A. INTRODUCTION

The proposed project would generate new demands on infrastructure, including water supply, sewage treatment, solid waste management, and energy services provided in the project site. (For the purposes of this infrastructure analysis, the residential mixed-use variation of the proposed project is the basis for the quantitative analysis, as residential use generally results in higher project-site infrastructure demands.) The proposed project would result in changes to local stormwater runoff patterns, and improvements in the local sewer system and stormwater management, both on and near the project site. City sewers in this area are part of a combined system that conveys sanitary and stormwater flows to the Gowanus Pumping Station, which in turn connects to the Red Hook Water Pollution Control Plant (WPCP). Both the Gowanus Pumping Station and the Red Hook WPCP are operated by the New York City Department of Environmental Protection (DEP).

This chapter assesses the proposed project's effects on these municipal infrastructure systems and services, and considers the net incremental impact between the continuation of the existing on-site uses in the future without the proposed project (No Build conditions) and the development program under the proposed project in both the 2010 and 2016 analysis years (Build conditions). This chapter also addresses the effects of the commercial mixed-use variation.

PRINCIPAL CONCLUSIONS

While the proposed project would create new infrastructure demands, the municipal systems serving the project site have adequate capacity to meet the projected increases in demand from the proposed project. In addition, when necessary, local improvements in City infrastructure, including in local sewers and water mains, as well as significant on-site stormwater management techniques, are proposed to address the infrastructure needs of the project. Principal conclusions of this chapter are as follows:

Water Supply

Water demands of the proposed project would not overburden the City's water supply systems. The incremental increase in water demand on the City's water supply system from the proposed project is 0.1 percent in 2010 and 0.25 percent in 2016. These are insignificant added demands on the City's water supply systems. As part of the proposed project, local water distribution mains would be replaced and upgraded. With these improvements, no impacts on local water pressure are expected. The proposed project would also include voluntary water conservation measures proposed by the project sponsors, as well as those required by New York City.

Sanitary Wastewater Treatment

The proposed project would generate sanitary sewage that is projected to be 0.7 million gallons per day (mgd) in 2010 and 1.75 mgd in 2016. These flow increases would not overburden the Red Hook WPCP, which is projected to have adequate surplus capacity to handle these flows. In both analysis years, the Red Hook WPCP is expected to receive flows at less than 60 percent of its design capacity with dry weather flow capacity of 60 mgd (far less than its operating capacity of 120 mgd), including the added flows of the proposed project. In addition, the proposed project would provide new and larger sewers in the area of the project site consistent with an amended drainage plan for the project and nearby blocks.

Stormwater Runoff and Combined Sewer Overflows (CSOs)

The proposed project has the potential to create new runoff to the City's sewer system (which is a combined system in this area and, therefore, conveys both sanitary sewage and stormwater runoff). However, the proposed project also includes a number of site-specific stormwater management approaches that would result in a net reduction to stormwater discharges (over the No Build condition), thus minimizing effects of CSO impacts and the resulting potential for any adverse water quality impacts on the Gowanus Canal or the East River would be avoided (see the discussion below). These measures include water conservation to reduce sanitary wastewater flows; on-site detention and retention tanks for stormwater with multi-level discharge points to optimize storage; and re-use of captured stormwater within the project site.

Gowanus Canal/East River Water Quality

The proposed project would not adversely impact the water quality of the Gowanus Canal or East River. Based on the proposed stormwater management techniques (described above) and the results of a modeling analysis performed for the Red Hook WPCP drainage area, with the proposed project, the frequency of CSO discharges from the Gowanus Pumping Station to the Gowanus Canal would not significantly increase and the volume would decrease. The combined effects of water conservation measures and stormwater management strategies would minimize flows from the proposed project to the Gowanus Pumping Station such that there would be no significant adverse impacts on the water quality of the Gowanus Canal. Similarly, the frequency and volume of CSO discharges to the East River would not significantly increase. Therefore, no significant adverse impacts on water quality of the East River are projected.

Solid Waste Management

No significant adverse impacts on solid waste and sanitation services would occur with the proposed project. The Department of Sanitation New York (DSNY), which collects solid waste and recyclables, currently provides municipal solid waste and sanitation services to the project site. Private carters also provide these services to non-residential users. The proposed project would increase the volumes of solid waste and recyclables, but would not affect the delivery of these services, nor would it place a significant burden on the City's solid waste management services (both public and private). In addition, the proposed project would not conflict with, or require amendments to, the City's Solid Waste Management Plan (SWMP).

Energy

The proposed project would increase demands on electricity and gas. However, relative to the capacity of these systems and the current levels of service within New York City, these increases in demand would be insignificant. Improvements are also proposed by Consolidated Edison and

KeySpan with respect to the local electric and gas distribution grids that would improve service to the project site. In addition, new electrical and gas lines are proposed within the beds of streets that would be reconstructed as part of the proposed project. It is therefore concluded that the demands of the proposed project would not result in a significant impact on the supplies of electricity and gas in the region or the City as a whole, and with the proposed improvements to the distribution network, no impact would occur locally with respect to electrical or gas utilities. For these reasons, the proposed project is not expected to significantly adversely impact energy systems.

B. METHODOLOGY[1]

As described below, this chapter will:

- Describe the existing water supply network currently serving the project site and, using water demand rates from the *City Environmental Quality Review* (*CEQR) Technical Manual*, determine the project's incremental increase in water demand for the two analysis years in order to assess the impacts of this incremental demand on the City's water supply and conveyance system.
- Provide data on the existing sewer lines serving the project site; provide data on the existing flows to the Red Hook WPCP for the latest 12-month period; estimate sanitary sewage generation for both analysis years in the future without the proposed project and then add to that the project's projected water-consumption demand; and, assess the proposed project's effects on the local sewer system and operations at the Red Hook WPCP.
- Describe any modifications to the stormwater collection system and the baseline stormwater runoff conditions, including the stormwater management strategies of the proposed project as well as capital projects proposed by the City, and assess project impacts on stormwater runoff patterns and local sewers for both analysis years.
- Model the effects of combined sanitary and stormwater runoff flows in the Red Hook WPCP service area and examine the flows generated by the proposed project to determine any potential impacts on CSO events and the water quality of the Gowanus Canal and East River.
- Describe the existing solid waste management services at the project site and, using solid waste generation rates for typical land uses and activities provided in the *CEQR Technical Manual*, determine future solid waste demands with the proposed project for the two analysis years, and assess the effects of this incremental demand on municipal and private sanitation services.
- Present data on the existing energy distribution system and estimated energy usage for existing conditions; determine future energy demands with the proposed project for the two analysis years using energy usage rates for typical land uses provided in the *CEQR Technical Manual* and other available literature sources; and assess the effects of this incremental energy demand on the local distribution system and regional energy supplies.

[1] Documents used in preparing this chapter include: "*Impacts of the Atlantic Yards Projects on Local Sewer Infrastructure: Summary Report*," prepared by HydroQual Environmental Engineers and Scientists P.C., for the Forest City Ratner Company, November, 2006.

In addition, this chapter describes the proposed design features that would be incorporated into the project design for the purposes of minimizing project demands on these infrastructure systems (see discussion below).

Construction period techniques, including an analysis of the construction-phase installation of proposed sewers and utilities, are presented in Chapter 17, "Construction Impacts."

SUSTAINABLE DESIGN FEATURES RELATED TO INFRASTRUCTURE

The proposed project includes a number of "sustainable design" features relative to infrastructure. These include:

- Landscaping that allows for stormwater re-use on-site as part of an overall stormwater management plan that also includes the use of permeable pavers and vegetated filters as well as stormwater reuse for air conditioning cooling towers;
- Stormwater retention measures with site-specific designs beyond those required by DEP that minimize impacts on the City's sewer system while avoiding CSO impacts on the Gowanus Canal;
- Use of high-efficiency, water flow control fixtures such as flow restrictors, low-flow toilets, low-flow sinks, low-flow showers, and waterless urinals (in the arena). These fixtures minimize demands on the City's water supply, and sewer collection system, and also on wastewater treatment demands at the Red Hook WPCP;
- Use of native plants that minimize irrigation needs; and
- Energy saving devices such as high-performance glazing and envelope assemblies, solar shading devices, daylight controls, occupancy sensors, energy-efficient lighting and appliances, and cooling heat recovery.

These measures would be part of the proposed project design (see Chapter 1, "Project Description").

C. EXISTING CONDITIONS

WATER SUPPLY

New York City's water supply system is comprised of three watersheds (Croton, Delaware, and Catskill), and extends as far north as the Catskill Mountains. This system, which is operated by DEP, delivers, on average, approximately 1.2 billion gallons of water per day (gpd) to the City's five boroughs and Westchester County. Daily demands, however, can reach up to 1.5 billion gpd during the peak summer months, and the public water supply system responds to these seasonal increases in demand. Water from these three upstate watersheds is conveyed to the City via a system of reservoirs, aqueducts, and tunnels that begin as far as 125 miles north of the City. Within the City, a grid of water pipes distributes water to customers. Of the three systems, the Croton watershed supplies an average of 10 percent of the City's water, primarily to users in the lower elevation portions of Manhattan and the Bronx. This watershed does not normally supply water to Brooklyn. The Delaware and Catskill systems supply all five boroughs and typically deliver about 90 percent of the City's drinking water.

The Delaware and Catskill watersheds collect runoff from the Catskill Mountains and deliver it to the Kensico Reservoir in Westchester County. From there, water is conveyed to the Hillview

Reservoir in Yonkers, which is used to balance the daily fluctuations in water use. Water is then delivered to the City through three tunnels, referred to as Tunnel Nos. 1, 2, and 3. Tunnel No. 1 carries water through the Bronx and Manhattan to Brooklyn; Tunnel No. 2 passes through the Bronx, Queens, Brooklyn, and then through the Richmond Tunnel to Staten Island; and Tunnel No. 3 goes through the Bronx and Manhattan, terminating in Queens. An extension of Tunnel No. 3 is currently being built in Queens and Brooklyn.

Tunnels No. 1 and 2 serve Downtown Brooklyn. The tunnel conveys water into shafts that deliver large volumes of potable water to the distribution system comprised of a network of water distribution mains. A number of large mains, ranging up to 6 feet in diameter, run under various streets and feed an interconnected grid of 8- and 12-inch water mains that exist beneath most streets in downtown Brooklyn. These 8- and 12-inch water mains supply water to individual building connections. This interconnected grid system equalizes water pressure and allows a segment to be shut down for repair or replacement without affecting the majority of local users.

As discussed in Chapter 1, "Project Description," the project site is largely vacant and underutilized with a few active uses, including office, light industrial/manufacturing, retail, and residential, as well as a below-grade open rail yard. Based on these uses, the existing water consumption demand (i.e., potable water use) on the project site is estimated to be approximately 53,647 gpd (see Table 11-1). All water consumption is assumed to enter the sanitary sewer system at the same rate of flow, while water from central air conditioning systems typically evaporates and does not enter the local sewer system. It is conservatively assumed that the majority of existing uses on the project site do not have air conditioning systems that generate this demand. Thus, the domestic water consumption is assumed to represent current demands.

Table 11-1
Existing Water Demands at the Project Site

Current Use	Size	Domestic Water Consumption Rate	Total Domestic Water Consumption (gpd)
Residential	61 occupied units	112 gpd/person[1]	16,397
Retail	67,647 sf	0.17 gpd/sf	11,500
Commercial/Office	73,759 sf	25 gpd/person[2]	1,750
Industrial/Manufacturing/Storage	102,898 sf (2.4 acres)	10,000 gpd/acre[3]	24,000
Total	**N/A**	**N/A**	**53,647**

Notes:
[1] Population estimates for residential water use assume 2.4 residents per unit.
[2] There are approximately 70 commercial office jobs currently on the project site.
[3] Since the *CEQR Technical Manual* does not provide water consumption rates for industrial uses, DEP factors were used in determining water demand for industrial uses. These factors are found at *DEP Draft Rules and Regulations Governing the Construction of Private Sewers and Drains,* NYCDEP.

Sources: Table 4-4 in Chapter 4, "Socioeconomic Conditions;" Water rates, *CEQR Technical Manual (2001)*.

