CHAPTER 12. INFRASTRUCTURE

12.1 INTRODUCTION

12.1.1 CONTEXT

The horrific events of September 11 resulted in severe damage to infrastructure systems within and around the Project Site. Within the WTC Site, all mechanical, electrical, and plumbing systems supporting the WTC Site were either destroyed or left inoperable. In addition, all water, sewer, steam, gas, stormwater, and telecommunications utilities on site, as well as major utility distribution lines coming into the site were destroyed. Near the Project Site, on the former Seven World Trade Center (7 WTC) site, two essential Consolidated Edison Company of New York (Con Edison) substations were destroyed, causing severe disruptions to large portions of the electricity distribution network in Lower Manhattan.

Con Edison is currently rebuilding the two substations at the base of the 7 WTC, thereby restoring capabilities to the Project Site. In addition, all other essential utilities have been restored in Lower Manhattan.

Water, sewer, and telecommunications distribution networks have also been restored on the Project Site for the limited demands from the existing uses on the WTC Site that include the temporary WTC PATH station and related uses, minor construction (site preparation) work, and the No. 1/9 IRT subway line. Electricity for the temporary WTC PATH station and related uses is being supplied by Public Service Energy & Gas (PSE&G) a provider based in New Jersey.

The Proposed Action would require infrastructure capabilities to serve the construction and operational needs for the World Trade Center Memorial and Memorial Center), up to 10 million square feet of commercial office space, up to 1 million square feet of retail space, a hotel with up to 800 rooms and up to 150,000 square feet of conference facilities, new open space areas, and cultural facilities and certain infrastructure improvements described in more detail below by their location on the Project Site (see also Chapter 2, "Methodology," for details of the program by analysis year). As noted in Chapter 1, "Project Description," the hotel and retail space together would not exceed 1.6 million square feet. Servicing the program needs of the Proposed Action would require a major reconstruction of utilities and mechanical and electrical systems on site and upgrades to the existing telecommunications network in the immediate area, an effort that would fulfill the mission of LMDC, which has been charged with the responsibility for planning and coordinating the remembrance, rebuilding, and renewal efforts on the WTC Site and in Lower Manhattan.

The *Sustainable Design Guidelines* are being developed by LMDC in cooperation with the Port Authority of New York and New Jersey (Port Authority), Silverstein Properties, and the "green group," a working committee comprised of environmental interest groups and other stakeholders (the current draft is included as Appendix A). These guidelines are a compendium of strategies and guidelines (outlined below in section 12.2.1, "Policies") and address reduction of natural

resource consumption. The sustainability principles have been developed to guide specific actions to be undertaken by the project sponsor and those with direct involvement in the Proposed Action to obtain: energy efficiency and enhanced indoor air quality (IAQ); conservation of materials and environmentally friendly operations and maintenance; water conservation; and more efficient waste management and recycling methods.

Consistent with sustainable principles, the Proposed Action would incorporate additional alternative energy components such as wind turbines on top of the Freedom Tower, and is exploring possibilities for cogeneration and alternative energy sources.

12.1.2 CONCLUSIONS

This chapter examines the infrastructure elements within and around the Project Site. It discusses existing conditions and the future needs of the Project Site with regard to infrastructure elements including: water supply, sanitary sewage disposal, solid waste, and energy usage. Mechanical and electrical infrastructure that existed pre-September 11 is also discussed here as it pertains to the Proposed Action and the two scenarios, Current Conditions and Pre-September 11.

In both 2009 and 2015 analysis years, the Proposed Action with the *Sustainable Design Guidelines* would result in reduced infrastructure demand and usage for water supply *and* sanitary sewage *generation*, stormwater runoff, and energy compared to pre-September 11 levels. It is expected that solid waste generation would be much lower than shown in Table 12-1, below, with the implementation of the *Sustainable Design Guidelines.* The reduction in demand and usage is a function of both significantly less office development on the Project Site and the implementation of the *Sustainable Design Guidelines*.

PRE-SEPTEMBER 11 SCENARIO

Table 12-1 summarizes the totals for infrastructure demand on the Project Site in the Pre-September 11 Scenario for the 2009 and 2015 analysis years.

Table 12-1
Totals for Pre-September 11 Scenario

	2009 Without the Proposed Action	2009 With the Proposed Action	2009 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)	2015 Without the Proposed Action	2015 With the Proposed Action[1]	2015 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)
Water Supply and Sewage Generation in gallons per day (gpd)	1,332,500	*546,174*	*417,174*	*1,382,500*	*1,434,314*	*1,037,024*
Solid Waste in tons per week	355	291	No specific total reduction[1]	*368*	*497*	No specific total reduction[1]
Energy in British Thermal Units (BTUs)	$9,948 \times 10^8$	$3,021 \times 10^8$	$2,684 \times 10^8$	$10,337 \times 10^8$	$9,937 \times 10^8$	$8,072 \times 10^8$

Notes: [1] While there are anticipated solid waste reductions with the implementation of the *Sustainable Design Guidelines* , there is no quantifiable measure for such reductions at this time.

In both 2009 and 2015 analysis years, the Proposed Action with *the Sustainable Design Guidelines* would result in reduced infrastructure demand and usage for water supply, sanitary sewage, stormwater runoff, and energy compared to pre-September 11 levels. It is expected that solid waste generation would also be less than shown in Table 12-1. The reduction in demand and usage is a function of both less office development on the Project Site and the implementation of the *Sustainable Design Guidelines*.

CURRENT CONDITIONS SCENARIO

Table 12-2 summarizes the totals for infrastructure demand on the Project Site in the Current Conditions Scenario for the 2009 and 2015 analysis years.

Table 12-2
Totals for Current Conditions Scenario

	2009 Without the Proposed Action	2009 With the Proposed Action	2009 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)	2015 Without the Proposed Action	2015 With the Proposed Action[1]	2015 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)[2]
Water Supply and Sewage Generation (gallons per day)	*Negligible*	*546,174*	*417,174*	*190,000*	*1,434,314*	*1,037,024*
Solid Waste (tons per week)	*Negligible*	291	No specific total reduction*	*49*	*497*	No specific total reduction*
Energy (BTUs)	*Negligible*	*3,201 x 10^8*	*2,684 x 10^8*	*1,479 x 10^8*	*9,937 x 10^8*	*8,072 x 10^8*

Notes: [1] While there are anticipated solid waste reductions with the implementation of the *Sustainable Design Guidelines*, there is no quantifiable measure for such reductions at this time.

12.2 METHODOLOGY

12.2.1 POLICIES

LMDC and the Port Authority intend to achieve improved environmental and sustainable attributes in the design, construction and operation of the Proposed Action. One method identified is the adoption and implementation of the *Sustainable Design Guidelines* for the WTC redevelopment projects. As discussed in Chapter 1, "Project Description," the *Sustainable Design Guidelines* identify and describe the environmental and sustainable attributes for the commercial buildings and structures of the Proposed Action.

The sources for the *Sustainable Design Guidelines* are the New York State Executive Order 111, US Green Building Council (USGBC), and the New York State Green Building Tax Credit. Executive Order 111 is designed to encourage energy efficiency in the design and construction of new buildings or improved energy efficiency in existing buildings. The Green Building Tax Credit facilitates this endeavor by granting tax credits to the owners of large residential or commercial buildings that achieve energy efficiency, improved indoor air quality (IAQ) and reduce overall impacts on the environment. The USGBC is an umbrella organization that has produced the LEED Green Building Rating System, a nationally accepted rating system for green building practices. LEED certification indicates compliance with certain green building practices that are also intended to be economically feasible.

Developed in conjunction with LMDC, the Port Authority, and the Net Lessees of the WTC Site, the *Sustainable Design Guidelines* go beyond the other comparable guidelines, which tend to be focused on only a specific building or project. At the World Trade Center, issues of regional and neighborhood scale (e.g., such as regional transportation systems and relationships to each individual building) necessitate strategies and guidelines that go beyond addressing only one particular building type. At its broadest level, the *Sustainable Design Guidelines* address issues of regional and neighborhood scale such as regional transportation systems and the Proposed Action's interface with surrounding neighborhoods.

12.2.2 ANALYSIS SCENARIOS AND YEARS

As described in Chapter 2, "Methodology," two scenarios (Current Conditions and Pre-September 11) and two analysis years (2009 and 2015) are considered. Under the Current Conditions Scenario, changes in infrastructure usage are assessed based on actual current conditions at the Project Site. For the Pre-September 11 Scenario, infrastructure impacts are assessed based on conditions that existed prior to September 11 and development that would have been expected to occur in the future had the events of September 11 never taken place. The first analysis year of 2009 represents a time when the initial phases of the Proposed Action would be in place, while 2015 assumes full build-out of the Proposed Action.

12.2.3 CRITERIA FOR QUANTIFIED ANALYSIS

This analysis will involve identifying infrastructure needs for the Proposed Action. The 2001 *City Environmental Quality Review (CEQR) Technical Manual* methodologies have been employed as a guide to calculate estimates for the demands on water supply, sewage generation, solid waste generation, and energy usage based upon user populations and square footage development known for each scenario. While these conservative estimates for infrastructure are essential, introduction of green measures designed to improve usage and reduce consumption will also be analyzed and presented in the Pre-September 11 Scenario.

The *Sustainable Design Guidelines* contain quantifiable conservation and efficiency goals for water usage, sewage generation and energy usage. They would require space for recycling operations comparable to the large scale recycling program that existed at the WTC Site prior to September 11. Part of the *Sustainable Design Guidelines* that would be effective for all types of infrastructure is the requirement of end-use metering for tenants occupying over 5000 square feet of space. This encourages greater resource conservation, as the tenant is charged for direct consumption as opposed to paying a flat rate. However, generation rates for all uses cannot be generated at this time due to the lack of specificity in design (such as the memorial-related and cultural uses). The analyses consider the infrastructure elements within an overall Comprehensive Resource Management Plan (SEQ-1[1]) that would include plans for water, materials management (solid waste), and energy.

To reduce the water consumption, and correspondingly, the burden on the city's water supply, a water management plan (referred to as guideline WEQ-1 in the *Sustainable Design Guidelines*) is considered for the Proposed Action Using the 1992 Energy Policy Act to determine a baseline building for water fixture requirements, the goal is a reduction in use of 30 percent for potable water (WEQ-3). This 30 percent reduction will be incorporated within the analysis of water

[1] Of the *Sustainable Design Guidelines.*

supply and sewage generation *with the exception of the Memorial water features. Reduction measures are not applied to the curtains of water or recessed pools.*

A materials management plan (MEQ-1) as part of the Comprehensive Resource Management Plan would be in place for solid waste collection, recycling and disposal. While there is no quantifiable measure at this moment for solid waste, it is anticipated that the materials management plan will reduce the amount of solid waste produced.

The Comprehensive Resource Management Plan also includes a site energy management plan (EEQ-1) to reduce energy consumption by a minimum of 20 percent below the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 90.1/1999 Standard (EEQ-3 of the *Sustainable Design Guidelines*). The use of a central chilling plant may require an adjustment to this goal. The site energy management plan could incorporate ENERGY STAR® compliant appliances to help achieve this goal as well.

