 1998)

(10) Site specific chronic and acute criteria for dissolved copper in New York/New Jersey Harbor

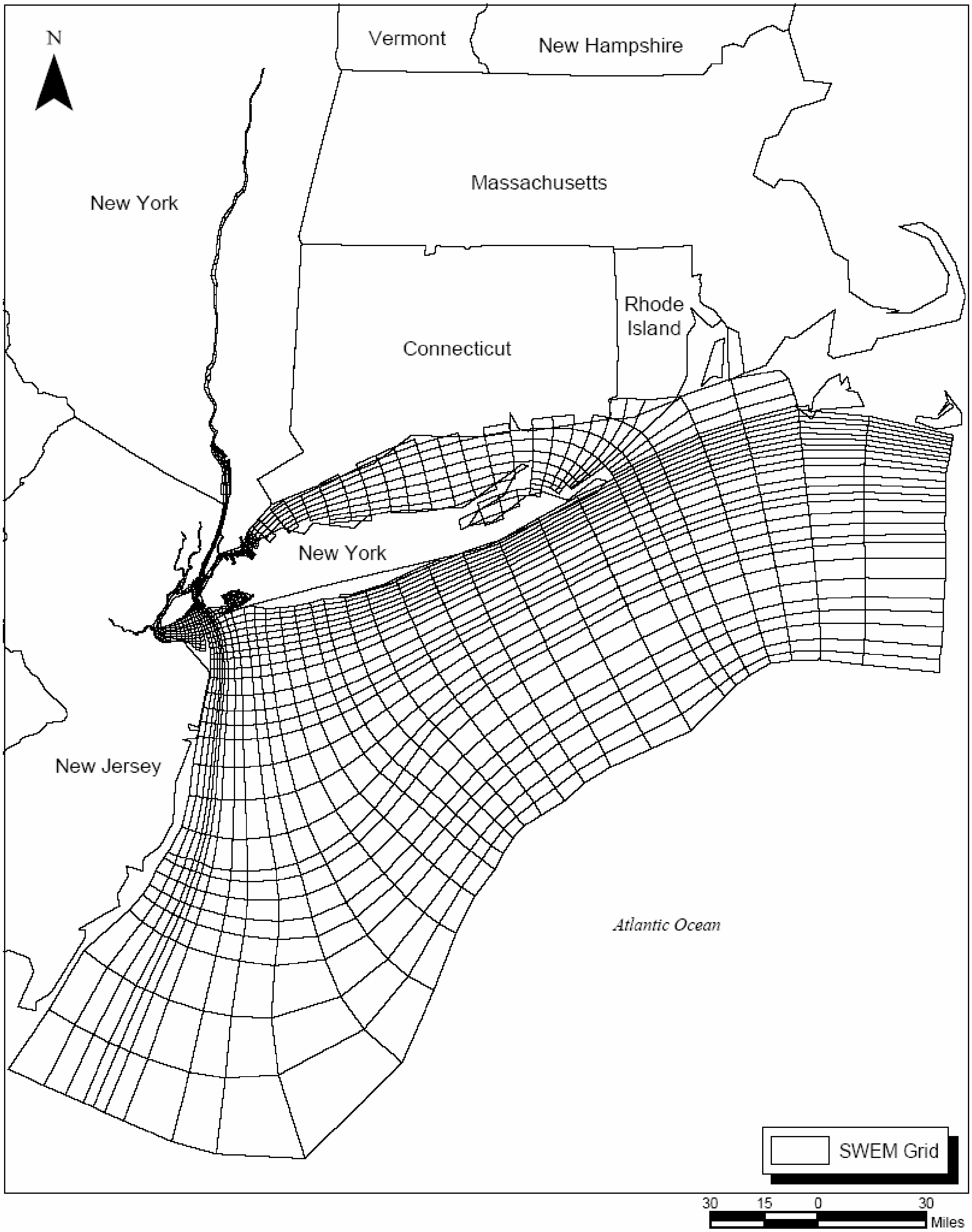
The water quality data for the Harlem River indicate that all of the water quality parameters reported were in compliance with NYSDEC Class I water quality standards and guidance values with the exception of mercury for station E-3.

3.2 DESCRIPTION OF THE SYSTEM WIDE EUTROPHICATION MODEL

A modeling framework was used to evaluate the potential changes with and without the Project on water quality. The System Wide Eutrophication Model (SWEM), a three-dimensional, time-variable coupled hydrodynamic/eutrophication water quality model of the New York/New Jersey (NY/NJ) Harbor – New York Bight system, was used for this assessment. The SWEM model was constructed for the DEP to evaluate the water quality impacts of upgrading wastewater treatment facilities and improving nutrient removal capabilities. It was also supported by a comprehensive field-monitoring program to collect data necessary to calibrate and validate the model and quantify source inputs. In addition, SWEM underwent an extensive peer review from the Model Evaluation Group (MEG) that was convened by the Harbor Estuary Program (HEP) and Long Island Sound Study (LISS) Nutrient work group. The model has been used to contribute to the Long Island Sound TMDLs developed by the states of New York and Connecticut under the guidance and assistance of the USEPA. The model is currently being used in technical assessments as part of New York and New Jersey Harbor TMDL development projects for nutrients and pathogens.

The spatial extent of the SWEM domain incorporates the core area of NY/NJ Harbor as defined by the Harbor Estuary Program and extends beyond to include the Hudson River Estuary, up to the Troy Dam, all of Long Island Sound and the NY Bight out to the continental shelf (Figure 3-5a). A close-up of the model grid in the Hudson River adjacent to Manhattan is shown in Figure 3-5b. The computational grid employs an orthogonal-curvilinear coordinate or boundary-fitted system that represents the complex and irregular shoreline/coastline of the NY/NJ Harbor-NY Bight region. In addition the model uses a vertical sigma-coordinate system that is scaled on the local water column depth.

The SWEM model consists of two linked submodels or computer codes, Estuary and Coastal Ocean Model (ECOM) and Row Column Aesop (RCA). The hydrodynamic modeling code, ECOM, computes the circulation and stratification within the model domain and is influenced by time-varying freshwater boundary inflows, tidally-driven surface water elevations, and meteorological forcings, including wind, solar radiation, ambient air temperature, and relative humidity. The hydrodynamic calculations are performed using time-steps on the order



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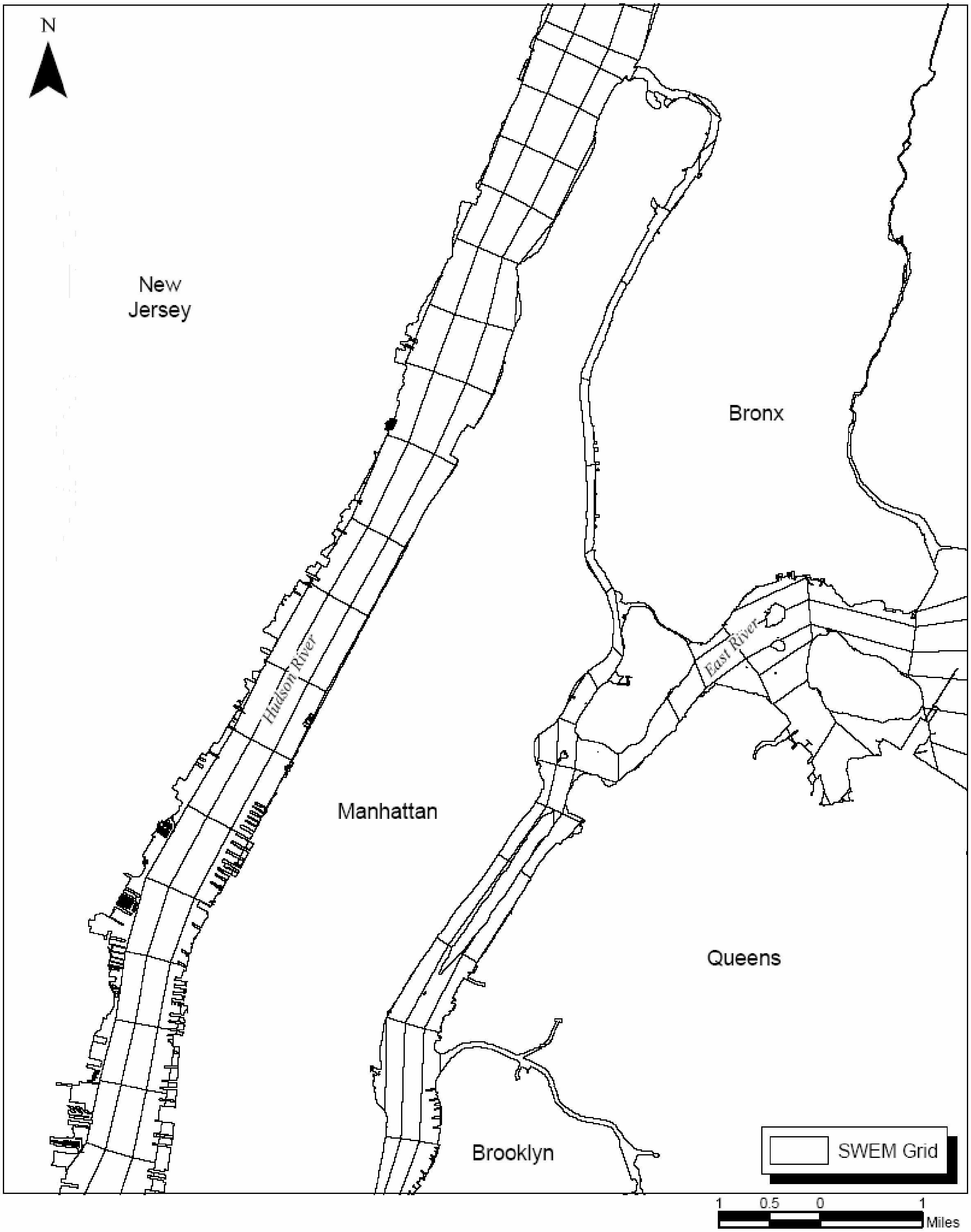
Full SWEM

