Heating Plant Alternative Feasibility Study

At the

Wards Island Water Pollution Control Plant

Wards Island, New York

Prepared for:
New York Power Authority
123 Main Street
White Plains, NY 10601-3170

Prepared by:
AECOM
20 Exchange Place
New York, NY 10005

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1. EXECUTIVE SUMMARY

1.1. Introduction

This Feasibility Study was developed under the direction of the New York Power Authority (NYPA) Energy Services Program (ESP). Under this program AECOM was authorized to develop a comprehensive heating alternative feasibility study for the New York City Department of Environmental Protection (DEP) - Wards Island Water Pollution Control Plant (WI WPCP).

The Feasibility Study is to explore and evaluate viable alternatives for meeting the long term heating requirements of the Wards Island WPCP. The plant currently exchanges produced digester gas for steam supply from the nearby New York State Office of Mental Health (NYS-OMH), Manhattan Psychiatric Center (MPC) boiler plant. With the exception of supplemental heating from a small standby boiler, installed at the WI WPCP, the MPC boiler plant supplies all of the heating and process steam for the plant. The current agreement between the DEP and MPC allows the MPC boiler plant to use the digester gas fuel produced as a by-product of the waste water treatment process. Currently, the majority of the digester gas produced is fed to the MPC boiler plant with the remainder being flared. Due to consolidation within the MPC facility, the existing MPC plant is expected to discontinue operations in 2011. When the plant shuts down, WI WPCP will be without a steam energy source if it does not begin planning to provide its own independent facility.

Based on the investigation and analysis conducted in this study, the DEP expects to implement a cost effective, reliable and energy efficient long term solution to ensure continued provision of the heating requirements of the WI WPCP, following the discontinuation of the MPC service. AECOM has analyzed the needs of the facility and following NYPA and DEP's instruction, we have identified viable options the Wards Island WPCP can pursue to provide its own independent thermal generating facility. These options are outlined in this report for the review and consideration of the DEP.

1.2 Study Objectives and Options

The objective of this feasibility study is to propose reliable, cost effective and energy efficient solutions to meet the continued heating requirements of the Wards Island WPCP. AECOM conducted detailed analysis of the Wards Island WPCP operational processes and equipment thermal load requirements to establish the overall heating needs. AECOM also reviewed the facility's historical steam and digester gas records to establish available heating plant fuel supply and to quantify any excess digester gas that may be available after thermal production. The study also performed a general overview of potential measures the facility could explore in the near future to maximize the utilization of any excess digester gas supply following the implementation of an independent heating facility. Also, following the DEP's instructions, AECOM completed a full assessment of the current condition of the Manhattan Psychiatric Center boiler plant to determine its present condition and its ability to provide the future heating requirements of the Wards Island WPCP. Under this study, AECOM's scope of work comprises of the review and analysis of the following options for consideration:

Option 1: Permanently Take Over the MPC Power Plant

This option investigates the feasibility of the DEP purchasing the existing MPC power plant and utilizing the plant to continue to meet its steam requirements. Under this option, the DEP will assume ownership of the plant and provide the necessary upgrades and staffing required in ensuring the plant's ability to provide its heating needs. As part of this option, the DEP will have to work with the NYS OMH to forge an agreement for the takeover of the existing plant and the conversion of the plant air permits under its jurisdiction.

Option 2: Install a New High Pressure Steam Central Boiler Plant

Under this option, the DEP will construct an independent high pressure steam (up to 150 psig) heating plant within its facility and will provide its own personnel to operate and maintain the new heating plant. The proposed high pressure steam plant will consist of five boilers comprising of (3) 800-BHP units and (2) 400-BHP units. The scope under this option will replace aging underground sections of the existing high pressure steam distribution piping and will maintain the current operation of existing terminal devices at the individual systems and buildings. A majority of the existing tunnel steam piping will remain in place.

Additionally, for this option, the DEP will be required to provide a team of licensed high pressure boiler plant operators to tend to the operation of the new plant, around the clock. The two locations considered for this option are:

<u>Option 2A: New High Pressure Central Boiler Plant in Old Boiler Building</u>
This option explores the feasibility of installing a new boiler plant located within the original building. The building, which dates from 1937, will require significant hazardous materials abatement, structural refurbishment, and major restoration work to bring the structure to modern standards of functionality. Since land space is at a premium at the plant, this option maximizes the use of this space and also addresses pressing remediation and restoration issues required by the building. All planned modifications for the building, including restoration or replacement work on the adjacent chimney, may need to be approved by the New York City Landmarks Preservation Commission depending upon the building's classification.

The location of the old boiler house is convenient in that the new system supply piping can be connected easily to the existing steam distribution loop. When the remediation work is completed, the building will have ample room for the installation of the required boiler capacity to meet the WI WPCP's long-term needs. The proposed plant will be operated primarily on digester gas, with No. 2 oil or natural gas as a secondary fuel.

<u>Option 2B: New High Pressure Steam Central Boiler Plant in New Location</u>
This option explores the feasibility of installing the same proposed plant within a new building, to be constructed on a portion of the lawn directly south of the Pump & Blower Building. The proposed plant will be adjacent to the existing steam distribution

loop and the digester gas line. The proposed plant will be identical to that which is proposed for installation within the Old Boiler Building, but will be housed in the new structure, occupying approximately an 80’ by 60’ footprint.

While this alternate location was considered for the possible placement of the boiler plant, the general feedback from the facility during the development of the study is that space is at a premium and it will be most beneficial to reuse the existing plant building rather than take up any of the limited green space remaining within the plant. As such remaining options considered for the central boiler plant are limited to placement within the existing building (Old Boiler Building).

Option 3: Install a New Low Pressure Steam Central Plant

Under this option, the DEP will consider the installation of a low pressure (up to 15 psi) steam central plant within the Old Boiler Building. The peak capacity of the plant will remain the same as that of the high pressure plant option except that low pressure rated boilers will be provided. As with Option 2, (3) 800-HP and (2) 400-HP fire tube boilers, including any related boiler system components and systems, will be installed within the refurbished Old Boiler Building. The recommended low pressure steam central plant will be fired primarily on digester gas, with No. 2 oil as back up fuel.

The implementation of a low pressure boiler plant will relieve the facility of the requirement to provide round-the-clock personnel for operation, as is required for a high pressure plant. However, since the existing steam distribution system was originally sized for high pressure steam service, a new, more appropriately sized low pressure distribution system will be required to carry the steam throughout the facility. As such, this option accounts for the replacement of the existing steam distribution and condensate return piping system.

