Draft Project Impact Report

Boston Medical Center
Energy Facility

March 22, 2010

Submitted To:
Boston Redevelopment Authority
One City Hall Square
Boston, MA 02201

Submitted pursuant to Article 80 of the Boston Zoning Code

Submitted by:
Boston Medical Center Corporation
One Boston Medical Center Place
Boston, MA 02118

Prepared By:
RFWalsh collaborative partners
51 Sleeper Street
Boston, MA 02210

In association with:
Tsoi/Kobus & Associates
Vanderweil Engineers
Oak Engineers
Howard/Stein-Hudson
Rubin and Rudman LLP
Epsilon Associates, Inc.
Haley and Aldrich

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Section 1.0

1.0 SUMMARY & PROJECT DESCRIPTION

1.1 Project Identification

Project Name:	Energy Facility
Address/Location:	The proposed Energy Facility location is adjacent to the existing Power Plant building at 750 Albany Street at Boston University Medical Center.
Proponent:	Boston Medical Center Corporation One Boston Medical Center Place Boston, MA 02118 (617) 638-6909 Ronald E. Bartlett, Vice President for Finance and Chief Financial Officer
Project Manager:	RFWalsh collaborative partners 51 Sleeper Street, 8th Floor Boston, MA 02210 (617) 778-0900 Jack C. Hobbs, FAIA, President and CEO Donna M. Camiolo, Project Executive
Architect:	Tsoi/Kobus & Associates, Inc. One Brattle Square P.O. Box 9114 Cambridge, MA 02138 (617) 475-4000 Greg Luongo, AIA, Principal
MEP Engineer:	Vanderweil Engineers, LLP 274 Summer Street Boston, MA 02210 (617) 423-7423 Garen H. Demirchian, P.E.
Civil Engineer:	Oak Engineers 40 Merrimac Street, #R Newburyport, MA 01950 (978) 465-9877 Sean Malone, P.E.
Geotechnical Consultant:	Haley and Aldrich, Inc. 465 Medford Street, Suite 2200 Boston, MA 02129 (617) 886-7400 Mark Balfe, P.E.

Transportation Consultant:	Howard/Stein-Hudson, Inc. 38 Chauncy Street, 9th Floor Boston, MA 02111 (617) 482-7080 Jane Howard, Principal
Legal Counsel:	Rubin and Rudman LLP 50 Rowes Wharf Boston, MA 02110 (617) 330-7000 James H. Greene, Attorney
Air Quality and Noise Consultant:	Epsilon Associates, Inc. 3 Clock Tower Place, #250 Maynard, MA 01754 (978) 897-7100 Victoria Fletcher, Principal

1.2 Introduction

1.2.1 Boston University Medical Center

Boston Medical Center ("BMC") is a part of the Boston University Medical Center along with Boston University Medical Campus ("BU Medical Campus"). Boston Medical Center Corporation (the "Proponent") is pleased to submit this Draft Project Impact Report ("DPIR") in response to the Boston Redevelopment Authority ("BRA") Scoping Determination dated 11/16/09 in accordance with Article 80 Large Project Review process for the proposed Energy Facility ("Project"). This is pursuant to Section 80B of the Boston Zoning Code ("Code"). The Proponent respectfully requests that the BRA, in the Preliminary Adequacy Determination for such DPIR, waive further review, if, after reviewing the DPIR and the public comments, the BRA finds that such DPIR adequately describes the proposed Project's impacts. This is pursuant to Section 80B-5.4(c)(iv) of the Code.

On May 18, 2000, the BRA approved the existing Boston University Medical Center IMP. Since that time, IMP amendments, Notices of Project Change ("NPC") and proposals for small additions have been filed to obtain approval for new construction or rehabilitation projects, or to revise and update uses as previously reported. The most significant of these include: the rehabilitation of the 66,952 s.f. Surgical Building (May 2001 IMP Amendment); the replacement of the approved Medical Services Center with the 133,217 s.f. Moakley Building (July 2003 NPC); and the approximately 245,000 s.f. new Shapiro Ambulatory Care Center (August 2007 IMP Amendment). Most recently, the BRA approved the IMP Renewal (June 2009) extending the term for 2 years including an Amendment for a minor 845 s.f. expansion to the Emergency Department. Additionally, the BRA approved the IMP

Amendment (January 2010) for the addition of the Albany Fellows Site and Graduate Student Housing Project.

BMC was incorporated as a Massachusetts charitable corporation July 1, 1996 with the merger of Boston City Hospital, Boston Specialty & Rehabilitation Hospital, and the Boston University Medical Center Hospital, referred to as University Hospital. BMC is a private, not-for-profit, 626-licensed bed, academic medical center located in Boston's historic South End. The hospital is the primary teaching affiliate for Boston University School of Medicine. Emphasizing community-based care, BMC, with its mission to provide consistently accessible health services to all, is the largest safety net hospital in New England. BMC provides a full spectrum of pediatric and adult care services, from primary to family medicine to advanced specialty care.

With the largest 24-hour Level 1 trauma center in New England, the Emergency Department had more than 129,169 visits in 2008. With 29,411 admissions and 953,510 patient visits in 2008, BMC provides a comprehensive range of inpatient, clinical and diagnostic services in more than 70 areas of medical specialties and subspecialties. In Fiscal Year 2008, the BMC operating budget was $1 billion.

The mission of BMC is "to provide consistently excellent and accessible health services to all in need of care regardless of status and ability to pay." The objective of BMC is to meet the health needs of the people of Boston and its surrounding communities by providing high quality, comprehensive care to all, particularly mindful of the needs of the vulnerable populations through an integrated delivery system, in an ethically and financially responsible manner. The goals of the integrated system of care are to promote health and well being, meet the medical and public health needs of all served, and educate future physicians and caregivers.

1.2.2 Project Summary

BMC is proposing to build a new combined heat and power energy facility based on three core energy delivery concepts: reliability, efficiency, and reduced environmental impact. The new 48,000 s.f. facility will use state-of-the-art technologies to produce electricity and steam. The Energy Facility will be located adjacent to the Power Plant building located at 750 Albany Street on the BUMC Campus. (The Power Plant supplies chilled water to the campus and is the steam and electric distribution center for Boston University Medical Center and is not a true power plant.)

The BUMC Campus relies on many utilities and energy infrastructure facilities that are approaching their operating limits. The Energy Facility is intended to meet the majority of the electrical demand and all of the high pressure steam demand required by Boston University Medical Center as well as BioSquare through cogeneration. (Cogeneration is the simultaneous production of electric power and steam.) See Figures 1-1 to 1-3 for Project location locus maps. See Section 1.5 – Project Description for more information.

1.2 Boston University Medical Center Sustainable Initiatives and Infrastructure

1.3.1 The Green Committee

Over the past ten years, Boston University Medical Center has taken steps to decrease its energy demand and improve energy efficiency throughout its campus. BMC established the Green Committee to oversee the direction, development, and implementation of sustainable programs and policies. The Green Committee is comprised of representatives from various Boston Medical Center departments. BU Medical Campus departments are also on the Green Committee and collaborate with BMC on campus-wide or shared programs.

In order to strengthen its initiatives, the Green Committee tracks the environmental and financial results of improvement programs, continuously reviews and improves existing programs, and identifies new improvement projects. It oversees the environmental strategies to ensure continuous improvement through various trending methods and control activities. Through effective communication, the committee relates Green program status throughout the organization and works with management, staff, and the public to increase awareness and participation in campus environmental programs and initiatives. (See Appendix D for the Green Committee September 2009 programs report.)

Through the leadership of the Green Committee and the Design and Construction Department, the implementation of sustainable design and construction elements in all of Boston University Medical Center's capital projects have increased significantly. The Carl J. & Ruth Shapiro Ambulatory Care Center (SACC), currently under construction, is registered with Green Guide for Health Care (GGHC) and is targeting a LEED Silver equivalent. The GGHC is based on the Leadership in Energy and Environmental Design (LEED) point system, the original national model for sustainable building design. Ultimately the Green Committee is dedicated to the continual development of its sustainable campus. As per the committee's charter, the goal is to promote the health of patients, visitors, employees, local communities, and the global community while operating economically and efficiently.

By creating and managing more sustainable energy systems and reducing its greenhouse gas emissions, Boston University Medical Center will align itself with City of Boston goals for environmental programs and green technologies. The Executive Order of Mayor Thomas M. Menino entitled "An Order Relative to Climate Action in Boston" (April 13, 2007) outlines sustainable practices adopted by the city including reduction of greenhouse gasses and improvement of overall energy efficiency for buildings. According to Climate: Change (the City of Boston's Climate Action Plan - December 2007), "78% of Boston's greenhouse gas emissions are related to buildings" (e.g. heating, cooling, and electricity). Within the report, the City of Boston encourages "all sectors of the community to use energy more efficiently in their facilities and…create environments that are more energy-efficient." The proposed Energy Facility will meet this challenge and reduce greenhouse gas emissions through the process of cogeneration. Cogeneration is considered an Eco-friendly "green" technology recognized by the Massachusetts Green Communities Act and the Massachusetts Technology Collaborative as a cost effective, scalable method of producing electricity and utilizing waste heat to increase efficiency at the host site.

1.3.2 Sustainable Infrastructure

Focused on environmental goals, Boston University Medical Center evaluated its campus infrastructure during the last ten years. Upgrades, replacements, and systems maintenance were performed in a manner that addressed obsolescence and allowed for efficiencies during future initiatives. Boston University Medical Center achieved demand-side energy savings through standardizing the use of energy-efficient lighting fixtures and water-saving plumbing fixtures and installing building automation systems controls to reduce the consumption of energy during off peak periods. Further, Boston University Medical Center implemented new procedures to manage infrastructure systems more efficiently overall.

Boston University Medical Center also centralized mechanical systems, such as chiller plants, and installed equipment that could be fueled by different sources. These measures help control cost and demand and create redundancy. Boston University Medical Center installed pipe and electrical infrastructure to allow for the connection of utilities from separately served ends of the campus. This new infrastructure improves the ability to maintain systems, provides opportunities for redundant energy delivery systems, and creates efficiencies. Having implemented the recommended energy efficiency and infrastructure improvements, Boston University Medical Center now needs to create an independent, efficient, environmental, and redundant energy source with the proposed Energy Facility. The Energy Facility will improve energy reliability and reduce the BUMC Campus carbon footprint. It will also eliminate the possibility of service failure or disruption that would be detrimental to the delivery of patient care in a 24/7 environment.

1.0 SUMMARY & PROJECT DESCRIPTION

Figure 1-1 Project Location – USGS Locus Map

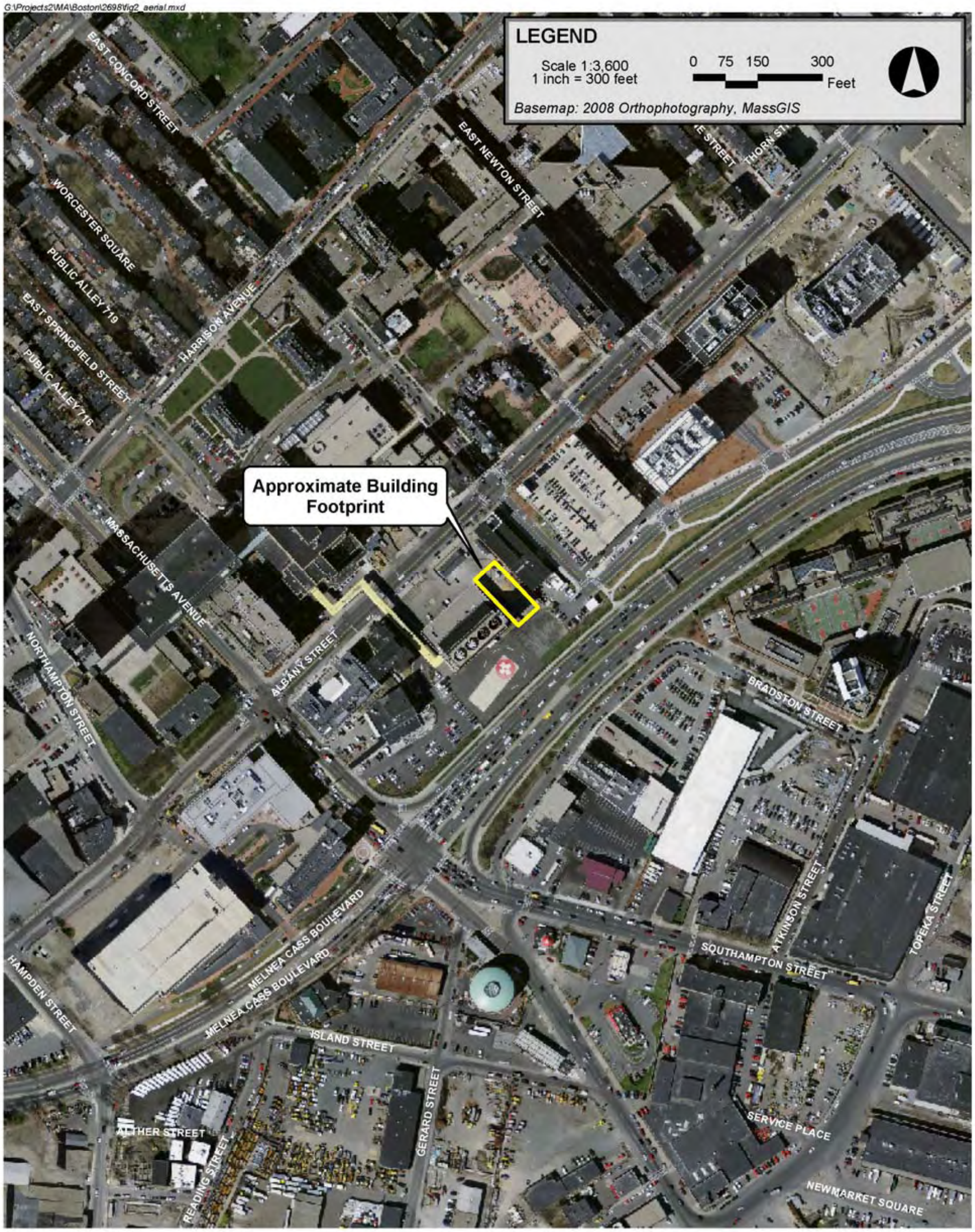
Boston University Medical Center Boston, Massachusetts

Epsilon

Figure 1
USGS Locus Map

1.0 SUMMARY & PROJECT DESCRIPTION

Figure 1-2 Project Location – Aerial Locus Map

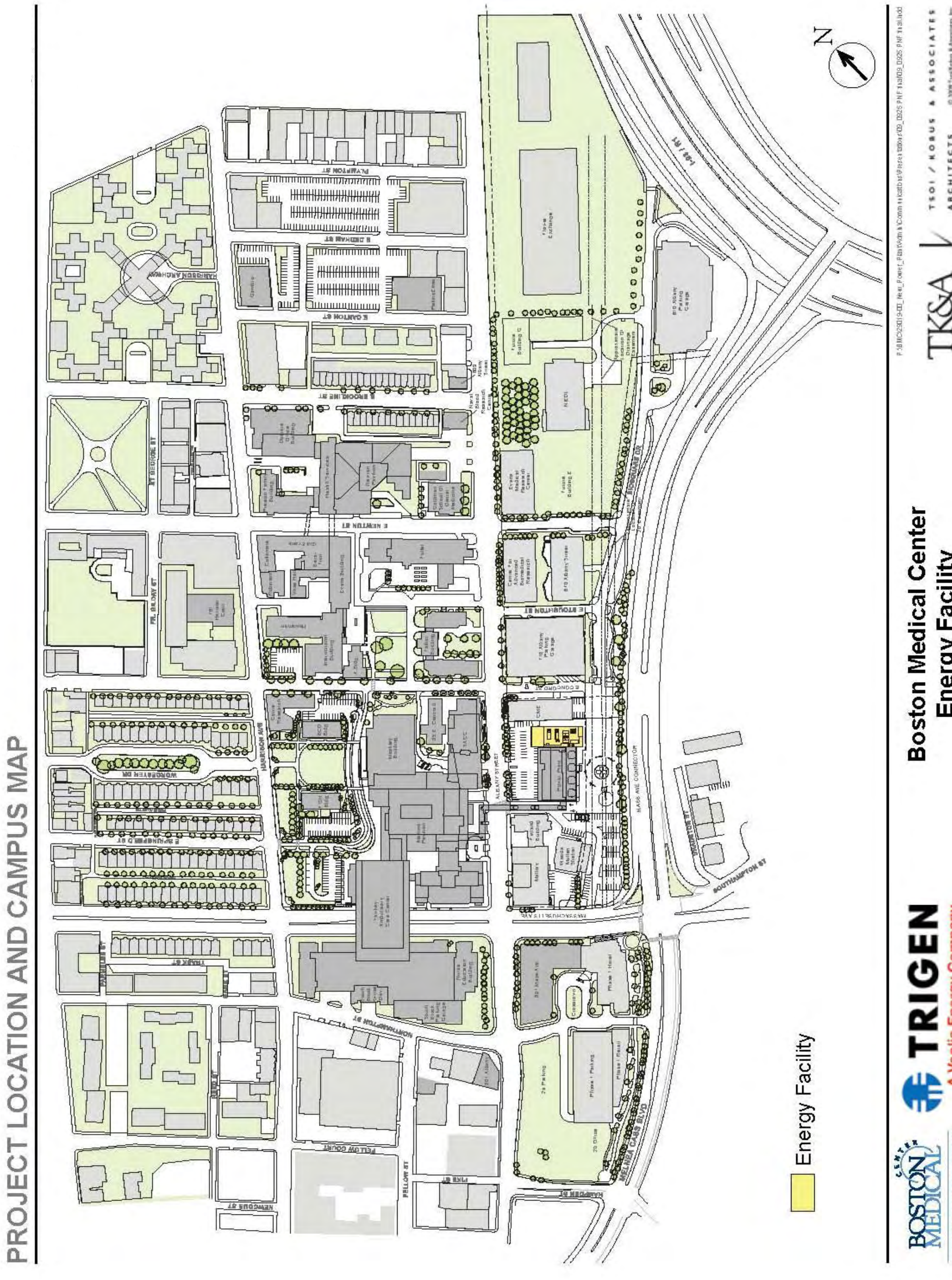


Boston University Medical Center Boston, Massachusetts

Epsilon

Figure 2
Aerial Locus Map

Figure 1-3 Project Location and Campus Plan



1.4 Project Description

1.4.1 Summary of Project Need

The BUMC Campus relies on many utilities and energy infrastructure facilities that are approaching their operating limits. Boston University Medical Center infrastructure systems are largely dependent on purchased utilities with significant utilization of electrical power and steam. Currently Boston University Medical Center uses a steam distribution system that is at capacity and an electrical distribution system that is not designed to support future growth. The campus relies to a lesser degree on natural gas and oil. Those fuel sources are primarily for back-up systems within patient care and research buildings and spaces.

Boston University Medical Center currently utilizes electrical power through two power distribution centers on the BUMC Campus. These stations (at the Power Plant and the Evans Building) are both over 30 years old and are using out of date technology that is not supported by replacement parts without customization or reliance on refurbished equipment. One of these stations is operating within five percent of its rated capacity. The other is presently operating at 65 percent of its capacity, but services an area of significant anticipated growth. Given the age of these stations and projected energy demand, upgrades and modernization of electrical infrastructure will be required in the very near future.

Given increased reliance on technology and ever increasing minimum standards, Boston University Medical Center's requirements for powering and cooling patient care and research space create new demands that continue to outpace the ability to reduce the amount of utilities used in total.

Boston University Medical Center now faces the challenge of managing the availability and reliability of energy service which is critical to a major medical center. In order to support the campus growth, keep up with advancements in health care technology, and deliver clinical services 24/7, Boston University Medical Center requires a new energy facility to address these issues. The goals of the proposed Energy Facility Project are to reduce demand on existing taxed infrastructure, create energy and system redundancy, increase system efficiency, and reduce overall environmental impact.