Computational Grid

Figure 3-5a

SWEM Grid

October 2004



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SWEM Grid in Hudson River

Adjacent to Manhattan

Figure 3-5b
SWEM Grid

October 2004

of minutes and the model has been validated against real time observations of tidal elevation, and current speed and direction, as well as spatial (including vertical casts) and temporal observations of salinity and temperature. Model versus data comparisons indicate that the hydrodynamic component of the SWEM model reproduces the major features of circulation and stratification within the NY/NJ Harbor-NY Bight domain.

The second component of the SWEM model, RCA, is a carbon-based eutrophication model of the NY/NJ Harbor-NY Bight domain. The eutrophication kinetic framework employed within SWEM describes the interactions between nutrients, primary production, phytoplankton biomass, and dissolved oxygen. The SWEM model includes two functional phytoplankton groups and also models detrital carbon, including labile and refractory forms of particulate and dissolved organic carbon. SWEM also includes a nutrient flux submodel, which accounts for the deposition of particulate organic matter, its diagenesis within the sediment bed, long-term burial of refractory organic material in the deeper portions of the sediment bed, and the resulting flux of inorganic nutrients and sediment oxygen demand back to the overlying water column.

SWEM simulates the circulation of water in the Harbor and its effect on various water quality parameters such as nutrients, phytoplankton and dissolved oxygen. The model has the ability to incorporate the effects of tidal interaction within New York Harbor and the Atlantic Ocean and freshwater inputs to the Harbor from Water Pollution Control Plants (WPCPs), combined sewer overflows (CSOs) and storm sewers. SWEM is currently configured to represent hydrologic ambient conditions (circulation, flow, temperature and stratification) for various periods depending on the application of interest. The model was used to calculate potential impacts with and without the proposed project on the Hudson and Harlem Rivers water quality. The parameters that were calculated were dissolved oxygen, metals (copper, lead, and zinc), total nitrogen, total phosphorus, TSS and total coliform bacteria for the CSOs with North River WPCP.

The model was used to calculate the impacts of project and non-project elements on Hudson River water quality for the following water quality parameters based on the following assumptions.

- Dissolved oxygen – D.O. was simulated using the full eutrophication kinetics capabilities of the model.
- Metals – Metals were simulated as non-reactive water quality parameters subject only to dilution and dispersion within the model.

- Total nitrogen, total phosphorus and TSS – These parameters were simulated as non-reactive water quality parameters subject only to dilution and dispersion within the model.
- Total coliform bacteria – Coliform bacteria were simulated using first order decay kinetics developed in other water quality modeling studies conducted within New York Harbor.

As the SWEM model is an extremely complex model, it was not possible to set-up the model for current conditions as part of this impact assessment. Therefore model input decks that were available for different periods of time were used as the basis for the analyses. The dissolved oxygen modeling was based on conditions present in the harbor for 1994/1995. The metals, nitrogen, phosphorus, total suspended solids and coliform modeling conditions represent 2003 conditions.

Simulations for all parameters utilized a standardized rainfall condition. 1988 represents an average hydrologic year with respect to rainfall and inflow, but does include significant storms. 1988 has been chosen as the base year for NYCDEP's Use and Standards Attainment and the Long Term Control Plan projects for all of New York City; has been used as the base year for the Long Island Sound TMDLs and is being used as the base year for New York Harbor nutrients and pathogen TMDLs. The New Jersey Department of Environmental Protection requires communities in New Jersey to use 1988 rainfall to develop their Phase II Long Term CSO Control Plans.

This modeling framework was used to determine the water quality impacts on the Hudson River due to the proposed increases in sanitary sewage to the North River WPCP and therefore, increases in the CSOs to the river.

3.3 METHODOLOGY FOR COMPUTING HUDSON YARDS WATER QUALITY IMPACTS

There are basically four categories for calculating the Hudson Yards impacts on water quality. Theses categories include the following:

North River WPCP Impacts for Conservative Substances and Coliform Bacteria
  Cu, Pb, Zn, T-N, T-P, TSS and Total Coliforms
North River CSO Impacts for Conservative Substances and Coliform Bacteria
  Cu, Pb, Zn, T-N, T-P, TSS and Total Coliforms

North River WPCP Impacts on Dissolved Oxygen
North River CSO Impacts on Dissolved Oxygen

For the purpose of this analysis, conservative substances are defined as substances that do not undergo reactions that would decrease their concentrations in the Hudson River. This analysis considered certain constituents as being conservative so that a worst case analysis would be conducted and so that water quality impacts would not be under estimated.

Each of these Impacts Analyses was evaluated for five existing and projection scenarios. These include the following:

Existing Conditions
2010 No Build (without the Project)
2010 Build (with the Project)
2025 No Build (without the Project)
2025 Build (with the Project)

Responses in the receiving waters for dissolved oxygen were calculated using the System-Wide Eutrophication Model (SWEM) that has been previously calibrated and peer reviewed for 1994-1995 conditions. In this case, the incremental loads affecting the dissolved oxygen balance, were added to the existing calibration condition, and the incremental responses in the receiving water were calculated. These incremental receiving water responses were than compared to the most recent observed measurements in the Hudson River.

The responses for the conservative substances and total coliform bacteria were calculated using the pathogen model (PATH); a model based on SWEM hydrodynamics but has the capability to include coliform kinetics and trace conservative materials. PATH is currently being calibrated for 2003 conditions for the Harbor Estuary Program (HEP) pathogens TMDL. In this case, since the conservative substances and coliform bacteria react linearly (responses are directly proportional to the input loads) the analysis was performed by inputting a unit load, calculating the receiving water response, and then proportioning the responses based on the projected incremental loads. All results, again, are compared to the actual recently observed data in the Hudson River.

In each of these scenarios, loads of the various pollutants were calculated using observed discharge concentrations and the estimated incremental flows for the conditions listed above. These loads are the basis for the projected incremental responses.

Following are schematics, descriptions, and input tables for the four major loading categories:

- North River WPCP Impacts Conservative Substances and Coliform Bacteria;
- North River CSO Impacts Conservative Substances and Coliform Bacteria;
- North River WPCP Impacts – Dissolved Oxygen; and
- North river CSO Impacts – Dissolved Oxygen.