The project site and adjoining streets currently have a complete interconnected grid of water distribution mains. For the east/west streets, these existing water mains are as follows:

- Under Dean Street, an 8-inch ductile pipeline installed in 1971;
- Under Pacific Street, an 8-inch cast iron pipe installed in 1930 and, east of Carlton Avenue, a 6-inch cast iron pipe installed in 1866 and a 24-inch cast iron pipe installed in 1909;

- Under Atlantic Avenue, an 8-inch ductile pipe installed in 1971, a segment of cast iron pipe with concrete liner installed in 1958, a 36-inch cast iron pipe installed in 1903 (east of Carlton Avenue), a 48-inch cast iron pipe installed in 1868, and a segment near Flatbush Avenue of a 36-inch cast iron pipe installed in 1919 and a 20-inch steel pipe installed in 1966 (the 36-inch lines under Atlantic Avenue have been decommissioned for about a year due to leakage); and
- Under Flatbush Avenue, a 16-inch cast iron pipe installed in 1890, a 12-inch cast-iron pipe installed in 1861, and a 16-inch cast iron pipe installed in 1904.

For the north/south streets, the water mains are as follows:

- Under 5th Avenue, an 8-inch ductile iron pipe installed in 1991;
- Under 6th Avenue, a 12-inch steel pipe encased with a 20-inch pipe installed in 1984, and an 8-inch cast iron pipe installed in 1929;
- Under Carlton Avenue, an 8-inch cast iron pipe installed in 1930, and a 24-inch cast iron pipe installed in 1909; and
- Under Vanderbilt Avenue, an 8-inch cast iron pipe installed in 1929, an 8-inch ductile iron pipe installed in 1971, a 24-inch cast iron pipe installed in 1910, and a 12-inch cast iron pipe installed in 1929.

SANITARY WASTEWATER

RED HOOK WPCP SERVICE AREA

Downtown Brooklyn is almost entirely within the tributary area of the Red Hook WPCP, which is operated by DEP and is located along the Brooklyn waterfront, near the former Brooklyn Navy Yard (see Figure 11-1). The service area/watershed for this WPCP covers about 3,000 acres of urban land cover. The project site is entirely within the service area of the Red Hook WPCP.

The Red Hook WPCP provides a secondary level of treatment (85 percent removal of solids and biological oxygen demand organics), and discharges the clarified and disinfected effluent to the East River. A New York State Pollutant Discharge Elimination System (SPDES) permit, issued to the plant by the New York State Department of Environmental Conservation (NYSDEC), regulates the allowable effluent flow volume and pollutant loads for the purposes of protecting the water quality of the East River and regional water quality as a whole. The Red Hook WPCP is permitted to treat a 12-month rolling average dry weather flow of 60 mgd. The treatment capacity of the WPCP is twice the design dry weather flow, or 120 mgd. This allows the plant to treat a certain volume of stormwater flow in wet weather events.

Flow records for the plant are maintained by DEP and are reported to NYSDEC. The standard for determining average daily flow rates at the City's WPCPs is determined by tabulating the dry weather flows over a 30-day (or monthly) period. Dry-weather flow includes only sanitary wastewater, i.e., contributions from residential, commercial, and industrial users, all of which is treated at the WPCP. The sanitary wastewater flow will vary over the course of the day, with peaking factors during periods of higher use. These variations are factored into the daily average. Table 11-2 presents the current flow data for the plant as reported by DEP. As shown in this table, the average daily flow rate at the plant for the period between March 2005 and February

2006 was 32.1 mgd, or about half the permitted capacity (60 mgd) and far less than the design capacity of the plant (120 mgd).

Table 11-2
Average Daily Flows by Month at the Red Hook WPCP

Year	Month	Flow (mgd)
2006	February	32
2006	January	35
2005	December	35
2005	November	35
2005	October	43
2005	September	27
2005	August	28
2005	July	31
2005	June	30
2005	May	27
2005	April	31
2005	March	31
	12-Month Average	32.1

Source: DEP, May 2006.

With the implementation of citywide water conservation measures, the trend in recent years has been towards a reduction in flow rates to most of the City's WPCPs. For example, at the Red Hook WPCP, the 1993 reported average flow was 46.5 mgd.

Sewers within the Red Hook WPCP service area collect both sanitary sewage and stormwater runoff that comes from roof and street drainage. In dry weather, the collection lines convey only sanitary sewage to the WPCP. However, during and immediately after precipitation events, such as rain and snow melts, the sewers carry both sanitary sewage and stormwater, referred to as combined flows, which can result in downstream CSO events, i.e., periods when the sewer system is over its capacity and untreated combined flows are discharged via outfalls to local receiving waters, e.g., the East River and the Gowanus Canal in the Red Hook WPCP service area.

The drainage area of the Red Hook WPCP is a highly urbanized land surface comprised primarily of impervious surfaces (e.g., building roofs, street pavement), which generate runoff. At the project site, with the exception of the below-grade open rail yard, most of the runoff is from impervious cover. (A more detailed description of runoff conditions at the project site is provided below.)

The conveyance capacity of the system is referred to as the wet-weather capacity. In New York City, nearly all sewers are combined, so pipes are sized to handle loads that are much greater than the average dry-weather flow, or even the peak dry-weather flow. Wet-weather flows, which last beyond the cessation of the precipitation event, are much greater than peak dry-weather flows. In wet-weather events, the volume of wastewater and combined flows in the collection system often increases well beyond the capacity of the WPCP to adequately treat such flows. Therefore, to prevent the WPCP treatment process from being overwhelmed, excess wet-weather flows are discharged from the collection system directly into local waters. When the wet-weather capacity of the system is exceeded, this combined wastewater and runoff overflows

from control points known as regulators into the receiving waters (e.g., the East River and Gowanus Canal) without treatment. These regulator chambers, therefore, prevent a surcharge in the collection system and are designed to direct the flow that is above the system's capacity (which is comprised of sanitary wastewater and stormwater runoff) to the receiving waters via an outfall sewer. The locations of these outfalls in the Red Hook WPCP service area are shown in Figure 11-1. This overflow of sanitary wastewater diluted by stormwater runoff is referred to as "combined sewer overflow (CSO)."

The impact of CSO events on local water quality is transitory at most locations. This is due principally to the mixing capacity of the receiving waters and the fact that sanitary flows are diluted by runoff. However, unlike the East River, because of the canal's confined physical structure and limited circulation, CSO discharges have the potential to cause prolonged water quality impairments, with reduced levels of dissolved oxygen and elevated levels of coliform bacteria if adequate flushing does not occur. This is particularly a concern at the head of the canal and less so nearer the outlet where tidal action mixing can better disperse CSO discharges. However, DEP operates a flushing system consisting of a large propeller-type pump and a tunnel that draws water from the East River into the head of the canal. This creates a flushing action within the canal that improves water quality and offsets the impacts of the poor circulation.

Figure 11-2 shows the combined drainage areas from the Red Hook and Owls Head WPCP service areas that are tributary to the Gowanus Canal. The outfalls shown in red are located in the Red Hook (RH) WPCP service area and are identified as RH-031, RH-033, RH-034, RH-035, RH-036, and RH-037. There are seven additional CSO outfalls on the east side of the canal that are within the Owls Head WPCP (this WPCP service area is located south of the Red Hook WPCP service area). The project site is within the CSO drainage area of the Gowanus Pumping Station, which is located at the head of the canal. The pumping station drainage area is identified as RH-034 on Figure 11-2. All sanitary flow in this drainage area goes to the Gowanus Pumping Station. The pumping station is designed to convey flows through a force main directly to the Red Hook WPCP interceptor, which conveys flows to the Red Hook WPCP. However, this force main is currently not operational. Therefore, the Gowanus Pumping Station discharges to the Bond-Lorraine Street sewer which in turn flows west to the Red Hook main interceptor connecting at a location near Regulator 2.

The Gowanus Pumping Station is limited in the amount of flow it can convey. A pumping station's conveyance capacity is defined as the design capacity of the mechanical pumps to lift wastewater from the influent well and force it under pressure through a pipe (referred to as a force-main) to another location. Inflow that exceeds the pumping station capacity must be bypassed in some way, i.e., discharged outside of the station by gravity flow, to avoid flooding the station and surrounding area.

The Gowanus Pumping Station has the capacity to divert up to 28.5 mgd into the Bond-Lorraine Street sewer, which connects to the Red Hook WPCP interceptor (see Figure 11-1). There is a hydraulic head loss in conveying flows to the Bond-Lorraine Street sewer, due to sedimentation and constrictions in this sewer. This loss results in greater CSO impacts on the Gowanus Canal than would occur under design operating conditions. The overflow from the Gowanus Pumping Station that occurs in wet weather conditions is directed to the Gowanus Canal.

For the above reasons, DEP has a facility plan to improve the Gowanus Pumping Station's capacity to 30 mgd. In addition to the pumping station improvements, as described above, DEP operates a flushing tunnel that channels water from the East River at an average rate of 150 mgd to the canal for the purposes of improving flushing and, thus, canal water quality. This flushing

tunnel provides substantial dilution to the CSO discharges from RH-034 and the other outfalls downstream in both the Red Hook and Owls Head Drainage Areas. These proposed improvements are described below under "Future Without the Proposed Project" sections.

In addition to the above projects, the 2004 Administrative Consent Order requires the planning, design, and construction of over 30 CSO abatement projects Citywide. These projects include off-line retention tanks; sewer separation; flushing tunnels; throttling facilities, and numerous other projects designed to optimize the operation of the sewer collection system, pumping stations, and treatment plants during wet weather events. When fully constructed, the estimated capital cost of these projects will be in excess of $2.1 billion (2004 dollars). Overall objectives are to provide treatment for 75.59 percent of wet weather flow, an improvement over the current 70.2 percent required under the 1992 Administrative Consent Order. Benefits will include water quality improvements and floatables removal. This is expected to result in a 90 percent removal efficiency for floatables.

In the long term, it is expected that these projects would result in improved water uses and continued improvements in the water quality of New York City's waterways, such that water use goals are attained in certain waterways and exceeded in others. In sum, the CSO abatement program under the 2004 Administrative Consent Order would achieve greater environmental benefits through improved wet weather capture and system performance than was required in the 1992 Consent Order. The abatement projects, along with long-term monitoring facility plans, and long-term control planning, are aimed at reducing CSO impacts in New York Harbor.

WASTEWATER RATES AND SEWER COLLECTION LINES

Based on the current land uses on the project site and the water consumption rates of the City's *CEQR Technical Manual*, the existing uses on the project site generate approximately 53,647 gpd of sanitary wastewater (see Table 11-1 above).

The project site and nearby streets currently have a complete grid of gravity flow collection lines. These lines generally flow from east to west. For the east/west streets, the existing sewers are as follows:

- Under Bergen Street, there are 12-, 15-, and 18-inch sewers that flow west from Washington Avenue to a 36-inch sewer under Flatbush Avenue;
- Under Dean Street, there are 12-, 15-, and 18-inch sewers that flow west from Washington Avenue to an outlet connected to a 3-foot by 4-foot, 9-inch sewer under Flatbush Avenue (Outlet No. 2);
- Under Pacific Street, there are 12-, 15-, 24-, and 30-inch lines that flow west from Washington Avenue to a 42-inch sewer under 5th Avenue; and
- Under Atlantic Avenue, there are 12-, 15-, and 18-inch lines that flow west from Washington Avenue to a 42-inch sewer under 5th Avenue.

For the north/south streets, the sewers are as follows:

- Under Flatbush Avenue, there are 12-inch sewers connected to a 36-inch sewer to Outlet No. 2.
- Under 5th Avenue, there is a 42-inch sewer that flows from Flatbush Avenue;
- Under 6th Avenue, there are 12-inch sewers between St. Marks Place and Atlantic Avenues;

- Under Carlton Avenue, there are 12-inch sewers between St. Marks Place and Atlantic Avenue;
- Under Vanderbilt Avenue, there are 12- and 18-inch sewers between St. Marks Place and Atlantic Avenue;
- Under Underhill Avenue, there are 12-inch sewers between St. Marks Place and Atlantic Avenue; and
- Under Washington Avenue, there are 12-inch sewers between St. Marks Place and Atlantic Avenue.