1.4.2 Project Site

The proposed Energy Facility site is located adjacent to the existing Power Plant at 750 Albany Street on the BUMC Campus, just north of the Massachusetts Avenue Connector and west of East Concord Street. It is paved and used for parking. The proposed site area will be approximately 11,000 s.f. The general area is urban in nature. The adjacency to the existing Power Plant is necessary in order to tie in to the existing system and enhance operational efficiency. See Figures 1-1 through 1-3 for Project location locus maps.

1.4.3 Building Program

The proposed Energy Facility is comprised of spaces designated for primary mechanical equipment such as combustion turbine generators (CTGs) and heat recovery steam generators (HRSGs), auxiliary systems and ancillary equipment, and the associated distribution infrastructure. Auxiliary systems include condensate and feed water systems, control system, natural gas, chemical treatment, ammonia, fuel gas piping, gas compressors, plant air systems, HVAC systems, and chilled water. Minor renovations will be made to the Power Plant to allow circulation between the two buildings. Other programmed spaces include a control room with a staff toilet and an electrical switchgear room. Refer to Table 1-1 for a more detailed breakdown. Each CTG will have a heat recovery steam generator to comprise one complete power island. Each power island will be provided with auxiliary systems and ancillary equipment necessary for production of steam and electricity through cogeneration.

The Energy Facility will be approximately 48,000 s.f. and approximately 100 feet in height from grade. Emissions stacks will be approximately 160 feet in height from grade. See Figures 1-4 through 1-14 for plans, sections, and elevations of the proposed Project. See Appendix A for context site photos.

At street level, the primary entrance to the building will be from a service road "interior" to the BUMC Campus on the south side of the site. The proposed building is bordered to the east and west by existing buildings. The north side of the site is planned to be developed as open space upon completion of the future Administration/Clinical Building for BMC.

1.4.4 Approximate Project Dimensions

Table 1-1 Proposed Project Square Footage Table

Energy Facility	Square Feet	Program and Comments
Level 0 (basement)	10,000	Electrical Switches, Water Softeners, Pumps and Storage Tanks
Level 1	12,000	Combustion Turbine-Generators and Heat Recovery System Generators (Gas Turbines and Boilers)
Mezzanine	1,000	Control Room, Emissions Control and Mechanical Equipment
Level 2	11,000	Switchgear Room, Boiler Economizers, Combustion Air Inlet Filters and Air Plenum
Level 3	11,000	Deaerators, Emergency Generator, CEMA, Electrical and HVAC Equipment
Penthouse	3,000	Gas Compressors, Cooling Tower and Rooftop Mechanical
Total Energy Facility Square Footage	**48,000**	

1.4.5 Project Schedule

Project construction is expected to commence in the 4th Quarter of 2010. Project construction is expected to conclude in the 2nd Quarter of 2012.