North River WPCP Impacts – Conservative Substances and Coliform Bacteria

Figure 3-6 shows the schematic of how the North River WPCP impacts were calculated for each conservative substance. The first step of the calculation was to compute the incremental loads (i.e. Lb./day) for each of the constituents of concern. These include copper, lead, zinc, total nitrogen, total phosphorus, and total suspended solids. These loads were computed at existing conditions and for the four projection scenarios. The concentrations used vary on a monthly basis and are averaged for a representative yearly concentration. The concentrations used for this analysis were based on measured information reported by DEP and are shown on Table 3-3.

The second step in the calculation was to use the PATH model to compute a unit response in the receiving water; in this case an arbitrary 1 million Lb./day discharged through the North River outfall was used as the basis for the analysis. The receiving water response (PATH) were then adjusted to the parameter loads calculated in the first step of the procedure for each projection scenario and incremental responses were calculated as the difference between the projection scenario and the baseline existing conditions. Finally, the calculated incremental responses for each projection scenario were compared to existing water quality data and new absolute values were projected. These results are shown on tables in the next section.

North River CSO Impacts – Conservative Substances and Coliform Bacteria

Figure 3-7 shows a schematic of how the North River CSO impacts are calculated. The first step of the calculation was to compute the incremental loads (i.e. Lb./day) for each of the constituents of concern. These include copper, lead, zinc, total nitrogen, total phosphorus, and total suspended solids. These loads were computed for existing conditions and for the four projection scenarios. In this category, the flows for each projection scenario were computed through the use of the calibrated InfoWorks model. Since a CSO discharge is a combination of

Figure 3-6. Calculation Methodology

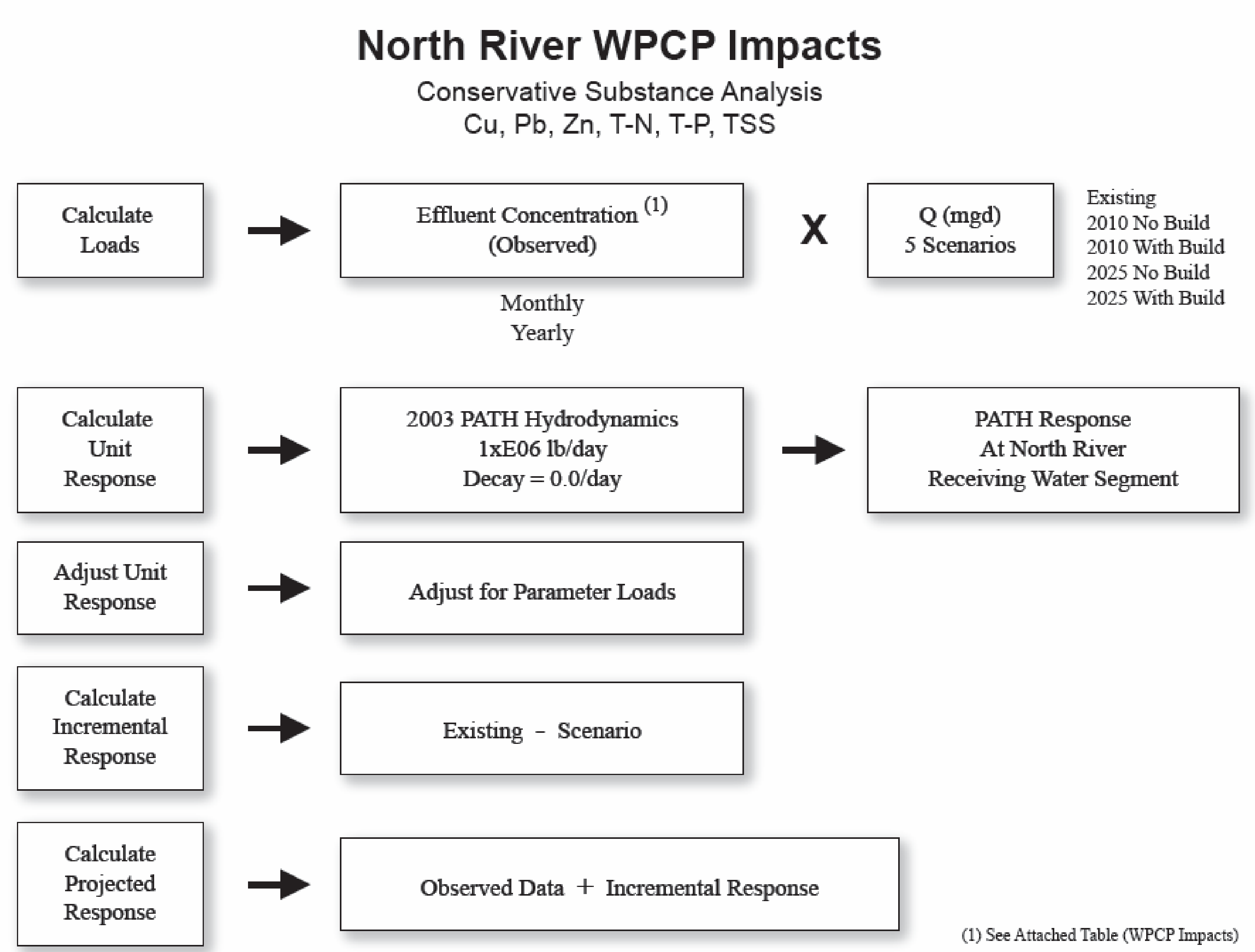
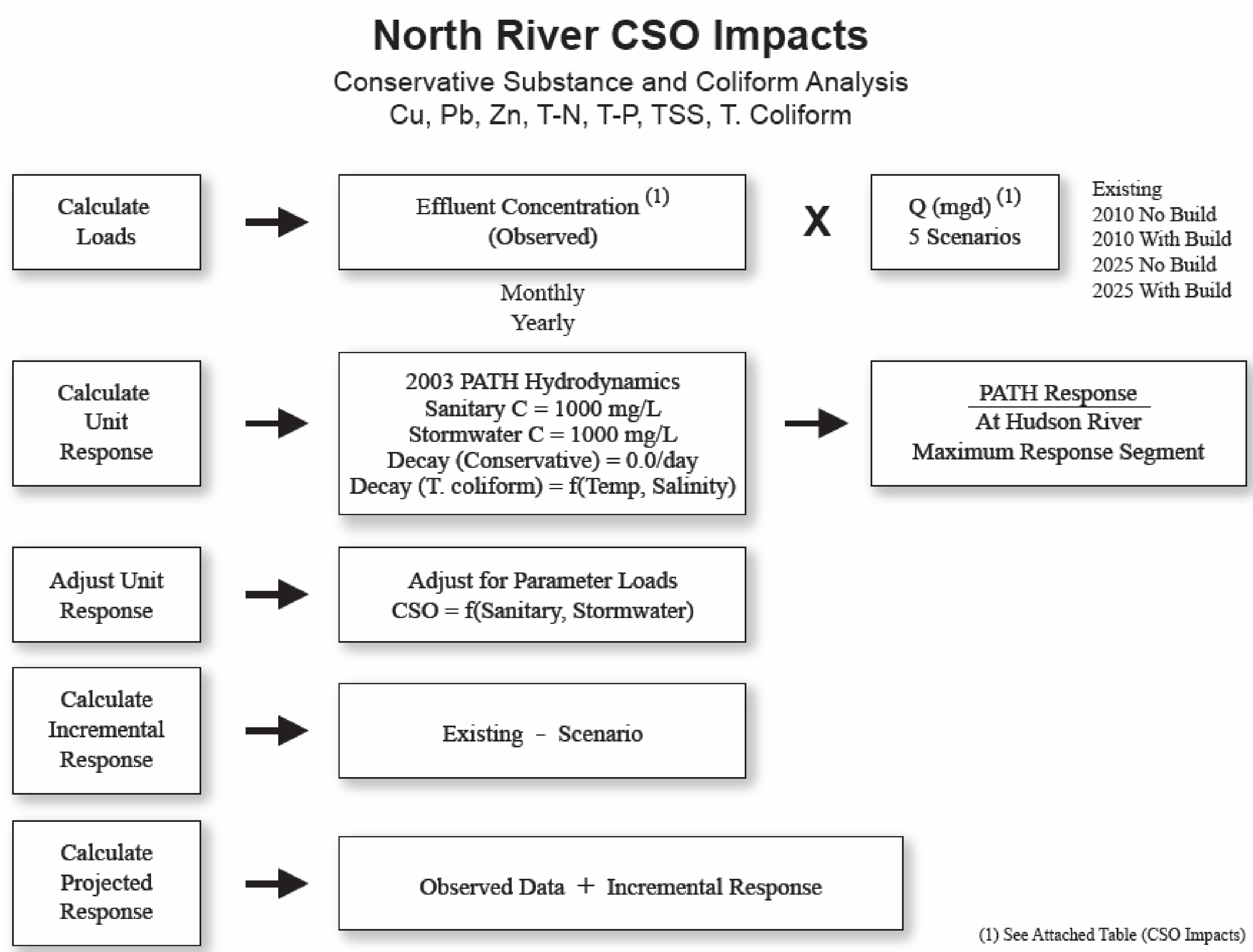