Storm and sanitary flows from the project site under the existing conditions flow in combined sewers to two major outlets under Flatbush Avenue, which are located between the Brooklyn-Manhattan Transit (BMT) and the Interborough Rapid Transit (IRT) tunnel structures. These outlets are:

- Outlet 1: a 48-inch circular pipe at 5th Avenue/Flatbush Avenue, and
- Outlet 2: a 32-inch by 57-inch brick culvert at Dean Street/Flatbush Avenue.

The total tributary area that flows to Outlets 1 and 2 is approximately 90.86 acres. The tributary area to Outlet 1 is approximately 27.53 acres, of which approximately 16.5 acres is within the project site. The tributary area to Outlet 2 is 64.72 acres, of which approximately 5.5 acres is within the project site. (The additional 1.39 acres is Site 5 on the west side of Flatbush Avenue, which is downstream of the outlets and is not within the area of the proposed amended drainage plan.)

Flow in these pipes is conveyed west to the Gowanus Pumping Station. As stated above, in wet weather, combined sanitary and stormwater runoff flows that cannot be handled at the pumping station are discharged to the Gowanus Canal as CSOs.

STORMWATER

Stormwater runoff is generated by rainwater that collects on the surfaces of land or built structures. The runoff generated by these surfaces varies depending upon the type of land cover, which is defined as pervious (allow more percolation to the ground below and generate less runoff) or impervious (impede percolation and generate greater runoff). For example, runoff from a suburban yard will percolate into the ground with less runoff to a local street or swale. The runoff coefficient from this type of land surface is typically about 0.20 (20 percent runoff). In contrast, a building roof has no percolation and, therefore, has a runoff coefficient of 1.00 (100 percent runoff). Paved areas (e.g., streets and sidewalks) primarily generate runoff, with some percolation to the ground below (a runoff coefficient of 0.85). Provided below is an overview of the current land coverage at the project site and the associated runoff conditions, based on the current land uses (see also Figure 11-3).

DESCRIPTION OF LAND COVERAGE ON THE PROJECT SITE

The approximately 22-acre project site comprises eight blocks (Blocks 927, 1118, 1119, 1127, 1120, a portion of 1128, 1121, and 1129) and segments of public streets. The project site is roughly bounded by Flatbush and 4th Avenues to the west, Vanderbilt Avenue to the east, Atlantic Avenue to the north, and Dean and Pacific Streets to the south (see Figure 11-3). Described below is the current land coverage on the site. Because the sewer system serving the

area is a combined system, the sewers (described above) would collect the street runoff from the project site. Runoff from the street enters the sewers at catch basins.

West of Flatbush Avenue

Block 927, at the western end of the project site, contains two one-story commercial buildings and a 32-space parking lot. It is largely impervious with some percolation in the small parking area. Runoff is to the local streets. (The small triangular lot containing the Brooklyn Bear's Pacific Street Community Garden at the eastern tip of the block is not part of the project site).

Flatbush Avenue to 6th Avenue

Block 1118 is a small triangle formed by Flatbush Avenue as it crosses Atlantic and 5th Avenues. The northwest portion of the block is owned by the New York City Department of Housing Preservation and Development (HPD), but is currently used by the Long Island Rail Road (LIRR) for staging for its Atlantic Terminal reconstruction. The buildings at 608-620 Atlantic Avenue consisted of vacant manufacturing structures. Due to safety concerns, they were demolished in March 2006. The remaining lots are occupied by an auto-related use and a two-story commercial structure. This block is therefore impervious with runoff to the local streets.

Block 1119 is a rectangular-shaped block north of Pacific Street between 5th and 6th Avenues, and has a U-Haul rental and vehicle storage facility along the 5th Avenue frontage. The remainder of the block is a below-grade storage yard for commuter rail trains. The at-grade portions of the block are impervious with paved surfaces that run off to local streets. Because the storage yard is below grade, it does not generate any runoff to the local streets.

Block 1127, to the south, is a trapezoid-shaped block that contains a mix of built structures containing a number of uses, including industrial, commercial, residential, and auto-related (repair and gas station), with some vacant land (and vacant buildings). The Fire Department of New York (FDNY) operates an equipment cleaning/storage facility at 648 Pacific Street. This block is therefore largely impervious with very little percolation from the vacant lots. Runoff is to the local streets.

This portion of the project site includes the street bed of 5th Avenue between Atlantic and Flatbush Avenues, as well as the street bed of Pacific Street between Flatbush and 5th Avenues. This paved street bed would have minimal percolation and street runoff.

6th Avenue to Carlton Avenue

Block 1120 is a long rectangular block between Atlantic Avenue and Pacific Street. It is largely occupied by the below-grade open rail yard used for commuter rail storage. At-grade and fronting on Atlantic Avenue are buildings used for storage, and a vacant lot that was formerly a gas station. Therefore, much of the land use on this block is a below-grade train yard that currently does not generate any street runoff. A limited volume of runoff would be expected from the existing structures fronting on Atlantic Avenue.

Only a portion of the western end of Block 1128 south of Pacific Street is on the project site. This portion of the block is mostly built with structures fronting along 6th Avenue that house commercial/storage uses along with four residential buildings (two of which are vacant), one mixed-use residential/commercial building, and two vacant lots. Most of this site is, therefore, impervious with minimal percolation at the vacant lots. Runoff is to the local streets.

Carlton Avenue to Vanderbilt Avenue

Fronting on Atlantic Avenue, Block 1121 is predominantly occupied by the below-grade, open rail yard and a New York City Transit (NYCT) storage yard for retired buses, both located below grade and assumed not to generate any street runoff. At-grade uses on this block front Vanderbilt Avenue and include a gas station and an auto repair shop, which would generate a limited amount of street runoff.

To the south of Pacific Street, Block 1129 contains mostly built structures that have light industrial and auto-related (parking, storage, and auto repair) activities with some residential and ground-floor commercial retail along Vanderbilt Avenue, as well as a community facility that provides temporary housing for homeless families. There are also five vacant buildings and two unoccupied lots on this block. Most of this site is, therefore, impervious with minimal percolation at the vacant lots. Runoff is to the local streets.

The project site includes the street bed of Pacific Street between Carlton and Vanderbilt Avenues. This paved street bed would have minimal percolation.

SOLID WASTE

DESCRIPTION OF SANITATION SERVICES

In New York City, DSNY is the agency responsible for the collection and disposal of solid waste and recyclable materials generated by residences, some nonprofit institutions, tax exempt properties, and City agencies. DSNY also collects waste from street litter baskets, and handles street-sweeping operations and lot cleaning activities. Commercial operations handle solid waste from other uses, e.g., commercial retail, office, and industrial operations. Fresh Kills Landfill, which was New York City's last operating landfill, was officially closed in March 2001. DSNY continues to collect residential and institutional solid waste and recyclables (the municipal waste stream) which are now transported out of the City. Currently, most of the City's municipal solid waste is collected and delivered to transfer stations for sorting and transfer to larger "hopper" trucks, and then transported out of the City. Likewise, municipal solid waste from the project site is collected and trucked via transfer stations to out-of-state landfills and waste-to-energy facilities. Private carters also consolidate solid waste from commercial and industrial operations and haul it to waste transfer facilities both inside and outside New York City, from where it is transported to out-of-City disposal facilities. It is estimated that DSNY collects over 12,000 tons of residential and institutional refuse and recyclables (solid waste) per day.[1] It is also estimated that the non-residential (commercial/industrial) waste stream is about 13,000 tons per day (tpd).[1] The total solid waste generated in the City therefore averages approximately 25,000 tpd.

The City's solid waste management services are undertaken in accordance with the SWMP. The New York City Department of Sanitation (DSNY) developed a new Draft SWMP in October 2004 to address anticipated future demands for solid waste management for the City. The new Draft SWMP was subsequently revised in July 2006 and approved by the New York City Council on July 19, 2006. The new SWMP is effective for the next 20 years and is expected to be fully operational by 2009.

The new SWMP addresses and recognizes the interdependency of the systems for managing recycling, residential waste, and commercial waste. The new SWMP introduces a shift from the

[1] DSNY website: http://www.nyc.gov/html/dsny/html/about/about.shtml (February 23, 2006).

current mode of truck-based export to export by barge and/or rail. The City intends to commit to a long-term (20-year) contract with the Hugo Neu Corporation for the processing and marketing of metal, glass, and plastic (MGP). An MGP processing facility will be developed in the City at the 30th Street Pier in South Brooklyn Marine Terminal. The plant will be barge-fed from Hugo Neu Corporation sites in Queens and the Bronx and a potential DSNY location in Manhattan.

The new SWMP includes a Long-Term Export Program for residential waste. The City's Long-Term Export Program is anticipated to be implemented through: (1) the development of four new converted marine transfer stations (MTS); (2) the award of up to five contracts with private transfer stations for barge or rail export of DSNY-managed waste for disposal; and (3) an intergovernmental agreement to dispose of a portion of Manhattan's DSNY-managed waste at a Port Authority waste-to-energy facility in New Jersey. Solid waste would be consolidated, containerized, and barged or railed out of the City from the converted MTSs or the five existing private transfer stations. The barges currently used at MTS facilities will be replaced or retrofitted with new sealed containers or "intermodal containers" capable of being transported on barge or rail. The four converted MTS facilities will be designed to each process up to 4,290 tons per day and accommodate 30 collection vehicles per hour. In the interim, all municipal solid waste will be trucked out of the City.[1]

The new SWMP also includes three broad categories of action to address traffic issues associated with commercial waste handling as follows: (1) improve conditions at and around transfer stations; (2) facilitate a transition from a network heavily reliant on trucks to one that relies primarily on barge and rail; and (3) redistribute private transfer capacity from a small number of communities that have the largest proportion of the system's impacts.

Local Law 19 of 1989 requires that DSNY and private carters collect recyclable materials and deliver them to material recovery facilities. New York City residents are required to separate aluminum foil, glass, plastic and metal containers, and newspapers and other paper wastes from household waste for separate collection. The SWMP also mandates that commercial and industrial establishments are subject to recycling requirements. Businesses must source-separate certain types of paper wastes, cardboard, metal items, and construction wastes. Food and beverage establishments must recycle metal, glass, and plastic containers, and aluminum foil, in addition to meeting the commercial recycling requirements. The project site is within DSNY's Brooklyn Community Service District 2 for public solid waste collection services. Commercial and industrial operations are handled by private carters.

SOLID WASTE GENERATION

As stated above, the project site currently has a number of active uses that generate solid waste. It is estimated that there are 61 currently occupied dwelling units on the project site. Assuming an average of 2.4 persons per household, the average household size for the Census tracts covering the project site based on 2000 Census data, it is estimated that the existing dwelling units house approximately 146 individuals. Based on the waste generation rates presented in Table 3M-1 of the *CEQR Technical Manual*, each individual is estimated to generate an average of 17 pounds of solid waste per week, for a total of approximately 2,482 pounds per week at the project site from existing residential uses. These residential units are served by DSNY collection routes.

[1] DSNY, Draft Comprehensive Solid Waste Management Plan, July 2006.

Based on Table 3M-1 of the *CEQR Technical Manual*, which states an average of 79 pounds of solid waste per retail employee per week, the current retail uses are estimated to generate approximately 10,270 pounds of solid waste per week. Based on Table 3M-1 of the *CEQR Technical Manual*, office employees generate an average of 13 pounds of solid waste per week. Therefore, the current office uses are estimated to generate 910 pounds of solid waste per week. Private businesses are served by commercial solid waste and recycling management companies.

Finally, there are approximately 102,898 square feet of active industrial/storage uses on the project site. Table 3M-1 of the *CEQR Technical Manual* provides rates for two categories of industrial uses. The average of the two rates, estimated at 183 pounds per week per employee, is utilized as representative of general industrial uses. Using these assumptions, the project site's industrial space generates an estimated 14,091 pounds of solid waste per week. These industrial uses are also served by private carters. In addition, any minimal demand from the LIRR rail yard would be hauled by private carters. However, the FDNY storage and cleaning facility would be served by DSNY collection services.

Table 11-3 summarizes the current solid waste generation conditions at the project site. As shown in the table, the existing uses currently generate a total of approximately 27,753 pounds of solid waste per week (about 2 tons per day), most of which is collected by private carters. There is also vacant land and buildings at the project site that do not generate solid waste.