12.3 CURRENT CONDITIONS SCENARIO

12.3.1 EXISTING CONDITIONS 2003

The study area consists of the Project Site, which includes the WTC Site and Southern Site. The WTC Site is an approximately 16-acre parcel bounded by Liberty, Church, and Vesey Streets, and Route 9A. The Southern Site comprises two adjacent blocks south of the WTC Site—one bounded by Liberty, Washington, Albany, and Greenwich Streets, and the other bounded by Liberty, Cedar, and Washington Streets and Route 9A—and portions of two streets: Liberty Street between those blocks and the WTC Site and Washington Street between Cedar and Liberty Streets.

On the Southern Site, the block at the intersection of Route 9A and Liberty Street is vacant and is part of the construction staging area for the WTC Site. 7 WTC, just north of the WTC Site, was destroyed in the September 11 attacks, its remnants have been removed, and it is being rebuilt. This structure will serve to restore the locations of two Con Edison substations that served the WTC Complex. The substructures of the two substations are complete.

Because of the extensive utility interruption and destruction due to the events of September 11, electric energy, gas, steam and telecommunications networks were disrupted throughout the area. Rapid response in the immediate aftermath restored temporary service in the interim before permanent restoration. Funds available through federal appropriation administered by the United States Department of Housing and Urban Development (HUD) through LMDC have been designated for the area's damaged properties and businesses, including the restoration of utility infrastructure. In order to rehabilitate infrastructure facilities, LMDC has prepared a Partial Action Plan for Utility Restoration and Infrastructure Rebuilding. The Plan identifies two objectives:

- To protect businesses and residential customers from bearing the cost of the infrastructure rebuilding; and
- To enhance the revitalization and redevelopment of Lower Manhattan as a world-class commercial and residential community by encouraging investment in energy and telecommunications infrastructure.

While some restoration and improvement is currently underway, it is expected that these items would continue to progress with the redevelopment of the Project Site. The current completed infrastructure restoration efforts are detailed below, where appropriate.

WATER SUPPLY

The water supply system of New York City is operated by the Department of Environmental Protection (NYCDEP) and is served by three watersheds: Croton, Delaware, and Catskill. The water supply system relies predominantly on gravity to supply New York City with approximately 1.1 billion gpd of water[1], via a system of reservoirs, aqueducts, and tunnels. Once the water reaches the city, an underground network of distribution mains facilitates water access to consumers as well as fire hydrants.

Water is currently brought to the Project Site by mains running north and south through the site parallel to the No. 1/9 IRT subway line. A water main is fed into the site on a three-utility rack that also carries parallel steam and sanitary sewer mains.

SANITARY SEWAGE AND STORM WATER

The sewer system is comprised of a network of underground sewers that direct wastewater to 14 water pollution control plants (WPCPs). "Drainage basins" are the areas served by each of the WPCPs. Most of the sewer system is combined, that is, it carries both sanitary sewage and stormwater. During dry weather, the sewers mostly collect sanitary sewage and wastewater from industrial uses. During wet weather, rainwater runoff can increase substantially, and may flood the WPCPs. To avoid this, relief valves called regulators are built into the combined sewers, directing the excess flow to the nearest waterway. Some of the excess flow contains sanitary sewage and debris from the streets. This is called "combined sewer overflow" (CSO).

The Project Site is within the drainage basin that is served by the Newtown Creek WPCP, located in Brooklyn. The rated capacity of this plant is 310 million gpd, the largest rated capacity of any plant in the five boroughs of New York City. The capacity is designed to treat double the amount of average dry weather flow so as to avoid surges from storms. The sanitary sewage and stormwater is treated at this facility and discharged into the East River. The WPCP operates under a State Pollutant Discharge Elimination System (SPDES) permit, which is intended to ensure that there are no adverse effects on the receiving body of water by the effluent. Stormwater overflow is discharged directly into the East River.

The collection system in the immediate vicinity of the Project Site consists of combined sewers that collect both sanitary sewage and stormwater flows along West Broadway, Vesey, Barclay, and Washington Streets. A pump station located at 14th Street and the Franklin Delano Roosevelt (FDR) Drive collects sanitary sewage and stormwater from the South Branch Interceptor that runs along Route 9A and South Street. Within the WTC Site, sub-level sump pumps operate to pump groundwater and stormwater runoff to prevent minimal flooding of the site.

SOLID WASTE

In New York City, solid waste from manufacturing and commercial uses is collected by private carters while residential refuse is handled by the New York City Department of Sanitation

[1] From NYCDEP website, "New York City's Water Supply System," http://www.nyc.gov/html/dep/html/droughthist.html.

(DSNY). Commercial solid waste is typically hauled to out-of-city landfills. Residential waste was formerly disposed of at the Fresh Kills Landfill, located on the western shore of Staten Island. After nearly 50 years of operation[1], the Fresh Kills site stopped receiving solid waste on March 22, 2001. DSNY currently collects solid waste, delivers it to transfer stations, and from there private carters take it to a landfill. Solid waste for Lower Manhattan is typically hauled to Essex County, New Jersey. The municipal waste systems handle about 12,000 tons per day and the private carters handle approximately 10,000 tons per day. Private waste collection companies charge by the cubic yard (CY) and employ either manual collection or containers.

In April 1989, the city passed a law requiring residents and businesses to separate recycling material from wastes and requiring 25 percent of the city's waste to be recycled. These local laws have reduced the volume of waste that is disposed of at the city's landfills. Nearly 18 percent of the daily waste (both commercial and residential) that is generated by the 7.5 million inhabitants of New York City is recycled.

ENERGY

Con Edison supplies electricity, natural gas, and steam in New York City, and to the Project Site. Annual electric consumption totals approximately 50 billion kilowatt hours (kWh) of electricity in the Con Edison service area. On September 11, Con Edison lost the two substations at 7 WTC and suffered damage to its underground power network. Substations decrease voltage in electric lines *in order to enable distribution of* electricity to neighborhoods. *Following September 11,* Con Edison *temporarily* restored electric service to Lower Manhattan by bypassing the underground electrical system and laying approximately 36 miles of electric *cable* above ground. *(The cable has since been removed.)* These activities were completed, as part of the HUD funds for Emergency and Temporary Response. Currently Con Edison is working to restore the power network to pre-September 11 capabilities. *Con Edison permanently restored electric service to Lower Manhattan by establishing a new substation on the Lower East Side, installing the associated distribution infrastructure from this substation and reconfiguring various networks.*

Con Edison delivers steam to the Project Site through a distribution main under Greenwich Street. A steam main feeds into the site on a 3-utility rack running north-south through the site parallel to the No. 1/9 IRT subway. Domestic water and sanitary sewer mains also run along this utility rack. The steam main is used by building tenants in heating ventilating and air conditioning (HVAC) systems and domestic water heaters.

Con Edison also supplies natural gas to the Project Site via *three* gas services. Prior to September 11, service entered off Vesey Street, for the concourse restaurants and through the Southeast Plaza Building, for the Commodities Exchange. Con Edison has since restored both steam and natural gas service to the Lower Manhattan area.

TELECOMMUNICATIONS

Telephone and cable lines are fed to the WTC Site through major entry points along the perimeter. The banks and casings remain intact and useable with the exception of a bank along the north side of the site. Empire City Subway, a subsidiary of Verizon, maintains telephone

[1] Except for the brief reopening for September 11-related material.

manholes and utilities. The telephone banks that remain may be rewired with a combination of telephone, cable or fiber optic lines.

Businesses and residents in Lower Manhattan have telecommunications needs ranging from telephone service to cable and internet access. In addition to communications needs, many financial businesses common in Lower Manhattan rely on their telecommunications networks for instantaneous information feeds both into and out of their office facilities. At the WTC Site, slurry wall access points and manhole facilities remain largely intact, and many of these facilities have already undergone restoration or rewiring in anticipation of new tenants' telecommunication needs. Advanced technology, such as fiber optic cables, is available within the vicinity of the Project Site.

The actions funded through HUD allocations to telecommunications include activities performed by Verizon and AT&T. These activities have been completed, as part of the HUD funding for Emergency and Temporary Response. Significant damage to telecommunications facilities serving Lower Manhattan prompted an immediate response to restore service to critical communications networks. Using alternate available facilities and internal emergency resources, AT&T and Verizon were able to restore communications services to the area. Restoration efforts that have been completed include:

- Cable restoration;
- Conduit repair and reconstruction;
- Upgrade of remote nodule and rebuilt transport node;
- Testing, repairing and replacing damaged facilities; and
- Rerouting of telecommunications traffic.

Some of these restoration efforts provide permanent solutions, while in some areas additional reparations may be needed to restore permanent facilities.

Emergency telecommunications are described in Chapter 1, "Project Description."

12.3.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO

In this scenario, it is assumed that without the Proposed Action, the Project Site will remain largely undeveloped, with the No. 1/9 IRT subway lines running through it and the permanent WTC PATH Terminal having replaced the temporary WTC PATH station.

WATER SUPPLY AND SANITARY SEWAGE GENERATION

There would be minimal water demands and usage from the permanent WTC PATH Terminal. There would be no water supply demand introduced to the WTC Site without the Proposed Action in 2009. The building lots would remain vacant and connections through the slurry wall to the water mains would remain idle. There would be minimal amounts of sanitary sewage generated from the permanent WTC PATH Terminal.

STORMWATER

Under this scenario, pumps currently in place on the WTC Site would continue on site to transfer the stormwater *and groundwater* to the city's sewer system. *Stormwater from portions of public streets (Liberty Street and Washington Street) that are within the Project Site are conveyed directly to catch basins. Groundwater is currently tested per NYSDEC permits.* There is a monitoring system in place to guard against flooding.

SOLID WASTE

Private carters would dispose of all the permanent WTC PATH Terminal solid waste.

ENERGY

The energy needs of the site would not change in the year 2009 in the absence of the Proposed Action. The energy needs of the permanent WTC PATH Terminal are negligible and would be provided by Con Edison.

TELECOMMUNICATIONS

No telecommunications needs would be introduced to the WTC Site without the Proposed Action, with the exception of telecommunication needs by the permanent WTC PATH Terminal.

12.3.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO

In 2009 it is assumed that the Memorial, *Memorial Center*, and cultural facilities would be complete in the southwest quadrant of the WTC Site; Freedom Tower and the performing arts facility would be complete in the northwest quadrant; and on the northeast and southeast quadrants the retail uses would be complete. The sub-grade levels across the entire site would have been developed as well as the two surface streets, Fulton and Greenwich, and the open spaces.

As described in Chapter 1, "Project Description," the Memorial will consist of several elements such as the Memorial Center, and an exposed portion of the western slurry wall between Fulton and Liberty Streets. The elements with potential infrastructure needs include the Memorial "voids" which represent the footprints of the former Twin Towers and reflect the absence of the towers. The voids consist of two 200 feet by 200 feet pools of water recessed approximately 30 feet below grade. Thin curtains of water will cascade from the plaza level at-grade down to the pools below. The proposed water features are anticipated to operate continuously throughout each day during the year. Although the final design of the Memorial has not been completed, is anticipated that the water features would also incorporate appropriately scaled lighting to illuminate the site at night.