Option 4: Install Three New Low Pressure Steam Decentralized Plants

This option investigates the feasibility of providing three new independent low pressure steam central plants to adequately meet the steam requirements of three distinct thermal load centers within the Wards Island WPCP. Based on discussions with the DEP, three potential locations for low pressure steam heating plants were identified. These locations are:

1. Old Boiler House;
2. Old Garage Building;
3. Storage Space in Fuel Oil Storage Facility Building (Marine Terminal).

Based on these three potential locations, AECOM segregated the thermal loads according to their proximity to each of the proposed boiler plants to determine which thermal loads will be met by each of the proposed plants. This resulted in the following distribution of steam loads:

Table 1.2.1 Facility Heating Zones

Plant Location	Buildings/Systems Serviced
Old Garage Building – Zone 1	Old Administration Building, New Administration Building, Garage Building.
Marine Terminal – Zone 2	Fuel Oil Storage Facility, Marine Office/Storage Building, Sludge Storage Tank Building, (8) Marine Service Stations.
Old Boiler Building - Zone 3	Solids Handling Facility, Primary Settling Tank Pump Stations 2 & 4, Waste Gas Burner Building, Return Sludge Pump Facility (E-Battery), North & South Sludge Pump Stations, Pump & Blower Building.

The physical layout of these zones can be seen in Figure 1.2.1 on the following page:

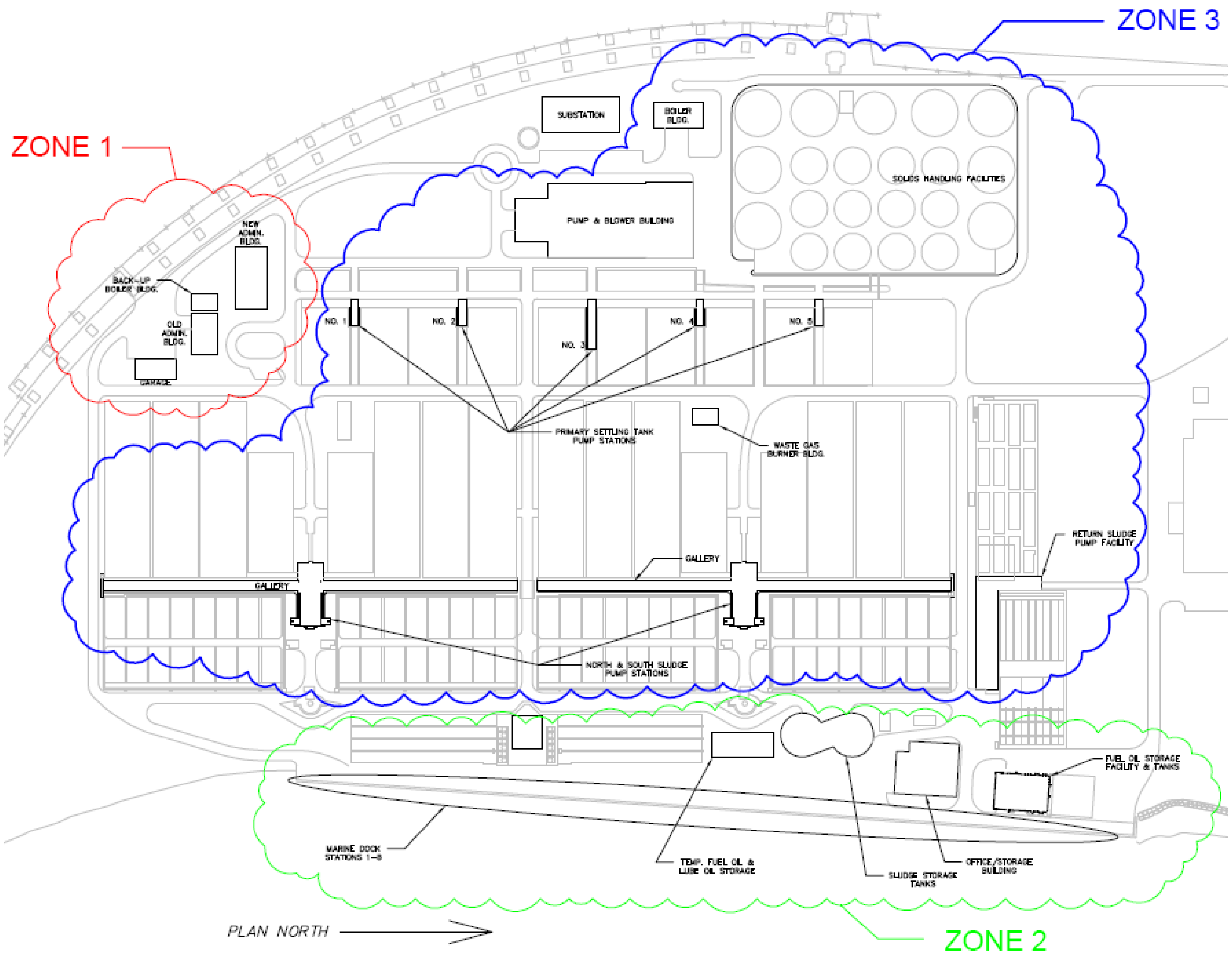


Figure 1.2.1 Facility Heating Zone Map

This separation resulted in the evaluation of three decentralized plants with the following characteristics:

Table 1.2.2 Facility Heating Zone Loads

Plant Location	Peak Load	Equipment Quantity	Plant Capacity
Old Garage Building – Zone 1	67 HP	(2) 100-HP	200 HP
Marine Terminal – Zone 2	105 HP	(2) 150-HP	300 HP
Old Boiler Building – Zone 3	2,025 HP	(3) 750-HP and (2) 350-HP	2,950 HP

The proposed plants will operate independently of each other to meet the heating requirements of their individual zones. The Old Boiler Building and old Garage Building plants will operate on digester gas as the primary fuel, with No. 2 fuel oil available as a secondary fuel. Due to the location of the proposed Marine Terminal boiler plant relative to the digester gas supply line and its relatively small size, it will not be provided with digester gas service. Instead, the proposed Marine Terminal Plant will utilize No. 2 fuel oil, which is available from the storage tanks located adjacent to the building. While this option will not require around the clock operators, it will require more operation and maintenance services than a central plant option, since there are more systems and equipment being installed.

Other than the independent service for the Marine and Administration sections of the facility, the bulk of the steam requirements will still be provided by the larger plant located in the Old Boiler Building. As such, the option for the implementation of a decentralized plant does not seem to be the most beneficial for the WI WPCP.

Option 5: Install a New Hot Water Central Plant

An additional option investigated for the WI WPCP is the potential to install a central hot water plant to generate all of the thermal requirements of the facility. A central hot water plant that produces hot water below 250°F and operates at less than 160 psi will not require the provision of around-the-clock boiler operators to oversee its operation. As with the low pressure steam option, this option can be ultimately beneficial to the DEP in conserving its long term operational costs. Conversely, the consideration of a central hot water plant will require a completely new hot water distribution piping system, where there currently is none. Furthermore, this option will require conversion of all existing terminal heating devices such as heat exchangers, air handling units, chillers, etc. to hot water heated units.