Table 11-3
Existing Solid Waste Generation at the Project Site

Use	Size	Solid Waste Rate	Total (lbs per week)
Residential[1]	61 occupied units	17 lbs per week per resident	2,482
Commercial/Retail[2]	67,647 sf	79 lbs per week per employee	10,270
Commercial/Office[3]	73,759 sf	13 lbs per week per employee	910
Industrial/Manufacturing/Storage[4]	102,898 sf (2.4 acres)	183 lbs per week per employee	14,091
Total	**N/A**	**N/A**	**27,753**

Notes:
[1] Population estimates for solid waste demand assumes 2.4 residents per unit.
[2] It is estimated that there are approximately 130 commercial retail jobs at the project site.
[3] It is estimated that there are approximately 70 commercial office jobs currently on the project site.
[4] It is estimated that there are approximately 100 industrial jobs at the project site.
Source: Table 4-4 in Chapter 4, "Socioeconomic Conditions," Solid waste generation rates, *CEQR Technical Manual* (October 2001).

ENERGY

ENERGY PROVIDERS

Electricity within New York City is generated by Consolidated Edison (Con Edison), as well as a number of independent power companies, including KeySpan Energy. In Downtown Brooklyn, Con Edison supplies electricity, while KeySpan supplies natural gas.

Electrical energy in New York City is supplied from a variety of sources that originate both within and outside the City. These sources include non-renewable sources such as oil, natural gas, and coal fuel, and renewable sources such as hydroelectric, and, to a much lesser extent, biomass fuels, solar, and wind power. New York City's electrical demands are met by a combination of sources including electricity generated within New York City, at locations across the Northeast, and from places as far away as Canada. For the more distant sources, once

electrical energy is generated as high voltage electrical power, a transmission grid conveys this power to New York City for distribution. An interconnected high voltage power grid extending across New York State and the Northeast allows for power to be imported from other regions as demand requires. A total of an estimated 50 billion kilowatt hours (KWH) or 170.75 trillion British Thermal Units (BTUs) of electricity are consumed in the City annually.

According to the New York Independent System Operator (NYISO) *2005 Load & Capacity Data* report, the peak electrical demand for New York City in summer 2004 was 9,769 megawatts (MW).[1] Typically, electricity generated within the City is sufficient to satisfy demand. However, during the summer peak demand period, this electricity is often supplemented by the Northeast transmission grid. As a result, there is an ongoing service and distribution improvement program for Con Edison infrastructure that upgrades localized areas that are continually high demand zones. Electricity required for these zones is supplied by other zones in New York City, or from sources elsewhere within the larger grid if necessary.

Con Edison distributes power throughout the City. Transmission substations receive electricity from the regional high voltage transmission system and reduce the voltage to a level that can be delivered to area substations. Area substations further reduce the voltage to a level that can be delivered to the distribution system, or street "grid." Within the grid, voltage is further reduced for delivery to customers. Each area substation serves one or more distinct geographic areas, called networks, which are isolated from the rest of the local distribution system. The purpose of the networks is that if one substation goes out of service the problem can be isolated to that network and not spread to other parts of the City. Substations are designed to have sufficient capacity for the network to grow. To this end, Con Edison is currently engaged in upgrading the primary distribution network and substations in the area to meet the projected demands for Downtown Brooklyn.

Power plants in the five boroughs generate electricity for New York City. According to NYISO's *Locational Installed Capacity Requirements Study* for the 2005-2006 period, New York City has an existing installed generating capacity of 9,887 MW (not including Special Case Resources).[2]

KeySpan Energy provides natural gas service to more than 2.6 million customers in the New York City boroughs of Brooklyn, Queens, and Staten Island, in Nassau and Suffolk Counties on Long Island, and in Massachusetts and New Hampshire. The company operates more than 21,000 miles of gas mains in its service territory, and also owns and operates electrical generating plants on Long Island and within New York City, with a total generating capacity of more than 6,600 megawatts.[3]

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[1] New York Independent System Operator 2005 Load & Capacity Data, www.nyiso.com/public/webdocs/services/planning/planning_data_reference_documents/2005_GoldBook_Redact.pdf (February 23,2006)

[2] NYISO Locational Installed Capacity Requirements Study Covering the New York Control Area for the 2005-2006 Capability Year, February 17, 2005, revised March 23, 2005. According to the Study, Special Case Resources (SCRs) are "loads capable of being interrupted, and distributed generators, rated at 100 kW or higher, that are not directly telemetered."

[3] Keyspan Energy website: http://www.keyspanenergy.com/corpinfo/about/facts_all.jsp (February 23, 2006)

ENERGY INITIATIVES

In 2001, New York State began taking measures to address the increasing electrical power capacity needs of the metropolitan New York City region. The Governor's Executive Order No. 111 (EO 111) was introduced in June of 2001, directing state agencies, state authorities, and other affected entities to address energy efficiency, renewable energy, green building practices, and alternate fuel vehicles. EO 111 identified the New York State Energy Research and Development Authority (NYSERDA) as the organization responsible for coordinating and assisting agencies and other affected entities with their responsibilities. NYSERDA and the utilities have implemented programs to encourage businesses to reduce energy usage and increase energy efficiency. In addition to the energy conservation techniques, NYPA constructed 11 new 44-MW, natural gas-fired, simple cycle turbine generating units, 10 of which are located within New York City, for emergency power generation (the other facility is on Long Island).

The independent, non-profit New York State Reliability Council (NYSRC) has determined that a minimum of 80 percent of the City's peak load must be provided by generating sources within the City to maintain compliance with the criteria established by the regional and national reliability councils. Currently, there is sufficient capacity within the City to meet this 80 percent goal. However, as energy demand increases over time, additional in-City generation may be needed.

EXISTING PROJECT SITE DEMAND

In estimating the existing annual energy consumption at the project site, the rates provided on Table 3N-1 of the *CEQR Technical Manual* were utilized. One measure of energy is the British Thermal Unit (BTU). One BTU is the quantity of heat required to raise the temperature of one pound of water by one Fahrenheit degree. This unit of measurement is often used to compare consumption of energy from different sources, taking into account how efficiently those sources are converted to energy. Use of BTUs allows for a common unit of measurement for different energy sources (e.g., horsepower, kilowatt hours, etc.) and consumption rates (e.g., tons per day, cubic feet per minute, etc.). In general, 1 kilowatt (kW) is the equivalent of 3,413 BTUs per hour. Based on the rates of the *CEQR Technical Manual*, current annual energy use at the project site is estimated to be approximately 20,484 million BTUs annually for all heating, cooling, and electric power.

D. FUTURE WITHOUT THE PROPOSED PROJECT—2010

In 2010, in the future without the proposed project, it is conservatively assumed that the uses currently on the project site would remain, although it is possible that some properties currently vacant would be reused and that some limited development could occur. However, growth and development would occur in the surrounding area and there would be changes in the City's infrastructure systems. These future No Build changes through 2010 are described below.

WATER SUPPLY

In 2010, the future without the proposed project, New York City's water supply system is not expected to change significantly. It is expected that the benefits of the City's comprehensive water conservation programs, through metering and low-flow fixtures requirements (Local Law No. 29, 1989), will continue to be realized. These and other measures—including leak detection programs and locking fire hydrant caps—are aimed at reducing the City's water needs and are

expected to continue to further the City's efforts to reduce flows to WPCP facilities. In addition, DEP's routine maintenance and system upgrades of old water mains and other components of the water system will further benefit the City's water distribution system.

Stage 2 of DEP's water supply Tunnel No. 3 is now under construction in Manhattan, Queens, and Brooklyn. When Tunnel No. 3 is complete, it will improve the adequacy and dependability of the entire water supply system as well as service and water pressure in outlying areas of the City. It will also allow DEP to inspect and repair City Tunnels Nos. 1 and 2 for the first time since they were activated. It is projected that Tunnel No. 3 will not be completed in its entirety until 2020. However, the Brooklyn segment of Water Tunnel No. 3 is currently anticipated to be active in 2009.

In the future without the proposed project in 2010, total water demand at the project site is assumed to be the same as in the existing condition.

SANITARY WASTEWATER

RED HOOK WPCP

As stated above, the Red Hook WPCP service area covers some 3,000 acres of land that is developed with urban uses. In addition, there are vacant and underdeveloped lands, some of which are expected to be built out over the next decade. For these reasons, it is expected that residential and commercial growth that would increase flows to the plant would occur in the Red Hook WPCP through 2010. DEP projects that the future flows to the plant would not increase over the next four years. As shown in Table 11-2 above, the current average daily flow to the Red Hook WPCP is 32.1 mgd. Projected flows are similar to current flows because additional flows from new developments are offset for 2010 by water conservation measures and the natural turnover of more efficient fixtures in existing developments. The projected flows therefore account for background growth in the WPCP service area, as well as discrete projects anticipated in the future without the proposed project, such as Brooklyn Bridge Park, the Downtown Brooklyn Development Plan, and IKEA in Red Hook. (See also Chapter 3, "Land Use, Zoning, and Public Policy.")

GOWANUS PUMPING STATION AND FLUSHING TUNNEL IMPROVEMENTS

As discussed above, the Gowanus Pumping Station is currently pumping flows to the Bond-Lorraine Street sewer, which has a limited capacity due to sedimentation and constriction in that sewer. However, in the future without the proposed project, DEP proposes to upgrade the pumping station and complete a new force main connection directly to the Red Hook WPCP main interceptor sewer. It is also proposed to increase the pumping station capacity to 30 mgd. In addition, improvements to the flushing tunnel are proposed that would modernize it, make it more reliable, and thereby improve flushing action in the canal. The primary objectives of this DEP project are to reduce CSO overflow from the pumping station into the Gowanus Canal and to improve the water quality of the canal. DEP expects that these improvements, including the rehabilitation of the pumping station and connection to the interceptor, would be underway by 2008, but not yet completed by the 2010 analysis year (see the discussion below under 2016).

PROJECT SITE

In the future without the proposed project, total sanitary wastewater demand from the project site in 2010 is assumed to be the same as in the existing condition.

STORMWATER

In the future without the proposed project in 2010, it is not expected that the existing stormwater runoff patterns and collection sewers within the project site would change. It is expected that the City and State would continue to move forward with planning and implementation of CSO abatement initiatives.

SOLID WASTE

In the future without the proposed project in 2010, there are no major changes expected with respect to solid waste generation on the project site. For the solid waste system as a whole, there are proposed improvements in this DSNY service district, one of which is to the existing Hamilton Avenue Marine Transfer Station (MTS) which serves DSNY's Brooklyn Community District 2.

Under the City's new SWMP, the existing Hamilton Avenue MTS will be demolished and a new MTS will be constructed on the same site that will receive and allow for containerization of solid waste. Containerized solid waste will then be exported from the new MTS by barge. As part of these improvements, the new Hamilton Avenue MTS is expected to have the capacity to handle up to 4,290 tpd of solid waste. However, based on DSNY projections, the daily average demand is expected to be only 1,900 tpd.

The new Hamilton Avenue MTS is expected to be fully operational by 2009.

ENERGY

In the future without the proposed project in 2010, the existing energy demands at the project site are not assumed to change. It is expected that adequate electrical capacity would be available in the New York City metropolitan area through this analysis year. It is also assumed that Con Edison would continue with its electrical distribution improvement program for the Downtown Brooklyn area.

E. PROBABLE IMPACTS OF THE PROPOSED PROJECT—2010

WATER SUPPLY

PROPOSED WATER SUPPLY SYSTEM IMPROVEMENTS

To support the proposed project, certain existing water mains within and around the project site would be replaced with new mains. These improvements would be implemented to support the phasing of the proposed project. For the 2010 analysis year, Phase I improvements would support project development west of 6th Avenue. For the east/west streets, installation of these water mains would be as follows:

- A new 20-inch line would be constructed under Dean Street west of 6th Avenue;
- A new 20-inch water main in the east side of Flatbush Avenue from Atlantic Avenue to Dean Street to replace the existing 16-inch water main;
- A new 20-inch line would be constructed under Dean Street east of Carlton Avenue connecting to the existing 8-inch and 12-inch lines under Vanderbilt Avenue and to the new 12-inch and 20-inch lines under Vanderbilt Avenue;
- A new 20-inch line would be constructed under Pacific Street east of 6th Avenue connecting to a new 20-inch line under Carlton Avenue;

- The existing 36-inch cast iron water main under Atlantic Avenue would be replaced as necessary, and connected with other project mains and the 30-inch main under Flatbush Avenue; and
- The existing 8-inch line in Atlantic Avenue would be replaced as necessary and connected to a new 20-inch line under Flatbush Avenue.