Figure 1-4 Site Plan

Figure 1-5 Basement Floor Plan

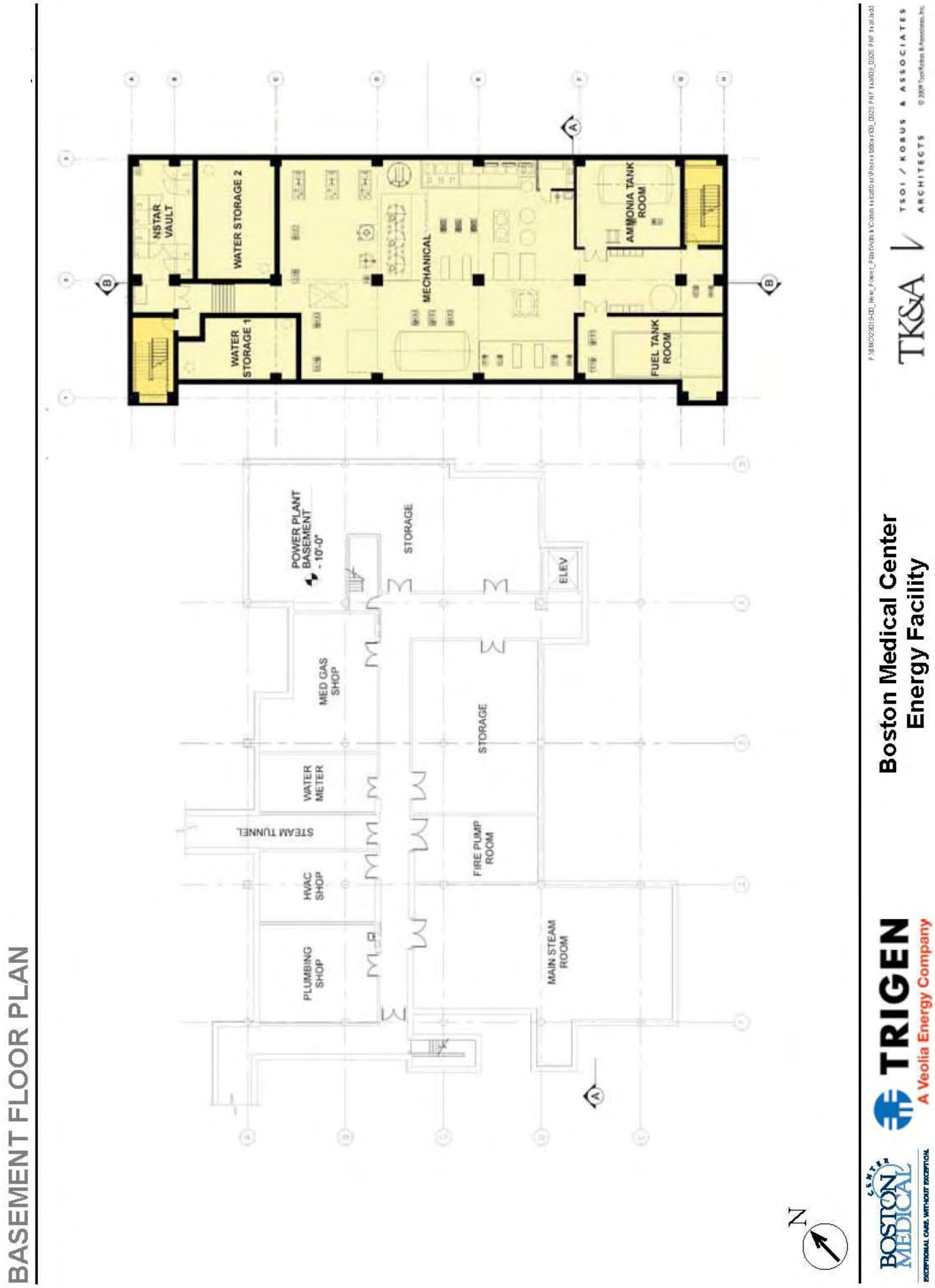


Figure 1-6 Level 1 Floor Plan

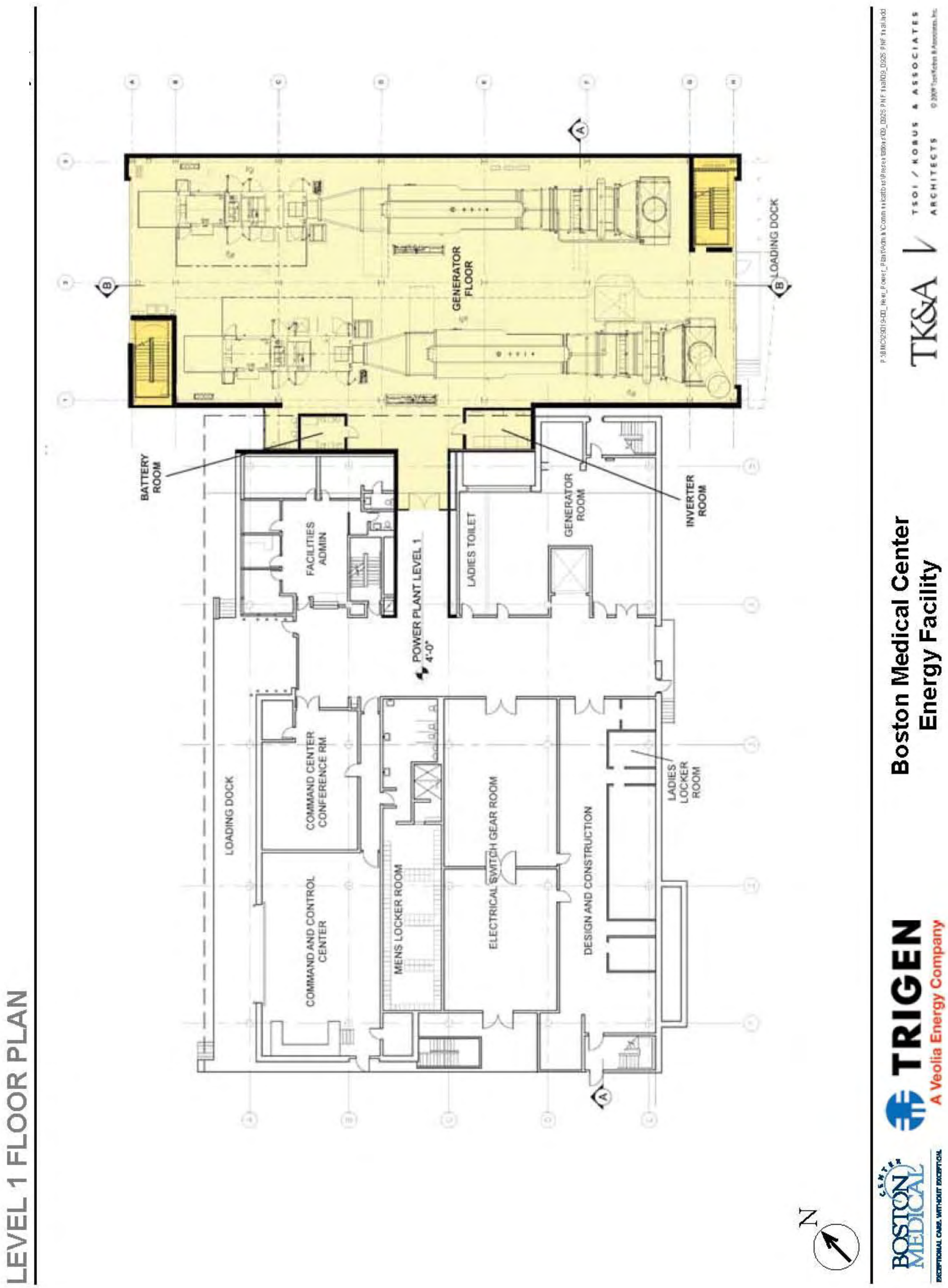


Figure 1-7 Level 2 Floor Plan

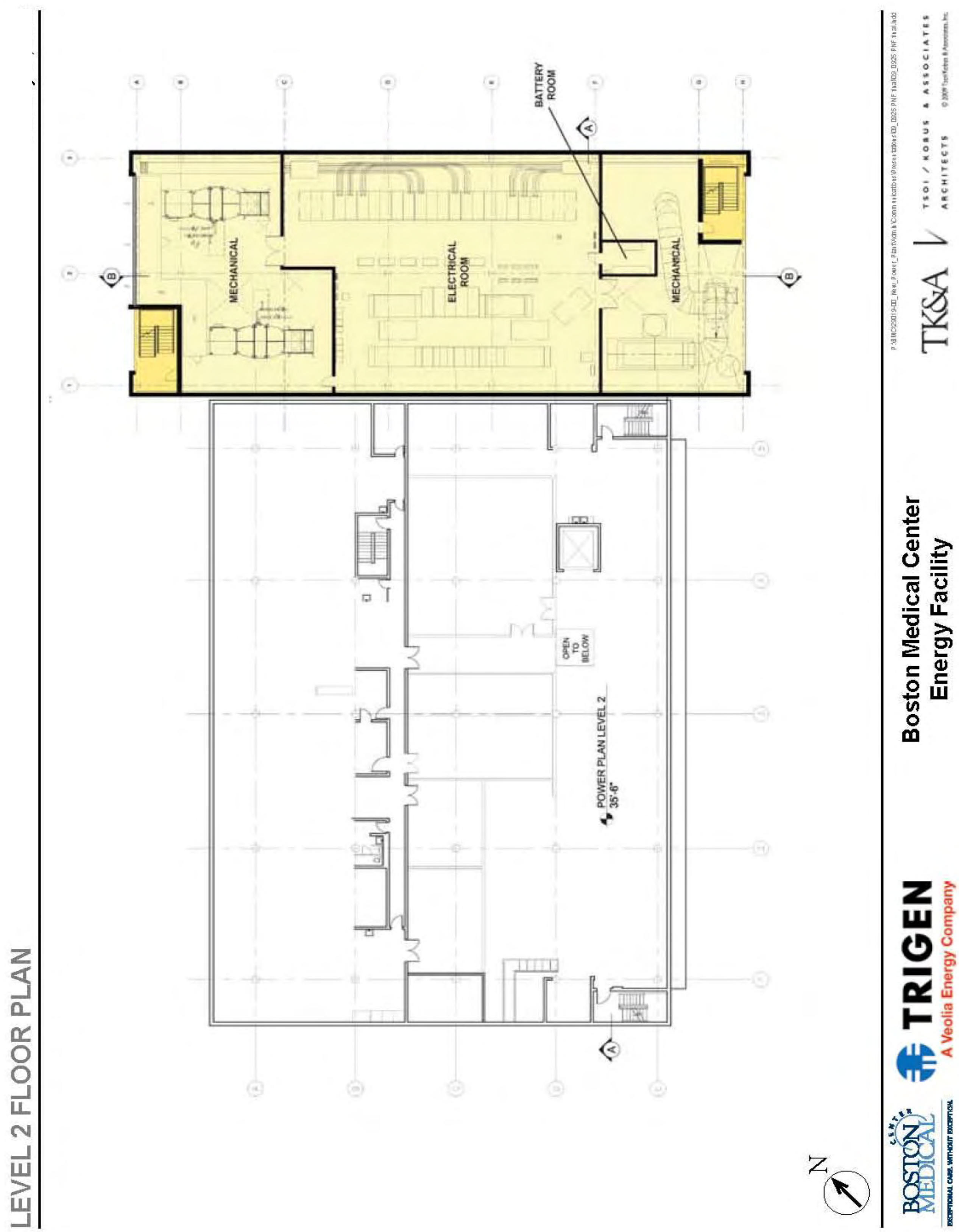


Figure 1-8 Level 3 Floor Plan

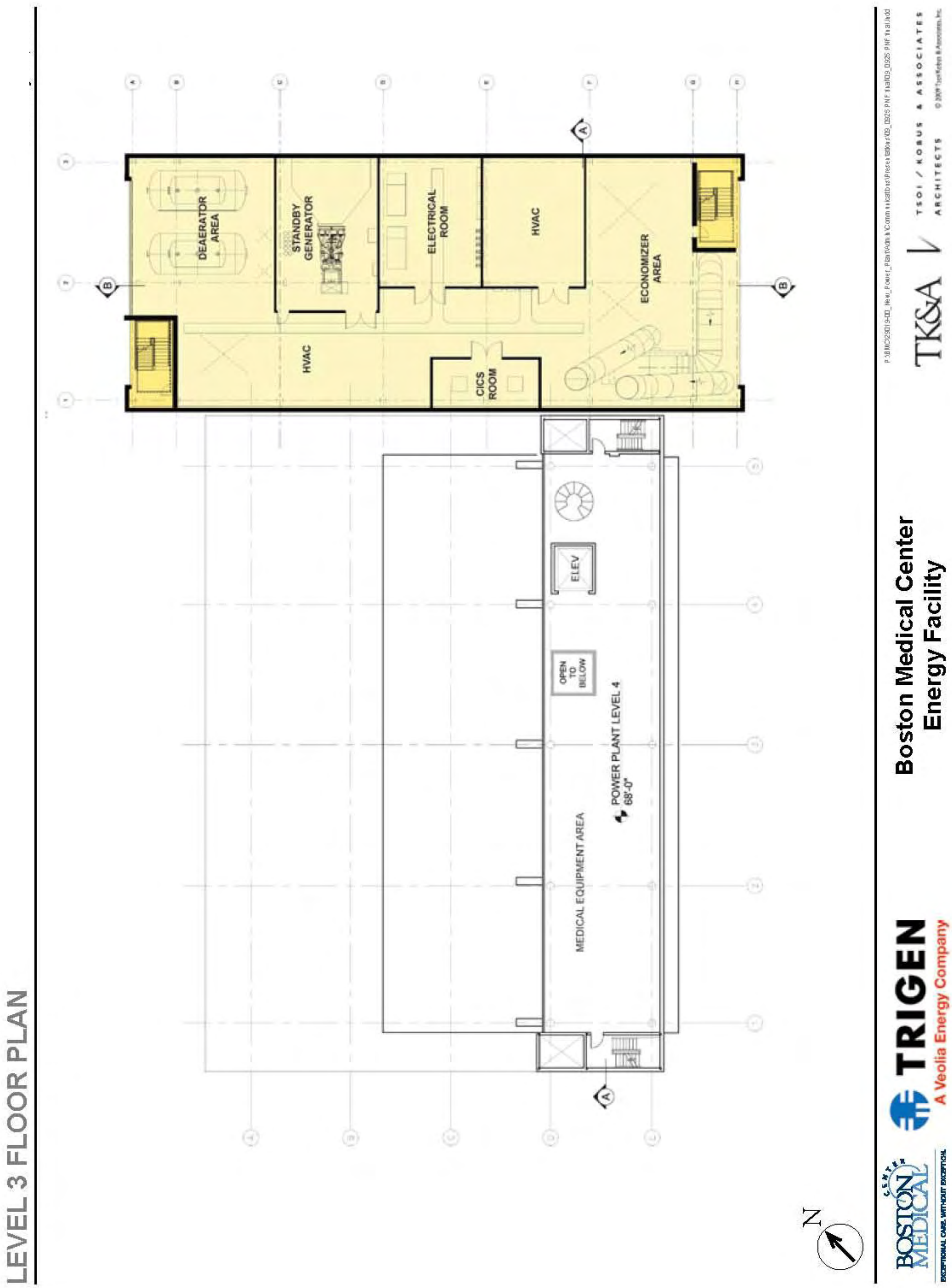


Figure 1-9 Penthouse Floor Plan

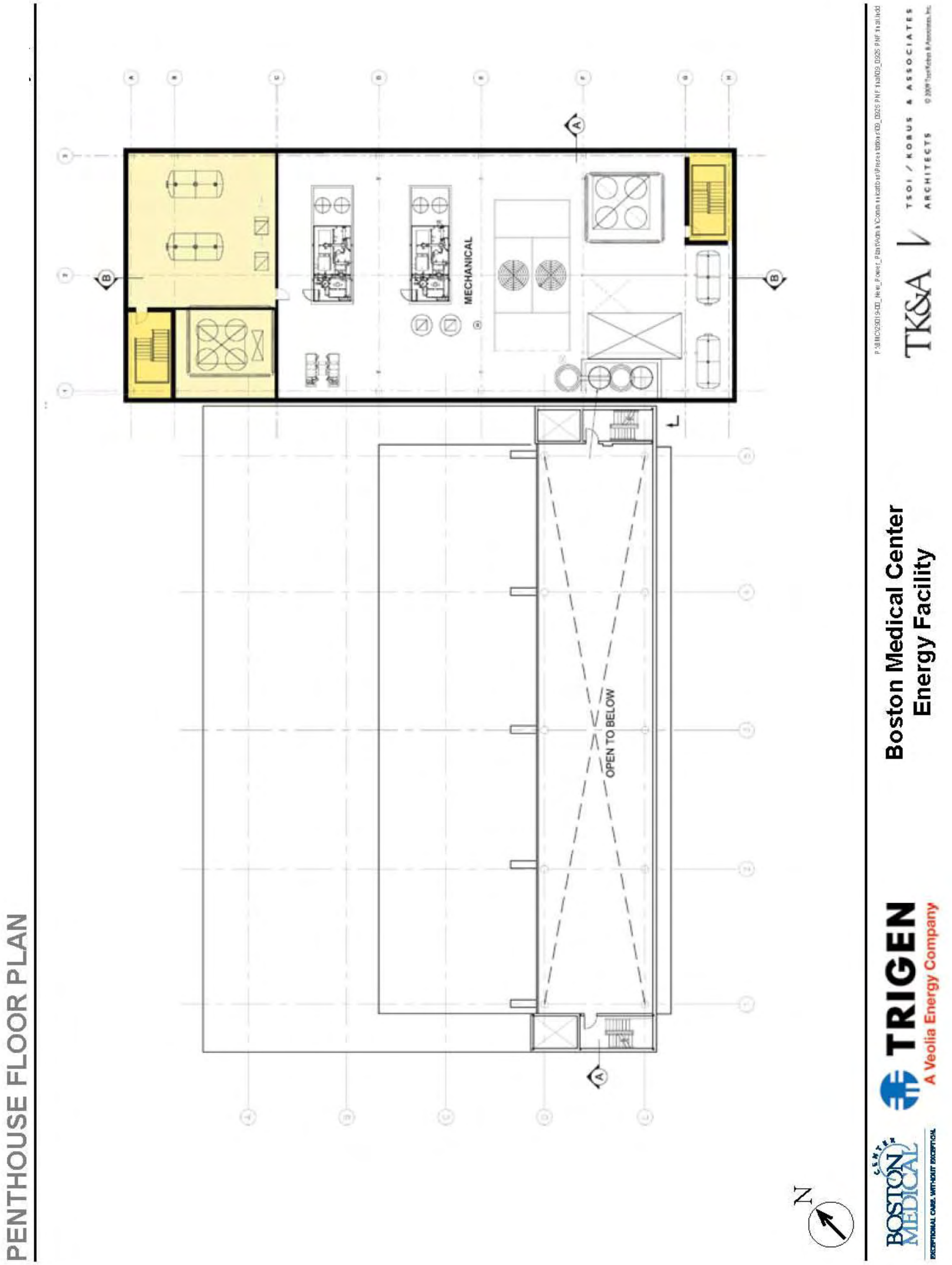


Figure 1-10 Roof Plan

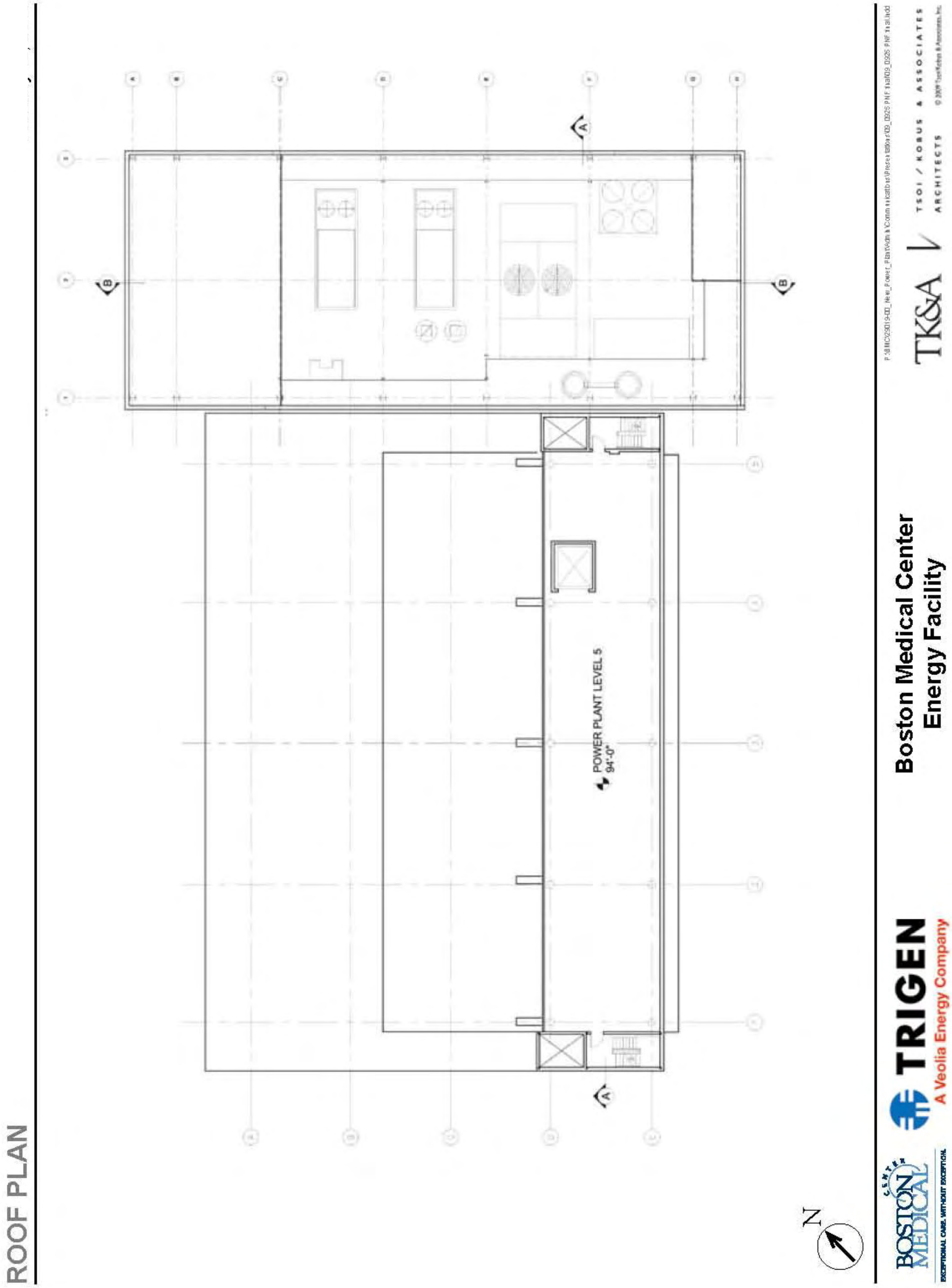


Figure 1-11 North Elevation

Fig
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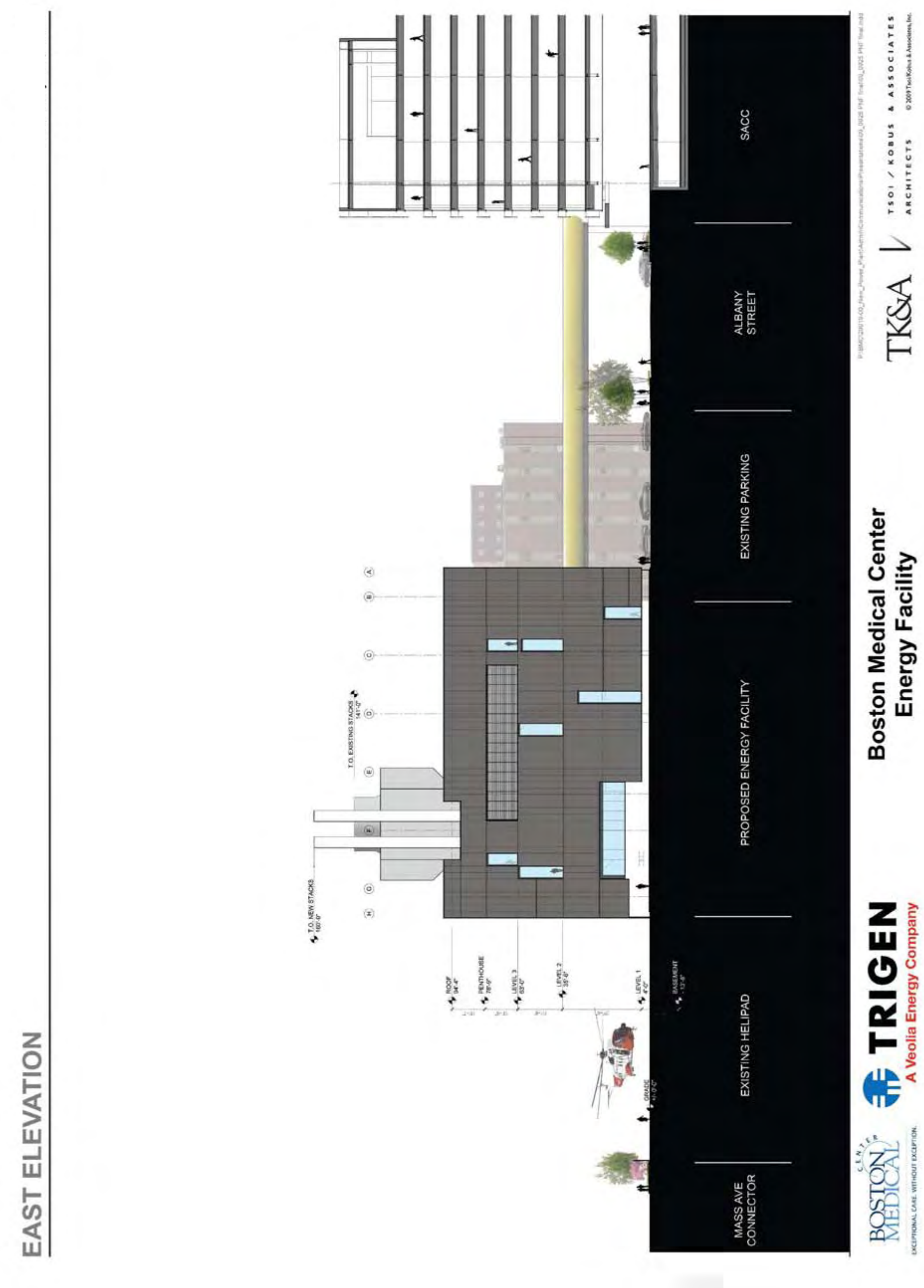
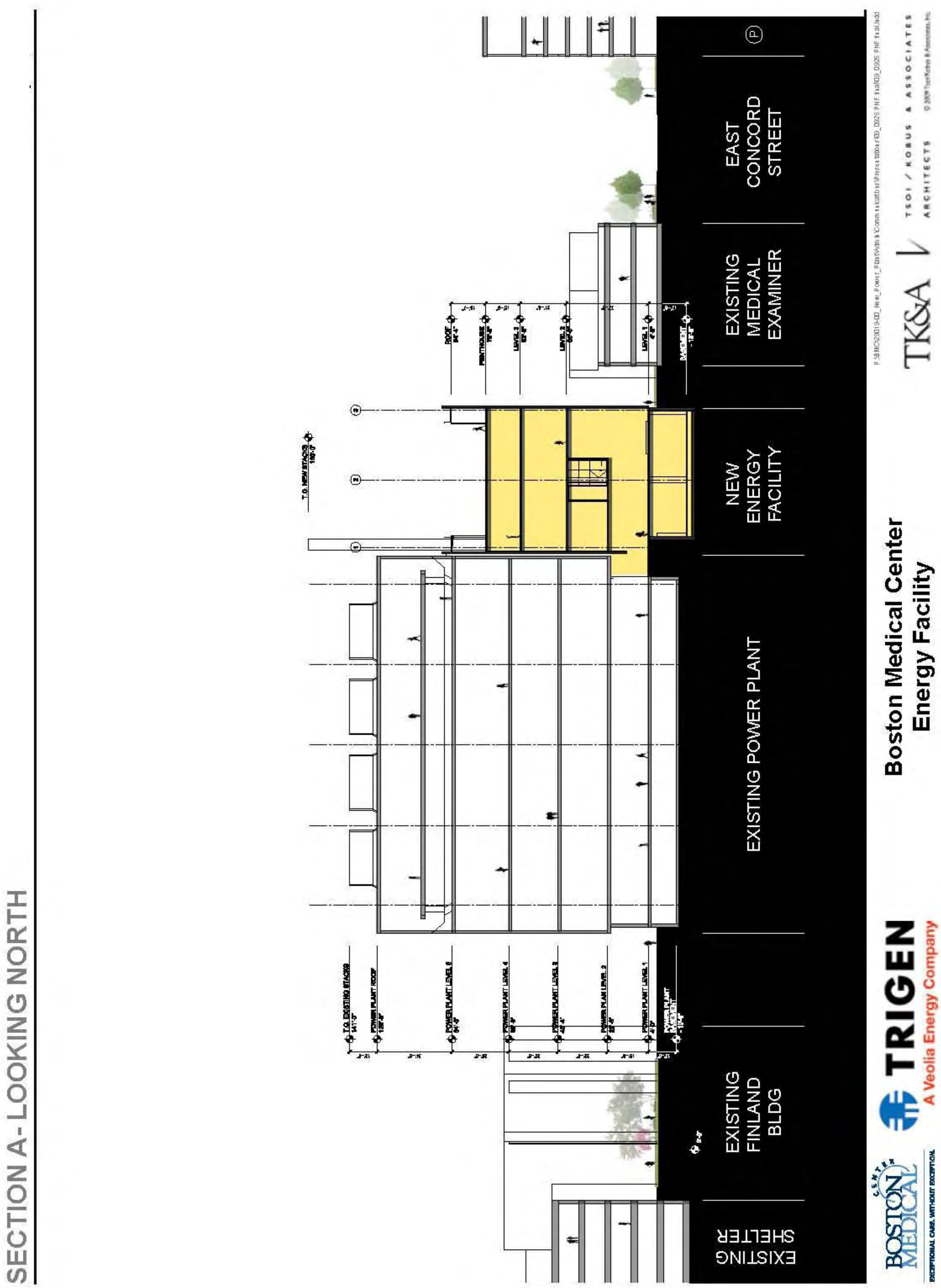
1-12 East Elevation



Figure

1-13 South Elevation

Figure 1-14 Section A – Looking North



1.5 Project Objectives

The following are the primary objectives of this Project:

- Reliability - The Energy Facility will add redundancy to Boston University Medical Center's existing energy supply and ensure a reliable power system – an especially important concept in operating a hospital. Currently, electricity is provided to the BUMC Campus by NSTAR and Trigen-Boston supplies the steam. Boston University Medical Center will stay connected to these existing suppliers in the event that back-up energy is needed (e.g. during peak periods, scheduled equipment maintenance, or unexpected shutdowns).

- Efficiency - The Energy Facility will be located close to where Boston University Medical Center needs the power – a concept known as distributed generation. Placing a facility close to where the power is used is much more efficient and reliable than sending power farther away. This is based on the premise that with shorter distances for power to travel, there are fewer points for system failures. Further, the efficiency of the proposed system is approximately 72% as compared to a conventional single cycle power plant capable of operating at 33%.

- Reduced Environmental Impact - With the Energy Facility, Boston University Medical Center will be able to make electricity and steam from the same process – a process known as "combined heat and power" (CHP) or also referred to as "cogeneration". In this process, a combustion gas turbine is fueled by natural gas to generate electricity. Waste heat from the combustion turbine is then sent to a Heat Recovery Steam Generator to produce usable steam. Boston University Medical Center uses steam to heat buildings and for medical equipment sterilization. Combining electric and thermal energy generation into a single integrated process reduces fuel consumption and the impact on the carbon footprint dramatically.

  With the new facility, Boston University Medical Center plans to make 75% of its own electricity and 95% of its own steam. Within a year of operating this new facility, it is anticipated that net annual greenhouse gas emissions will be reduced in excess of 18,000 metric tons of carbon dioxide, equal to the absorption potential of approximately 4,000 acres of pine forest.

1.6 Project Benefits

1.6.1 Direct Project Benefits

- Job Creation and Retention - The Energy Facility will create construction jobs in addition to generating highly-skilled long-term operations and maintenance jobs. During the approximately eighteen month construction phase of the Project, thirty-nine construction jobs will be created. Once the Project is complete, the Energy Facility will require seven new long-term operations and maintenance jobs.

- "Green" Job Creation and Training – The new full-time staff of the Energy Facility will receive training specific to the operation and maintenance of the associated state-of-the-art green technologies. Topics include: combustion turbines, heat recovery systems, emissions control equipment, dispatch optimization controls, and ISO New England programs.
- Reduced Environmental Impact – Meeting this Project objective will help Boston University Medical Center to shrink its carbon footprint through lesser greenhouse gas emissions and lower its impact on the local environment. See Section 1.5 for more information.
- Reduced Local Utility Impact – The proposed Energy Facility will enable Boston University Medical Center to generate 75% of its electricity and 95% of its steam. This subsequently decreases Boston University Medical Center's impact on the locally taxed energy infrastructure.
- Reduced Energy Costs – By producing steam and electricity through cogeneration, Boston University Medical Center will decrease its energy costs.

1.6.2 Annual Property Taxes / PILOT

Although much of the BUMC Campus property is tax-exempt, BMC contributes annually to the City of Boston's Payment in Lieu of Taxes (PILOT) program.

1.6.3 Linkage

Upon approval of the Boston University Medical Center IMP in 2000, Boston University Medical Center entered into a Development Impact Project ("DIP") Agreement with the BRA for its institutional projects which exceeded the threshold requirements of Article 80B of the Code. With the adoption of the new IMP for a new 10 year term commencing in 2010, Boston University Medical Center and the BRA will enter into a new DIP Agreement which will govern all new projects which exceed the thresholds set forth in Article 80B of the Code. Due to the size of the proposed Energy Facility of approximately 48,000 square feet, such project will not be a Development Impact Project. Future institutional projects to be undertaken by Boston University Medical Center under the new IMP that are designed to exceed 100,000 square feet, including the Administration/Clinical Building and the New Inpatient Building, will be subject to linkage in accordance with Article 80B, Section 80B-7 of the Code.

1.6.4 Other Economic Benefits

BMC's community goals are to continue to provide effective and accessible services to vulnerable populations in the Boston community and to continue to expand efforts that deepen relationships with the communities they serve. Estimated BMC direct expenses on community benefit programs in fiscal year 2008 totaled $18,434,426. Total community benefits programs expenditures in fiscal year 2008 per the Attorney General's guidelines were $30,204,021. In addition, this expenditure and budget summary does not include the costs associated with numerous other programs and projects of BMC that make valuable contributions to the community.

BMC contributes to the local economy through employment of Boston residents and the purchase of goods and services from Boston businesses. BMC spent $111 million in fiscal year 2008 for goods and services provided by Boston suppliers.

1.7 Anticipated Permits, Reviews, and Approvals

Table 1-2 below catalogs the permits, reviews, and approvals anticipated throughout the process.

Table 1-2 Anticipated Permits, Reviews and Approvals

Agency Name	Permit / Review / Approval
Federal	
Federal Aviation Authority	Construction Permit for Temporary Airspace Obstruction
State	
Executive Office of Environmental Affairs, Massachusetts Environmental Policy Act	Request for Advisory Opinion, or Secretary's Certificate, if required
Massachusetts Historical Commission	State Register Review, if required
Department of Environmental Protection, Division of Air Quality Control	Non-Major Comprehensive Air Plan Approval Environmental Results Program Certification
Department of Environmental Protection, Division of Water Pollution Control	Groundwater Discharge Permit Clean Water Act - Pre-treatment Standards Sewer Extension/Connection Compliance Certification
Massachusetts Water Resources Authority	Sewer Use Discharge Permit Individual Discharge/Sewer Permit
Department of Public Safety	Storage Tank Permit
State Fire Marshall	Flammable Storage License
Local	
Boston Redevelopment Authority	Article 80 Project Review
Boston Landmarks/South End Landmark District Commission	Application for Certificate of Design Approval
Boston Civic Design Commission	Design Review
Boston Groundwater Trust	Groundwater Trust Certification
Boston Transportation Department	Construction Management Plan
Boston Air Pollution Control Commission	Air Quality Control Permit
Boston Water and Sewer Commission	Construction Dewatering Permit Sewer/Extension/Connection Permit Stormwater Management Plan Site Plan Approval
Boston Inspectional Services Department	Building and Occupancy Permits
Boston Public Improvement Department	Street and Sidewalk Occupancy Permits
Boston Public Works Department	Street Opening Permit
Boston Fire Department	Plan Review
Joint Committee on Licenses	Flammable Storage License

1.8 Zoning

The proposed Project site is located within the Boston University Medical Center Institutional Master Plan area and shown on Map 1P of the South End Neighborhood District which was adopted by MAP Amendment No. 273 by the Boston Zoning Commission on June 28, 2000, subsequent to the approval by the BRA on May 18, 2000 of the BUMC IMP. In accordance with the provisions of the Boston Zoning Code and Article 64, the South End Neighborhood District Zoning, projects within the district are subject to the provisions of the approved Institutional Master Plan. The Boston University Medical Center IMP was approved by the BRA on May 18, 2000 and the Zoning Commission on June 28, 2000, and approved by the Mayor on July 13, 2000. In accordance with provisions of Section 80D-2, institutional projects are required to be consistent with the approved Institutional Master Plan. The Project will be consistent with zoning upon approval of the new Boston University Medical Center IMP by the BRA and the Zoning Commission which is filed contemporaneously with this DPIR.