Within the WI WPCP, there are select heating devices and systems, such as the Marine Docking stations, which require the supply of low pressure steam. A hot water system can only be utilized to generate steam if the water temperature is above 250°F. To achieve high quality steam, the water temperature must be well in excess of this temperature. Above this operating range, a plant is considered a high pressure plant, and as such will require boiler operators around the clock. Consequently, the Marine Terminal area – Zone 2 – is provided with its own, independent low pressure steam plant. The rest of the plant will then receive terminal equipment replacements or provisions such as water-to-water heat exchangers, where necessary, to be able to operate with low temperature hot water. These replacements will add significant costs to the proposed boiler plant installation, making this option less desirable when compared to other options. As with the low pressure steam central plant option, option 5 will not require around the clock operating engineers.

Option 6: Install New Hot Water Decentralized Plants

Utilizing the same principles, plant sizing and location criteria established in Option 4, this option explores the installation of three decentralized hot water heating plants for the WI WPCP.

Similar to the earlier option, the plant dedicated to the Marine Terminal will remain a low pressure steam system, while the other two plants will generate low temperature hot water. The three potential zones and locations remain the same as those discussed in Option 4: the Old Garage (Zone 1); Marine Terminal (Zone 2); and the Old Boiler Building (Zone 3).Essentially, this option presents the same benefits and drawbacks as Option 4, with the added disadvantage of having to replace all terminal equipment in Zones 1 and 3 with hot water equipment (or make appropriate provisions, as discussed previously). There will also be incremental operations and maintenance requirements due to the number of boiler plants involved.

Option 7: Temporary Heating Plant Services

Taking into consideration the fact that MPC will discontinue its boiler plant operation in the very near future, DEP will require a temporary means to provide for the Wards Island WPCP's heating demands while the permanent solution is being permitted and constructed. AECOM has prepared three interim service options for DEP's consideration. These options are as follows:

<u>Interim Option 7A: Temporarily Take over the MPC Boiler Plant</u>
This option investigates the temporary operation of the MPC boiler plant by DEP personnel. This is estimated to be for a period of approximately 1-2 years following the cessation of MPC operation. During this period, the new boiler plant will be in construction. The operation of the MPC plant will allow for continual steam services to the WI WPCP site. To facilitate this interim operation, the DEP will need to consummate an agreement with the NYS OMH, extend the plant's air permit, perform some much needed upgrade to the plant and invest in a pool of around the clock

operators. Once the new boiler plant is commissioned the MPC plant can be turned back over to the OMH.

Interim Option 7B: Rent Trailer Mounted Mobile Boiler Plant
Another option that will ensure no interruption in steam supply is the installation of temporary boilers. This option investigates the installation and operation of trailer mounted boilers during the new plant construction. The temporary boilers will utilize digester gas with No. 2 fuel oil as a backup. This is estimated to be for a period of approximately 1-2 years following the cessation of OMH operation. This option will allow for continual steam services to the WI WPCP site. In addition, the contractor will provide operators to run and maintain the system. Temporary distribution and condensate tie in points will be constructed to support interim operation. Once the new boiler plant is commissioned the temporary boilers will be disconnected and returned to the rental service.

Interim Option 7C: Purchase Trailer Mounted Mobile Boiler Plant
Utilizing the same method for interim service described in Option 7B, this option explores DEP purchase of the trailer mounted mobile boilers as opposed to renting.

These options are fully investigated in this report to identify the best course of action for the DEP to effectively continue its critical mission at the Ward Island WPCP.

1.3 Study Approach - Methodology

AECOM's technical evaluations for this feasibility analysis are based on the best information available during the study, and include, but are not limited to: engineering drawings, original equipment design specifications, information provided by the customer, consumption totals, vendors' quotations, and information collected during on-site inspections. The economic evaluations are based on detailed cost estimates using AECOM estimating data and vendors' budget cost quotations.

The volume of MPC steam consumed by the WI WPCP and the digester gas production of the facility was available from the DEP. The information provided hourly and daily production totals. Unfortunately, due to ongoing construction endeavors and equipment deficiencies, steam service and digester gas production are not at their full, steady state capacities. Electrical consumption and tariff data was available from NYPA. The results of this report are based on the tabulated data received from these sources. There are minor fluctuations in the annual totals, so AECOM took the average of the 2006 through 2008 data as a baseline in order to compare different operating scenarios.

With regards to the methods in which potential heating plants were sized, AECOM evaluated all existing equipment installed at the facility to determine the estimated design heating and process loads for each of the potential options. The peak heating design load is estimated at 29,764 MMBtu/hr while peak process load is estimated at 48,300 MMBtu/hr. This amounted into a design peak for a proposed heating plant of 78,064 MBH (2,334 Boiler HP). Assuming a 90% diversity factor, the estimated peak design requirement is 70,258 MBH (2,100 Boiler HP).

In addition, the 2006-2008 weather data in conjunction with past steam consumption data and existing equipment design loads were used to model thermal heating requirements for the plant. In order to differentiate between process and thermal heat loads, the calculated thermal heat loads were subtracted from the total consumption.

1.4 Conclusion and Recommendations

This section provides summarized capital construction costs, operating costs and life cycle costs for each of the options considered in this study. Based on the analyses conducted, all of the options considered provide some benefit to the DEP. With regard to initial capital, (i.e., simple payback) the least expensive option for the DEP to implement is Option 2A; a new high pressure steam boiler plant in the existing DEP boiler building. This option will also keep most of the aging steam distribution piping in place. However, since the DEP does not prefer the increased staffing costs associated with employing high pressure operators required for Options 1 and 2, the next least cost alternative is Option 3.

One aspect of this study that affected the analysis results is the fact that the digester gas production volumes were estimated via calculations and not actually measured. The estimate provided conservative digester gas production volumes that were used. With the ongoing upgrade work to the digester gas collection and storage systems, the WI WPCP will enjoy the benefit of capturing and utilizing more of its digester gas thereby possibly increasing the volume available for future use in other potentially related energy projects.

With regards to the interim options for providing the heating requirements of the facility, our analysis confirms that it will be cheaper and much more reliable for the DEP to deploy Interim Option 7B, which entails renting the trailer-mounted mobile boiler plants. This option will provide more flexibility and control for the DEP and it will eliminate its reliance on other Agencies to provide its steam requirements which is very critical to its mission as a Water Pollution Control Plant. However, should interim services be required for a period longer than one and a half years, the DEP may wish to consider purchasing rather than renting temporary service boilers as presented in Option 7C.