Table 3-3. North River WPCP Impacts
Input Parameters
All Scenarios

Month	Effluent Concentrations[1]					
	Cu (µg/L)	Pb (µg/L)	Zn (µg/L)	T-N (mg/L)	T-P (mg/L)	TSS (mg/L)
October	9.0	1.8	42.4	18.6	3.4	13.0
November	19.9	1.4	60.0	19.3	2.5	16.0
December	28.9	2.6	42.7	20.5	3.1	18.0
January	22.6	2.1	89.5	19.7	3.6	13.0
February	31.1	2.3	67.4	21.4	3.0	22.0
March	25.2	1.8	54.5	21.4	3.4	18.0
April	22.4	1.2	37.5	22.2	2.6	20.0
May	17.6	1.9	55.3	22.6	3.1	19.0
June	10.2	1.8	36.8	16.2	2.5	17.0
July	13.5	1.5	34.4	15.3	4.0	10.0
August	12.0	1.4	30.2	16.3	2.7	10.0
September	13.6	2.5	38.5	18.5	4.4	12.0
Average	18.8	1.9	49.1	19.3	3.2	15.7

Notes:
[1] Basis - 2003 Simulation Conditions, Conservative Substance

Figure 3-7. Calculation Methodology



both raw sanitary water and stormwater, the percentage of sanitary water and stormwater were computed for each discharge event and for each CSO. The mixture of sanitary water and stormwater was used to calculate the total CSO discharge. The flows for each projection scenario and the assigned concentrations for the sanitary water and the stormwater was summarized on Table 3-4. The sanitary concentrations used for this analysis were based on measured influent concentrations reported by NYCDEP and the stormwater concentrations are based on historical concentrations as reported in Harbor Estuary Program (HEP) report 7.1 (1994).

The second step in the calculation was to use the PATH model to compute a unit response in the receiving water; in this case a 1000 mg/L concentration was assigned separately to both the sanitary portion of the CSO and to the stormwater portion of the CSO. The maximum response segment (throughout the Hudson River and Harlem River) was used as the basis for the calculation. The receiving water responses (PATH – for sanitary and stormwater) were then adjusted to the parameter loads calculated in the first step of the procedure for each projection scenario and incremental responses are calculated as the difference between the projection scenario and the baseline existing conditions. Finally, the calculated incremental responses for each projection scenario were compared to existing water quality data and new absolute values are projected. These results are shown on tables in the next section (Table 3-4).

North River WPCP and CSO Dissolved Oxygen Impacts

Dissolved Oxygen impacts were based on the SWEM model calibration for 1994-1995 conditions. The SWEM model is a state-of-the-art nutrient and dissolved oxygen model that includes nutrient kinetics and sediment-water column interactions. The model has been peered reviewed, over the years, by academic experts in both the fields of hydrodynamics and receiving water modeling. The model is complex; it includes inputs from 25 constituents that impact the dissolved oxygen balance including nutrient forms, carbon forms, salinity, and temperature.

Schematics of the dissolved oxygen analysis are shown on Figures 3-8 and 3-9. In general, the methodology for computing the dissolved oxygen impacts for both the WPCP and the CSOs are the same. That is, the loads for the various scenarios (both WPCP and CSO were incremented by the projected flow increases; concentrations remained constant since the SWEM CSO concentrations assigned to the total CSO discharges did not distinguish between sanitary and stormwater proportions. Incremental responses were calculated by the difference between baseline (1994-1995 conditions) and the calculated response at the various scenario conditions. Finally, the projected absolute response was calculated by subtracting the incremental response

Table 3-4. North River CSO Impacts
Input Parameters
All Scenarios

Changes in CSO Volume from Existing Conditions[1]

	2010 Future Without Proposed Action	2010 Future With Proposed Action	2025 Future Without Proposed Action	2025 Future With Proposed Action
Q (mg/yr)	22	31	71	114

Concentrations Assigned

	Cu (µg/L)	Pb (µg/L)	Zn (µg/L)	T-N (mg/L)	T-P (mg/L)	TSS (mg/L	Total Coliform (MPN/100 ml)
Sanitary Water[2]	0.220	0.066	0.420	26.1	4.75	150.0	$15x10^6$
Stormwater [3]	0.035	0.028	0.154	2.40	0.36	27.0	200,000

Notes:
[1] CSO flows based on InfoWorks simulations using 1988 Central Park Rainfall
[2] Fiscal year 2003 North River WPCP concentrations; Cu, Pb and Zn are maximum monthly concentrations;
T-N, T-P and TSS are yearly averages
[3] Harbor Estuary Program (HEP) Report 7.1 (1994)