For the north/south streets, installation of these water mains would be as follows:

- New 12-inch and 20-inch lines would be constructed under Vanderbilt Avenue, between Atlantic Avenue on the north and Dean Street on the south, interconnecting the new Dean, Pacific, and Atlantic Avenue lines;
- A new 20-inch line would be constructed under 6th Avenue interconnecting with the new Dean Street and Pacific Street lines;
- A new 8-inch line would be constructed under 6th Avenue from Atlantic Avenue to Pacific Street, interconnecting with the Atlantic and Pacific lines.
- A new 20-inch line would be constructed under Carlton Avenue interconnecting with the new Dean Street and Pacific Street lines.

The proposed water main plan, including proposed pipe sizes, is subject to final review and approval by DEP.

WATER SUPPLY NEEDS OF THE PROPOSED PROJECT

The proposed project has a mix of uses that would have water supply needs for both domestic and commercial use water consumption, as well as the water demands of air conditioning systems. These projected water demands are presented in Table 11-4 for the 2010 analysis year. The water demand rates used in the table are based on the rates provided in the City's *CEQR Technical Manual*, by use. In the future with the proposed project in 2010, the anticipated water demand at the project site is estimated at 1,270,167 gpd. Subtracting the estimated amount of water demand currently at the project site (53,647 gpd), the net increase in demand anticipated with the proposed project is about 1.2 mgd in 2010. This increase is about 0.1 percent of the City's total current average daily water demand. An increase in demand such as this does not adversely impact the City's water supply system, or DEP's ability to reliably deliver water to its customers. This water demand is also not expected to adversely affect local water pressure since the proposed new water mains throughout the project site that would convey water to the proposed project would also benefit the adjacent areas with new and improved water mains.

In addition to the above demand, there would be a minimum amount of water demand for landscaping. This minimal demand would add only seasonally to the above described flow volumes. In addition, it is expected that all, or some portion of, the landscaping demand would be met through recycled water that would be collected in stormwater runoff tanks (see the discussion below).

With respect to the impacts of the proposed commercial mixed-use variation, based on water demand rates of the *CEQR Technical Manual*, water demand under the commercial mixed-use variation would not significantly vary from that presented above for the residential mixed-use alternative. Thus, this analysis addresses the potential impacts of the commercial mixed-use variation as well. It is therefore concluded that, like the residential mixed-use variation, the commercial variation would not result in any significant adverse impacts on water supply in 2010.

Table 11-4
Projected Average Daily Water Demands (gpd) with the Proposed Project in 2010

Proposed Use	Size	Water Consumption Rate	Domestic Water Consumption (gpd)	Air Conditioning Water Use Rate	Air Conditioning Water Use (gpd)	Total Projected Water Demand by Use (gpd)
Analysis Year: 2010 (Phase I: Development of Arena Block and Site 5)						
Residential	2,085,000 gsf (2,110 units)	112 gpd/person[1]	496,272	0.17 gpd/sf[2]	354,450	850,722
Hotel	165,000 gsf (180 rooms)	150 gpd/room plus 0.17 gpd/sf function space[3]	29,805	0.10 gpd/sf	16,500	46,305
Retail	91,000 gsf	0.17 gpd/sf	15,470	0.17 gpd/sf	15,470	30,940
Commercial/ Office	336,000 gsf	25 gpd/person[4]	33,600	0.10 gpd/sf	33,600	67,200
Arena	850,000 gsf (19,925 seats)	5 gpd/patron + 25 gpd/employee[5]	130,500	0.17 gpd/sf	144,500	275,000
Total	**3,527,000 gsf**	**N/A**	**705,647**	**N/A**	**564,520**	**1,270,167**

Notes:
[1] Numbers of persons based on Chapter 4, "Socioeconomic Conditions."
[2] Since the *CEQR Technical Manual* does not provide a rate for air conditioning water use in residential buildings, the retail rate was applied as a conservative measure.
[3] Hotel domestic water demand assumes 16,500 gsf of function space, or 10 percent.
[4] Number of commercial, arena, and office employees based on Chapter 4, "Socioeconomic Conditions."
[5] Water use rates for the arena seating are based on rates used in the Hudson Yards FGEIS for stadium users. Demands are based on 20,500 patrons and 1,120 employees and assume two events. This is a conservative assumption since the actual maximum seating capacity is now expected to be 19,925.
Source: Demand rates based on the *CEQR Technical Manual* (2001), unless otherwise noted.

It is noted that the use of the *CEQR Technical Manual* water use rates shown in Table 11-4 are conservative for evaluating water demand impacts of the proposed project. Project-specific water demand needs have been determined based on the project's proposed use of low-flow fixtures and other water conservation measures. All water consumption is assumed to enter the sanitary sewer system at the same rate of flow. These project-specific flow projections are presented in Table 11-5, below. As shown in Table 11-5, using these data, the total water consumption (non-air conditioning demand) in 2010 would be 624,719 gpd, or about 80,928 gpd below domestic water consumption (non-air conditioning demand) projected using the *CEQR Technical Manual* rates and assumed for purposes of this FEIS analysis.

SANITARY WASTEWATER AND STORMWATER

PROPOSED AMENDED DRAINAGE PLAN AND PROJECT SITE IMPROVEMENTS

Overview

Construction of the proposed project requires the replacement of sewers on the project site and in adjacent areas in order to upgrade the sewer system and to adequately collect and convey the project-generated wastewater and storm flows. Development in the City must either comply with the adopted drainage plan or propose an amendment to the plan. The drainage plan is an official document that shows that the local sewers have been deemed capable of serving the drainage needs of a particular area. Because the proposed project would close certain segments of local streets and require new sanitary and stormwater infrastructure, an amended drainage plan has been prepared (draft April 2006). That plan is currently being reviewed by DEP.

Table 11-5
Projected Average Daily Sanitary Wastewater Flows (gpd) with Proposed Water Conservation Measures in 2010

Project Element	Proposed Uses	Sanitary Wastewater Flows (gpd) with Conservation
Phase I: 2010		
Building 1	Residential/Hotel/Office/Arena	249,824
Building 2	Residential	73,050
Building 3	Residential	65,800
Building 4	Residential	161,250
Site 5	Residential	74,795
Total		**624,719**

Notes:
Water rates used in the table above are as follows: 1) arena—5 gpd per person; 2) office—15 gpd per person @150 sq ft per person; 3) hotel—75 gpd per person @ 50 percent of room single occupancy and 50 percent double occupancy; 4) residential—studio units, one-person household at 100 gpd per person; one-bedroom units, two-person household at 100 gpd per person; two-bedroom units, 2.5 persons per household at 100 gpd per person; and three-bedroom units, 3.5 persons per household at 100 gpd per person. These figures are used for sanitary wastewater rates and do not include air conditioning water use. All water consumption is assumed to enter the sanitary sewer system at the same rate of flow. The arena component of the sanitary flows is at Building 1.
Source: Flack+Kurtz, October 25, 2006.

The area of the proposed amended drainage plan is larger than the project site and extends from Flatbush Avenue to the west to just east of Washington Avenue to the east. In total, the drainage plan area covers about 91 acres. The amended drainage plan area extends beyond the project site (to the east) to address off-site flows coming from a higher elevation and draining through the project site (gravity flow is from east to west). Because these flows would pass through the project site, they must be taken into consideration in the drainage plan. Site 5, on the west side of Flatbush Avenue, would use existing connections for project-generated sanitary and stormwater and is not part of the amended drainage plan. It is also downstream (below) the outlets in Flatbush Avenue and is, therefore, in a different subdrainage area than the other elements of the project site.

Under the proposed drainage plan amendment, the sewer replacement would serve the dual purposes of handling the added flow from the proposed project while replacing old pipes (some of which date from the 19th and early 20th century) with new 15- to 60-inch sewers. In addition, the sewers beneath the segments of 5th Avenue and Pacific Street would be decommissioned and the flows re-routed to new pipes. The installation of sewers would be phased, generally following the development of the proposed project. In total, approximately 6,900 linear feet of sewer improvements would be constructed with the proposed project, with 3,929 linear feet proposed as part of Phase I. This phase of construction is described below. All proposed project sewer improvements would be undertaken in accordance with an approved amended drainage plan for this area, and are currently proposed as follows.

Phase I Sewer Improvements

- From Outlet 1 (intersection of Dean Street and Flatbush Avenue), east on Dean Street to the intersection of Dean Street and 6th Avenue, a 60-inch diameter combined sewer, reducing down to a 54-inch combined sewer, would be installed. This would include the construction of a new outlet chamber at the Dean Street and Flatbush Avenue intersection to accommodate the new 60-inch combined sewer; the existing 36-inch combined sewer in Flatbush Avenue; the new 36-inch combined sewer to be installed north to the intersection

of Pacific Avenue and Flatbush (Outlet 2); and the existing combined sewer which runs east to west under Flatbush Avenue.

- From the intersection of Dean Street and 6th Avenue, north on 6th Avenue to the intersection of Pacific Street, a new 42-inch combined sewer would be installed. A new manhole chamber would also be installed at the intersection of 6th Avenue and Pacific Street. This chamber would be designed to accommodate the existing flows from the 24- and 36-inch combined sewers in Pacific Street as well as the Phase II 36-inch combined sewer in Pacific Street (see discussion below).
- From Outlet 1 Chamber to Outlet 2 Chamber (intersection of Flatbush Avenue and Pacific Street), a new 36-inch diameter combined sewer would be installed to interconnect the two existing combined sewers in Flatbush Avenue. A new Outlet 2 Chamber would also be constructed to accommodate the proposed 36-inch combined sewer and the proposed 36-inch combined sewer which would be installed from Outlet 2 to the intersection easement of Flatbush Avenue and Atlantic Avenue.
- Through the proposed DEP 40-foot-wide sewer easement from Flatbush Avenue to Atlantic Avenue, a 36-inch diameter combined sewer would be installed.
- From the proposed sewer easement and east under Atlantic Avenue, east toward 6th Avenue, a 36-inch pipe is proposed.
- From the intersection of 6th Avenue and Atlantic Avenue east on Atlantic Avenue, 18-inch and 24-inch diameter pipes are proposed.

As mentioned above, the proposed drainage plan amendment is subject to final review and approval by DEP. During that review, pipe sizes may change. However, the final approved drainage plan would ensure the replacement of all lines in the street segments described above and require that all pipes be adequately sized to handle the proposed project and adjacent areas contained within the drainage plan boundaries.

STORMWATER MANAGEMENT STRATEGIES

As stated above, the proposed project would increase sanitary flows with the introduction of added residential units, the arena, hotel, and commercial retail and office space. The proposed project would also increase stormwater flows by increasing the percentage of land area that directly contributes runoff to the local sewer system. This increase in runoff is in large part the result of covering the existing rail yard with a foundation slab, thereby making it impervious.

Although the project site is small compared with the entire Red Hook WPCP drainage area (about 0.7 percent of the total land area in the Red Hook WPCP service area), and the projected increases in sanitary wastewater flow would not exceed the capacity of the Red Hook WPCP service area, there is the potential for increased CSO discharges with the proposed project, because it is part of the drainage area for the Gowanus Canal, as well as the East River. This potential impact exists because the drainage area is a combined system and increases in flow from both sanitary and stormwater flows on the downstream collection system and support facilities can affect CSO events.

As described above, to address this concern, significant water conservation measures are included in the proposed project to reduce sanitary wastewater flow contributions to the collection system. This is achieved through the low-flow fixtures proposed throughout the

development. These devices have a demonstrated effectiveness in reducing overall water demand from new development.

There are two strategies in the project design that are directed at managing stormwater runoff: detention and retention. These strategies have the shared purpose of reducing the potential for added CSO events or discharges downstream by reusing and detaining project-generated runoff contributions to the local sewer system. This is achieved through either the absolute reduction of runoff volumes, or by temporarily delaying the runoff contribution to the collection system, thus reducing the peak surge during the wet weather period.