In conclusion, AECOM recommends that the DEP proceed with the development of an independent low pressure steam central heating plant to be cited in the Old Boiler Building. Additionally, when the NYS-OMH discontinues the steam supply services, the DEP should utilize temporarily rental boilers to bridge the gap between the loss of service and the commissioning of the new plant.

The following provides a summary of the project economics. The first table summarizes the capital cost and operating cost estimates for each option as well as the temporary heating options with the recommended options being highlighted. The second table summarizes the life cycle cost of each option over a 20 year period.

An important note to the project economics is that following the DEP renewed interest to pursue the provision of natural gas as a back-up fuel for the proposed heating plant, the implementation cost for the project was updated to include the $2 million budget required by Con Edison to complete the provision of natural gas from the Bronx to the Island.

Table 1.4.1 Estimated Construction Cost, Annual Energy Savings and O&M Comparison

Options	Project Total Cost*	Project Energy Savings	Simple Payback (yrs)	Annual O&M Costs
Option 1	$39,779,212	$1,963,803	20.3	$ 2,261,373
Option 2A	$35,848,808	$2,992,359	12.0	$ 1,858,183
Option 2B	$39,165,722	$2,992,359	13.1	$ 1,858,183
Option 3	$65,665,915	$2,992,359	21.9	$ 892,082
Option 4	$73,426,488	$2,938,167	25.0	$ 1,477,898
Option 5	$97,370,266	$2,938,163	33.1	$ 1,046,795
Option 6	$97,115,772	$2,938,167	33.1	$ 1,474,599
Int Opt 7A	$6,563,075	N/A	N/A	$ 2,261,373
Int Opt 7B	$6,566,896	N/A	N/A	$ 1,710,173
Int Opt 7C	$8,178,025	N/A	N/A	$ 2,116,727

A life-cycle cost analysis (LCCA) was performed on each of the proposed options. Life cycle costs are determined by taking into account the capital costs, equipment service life, current maintenance costs as well as the utility costs. The results of the LCCA are presented in Attachment H.

Table 1.4.2 20 yr - Present-value Life Cycle Cost Comparison

Options	Total Implementation Cost	Energy Life Cycle Cost	O&M Life Cycle Cost	Total Present Value Life Cycle Cost
Option 1	$ 39,779,212	$ 25,700,308	$ 40,889,410	$ 95,568,510
Option 2A	$ 35,848,808	$ 1,812,862	$ 39,294,787	$ 64,651,621
Option 2B	$ 39,165,722	$ 1,812,862	$ 39,294,787	$ 67,065,491
Option 3	$ 65,665,915	$ 1,812,862	$ 16,130,336	$ 63,205,388
Option 4	$ 73,426,488	$ 5,068,818	$ 26,772,870	$ 82,707,444
Option 5	$ 97,370,266	$ 5,068,919	$ 18,927,806	$ 92,313,865
Option 6	$ 97,115,772	$ 5,068,818	$ 26,663,219	$ 99,129,472

1.5 Excess Digester Reuse Options

One of the considerations as part of the investigation of a cost effective heating plant alternative for the WI WPCP is parallel identification of viable options in which the facility can deploy at the same time to maximize the use of the free fuel (i.e., digester gas) available to it. The most reasonable option to effectively accomplish this goal is the deployment of a combined heat and power (cogeneration) plant. With the availability of enough digester gas production, a facility such as the WI WPCP can deploy the cogeneration plant to generate all of the thermal requirements of the facility and concurrently produce some amount of electrical power to reduce its power requirements from the utility.

The option to deploy a cogeneration plant was considered for the WI WPCP but several factors did not prove this option to be beneficial for the plant. These factors were:

- The digester gas production records could not support the deployment of a big enough cogeneration plant to generate all of heat required for the facilities needs. To date the WI WPCP is still involved in various projects which limits its processing capabilities and therefore has an effect on the digester gas production. Any proposed cogeneration plant will require more significant amounts of digester gas that is not available and hence will require DEP to purchase additional fuel to maximize its operation. Such a requirement therefore makes the cogeneration option uneconomical.

- Due to the significant size of the electrical power requirements of the facility and its individual feeder sizes, the minimum size requirement for a proposed generation facility is the 5MW range to be able to appropriately support the facility's operation.

Additionally, due to the low heating content of digester gas as compared to natural gas or fuel oil, any proposed cogeneration plant will need to be sized much larger, in the 7MW to 8MW range, such that it can provide enough starting capacity for the supported systems. All of these requirements contribute to the lack of cost effectiveness of any proposed cogeneration option.

Following the implementation of the current upgrade projects and the installation of the recommended heating plant, the true amount of excess digester gas production for the WI WPCP can be confirmed. The DEP can then begin to investigate other potential uses for the digester gas, such as a plant connected to smaller secondary or tertiary electrical feeders and sized to utilize all available excess gas or other viable alternatives.

2. EXISTING INFRASTRUCTURE

2.1 Background

The Wards Island Water Pollution Control Plant was built in 1937 and currently occupies about one quarter of the Island. The facility design capacity is currently 275 million gallons per day (MGD), servicing a population of over 1 million New York City occupants. The facility serves a drainage area of 12,056 acres comprising of the western section of the Bronx and Upper East Side of Manhattan. The facility currently operates with a staff of approximately 120 personnel. All of the effluent is processed at the facility and the sludge is dewatered onsite. The treated water is tested and released into the East River. The plant has docking facilities that accommodate barges delivering sludge to the facility. The dock has the capabilities of providing steam service, electrical and pumping connections for the barges utilizing the station.

The facility is supplied steam for heating and for its treatment processes by the nearby Manhattan Psychiatric Center (MPC) boiler plant. The MPC provides steam for approximately two dozen buildings on its campus in addition to providing steam to the Ward Island WPCP. Some of the buildings within the MPC site are occupied by other Agencies. The MPC plant also includes a central chiller plant which supplies the Dunlap building with chilled water and it houses a main electrical distribution station which powers the MPC site.

The MPC plant supplies steam to the Wards Island WPCP through (2) 10-inch underground supply pipes. The piping runs underground for approximately 1,200 feet on the MPC property through an interconnecting roadway on the Island, and into the Wards Island property. The line is then connected through valves to the WI steam distribution loop directly behind the New Administration Building. One of the two 10-inch lines has been out of service for several years, so that only one line currently supplies steam to the plant.