Figure 3-8. Calculation Methodology

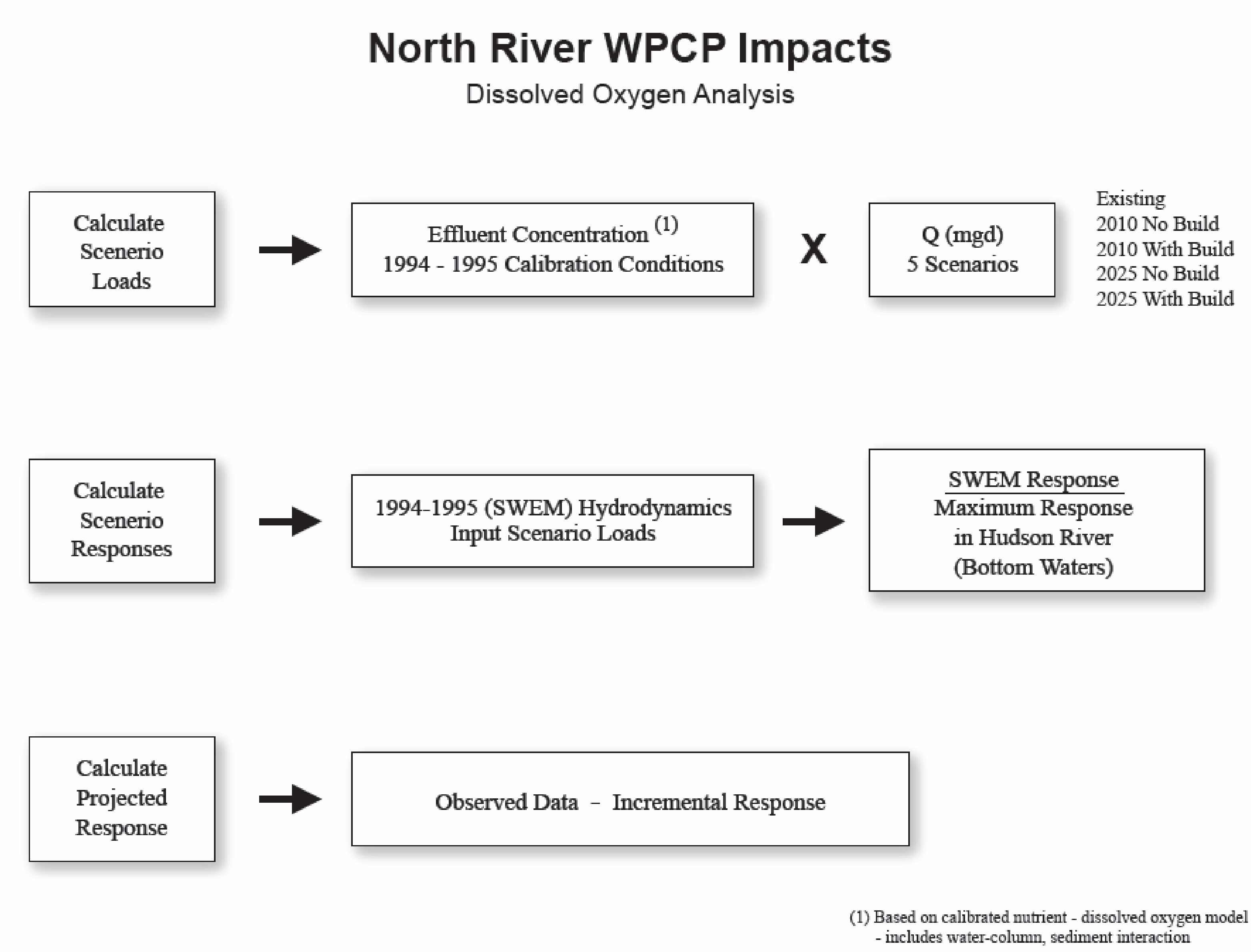
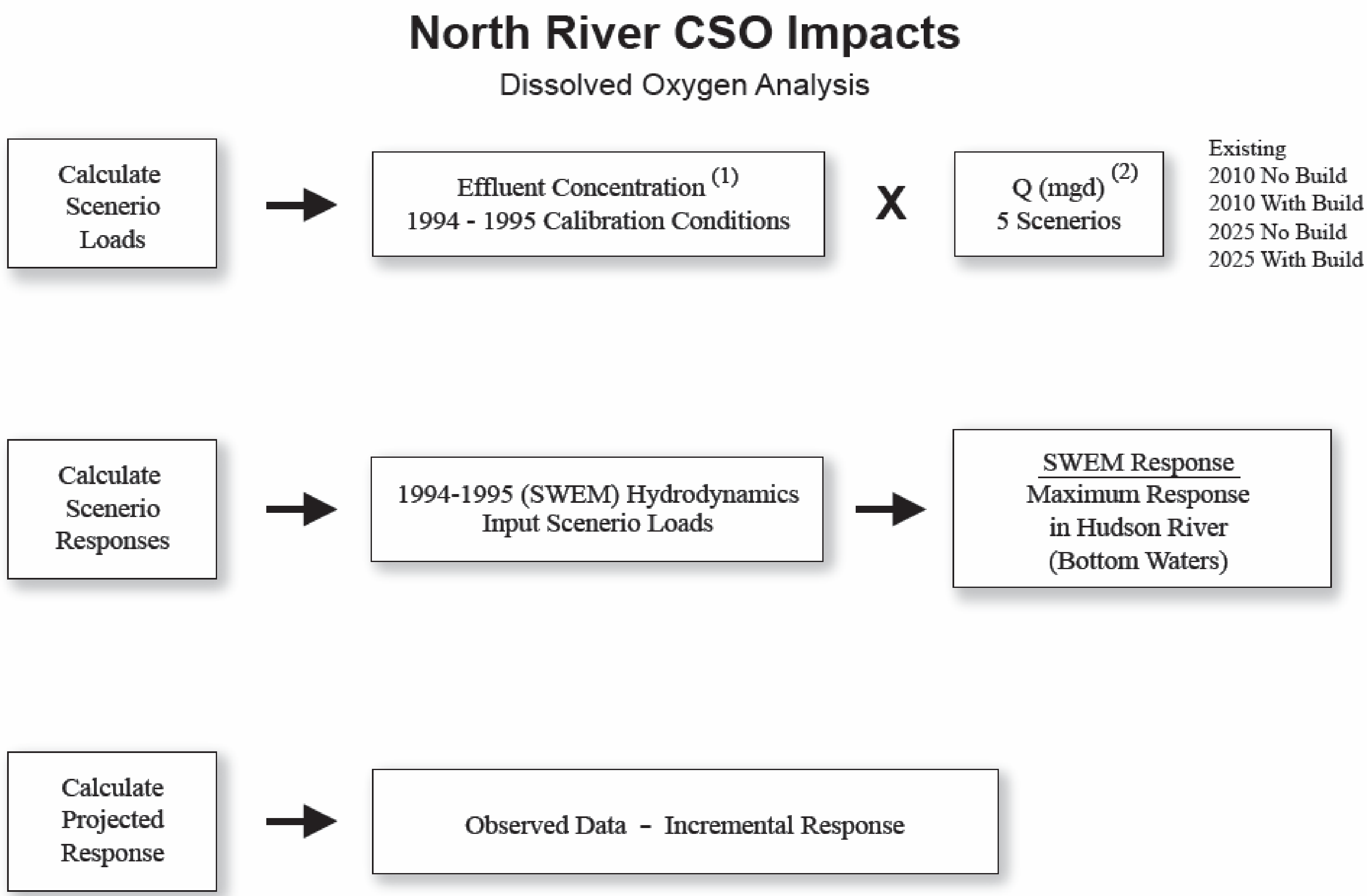


Figure 3-9. Calculation Methodology



(1) Based on calibrated nutrient - dissolved oxygen model
- includes water-column, sediment interaction
- uses 1994-1995 calibration CSO concentrations
(2) Based on info-works projections

from the most recent observed data. The results of this evaluation are presented in the following section.

3.4 IMPACTS OF NORTH RIVER WPCP ON WATER QUALITY

After developing the WPCP volumes for the current conditions, model inputs were developed for the water quality (pollutant loadings) model. The parameters chlorophyll-a and DO were calculated by the water quality model as a function of nutrient and BOD loads and, therefore, were not required for model input. The three metals analyzed (copper, lead and zinc) are the predominant metals typically found in stormwater runoff. The baseline condition represented current water quality (2003) in the Hudson River due to existing discharges including the existing WPCP outfall and existing CSOs to the river. The future conditions were developed with and without the Proposed Action using the 1988 rainfall and hydrologic ambient conditions.

After the model inputs were developed, the water quality model was run for the future conditions as described in Section 3.3. The resulting water quality impacts of future loading scenarios were then computed and impacts in the vicinity of the proposed Project extracted from the 10's of millions of numbers computed by the model.

The water quality impacts of the proposed future discharges were estimated based on the following:

- Existing water quality was developed from current water quality conditions.
- Changes in water quality that were calculated by the SWEM and PATH models.

The SWEM calculated pollutant concentration changes were used to determine the change in the background water quality (baseline condition) due to the anticipated additional North River effluent and additional CSO discharges for the following parameters (DO, fecal coliform, copper, lead and zinc) for the eight future conditions. Tables were developed that summarize the absolute water quality concentrations and changes in water quality for each of the eight scenarios. Future water quality conditions were compared with applicable NYSDEC water quality standards and guidance values for the applicable water body classification.

2010 Future Without the Project

The estimated water quality in the Hudson and Harlem Rivers was assessed for 2010 without the Hudson Yards Project. This assessment considered projected growth and development within the North River drainage area that would occur in 2010 without the Proposed Action.

Under the 2010 No Build condition, flows to the North River WPCP would continue to increase. An average daily flow of 135.5 mgd would be projected for the North River WPCP without the project.

The estimated impact of the No Build condition for 2010 on the North River WPCP is presented in Table 2-1 for the average effluent and the maximum month. Performance of the WPCP was assumed to remain comparable to existing conditions. As shown on Table 2-1, the SPDES permit limitations would be expected to be met for both the average and the maximum effluent month under the 2010 No Build for those parameters that have a SPDES permit limit.

Utilizing the projected pollutant loadings for the 2010 No Build, the potential effect of the increased flows to the North River WPCP upon water quality within the Hudson River were calculated. These effects were evaluated through the use of the SWEM. The predicted concentrations for the maximum 24-hour impact and the maximum 30-day impact in the Hudson River for the 2010 No Build condition are presented in Table 3-5. Table 3-5 also shows the incremental change in water quality concentrations resulting from the projected 2010 No Build flow of 135.5 mgd. Dissolved oxygen levels in both the bottom and surface layer within the Hudson River near the North River WPCP would be predicted to decrease by between 0.005 to 0.006 mg/L for the maximum 24-hour impact and maximum 30-day impact. This would largely represent no change in dissolved oxygen levels due to the increase flow as dissolved oxygen can only be measured to an accuracy of approximately +/- 0.1 mg/L. The predicted incremental change in dissolved oxygen within the Hudson River would, therefore, not be detectable. Dissolved oxygen concentrations would be predicted to remain above the NYSDEC Class I water quality standard of 4.0 mg/L.