WATER SUPPLY AND SEWAGE GENERATION

Predictions for the estimated water usage and sewage generation rates, measured in gallons per day (gpd), are outlined below. Water usage and sewage generation are considered to be roughly equal with no loss in this analysis. Table 12-3 outlines the potential water usage and sewage generation in 2009 as well as a 30 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

Table 12-*3*
Water Supply and Sewage Generation in 2009 Under Current Conditions

	Square Footage	No. of Employees	Rate (gpd)	Total (gpd)	With 30% Reduction[1] (gpd)
Office	N/A	10,400	25 gpd/person	260,000	182,000
Retail	1,000,000	N/A	0.17 gpd/sf	170,000	119,000
Memorial Interpretive Center, Memorial Center and Cultural Facilities (Institutional)	380,000	N/A	0.17 gpd/sf	64,600	64,600
Performing Arts Center	2,200 seats	N/A	5 gpd/seat	11,000	11,000
Memorial	*212,200*	N/A	0.17 gpd/sf	*36,074*	*36,074*
Memorial Pools	*N/A*	*N/A*	*N/A*	*4,500*[2]	*4,500*
TOTAL	N/A	N/A	N/A	*546,174*	*417,174*

Notes:

[1] Currently the *Sustainable Design Guidelines* water reduction of 30 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of those elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.

[2] *The Memorial pools would require approximately 310,000 gallons to begin operation. With an evaporation loss of 110 gallons per hour, the curtains of water and pools would require an additional 2,640 gallons per day to maintain the amount of water needed for continuous use. Assuming replenishment of both pools twice a year, the total average water requirements would be approximately 4,500 gallons per day.*

N/A = Not Applicable for calculating the rate

While the events of September 11 resulted in severe damage to infrastructure systems, the intakes, pumps, outfalls, and associated pipelines that conveyed Hudson River water as part of the site's pre-September 11 cooling system remained largely intact. This existing infrastructure is proposed to be used as part of a cooling system using water from the Hudson River. A cooling system using river water is considered more environmentally sound and cost and space efficient than a conventional system. A conventional system would rely on cooling towers with refrigeration plants using potable water for the cooling of individual office buildings, retail space, Memorial/cultural uses and the PATH Terminal.

River water, at the intake point, on average has a lower temperature than the potable water used in the cooling tower process.

STORMWATER

Construction of the Proposed Action would not be expected to result in any adverse impacts on surface water quality. Runoff from the construction site will be controlled in accordance with "New York Standards and Specifications for Erosion and Sediment Control" developed by the Empire State Chapter of the Soil and Water Conservation Society (see Chapter 21, "Construction Impacts").

Although the Proposed Action could result in the discharge of stormwater during heavy rain events and involves construction of more than one acre, a state pollutant discharge elimination system (SPDES) general permit for construction would not be required. Stormwater runoff from impervious surfaces at the Project Site would be directed to municipal sewer catch basins. The project area is serviced by combined sewers, as opposed to municipal storm sewers, thus stormwater would be directed to the municipal wastewater treatment facility prior to discharging to surface water bodies. The Port Authority, in conjunction with federal, state, and city regulatory agencies, would develop measures to minimize temporary impacts from stormwater and implement these measures during construction.

As part of the Sustainable Design Guidelines, stormwater on the Project Site (excluding the public streets of Greenwich and Fulton) will be captured and reused in a greywater system. The greywater system, as part of the WEQ-3 Water Use Efficiency, will treat and re-circulate the water for non-potable water usage such as toilet flushing, vehicle maintenance, and irrigation needs.

The table above includes a minimum reduction of 30 percent in water usage and sewage generation. While the Sustainable Design Guidelines propose a 30 percent reduction, it is believed that a reduction of up to approximately 85 percent of the annual rainfall flowing directly into the sewer system and CSO can be achieved through the greywater system. Consideration in the design of ledges, roofs and setbacks will be made to facilitate the capture of stormwater off buildings. In addition, stormwater will be captured (possibly through subterranean structures) from the pervious and impervious surface areas of the Project Site without buildings.

For the new Greenwich and Fulton Streets that bisect the Project Site, the capture of stormwater runoff will be achieved via sewer drainage catch basins. As a Best Management Practice, an oil/water separator would be used to filter the stormwater runoff before it flows into the main trunk line connected to the sewer system and the CSO. The oil/water separator will periodically be replaced to ensure the effective filtration of stormwater. The final engineering plans would determine the layout of the drainage basins and the oil/water separator or equivalent measures to prevent non-point discharge to the sewer system.

While the greywater system is expected to be designed to capture typical volumes of stormwater from the site, severe storm events may result in rainfall that would exceed the system's ability to capture all stormwater on site. In such cases, discharges to the sewer system may occur.

Water Quality Certification

As the Proposed Action would not affect any surface waters or wetlands, it would not require a Water Quality Certificate from NYSDEC.

SOLID WASTE

The below-grade levels of the Proposed Action include centralized solid waste facilities, similar in form to the pre-September 11 facilities (i.e., trucking services, freight and service elevators, vehicular access, and containers).

Solid waste is estimated in pounds per employee per week. Recycling trucks are assumed to carry approximately 11.5 tons of paper or 10.0 tons of metal or glass. Trucks used by private commercial carters carry on average 12 to 15 tons of solid waste. The following potential impact scenarios utilize these estimates and use the midpoint of 13.5 tons for the amount of solid waste per truck. Table 12-*4* outlines the potential solid waste generation in 2009.

Table 12-*4*
Solid Waste Generation in 2009 Under Current Conditions

	No. of Employees	Solid Waste Rate (pounds per week per employee)	Solid Waste (pounds per week)	Tons per week	Trucks
Office	10,400	13	135,200	68	5
Retail	3,000	79	237,000	119	9
Memorial and Cultural Facilities (Institutional)	430	451	194,000	97	7
Performing Arts Center (2,200 seats)	169	79	13,351	7	1
TOTAL	13,999	N/A	579,551	291	22
N/A= Not Applicable for calculating the rate					

ENERGY

The sub-grade levels of the Proposed Action include energy facilities, similar in form to the pre-September 11 facilities (i.e., electrical systems, gas and steam services).

Standard energy usage is estimated in BTUs per square foot, per year. Table 12-*5* outlines the energy usage in 2009 as well as a 20 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

Table 12-5
Energy Consumption in 2009 Under Current Conditions

	Square Footage	BTU Averages	2009 BTUs	With a 20% Reduction[1]
Office	2,600,000	77,900	$2,025 \times 10^8$	$1,620 \times 10^8$
Retail	1,000,000	55,800	558×10^8	446×10^8
Memorial Center and Cultural Facilities (Institutional)	380,000	70,850	269×10^8	269×10^8
Performing Arts Center (2,200 seats)	200,000	65,300	131×10^8	131×10^8
Memorial (all other areas)	*212,200*	57,500	*122* $\times 10^8$	*122* $\times 10^8$
Memorial Pools[2]	*N/A*	*N/A*	*96 x* 10^8	*96 x* 10^8
TOTAL	*4,392,200*	N/A	*3,201 x* 10^8	*2,684 x* 10^8

Notes:
1 Currently the *Sustainable Design Guidelines* water reduction of 20 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of these elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.
2 Using preliminary design estimates, the Memorial Pools are estimated to require 320 kilowatts per hour. It is expected that the Memorial Pools would run 24 hours per day, 365 days per year.
N/A = Not Applicable for calculating the rate

ENERGY COMPARISON

The estimates in Table 12-5 are based on the CEQR Technical Manual which uses standard rates derived from traditional cooling tower methods and data and technology more than 15 years old. A more accurate estimate based upon current technology estimates that the existing central refrigeration plant cooling system would require approximately 650,000 fewer kilowatts per hour (kwh) per year than the traditional cooling tower system.

The existing Hudson River intake and central chiller system would require less space on the WTC Site, an important consideration given the complexity of uses and competition for the limited space within the sub-grade areas of the Project Site. Individual cooling towers would be required in each building for the Proposed Action, each requiring approximately 24,000 square feet and 65 feet in each building, resulting in potential shadow and urban design impacts in addition to the utility needs described in this chapter.

More detailed quantitative analysis of energy savings and costs of alternative cooling scenarios are ongoing. A comparison of the two cooling systems is also described in Chapter 23, "Alternatives."

TELECOMMUNICATIONS

In 2009, the WTC Site would have telecommunications needs ranging from telephone service to cable and internet access. In addition to communications needs, many financial businesses common in Lower Manhattan rely on their telecommunications networks for instantaneous information feeds both into and out of their office facilities. As the slurry wall access points and manhole facilities remain largely intact, many of these facilities have already undergone restoration or rewiring in anticipation of new tenants' telecommunication needs. Advanced technology such as fiber optic cable allows a larger amount of information and more customers to be served through a thinner cable. It is expected that the existing manhole access and slurry wall entry points would accommodate the needs of future tenants on the WTC Site as development progresses throughout the Proposed Action.

12.3.4 FUTURE WITHOUT THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO

In 2015 without the Proposed Action, it is assumed for analysis purposes that the WTC Site will remain vacant, except for the permanent WTC PATH Terminal and the No. 1/9 IRT subway lines. In addition, 130 and 140 Liberty Street sites on the Southern Site are presumed to contain office buildings. Table 12-*6* shows projected infrastructure usage in this scenario.

Table 12-*6*
Future Without the Proposed Action—Current Conditions Scenario 2015

	Water Supply and Sewage Generation (gallons per day)	Solid Waste (tons per week)	Energy (BTUs)
130 Liberty Street	140,000	36	1090×10^8
140 Liberty Street	*50,000*	*13*	*389×10^8*
TOTAL	*190,000*	*49*	*$1,479 \times 10^8$*

WATER SUPPLY AND SANITARY SEWAGE GENERATION

Other than minimal water supply and sewage generation from the permanent WTC PATH Terminal, there would be no water supply or sewage generation introduced to the WTC Site without the Proposed Action in 2015. The *Southern* Site would produce a total demand of approximately 190,000 gpd.

STORMWATER

Pumps currently in place on the WTC Site would continue on site to transfer the stormwater to the city's sewer system. There is a monitoring system in place to guard against flooding. (Without the Proposed Action, stormwater runoff and basin drainage needs would remain at a maximum since the entire site within the slurry wall bathtub is a paved surface.)

SOLID WASTE

There would be no introduction of solid waste facilities or collection on the WTC Site. The site would remain largely vacant and without development on site to create solid waste. However, the *Southern* Site would produce approximately 49 tons per week.

ENERGY

The energy needs of the WTC Site would not change in the year 2015 in the absence of the Proposed Action. However, the *Southern Site* would require 1,479 x 10^8 BTUs.

TELECOMMUNICATIONS

Under this scenario, the developed *Southern Site* would require telecommunication needs.

12.3.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO

By 2015, the redevelopment of the Project Site would be complete. The office space with five towers and a hotel would be completed, bringing the total office space to 10 million square feet. All other development would be as described for 2009.