Steam pressure has varied over the years, but the WI WPCP confirmed that although the steam supply pressure typically required for proper operation of their process is in the 65-psig range, the nominal pressure received is about 40 psig. During peak steam load periods, the facility has recorded drops in steam supply pressure down to the 20-psig level. Over the years, the facility has also recorded a decline in the quality of the steam, which tends to be wet by the time it is used for its processes. This condition was prevalent at the marine terminal section of the facility. As a result, to provide some back up capabilities, the DEP has installed a 400-HP Cleaver Brooks oil-fired boiler in a prefabricated structure located behind the Old Administration Building. Although this standby boiler has improved the facility operation, there have been issues with operating both the MPC steam supply and the standby unit in parallel due to pressure imbalances within the distribution piping.

The Wards Island WPCP has a decommissioned boiler plant located in Building 10 (Old Boiler Building) that was abandoned in early 1985 when the facility began to obtain its steam supply from the MPC. The building has not been actively used since then. It now serves as storage space and contains fuel oil pumps for the standby turbine generators. The Old Boiler Building currently houses the (3) original Union Iron Works boilers built in 1937. The defunct boilers were rated at 155 HP and operating on No. 4 fuel oil at the time of their retrofit in the mid 1950's. The Old Boiler Building consists of two floors, and is very spacious. Much of the peeling paint on the walls in the abandoned building is hazardous lead-based paint, and the defunct boilers and piping joints may also contain asbestos. The original masonry stack next to the building has been reinforced with banding and will require a thorough inspection and considerable upgrade work if being considered for re-use.

2.2 Manhattan Psychiatric Center Power Plant

2.2.1 Building Description

The Manhattan Psychiatric Center Power Plant building is a concrete, steel and masonry building consisting of approximately 19,450 square feet of space. The building was constructed in the mid 1950’s and appears to be in fair condition. In 1997, the plant underwent a boiler retrofit upgrade, at which point the ancillary equipment was upgraded and steam distribution piping was reinsulated. The general appearance inside the building is that of an older facility that is fairly well maintained.

The eastern-most section of the building houses the (4) steam boilers, an emergency generator, and the boiler control room. The boiler plant section of the building is approximately 35 feet in height with roughly 8,850 square feet of floor space. The western-most section of the building contains the central chiller plant and an open storage garage. The cooling tower associated with the chiller plant is located on the roof of the power plant. The ceiling height within this section of the plant is about 20 feet, and the entire space is about 6,550 square feet. The remaining portion of the plant consists of the northeastern portion of the building, totaling about 4,050 square feet, and containing the facility’s electrical distribution switchgear and an office space.

The original masonry stack appears to be good condition, with the top 35 feet of the stack already reinforced with banding. The total stack height is approximately 150 feet. Behind the boiler plant, on the east side of the building, are (2) 100,000-gallon, No. 6 fuel oil storage tanks, with a rupture dike and leak detection system. The oil is heated and transferred to the plant through a network of fuel oil transfer pumps and steam-heated fuel oil heat exchangers contained in a detached structure located between the tanks and the boiler plant

2.2.2 Utilities Provided and Buildings Served

The MPC plant supplies steam for space heating to all 21 buildings at the MPC site, in addition to meeting all of the steam needs of the Wards Island WPCP.

As part of its long-term planning for the MPC, the NYS-OMH is in the process of consolidating its activities at the site and will relocate its functions to only a handful of buildings. Also included in this plan is the construction of a new power plant to serve only the requirements of the MPC long-term buildings. Once this work (with a 2011 deadline) is completed by the MPC, the Agency plans to discontinue the use of the existing plant. At this time, all of the various agencies on the steam distribution service will need to have their own heating service provisions in place.

The MPC plant also contains a 3,350-ton chiller plant consisting of (2) 1300-ton units and a 750-ton unit. This chiller plant provides chilled water primarily to the No. 102 Dunlap Building. The chillers were installed 16 years ago and operate on 4,160 volts. No other buildings at the MPC are provided with chilled water from the plant.

The Manhattan Psychiatric Center plant also contains (2) Con-Edison 13.2-kV feeders and electrical distribution panels for the provision of dual-feeder electric service to the all of the buildings at the MPC site. The second feeder is redundant. The incoming service from the feeders is stepped down to 4,160 volts for distribution panels located at the plant.

2.2.3 Boiler Plant Description

The Manhattan Psychiatric Center Power Plant consists of (4) 1,035-HP high pressure Titusville Iron Works water tube steam boilers. All four boilers are capable of operation on No. 6 oil with boilers No. 2 and 3 capable of dual-fuel operation, burning a combination of either fuel oil or digester gas. The boiler plant is approximately 54 years old. Originally rated for higher pressures, the boilers are now operated at 110 psig to preserve their integrity and to ensure their longevity. The generated steam pressure is then reduced inside the plant for distribution.

The boilers are capable of operation to a maximum capacity of approximately 40,000 lbs per hour, but are de-rated to 33,000 lbs per hour to meet the Title V air permit. The permit is held by the OMH office and is currently set to expire in the spring of 2011. The current operating capacity equates to about 1,100 HP for each boiler based on a conversion factor of 33,446 Btu/lb-bhp. Each boiler is fitted with COEN burners.

Photo 2.2.3.1 MPC Boiler Plant Interior

Photo 2.2.3.2 COEN Burner Throat and Control Panel

In 1997, two of the boilers were re-tubed and significant internal upgrade work was also completed. External inspection of the boilers revealed that the units appeared to be in good operating condition.

Interviews with plant staff revealed some concerns of reduced operating efficiency due to the age of the boilers, and reports of air leaks on the fireside of some units. The plant staff also confirmed that the MPC has kept up with the water treatment at the plant, which was contracted through Gotham, while the boiler control is maintained by Analytical Combustion Systems. The boiler plant controls are Preferred, Rimcor Model PCC2 brand. These controls appear to be functional, but the plant staff commented that this brand of control has not been supported by the manufacturer for close to a decade; so replacement parts are not readily available. Despite this, the system is still in operation; however it is past its useful life and will need to be replaced.

During one of the tours, AECOM performed an internal inspection of boiler No. 3 to confirm the typical condition of the boilers. The inspection revealed some internal oil spalling on the rear and front internal boiler walls. Also observed was some cracking on the refractory section that will require attention. The refractory across from the burner was scaled away, revealing a clean surface. Small sections of refractory also appeared to be patched around the view ports and the burner nozzle throat. These signs indicate evidence of prolonged high ramp-up rates and refractory that may require service.

Photo 2.2.3.2 No.3 Boiler Internal Inspection Showing Some Spalling

The Wards Island staff has maintained that the steam supply pressure is unreliable and varies with heating loads. The staff has recorded the steam supply pressure to vary from about 40 psig down to the 20 psig range during peak heating periods. The MPC plant supplies the WPCP with an average of 14,000 lbs per hour of steam in the winter. This amount drops to around 9,000 lbs per hour in the summer. Peak winter output steam load from the MPC plant is around 38,000 lbs per hour, while the average summer output is usually around the 9,000 lbs per hour range. Steam supplied to Wards Island is metered on both ends of the main feed line, however during the time of the field activities for this report, the steam flow meters on both sides were out of service.