In addition, the incremental change in the total nitrogen, total phosphorus and total suspended solids concentrations would also be insignificant. Total nitrogen would be calculated to increase by approximately 0.01 mg/L for both the maximum 24-hour impact and maximum 30-day impact, while total phosphorus and total suspended solids concentrations would remain constant.

Table 3-5a. Water Quality Predictions in the Hudson River Near the North River WPCP for 2010 Future Without the Proposed Action

			2010 Future Without the Proposed Action				
			Maximum 24-Hour Impact[8]		Maximum 30-Day Impact[9]		NYSDEC
Parameter	Units	Existing Conditions 2003 [1]	Incremental[7] Change 2010	Projected Water[10] Quality 2010	Incremental[7] Change 2010	Projected Water[10] Quality 2010	Standard Class I Waters
Dissolved Oxygen (surface)[2]							
Summer Average[3]	mg/L	7.50	-0.005	7.50	-0.006	7.49	4.0
Absolute Minimum	mg/L	5.51	-0.005	5.51	-0.006	5.50	4.0
Dissolved Oxygen (bottom)[2]							
Summer Average[3]	mg/L	5.67	-0.005	5.66	-0.006	5.66	4.0
Absolute Minimum	mg/L	4.69	-0.006	4.68	-0.007	4.68	4.0
Total Nitrogen	mg/L	1.49	0.007	1.50	0.008	1.50	--
Total Phosphorus	mg/L	0.12	0.001	0.12	0.001	0.12	--
Total Suspended Solids	mg/L	71	0.006	71	0.009	71	--
Total Coliform[4]	MPN/100ml	1087	1	1088	1	1088	10,000
Copper[5,6]	µg/L	1.95	0.007	1.96	0.012	1.96	5.6
Lead [5,6]	µg/L	0.147	0.001	0.148	0.001	0.148	8
Zinc[5,6]	µg/L	4.49	0.018	4.51	0.026	4.52	66

Notes

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum 24-hour impact represents the maximum hourly impact in the North River WPCP Outfall receiving water segment

(9) Maximum 30-day impact represents the maximum monothly impact in the North River WPCP outfall receiving water segment

(10) Projected water quality due to incremental change represents the projected water quality concentration derived from the increase or decrease of the calculated incremental change from existing conditions

Table 3-5b. Water Quality Predictions in the Hudson River Near the North River WPCP for 2010 Future With the Proposed Action

			2010 Future With the Proposed Action					
			Maximum 24-Hour Impact[8]			Maximum 30-Day Impact[9]		
Parameter	Units	Existing Conditions 2003[1]	Incremental[7] Change 2010	Incremental[11] Change Due to Proposed Action 2010	Projected Water[10] Quality 2010	Incremental[11] Change Due to Proposed Action 2010	Projected Water[10] Quality 2010	NYSDEC Standard Class I Waters
Dissolved Oxygen (surface)[2]								
Summer Average[3]	mg/L	7.50	-0.007	-0.002	7.49	-0.002	7.49	4.0
Absolute Minimum	mg/L	5.51	-0.006	-0.001	5.50	-0.002	5.50	4.0
Dissolved Oxygen (bottom)[2]								
Summer Average[3]	mg/L	5.67	-0.007	-0.002	5.66	-0.003	5.66	4.0
Absolute Minimum	mg/L	4.69	-0.008	-0.003	4.68	-0.003	4.68	4.0
Total Nitrogen	mg/L	1.49	0.010	0.003	1.50	0.004	1.50	--
Total Phosphorus	mg/L	0.12	0.002	0.001	0.12	0.001	0.12	--
Total Suspended Solids	mg/L	71	0.008	0.002	71	0.004	71	--
Total Coliform[4]	MPN/100ml	1087	1	0	1088	0	1088	10,000
Copper[5,6]	µg/L	1.95	0.010	0.003	1.96	0.005	1.97	5.6
Lead [5,6]	µg/L	0.147	0.001	0.000	0.148	0.000	0.148	8
Zinc[5,6]	µg/L	4.49	0.026	0.008	4.52	0.011	4.53	66

Notes

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum 24-hour impact represents the maximum hourly impact in the North River WPCP outfall receiving water segment

(9) Maximum 30-day impact represents the maximum monthly impact in the North River WPCP outfall receiving water segment

(10) Projected water quality due to incremental change represents the projected water quality concentration derived from the increase or decrease of the calculated incremental change from existing conditions.

(11) Incremental change due to proposed projrect represents the change solely from the implementation of the Hudson Yards project in 2010

Under the 2010 No Build condition, total coliforms would be predicted to increase by 1 MPN/100mL for both the maximum 24-hour impact and the maximum 30-day impact and would remain below the NYSDEC Class I water quality standard of 10,000 MPN/100ml.

Incremental changes in copper, lead and zinc concentrations within the Hudson River would be predicted to be insignificant with incremental changes of 0.03 µg/L or less. Copper, lead and zinc concentrations would be expected to remain below the NYSDEC Class I water quality standards.

2010 Future With The Project

The predicted concentrations in the Hudson River for the 2010 with the project are presented on Table 3-5. Also shown on Table 3-5 are the incremental differences from the existing conditions and the differences in water quality due to the project. This difference in water quality due to the project is based on the difference in water quality from the 2010 with the project and the predicted water quality in 2010 without the project.

The decrease in the dissolved oxygen in the Hudson River due to the project for both the maximum 24-hour impact and maximum 30-day impact are below what can be detected. Dissolved oxygen concentrations are predicted to remain above the NYSDEC Class I Water Quality Standard of 4.0 mg/L.

Total coliform are predicted to remain constant for both the daily average and maximum month and are below the NYSDEC Class I Water Quality Standard of 10,000 MPN/100ml.

The difference in the total nitrogen, total phosphorus, total suspended solids, copper, lead and zinc concentrations in Hudson River concentration due to the project is predicted to be insignificant The concentrations in the Hudson River are predicted to remain constant and below the NYSDEC Class I Water Quality Standard.

2025 Future Without the Project

The estimated impact in 2025 of the no build conditions on the North River WPCP is presented in Table 2-1 for the average effluent and the maximum month. As shown on Table 2-1, the SPDES permit limitations are expected to be met for both the average and maximum month effluent under the 2025 based on the predicted growth and development of the North River

WPCP drainage area without the Project for the parameters that have a SPDES permit limit under the current permit.

The predicted concentrations in the Hudson River for the 2025 no build scenario are presented on Table 3-6. Also shown on Table 3-6 are the incremental differences in concentrations resulting from the projected 2025 no build flow. The dissolved oxygen levels in both the bottom and surface layer within the Hudson River near the North River WPCP are predicted to decrease by a maximum of 0.02 mg/L when compared to the existing conditions. As noted above dissolved oxygen can only be measured to an accuracy of approximately +/- 0.1 mg/L. The predicted incremental change in dissolved oxygen in the Hudson River would not be detectable. Dissolved oxygen concentrations are predicted to remain above the NYSDEC Class I Water Quality Standard of 4.0 mg/L.

The incremental difference in the total nitrogen, total phosphorus and total suspended solids concentrations is predicted to be insignificant. The total nitrogen concentration in the Hudson River is predicted to increase by 0.02 mg/L for the maximum 24 hour impact and 0.03 mg/L for the maximum 30 day impact. The total phosphorus and total suspended solids concentrations in the Hudson River are predicted to remain constant.

Total coliform are predicted to increase by 1 MPN/100ml for both the maximum 24-hour impact and maximum 30 day impact and are predicted to remain below the NYSDEC Class I Water Quality Standard.

The incremental difference in the copper, lead and zinc concentrations is predicted to be insignificant with incremental differences of 0.08 µg/L or less. The copper, lead and zinc concentrations based on the projected growth and development in the North River WPCP drainage area without the project are expected to remain below the NYSDEC Class I Water Quality Standard.

2025 Future With The Project

The predicted concentrations in the Hudson River for the 2025 with the project are presented on Table 3-6. Also shown on Table 3-6 are the incremental differences from the existing conditions and the differences in water quality due to the project. This difference in water quality due to the project is based on the difference in water quality from the 2025 with the project and the predicted water quality in 2025 without the project.