1.9 Public Review Process

The Boston Redevelopment Authority (BRA) has established a Task Force representing the area community to participate in the public review of the Project as part of the Boston University Medical Campus IMP. The Proponent had several meetings with the Task Force as well as public and city regulatory agencies and will continue an open and inclusive public process. Table 1-3 below provides a list of meetings that have been held on the Project since the filing of the PNF in September 2009.

Table 1-3 Community, Public, City Agency Meetings

Date	Group	Location
9/22/09	Worcester Square Neighborhood Association	Newton Pavilion, Conf. Rooms C/D
9/28/09	Task Force – BUMC IMP Introduction	Newton Pavilion, Conf. Rooms C/D
10/8/09	South End Landmarks Staff Planner	City Hall, Rm. 805
10/8/09	BRA Design Staff	City Hall, 9th Floor
10/13/09	Boston Water & Sewer Commission	980 Harrison Avenue
10/13/09	BRA Scoping Session	City Hall, 9th Floor, BRA Board Room
10/13/09	Task Force – Energy Facility	Menino Pavilion, Conf. Room A
10/14/09	Public Improvements Commission	City Hall, 7th Floor
10/19/09	Boston Transportation Department	City Hall, Rm. 721
10/20/09	BRA Public Meeting	BioSquare, 670 Albany Street
10/23/09	Office of Jobs & Community Services	43 Hawkins Street
11/9/09	Task Force – BUMC Campus Tour	Talbot Building
11/10/09	Boston Civic Design Commission (BCDC) – IMP	City Hall, Rm. Piemonte Room
12/22/09	BCDC Subcommittee – Energy Facility	City Hall, Rm. 937A
2/23/10	BCDC Subcommittee – Energy Facility	City Hall, Rm. 933A
3/4/10	South End Landmarks District Commission	City Hall, Rm. 801

Section 2.0

2.0 ASSESSMENT OF DEVELOPMENT REVIEW COMPONENTS

2.1 Urban Design

2.1.1 Introduction

From the outset of the merger of Boston City Hospital, Boston Specialty and Rehabilitation Hospital, and University Hospital in 1996, the dominant urban design objective of BMC has been to create a cohesive medical center campus. It has also been a goal to integrate the overall campus with the surrounding neighborhoods through sensitive building, open space planning and site beautification along the periphery of the campus. The combination of these design principles will continue to enhance the physical image of the BUMC Campus as well as improve patient, staff and student perceptions of Boston University Medical Center.

2.1.2 Urban Design Principles

The Energy Facility is designed in the context of future development proposed for the South of Albany Campus defined in the recently submitted Boston University Medical Center IMP. It is in this context that important urban planning principles become the guidelines for its design. These principles include:

- Transforming the Albany Street campus image;
- Complementing existing context, i.e. massing, scale and materials;
- Creating a clear and welcoming sense of arrival;
- Enhancing open space opportunities on the campus;
- Developing pedestrian-friendly street edges;
- Enhancing accessibility to parking and existing buildings;
- Integrating sustainable design principles and operations; and
- Planning for future long-term growth and transformation.

2.1.3 Existing Context and Project Location

The current Albany Street edge is defined by varying building setbacks and urban densities. The buildings have different vintages and styles. As BMC evaluated expansion and renovation opportunities, it began to recognize the Albany Street edge of the campus as a primary arrival zone. BMC thusly decided to transform the Albany Street image through urban planning and various street level improvements, such as plantings and landscaping. The Shapiro Ambulatory Care Center (SACC), which is currently under construction, marks the first phase in a long-term objective of transforming the nature and image of the Albany Street edge of the BUMC Campus.

The proposed location of the Energy Facility to the east of the existing Power Plant will begin to better define the Albany Street edge, allow for future development of the South of Albany Campus, and align with the previously mentioned urban planning principles. As future phases of the Master Plan are developed, the desired balance of density and open space enhancements, and further definition of Albany Street will be realized.

The Energy Facility will abut the existing Power Plant to the west and will be shorter than that building in overall height. (See Section 2.1.4 and Figures 2-1 through 2-6.) The Project will closely border the Chief Medical Examiner's Office building to the east. The north side of the site will be developed as open space in conjunction with the construction of the future Administration/Clinical Building for BMC. This configuration of buildings will continue to capitalize on the unique open space characteristics of the medical campus and will provide relief for pedestrians and staff. It will also establish a direct relationship with the views from the public elevator lobby of the Shapiro Ambulatory Care Center on the opposite side of Albany Street. The south side of the site fronts the Massachusetts Avenue Connector, a major vehicular approach. See Appendix A for context site photos.

2.1.4 Height and Massing

The height and massing are primarily dictated by dimensional clearances required for the large pieces of equipment to be housed within the building envelope. The height of the building will be approximately 100 feet to the top of the partially enclosed penthouse level. The north face will extend approximately fifteen feet in front of the north face of the existing Power Plant. The existing staff parking along Albany Street will be maintained until the proposed Administration/Clinical Building and open space is developed. The south side is bound by setbacks associated with the Roxbury Canal.

Two 6'-0" diameter exhaust stacks will be approximately 160 feet above grade. They will be located adjacent to the taller portion of the existing Power Plant to reduce the perceived height. The height (to the top of the roof) of the Energy Facility will be approximately 30'-0" shorter than the height (to the top of the roof) of the Power Plant.

The Project's height and massing are consistent and compatible with the institutional scale and density of the existing BioSquare development to the east and Crosstown development to the west. The massing of the Energy Facility also establishes a relationship with the scale and massing of the Shapiro Ambulatory Care Center across Albany Street. Likewise, the change in plane of the Shapiro Ambulatory Care Center street wall along Albany Street relates to the footprint of the Energy Facility and the future open space that will be developed in front of the Project. This future open space will provide visual interest for patients and staff traveling within the elevator lobbies of the Shapiro Ambulatory Care Center. These relationships will contribute to the creation of a pedestrian sensitive environment along Albany Street.

See Figures 2-1 and 2-6 for aerial and perspective views.

2.1.5 Material and Image

Simple massing and a minimal material palette are proposed for the Project. Dark grey metal panels and curtain wall glazing will be featured establishing a relationship with the existing Power Plant. The building's simple form celebrates its utilitarian function while softening the visual impact to the neighborhood to the north.

A large expanse of curtain wall is proposed along the north and south ends facing Albany Street and the Massachusetts Avenue Connector, respectively. These large visual portals will provide passers-by glimpses into this facility highlighting its "green" technology and operations. From the north, the large scale curtain wall is organized in a top and bottom segment separated by a louver which brings the scale down to the pedestrian level along Albany Street. From the south, the large scale curtain wall expression relates to the expression of the existing Power Plant along this edge. The south façade of the Energy Facility responds appropriately to the macro scale of the Massachusetts Avenue Connector and complements the other architectural statements along the Expressway and Massachusetts Avenue Connector. Bold color will be applied internally at the emergency egress stairwells that flank the side of the curtain wall at each end of the building. This use of color will add visual interest and animate these edges.

Small scale vertical openings, louvers and a pattern of horizontal reveals are proposed along the east façade. These elements help break down the scale of the massing along this face and further add visual interest to this prominent view when approached from the Massachusetts Avenue Connector.

At night, the facility will be internally illuminated during limited hours to enhance the prominence of this site. The Energy Facility will act as a visual gateway to the BUMC Campus and will represent Boston University Medical Center's and the City of Boston's forward-thinking approach to sustainable development and environmental responsibility.

2.1.6 Vehicular Access and Circulation

Normal staff access and small material deliveries for the Energy Facility will be via existing Power Plant entrances and loading docks located along the Albany Street side of the existing facility. A loading dock and service access is planned on the south side of the Energy Facility for routine maintenance and to accommodate deliveries of large equipment and regular deliveries of materials to support ongoing operations. The existing fence at the helipad will be slightly modified to allow truck access from Albany Street via the East Concord Street Extension to the rear of the Energy Facility.

2.1.7 Site Improvements

Sidewalk and landscaping improvements along the Project frontage at Albany Street will occur as part of the previously approved Shapiro Ambulatory Care Clinic (SACC). Improvements include new scored concrete sidewalks with a brick paving strip, new double-acorn street lighting and new street trees and tree grates. Additionally, pedestrian ramps will be reconstructed and include detectable warning pavers. The vehicle ramp to the staff parking lot of the existing Power Plant will also be reconstructed and include detectable warning pavers. (See Figure 1-4, Site Plan for the rendered improvements associated with the SACC.) The existing staff parking lot will be re-paved and re-striped.

Figure 2-1 Aerial View Looking East

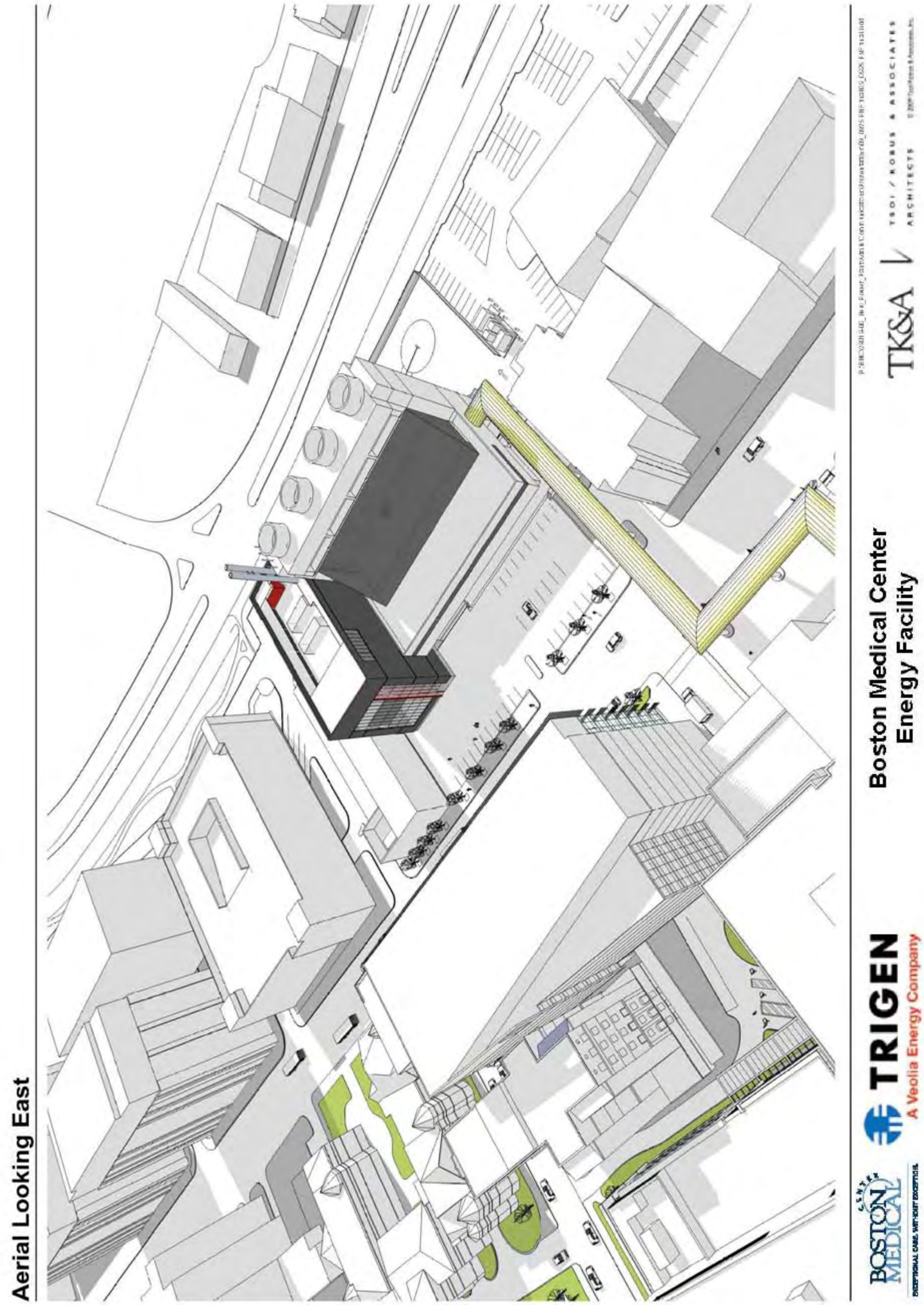


Fig ure

2-2 Perspective Looking West

Figure 2-3 Perspective Looking North

Figure 2-4 View from Albany Street

Figure 2-5 View from Massachusetts Avenue Connector

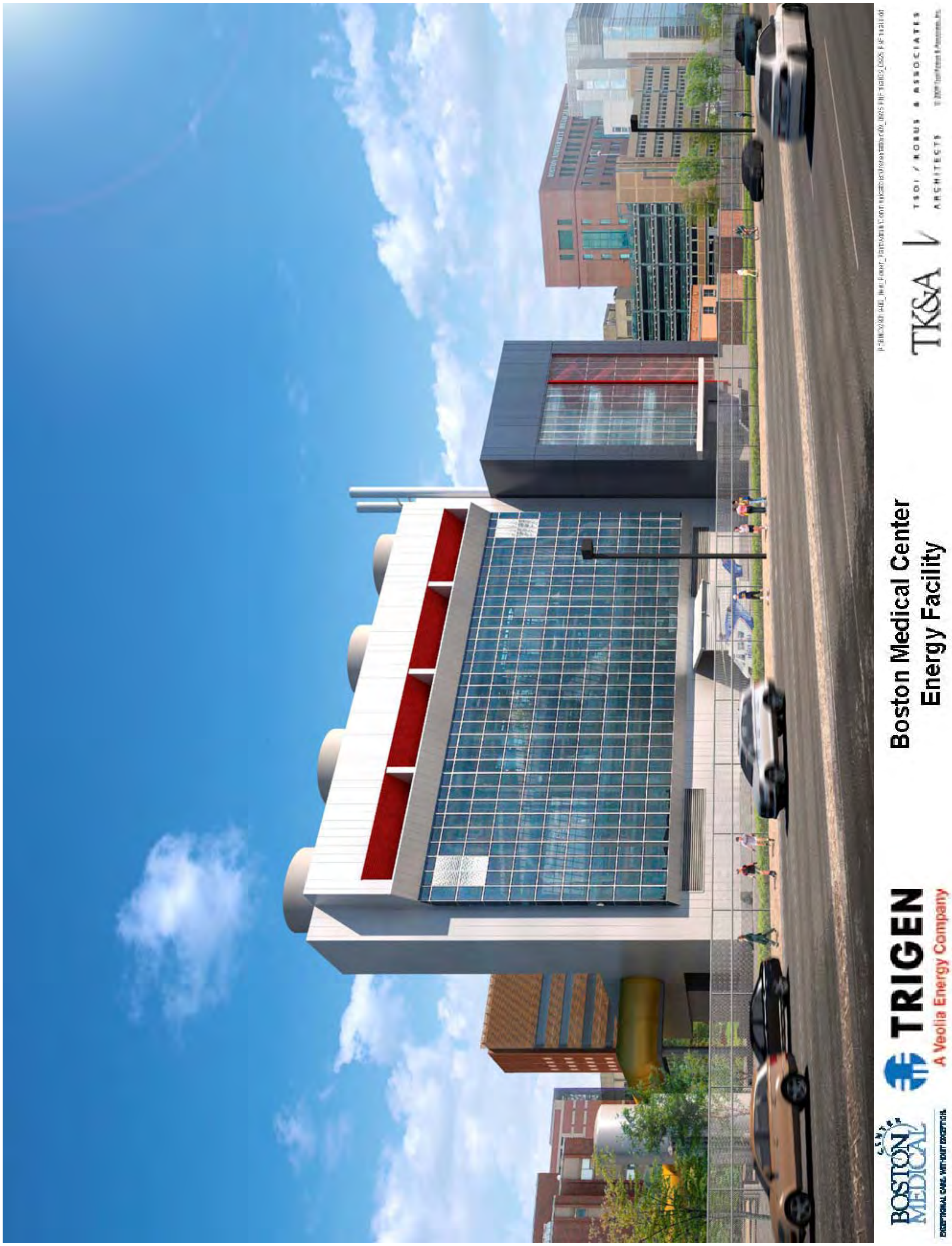
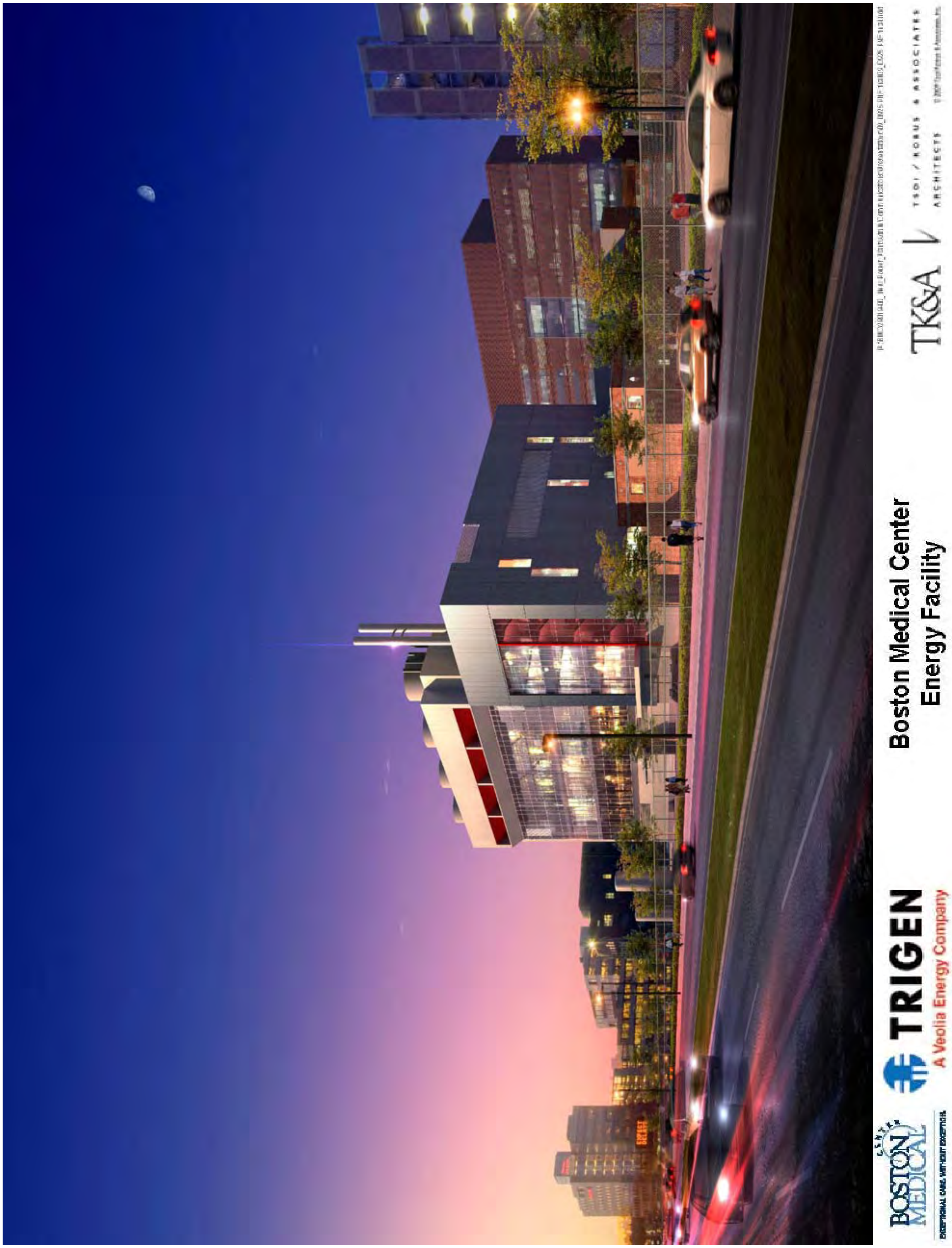


Figure 2-6 Night View from the Massachusetts Avenue Connector



2.2 Sustainable Design

2.2.1 Introduction

The proposed Energy Facility represents Boston University Medical Center's commitment to environmental responsibility and aligns itself with the City of Boston's forward-thinking approach to sustainable development. The Project will meet the challenge set forth in the City of Boston's Climate Action Plan – December 2007, as discussed in Section 1.3.1.