Detention is the temporary withholding of stormwater from the local sewer system for a given period of time. As part of the proposed project, this would be accomplished through storage tanks that would fill with stormwater and then release it in a controlled flow to the local sewers. Under this approach, the stormwater runoff is held temporarily, but the reduction in peak flows can be substantial. Detention of stormwater is required by DEP for new developments in certain parts of New York City, and the proposed project would exceed this requirement (see the discussion below).

Retention is the permanent withholding of stormwater by means of a storage device that does not drain to the local sewer system. This retained runoff is stored and then either recycled, allowed to evaporate or infiltrate into the soil, or is handled in other ways that do not lead to the local sewers.

The proposed amended drainage plan (see the discussion below) identifies a number of improvements in the local sewer system that would address the added sanitary and storm sewer flows expected to be generated under the proposed project. These include replacement of local sewers as well as a site design that goes beyond the stormwater detention requirements of DEP. For a new development to be issued a permit to connect to the City sewers, DEP requires that stormwater runoff in excess of the amount allowed under the approved drainage plan be detained on-site. For the proposed project, the detention volume computed under these requirements is approximately 334,000 gallons, and the plan has dedicated space to accommodate a volume that is beyond the DEP requirements. With these proposed improvements, there is a net reduction in runoff conditions from the project site as compared with the current condition.

In order to meet the project objectives of avoiding impacts on the downstream infrastructure or the water quality of the Gowanus Canal, additional detention/retention technologies are proposed over and above the DEP requirements with respect to on-site detention. A conceptual design for stormwater management was developed for the proposed project that minimizes the stormwater runoff contributions to the City's sewer system through a combination of reuse and detention that exceeds the DEP requirements. The result of these strategies would be that there is no significant increase in CSO discharges at the Gowanus Pumping Station and, as a result, the proposed project would not cause any potential significant adverse water quality impacts within the Gowanus Canal or along the East River. (The results of a modeling analysis that examined these effects is presented below under Section H, "Modeling Analysis of Potential Impacts on Combined Sewer Overflows.")

This proposed stormwater management plan contains a number of features, including enlarged and specially designed storage tanks, recycling of water to cooling towers, and to new landscaped open spaces. Specifically, the proposed plan includes:

- Two 100,000-gallon tanks;
- Two storage tanks in the LIRR rail yard with a combined capacity of 124,000 gallons;
- Four storage tanks within the arena, providing a total of 291,000 gallons; and
- Two 12,000-gallon tanks at Site 5.

With the above measures, the total storage volume capacity at the project site would be 639,000 gallons, which is nearly double the DEP detention requirement of 334,000 gallons. Also, proposed water features within new landscaped areas would add approximately 279,000 gallons of stormwater retention capacity. While this is a substantial volume of storage, timing of the discharge release is another factor in the design. For the proposed project, specific control devices were added to the detention tanks for the purposes of reducing the rate of stormwater release during storm events. This design feature has two outlets in each storage tank, with a smaller outlet at the base and another larger outlet at a higher elevation in the tank wall. Under this proposed design, the smaller outlet restricts outflow in small storms and, thus, the lower level of the tank provides additional small storm storage not otherwise provided in a standard tank design, which provides only a single outlet. This design restriction, during smaller storms, has the effect of reducing downstream CSO impacts during more frequent small storm events.

Reuse of stormwater is also proposed. This would include using recycled stormwater in the cooling towers for make-up water, and also for landscaping. The anticipated rate of reuse for cooling tower make-up is expected to be, on a monthly average basis, between 0 and 100 gallons per minute, depending on the season. This reuse would reduce the amount of water that is discharged to the City's sewer system.

The above-described stormwater design was modeled for potential downstream impacts on the City's infrastructure (see "Modeling Analysis of Potential Impacts for Combined Sewer Overflows"). As described in greater detail below, the results of this modeling show that the proposed project, with the measures described above, would not cause significant adverse impacts on Gowanus Canal and East River water quality.

SANITARY WASTEWATER TREATMENT

Based on the *CEQR Technical Manual* rates for water consumption, the sanitary wastewater rates with the proposed project in 2010 are 705,647 gpd (see Table 11-4, water consumption only). In dry weather conditions, this wastewater would be conveyed to the Red Hook WPCP for treatment. Subtracting the estimated existing wastewater flows generated on the project site (53,647 gpd), the net increase in wastewater to be conveyed to the Red Hook WPCP is 652,000 gpd in 2010, or 2.0 percent of the projected flows to the plant (projected flows are 32 mgd in 2010 without the proposed project and 32.6 mgd with the proposed project). The additional wastewater expected from the proposed project would not cause the Red Hook WPCP to exceed its capacity or SPDES permit limits in 2010. Therefore, sanitary wastewater generated by the proposed project would not compromise the Red Hook WPCP's ability to properly treat wastewater. It is, therefore, concluded that the proposed project would not significantly impact the City's Red Hook WPCP in the 2010 analysis year.

In addition, as stated above, the use of the *CEQR Technical Manual* water demand rates in this sanitary wastewater treatment analysis is conservative. Since the proposed project would incorporate water conservation measures, lower water consumption and sanitary flow volumes are expected from the proposed project. These site-specific water demand projections are presented in Table 11-5.

STORMWATER

As previously mentioned, the project site is currently a mix of at-grade structures and impervious surfaces that generate stormwater runoff to the City's sewer system, with some vacant lots and a below-grade open rail yard. As also described above, the proposed project

includes an extensive network of sewer improvements that, because the City system is a combined system in this area, would carry runoff from streets and buildings in addition to the sanitary wastewater flows. The sewers proposed in the amended drainage plan have been sized to adequately convey this flow to the downstream system in accordance with the City's design criteria. In addition, the proposed project includes a number of previously described, site-specific runoff management technologies, that are proposed for the purposes of avoiding impacts to the downstream system, in particular the Gowanus Pumping Station and any associated CSO impacts on the Gowanus Canal. A modeling analysis was undertaken to determine the potential impacts of the combined sanitary wastewater and stormwater runoff flows (with the proposed control technologies) with the proposed project. That analysis is presented in "Modeling Analysis of Potential Impacts for Combined Sewer Overflows," below.

Since there would not be a significant difference in site coverage or runoff patterns between the residential mixed-use variation and the commercial mixed-use variation, the analysis below applies to both build-out conditions.

SOLID WASTE

To determine future solid waste volumes, the solid waste generation rates from the *CEQR Technical Manual* were applied to the proposed project. Table 11-6 presents the cumulative solid waste volumes expected under the proposed project using these assumptions. As shown in the table, it is estimated that the proposed project would generate approximately 140,020 pounds of solid waste per week (10 tons per day) in 2010. This daily increase in solid waste would be 8 tons per day in 2010 and is the equivalent of 0.04 percent of the total amount of solid waste currently handled each day in New York City. This is not a significant increase in the City's solid waste stream.

Table 11-6
Solid Waste Generation with the Proposed Project in 2010

Use	Size	Solid Waste Rates (lbs per week)	Total (lbs per week)
Analysis Year: 2010 (Phase I: Development of Arena Block and Site 5)			
Residential[1]	2,085,000 gsf (2,110 units)	17 lbs per week per resident	75,310
Hotel[2]	165,000 gsf (180 rooms)	75 lbs per employee	5,250
Retail[2]	91,000 gsf	79 lbs per employee	21,330
Office[2]	336,000 gsf	13 lbs per week per employee	17,420
Arena[2,3]	850,000 gsf	0.3 lbs/week/patron + 13 lbs/week/employee	20,710
Total	**3,527,000 gsf**		**140,020**

Notes:
[1] Residential population is based on data calculated in Chapter 4. "Socioeconomic Conditions."
[2] Hotel, arena, and commercial office and retail employment based on data for project-generated employment as presented in Chapter 4, "Socioeconomic Conditions."
[3] Arena solid waste rates based on rates used in Hudson Yards FGEIS.
Source: Solid Waste Demand Rates based on the *CEQR Technical Manual* (2001).

Whereas most of the existing solid waste generated on the project site is currently from non-residential uses and, therefore, collected by private carting companies, in 2010 an estimated 75,310 pounds (38 tons) per week of solid waste generated by the proposed project would be from residential uses. This residential solid waste would be collected by DSNY. According to the *CEQR Technical Manual* guidelines, the typical DSNY collection truck has a capacity of 12.5 tons. Therefore, the proposed project would be expected to generate solid waste for DSNY

collection that is equivalent to approximately 1.0 added truck loads per day in 2010, assuming a three-day work week for solid waste collection services. This is not a significant impact on solid waste services for DSNY.

The non-residential solid waste (hotel, retail, office, and arena uses) would be collected by private contractors. The total volume of this waste would be 64,710 pounds (32.4 tons) per week in 2010. Given that the typical collection truck averages a 12.5-ton capacity, the increment would be about 2.5 truck loads per week or an additional truck every other day, assuming a six-day work week. This is not a significant increase in demand and would be met by private-sector response to the increase in service needs.

While the commercial mixed-use variation would generate a greater volume of solid waste (161,370 pounds per week), the additional volume would come from commercial uses and, therefore, be carted by private companies (residential demand would therefore be less under this scenario). It is expected that private companies could handle the added volumes of solid waste and recyclable materials that would be generated under the commercial mixed-use variation (for both analysis years) without any significant adverse impacts. There would also be a corresponding reduction in residential waste.

It is concluded that in the future with the proposed project in 2010, there would be no significant adverse impacts on residential or commercial solid waste collection and disposal services, nor would the proposed project conflict with, or require any amendments to, the City's solid waste management objectives as stated in the SWMP.

ENERGY

The proposed project would result in added energy demands. This added demand for natural gas and electricity is shown in Tables 11-7 and 11-8, respectively.

Table 11-7
Estimated Natural Gas Demand for the Proposed Project

Use	Demand1
Phase I (2010)	505,189
Phase II (2016)	595,966
Total Full Build-Out	**1,101,155**

Notes: [1] Annual consumption, DKTh
Sources: Flack + Kurtz, October 2006

Table 11-8
Anticipated Electric Demand for the Proposed Project

Project Phase	Year of Completion	Annual Usage MWH	Demand-General KW	Demand-AC KW	Demand-Total KW
Phase I (Arena Block)	2010	105,929	17,026	14,026	31,052
Phase I (Site 5)	2010	15,597	1,900	1,412	3,312
Subtotal (Phase 1—2010)	**2010**	**121,886**	**18,926**	**15,438**	**34,364**
Phase II (Master Plan—2016)	2016	122,654	13,098	12,316	25,414
Total at Completion	**2016**	**244,540**	**32,024**	**27,754**	**59,778**

Source: Flack + Kurtz, October, 2006.

To provide this level of energy service to the site would require localized upgrades in electrical and gas transmission lines and facilities serving the project site, as well as the decommissioning of lines in the streets proposed to be closed. Within the project site and adjoining streets, new gas mains, service lines, and metering would be necessary within beds of streets to be reconstructed as part of the proposed project. Improvements are also proposed by Consolidated Edison with respect to the local distribution grid that would improve service not only to the project site, but Brooklyn as a whole. These would include electrical substations and primary feeder cables (in the 22kv network) that would be upgraded by Consolidated Edison to meet the demands of the proposed project as well as other projected increases in demand for electricity throughout Brooklyn. As site design moves forward, the local utility companies may also identify any additional site-specific upgrade needs of the proposed project.

It is noted that, the added total energy and the electrical demands of the project are minor relative to the overall demands within the City as a whole (the proposed project would add less than 0.1 percent to this demand). The improvements in local connections that are necessary to provide these services to the proposed project would not adversely impact the local system. It is therefore concluded that the proposed project would not have any significant adverse impacts on energy systems. In addition, as described in Chapter 1, "Project Description," the proposed project includes a number of energy conservation measures.

Based on the energy demand rates of the *CEQR Technical Manual*, energy demand under the commercial mixed-use variation would not be significantly different. Thus, this analysis and the conclusion of no significant adverse impacts apply to both the residential and the commercial mixed-use variations with respect to energy demand.

F. FUTURE WITHOUT THE PROPOSED PROJECT—2016

As in the 2010 analysis year, in the future without the proposed project in 2016, it is conservatively assumed that the uses currently on the project site would remain, although it is possible that some properties currently vacant would be reused and that some limited development could occur. Likewise, growth and development would occur in the surrounding area and there would be changes in the City's infrastructure systems. These future changes without the proposed project in place are described below for the 2016 analysis year.