Any additional infrastructure needs, including water, sewer, and solid waste generation, identified under this scenario would reflect the impact of the Proposed Action compared to Current Conditions.

WATER SUPPLY AND SEWAGE GENERATION

Table 12-7 outlines the potential water usage and sewage generation in 2015 as well as a 30 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines. In addition, the greywater system described in Section 12.3.3 utilizing stormwater recapture and re-use with low-flow fixtures would significantly reduce the demand on the city's potable water supply and sewage generation into the city's sewer system.*

Table 12-*7*
Water Supply and Sewage Generation in 2015 under Current Conditions

	Square Footage	No. of Employees	Rate (gpd)	Total (gpd)	With 30% Reduction[1] (gpd)
Office	N/A	40,000	25 gpd/person	1,000,000	700,000
Retail	1,000,000	N/A	0.17 gpd/sf	170,000	119,000
Memorial Center and Cultural Facilities (Institutional)	380,000	N/A	0.17 gpd/sf	64,600	64,600
Performing Arts Center	2,200 seats	N/A	5 gpd/seat	11,000	11,000
Memorial	*212,200*	N/A	0.17 gpd/sf	*36,074*	*36,074*
Memorial Pools	*N/A*	*N/A*	*N/A*	*4,500*[2]	*4,500*
Hotel	800 rooms	N/A	150/gpd/rm/occupant	120,000	84,000
Hotel Function Space	150,000	N/A	0.17 gpd/sf	25,500	17,850
TOTAL	N/A	N/A	N/A	*1,434,314*[3]	*1,037,024*

Notes:

[1] Currently the *Sustainable Design Guidelines* water reduction of 30 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses would be made upon design of these elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted. The office tower at Site 26, while located on the Project Site, is not part of the Proposed Action.

[2] *The Memorial pools would require approximately 310,000 gallons to begin operation. With an evaporation loss of 110 gallons per hour, the curtains of water and pools would require an additional 2,640 gallons per day to maintain the amount of water needed for continuous use. Assuming replenishment of both pools twice a year, the total average water requirements would be approximately 4,500 gallons per day.*

STORMWATER

The capture of stormwater will continue as in 2009 Current Conditions. That is, approximately 85 percent of annual rainfall will be collected and utilized. Stormwater runoff from Fulton and Greenwich Streets will continue to be captured by drainage basins and filtered into the CSO system.

Water Quality Certification

As the Proposed Action would not affect any surface waters or wetlands, it would not require a Water Quality Certificate from NYSDEC.

SOLID WASTE

Estimates of waste collection per day are projected to result in 390 tons of waste. The waste is comprised of recyclable material and non-recoverable, organic waste.

Projected number of trips per day for solid waste management is 18 to 24. The total collection is projected for the entire Project Site. Table 12-8 outlines the potential solid waste generation in 2015.

Table 12-*8*
Solid Waste Generation in 2015 Under Current Conditions

	No. of Employees	Solid Waste Rate (pounds per week per employee)	Solid Waste (pounds per week)	Tons per week	Trucks
Office	40,000	13	520,000	260	19
Retail	3,000	79	237,000	119	9
Memorial *(all elements) and* Cultural Facilities (Institutional)	430	451	194,000	97	7
Performing Arts Center	169	79	13,351	7	1
Hotel and Function Space	381	75	28,575	14	1
TOTAL	*43,980*	N/A	*992,926*	*497*	*37*
Note: N/A= Not Applicable for calculating the rate					

As there is no information with regard to the number of trucks that serviced the WTC complex pre-September 11, the projections used in this analysis are based on industry standards for comparable developments. Truck trips for solid waste collection are estimates based upon the volume and weight of solid waste, including recycling. The estimated number of truck trips for solid waste is less than 3 percent of the total truck trips estimated to service the entire Project Site by 2015.

ENERGY

The mechanical and electrical systems would be designed to contribute towards efficiency in power consumption, and indoor air quality standards, as determined by the ASHRAE Standard 62-2001, *Ventilation for Acceptable Indoor Air Quality*. Emergency and standby components of the electrical system would be incorporated for safety and reliability.

Changes or impacts anticipated under this scenario are the energy facilities (that would be in place in 2009) that would be in full capacity operation by 2015. Table 12-*9* outlines the potential energy usage in 2015 as well as a 20 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

Table 12-*9*
Energy Consumption in 2015
Under Current Conditions

	Square Footage	BTU Averages	2015 BTUs	With 20% Reduction[1]
Office	10,000,000	77,900	7,790 x 10^8	6,232 x 10^8
Retail	1,000,000	55,800	558 x 10^8	446 x 10^8
Memorial Interpretive Center, Memorial Center, and Cultural Facilities (Institutional)	380,000	70,850	269 x 10^8	269 x 10^8
Performing Arts Center	200,000	65,300	131 x 10^8	131 x 10^8
Memorial (all other areas)	*212,200*	57,500	*122* x 10^8	*122* x 10^8
Memorial Pools[2]	*N/A*	*N/A*	*96 x 10^8*	*96 x 10^8*
Hotel	600,000	145,500	873 x 10^8	698 x 10^8
Hotel Function Space	150,000	65,300	98 x 10^8	78 x 10^8
TOTAL	*10,302,670*	N/A	*9,937 x 10^8*	*8,072 x 10^8*

Notes:
1 Currently the *Sustainable Design Guidelines* water reduction of 20 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses ill be made upon design of these elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.
2 Using preliminary design estimates, the Memorial Pools are estimated to require 320 kilowatts per hour. It is expected that the Memorial Pools would run 24 hours per day, 365 days per year.
N/A = Not Applicable for calculating the rate

ENERGY COMPARISON

The estimates in Table 12-9 are based on the CEQR Technical Manual. As discussed in Section 12.3.3., a more accurate estimate based upon current technology estimates that the existing central refrigeration plant cooling system would require approximately 1,350,000 fewer kilowatts per hour (kwh) per year than the traditional cooling tower system.

The existing Hudson River intake and central chiller system would require less space on the WTC Site, an important consideration given the complexity of uses and competition for the limited space within the sub-grade areas of the Project Site. Individual cooling towers would be required in each building for the Proposed Action, each requiring approximately 24,000 square feet and 65 feet in each building, resulting in potential shadow and urban design impacts in addition to the utility needs described in this chapter.

More detailed quantitative analysis of energy savings and costs of alternative cooling scenarios are ongoing. A comparison of the two cooling systems is also described in Chapter 23, "Alternatives."

TELECOMMUNICATIONS

In 2015, the fully redeveloped Project Site would have telecommunications needs ranging from telephone service to cable and internet access. In addition to communications needs, many financial businesses common in Lower Manhattan rely on their telecommunications networks for instantaneous information feeds both into and out of their office facilities. The slurry wall access points and manhole facilities remain largely intact, and many of these facilities have

already undergone restoration or rewiring in anticipation of new tenants' telecommunication needs. Advanced technology such as fiber optic cable allows a larger amount of information and more customers to be served through a thinner cable. It is expected that the existing manhole accesses and slurry wall entry points would accommodate the needs of future tenants on the Project Site after completion of the Proposed Action.

12.3.6 INFRASTRUCTURE TOTALS FOR CURRENT CONDITIONS SCENARIO

Total infrastructure usage for the Current Conditions Scenario with and without the Proposed Action in the two analysis years is shown in Table 12-*10*.

Table 12-*10*
Totals for Current Conditions Scenario

	2009 Without the Proposed Action	2009 With the Proposed Action	2009 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)	2015 Without the Proposed Action	2015 With the Proposed Action[1]	2015 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)[2]
Water Supply and Sewage Generation (gallons per day)	*Negligible*	*546,174*	*417,174*	*190,000*	*1,434,314*	*1,037,024*
Solid Waste (tons per week)	*Negligible*	291	No specific total reduction*	*49*	*497*	No specific total reduction*
Energy (BTUs)	*Negligible*	*3,201 x 10^8*	*2,684 x 10^8*	*1,479 x 10^8*	*9,937 x 10^8*	*8,072 x 10^8*

Notes: [1] While there are anticipated solid waste reductions with the implementation of the *Sustainable Design Guidelines* , there is no quantifiable measure for such reductions at this time.

12.4 PRE-SEPTEMBER 11 SCENARIO

12.4.1 BASELINE CONDITIONS

Prior to September 11, the WTC Site contained over 10 million square feet of office space in five buildings; approximately 350,000 to 400,000 square feet of retail space depending on occupancy, a hotel, and a public plaza (see Figure 3-6). The site was best known for the Twin Towers, 1 and 2 WTC, two 110-story buildings that rose over 1,350 feet. Each tower contained more than 4.7 million square feet of rentable Class A office space. The four other buildings on the site totaled 1.9 million square feet. Between the Towers at the southwest corner of the WTC Site was 3 WTC, a Marriott Hotel with 820 rooms and meeting spaces. Along the northeast and southeast edges of the WTC Site were two nine-story buildings (4 and 5 WTC). The eight-story U. S. Customs House (6 WTC) was located at the northwest corner of the WTC complex.

The infrastructure of the WTC included a 351.5-foot mast on 1 WTC supporting television and radio antennae for major public and private broadcasters in New York City. Also included as part of the infrastructure was a Hudson River water pump station located along the Hudson River north of Liberty Street.

130 Liberty Street contained an office tower, known as the Deutsche Bank building. This office tower contained 1.4 million square feet. The Southern Site also included St. Nicholas Church, which had minimal infrastructure.

WATER SUPPLY

The water system for the WTC complex was comprised of a potable water supply brought in by mains running north and south through the site parallel to the No. 1/9 IRT subway line. A water main fed into the site on the three-utility rack that also carried parallel steam and sanitary sewer mains.

The cold water system of Towers 1 and 2 consisted of cold water supplied via a header that connected to the city's water mains under Barclay and Liberty Streets, at the north and south ends of the site. The water passed through water meters (one for each tower) that measured consumption. There were devices to prevent a loss of water pressure, specifically booster pumps to ensure pressure to the higher floors. The plaza buildings on the WTC Site were fed from the city water main at the south end of the site and were outfitted with separate booster pumps from Towers 1 and 2.

The hot water systems for each of the towers and the plaza buildings consisted of hot water preheaters, hot water heaters, and hot water circulation pumps. Hot water was used for potable supply and also for the central heating system. A corresponding return system was in place for each heating segment in order to maintain suitable floor temperatures for various uses such as drinking water, toilets, janitorial sinks, etc.

130 Liberty Street was supplied with water by the city's water mains.

SANITARY SEWAGE AND STORMWATER DISPOSAL

There were a total of six gravity sewer systems at the WTC complex. Because the sewers were located below the city gravity sewers, each of the six sewage systems incorporated two sewage ejector pumps which pumped the collected sewage into the New York City Gravity Sewage System (NYCGSS). Towers 1 and 2 shared a connection to the NYCGSS through a pipe facing West Street. The plaza buildings connected to the NYCGSS through two pipes on Liberty Street and two pipes on Vesey Street.