Table 3-6a. Water Quality Predictions in the Hudson River Near the North River WPCP for 2025 Future Without the Proposed Action

			2025 Future Without the Proposed Action				
			Maximum 24-Hour Impact[8]		Maximum 30-Day Impact[9]		NYSDEC
Parameter	Units	Existing Conditions 2003 [1]	Incremental[7] Change 2025	Projected Water[10] Quality 2025	Incremental[7] Change 2025	Projected Water[10] Quality 2025	Standard Class I Waters
Dissolved Oxygen (surface)[2]							
Summer Average[3]	mg/L	7.5	-0.015	7.49	-0.018	7.48	4.0
Absolute Minimum	mg/L	5.51	-0.015	5.50	-0.018	5.49	4.0
Dissolved Oxygen (bottom)[2]							
Summer Average[3]	mg/L	5.67	-0.016	5.65	-0.018	5.65	4.0
Absolute Minimum	mg/L	4.69	-0.018	4.67	-0.021	4.67	4.0
Total Nitrogen	mg/L	1.49	0.022	1.51	0.026	1.52	--
Total Phosphorus	mg/L	0.12	0.004	0.12	0.004	0.12	--
Total Suspended Solids	mg/L	71	0.018	71	0.027	71	--
Total Coliform[4]	MPN/100ml	1087	1	1088	1	1088	10,000
Copper[5,6]	µg/L	1.95	0.021	1.97	0.038	1.99	5.6
Lead [5,6]	µg/L	0.147	0.002	0.149	0.003	0.150	8
Zinc[5,6]	µg/L	4.49	0.056	4.55	0.082	4.57	66

Notes

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum 24-hour impact represents the maximum hourly impact in the North River WPCP outfall receiving water segment

(9) Maximum 30-day impact represents the maximum monthly impact in the North River WPCP outfall receiving water segment

(10) Projected water quality due to incremental change represents the projected water quality concentration derived from the increase or decrease of the calculated incremental change from existing conditions.

Table 3-6b. Water Quality Predictions in the Hudson River Near the North River WPCP for 2025 Future With the Proposed Action

			2025 Future With the Proposed Action					
			Maximum 24-Hour Impact[8]			Maximum 30-Day Impact[9]		
Parameter	Units	Existing Conditions 2003[1]	Incremental[7] Change 2025	Incremental[11] Change Due to Proposed Action 2025	Projected Water[10] Quality 2025	Incremental[11] Change Due to Proposed Action 2025	Projected Water[10] Quality 2025	NYSDEC Standard Class I Waters
Dissolved Oxygen (surface)[2]								
Summer Average[3]	mg/L	7.5	-0.025	-0.010	7.48	-0.011	7.47	4.0
Absolute Minimum	mg/L	5.51	-0.024	-0.010	5.49	-0.011	5.48	4.0
Dissolved Oxygen (bottom)[2]								
Summer Average[3]	mg/L	5.67	-0.026	-0.010	5.64	-0.012	5.64	4.0
Absolute Minimum	mg/L	4.69	-0.030	-0.012	4.66	-0.013	4.66	4.0
Total Nitrogen	mg/L	1.49	0.036	0.014	1.53	0.017	1.53	--
Total Phosphorus	mg/L	0.12	0.006	0.002	0.13	0.003	0.13	--
Total Suspended Solids	mg/L	71	0.030	0.012	71	0.017	71	--
Total Coliform[4]	MPN/100ml	1087	1	0	1088	0	1088	10,000
Copper[5,6]	µg/L	1.95	0.035	0.014	1.99	0.025	2.01	5.6
Lead [5,6]	µg/L	0.147	0.004	0.001	0.151	0.002	0.152	8
Zinc[5,6]	µg/L	4.49	0.092	0.036	4.58	0.053	4.63	66

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum 24-hour impact represents the maximum hourly impact in the North River WPCP outfall receiving water segment

(9) Maximum 30-day impact represents the maximum monthly impact in the North River WPCP outall receiving water segment

(10) Projected water quality due to incremental change represents the projected water quality concentration derived from the increase or decrese of the calculated incremental change from existing conditions.

(11) Incremental change due to proposed project represents the change resulting solely from the implementation of the Hudson Yards project in 2025

The decrease in the dissolved oxygen in the Hudson River due to the project for both the maximum 24-hour impact and maximum 30-day impact are approximately 0.01 mg/l. Dissolved oxygen can only be measured to an accuracy of approximately +/- 0.1 mg/L. The predicted incremental change in dissolved oxygen in the Hudson River would not be detectable. The dissolved oxygen concentrations are predicted to remain above the NYSDEC Class I Water Quality Standard of 4.0 mg/L.

Total coliform is predicted to remain constant for the daily average and increase by 1 MPN/100ml for the maximum month. The fecal coliform will remain below the NYSDEC Class I Water Quality Standard of 10,000 MPN/100ml.

The total nitrogen and total phosphorus concentrations for both the maximum 24 hour impact and maximum 30 day impact are predicted to increase by 0.01 mg/L over the concentrations predicted for 2025 without the project. The total suspended solids concentrations in the Hudson River are predicted to remain the same as without the project.

The predicted increase in copper concentration in the Hudson River due to the project is 0.02 μg/L for both the maximum 24-hour impact and maximum 30-day impact. The lead concentration is predicted to increase by 0.001 μg/L for the maximum 24-hour impact and 0.002 μg/L for the maximum 30 day impact due to the project. An increase in zinc concentration due to the project is predicted to be 0.03 μg/L for the maximum 24 hour impact and 0.04 μg/L for the maximum 30 day impact. The copper, lead and zinc concentrations in the Hudson River are predicted to remain below the NYSDEC Class I Water Quality Standards.

3.5 IMPACTS OF CSOs ON WATER QUALITY

After developing the CSO volumes for the current conditions, model inputs were developed for the water quality (pollutant loadings) model. For existing and future CSOs to the Hudson River, pollutant loadings for each water quality parameter were calculated by assigning pollutant concentrations to the stormwater runoff flow and sanitary sewage flows.

The baseline condition represented current water quality in the Hudson River due to existing discharges to the system including the existing WPCP outfall and existing CSOs to the river. The future conditions are identical to the baseline condition except the future conditions were developed with and without the Proposed Action using the 1988 rainfall and hydrologic ambient conditions.

The water quality impacts of the proposed future discharges were estimated based on the following:

- Existing water quality was developed from current water quality conditions.
- Changes in water quality were calculated by the SWEM or PATH models.

The calculated pollutant concentrations were used to determine the change in the background water quality (baseline condition) due to the anticipated additional CSO discharges for the following parameters: DO, total coliform, copper, lead and zinc for the future conditions. Tables were developed which summarize the absolute water quality concentrations and changes in water quality for each of the four scenarios. Future water quality conditions were compared with applicable NYSDEC water quality standards and guidance values for the applicable waterbody classification.

2010 Without the Project

In addition to an assessment of the potential effect of increased flows to the WPCP under the 2010 No Build Condition, an evaluation of the potential effects on CSOs and the associated potential changes in water quality were calculated. The predicted concentrations in the Hudson and Harlem Rivers for the 2010 No Build scenario are presented in Table 3-7. The results of the model calculation show that the maximum change in concentration would occur within the Hudson River. Table 3-7 shows the incremental changes in concentrations resulting from the projected 2010 CSO volume changes and the projected water quality concentrations based upon measured existing conditions. Dissolved oxygen levels in both the bottom and surface layer within the Hudson River would be predicted to not change. Dissolved oxygen concentrations would be predicted to remain above the NYSDEC Class I water quality standard of 4.0 mg/L. Likewise, incremental change in CSO total nitrogen, total phosphorus and total suspended solids concentrations under the maximum impact is predicted to be insignificant.

The maximum incremental change in the total coliform would be predicted to increase by less than 1 MPN/100ml and would remain below the NYSDEC Class I water quality standard of 10,000 MPN/100ml. The maximum incremental change in the copper concentration would be calculated to be 0.03 µg/L. The maximum incremental difference for the lead concentration would be predicted to be approximately 0.016 µg/L and for zinc 0.09 µg/L. The copper, lead, and zinc concentrations would all be predicted to remain below the NYSDEC Class I water quality standard.