The Project is a Combined Heat and Power (CHP) facility. CHP is considered an Eco-friendly "green" technology recognized by the Massachusetts Green Communities Act and the Massachusetts Technology Collaborative as a cost effective, scalable method of producing electricity and utilizing waste heat to increase efficiency at the host site.

The benefits of this type of facility will extend beyond the BUMC Campus to the surrounding communities within and around downtown Boston. By allowing Boston University Medical Center to produce its own electricity and steam, the Project will help to alleviate the demand on the locally taxed energy infrastructure. This will improve delivery of existing energy service to the surrounding city communities. Additionally, the new facility will produce Boston University Medical Center's energy service using a cleaner, state-of-the-art process known as cogeneration. The local energy infrastructure that the BUMC Campus and BioSquare currently rely on to meet its energy demand employs conventional technologies that generate higher amounts of air emissions. Removing Boston University Medical Center's demand from this old technology will reduce the amount of air emissions and will greatly improve the environment for the surrounding city communities.

2.2.2 Energy System Summary

Combined heat and power is the simultaneous production of two useful forms of energy (electricity and thermal) from a single fuel source. The CHP system configured for the Energy Facility is comprised of two (2) 7.5 MW nominal capacity natural gas combustion turbine generators (CTGs) coupled with heat recovery steam generators (HRSGs). The HRSGs utilize the exhaust waste heat from the CTGs to produce steam. The CHP system for the Project is expected to have total efficiency of 72%. The overall efficiency of the Project is expected to be higher than the combination of the traditional utility grid power generation and the conventional steam heating plants.

It is estimated that the Energy Facility will average 434,338 MMBTU savings per year in utilizing CHP instead of purchasing utility produced electricity and steam. By utilizing the waste heat to produce steam, the overall efficiency is boosted. Over the course of thirty (30) years, it is estimated that 13,030,141 MMBTU's of energy will be saved through the use of cogeneration at the proposed Energy Facility.

In summary, the proposed CHP for the Energy Facility has the following important benefits:

- Reduces Carbon Footprint – CHP generation reduces carbon emissions by over 20% over electricity purchased from the electrical utility and heat/chilling generated with traditional boilers and chillers.
- Energy Efficiency and Operating Cost Savings – The CHP plant has very high overall cycle efficiency. It is in excess of 70%, which results in large energy operating cost savings.
- Lower Air Emissions – Since the CHP plant operates at a higher overall cycle efficiency, it will have lower air emissions for the total energy produced (electrical plus thermal), as compared to the same total energy generated by the traditional electrical generating stations plus the conventional steam boiler plants.
- Best Available Control Technology - The proposed CHP plant is expected to employ Best Available Control Technology to further reduce the CO and NOx emissions.

2.2.3 Design

As evidenced by its initiatives undertaken through the Green Committee discussed in Section 1.3.1, Boston University Medical Center considers LEED qualification important and relative to the Project.

In addition to the “green” technology that the Energy Facility will employ, the Project is being designed to be consistent with many LEED credits. The Project is also consistent with Boston Green Building Credits for Modern Grid since the Project qualifies as a CHP facility and is in an area of taxed utility infrastructure.

The Project will comply with Article 37 of the Boston Zoning Code. Appendix C provides a draft LEED 2009 for New Construction (LEED 2009 NC) checklist that is being used to address other sustainability issues that may be attainable for this particular project.

The CHP facility and the cogeneration process will incorporate to the extent practical various sustainable design and energy recovery measures namely:

- Energy Efficient Building Envelope
- Energy Efficient Lighting System
- Process Waste Water Reclamation
- Waste Heat Recovery from Boiler Blow Down
- Waste Heat Recovery with Stack Economizers

2.3 Transportation

2.3.1 Vehicle Traffic

The proposed Energy Facility will require seven new full time employees and is not expected to have any impact on the surrounding transportation network: Albany Street, Massachusetts Avenue, or any other local or regional roadways. As the number of new employees required for the Energy Facility is minimal, person trips that are generated will be negligible. No new parking spaces are proposed.

2.3.2 Service and Loading

Trucks will need to access the Energy Facility periodically to service the equipment or for deliveries of new equipment and materials. All servicing for equipment and regular deliveries of materials to support ongoing operations will occur at the new loading dock at the south side of the Energy Facility. Servicing for equipment and deliveries will be scheduled to occur during off-peak traffic hours. Trucks will enter the Project site via the East Concord Street Extension from Albany Street to rear of the Energy Facility. Normal staff access and small material deliveries will occur at the loading dock of the Power Plant via the existing access from Albany Street.

When the north side of the Project site is developed for the Administration/Clinical Building, the existing loading dock for the Power Plant and the West Campus loading dock at the Menino Pavilion will be relocated to the south side of the Project site. At that time, trucks will access the Energy Facility south loading dock via the Southbound Frontage Road access and BioSquare Drive eliminating this function from Albany Street.

2.3.3 Bicycle Facilities

Boston University Medical Center has a very active bicycle program. Through TranSComm, the area's Transportation Management Association, sheltered and secured bicycle parking is offered at several locations on the BUMC Campus. The combination of bicycle racks and cages provides storage for a total of approximately 390 bicycles. See Figure 2-7, BUMC Campus Bicycle Facilities, for bicycle and shower facilities on the BUMC Campus.

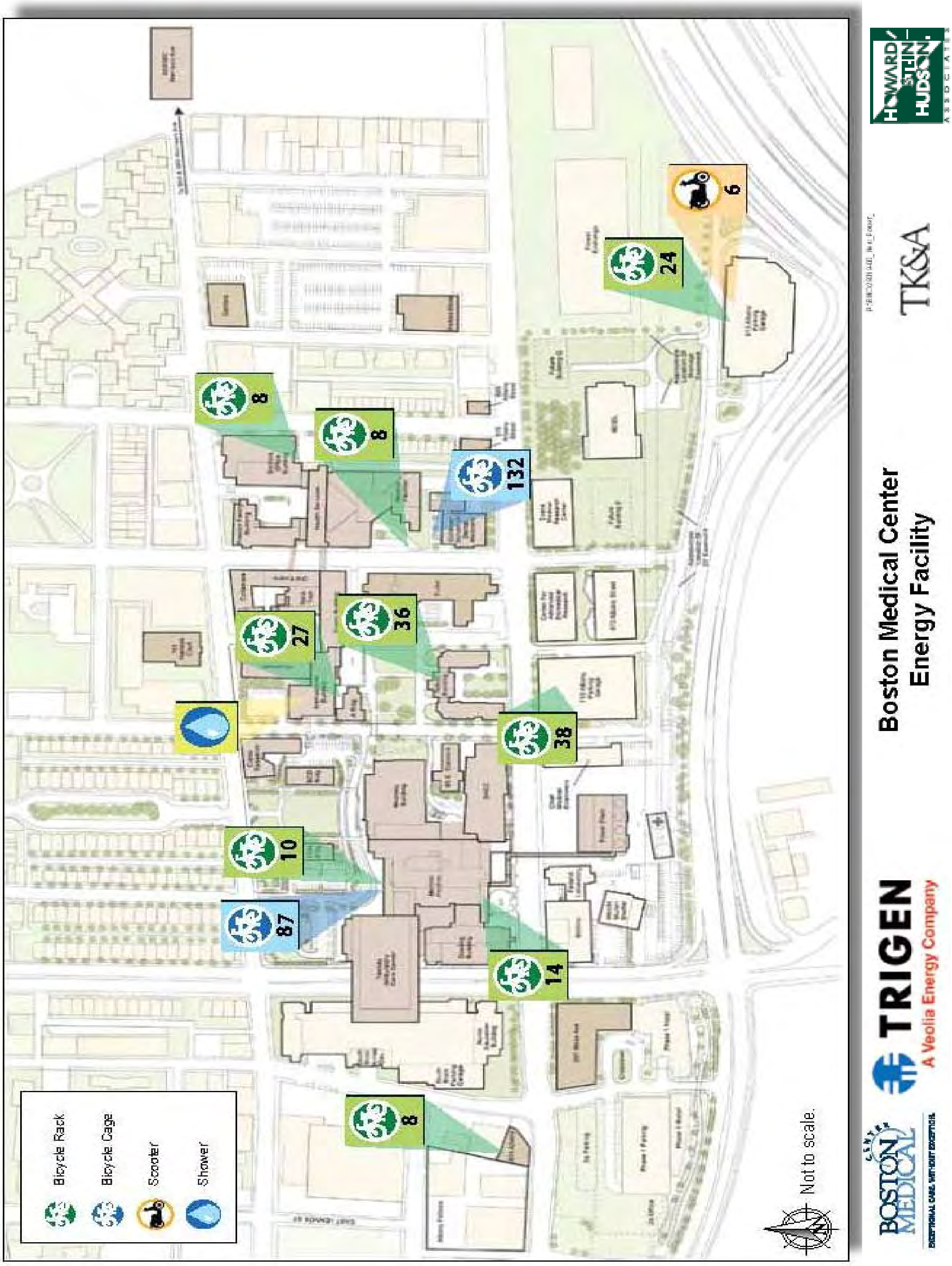
A 2002 TranSComm survey of the Boston University Medical Center employees indicated that only about 1% of employees rode bicycles to work. As outlined in the recently submitted Boston University Medical Center IMP, TranSComm continues to provide amenities and programs to encourage cycling as a healthy, inexpensive and environmentally positive alternative to driving alone. There is also an active biking community on the BUMC Campus, the Bicycle User Group (BUG), which is a network of cyclists working together to continue to improve biking at the medical center.

For the Project, it is anticipated that new lockable bicycle racks for employees and staff will be installed adjacent to the Energy Facility where feasible.

2.3.4 Construction Period Impacts

During construction of the Energy Facility, the impacts to the transportation network and to the community are expected to be minor. The Project will be located several blocks from any residences thusly eliminating any impacts to them. The majority of the work will be staged on Boston University Medical Center property to minimize any effects on pedestrian, bicycle and vehicle operations in the area. See Section 2.5 – Construction Management Plan for more information on managing impacts. Prior to commencing construction, BMC will submit a Construction Management Plan (CMP) to the Boston Transportation Department for review and approval.

Figure 2-7 BUMC Campus Bicycle Facilities



2.4 Environmental Protection

2.4.1 Wind

The Energy Facility is designed to be of similar height and massing to buildings in the vicinity of the Project Site. The building itself will be approximately 100 feet above grade and the 6'-0" diameter stacks will be approximately 160 feet above grade.

Vertical deflection of upper winds usually results from buildings of 300 feet or more in height. As the height of the Project is approximately 100 feet above grade, it is not anticipated that the Project will deflect upper level winds. Channeling of airflows and induced turbulence usually occurs in high-density areas or urban street canyons. The Project does not create a canyon effect and is not expected to result in increased wind speeds.

Based on the height of the Project and its similar massing to surrounding buildings, the Project is not expected to cause significant material impacts to upper level or pedestrian level winds.

2.4.2 Daylight

The Project site is located within a dense urban environment surrounded by buildings of similar height and massing as the proposed Project. The Project is set back approximately 65 feet from the sidewalk and Albany Street (to the north). The site is immediately bordered to the east and west by buildings of similar height. Due to the existing configuration of the Project site, minimal impacts to daylight obstruction are anticipated.

2.4.3 Shadow

The proposed Project site is located in a densely urban area. As the proposed Energy Facility will be surrounded by and adjacent to structures of similar height and massing, any shadow impact will be comparable to the neighboring buildings. Additionally, due to the slender nature of the emissions stacks and the location and position of these stacks, they are less prominent. Net new shadow impacts from these elements are almost imperceptible and mostly fall on the roof of the Energy Facility itself. It is anticipated that the Energy Facility will not create significant net new shadow coverage on public ways or open spaces in the area during the time periods studied. See Appendix B for Shadow Study diagrams.

2.4.4 Solar Glare

It is not anticipated that the Project will include the use of reflective glass or other reflective materials on the building facades that would result in adverse impacts from reflected solar glare from the Project.

2.4.5 Air Quality

2.4.5.1 Emissions Summary

The Project will allow Boston University Medical Center to generate 75% of its own electricity and 95% of its own steam. Cogeneration is a highly efficient method to produce steam and power, resulting in one of the lowest fossil fuel emissions and greenhouse gases. The facility, within one year of operation, will reduce net annual greenhouse gas emissions in excess of 18,000 metric tons of carbon dioxide. The cogeneration facility will consist of two Taurus 70 gas turbines and two duct burners to provide supplemental steam to the Boston University Medical Center distribution system. The gas turbines and duct burners will be fueled by natural gas under normal operating conditions.

The facility will be a minor source of air emissions and will need to file an Environmental Results Program form for a Non-Emergency Turbine and a Non Major Comprehensive Air Plans Approval application for its duct burners. The turbine and duct burner will be designed to meet Massachusetts Department of Environmental Protection's (MassDEP) requirements for Best Available Control Technology. As noted in Section 2.4.5.4, the cogeneration facility demonstrates compliance with the National Ambient Air Quality Standards. Furthermore, the Project will not result in material increases in vehicle trip generation and therefore air quality impacts associated with vehicle emissions will be minimal.

Turbine and Duct Burner Emissions

The Project proposes two Solar Taurus 70 turbines that exhaust to a Heat Recovery Steam Generator (HRSG). Each of the dual fueled-fired turbines will have a heat input of 85.9 MMBtu/hr. The HRSG is capable of supplementary duct firing to produce additional steam. Each of the natural gas-fired duct burners will have a heat input of 129.2 MMBtu/hr.

The turbines will be capable of firing natural gas or Ultra Low Sulfur Diesel (ULSD). Natural gas will be used under normal operating conditions. ULSD would only be used to operate the turbines as an emergency fuel in the event of starting the turbines during a grid power outage, known as a “black start”. The turbines will be limited by capacity of the ULSD tank to firing a maximum of 14 hours of operation using the alternate fuel.

The turbines will be equipped with Selective Catalytic Reduction (SCR) to minimize Oxides of Nitrogen (NOx) emissions and an Oxidation Catalyst to minimize Carbon Monoxide (CO) and Volatile Organic Compound (VOC) emissions. Emissions of Particulate Matter (PM10/PM2.5) and Sulfur Dioxide (SO2) are minimized by efficient combustion controls and choice of natural gas and ULSD as the fuels. The emissions from these units for each fuel are presented in Table 2-1 on the next page.

Table 2-1 Short Term Turbine and Duct Burner Emissions

	Turbine Only		Turbine w/ Duct Firing		
Pollutant	**Natural Gas**	**ULSD**	**Natural Gas**	**ULSD**	**Units**
NO_x	2.5	5	2.5	5	Ppm @ 15% O2
CO	5	5	5	5	ppm @ 15% O2
VOC	3	12	3	12	ppm @ 15% O2
PM10	0.021	0.039	0.014	0.021	lb/MMBtu
PM2.5	0.021	0.039	0.011	0.018	lb/MMBtu
SO_2	0.0006	0.0015	0.0006	0.0010	lb/MMBtu
NH_3	2	2	2	2	ppm @ 15%O2

These emissions will comply with the turbine emission limits established by DEP's air regulations at 310 CMR 7.26(43) or the cogeneration requirements at 310 CMR 7.26(45).

Energy Facility Annual Emissions

The Energy Facility turbines will operate on natural gas with a maximum limit of 720 hours per year of ULSD firing for black start conditions. The Energy Facility's emissions limits for the two turbines and HRSG systems are as follows:

Table 2-2 Estimated Annual Emissions

Pollutant	Energy Facility (tpy)
NO_x	19.7
CO	22.1
VOC	9.5
SO_2	1.2
PM_{10}	29.0
$PM_{2.5}$	23.0

2.4.5.2 Background Air Quality

To estimate background pollutant levels representative of the area, the most recent monitoring values were obtained from the following United States Environmental Protection Agency (EPA) website. Data for 2006 through 2008 were acquired from http://www.epa.gov/air/data/. DEP guidance specifies the use of the latest three years of available monitoring data from within 10 km of the project site.

Background concentrations were determined from the closest available monitoring stations to the Energy Facility. The closest monitoring site is located at Harrison Avenue in Boston, approximately 0.6 miles southwest of the BUMC Campus. See Figure 2-8, DEP Monitoring Station. All pollutants are monitored at Harrison Avenue, i.e., SO_2, CO, NO_2, PM-10, and PM-2.5.