A sanitary sewer main fed out of the site on the three-utility rack. Domestic water and steam mains also ran along this utility rack. Sewage from the sub-grade levels was strained through a soil trap and a sewage inlet pipe. There was also an overflow strainer that strained solid and liquid wastes into a discharge pit, between the ejector pumps.

Sanitary sewage also had a sub-level drainage system, which was located below the gravity sewer level. As a result, sewage ejector pumps were necessary to discharge the sewage from a system of pits into the house gravity sewer system and then into the New York City sewer system.

Surface water was collected via a sub-soil drainage and piping system that collected clear wastewater from machinery. As with sewage, this water was collected below the New York City gravity storm system, so a separate drainage pump system was in place to pump the clear wastewater from sump pits into storm lines.

The Gravity Sump Drainage System consisted of five sub-level sump pits (each of which were comprised of a wet pit and a dry pit) that received clear wastewater and surface water. The sump pumps discharged effluent into the New York City Gravity Storm Sewer System.

Storm water was collected in basins and pumped into the city system or flowed directly into storm drains which fed into the Hudson River. Water collected in these basins would have included runoff from nonporous and paved surfaces such as garages and rooftops. Subset

ejectors in the bathtub areas pumped storm water from collection basins beneath the site out to the Hudson River. The storm sewer drainage system for Towers 1 and 2 shared a connection to the city's storm sewer through a pipe. Hudson River water intake pipes served the HVAC cooling system, with four pipes circulating river water.

Stormwater form the portions of the public streets (Liberty Street and Washington Street) are conveyed directly to the city's sewer system.

130 Liberty pumped wastewater into the New York City sewer system.

The pre-September 11 conditions for water supply and sewage generation are presented in Table 12-*11*.

Table 12-*11*
Water Supply and Sewage Generation—Pre-September 11*

	Square Footage	No. of Employees	Rate (gpd)	Total (gpd)[1]
Office	N/A	40,400	25 gpd/person	1,010,000
Retail	350,000[2]	N/A	0.17 gpd/sf	59,500
Hotel	820 rooms	N/A	150 gpd/rm/occupant	123,000
130 Liberty	N/A	5,600	25 gpd/person	140,000
TOTAL	N/A	N/A	N/A	1,332,500

Notes:

[1] For the purposes of this analysis, in lieu of existing pre-September 11 numbers, calculations are made with CEQR estimates.

[2] The retail space ranged from 350,000 to 400,000 square feet depending on occupancy. To be conservative, this analysis is based on 350,000 square feet of retail space at the former WTC Site.

N/A = Not Applicable for calculating the rate

SOLID WASTE

There was a total of 323,200 square feet of solid waste facilities, which included gross trucking services, freight and shuttle service elevators, and vehicular access. Solid waste management served approximately 10 million square feet of office space with tenant occupancy of 50,000 people.[1]

The waste containers were: four 42 CY compacted containers; two 32 CY containers; and two 22 CY containers.[2] The containers were used to collect dry waste, construction/renovation waste, wet waste and recycling. Each type of waste went through a process of sorting, compacting, interim storage, on-site movement, truck dock storage and off-site movement. Waste from the public plaza was also collected and moved to the truck docks.

The recycling program at the WTC won awards for its success, some of which included a Green Star Award in 1999 from the Environmental Action Coalition, and recognition at the

[1] The Port Authority of NY & NJ, *Downtown Restoration Program World Trade Center Complex Pre September 11 Conditions Final Draft*, March 21, 2003, Chapter 6 Traffic.

[2] The Port Authority of NY & NJ, *Draft Overview of Options for Goods Delivery and Waste Management Systems for the World Trade Center Site*, p.28.

Environmental Protection Agency (EPA) Environmental Expo in 1998.[1] The recycling program processed 20 tons per day.

Access and egress to the former WTC for trucks was restricted to Barclay Street. The trucks entered the sub-grade loading docks by ramp at 7 WTC. The number of spaces dedicated to trucks within the WTC complex was 64 on sublevel B1 and 53 on sublevel B2, for a total of 117 truck spaces.[2]

Some of the problems encountered with the solid waste facilities included the difficulty of large trucks accessing the site (due to height restrictions, and the lack of proper turning radii on the sub-grade levels); shipping waste (from deliveries) and unidentified dumping of waste at the truck docks; spillage of wet waste from the containers; freight elevators limited capacity and sensitivity to weather conditions; and lack of a dedicated wet waste area (for storage and cleaning of the containers).

130 Liberty Street utilized private haulers for disposal of solid waste and recycling.

The pre-September 11 estimates for solid waste generation are presented in Table 12-*12*.

Table 12-*12*
Solid Waste Generation—Pre-September 11[1]

	No. of Employees	Solid Waste Rate (pounds per week per employee)	Solid Waste (pounds per week)	Tons per week	Trucks
Office	40,400	13	525,200	263	19
Retail	1,051	79	83,029	42	3
Hotel	381	75	28,575	14	1
130 Liberty Street	5,600	13	72,800	36	3
TOTAL	47,432	N/A	745,233	355	26

Note: [1] For the purposes of this analysis, in lieu of existing pre-September 11 numbers, calculations are made with CEQR estimates.

N/A= Not Applicable for calculating the rate

ENERGY

Electricity, steam and gas were the types of energy used pre-September 11. All energy for the WTC complex was supplied by Con Edison. All electricity for the WTC complex was *supplied by Con Edison via eight dedicated high tension feeders from the World Trade Center Substation located at 7 WTC through a customer substation. The customer substation was controlled by the Port Authority and located in the northwest corner of the bathtub.* From this single-point interface with the local electricity grid, on-site distribution lines and several substations dispersed energy to the buildings and concourse levels of the WTC complex.

[1] Sponsored by the Port Authority, EPA, the New York Power Authority, and the Public Service Electric and Gas Company.

[2] The Port Authority of NY & NJ, *Downtown Restoration Program World Trade Center Complex Pre September 11 Conditions Final Draft*, March 21, 2003, Chapter 6 Traffic.

Electrical service was provided by Con Edison from eight dedicated primary feeders. The feeders came from the substation at *7 WTC. The Con Edison service was designed to maintain full electrical service to the WTC complex even with the loss of any two feeders.* The feeders were designed to lose any two feeders without shedding the entire electrical load.[1] The eight primary feeders were from the Con Edison service manholes at the property line, which were incased in concrete conduits that led to the Primary Distribution Center (PDC) sub-grade. The eight main service switchgear assemblies were used to distribute the electricity throughout the WTC complex, via "spot networks." The electrical service was metered by Con Edison at each of the eight main switchgear assembles. Office tenants were provided with a capacity of 10 watts per square foot.

Emergency electric service was provided via a diesel generator plant located on the WTC Site. The plant consisted of six diesel generators, which were river-water cooled. The generators were 1,250 kilowatts (kW) each and generated 480 volts. The emergency generators were to supply loads for stair and egress lighting, fire pumps, elevators, a fire alarm system and critical emergency operations such as the Operations Control Centers (OCCs). Also supplied by the emergency generator were river water, chilled water, and sump and ejector pumps. Standby electric service consisted of four diesel generators located on the roof of 5 WTC.

Steam that was used for heating was from Con Edison, delivered through a distribution main from under Greenwich Street. A steam main fed into the site on the three-utility rack. Domestic water and sanitary sewer mains also ran along this utility rack. The steam main was used for the HVAC system and domestic water heaters as well as a component of the fire suppression and humidification systems within the WTC complex.

Natural gas was supplied to the WTC complex buildings by Con Edison via *three* gas services. *The third service was installed in the Southwest Plaza Building. This was installed to serve the Vista Hotel.* The first service entered off Vesey Street, which was for the concourse restaurants. The second service was installed in the Southeast Plaza Building. This was installed for the Commodities Exchange.

The WTC cooling system used water from the Hudson River that was circulated through the central refrigeration plant. The air conditioning system in Towers 1 and 2 called for the cooling of 8 million cubic feet of air per minute for circulation, and this was accomplished through a sub-grade refrigeration plant. The refrigeration plant used *once-through, non-contact cooling water system* from the Hudson River to withdraw heat from the HVAC system. This type of system is referred to as a *once-through* system because the river water was drawn from and returned to the Hudson River through a *series* of pipes. The river water was brought through the pipes as in a conveyor, without direct contact to other elements in the refrigeration plant outside of the pipe walls. River water intake pipes drew and returned the water through pipes. The pipes ran below grade, east-west across Route 9A, to connect the river water to entry points in the slurry wall. The entry points to the WTC Site were located mid-block between Vesey and Liberty Streets on the east side of West Street. The pump house controlling these intakes was equipped with eight pumps and two emergency pumps. An emergency remote river water control, installed in 1993, allowed for the emergency diversion of water to distribution points.

[1] This is called *second* contingency.

The reuse of the existing Hudson River water intakes and outfalls is the most economical and efficient method to provide cooling for the components of the Proposed Action for a number of reasons. While the events of September 11 resulted in severe damage to infrastructure systems, the intakes, pumps, outfalls, and associated pipelines remained largely intact. Thus, it would be extremely cost-effective to rely on an already established and available infrastructure, since other cooling alternatives for individual office buildings, retail space, museum/cultural center and the PATH Terminal would be more costly and take up valuable development space within the Proposed Action. Other cooling alternatives would also significantly increase the consumption of potable water, which would jeopardize the goal of reducing potable water demands as stated in guidelines WEQ-1, Comprehensive Water Management Plan, and WEQ-3, Water Use Efficiency. In addition, since river water, on average, provides lower supply temperature than other alternatives, greater energy efficiency during the heat transfer process would be achieved. More detailed quantitative analysis of energy savings and costs of alternative cooling scenarios are ongoing.

130 Liberty Street received electricity, steam, and natural gas from Con Edison.

The pre-September 11 estimates for energy demands are presented in Table 12-*13*.

Table 12-*13*
Energy Generation—Pre-September 11[1]

	Square Footage	BTU Averages	2001 BTUs
Office	10,000,000	77,900	$7{,}790 \times 10^8$
Retail	350,000	55,800	195×10^8
Hotel	600,000	145,500	873×10^8
130 Liberty Street	1,400,000	77,900	$1{,}090 \times 10^8$
TOTAL	12,850,000	N/A	$9{,}948 \times 10^8$

Notes:
[1] For the purposes of this analysis, in lieu of existing pre-September 11 numbers, calculations are made with CEQR estimates.
N/A = Not Applicable for calculating the rate

TELECOMMUNICATIONS

Telephone and cable lines came into the WTC Site through major entry points along the perimeter of the WTC complex. The banks and casings remain intact and useable with the exception of a bank along the north side of the site. The telephone manholes and utilities are maintained by Empire City Subway, a subsidiary of Verizon. The telephone banks that remain may be rewired with a combination of telephone, cable or fiber optic lines.

130 Liberty Street had telephone and cable lines enter the building.

12.4.2 FUTURE WITHOUT THE PROPOSED ACTION 2009— PRE-SEPTEMBER 11 SCENARIO

Without the Proposed Action, a Pre-September 11 Scenario is theorized to still exist into the future, and that all utilities and infrastructure activities would be approximately identical to those in the pre-September 11 baseline conditions (see Table 12-14).