Another issue noted during the tour was the fact that the MPC staff advised that there is typically very minimal condensate return to the plant. The steam and condensate distribution system on both the MPC and WI WPCP sites appear to have leaks. The condensate return pumps, especially the submersible units by the dock, are in need of repair, upgrade, and/or relocation. One particular unit located in a pit on the dock roadway appears to get submerged in water during heavy flooding and requires continued maintenance to keep it operational.

During the week, the MPC plant is manned around the clock with staff in attendance on a daily, three-shift rotation. On weekdays, there is a staff of (4) engineers and (1) fireman on shift. During all other shifts and on weekends, there is one (1) engineer and (1) fireman on duty.

The MPC staff also commented on the fact that the digester gas supply from the Wards Island WPCP has been historically unreliable. Prior to the eventual rupture of the 10-inch digester gas supply line to the plant, there were several complaints made to the DEP that the volume and quality of the gas being distributed was poor, and could not be steadily utilized in the boilers. An update to this issue is that the WI WPCP recently completed the relining and selective replacement of the digester gas piping. The MPC staff confirmed that the digester gas supply is now operating more effectively.

2.2.4 Chiller Plant Description

The MPC chiller plant is located in the western portion of the boiler plant building and shares space with a utility garage.

The chiller plant consists of (2) Carrier electric centrifugal chillers, model 17FA321-144-43, rated at 1,350 tons each and (1) McQuay 750-ton electric centrifugal chiller, model 02XR-382CPS64. The two Carrier units were installed in 1993 and operate on R-22 refrigerant, while the third unit operates on R-134A refrigerant. The units are powered via 4,160-V electrical service, and all appear to be in good condition. A 4-cell cooling tower located on the roof of the chiller plant is used to reject heat from the chillers. The chiller plant only supplies chilled water to the Dunlap building at the Manhattan Psychiatric Center site, with sets of primary and secondary chilled water pumps located at the opposite end of the mechanical room.

Photo 2.2.4.1 One of the Chillers in the Chiller Plant

2.2.5 Electrical Service Feeders

Electrical service is brought into the MPC through (2) 13.2-kV Con-Edison service feeders located in the switchgear room. The double-ended feeders are stepped down to 4,160 volts and distributed to each building by distribution panels. The service distribution panels contain (14) panels for power distribution throughout the facility and also have automatic transfer switch panels and controls to route the electrical service through the emergency generation panel. At each building, the electrical voltage is again stepped down to 480/277 or 208/120 volts for use in the individual buildings. The emergency generator is located a few yards from the plant

2.2.6 Fuel Oil Storage Tanks

The Manhattan Psychiatric Center boiler plant utilizes (2) 100,000-gallon No. 6 fuel oil storage tanks located just behind the MPC boiler plant. The tanks are installed in a concrete dike to contain any leakage. The fuel station is equipped with leak detection and level alarms. The rainwater is drained to sewer through an oil-water separator as required by New York City Code.

Photo 2.2.6.1 No. 6 Oil Tanks

2.2.7 Fuel Oil Transfer System

Fuel oil for use at the boilers is heated and transferred to the plant through an adjacent shed fitted with (2) steam-fed heat exchangers and (3) 3-HP Baldor fuel oil transfer pumps. No. 6 oil is thick at ambient temperatures and requires heating to approximately 200°F in order to make the oil less viscous and flow easier. The oil tanks have steam-fed heaters near their respective pickup tubes, enabling flow to the existing heat exchangers. Once at the boiler, atomizing steam assists the fuel oil in the combustion process. The boilers are also equipped with electric steam atomizers for cold startup capability.

Photo 2.2.7.1 Fuel Oil Transfer Pumps

2.2.8 Digester Gas Supply System

The digester gas produced as part of the anaerobic process is generally extracted and collected in a gas storage tank. Then, through a set of booster pumps, the gas is sent to the MPC plant for combustion as fuel in the boilers, or to the flares as excess to be burned. There is no gas analysis report available for the digester gas. The gas is estimated to have a heating value of 600 Btu/ft^3, as quoted by the DEP.

The digester gas collection and storage system is currently under repair and upgrade after a lightning strike to one of the digester tanks about two years ago. The work includes the repair and sectional replacement of the 10-inch underground supply piping to the MPC facility. The lines had accumulated significant particulate buildup and sectional rusting. Prior to these repairs, all of the digester gas was being flared. The newly repaired sections of digester gas piping are polymer-lined to alleviate future rusting and degradation in addition to the sections of new piping installed. The digester gas is pumped to the MPC boiler plant using dual Spencer brand hermetically-sealed gas boosters.

Photo 2.2.8.1 Clogged and Failed Digester Gas Supply Line

2.3 Wards Island Heating Distribution System

2.3.1 Steam Distribution Circuit Description

The steam distribution network for the Wards Island WPCP consists of a 10-inch main steam supply line from the MPC plant and a 4-inch condensate return pipe operating between the two facilities. Both the steam and condensate piping are underground and are run under the Hell Gate Bridge to the basement of the WI WPCP Administration Building. From this point, the main steam supply and condensate lines are run mostly in tunnels to supply the steam and condensate on the southern end of the plant. Within the WI WPCP, about 45% of the piping is underground while the remaining 55% is within the tunnel system.

The other section of the main underground steam piping is the 10-inch section of the network that runs from the side of the Administration Building, connects the Old Boiler Plant, and runs to the Solids Handling and Pump & Blower buildings. This section of the piping originally carried steam from the old boiler plant to feed the entire facility. The steam line is reduced to an 8-inch line to supply the new steam-to-hot water heat exchangers installed in the Sludge Handling Facility for reducing the sludge moisture content.

The steam network connecting the basement of the Administration Building to the North Return sludge Pump Station is reduced to 6 inches. This line takes care of the steam requirements of this building and continues on to a 6-inch steam and 2-inch condensate branch which feeds the Old Administration and Garage Buildings. Another 6-inch off this same line and an associated 4-inch condensate line located in the tunnels feed the Nos. 1 through 5 Primary Settling Tank Pumping Stations, the Waste Gas Burner Building, and the North and South Return Sludge Pumping Stations. A branch off of this main trunk feeds the northernmost Return Sludge Pumping Station, the Sludge Storage Tanks, the Office/Storage building, the Fuel Oil Storage Tanks, and the (8) waterfront Docking Stations. The Docking Station condensate return pumps have been temporarily replaced with pneumatic pumps, as the original electric pumps became submerged during wet weather or system leaks.