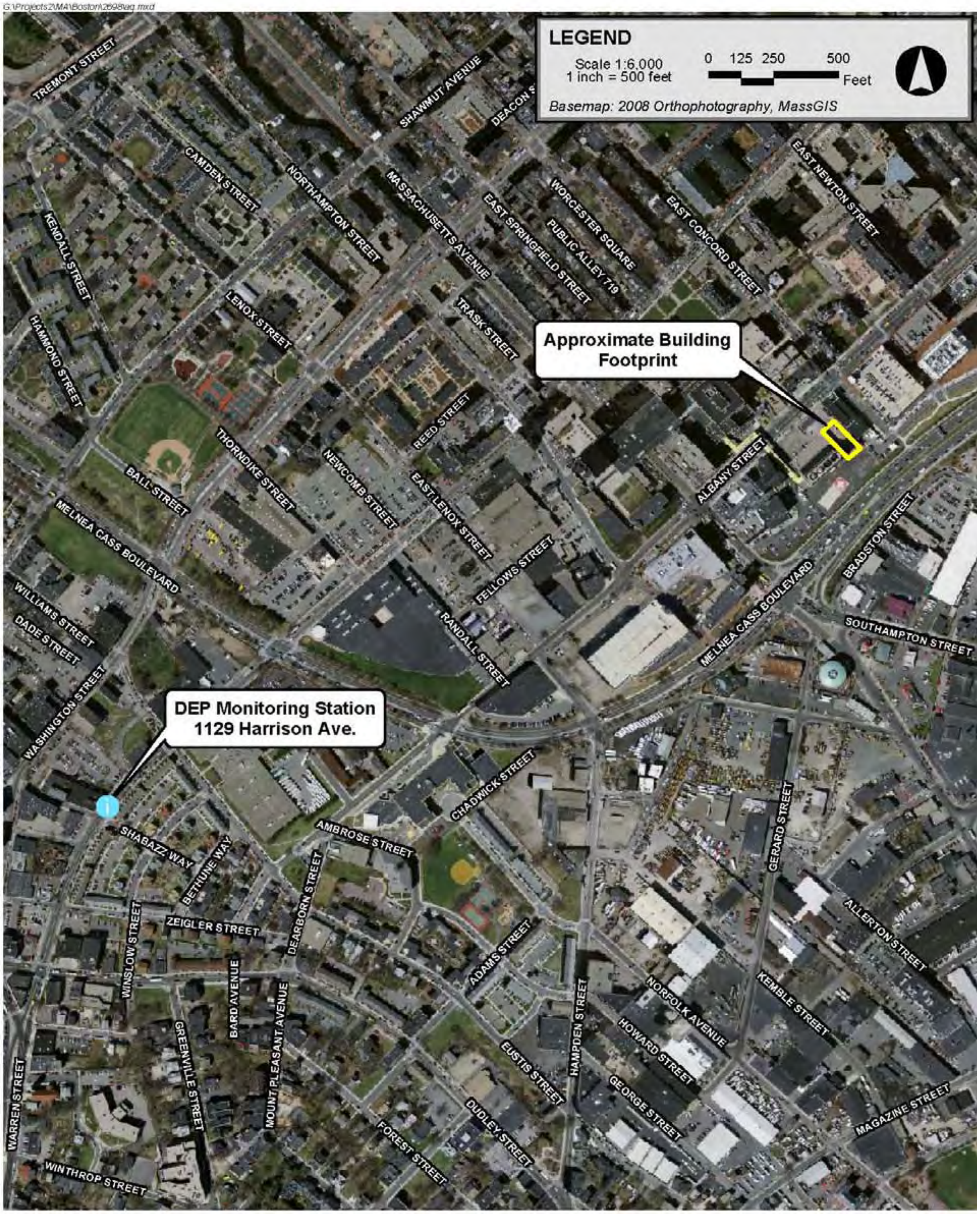
A summary of the background air quality concentrations based on the 2006-2008 data is presented in Table 2-3. For short-term averages (24 hours or less), the highest of the second-highest or the yearly observations will be estimated to be the background concentration, with the exception of $PM_{2.5}$ 24-hour where the 98^{th} percentile concentration was used, consistent with the short-term ambient air quality standards. The short-term ambient air quality standards are not to be exceeded more than once per year. For long-term averages, the highest yearly observation was used as the background concentration.

Table 2-3 Observed Ambient Air Quality Concentrations at Harrison Avenue and Selected Background Levels

	Averaging Period	2006	2007	2008	Background Level	NAAQS
PM-10* (µg/m^3)	24-Hour	38/32/30/28	40/24/23/22	28/27/26/25	30**	150
	Annual	16	14	14	16	50
PM-2.5 (µg/m^3)	24-Hour	27.3	31.5	28.0	28.9***	35
	Annual	9.69	10.48	10.08	10.1***	15
CO (µg/m^3)	1-Hour	3,420	2,280	1,710	3,420	40,000
	8-Hour	1,938	1,368	1,026	1,938	10,000
SO2 (µg/m^3)	3-Hour	49.8	57.6	49.8	57.6	1300
	24-Hour	31.4	34.1	31.4	34.1	365
	Annual	7.9	7.9	5.2	7.9	80
NO2 (µg/m^3)	1-Hour	112.8	135.4	116.6	135.4	188
	Annual	35.7	37.6	37.6	37.6	100

Notes: * Four highest 24-Hour averages during each calendar year.
** Background level for PM10 is the 4th highest over three years.
*** Background level for PM2.5 is the average over three years.

Figure 2-8 DEP Monitoring Station



2.4.5.3 Air Quality Modeling

The EPA *Guideline on Air Quality Models* (EPA, 2005) recommends that an air quality dispersion modeling analysis be performed to assess the pollutant impact in the vicinity of the project applying for a permit. Air quality dispersion modeling was used to document that project emissions will not cause or contribute to any violation of applicable ambient air quality standards. Methods and results are presented in this Section.

Air Quality Model Selection

The EPA approved air quality model used for this analysis is the AERMOD model (version 09292). Using the regulatory default options, AERMOD was used to identify maximum impact concentrations. The AERMODView graphical user interface (GUI) Version 6.4, created by Lakes Environmental, was used to facilitate model setup and post-processing of data.

The AERMOD model is a steady state plume model, using Gaussian distributions that calculate concentrations at each receptor for every hour in the year. The model is designed for rural or urban applications and can be used with a rectangular or polar system of receptors that are allowed to vary with terrain. AERMOD is designed to operate with two preprocessor codes: AERMET processes meteorological data for input to AERMOD, and AERMAP processes terrain elevation data and generates receptor information for input to AERMOD. The AERSURFACE program, a tool provided by EPA, was used to assess the surface characteristics near the meteorological observation site and those data used as input to AERMET. The AERMOD model was selected for the air quality modeling analysis because of several model features that properly simulate the proposed facility environs, including the following:

- Concentration averaging time ranging from one hour to one year;
- Estimating air quality impacts associated with building downwash; and
- Use of actual representative hourly average meteorological data.

The AERMOD model incorporates the Plume Rise Model Enhancements (PRIME), the latest EPA building downwash algorithm for the improved treatment of building downwash. PRIME can also account for the stack placement relative to the building thereby allowing for the ability to calculate impacts in the cavity region near the stack.

A complete technical description of the AERMOD model may be found in the *User's Guide for AERMOD* (EPA, 2004).

Receptor Grid

A nested Cartesian grid of receptors was generated with spacing of 50 meters in a 600 meter by 600 meter bounding box centered on the stacks, 100 meter spacing out to 1000 meters, and 500 meter spacing out to 5 km.

Terrain around the immediate site is relatively flat. The terrain elevation for each receptor was obtained electronically from USGS digital terrain data. The National Elevation Dataset (NED), with a resolution of one arc-second (approximately 30 meters) was processed using the AERMAP program.

AERMOD Model Options

The Boston University Medical Center sources were modeled hour-by-hour using refined modeling techniques for the five years of hourly meteorological data from Logan International Airport. The AERMOD model was used with the regulatory default option set. This automatically selects the EPA recommended options for stack tip downwash, effects of elevated terrain, calm and missing data processing routines, and uses the upper-bound concentration estimates for sources influenced by building downwash from super-squat buildings. Building downwash was modeled using the building dimensions output from BPIP-Prime.

2.4.5.4 AERMOD Results

Predicted concentrations for the combined impact from both combustion turbines are shown in Table 2-4. Modeled impacts were added to ambient measured background levels to document compliance with the National Ambient Air Quality Standards (NAAQS). These predicted concentrations occurred approximately 250 meters to the west of the stacks for each pollutant and averaging time, with the exception of the 1-hour CO impact which was predicted to occur approximately 255 meters to the west-southwest of the stacks.

As documented in Table 2-4 on the next page, the Project complies with the NAAQS for all pollutants and averaging times.

Table 2-4 Comparison of Project Predicted AERMOD Results with the National Ambient Air Quality Standard

Pollutant	Averaging Period	Project Predicted Concentration (µg/m³)	Receptor Location (UTM-E, UTM-N, Elev.) (meters)	Period	Monitored Background Concentration (µg/m³)	Total Impact (µg/m³)	NAAQS (µg/m³)	Percent of NAAQS (%)
PM-10	24-Hr H2H	6.72	329099, 4688957, 4.7	10/12/04	30	36.7	150	24%
PM-2.5	24 Hr H8H	3.94	329099, 4688957, 4.7	12/7/04	28.9	32.8	35	94%
	Annual	0.49	329099, 4688957, 4.7	2004	10.1	10.6	15	71%
NO_2	1-Hr H2H*	17.8	329099, 4688907, 4.9	7/12/05 hr 14	135.4	153.2	188	81%
	Annual	0.42	329099, 4688957, 4.7	2004	37.6	38.0	100	38%
SO_2	3-Hr H2H	5.28	329099, 4688957, 4.7	7/5/08 hr 15	57.6	62.9	1300	5%
	24-Hr H2H	0.29	329099, 4688957, 4.7	7/5/08	34.1	34.4	365	9%
	Annual	0.026	329099, 4688957, 4.7	2004	7.9	7.9	80	10%
CO	1-Hr H2H	10.73	329099, 4688907, 4.9	7/12/05 hr 14	3,420	3,431	40,000	9%
	8-Hr H2H	7.05	329099, 4688957, 4.7	11/30/05 hr 8	1,938	1,945	10,000	19%

2.4.6 Noise

2.4.6.1 Introduction

This section includes a noise analysis for the Project, including a noise-monitoring program to determine existing noise levels and an estimate of future noise levels when the Project is in operation. The analysis indicates that predicted noise levels from Project mechanical equipment will be below the most stringent City of Boston Noise Zoning requirements for nighttime and daytime residential zones, and well below existing measured baseline noise levels in the area.

The Project site is located proximate to I-93 and the Massachusetts Avenue Connector which are the sources for much of the ambient noise in the area. In addition, the ambient noise levels around the Project site are elevated due to the urban nature of the area. As discussed in detail below, the noise modeling analysis demonstrates that the noise levels from the Project will be below Massachusetts Department of Environmental Protection and City of Boston standards in relationship to background noise conditions.

2.4.6.2 Noise Terminology

There are several ways in which sound (noise) levels are measured and quantified. All of them use the logarithmic decibel (dB) scale. The following information defines the noise measurement terminology used in this analysis.

The decibel scale is logarithmic to accommodate the wide range of sound intensities found in the environment. A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a sound of 50 dB is added to another sound of 50 dB, the total is only a three-decibel increase (to 53 dB), not a doubling to 100 dB. Thus, every three dB change in sound levels represents a doubling or halving of sound energy. Related to this is the fact that a change in sound levels of less than three dB is imperceptible to the human ear.

Another property of decibels is that if one source of noise is 10 dB (or more) louder than another source, then the total sound level is simply the sound level of the higher source. For example, a source of sound at 60 dB plus another source of sound at 47 dB is 60 dB.

The sound level meter used to measure noise is a standardized instrument. It contains "weighting networks" to adjust the frequency response of the instrument to approximate that of the human ear under various circumstances. One network is the A-weighting network (there are also B- and C-weighting networks). The A-weighted scale (dBA) most closely approximates how the human ear responds to sound at various frequencies. Sounds are frequently reported as detected with the A-weighting network of the sound level meter. A-weighted sound levels emphasize the middle frequency (i.e., middle pitched – around 1,000

Hertz sounds), and de-emphasize lower and higher frequency sounds. A-weighted sound levels are reported in decibels designated as “dBA.”

Because the sounds in our environment vary with time they cannot simply be described with a single number. Two methods are used for describing variable sounds. These are exceedance levels and the equivalent level, both of which are derived from a large number of moment-to-moment A-weighted sound level measurements. Exceedance levels are values from the cumulative amplitude distribution of all of the sound levels observed during a measurement period. Exceedance levels are designated L_n, where ‘n’ can have a value of 0 to 100%. For example:

- L_{90} is the sound level in dBA exceeded 90% of the time during the measurement period. The L_{90} is close to the lowest sound level observed. It is essentially the same as the residual sound level, which is the sound level observed when there are no obvious nearby intermittent noise sources.

- L_{50} is the median sound level: the sound level in dBA exceeded 50% of the time during the measurement period.

- L_{10} is the sound level in dBA exceeded only 10% of the time. It is close to the maximum level observed during the measurement period. The L_{10} is sometimes called the intrusive sound level because it is caused by occasional louder noises like those from passing motor vehicles.

- L_{eq}, the equivalent level, is the level of a hypothetical steady sound that would have the same energy (i.e., the same time-averaged mean square sound pressure) as the actual fluctuating sound observed. The equivalent level is designated L_{eq} and is also A-weighted. The equivalent level represents the time average of the fluctuating sound pressure, but because sound is represented on a logarithmic scale and the averaging is done with linear mean square sound pressure values, the L_{eq} is mostly determined by occasional loud, intrusive noises.

- The maximum sound level (designated L_{max}) is the greatest sound level measured within a stated time interval.

By using various noise metrics it is possible to separate prevailing, steady sounds (the L_{90}) from occasional, louder sounds (L_{10}) in the noise environment or combined average levels (L_{eq}). This analysis of sounds expected from the Project treats all noises as though they will be steady and continuous and hence the L_{90} exceedance level was used. In the design of noise control treatments it is essential to know something about the frequency spectrum of the noise of interest. Noise control treatments do not function like the human ear, so simple A-weighted levels are not useful for noise-control design. The spectra of noises are usually stated in terms of octave band sound pressure levels, in dB, with the octave frequency bands being those established by standard. To facilitate the noise-control design process, the estimates of noise levels in this analysis are also presented in terms of octave band sound pressure levels.

Baseline noise levels were measured in the vicinity of the proposed buildings and were compared to predicted noise levels that were based on standard engineering practice or information provided by the manufacturers of representative mechanical equipment. The predicted noise levels were compared to the City of Boston Zoning District Noise Standards, and the Massachusetts Department of Environmental Protection (MassDEP) Noise Policy.

2.4.6.3 Noise Regulations and Criteria

The primary set of regulations relating to the potential increase in noise levels is the City of Boston Zoning District Noise Standards (City of Boston Code – Ordinances: Section 16–26 Unreasonable Noise and City of Boston Air Pollution Control Commission Regulations for the Control of Noise in the City of Boston). Results of the baseline ambient noise level survey and the modeled noise levels were compared to the City of Boston Zoning District Noise Standards. Separate regulations within the Standard provide criteria to control different types of noise. Regulation 2 is applicable to the effects of the completed proposed buildings and was considered in this noise study. Table 2-5 includes the Zoning District Standards.

The Massachusetts Department of Environmental Protection (MassDEP) regulates community noise by its Noise Policy: DAQC policy 90-001. The MassDEP policy limits source sound levels to a 10-dBA increase in the ambient measured noise level (L_{90}) at the Project property line and at the nearest residences. The policy further prohibits pure tone conditions – when any octave band center frequency sound pressure level exceeds the two adjacent center frequency sound pressure levels by three decibels or more.

Table 2-5 City of Boston Zoning District Noise Standards, Maximum Allowable Sound Pressure Levels

Octave Band Center	Residential Zoning District		Residential-Industrial Zoning District		Business Zoning District	Industrial Zoning District
Frequency (Hz)	Daytime (dB)	All Other Times (dB)	Daytime (dB)	All Other Times (dB)	Anytime (dB)	Anytime (dB)
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1000	50	40	56	45	56	61
2000	45	33	51	39	51	57
4000	40	28	47	34	47	53
8000	38	26	44	32	44	50

A-Weighted (dBA)	**60**	**50**	**65**	**55**	**65**	**70**

Notes:
- ♦ Noise standards are extracted from Regulation 2.5, City of Boston Air Pollution Control Commission, "Regulations for the Control of Noise in the City of Boston", adopted December 17, 1976.
- ♦ All standards apply at the property line of the receiving property.
- ♦ dB and dBA based on a reference pressure of 20 micropascals.
- ♦ Daytime refers to the period between 7:00 am and 6:00 pm daily except Sunday.

2.4.6.4 Existing Conditions

Baseline Noise Environment

An ambient noise level survey was conducted to characterize the existing “baseline” acoustical environment in the vicinity of the Project. Existing noise sources in the vicinity of the Project include: vehicular traffic (including trucks) on the local roadways; pedestrian traffic; and mechanical equipment located on the surrounding buildings.

Noise Measurement Locations

The selection of the sound monitoring receptor locations was based upon a review of the current land use in the area of the Project Site. Noise was measured at six locations in the vicinity of the Project site to establish background noise conditions. The measurement locations are depicted on Figure 2-9 and are described below.

- Location 1 is in a Boston Medical Center parking lot on East Brookline Street. The receptor was located south of the parking lot gate, adjacent to the residential property at 81 East Brookline Street.
- Location 2 is near the residential property at 107 East Brookline Street.
- Location 3 is near the Boston Medical Center Menino Pavilion entrance on Albany Street.
- Location 4 is near the Hampton Inn at 811 Massachusetts Avenue.
- Location 5 is near the intersection of Harrison Avenue and Public Alley 716 (between Massachusetts Avenue and East Springfield Street) which is representative of the residential area north of Harrison Avenue.
- Location 6 is near the residential property at 39 Worcester Square.

Noise Measurement Methodology

Short-term sound level measurements were made at all six locations for 20 minutes per location during daytime hours (11:00 am to 4:00 pm) on January 07, 2010, and nighttime hours (12:00 am to 4:00 am) on January 08, 2010. Since noise impacts are greatest at night when existing noise levels are lowest, the study was designed to measure community noise levels under conditions typical of a “quiet period” for the area. Daytime measurements were scheduled to exclude peak traffic conditions.

In addition to the short-term sampling data, one continuous programmable sound level meter was placed at Location 1 on January 06, 2010. This monitor continuously measured and stored hourly sound level statistics for 36 consecutive hours in order to confirm that the short-term sampling was indeed representative of the lowest sound levels. This monitor ran from 3:00 P.M. Wednesday, January 06, 2010, until 3:00 AM on Friday, January 08, 2010. Field personnel periodically checked on the integrity of the continuous equipment, and observed and recorded the noise sources at the monitoring location.

Short-term sound levels were measured at a height of five feet above the ground while the continuous sound level was measured at a height of six feet above the ground. Both continuous and short-term sound levels were measured at publicly accessible locations. The measurements were generally made under low wind conditions and with dry roadway surfaces. Wind speed measurements were made with a Davis Instruments TurboMeter electronic wind speed indicator, and temperature and humidity measurements were made using a psychrometer. Unofficial observations about meteorology or land use in the community were made solely to characterize the existing sound levels in the area and to estimate the noise sensitivity at properties near the proposed Project.

Measurement Equipment

Short-term measurements were taken with a CEL Instruments Model 593.C1 Precision Sound Level Analyzer equipped with a CEL-257 Type 1 Preamplifier, a CEL-250 half-inch electret microphone, and a four-inch foam windscreen. Both short-term broadband and octave band ambient sound pressure level data were collected. This instrument meets the “Type 1 - Precision” requirements set forth in American National Standards Institute (ANSI) S1.4 for acoustical measuring devices. The microphone was tripod-mounted at a height of five feet above ground, and the meter was set to the “slow” response. Statistical descriptors (L_{eq}, L_{90}, etc.) were calculated for each 20-minute sampling period. Octave band levels for this study correspond to the same data set processed for the broadband levels. The measurement equipment was calibrated in the field before and after the surveys with a CEL-110/1 acoustical calibrator, which meets the standards of IEC 942 Class 1L and ANSI S1.40-1984.

A Larson Davis model 812 Sound Level Meter was used for the continuous monitoring. This meter was equipped with a Larson Davis PRM828 Preamplifier, a PCB Piezotronics 337B02 microphone, and a foam windscreen. This instrument meets Type 1 ANSI S1.4-1983 standards for sound level meters. The microphone was mounted at a height of six feet above ground, and the meter was set to the “slow” response. The model 812 has data logging capability and was programmed to log statistical data every hour for the following parameters: L_1, L_{10}, L_{50}, L_{90}, L_{max}, L_{min}, and L_{eq}. The measurement equipment was calibrated in the field before and after the surveys with a CEL-110/1 acoustical calibrator, which meets the standards of IEC 942 Class 1L and ANSI S1.40-1984.

Both instruments have been calibrated and certified as accurate to standards set by the National Institute of Standards and Technology by an independent laboratory within the past 12 months.

Figure 2-9 Sound Level Measurement Locations

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Boston University Medical Center Boston, Massachusetts

Epsilon

Noise Monitoring Locations

Baseline Ambient Noise Levels

The existing ambient noise environment for the short-term 20-minute measurements is impacted primarily by mechanical equipment located on surrounding buildings and by vehicular traffic on nearby roadways, including Albany Street, Harrison Avenue, and Massachusetts Avenue. Baseline short-term 20-minute noise monitoring results are presented in Table 2-6, and summarized below.