Table 12-14
Future Without the Proposed Action—Pre-September 11 Scenario 2009

	Water Supply and Sewage Generation (gallons per day)	Solid Waste (tons per week)	Energy (BTUs)
130 Liberty Street	*140,000*	*36*	*1,090 x 10^8*
WTC Site	*1,192,500*	*319*	*8,858 x 10^8*
TOTAL	*1,332,500*	*355*	*9,948 x 10^8*

12.4.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009— PRE-SEPTEMBER 11 SCENARIO

In 2009 it is assumed that the Memorial, *the Memorial Center*, and cultural facilities would be complete in the southwest quadrant of the WTC Site; Freedom Tower and the performing arts facility would be complete in the northwest quadrant; and on the northeast and southeast quadrants the retail uses would be complete. The sub-grade levels across the entire site would have been developed as well as the two surface streets, Fulton and Greenwich, and the open spaces.

WATER SUPPLY AND SEWAGE GENERATION

The water system for the Proposed Action will be comprised of a potable water supply brought in by mains running north-south through the site parallel to the No. 1/9 IRT subway line, along with a water main which will feed into the site via the three-utility rack that also carries parallel steam and sanitary sewer mains. The Proposed Action's water system will be similar to what existed on site pre-September 11.

Table 12-*15* outlines the potential water usage and sewage generation in 2009 as well as a 30 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

Table 12-15
Water Supply and Sewage Generation of the Proposed Action in 2009

	Square Footage	No. of Employees	Rate (gpd)	Total (gpd)	With 30% Reduction[1] (gpd)
Office	N/A	10,400	25 gpd/person	260,000	182,000
Retail	1,000,000	N/A	0.17 gpd/sf	170,000	119,000
Memorial Interpretive Center, Memorial Center and Cultural Facilities (Institutional)	380,000	N/A	0.17 gpd/sf	64,600	64,600
Performing Arts Center	2,200 seats	N/A	5 gpd/seat	11,000	11,000
Memorial	*212,200*	N/A	0.17 gpd/sf	*36,074*	*36,074*
Memorial Pools	*N/A*	*N/A*	*N/A*	*4,500*[2]	*4,500*
TOTAL	N/A	N/A	N/A	*546,174*	*417,174*

Notes:

1 Currently the *Sustainable Design Guidelines* water reduction of 30 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of those elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.

2 *The Memorial pools would require approximately 310,000 gallons to begin operation. With an evaporation loss of 110 gallons per hour, the curtains of water and pools would require an additional 2,640 gallons per day to maintain the amount of water needed for continuous use. Assuming replenishment of both pools twice a year, the total average water requirements would be approximately 4,500 gallons per day.*

COMPARISON OF PROBABLE IMPACTS

Water usage and sewage generation would be less in 2009 with the adoption of the sustainable design measures. A goal of reducing potable water consumption by 30 percent as compared to a baseline building (as per the 1992 Energy Policy Act) would encourage the maximization of water efficiency and reduce energy usage as well as demand on the city's water supply. When comparing the pre-September 11 demand, the 2009 analysis without the 30 percent reduction is also smaller. Part of this reduction can be attributed to less office space and fewer employees.

As part of the Comprehensive Resource Management Plan from the *Sustainable Design Guidelines*, a comprehensive water management plan would help to maximize the reuse of sewage and potable water. By coordinating these actions, water efficiency increases while the demand for potable water correspondingly decreases. Green infrastructure on the Project Site, in the form of landscaping and planting vegetation that requires less irrigation or that can be sustained by rainfall also can greatly reduce the consumption of potable water. Reusing stormwater and potable water for maintaining vegetation not only conserves water resources, but also minimizes impacts on the city's combined sewer system. Other sustainable design measures include using energy efficient water fixtures, automatic controls and waterless urinals in the buildings. Similar to the policy suggested for solid waste, by requiring tenant end-use metering, the incentive to conserve water resources is potentially greater.

As discussed in Section 12.3.3, while the events of September 11 resulted in severe damage to infrastructure systems, the intakes, pumps, outfalls, and associated pipelines remained largely intact. Thus, it would be appropriate to rely on already established and available infrastructure, rather than other cooling alternatives, such as traditional cooling towers with refrigeration plants for individual office buildings, retail space, Memorial/cultural uses and the PATH Terminal, which would be less cost-effective and environmentally sound. Other cooling

alternatives would also significantly increase the consumption of potable water, which would jeopardize the goal of reducing potable water demands. In addition, since river water, on average, provides lower supply temperature than other alternatives, greater energy efficiency during the heat transfer process would be achieved.

STORMWATER

The comprehensive water management plan would also maximize the reuse of stormwater. Stormwater can be captured on the Project Site and treated to be reclaimed and used for landscaping, flushing toilets, cooling tower makeup, and vehicle maintenance. Not only does the reuse of stormwater reduce the need for potable water, it also reduces impacts on the city's combined sewage system and WPCP, as there is also a reduction in the amount of potable water needed to convey the stormwater and sewage.

To decrease stormwater runoff, Project Site landscaping, permeable paving materials, and green roofs can help slow the stormwater from entering the sewers and potentially stop the overflow mechanism from engaging. These options also help to naturally filter the water, therefore requiring less mechanical filtration. Additionally, capturing the stormwater off of the buildings from high elevations can reduce the need for water pumps (and the associated energy required). By treating stormwater at the capture point, the higher floors may take advantage of the reclaimed water.

Although the Proposed Action could result in the discharge of stormwater during heavy rain events and involves construction of more than one acre, a state pollutant discharge elimination system (SPDES) general permit for construction would not be required. Stormwater runoff from impervious surfaces at the Project Site would be directed to municipal sewer catch basins. The project area is serviced by combined sewers, as opposed to municipal storm sewers, thus stormwater would be directed to the municipal wastewater treatment facility prior to discharging to surface water bodies. The Port Authority, in conjunction with federal, state, and city regulatory agencies, would develop measures to minimize temporary impacts from stormwater and implement these measures during construction.

As part of the Sustainable Design Guidelines, stormwater on the Project Site (excluding the public streets of Greenwich and Fulton) will be captured and reused in a greywater system. The greywater system, as part of the WEQ-3 Water Use Efficiency, will treat and re-circulate the water for non-potable water usage such as toilet flushing, vehicle maintenance, and irrigation needs.

The table above includes a minimum reduction of 30 percent in water usage and sewage generation. While the Sustainable Design Guidelines propose a 30 percent reduction, it is believed that a reduction of up to approximately 85 percent of the annual rainfall flowing directly into the sewer system and CSO can be achieved through the greywater system. Consideration in the design of ledges, roofs and setbacks will be made to facilitate the capture of stormwater off buildings. In addition, stormwater will be captured (possibly through subterranean structures) from the pervious and impervious surface areas of the Project Site without buildings.

For the new Greenwich and Fulton Streets that bisect the Project Site, the capture of stormwater runoff will be achieved via sewer drainage catch basins. As a Best Management Practice, an oil/water separator would be used to filter the stormwater runoff before it flows

into the main trunk line connected to the sewer system and the CSO. The oil/water separator will periodically be replaced to ensure the effective filtration of stormwater. The final engineering plans would determine the layout of the drainage basins and the oil/water separator or equivalent measures to prevent non-point discharge to the sewer system.

While the greywater system is expected to be designed to capture typical volumes of stormwater from the site, severe storm events may result in rainfall that would exceed the system's ability to capture all stormwater on site. In such cases, discharges to the sewer system may occur.

SOLID WASTE

The sub-grade levels of the Proposed Action include centralized solid waste facilities, similar in form to the pre-September 11 facilities (i.e., trucking services, freight and shuttle elevators, vehicular access, and containers). Table 12-16 outlines the potential solid waste generation in 2009.

Table 12-16
Solid Waste Generation of the Proposed Action in 2009

	No. of Employees	Solid Waste Rate (pounds per week per employee)	Solid Waste (pounds per week)	Tons per week	Trucks
Office	10,400	13	135,200	68	5
Retail	3,000	79	237,000	119	9
Memorial *(all elements) and* Cultural Facilities (Institutional)	430	451	194,000	97	7
Performing Arts Center (2,200 seats)	169	79	13,351	7	1
TOTAL	13,999	N/A	579,551	291	22
N/A= Not Applicable for calculating the rate					

SOLID WASTE COMPARISON

Recycling will also make a difference when solid waste leaves the Project Site. Recycling facilities are expected for each of the various elements that constitute the Project Site, in the form of recycling receptacles that are alongside traditional solid waste receptacles as well as more centralized facilities for office and retail recycling needs. While the extent of recycling is yet to be determined (as the City of New York is currently exploring the expansion of recycling), Table 12-17 summarizes the future percentage estimates for recycling of various materials.

Table 12-17
Estimates for Recycling Volumes[1]

	Generation ratio (CY/1000 square feet/day)	Non-recoverable	Paper	Glass	Cardboard	Plastic	Metal
Retail	0.2616	20%	8%	4%	36%	24%	8%
Office	0.0393	30%	50%	5%	6%	3%	6%
Hotel	0.1218	50%	10%	10%	15%	10%	5%
Memorial	0.2616	70%	5%	6%	5%	10%	4%

Note: [1] Table from The Port Authority of NY & NJ, *Draft Overview of Options for Goods Delivery and Waste Management Systems for the World Trade Center Site*, p.34.

As the previous WTC complex was award-winning for its recycling program, it is expected that the Proposed Action will meet, if not surpass, the volumes of recycling which will reduce the amount of solid waste headed for landfills.

There are a variety of policies and options that would make solid waste management more environmentally sound in 2009. The strategies to achieve a reduction in the amount of waste, as well as better handling of waste, require both tenant and management cooperation. Technology also plays a role in the ability to improve on collection and disposal. Green measures can diminish many negative environmental effects on the surrounding Project Site. Green measures can, over the long run, reduce maintenance needs, replacement costs and improve overall solid waste management. The benefits of these measures extend beyond the Project Site itself to Lower Manhattan, and the region as a whole. Some of the most effective green measure policies are outlined below.

The initial step in establishing comprehensive green measures is to create a comprehensive material management plan that can be incorporated in the contracts with the building management. This plan can help monitor progress and determine how to improve efficiency and reduce associated solid waste management costs. To further a more efficient waste management system, solid waste collection and recovery of recyclables should be centralized in such a way as to create economies of scale, and still meet the potentially diverse requirements of the tenants. Recycling facilities would consist of sorting and separating areas for paper, cardboard, glass, plastic, and metal. These policies and green measures can significantly reduce the amount of waste generated. However, there is no quantifiable measure available at this time.