2010 With the Project

The predicted concentrations in the Hudson River for the 2010 with the project are presented on Table 3-7. Also shown in Table 3-7 are the incremental differences from the existing conditions and the differences in water quality due to the project. This difference in water quality due to the project is based on the difference in water quality from the 2010 with the project and the predicted water quality in 2010 without the project.

The decrease in the dissolved oxygen in the Hudson River due to the project at the location of the maximum change is below what can be detected. Dissolved oxygen concentrations are predicted to remain well above the NYSDEC Class I Water Quality Standard of 4.0 mg/L. Total coliform are predicted to remain constant for the maximum impact and remain well below the NYSDEC Class I Water Quality Standard of 10,000 MPN/100ml. The difference in the total nitrogen, total phosphorus and total suspended solids, Hudson River concentration due to the project is predicted to be insignificant

The concentration of copper in the Hudson River is predicted to increase by 0.01 µg/L due to the project. The lead concentration is predicted to increase by 0.006 µg/L and the zinc concentration due to the project is predicted to be 0.03 µg/L. The concentrations of copper, lead and zinc will remain below the NYSDEC Class I Water Quality Standard.

2025 Without the Project

The predicted concentrations in the Hudson River for the 2025 no build scenario are presented on Table 3-8. Also shown on Table 3-8 are the incremental differences in concentrations resulting from the projected 2025 CSO volume changes. The dissolved oxygen levels in surface layer within the Hudson River near the North River WPCP are predicted to remain constant. Dissolved oxygen concentrations in the bottom layer are predicted to decrease by approximately 0.01 mg/L. Dissolved oxygen can only be measured to an accuracy of approximately +/- 0.1 mg/L. The predicted incremental change in dissolved oxygen in the Hudson River would not be detectable. The dissolved oxygen concentrations are predicted to remain above the NYSDEC Class I Water Quality Standard of 4.0 mg/L.

Table 3-7. Water Quality Predictions of the Potential Impact of North River WPCP CSOs For 2010 Future With and Without the Proposed Action

			Future Without Proposed Action		Future With Proposed Action		
			Maximum Impact[8]		Maximum Impact[8]		
Parameter	Units	Existing Conditions 2003[1]	Incremental[7] Change 2010	Projected Water[9] Quality 2010	Incremental[10] Change Due to Proposed Action 2010	Projected Water[9] Quality 2010	NYSDEC Standard Class I Waters
Dissolved Oxygen (surface)[2]							
Summer Average[3]	mg/L	7.5	-0.001	7.50	-0.001	7.50	4.0
Absolute Minimum	mg/L	5.51	-0.001	5.51	-0.001	5.51	4.0
Dissolved Oxygen (bottom)[2]							
Summer Average[3]	mg/L	5.67	-0.002	5.67	-0.001	5.67	4.0
Absolute Minimum	mg/L	4.69	-0.002	4.69	-0.001	4.69	4.0
Total Nitrogen	mg/L	1.49	0.003	1.49	0.001	1.49	--
Total Phosphorus	mg/L	0.12	0.001	0.12	0.000	0.12	--
Total Suspended Solids	mg/L	71	0.023	71	0.010	71	--
Total Coliform[4]	MPN/100ml	1087	4	1091	1	1092	10,000
Copper[5,6]	µg/L	1.95	0.035	1.98	0.014	2.00	5.6
Lead[5,6]	µg/L	0.147	0.017	0.164	0.007	0.17	8
Zinc[5,6]	µg/L	4.49	0.099	4.59	0.040	4.63	66

Notes

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum impact represents the maximum impact in the Hudson and Harlem Rivers

(9) Incremental change plus existing represents the projected water quality concentration derived from the increase or decrease of the calculated incremental change from existing conditions

(10) Incremental change due to proposed project represents the change resulting solely from the implementation of the Hudson Yards project in 2010

The maximum incremental difference in the total phosphorus and total suspended solids concentrations is predicted to be insignificant. The concentrations of total phosphorus and total suspended solids in the Hudson River are predicted to remain constant. The concentration of total nitrogen is predicted to increase by 0.01 mg/L in the Hudson River. The maximum incremental difference in the total coliform are predicted to increase by approximately 1 MPN/100ml and will be below the NYSDEC Class I Water Quality Standard of 10,000 MPN/100ml.

The incremental difference in the copper concentration is predicted to be 0.11 µg/L. The maximum incremental difference for the lead concentration is predicted to be 0.05 µg/L and for zinc 0.31 µg/L. The copper, lead, and zinc concentrations in the Hudson River are predicted to remain below the NYSDEC Class I Water Quality Standard.

2025 With the Project

The predicted concentrations in the Hudson River for the 2025 with the project are presented in Table 3-8. Also shown on Table 3-8 are the incremental differences from the existing conditions and the differences in water quality due to the project. This difference in water quality due to the project is based on the differences in water quality from the 2025 with the project and the predicted water quality in 2025 without the project.

The decrease in the dissolved oxygen in the Hudson River due to the project at the location of maximum change is predicted to be 0.0033 mg/L. Dissolved oxygen can only be measured to an accuracy of approximately +/- 0.1 mg/L. The predicted incremental change in dissolved oxygen in the Hudson River would not be detectable. The dissolved oxygen concentrations are predicted to remain well above the NYSDEC Class I Water Quality Standard of 4.0 mg/L.

Total coliform bacteria are predicted to increase by 1 MPN/100 ml and remain well below the NYSDEC Class I Water Quality Standard of 10,000 MPN/100 ml. The total phosphorus and total suspended solids Hudson River concentration due to the project are predicted to remain constant. The total nitrogen concentration is predicted to increase by approximately 0.01 mg/L with the completion of the project.

Table 3-8. Water Quality Predictions of the Potential Impact of North River WPCP CSOs For 2025 Future With and Without Proposed Action

			Future Without Proposed Action		Future With Proposed Action		
			Maximum Impact[8]		Maximum Impact[8]		
Parameter	Units	Existing Conditions 2003[1]	Incremental[7] Change 2025	Projected Water[9] Quality 2025	Incremental[10] Change Due to Proposed Action 2025	Projected Water[9] Quality 2025	NYSDEC Standard Class I Waters
Dissolved Oxygen (surface)[2]							
Summer Average[3]	mg/L	7.5	-0.005	7.50	-0.003	7.49	4.0
Absolute Minimum	mg/L	5.51	-0.005	5.51	-0.003	5.50	4.0
Dissolved Oxygen (bottom)[2]							
Summer Average[3]	mg/L	5.67	-0.007	5.66	-0.004	5.66	4.0
Absolute Minimum	mg/L	4.69	-0.007	4.68	-0.004	4.68	4.0
Total Nitrogen	mg/L	1.49	0.011	1.50	0.006	1.51	--
Total Phosphorus	mg/L	0.12	0.002	0.12	0.001	0.12	--
Total Suspended Solids	mg/L	71	0.076	71	0.046	71	--
Total Coliform[4]	MPN/100ml	1087	13	1100	9	1109	10,000
Copper[5,6]	µg/L	1.95	0.112	2.06	0.068	2.13	5.6
Lead[5,6]	µg/L	0.147	0.055	0.202	0.033	0.230	8
Zinc[5,6]	µg/L	4.49	0.318	4.81	0.193	5.00	66

Notes

(1) NYCDEP Harbor Survey Station N-3B - West 125th Street

(2) Dissolved oxygen data for 2003

(3) Summer average - June 1 to September 30

(4) Total coliform data for 1996

(5) USEPA Survey Station H3; 1991

(6) Existing conditions and standards for metals for dissolved form

(7) Incremental changes were calculated through the use of SWEM

(8) Maximum impact represents the maximum impact in the Hudson and Harlem Rivers

(9) Projected water quality due to incremental change represents the projected water quality concentration derived from the increase or decrease of the calculated incremental change from existing conditions

(10) Incremental change due to proposed project represents the change resulting solely from the implementation of the Hudson Yards project in 2025

The concentration of copper in the Hudson River is predicted to increase by 0.08 μg/L due to the project. The lead concentration is predicted to increase by 0.04 μg/L and the zinc concentration due to the project is predicted to be 0.23 μg/L. The concentrations of copper, lead and zinc will remain below the NYSDEC Class I Water Quality Standard.

SECTON 4.0

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