- The daytime residual background (L_{90}) measurements ranged from 54 to 65 dBA;
- The nighttime residual background (L_{90}) measurements ranged from 49 to 62 dBA;
- The daytime equivalent level (L_{eq}) measurements ranged from 61 to 74 dBA; and
- The nighttime equivalent level (L_{eq}) measurements ranged from 51 to 67 dBA.

The existing ambient noise environment for the long-term measurement is impacted primarily by mechanical equipment located on surrounding buildings, vehicular traffic entering and exiting the adjacent parking lot and parking garage, and vehicular traffic on nearby roadways, including Albany Street, Harrison Avenue, Massachusetts Avenue, and East Brookline Street. Baseline long-term noise monitoring results are presented in Table 2-7, plotted on Figure 2-10, and summarized below.

- The long-term residual background (L_{90}) measurements ranged from 51 to 55 dBA;
- The long-term equivalent level (L_{eq}) measurements ranged from 52 to 65 dBA.

Table 2-6 Baseline Ambient Noise Measurements

							Octave Band Center Frequency (Hz)								
Location and Period	Start	L_{10}	L_{50}	L_{90}	L_{eq}	L_{max}	32	63	125	250	500	1000	2000	4000	8000
	Time	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)	L_{90} (dB)
Loc 1 Day	1:47 PM	65	58	**57**	62	-	66	62	59	57	55	51	47	37	28
Loc 2 Day	11:25 AM	68	60	**57**	66	81	66	64	59	58	56	51	45	34	22
Loc 3 Day	3:02 PM	74	68	**65**	71	-	71	71	67	64	63	61	56	48	38
Loc 4 Day	2:30 PM	76	68	**64**	74	92	74	75	70	62	59	59	55	48	40
Loc 5 Day	12:31 PM	71	65	**61**	68	84	72	71	65	59	57	56	53	47	40
Loc 6 Day	1:12 PM	64	57	**54**	61	76	65	63	57	53	52	49	44	37	30
Loc 1 Night	2:39 AM	52	52	**51**	52	56	58	57	55	53	51	45	38	28	19
Loc 2 Night	2:09 AM	57	55	**55**	56	65	64	60	57	57	55	48	41	32	21
Loc 3 Night	12:19 AM	69	64	**62**	67	84	66	64	65	60	59	57	53	44	33
Loc 4 Night	12:47 AM	68	61	**57**	65	84	64	64	62	55	53	52	48	39	31
Loc 5 Night	1:15 AM	63	56	**53**	60	75	63	59	56	53	51	48	44	36	33
Loc 6 Night	1:41 AM	53	49	**49**	51	63	58	56	51	50	48	43	37	26	16

Notes:

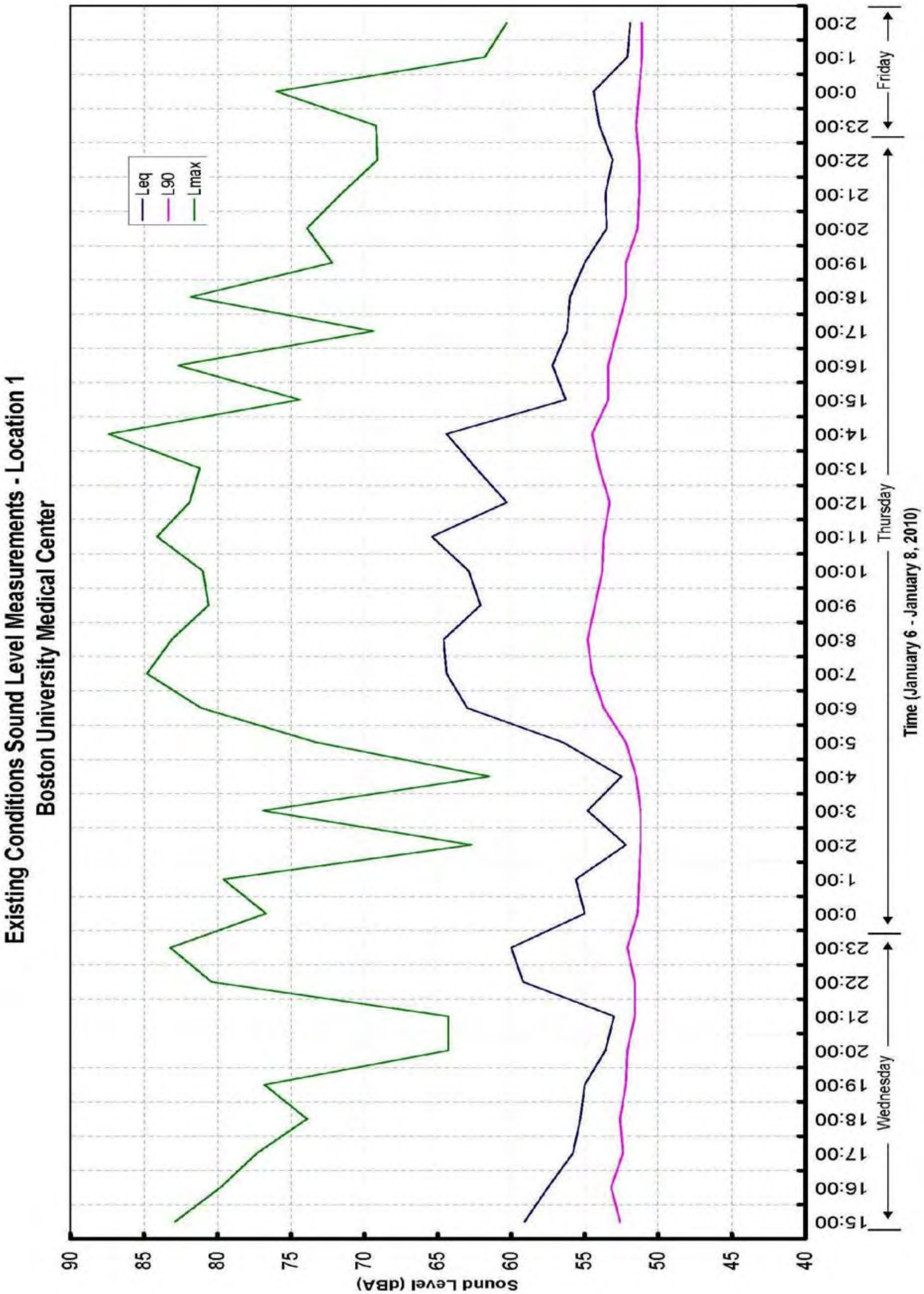
1. Daytime weather: Temperature = 39^0 F, RH = 51%, skies sunny, winds 0-4 mph.
   Nighttime weather: Temperature = 30^0 F, overcast skies, winds 0-8 mph.
2. Road Surfaces were dry during all periods.
3. All sampling periods were approximately 20 minutes duration.
4. Daytime measurements were collected on January 07, 2010.
   Nighttime measurements were collected on January 08, 2010.

Table 2-7 Continuous Ambient Noise Measurement

Date	Start Time	L_{90} (dBA)	L_{eq} (dBA)	L_{max} (dBA)
January 6, 2010	3:00 PM	53	59	83
January 6, 2010	4:00 PM	53	58	80
January 6, 2010	5:00 PM	52	56	77
January 6, 2010	6:00 PM	53	55	74
January 6, 2010	7:00 PM	52	55	77
January 6, 2010	8:00 PM	52	54	64
January 6, 2010	9:00 PM	52	53	64
January 6, 2010	10:00 PM	52	59	80
January 6, 2010	11:00 PM	52	60	83
January 7, 2010	12:00 AM	51	55	77
January 7, 2010	1:00 AM	51	56	80
January 7, 2010	2:00 AM	51	52	63
January 7, 2010	3:00 AM	51	55	77
January 7, 2010	4:00 AM	52	53	62
January 7, 2010	5:00 AM	52	57	73
January 7, 2010	6:00 AM	54	63	81
January 7, 2010	7:00 AM	55	64	85
January 7, 2010	8:00 AM	55	65	83
January 7, 2010	9:00 AM	54	62	81

Date	Start Time	L_{90} (dBA)	L_{eq} (dBA)	L_{max} (dBA)
January 7, 2010	10:00 AM	54	63	81
January 7, 2010	11:00 AM	54	65	84
January 7, 2010	12:00 PM	53	60	82
January 7, 2010	1:00 PM	54	62	81
January 7, 2010	2:00 PM	55	64	87
January 7, 2010	3:00 PM	53	56	74
January 7, 2010	4:00 PM	53	57	83
January 7, 2010	5:00 PM	53	56	69
January 7, 2010	6:00 PM	52	56	82
January 7, 2010	7:00 PM	52	55	72
January 7, 2010	8:00 PM	51	54	74
January 7, 2010	9:00 PM	51	54	72
January 7, 2010	10:00 PM	51	53	69
January 7, 2010	11:00 PM	52	54	69
January 8, 2010	12:00 AM	51	54	76
January 8, 2010	1:00 AM	51	52	62
January 8, 2010	2:00 AM	51	52	60

Figure 2-10 Baseline Long-Term Noise Monitoring



Overview of Potential Project Noise Sources

This section provides a detailed discussion of the primary components of the Energy Facility and their associated reference sound level data. The key component – gas turbine generator – has been selected and manufacturer's sound level data for this component is used in the analysis. As is typical for a power project, certain components are selected and purchased by the EPC contractor later in the Project development effort. Accordingly, the reference sound level data used for the noise modeling includes the primary vendor data, as well as representative data from comparable projects, field measurements of similar equipment made at existing plants, and values from the literature based on engineering parameters. Several non-major noise sources which might otherwise have been included in the analysis were not modeled since they will be inside the Energy Facility building, and will be insignificant.

Table 2-8 summarizes the sound level data for the equipment described in the following sections. These sound levels constitute the "Base Case" which represents a reasonably well-controlled package, including enclosures, rated at "85 dBA at 1 meter." The primary sources of noise from the Energy Facility are the gas turbine generator and associated air intake and exhaust, wet mechanical cooling tower, and the rooftop air intake/exhaust fans.

Gas Turbine Generator Package

Two Solar Taurus 70 turbines are proposed. These packages will consist of both a gas turbine and an AC generator module. Each unit is rated at approximately 7 MW. The gas turbine will be housed within an acoustical enclosure, and located within the Energy Facility building. According to the manufacturer, these units will not exceed 85 dBA at 3 feet.

Gas Turbine Air Inlet

Each gas turbine generator package is equipped with an air inlet filter. Each air inlet filter will be located within Level 2 of the Energy Facility building. Fresh air will be drawn in through a louver in the north wall facing Albany Street, and ducted through a combustion air inlet plenum. The elevation of the air inlet filter ranges from approximately 38 feet above ground level (bottom of louver) to 59 feet above ground level (top of louver). Sound from each air inlet will be reduced by two devices – an inlet silencer and the pulse-cleaning cross-flow system. Air inlet and sound level reduction data were provided by Solar from comparable projects.

Gas Turbine Stack Exhaust

Each gas turbine generator package will exhaust through an SCR and HRSG, and then up an exhaust stack. Sound levels radiating out the top of the stack approximately 160 feet above ground level were included as an elevated sound source. Sound from the unsilenced gas turbine exhaust will be reduced by both the SCR and HRSG prior to exiting the stack.

Exhaust data were provided by Solar while the reduction from the SCR and HRSG were estimated based on other vendor data.

Cooling Tower

A 2-cell wet mechanical cooling tower is proposed for the rooftop of the Energy Facility building. A typical cooling tower for this type of application is the Marley NC8403QAN2 which is approximately 12 feet high. Marley provided sound power level data for this source.

Gas Compressors

Two natural gas compressors will be located on the rooftop of the Energy Facility building. These units will be located inside an enclosure to reduce sound levels. Sound level data are not currently available for the compressors. For this analysis, sound level data from another power plant project using similarly sized gas compressors in an enclosure were used in the modeling.

Exhaust/Supply Air Fans

Three exhaust air fans and three supply air fans will be mounted on the roof of the Energy Facility building. Sound level data for typical fans were used in the modeling.

Insignificant Sources

Several sources were considered as part of the sound modeling but were not included as they were insignificant as compared to the primary sources. These included:

- Lube oil cooler (minor source and inside building);
- Transformers (inside building);
- Gas metering station.

Table 2-8 Sound Power or Sound Pressure Level Data for Project Noise Modeling – Base Case (per unit) (dB)

Plant Component	No.	Ref. distance	dBA	Octave Band Center Frequency (Hz)								
				31.5	63	125	250	500	1k	2k	4k	8k
Solar Taurus 70 Air Inlet (unsilenced)	2	50 ft	127	79	85	91	92	93	95	98	126	118
Combustion air inlet – silencer insertion loss	2	NA	NA	1	3	7	11	20	40	55	53	41
Combustion air inlet – pulse-cleaner insertion loss	2	NA	NA	0	3	5	7	12	9	18	17	24
Solar Taurus 70 gas turbine generator – enclosed package	2	3 ft	85	96	89	86	83	81	80	78	75	70
Solar Taurus 70 gas turbine exhaust (unsilenced)	2	Lw	130	123	126	123	127	129	125	119	112	99
SCR/HRSG – noise reduction for turbine exhaust	2	NA	NA	17	23	29	35	45	55	55	51	37
Wet mechanical cooling tower	1	Lw	101	--	105	103	104	99	94	90	86	80
Gas compressors on roof	2	Lw	91	88	88	85	83	85	77	85	84	84
Exhaust air fans on roof	3	Lw	117	--	110	109	109	112	112	110	107	107
Supply air fans on roof	3	Lw	112	--	105	104	104	109	108	105	102	100

Lw = sound power level.
NA= Not applicable to sound power level, or insertion loss.
-- = Data unavailable from the manufacturer

Modeling Methodology

Anticipated noise impacts associated with the Project were predicted at the nearest residences around the Project site using the CadnaA noise calculation software. This software uses the ISO 9613-2 industrial noise calculation methodology. CadnaA allows for octave band calculation of noise from multiple noise sources, as well as for computation of diffraction around building edges and multiple reflections off parallel buildings and solid ground areas. In this manner, all significant noise sources and geometric propagation effects are accounted for in the noise modeling.

2.4.6.6 Conclusions

Predicted mechanical equipment noise levels from the Project at each receptor location, taking into account attenuation due to distance, structures, and noise control measures, are all below the MassDEP criteria of 10 dBA over the quietest nighttime sound levels. The predicted Project-generated exterior sound levels are expected to range from 20 dBA to 49 dBA at nearby receptors. The predicted sound levels from Project-related equipment are within the most stringent nighttime residential zoning limits for the City of Boston (50 dBA or less) at closest residential receptors. Locations 3 (Menino Pavilion) and the Energy Facility courtyard are part of the BUMC Campus and not considered off-site. It should be noted that the existing ambient background levels already exceed 50 dBA at most locations studied.

The Project's mechanical equipment will not create any pure tone conditions when combined with existing middle of the night background sound levels. The results of the modeling, including mitigation, are shown in Table 2-9 (MassDEP criteria) and Table 2-10 (Boston criteria).

The results indicate that noise levels due to the Project at the various receptor locations are below the most stringent City of Boston Noise Zoning requirements for a nighttime residential zone for street-level receptors, and they are below existing measured nighttime baseline noise levels. As shown in Table 2-9, the increase in sound level is expected to be zero dBA. Therefore, the results of the analysis indicate that the proposed Project can operate without significant impact on the existing acoustical environment.

Table 2-9 Comparison of Future Predicted Nighttime Sound Levels with Existing Background – MassDEP Criteria

Location	Lowest Existing L_{90} -- Nighttime (dBA)	Project-Generated Sound Levels (dBA)[1]	Future L_{90} – Nighttime Total (dBA)	Increase (dBA)
Location 1 – East Brookline Ave	51	20	51	0
Location 2 - East Brookline Ave.	55	27	55	0
Location 3 – Menino Pavilion (on-site)	62	45	62	0
Location 4 – Hampton Inn	57	29	57	0
Location 5 – Harrison Ave/Mass Ave	53	27	53	0
Location 6 – Worcester Square	49	32	49	0
BMC Energy Facility Courtyard (on-site)	62[2]	49	62	0

1. Assumes equipment operates continuously.
2. Use Location 3 measurement as representative background.

Table 2-10 Comparison of Future Predicted Nighttime Sound Levels Incorporating Appropriate Mitigation to City of Boston Criteria – Off-site Locations

		Octave Band Center Frequency (Hz)								
Location	**A-wtd**	**31.5[1]**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
	(dBA)	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**	**L_{90} (dB)**
Location 1	20	--	37	28	23	16	8	8	0	0
Location 2	27	--	41	31	24	23	17	22	13	0
Location 4	29	--	45	35	29	26	19	23	16	0
Location 5	27	--	42	34	31	24	16	13	4	0
Location 6	32	--	44	38	36	30	22	20	9	0
City of Boston - Nighttime Limits	50	68	67	61	52	46	40	33	28	26

1. Predictive 31.5 Hz octave band level cannot be calculated due to absence of manufacturer's data (see Table 2-8.)

2.4.7 Flood Hazard Zones / Wetlands

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the site located in the City of Boston - Community Panel Number 250286 0010 C indicates the FEMA Flood Zone Designations for the site area. The map shows that the Project is located in a Zone C, Area of Minimal Flooding. The site does not contain wetlands.

2.4.8 Geotechnical/Groundwater

2.4.8.1 Subsurface Conditions

Generally the site is overlain with approximately 8 to 10 ft of miscellaneous fill. The fill unit is underlain by relatively soft organic silt and peat (15 to 20 ft thick layer). Naturally deposited marine clay is present approximately 25 to 30 ft below grade. These deposits are comparatively thick and underlain by a glaciomarine deposit and glacial till. Bedrock is approximately 125 to 175 ft below the ground surface.

Groundwater level measurements obtained at monitoring wells installed on and in the vicinity of the Project have been reviewed to develop an understanding of groundwater conditions and considerations for below-grade construction design and planning. Groundwater levels vary with season and other local influences, and groundwater levels ranging between three and eight feet below grade (El. 9 to 14) were recorded in the past.

2.4.8.2 Foundation Methodology

The surficial fill and organic soils are not suitable for foundation support. It is anticipated that the proposed foundations would need to extend at least to the naturally deposited, inorganic marine clay or glacial till/bedrock, depending upon the structure loads. For the one basement level design being considered, foundations that are feasible include drilled shafts, piles, and pressure injected footings.

2.4.8.3 Excavation Support

For construction of the basement space, a temporary excavation support system that is compatible with subsurface conditions will be designed in order to provide adequate support and protection of the adjacent streets and utilities. It is anticipated that in general, the excavation support systems will consist of soldier piles and lagging or interlocking steel sheets.

2.4.8.4 Groundwater Conditions

Groundwater level measurements obtained at monitoring wells installed on and in the vicinity of the Project have been reviewed to develop an understanding of groundwater conditions and considerations for below-grade construction design and planning.

Groundwater levels vary with season and other local influences, and groundwater levels ranging between 3 and 8 ft below grade (El. 9 to 14) were recorded in the past.
The proposed structure includes one below grade level. The foundation elements that are required to extend down to competent soils, below the groundwater level, will be solid, discontinuous, discrete elements that will not cause the groundwater to raise, pond or be lowered.

The Project is located within the Groundwater Conservation Overlay District (GCOD). The Project design will comply with GCOD and City standards by establishing design and construction methodology which protects groundwater. The Project will demonstrate that the permanent construction results in no negative impacts to groundwater levels through engineering evaluations. An engineers' certification report will be submitted to demonstrate that the standards have been met. Methods to assure these standards include use of fully waterproofed basement (walls and lowest level floor slabs) for the portion of the structure that extends below groundwater levels which will be designed to resist hydrostatic uplift pressures. Design criteria for the Project will include provision that no long term groundwater pumping will be allowed.