The steam system flow schematic diagram for the WPCP is shown in Figure 2.3.1.1 on the next page. A site map of the WI WPCP showing the points of connection of the steam system and potential location of the future plant is included in the Appendix – Attachment G for reference.

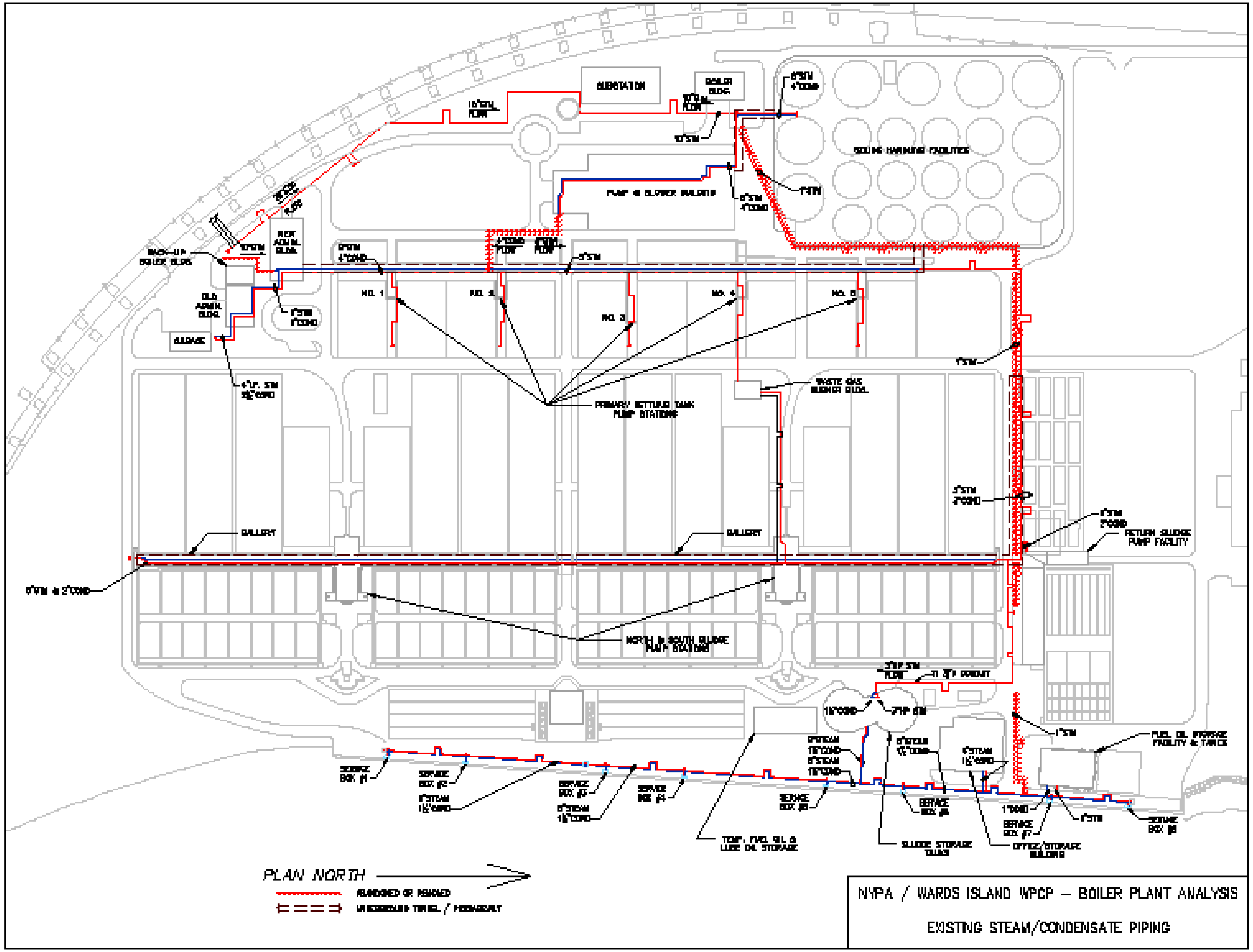


Figure 2.3.1.1 Existing Steam and Condensate Distribution Piping

2.3.2 Steam Operating Pressures

Despite the need to have steam supply pressure around 65 psig, the Wards Island WPCP only receives steam for distribution in the 40-psig range. Additionally, the steam supply pressure to the plant has been recorded to drop as the outside temperature decreases. At outdoor air conditions of 40°-45°F, it has been noted that the supply pressure drop is significant.

Inside the plant, the Pump and Blower Building operates on 5-8-psig steam. Of the (5) Primary Settling Pumping Stations, only Stations 2 and 4 require steam for heating. The E-Battery (Return Sludge Pumping Station) receives steam at about 8 psig, where it is converted to hot water for the sludge drying process.

2.3.3 Steam Distribution Infrastructure Assessment

Approximately 55 percent (55%) of the Wards Island steam distribution and condensate piping is located within tunnels on the property and is easily accessible. The remaining sections of the piping are located underground and not readily accessible. The one operating 10-inch steam supply pipe from the MPC boiler plant is located underground. The condition of this pipe, being the plant's main source of steam, is a major concern for the facility.

Within the DEP facility, the 10-inch underground steam line leading to the original boiler plant was patched in 2008. Additionally, the 5-inch steam line extending from the No. 5 Settling Tank Pumping Station to the end of the tunnel was replaced following detection of leaks. New 5-inch steam line replacements have also been installed to feed the Galleries, E-Battery, Sludge Storage Building, Dock & Marine Building, and the Fuel Oil Storage Building. In the North tunnel, the 3-inch condensate return line was replaced in 2001.

In the dock area, the underground steam supply piping, associated insulation and condensate pumps located in a roadway pit were noted as requiring repair. The manholes have often filled with water, necessitating temporary replacement of the electric pumps with pneumatically powered vacuum pumps.

2.4 Old Boiler Building – Current Condition

2.4.1 Original Boiler Building - Assessment

AECOM is currently attempting to confirm the Landmark status of the old boiler plant, Building 10. It is still unclear whether the building is considered to be 'landmark' or 'landmark eligible'. The building itself is approximately 90 feet long by 50 feet wide, with a basement underneath the boiler room floor. The concrete, steel, and masonry building was constructed in 1937. The basement level is 10'-2" from the floor to the bottom of the ceiling beam, and 12'-2" from level floor to the underside of the floor above. The basement contains (6) 27-inch thick concrete walls used to support the old boilers located on the first floor. The main floor of the structure houses the original boilers and the space is about 30' in height from the floor to the underside of the steel spandrels.