ENERGY

The below-grade levels of the Proposed Action include energy facilities, similar in form to the pre-September 11 facilities (i.e., electrical systems, gas and steam services). Table 12-18 outlines the potential energy usage in 2009 as well as a 20 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

Table 12-18
Energy Consumption of the Proposed Action in 2009

	Square Footage	BTU Averages	2009 BTUs	With a 20% Reduction[1]
Office	2,600,000	77,900	2,025 x10^8	1,620 x10^8
Retail	1,000,000	55,800	558 x10^8	446 x10^8
Memorial Center and Cultural Facilities (Institutional)	380,000	70,850	269 x10^8	269 x10^8
Performing Arts Center	200,000	65,300	131 x10^8	131 x10^8
Memorial	*212,200*	57,500	*122* x10^8	*122* x10^8
Memorial Pools[2]	*N/A*	*N/A*	*96 x 10^8*	*96 x 10^8*
TOTAL	*4,392,200*	N/A	*3,201x 10^8*	*2,684 x 10^8*

Notes:

1 Currently the *Sustainable Design Guidelines* water reduction of 20 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of these elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.

2 Using preliminary design estimates, the Memorial Pools are estimated to require 320 kilowatts per hour. It is expected that the Memorial Pools would run 24 hours per day, 365 days per year.

N/A = Not Applicable for calculating the rate

ENERGY COMPARISON

Energy usage would be less in 2009 with the adoption of green measures. A goal of reducing energy consumption by 20 percent would encourage the energy conservation as well as reduce demand on the city's power supply. When using the green measure of a 20 percent reduction, the increase in energy usage is significantly less as compared to the pre-September 11 levels. When comparing the pre-September demand, the 2009 analysis without the 20 percent reduction is also smaller. Part of this reduction can be attributed to less office space and fewer employees.

In order to reduce the energy needed for daily operations of buildings on the Project Site, a comprehensive energy management plan can help to achieve energy efficiency that results in not only environmental savings, but cost savings as well. The plan may include an energy use budget that measures energy consumption by usage category (e.g., heating, cooling, fan, pump, lighting, etc.) on a yearly basis. The plan may also measure on-site renewable energy generation.

A fully integrated Building Management System (BMS) can effectively track energy utilization as well as maintenance requirements. Part of the comprehensive energy management plan would be to recognize renewable energy sources and the flexibility of the energy infrastructure to transition to future renewable technologies as they become less cost prohibitive.

Consideration of the optimization of building performance can help to moderate peak power loads and increase energy conservation. The building performance is dependent upon both the architecture and the mechanical elements of the Proposed Action. Maximizing daylight penetration into the buildings, along with energy efficient windows, can greatly reduce the lighting and heating/cooling needed.[1] Additionally individual tenant build out within the office

[1] Occupancy sensors can save on energy use by turning off lights when a room has been vacant for 6 minutes. In addition polymer films on thermal-paned windows can utilize natural light and repel

towers can also effect energy consumption. That is, office floor configuration and types of materials used, can effect energy consumption.[1] Using end-user metering for energy consumption can encourage tenants to control and conserve this resource.[2]

By using green building techniques, energy consumption can be reduced. Buildings that have insulation systems, or "tight envelopes" help to prevent the mechanically cooled or heated air from escaping. To reduce "heat island effect" the use of high albedo surfaces helps to decrease thermal loading of the surfaces of the Project Site and the roofs of the buildings. Using roofing that is in compliance with ENERGY STAR® would help to reduce heat island effect as well as help insulate buildings.

Annual review of the energy management plan can help to assess the budgets for each energy component, and tailor future strategies to coordinate the conservation of energy throughout the entire site.

The estimates in Table 12-18 from the CEQR Technical Manual are based on *standard rates derived from older, traditional cooling tower systems.*

Estimates based upon current technology used for similar applications indicates that the existing central refrigeration plant cooling system would require approximately 1,350,000 fewer kilowatts per hour (kwh) per year than the traditional cooling tower system.

The existing Hudson River intake and central chiller system would require less space on the WTC Site. This is an important consideration given the complexity of uses and scarcity of space within the sub-grade areas of the Project Site. Without the Hudson River intake and central chiller system, individual cooling towers would be required in each building on the Project Site. Each of the cooling towers would require approximately 24,000 square feet and a height of 65 feet in each building. The increase in building height to accommodate such structures would, result in potential shadow and urban design impacts in addition to the utility needs described in this chapter.

More detailed quantitative analyses of the energy savings and economics of alternative cooling scenarios are continuing as design proceeds. A comparison of cooling systems is presented in Chapter 23, "Alternatives."

Wind Turbines

The Proposed Action includes on-site power generation from wind turbines. Wind power has been utilized for centuries through applications such as milling, and has more recently been employed for both large and small scale power generation *as wind is a renewable, combustion-free electricity source*.

With widespread use, wind power can play an important role in reducing emissions and reliance on fossil fuel. Wind turbines are typically designed to operate at a constant speed under a range

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ultraviolet and infrared rays (which keeps the buildings cooler in summer and warmer in winters). This translates to a reduction of unwanted heat which will allow for smaller HVAC systems, thus making the buildings more energy efficient.

[1] For example, having the work spaces away from natural light sources, requires more lighting.

[2] That is, tenants have the ability to adjust thermal comfort for seasonal changes which is incorporated into the HVAC system and can be monitored with the overall comprehensive energy management plan.

of wind conditions, with integrated computerized control modules that control the orientation and blade pitch to optimize power output with changes in wind speed and direction. Four main components are present in any wind turbine apparatus: rotor, transmission system, generator and control system. These elements convert the kinetic energy of wind into electricity. The turbines would be driven by the wind, and as such would not present any impacts to the surrounding air such as thrust or suction.

Wind power is considered to be extremely reliable provided sufficient winds are blowing. Design features would be incorporated to ensure dependable and safe operation. These would include materials selection to reduce accretion of ice in cold weather. The apparatus would be designed for low noise. Technological progress in turbine design has made modern turbines much quieter. The impact of bird strikes on the ecological community and on the mechanical operation of the turbines would also be considered. Many other forms of energy production also have adverse effects on birds. For example certain hydroelectric plants are located in sensitive bird habitats. Reliance on fossil fuel has brought harm to bird habitats from oil spills and mining practices. Wind power contributions present significant environmental benefits through the production of clean energy from a renewable and abundant resource.

The Proposed Action would include wind turbines located on the Freedom Tower at a higher altitude than surrounding buildings, presenting an opportunity for unobstructed wind power generation in an urban environment. The top of the Freedom Tower will be comprised of a lacy system of tension cables that form the perimeter of the building's top. This unoccupied, open air structure will house the wind turbines. While the design of the wind turbines has yet to be finalized, preliminary designs consist of 25 turbines above the 70th floor of the Tower, at a height of 1,150 feet.

The height and location of the Freedom Tower at the confluence of the Hudson and East Rivers is expected to allow the wind turbines to generate electricity for a large percentage of the time (at levels of at least 95 percent). Electricity produced by the turbines would be measured using demand and consumption metering and transmitted to the electricity grid utilized within the Freedom Tower, reducing the net draw of electricity for the overall site.

Sustainable Design Measures for Mechanical Infrastructure

Efficiency of the other types of infrastructure correlates to higher efficiency for the mechanical infrastructure. That is, more efficient building structures, with less usage of heating and cooling by design, translates into smaller HVAC systems[1] that use less energy. Monitoring IAQ also contributes to the most efficient use of ventilation equipment. An IAQ monitoring system can track both IAQ (and any potential contaminants) within the buildings as well as monitor the filtration media of the HVAC systems, rather than relying on annual testing (as required by NYS EO 111).

The BMS can help to monitor consumption and help to establish a maintenance plan to ensure mechanical equipment efficiency.

[1] Specifically, HVAC systems that do not use CFC refrigerants.

With regards to allowing tenants control of heating and cooling, the mechanical HVAC systems should be designed to accommodate part-load cooling conditions in order to maintain balanced dehumidification levels[1].

TELECOMMUNICATIONS

In 2009, the WTC Site would have telecommunications needs ranging from telephone service to cable and internet access. In addition to communications needs, many financial businesses common in Lower Manhattan rely on their telecommunications networks for instantaneous information feeds both into and out of their office facilities. The slurry wall access points and manhole facilities remain largely intact, and many of these facilities have already undergone restoration or rewiring in anticipation of new tenants' telecommunication needs. Advanced technology, such as fiber optic cable, allows a larger amount of information and more customers to be served through a thinner cable. It is expected that the existing manholes accesses and slurry wall entry points would accommodate the needs of future tenants on the WTC Site as development progresses throughout the Proposed Action.

12.4.4 FUTURE WITHOUT THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO

Under this scenario, all utilities and infrastructure activities would be approximately identical to those in the pre-September 11 baseline conditions except new buildings at 140 Liberty Street. Table 12-*19* shows projected infrastructure usage in this scenario.

Table 12-*19*
Future Without the Proposed Action—Pre-September 11 Scenario 2015

	Water Supply and Sewage Generation (gallons per day)	Solid Waste (tons per week)	Energy (BTUs)
130 Liberty Street	140,000	36	$1,090 \times 10^8$
140 Liberty Street	50,000	13	389×10^8
WTC Site	1,192,500	319	$8,858 \times 10^8$
TOTAL	*1,382,500*	*368*	*$10,337 \times 10^8$*

12.4.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO

By 2015 the redevelopment of the Project Site would be complete. The office space within five towers and a hotel would be completed. All other development would be as described in section 12.4.3 under 2009.

WATER SUPPLY AND SANITARY SEWAGE

It is estimated that the water supply demands of the Proposed Action *would be considerably lower than waste usage and sewage generation* in the pre-September 11 WTC complex *due to the greywater system that would recapture the stormwater from the site and re-use the stormwater in low-flow fixtures.*

[1] See IEQ-8 of the *Sustainable Design Guidelines*.

It is also expected that the same entry points to the municipal system from the site would be utilized as in the pre-September 11 WTC complex. As preliminary engineering progresses, it may be found that an increase in sanitary sewage is presented with the increased retail and cultural space.

Table 12-*20* outlines the potential water usage and sewage generation in 2015 as well as a 30 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines.*

WATER SUPPLY AND SEWAGE GENERATION COMPARISON

Water usage and sewage generation would be less in 2015 with the adoption of green measures. A goal of reducing potable water consumption by 30 percent as compared to a baseline building (as per 1992 Energy Policy Act) would encourage the maximization of water efficiency and reduce energy usage as well as demands on the city's water supply.

Table 12-*20*
Water Supply and Sewage Generation of the Proposed Action in 2015

	Square Footage	No. of Employees	Rate (gpd)	Total (gpd)	With 30% Reduction[1] (gpd)
Office	N/A	40,000	25 gpd/person	1,000,000	700,000
Retail	1,000,000	N/A	0.17 gpd/sf	170,000	119,000
Memorial Center and Cultural Facilities (Institutional)	380,000	N/A	0.17 gpd/sf	64,600	64,600
Performing Arts Center	2,200 seats	N/A	5 gpd/seat	11,000	11,000
Hotel	800 rooms	N/A	150/gpd/rm/occupant	120,000	84,000
Hotel Function Space	150,000	N/A	0.17 gpd/sf	25,500	17,850
Memorial	*212,200*	N/A	0.17 gpd/sf	*36,074*	*36,074*
Memorial Pools	*N/A*	*N/A*	*N/A*	*4,500*[2]	*4,500*
TOTAL	N/A	N/A	N/A	*1,434,314*	*1,037,024*

Notes:

[1] Currently the *Sustainable Design Guidelines* water reduction of 30 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of those elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted.