Roof runoff from the Project will be directed to an underground infiltration system at the rear of the proposed building. The infiltration system will likely consist of plastic chambers surrounded by crushed stone and wrapped in geotextile. The system has been sized to retain and infiltrate a volume of stormwater greater than 1" of rainfall over the entire roof area. Supporting design calculations are noted on the schematic site plan. See Figure 2-11 under Infrastructure Systems.

The Proponent has met with the Boson Groundwater Trust (BGwT) to review the proposed infiltration system as well as groundwater monitoring prior to and during construction. BGwT has confirmed that the proposed infiltration system location is acceptable. One groundwater monitoring well will be installed prior to construction to document existing groundwater levels and hydrogeologic conditions. The well will be installed in accordance with City and BGwT standards for permanent monitoring wells. The proposed well location is in the vicinity of the Chief Medical Examiner's Office building where it will be accessible for long term monitoring.

2.4.9 Water Quality

The proposed Project will be designed and constructed to protect surface and ground waters from negative impact to water quality both during and post construction. The site of the proposed Project is currently 100% paved and used for parking and as a storage area. Approximately 11,000 s.f. of this pavement area will be removed and replaced with a new building. Runoff from the new building roof, which is not subjected to parking lot pollutants such as sand and salt, will likely be free of sediments and will be able to be infiltrated into the ground. Runoff from the proposed building will be directed to a new infiltration system at the rear of the project site. The replacement of paved parking area with building area will decrease the pollutant load in runoff from the site and help to improve water quality within the area.

Stormwater runoff from the site during construction will be monitored and is expected to be minimal. It will be controlled through the use of sedimentation barriers, catch basin silt sacks, stabilized construction entrances and other appropriate Best Management Practices (BMP's). These BMP's will serve to protect water quality by preventing sediment laden runoff from leaving the work area and entering the existing stormwater system and ultimately Boston Harbor.

2.4.10 Solid and Hazardous Wastes

2.4.10.1 Existing Soil Conditions

Testing of soil and groundwater is planned in advance of construction to characterize materials to be excavated; to support planning for off-site disposition of soils and management of construction dewatering effluent; and to identify environmental regulatory requirements, if applicable.

2.4.10.2 Construction Waste and Disposal

Solid waste generated by construction will consist of excavated material and debris. Excavated material will be composed of miscellaneous fill and underlying natural deposits. Excavation and off-site disposition will be conducted in accordance with a Soil Management Plan developed for the Project and included as part of the Construction Documents. The Soil Management Plan will describe procedures for identification, management and off-site transport of any contaminated soils. Management of soil during excavation and construction will be conducted in accordance with applicable local, state, and federal laws and regulations.

Construction dewatering will be conducted in accordance with a Groundwater Management Plan that will be included as part of the Construction Documents. The Groundwater Management Plan will describe the procedures for maintenance of groundwater levels and for the treatment (if necessary) and discharge of effluent from dewatering activities.

2.4.10.3 Solid Waste Generation and Recycling

The Project will generate solid waste from employee and staff maintenance offices such as wastepaper, cardboard, glass bottles, aluminum cans, etc. Recycling of this material will be encouraged and managed through Boston University Medical Center's active campus recycling program. There are staging areas in the existing Power Plant for recycling bins that will accommodate the recyclable material from the Energy Facility.

2.4.11 Rodent Control

A rodent extermination certificate will be filed with the building permit application to the City. Rodent inspection monitoring and treatment will be carried out before, during, and at the completion of all construction work for the proposed Project, in compliance with the City's requirements. Rodent extermination prior to work start-up will consist of treatment of areas throughout the site. During the construction process, regular service visits will be made.

2.4.12 Wildlife Habitat

The site is within a fully developed urban area and, as such, the proposed Project will not impact wildlife habitats as shown on the National Heritage and Endangered Species Priority Habitats of Rare Species and Estimated Habitats of Rare Wildlife.

2.5 Construction Management Plan

A Construction Management Plan (CMP) will be submitted to the Boston Transportation Department (BTD) for review and approval prior to issuance of a building permit. The CMP will define truck routes which will help minimize the impact of trucks on local streets. The construction contractor will be required to comply with the details and conditions of the approved CMP.

Construction methodologies that ensure public safety and protect nearby businesses will be employed. Techniques such as barricades, walkways, painted lines, and signage will be used as necessary. Construction management and scheduling, including plans for construction worker commuting and parking, routing plans and scheduling for trucking and deliveries, protection of existing utilities, maintenance of fire access, and control of noise and dust, will minimize impacts on the surrounding environment.

2.5.1 Construction Schedule and Coordination

Construction of the Project is estimated to last approximately 18 months. Initial site work is expected to begin during the 4^{th} Quarter of 2010.

Typical construction hours will be from 7:00 am to 6:00 pm, Monday through Friday, with most shifts ordinarily ending at 3:30 pm. No sound-generating activity will occur before 7:00 am. If longer hours, additional shifts, or Saturday work is required, the Construction Manager will place a work permit request to the Boston Air Pollution Control Commission and BTD in advance. Notification should occur during normal business hours, Monday through Friday. It is noted that some activities such as finishing activities could run beyond 6:00 pm to ensure the structural integrity of the finished product. (Certain components must be completed in a single pour and placement of concrete cannot be interrupted.)

Proper planning with the City, neighborhood and developers of other projects under construction in the area will be essential to the successful construction of the Project. The construction contractor will be responsible for coordinating construction activities during all phases of construction with City of Boston agencies to minimize potential scheduling and construction conflicts with other ongoing construction projects in the area.

2.5.2 Construction Staging and Public Safety

Primary staging will be on-site. The proposed construction staging plan will be designed to isolate the construction while providing safe access for pedestrians and vehicles during normal day-to-day activities and emergencies. The staging areas will be secured by chain-link fencing to protect pedestrians from entering these areas.

Although specific construction and staging details have not been finalized, the Proponent and its construction management consultants will work to ensure that staging areas will be located to minimize impacts to pedestrian and vehicular flow. Secure fencing and barricades will be used to isolate construction areas from pedestrian traffic adjacent to the site. In addition, sidewalk areas and walkways near construction activities will be well marked and lighted to protect pedestrians and ensure their safety. If required by BTD and the Boston Police Department, police details will be provided to facilitate traffic flow. Construction procedures will be designed to meet all Occupational Safety and Health Administration (OSHA) safety standards for specific site construction activities.

2.5.3 Construction Employment and Worker Transportation

The number of workers required during the construction period will vary, with an estimated average daily work force ranging from approximately 10 to 20. The Proponent will make reasonable good-faith efforts to have at least 50 percent of the total employee work hours for Boston residents, at least 25 percent of total employee work hours for minorities and at least 10 percent of the total employee work hours for women. The Proponent will enter into a construction jobs agreement with the City of Boston.

To reduce vehicle trips to and from the construction site, minimal construction worker parking will be available at the site and all workers will be strongly encouraged to use public transportation and ridesharing options. The Proponent and contractor will work aggressively to ensure that construction workers are well informed of the public transportation options serving the area. Five bus routes currently service the area, and the Project site is proximate to the Silver Line. Space on-site will be made available for workers' supplies and tools so they do not have to be brought to the site each day.

2.5.4 Construction Truck Routes and Deliveries

The construction team will manage deliveries to the site during morning and afternoon peak hours in a manner that minimizes disruption to traffic flow on adjacent streets. The construction team will provide subcontractors and vendors with Construction Vehicle &

Delivery Truck Route Brochures in advance of construction activity. “No Idling” signs will be included at the loading, delivery, pick-up and drop-off areas.

Truck traffic will vary throughout the construction period depending on the activity. Construction truck routes to and from the Project site for contractor personnel, supplies, materials, and removal of excavations will be coordinated by the Proponent with the BTD and established in the CMP. These routes will be mandated as a part of subcontractors' contracts for the Project. Traffic logistics and routing are planned to minimize community impacts.

See also Section 2.3.4 for more information.

2.5.5 Construction Noise

The Proponent is committed to mitigating noise impacts from Project construction. Construction work will comply with the requirements of the City of Boston Code -- Ordinances and the Regulations for Control of Noise in Boston administered by the Boston Environment Department. Every reasonable effort will be made to minimize the noise impact of construction activities.

Construction period noise mitigation measures are expected to include the following:

- Instituting a proactive program to ensure compliance with the City of Boston ordinances and regulations;
- Using appropriate mufflers on all equipment and ongoing maintenance of intake and exhaust mufflers;
- Muffling enclosures on continuously running equipment, such as air compressors and welding generators;
- Replacing specific construction operations and techniques by less noisy ones where feasible;
- Scheduling equipment operations to keep average noise levels low, to synchronize noisiest operations with times of highest ambient levels, and to maintain relatively uniform noise levels;
- Turning off idling equipment; and
- Locating noisy equipment at locations that protect sensitive locations by shielding or distance.

2.5.6 Construction Air Quality

Impacts associated with construction activities may generate fugitive dust, which will result in localized increases in airborne particulate levels. Fugitive dust emissions from construction activities will depend on such factors as the properties of the emitting surfaces (e.g., moisture content, and volume of spoils), meteorological variables, and construction practices employed.

To reduce emissions of fugitive dust and minimize impacts on the local environment, the construction work will adhere to a number of strictly enforced mitigation measures. These measures may include the following:

- Using wetting agents regularly to control and suppress dust that may come from the construction materials;
- Fully covering all trucks used for transportation of construction debris;
- Retrofitted equipment and ultra low-sulfur diesel (ULSD) fuel (15 ppm) will be used, in off-road construction equipment;
- Removing construction debris from each site regularly as needed;
- Monitoring construction practices to ensure that unnecessary transfers and mechanical disturbances of loose materials are minimized and to ensure that any emissions of dust are negligible;
- Providing a wheel wash at all exits from the construction areas; and
- Regular vacuum cleaning of streets and sidewalks in the Project area will be employed to ensure that they remain free of dust and debris from the Project.

2.5.7 Construction Waste

The Proponent will reuse or recycle construction materials to the extent feasible. Construction procedures will allow for the segregation, reuse, and recycling of materials. Materials that cannot be reused or recycled will be transported in covered trucks by a contract hauler to a licensed facility, per the MassDEP regulations for Solid Waste Facilities, 310 CMR 16.00.

2.5.8 Protection of Utilities

Existing public and private infrastructure located within the public right-of-way will be protected during construction. The installation of proposed utilities within the public way will be in accordance with the BWSC, Boston Public Works Department, the Dig Safe program, and the governing utility company requirements. All necessary permits will be obtained before the commencement of the specific utility installation. Specific methods for constructing proposed utilities where they are near to, or connect with, existing water, sewer and drain facilities will be reviewed by BWSC as part of its Site Plan Review Process.

2.6 Historic and Archaeological Resources

2.6.1 Historic Resources

Boston University Medical Center is located within the South End Protection Area, formed to maintain an architecturally compatible boundary adjacent to the south border of the South End National Register and Landmark Districts.

The proposed Energy Facility site is located adjacent to the existing Power Plant at 750 Albany Street on the BUMC Campus, just north of the Massachusetts Avenue Connector and west of East Concord Street. See Figures 1-1 through 1-3 for Project location and campus map.

The Project Site is located within the South End Harrison/Albany Protection Area ("Protection Area") and is subject to review by the South End Landmarks District Commission ("SELDC"). According to the Standards and Criteria of the SELDC, the following activities are subject to review: demolition, land coverage, height of structure, topography, and landscaping. The goals of the Protection Area are to protect views of the adjacent Landmark District and to insure that new development is architecturally compatible in massing, setback and height to protect light and air circulation within the Landmark District.

The height limit for the area southeast of Albany Street is 150 feet. The Project has a height of 100 feet from grade to the top of the partially enclosed penthouse and complies with the standard. The height of the proposed stacks is 160 feet which is dictated by the requirements to meet the EPA National Ambient Air Quality Standards (NAAQS). The height of the new stacks is considered an addition to the structure and may exceed the allowed height of 150 feet if not visible from the nearest public way within the Landmark District.

The Project team has performed a view analysis and determined that the additional height is not visible from the nearest public way within the Landmark District. The Proponent presented the Project to the SELDC at its March 4, 2010 hearing. The SELDC confirmed that the height of the stacks is not visible from the nearest public way within the Landmark District and voted to approve the Project as presented. If review by the MHC is required, the appropriate project documentation will be submitted. Due to the small scale of the proposed Project, no adverse effects to State Register properties are anticipated.

2.6.2 Archaeological Resources

A review of the National Register and Inventory of Historic and Archaeological Assets of the Commonwealth identified no previously known archaeological resources within the Project site.

2.7 Infrastructure Systems

2.7.1 Introduction

This section evaluates the infrastructure systems that will support the proposed Energy Facility. Based on initial investigations and consultations with the regulating agencies and utility companies, the existing infrastructure systems in the area appear to be able to accommodate the incremental increase in demand associated with the proposed Project.

The design process for the proposed Energy Facility will include the required engineering analyses and will adhere to applicable protocols and design standards, ensuring that the proposed Project is properly supported by and properly uses the City's infrastructure.

The systems discussed below include those owned or managed by the Boston Water and Sewer Commission (BWSC), private utility companies, and on-site infrastructure. There will be close coordination between these entities and the Project team during subsequent reviews and the design process. All improvements and connections to BWSC infrastructure will be reviewed as part of the BWSC site plan review process. This process includes a comprehensive design review of the proposed service connections, assessment of system demands and capacity and establishment of service accounts. See Figure 2-11 – Schematic Site Plan, for proposed utility connections.

2.7.2 Regulatory Framework

All connections will be designed and constructed in accordance with city, state and federal standards.

- In the City of Boston, BWSC is responsible for all water, sewer and stormwater systems.
- The Boston Fire Department (BFD) will review the proposed Project with respect to fire protection measures such as Siamese connections and standpipes.
- Design of the site access, hydrant locations, and energy systems (gas, steam and electric) will also be coordinated with the respective system owners.
- New utility connections will be authorized by the Boston Public Works Department through the street opening permit process, as required.
- New Steam and Power conduits between campus buildings and within City Streets will require permitting with the Public Improvements Commission.

2.7.3 Wastewater

2.7.3.1 Existing Wastewater

Local sewer service in the City of Boston is provided by the BWSC. Wastewater generated in the proposed Project area will be conveyed to the Massachusetts Water Resources Authority (MWRA) facility on Deer Island via the 66" x 68" interceptor on Albany Street.

2.7.3.2 Demand/Use

The proposed Project will generate approximately an average of 22 gallons per minute or 31,800 gallons per day of wastewater from the proposed building. This wastewater will be mostly generated from process water during the steam generation and condensate. It is estimated that the peak wastewater generation from the proposed building will be approximately 85 gallons per minute. These flow rates were reviewed with BWSC and determined that the existing sewer has capacity to handle these flows.

2.7.3.3 Proposed Connection

As shown on the schematic site plan, the wastewater generated by the Project will be piped by a new sanitary service to the existing sewer in Albany Street. The Proponent will coordinate with the BWSC on the design and capacity of the proposed connection to the sewer system. In addition, the proponent will submit a General Service Application and site plan for review as the proposed Project progresses.

2.7.4 Domestic Water and Fire Protection

2.7.4.1 Existing Water Supply System

The proposed Project is located in the South End service area of the BWSC public water supply service areas. Albany Street is served by 12-inch high and low pressure lines. Domestic water demand will be determined by the rate of steam production. It is estimated that the proposed Project will require approximately an average of 432,000 gallons of water per day with a peak demand of 600 gallons per minute.

Hydrant test data provided by the BWSC is presented in Table 2-11 below.

Table 2-11 Hydrant Test Data

Date	Location	Static Pressure (psi)	Residual Pressure (psi)	Total Flow (gpm)	Flow (gpm) at 20 psi[1]
3/21/05	12” Low Albany Street	68	62	3,182	1,083
9/26/00	12” High Albany Street	96	88	4,388	1,479

[1] psi = pounds per square inch

The results of the hydrant flow test indicate the actual amount of water (flow) available and the actual pressure (residual) flow provided. These flow metrics are analyzed to establish the quantity of water that will be delivered at 20 psi as a common evaluation point.

2.7.4.2 Proposed Connection

Domestic water service for the project will be provided from the existing 12” low pressure water main on the north side Albany Street as shown on the site plan. The project proposes two separate domestic lines to provide redundant service for the purpose of periodic maintenance shutdown or disruption to one of the service lines.

As shown on the schematic site plan, a fire service will be provided for the building sprinkler system. This service will be connected to the existing 12” high pressure main on the south side of Albany Street.

The Project flow rates were reviewed with BWSC. BWSC indicated that the proposed connections will be acceptable and the existing mains have capacity to handle these flows. Compliance with the standards for the domestic water system service connections will continue to be reviewed as part of BWSC's Site Plan Review Process. The review includes but is not limited to sizing of water supply and fire protection services, calculation of meter sizing, backflow prevention design, and location of hydrants and Siamese connections to conform to BWSC and Boston Fire Department requirements.

2.7.5 Stormwater Management

2.7.5.1 Existing Conditions

The BUMC Campus is serviced by several BWSC drain lines. The Project site is occupied entirely by paved parking and driveways. Runoff from the site flows southerly and is captured by the existing catch basin immediately adjacent to the proposed building and the west wall of the Chief Medical Examiner's office building. The catch basin is piped southerly and connects drains behind the Chief Medical Examiner's office building which connects directly to the Roxbury Canal Conduit.

2.7.5.2 Proposed Conditions

Stormwater from the site will be routed to follow existing infrastructure to the Roxbury Canal Conduit. As per Section 2.4.8.3 – Groundwater Conditions, the project will be required to infiltrate 1" of runoff per square foot of new building footprint. Additional run-off from non-roof areas and storms in excess of 1" of rainfall will discharge to the Roxbury Canal Conduit. Because the Project site is entirely an existing paved surface, the proposed Project will not change the overall area of impervious surface and will not result in an increase in stormwater generation from the site. The introduction of a stormwater infiltration system will result in a net decrease in the amount of stormwater discharged from the site and increase the recharge to the aquifer. There will be no change in the drainage patterns or increase to any portion of the BWSC drainage system.

The schematic site plan was reviewed with BWSC. Because there is no increase in impervious area and there will be a net decrease in runoff with the introduction of the infiltration system, it has been determined that a detailed drainage analysis will not be required.

Stormwater management controls will be established in compliance with BWSC standards and the Groundwater Conservation Overlay District. The proposed Project will be designed so as to not introduce increased peak flows, pollutants, or sediments to existing drainage infrastructure. In conjunction with the site plan and the General Service Application, the proponent will submit a stormwater management plan to the BWSC. Compliance with the standards for the final site design will be reviewed as part of the BWSC Site Plan Review Process.

2.7.6 Anticipated Energy Needs

2.7.6.1 Natural Gas Service

Natural gas for the Project will be provided by National Grid. The building will tie into the existing 30" gas main in Albany Street.

2.7.6.2 Electrical Service

Boston University Medical Center purchases electricity from NSTAR Electric in bulk and redistributes from the existing Power Plant located immediately adjacent to the proposed Project site. New electric services will be constructed on campus to distribute power generated by the Project. The Energy Facility will cogenerate electrical power and heat (steam) and is anticipated to generate an average of 314,200 kWh per day. See Section 2.2.2 for more information.

2.7.6.3 Steam

The proposed Project is a new combined heat and power generating facility. Steam and electric energy generated by the proposed Project will be distributed to the BUMC Campus and BioSquare buildings through existing and new infrastructure.

The Project is anticipated to generate on average 4,124,000 lbs of steam per day. This steam is sufficient to supply Boston University Medical Center's needs and will negate the need for importing steam from offsite sources.

2.7.6.4 Telecommunications

Verizon will provide telephone and telecommunication services to the proposed Project. The Project will receive telecommunication service directly from the existing Power Plant.

Figure 2-11 Schematic Site plan