WATER SUPPLY

In the future without the proposed project in 2016, New York City's water supply system is not expected to change significantly. As with the 2010 analysis year, it is expected that the benefits of the City's comprehensive water conservation programs to reduce water use through metering and low-flow fixtures requirements (see the discussion above) will continue to be realized.

Work on the City's water supply Tunnel No. 3 will still be under construction in Manhattan and Queens in the 2016 analysis year, with an expected completion date in 2020. As stated above, it is projected that the Brooklyn segment would be completed in 2009.

In 2016, total water demand at the project site is assumed to be the same as in the existing condition.

SANITARY WASTEWATER

RED HOOK DRAINAGE AREA

For the same reasons as mentioned in the 2010 analysis, it is expected that residential and commercial growth that would increase flows to the Red Hook WPCP plant would occur through 2016. DEP projections of future flows to the Red Hook WPCP are 32 mgd. As shown in Table 11-2 above, the current average daily dry weather flow of the Red Hook WPCP is 32.1 mgd. Projected flows are similar to current flows because additional flows from new developments are offset for 2016 by water conservation measures and the natural turnover of more efficient fixtures in existing developments. The projected flows account for background growth in the WPCP service area, as well as discrete projects anticipated in the future without the proposed project, such as Brooklyn Bridge Park, the Downtown Brooklyn Development Plan, and IKEA in Red Hook. (See also Chapter 3, "Land Use, Zoning, and Public Policy.")

GOWANUS PUMPING STATION AND FLUSHING TUNNEL IMPROVEMENTS

By the year 2016, it is expected that the proposed improvements to the Gowanus Pumping station and a new force main connection to the interceptor, as well as improvements to the flushing tunnel will have been completed (these improvements are expected to be completed by 2012). The objectives of this DEP project are to reduce CSOs from the pumping station into the Gowanus Canal and improve the water quality of the canal. With these improvements, DEP expects that the Gowanus Canal would be in compliance with its designated waste quality standard, SD, or fishing (suitable for fish survival).

PROJECT SITE

In the future without the proposed project, total sanitary wastewater rates from the project site in 2016 is assumed to be the same as in the existing condition.

STORMWATER

In the future without the proposed project in 2016, it is not expected that the existing stormwater runoff patterns and collection sewers within the project site would change. As in the 2010 analysis year, it is expected that the City and State will continue to move forward with CSO abatement initiatives.

SOLID WASTE

In the future without the proposed project in 2016, there are no major changes expected with respect to solid waste generation on the project site. As previously noted, it is expected that the new Hamilton Avenue MTS would be completed and operational by the 2010 analysis year.

ENERGY

In the future without the proposed project, it is expected that adequate electrical capacity would be available in the New York City metropolitan area through the analysis year of 2016. The existing energy demands at the project site are not assumed to change. It is also assumed that Con Edison would install any improvements in the distribution network that are necessary to provide service to customers in Downtown Brooklyn and the borough as a whole.

G. PROBABLE IMPACTS OF THE PROPOSED PROJECT—2016

WATER SUPPLY

PROPOSED WATER SUPPLY SYSTEM IMPROVEMENTS

Section E, "Probable Impacts of the Proposed Project—2010," provides a detailed discussion on proposed water supply system improvements. The continuation of these improvements from the 2010 interim analysis year would be implemented to support Phase II of the proposed project, and would complete improvements required to support project development by 2016.

WATER SUPPLY NEEDS OF THE PROPOSED PROJECT

Table 11-9 shows projected volumes of water demand for the project in 2016. The water demand rates used in the table are based on the rates provided in the City's *CEQR Technical Manual*, by use. In the future with the proposed project in 2016, the anticipated water demand of the project site is estimated at 3,066,531 gpd. Subtracting the estimated amount of water demand currently at the project site (53,647 gpd), the net increase in demand anticipated with the proposed project would be approximately 3.0 mgd in 2016. This increase is 0.25 percent of the City's total current average daily water demand. As in 2010, a minor increase in demand such as this does not adversely impact the City's water supply system or DEP's ability to reliably deliver water to its customers. This water demand is also not expected to adversely affect local water pressure because the proposed new water mains throughout the project site would convey water to the proposed development and would also benefit the adjacent areas with new and improved water mains (see the description above).

Table 11-9
Projected Average Daily Water Demands (gpd) with the Proposed Project in 2016

Proposed Use	Size	Water Consumption Rate	Domestic Water Consumption (gpd)	Air Conditioning Water Use Rate	Air Conditioning Water Use (gpd)	Total Projected Water Demand by Use (gpd)
Residential	6,363,000 gsf (6,430 units)	112 gpd/person[1]	1,512,336	0.17 gpd/sf[2]	1,081,710	2,594,046
Hotel	165,000 gsf (180 rooms)	150 gpd/room plus 0.17 gpd/sf function space[3]	29,805	0.10 gpd/sf	16,500	46,305
Retail	247,000 gsf	0.17 gpd/sf	41,990	0.17 gpd/sf	41,990	83,980
Commercial/ Office	336,000 gsf	25 gpd/person[4]	33,600	0.10 gpd/sf	33,600	67,200
Arena	850,000 gsf (20,500 seats)	5 gpd/patron + 25 gpd/ employee[5]	130,500	0.17 gpd/sf	144,500	275,000
Total	**7,961,000**	**N/A**	**1,748,231**	**N/A**	**1,318,300**	**3,066,531**

Notes:
[1] Numbers of persons based on Chapter 4, "Socioeconomic Conditions."
[2] Since the *CEQR Technical Manual* does not provide a rate for air conditioning water use in residential buildings, the retail rate was applied as a conservative measure.
[3] Hotel domestic water demand assumes 16,500 gsf of function space, or 10 percent.
[4] Number of commercial, arena, and office employees based on Chapter 4, "Socioeconomic Conditions."
[5] Water use rates for the arena seating are based on rates used in the Hudson Yards FGEIS for stadium users. Demands are based on 20,500 patrons and 1,120 employees. This is a conservative assumption since the actual maximum seating capacity is now expected to be 19,925.
Source: Demand rates based on the *CEQR Technical Manual* (2001 guidelines), unless otherwise noted.

There would be a minimum amount of water demand for landscaping. This demand would be limited and would add only seasonally to the above described flow volumes. In addition, it is expected that all, or some portion of, the landscaping demand would be met through recycled water that would be collected in stormwater runoff tanks (see the discussion below).

With respect to the impacts of the proposed commercial mixed-use variation, based on water demand rates of the *CEQR Technical Manual*, the water demands under the commercial mixed-use variation would not significantly vary from those presented above (they would be slightly less) for the 2016 analysis year. Thus, this analysis of the proposed project conservatively addresses the potential impacts of the commercial mixed-use variation for the 2016 analysis year as well. It is therefore concluded that, like the residential mixed-use variation, the commercial variation would not result in any significant adverse impacts on water supply in 2016.

SANITARY WASTEWATER

PROPOSED AMENDED DRAINAGE PLAN AND PROJECT SITE IMPROVEMENTS

Overview

The proposed amended drainage plan and project site improvements are discussed in detail above. Under the proposed project, approximately 6,900 linear feet of sewer improvements would be constructed with 2,971 linear feet completed as part of Phase II. All proposed project sewer improvements would be undertaken in accordance with the amended drainage plan for this area, and are proposed as follows:

Phase II Sewer Improvements

- From the Phase I manhole chamber located at the intersection of Dean Street and 6th Avenue, a 48-inch diameter combined sewer would be installed in Dean Street, east to the intersection with Vanderbilt Avenue. New manhole chambers would be installed at the Dean Street intersections with Carlton Avenue and Vanderbilt Avenue to accommodate the existing combined sewers.
- From the intersection of Dean Street and Vanderbilt Avenue, north in Vanderbilt Avenue to the intersection of Pacific Street, a 48-inch diameter combined sewer would be installed. A new manhole chamber would be constructed at the intersection to connect the existing combined sewers to the newly installed 48-inch diameter combined sewer.
- From the Phase I manhole chamber at the intersection of 6th Avenue and Pacific Street east to the intersection of Pacific Street and Carlton Avenue, a 36-inch combined sewer would be installed.
- A new 15-inch combined sewer under Carlton Avenue from Pacific Street to Dean Street would be installed, connecting to the 36-inch sewer in Pacific Street.

The draft drainage plan amendment for the project is subject to final review and approval by DEP and, during that review certain pipe sizes may change. However, the final approved drainage plan would ensure the replacement of all sewers in the streets described above would be adequately sized to handle the proposed project and adjacent areas contained within the drainage plan boundaries.

STORMWATER MANAGEMENT STRATEGIES

The impacts and measures to manage stormwater are the same for the 2016 analysis year as for the 2010 analysis year.

SANITARY WASTEWATER TREATMENT

Based on the *CEQR Technical Manual* rates for water consumption, the sanitary wastewater rates with the proposed project in 2016 would be 1,748,231 gpd (see Table 11-9, water consumption only). In dry weather conditions, this wastewater would be conveyed to the Red Hook WPCP for treatment. Subtracting the estimated existing wastewater flows generated on the project site (53,647 gpd), the net increase in wastewater to be conveyed to the Red Hook WPCP would be 1,694,584 gpd in 2016, or 5.3 percent of the projected future flows to the plant (projected to be 32 mgd in 2016). As with the year 2010, in the 2016 analysis year, the Red Hook WPCP would continue to operate within its permitted and treatment capacity with projected flow of 33.7 mgd, or about 56 percent of its permitted capacity and much less than its treatment capacity of 120 mgd. The additional wastewater expected from the proposed project would not cause the Red Hook WPCP to exceed its capacity or SPDES permit limits in 2016. Therefore, sanitary wastewater generated by the proposed project would not compromise the WPCP's ability to properly treat wastewater in either analysis year. It is, therefore, concluded that the proposed project would not significantly impact the City's Red Hook WPCP.

As with 2010, the use of the *CEQR Technical Manual* water demand rates in this sanitary wastewater treatment analysis is conservative. Since the proposed project would incorporate water conservation measures beyond those typically required by the City, lower water consumption and sanitary flow volumes are expected from the proposed project at full build-out. These site-specific water demands are presented in Table 11-10.

STORMWATER

The modeling analysis of potential impacts for combined CSOs for 2016 is presented below in Section H.

SOLID WASTE

Table 11-11 presents the cumulative solid waste volumes expected under the proposed project using the same assumptions as those used for 2010. As shown in the table, it is estimated that the proposed projected would generate approximately 331,340 lbs of solid waste per week in the year 2016. The daily increase in solid waste would be 24 tons per day, which is the equivalent of about 0.1 percent of the total amount of solid waste currently handled each day in New York City. This is not a significant increase in the City's solid waste stream.

An estimated 229,551 pounds (115 tons) per week of solid waste generated by the proposed project would be from residential uses. This represents an increase of only 0.14 percent in the residential waste stream of the City. This residential solid waste would be collected by DSNY. The proposed project would be expected to generate solid waste for DSNY collection that is equivalent to approximately 9.2 trucks per week, or about 3.0 added trucks per service day, assuming three residential collections per week and a 12.5 ton capacity for DSNY trucks. This is not a significant increase in solid waste handling for DSNY.

Table 11-10
Projected Average Daily Sanitary Wastewater Flows (gpd)
with Proposed Water Conservation Measures in 2016

Project Element	Proposed Uses	Sanitary Wastewater Flows (gpd) with Conservation
Building 1	Residential/Hotel/Office/Arena	249,824
Building 2	Residential	73,050
Building 3	Residential	65,800
Building 4	Residential	161,250
Site 5	Residential	74,795
Building 5	Residential	123,050
Building 6	Residential	84,350
Building 7	Residential	144,375
Building 8	Residential	101,250
Building 9	Residential	131,350
Building 10	Residential	91,750
Building 11	Residential	62,750
Building 12	Residential	60,300
Building 13	Residential	62,300
Building 14	Residential	56,266
Building 15	Residential	65,170
Total		**1,654,456**

Notes:
Water rates used in the table above are as follows: 1) arena—5 gpd per person; 2) office—15 gpd per person @150 sq ft per person; 3) hotel—75 gpd per person @ 50 percent of room single occupancy and 50 percent double occupancy; 4) residential—studio units, one-person household at 100 gpd per person; one-bedroom units, two-person household at 100 gpd per person; two-bedroom units, 2.5 persons per household at 100 gpd per person; and three-bedroom units, 3.5 persons per household at 100 gpd per person. These figures are used for sanitary wastewater rates and do not include air conditioning water use. All water consumption is assumed to enter the sanitary sewer system at the same rate of flow. The arena component of sanitary flows is at Building 1.
Source: Flack+Kurtz, October 25, 2006.