[2] *The Memorial pools would require approximately 310,000 gallons to begin operation. With an evaporation loss of 110 gallons per hour, the curtains of water and pools would require an additional 2,640 gallons per day to maintain the amount of water needed for continuous use. Assuming replenishment of both pools twice a year, the total average water requirements would be approximately 4,500 gallons per day.*

The reuse of the existing Hudson River water intakes and outfalls is proposed for re-use for a number of reasons, including economy and efficiency in providing cooling for the components of the Proposed Action. While the events of September 11 resulted in severe damage to infrastructure systems, the intakes, pumps, outfalls, and associated pipelines that conveyed Hudson River water as part of the site's pre-September 11 cooling system remained largely intact. Thus, it would be appropriate to rely on already established and available infrastructure, rather than other cooling alternatives such as traditional cooling towers with refrigeration plants for individual office buildings, retail space, Memorial/cultural uses and the PATH Terminal. Other cooling alternatives, which are less cost-effective and environmentally sound, would significantly increase the consumption of potable water, jeopardizing the goal of reducing potable water demands. River water, on average, provides lower supply temperature than other alternatives, and greater energy efficiency during the heat transfer process.

STORMWATER

Construction of the Proposed Action would not be expected to result in any adverse impacts on surface water quality. Runoff from the construction site will be controlled in accordance with "New York Standards and Specifications for Erosion and Sediment Control" developed by the Empire State Chapter of the Soil and Water Conservation Society (see Chapter 21, "Construction Impacts").

Although the Proposed Action could result in the discharge of stormwater during heavy rain events and involves construction of more than one acre, a state pollutant discharge elimination system (SPDES) general permit for construction would not be required. Stormwater runoff from impervious surfaces at the Project Site would be directed to municipal sewer catch basins. The project area is serviced by combined sewers, as opposed to municipal storm sewers, thus stormwater would be directed to the municipal wastewater treatment facility prior to discharging to surface water bodies. The Port Authority, in conjunction with federal, state, and city regulatory agencies, would develop measures to minimize temporary impacts from stormwater and implement these measures during construction.

As part of the Sustainable Design Guidelines, stormwater on the Project Site (excluding the public streets of Greenwich and Fulton) will be captured and reused in a greywater system. The greywater system, as part of the WEQ-3 Water Use Efficiency, will treat and re-circulate the water for non-potable water usage such as toilet flushing, vehicle maintenance, and irrigation needs.

The table above includes a minimum reduction of 30 percent in water usage and sewage generation. While the Sustainable Design Guidelines propose a 30 percent reduction, it is believed that a reduction of up to approximately 85 percent of the annual rainfall flowing directly into the sewer system and CSO can be achieved through the greywater system. Consideration in the design of ledges, roofs and setbacks will be made to facilitate the capture of stormwater off buildings. In addition, stormwater will be captured (possibly through subterranean structures) from the pervious and impervious surfaces areas of the Project Site without buildings.

For the new Greenwich and Fulton Streets that bisect the Project Site, the capture of stormwater runoff will be achieved via sewer drainage catch basins. As a Best Management Practice, an oil/water separator would be used to filter the stormwater runoff before it flows into the main trunk line connected to the sewer system and the CSO. The oil/water separator will periodically be replaced to ensure the effective filtration of stormwater. The final engineering plans would determine the layout of the drainage basins and the oil/water separator or equivalent measures to prevent non-point discharge to the sewer system.

While the greywater system is expected to be designed to capture typical volumes of stormwater from the site, severe storm events may result in rainfall that would exceed the system's ability to capture all stormwater on site. In such cases, discharges to the sewer system may occur.

SOLID WASTE

The solid waste facilities (discussed in section 12.5.3) would be in full capacity operation by 2015.

Estimations of waste collection per week are projected to result in 533 tons of waste. The waste is comprised of both recyclable material and non-recoverable, organic waste.

The total collection is projected for the entire Project Site. Table 12-2*1* outlines the potential solid waste generation in 2015.

SOLID WASTE COMPARISON

Solid waste generation would be less in 2015 with the adoption of green measures such as recycling. The conservative estimates for 2015 as compared with pre-September 11 indicate an increase in the amount of solid waste generated. However, it is anticipated that policies and options of the materials management plan (under the Comprehensive Resource Management Plan) would make solid waste management more environmentally sound in the 2015. It is anticipated that solid waste management practices would be in place in 2015 that would result in less solid waste generated than pre-September 11.

Table 12-*2*1
Solid Waste Generation of the Proposed Action in 2015

	No. of Employees	Solid Waste Rate (pounds per week per employee)	Solid Waste (pounds per week)	Tons per week	Trucks
Office	40,000	13	520,000	260	19
Retail	3,000	79	237,000	119	9
Memorial *(all elements) and* Cultural Facilities (Institutional)	430	451	194,000	97	7
Performing Arts Center	169	79	13,351	7	1
Hotel and Function Space	381	75	28,575	14	1
TOTAL	*43,980*	N/A	*992,926*	*497*	*37*
Note: N/A= Not Applicable for calculating the rate					

ENERGY

The energy demands of the Proposed Action are anticipated to be comparable to those in the former WTC complex. As the preliminary engineering progresses, it may be found that an increase in some energy needs is presented with the increased retail and cultural space. However, this potential increase in energy needs is expected to be offset by a reduced per-square-foot energy draw for typical office space due to increased technological efficiency.

Changes or impacts anticipated under this scenario are the energy facilities (see section 12.4.3) would be in full capacity operation by 2015.

Estimations of energy consumption per year are projected using estimates from the *CEQR Technical Manual*. Energy usage is projected for the entire Project Site. Table 12-*21* outlines the potential energy usage in 2015 as well as a 20 percent reduction in usage, as prescribed by the *Sustainable Design Guidelines*.

Table 12-*22*
Energy Consumption of the Proposed Action in 2015

	Square Footage	BTU Averages	2015 BTUs	With 20% Reduction[1]
Office	10,000,000	77,900	$7{,}790 \times 10^8$	$6{,}232 \times 10^8$
Retail	1,000,000	55,800	558×10^8	446×10^8
Memorial Center, and Cultural Facilities (Institutional)	380,000	70,850	269×10^8	269×10^8
Performing Arts Center	200,000	65,300	131×10^8	131×10^8
Hotel	600,000	145,500	873×10^8	698×10^8
Hotel Function Space	150,000	65,300	98×10^8	78×10^8
Memorial	*212,200*	57,500	*122* $\times 10^8$	*122* $\times 10^8$
Memorial Pools[2]	*N/A*	*N/A*	*96 x* 10^8	*96 x* 10^8
TOTAL	*12,542,200*	N/A	*9,937 x* 10^8	*8,072 x* 10^8

Notes:

1 Currently the *Sustainable Design Guidelines* water reduction of 20 percent applies only to commercial space. Future application of similar green measures to the cultural and Memorial uses will be made upon design of these elements. For this reason, it is not possible to ascribe reduction rates to these elements of the Proposed Action. The conservative calculations for these elements of the Proposed Action are therefore substituted. The office tower at Site 26, while located on the Project Site, is not part of the Proposed Action.

2 Using preliminary design estimates, the Memorial Pools are estimated to require 320 kilowatts per hour. It is expected that the Memorial Pools would run 24 hours per day, 365 days per year.

N/A = Not Applicable for calculating the rate

ENERGY COMPARISON

Energy usage would be less in 2015 with the adoption of green measures. A goal of reducing energy consumption by 20 percent would encourage the energy conservation as well as reduce demand on the city's power supply. When using the green measure of a 20 percent reduction, the increase in energy usage is less as compared to the pre-September 11 levels. When comparing the pre-September demand, the 2009 analysis without the 20 percent reduction is also smaller. Part of this reduction can be attributed to less office space and fewer employees.

The reuse of the existing Hudson River water intakes and outfalls is the most economical and efficient method to provide cooling for the components of the Proposed Action for a number of reasons. While the events of September 11 resulted in severe damage to infrastructure systems, the intakes, pumps, outfalls, and associated pipelines remained largely intact. Thus, it would be appropriate to rely on already established and available infrastructure, rather than other cooling alternatives such as traditional cooling towers with refrigeration plants for individual office buildings, retail space, Memorial/cultural uses and the PATH Terminal, which would be less cost-effective and environmentally sound. Other cooling alternatives would also substantially increase the consumption of potable water, which would run contrary to the goal of reducing potable water demands.

The estimates in the table above are based on the CEQR Technical Manual. As discussed in Section 12.3.3., a more accurate estimate based upon current technology estimates that the existing central refrigeration plant cooling system would require approximately 1,350,000 fewer kilowatts per hour (kwh) per year than the traditional cooling tower system.

The existing Hudson River intake and central chiller system would require less space on the WTC Site, an important consideration given the complexity of uses and competition for the limited space within the sub-grade areas of the Project Site. Individual cooling towers would be required in each building for the Proposed Action, each requiring approximately 24,000 square feet and 65 feet in each building, resulting in potential shadow and urban design impacts in addition to the utility needs described in this chapter.

More detailed quantitative analysis of energy savings and costs of alternative cooling scenarios are ongoing. A comparison of the two cooling systems is also described in Chapter 23, "Alternatives."

TELECOMMUNICATIONS

In 2015, the fully redeveloped Project Site would have telecommunications needs ranging from telephone service to cable and internet access. In addition to communications needs, many financial businesses common in Lower Manhattan rely on their telecommunications networks for instantaneous information feeds both into and out of their office facilities. The slurry wall access points and manhole facilities remain largely intact, and many of these facilities have already undergone restoration or rewiring in anticipation of new tenants' telecommunication needs. Advanced technology, such as fiber optic cable, allows a larger amount of information and more customers to be served through a thinner cable. It is expected that the existing manholes accesses and slurry wall entry points would accommodate the needs of future tenants on the WTC Site after completion of the Proposed Action.

12.4.6 INFRASTRUCTURE TOTALS FOR PRE-SEPTEMBER 11 SCENARIO

Total infrastructure usage for the Pre-September 11 Scenario with and without the Proposed Action in the two analysis years is shown in Table 12-2*3*.

Table 12-*2*3
Totals for Pre-September 11 Scenario

	2009 Without the Proposed Action	2009 With the Proposed Action	2009 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)	2015 Without the Proposed Action	2015 With the Proposed Action[1]	2015 With the Proposed Action (With *Sustainable Design Guidelines* Reduction)
Water Supply and Sewage Generation in gallons per day (gpd)	1,332,500	*546,174*	*417,174*	*1,382,500*	*1,434,314*	*1,037,024*
Solid Waste in tons per week	355	291	No specific total reduction*	*368*	*497*	No specific total reduction*
Energy in British Thermal Units (BTUs)	9,948 x 10^8	*3,021 x 10^8*	*2,684 x 10^8*	*10,337 x 10^8*	*9,937 x 10^8*	*8,072 x 10^8*

Notes: [1] While there are anticipated solid waste reductions with the implementation of the *Sustainable Design Guidelines*, there is no quantifiable measure for such reductions at this time.

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