Table 11-11
Solid Waste Generation with the Proposed Project in 2016

Use	Size	Solid Waste Rates (lbs per week)	Total (lbs per week)
Residential[1]	6,363,000 gsf (6,430 units)	17 lbs per week per resident	229,500
Hotel[2]	165,000 gsf (180 rooms)	75 lbs per employee	5,250
Retail[2]	247,000 gsf	79 lbs per week per employee	58,460
Office[2]	336,000 gsf	13 lbs per week per employee	17,472
Arena[2,3]	850,000 gsf (20,500 seats)	0.3 lbs/week/patron + 13 lbs/week/employee	20,710
Total	**7,961,000 gsf**	**N/A**	**331,392340**

Notes:
[1] Residential population is based on data calculated in Chapter 4, "Socioeconomic Conditions."
[2] Hotel, arena, and commercial office and retail employment based on data for project-generated employment as presented in Chapter 4, "Socioeconomic Conditions." This is a conservative assumption since the actual maximum seating capacity is now expected to be 19,925.
[3] Arena solid waste rates based on rates used in Hudson Yards FGEIS.
Source: Solid Waste Demand Rates based on the *CEQR Technical Manual* (2001).

As with the 2010 analysis year, it is expected that DSNY would handle the added project demands for solid waste collection with expanded service to the project site. New residential development in the City is served through existing DSNY collection routes with adjustments in service to appropriately collect solid waste and recyclables in each community service area. Residents of the proposed project would be required to meet the City's local law with respect to recycling of paper, metals, and certain types of plastics and glass.

Non-residential solid waste would be collected by private contractors. The total volume of this waste would be 101,840 pounds per week in 2016. This is the equivalent of approximately 7.3 tons per day at full build-out. Even at full build-out, this represents an increase of only about 0.05 percent in the non-residential waste of the City, and about 4 truck loads per week, or about one truck every other day, assuming six collection days per week. This is not a significant increase in demand and would be met by private-sector response to the increase in service needs.

While the commercial mixed-use variation would generate a greater volume of solid waste (a total of approximately 352,690 pounds per week) in 2016, the additional volume would come from commercial uses and, therefore, be carted by private companies (in addition, residential demand would be less under this scenario). Thus, it is expected that the private companies would handle the added volumes of solid waste and recyclable materials that would be generated under the commercial mixed-use variation without any significant adverse impacts. There would also be a commensurate reduction in residential waste.

It is therefore concluded that in 2016 the proposed project would not have significant adverse impacts on residential or commercial solid waste collection and disposal services, nor would the proposed project conflict with, or require any amendments to, the City's solid waste management objectives as stated in the SWMP.

ENERGY

Energy demands for 2016 are presented above in Tables 11-7 and 11-8, respectively, for gas and electricity. As discussed above, under 2010, to provide this level of service to the project site, localized upgrades in the distribution system are expected. This would also include decommissioning lines in streets to be closed, as well as new lines in project streets and adjoining streets. As the site design moves forward, the local utility companies may also identify any additional site-specific needs of the proposed project. However, as discussed above, the overall energy needs of the proposed project at full build-out would be minor compared with the overall energy consumption within the City and the necessary local improvements to serve the proposed project would not adversely impact the local utility systems. It is therefore concluded that the proposed project would not adversely impact local energy systems at full build-out. In addition, as described in Chapter 1, "Project Description," the proposed project includes a number of energy-saving measures.

H. MODELING ANALYSIS OF POTENTIAL IMPACTS OF COMBINED SEWER OVERFLOWS

METHODOLOGY

A principal infrastructure goal of the proposed project is to have a stormwater management plan that avoids CSO and water quality impacts on the Gowanus Canal. Although the volume of project-generated combined flows can be determined, the impacts of that added flow on the local sewer system, and ultimately CSO discharges and local water quality, cannot be predicted without a modeling simulation of the response of the sewer system to this added flow. Therefore, modeling was performed that examined all sewer facilities in the Red Hook WPCP service area, including the Red Hook interceptor, the Gowanus Pumping Station, combined sewers larger than 60 inches in diameter; and the East River regulators and outfalls, and their response to conditions with the proposed project.

The model used in this simulation was InfoWorks, an urban watershed model, which is a detailed hydraulic model that determines runoff flows, water surface elevations, and flows within sewers. InfoWorks tabulates data at each designated node, thereby allowing for detailed examination of CSO frequency and volume over a period of time. The model input that drives the simulation is hourly rainfall and sanitary flows. The model characterizes segments of a drainage area in terms of imperviousness and capacity to infiltrate rainwater with storage nodes that represent designed capture, retention, or temporary storage structures (such as those in the proposed project).

The InfoWorks application developed for this analysis was directly calibrated to flows monitored within the sewer system of the Red Hook WPCP drainage area, and was also calibrated to the dry and wet weather inflows at the Red Hook WPCP. The data compiled as part of the Gowanus Pumping Station upgrade were also used to calibrate dry and wet weather in flows to the pumping station.

To calibrate the simulation of the system's performance under current conditions, hourly precipitation data from Central Park were used, as were National Oceanic and Atmospheric Administration tide data for the gauge at the Battery (the latter data used for the purposes of understanding tidal stage conditions at each outfall in the Red Hook WPCP system). For evaluations of future and proposed conditions, a 12-month continuous rainfall record was used. The rainfall year used in the analysis was 1988, which is the year that best represents a typical year in terms of the total amount of rainfall, total number of storms, average intensity of storms, average duration of storms, average period of no-rainfall between storms, and other factors.

The proposed project was simulated within the larger drainage system as a set of sub-drainage areas that correspond to the project plan. Land use cover categories under the proposed plan were translated into modified values for surface imperviousness (expressed as the runoff coefficient, 'C') for input to the simulation. Specific proposed stormwater management features, e.g., storage tanks and water reuse, described above, were also factored into the model. The model also took into account time-varying values, such as diurnal variations in wastewater flow, seasonality in water re-use rates, and attendance at the arena.

The background flows used in the future analysis years (2010 and 2016) include projected increases in population and wastewater flow from other developments in the Red Hook WPCP drainage area for the two analysis years. The increments of the proposed project were then added to these future conditions. These project increments were based on the site-specific projections of water use and are presented in Table 11-12.

The model simulations were run for the 2010 and 2016 analysis years as follows:

- The future without the proposed project (No Build Condition);
- The proposed project without stormwater management; and
- The proposed project (Build Condition) with stormwater management features, including an on-site water feature that would re-use stored runoff, seasonally adjusted water reuse, detention/retention tanks with dual-level discharge outlets, and enlarged storage tanks with specially designed adaptive release controls.

As stated above under "Existing Conditions," the local sewer system currently affects water quality in the Gowanus Canal due to discharges of CSOs during rain events, with the largest CSO discharges coming from the Gowanus Pumping Station. By simulating the behavior of the

sewer system over a typical year, the model projected changes in CSO discharges at the Gowanus Canal under the No Build and Build Conditions.

The behavior of CSOs is reflected by two quantities in the model output: total volume and frequency of occurrence. The measure of volume is the gallons of CSO discharge during the simulation period. While the impacts of CSO overflow on water quality will vary, and are subject to other environmental factors such as the water temperature, tidal conditions, etc., total CSO volume and associated pollutant loads are the best potential indicator of water quality impacts.

The second measure is frequency of occurrence, which is the measure of total events over the modeled period. Frequency does not indicate when the event occurred or its magnitude (i.e., volume). CSO events are extremely variable, with some events being relatively small in volume and short in duration, while a few events are larger in volume and occur over a larger period. It can therefore be the case that significant reductions in CSO frequency have little effect on discharge volume. For these reasons, both are important measures of impact with respect to water quality.

MODELING RESULTS

The results of the InfoWorks modeling simulations are presented in Table 11-12. It is noted that this modeling did not take into account the Gowanus Pumping Station improvements in the 2010 analysis year, but did account for the improvements in the 2016 analysis year (it is anticipated that the improvements would be completed in 2012). This table provides the modeling results in both frequency and volume.

Table 11-12
Results of CSO Modeling

	Upper Gowanus Canal CSO Volume per year (mg)[3]	Lower Gowanus Canal CSO Volume per year (mg)	Gowanus Canal Total CSO Volume per year (mg)	East River CSO Volume per year (mg)	Total CSO Volume per year (mg)	CSO Frequency at Gowanus Pumping Station per year	CSO Frequency at East River Regulators[4]
No Build (2010)	119.7	143.0	262.7	293.1	555.7	49	**24/14**
Proposed Project [1]	-2.1	+1.9	**-0.2**	+0.4	+0.2	+1	**+0/+0**
No Stormwater Controls	+3.1	+2.8	+5.9	+0.4	+6.3	+1	
No Build (2016)	115.6	24.1	139.7	366.2	505.9	50	**28/16**
Proposed Project [2]	-2.3	+0.0	-2.3	+0.7	-1.6	+1	+1/+1
No Stormwater Controls	+7.4	+0.0	+7.4	+0.8	+8.2	+1	

Notes:
[1] Includes detention tanks in Arena block and LIRR, seasonal retention in Arena block, and Arena green roof
[2] Includes above controls in 2010 and dynamic tank outflow controls
[3] The Upper Gowanus Canal is defined as the outfall at the Gowanus Pumping Station at the head of the canal.
[4] Including the 23 outfalls within the Red Hook WPCP catchment area along the East River and Buttermilk Channel. Two of these outfalls would experience one additional CSO event each with the proposed project in 2016. The data in this column pertain to those two outfalls. The other 21 outfalls would not experience an increase in the frequency of CSO events from the proposed project.

Sources: *Impact of the Atlantic Yards Project on Local Sewer Infrastructure,* HydroQual Environmental Scientists and Engineers, P.C.: Summary Report, November 2006. "*Impacts of the Atlantic Yards Projects on Local Sewer Infrastructure: Summary Report*," prepared by HydroQual Environmental Engineers and Scientists P.C., for the Forest City Ratner Company, November, 2006.

In 2010, as shown in the table above, the proposed project (with stormwater controls) results in a 2.1 mg reduction in CSO overflow volume at the Gowanus Pumping station outfall (the Upper Gowanus Canal), and an increased discharge of 1.9 mg over a year in the Lower Gowanus Canal for an overall decrease of 0.2 mg annually, for the canal as a whole. This one event increase in CSO events is insignificant and is concluded to not affect water quality in the Gowanus Canal during the interim build year period. Similarly, the 0.4 mg annual increase in discharges into the East River (with no additional events) is considered insignificant due to the enormous water exchange available for dilution in the East River. It is therefore concluded that the proposed project would not adversely impact the water quality of the East River.

In 2016, with the improvements to the Gowanus Pumping Station (see the discussion above), as well as the expanded on-site stormwater management infrastructure, even with the additional on-site development, there would be a reduction in discharge volume of 2.3 mg per year in the Upper Gowanus Canal as compared to the No Build condition, with no increases in the Lower Canal for an overall Gowanus Canal reduction of 2.3 mg annually. To achieve this reduction, the use of dynamic orifices and the larger tanks on the project site under the proposed stormwater management plan minimizes the added stormwater flow of the project site to the Gowanus Pumping Station, and has the effect of reducing CSO volumes. Like the 2010 condition, the increase in frequency of one event in the Upper Gowanus Canal is insignificant given the overall reduction in volume combined with the improvements to the Gowanus Canal flushing tunnel that are expected to be on-line. Taking into account all of these factors, it is concluded that, as in the 2010 interim analysis year, the proposed project would not cause a significant adverse impact on water quality in the Gowanus Canal. In addition, with an increase of only two additional events and 0.7 mgd of CSO annually, the proposed project would not adversely impact the water quality of the East River. ✷