The building contains the (3) original Union Iron Works boilers, original fuel oil pumps, old piping and the common flue duct connecting the exterior chimney. The building also houses an electrical storage bin and fuel oil pumps for the (4) standby gas turbine generators located across the street. Though much of the original abandoned equipment is labeled as containing hazardous materials, most of the piping insulation has been abated and replaced with fiberglass. However, it is anticipated that the boilers still contain asbestos. The single masonry stack next to the building is original and appears to show some evidence of restoration work performed on it in the past.

The following images provide the interior and exterior overview of the old boiler plant:

Photo 2.4.1.1 Old Boiler House in the Wards Island WPCP

The proximity of the building to the digester tanks, its central location, and the lack of additional space make this abandoned plant an attractive location for a new plant on the Wards Island premises. To verify the structural integrity of the building, AECOM conducted a structural inspection. The inspection confirmed that the structural integrity of the building is still intact, but some remediation and restoration work will be required. Restoring the building for the future use will require hazardous material abatement, cleanup, demolition of existing equipment, and structural renovation. This work may require coordination and permitting with the New York City Landmarks Preservation Commission.

A copy of the structural integrity inspection report completed for the building is included in Appendix - Attachment F of this report.

3. DIGESTER GAS PRODUCTION

3.1 Current Limitations

The digester gas collection, storage and distribution system within the WI WPCP is currently undergoing a significant number of upgrades. The purpose of this section is to identify these upgrades and illustrate their impact on the plant's current digester gas production capabilities. It is estimated that the upgrades will be completed by 2013.

Part of the approach AECOM used in determining the feasibility of the various options under consideration by the DEP began with quantifying the plant's digester gas production volumes. AECOM investigated the treatment plant's operation and digester gas production by interviewing plant staff and reviewing digester gas production data recorded by the plant. Since the plant does not have metering in place, the historical production values provided for this study were based on estimates provided by the facility's process engineers. Due to this, and other related factors such as plant development work, it was not feasible to determine the maximum/optimum digester gas production capabilities at the plant. The following ongoing improvements currently affect the WI WPCP's digester gas utilization/production/capability:

a. A gas storage holder damaged approximately two years ago and to date is still out of service.
b. A temporarily disabled digester gas supply line that was recently repaired.
c. Due to ongoing repair work, one digester tank being continuously out of service.
d. Aeration tanks are being taken out of service intermittently in order to perform biological nutrient removal (BNR) upgrades.

With this work completed, any of the digester gas not being supplied to the MPC still has to be flared. It is expected that the gas extraction and holder work will be completed within the next few months. Completion of this work will allow the plant to move closer to understanding its digester gas production capabilities.

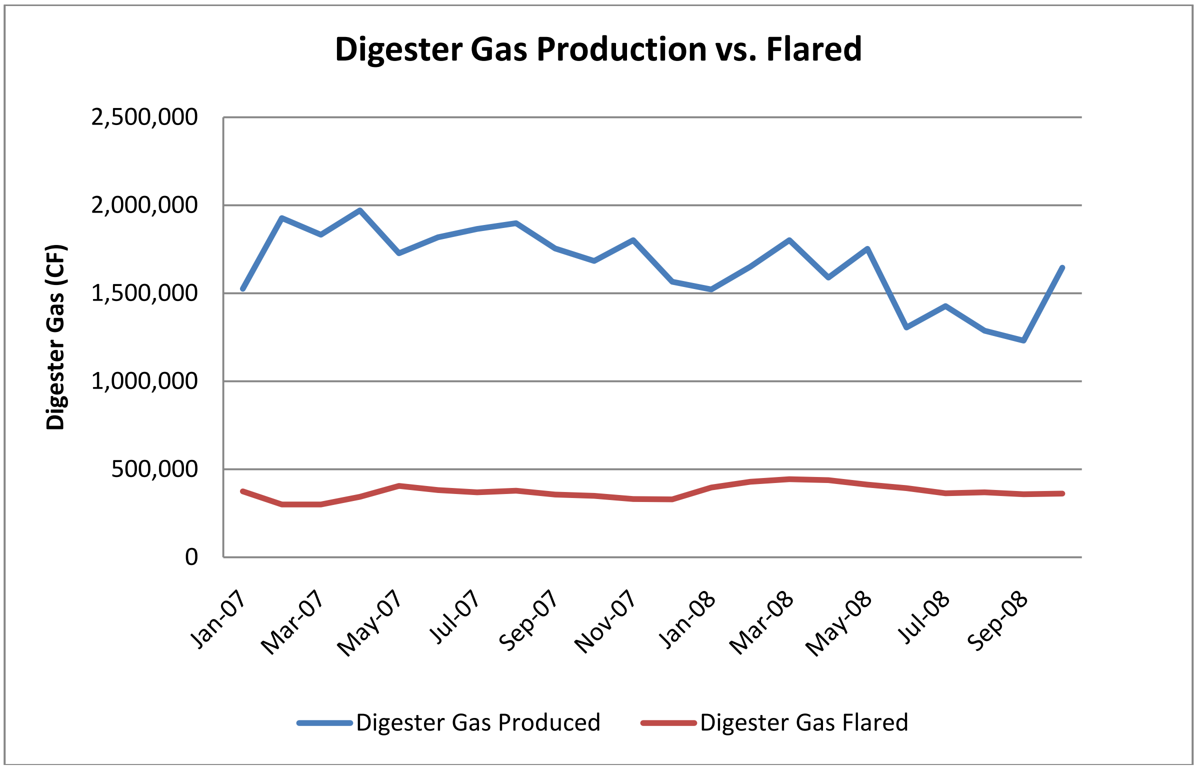
Based on these issues, AECOM was unable to obtain any further information on digester gas production and therefore were unable to estimate the full load digester gas production of the plant. The maximum production capability for the WI WPCP will be determined once all of the upgrade work is completed and gas metering is in place.

3.2 Digester Gas Booster System

The digester gas booster system is being retrofitted with (4) Spencer, model GH-3625-H-MOD hermetic digester gas boosters rated, at 600 SCFM at 3.8 psig each, to pressurize the gas into the pipeline currently feeding the MPC boiler plant. The digester system is also being fitted with numerous flame arrestors throughout the system to alleviate potential safety hazards. Sections of the existing pipeline were recently repaired and replaced with new polyethylene lining to avoid further corrosion and degradation.

3.3 Flares

The flares are currently fed excess digester gas from the non-functioning digester gas holder through a 24-inch pipeline header. In the future, any digester gas that is not sent to the new boiler plant will be stored in the soon-to-be refurbished gas holder. It is anticipated that with the implementation of this project and the refurbishment of the digester gas holder, the amount of digester gas flared to atmosphere will be reduced drastically or possibly even eliminated during certain operational periods. The following chart compares both historical digester gas production and flare data on a monthly basis from 2007 to 2008.



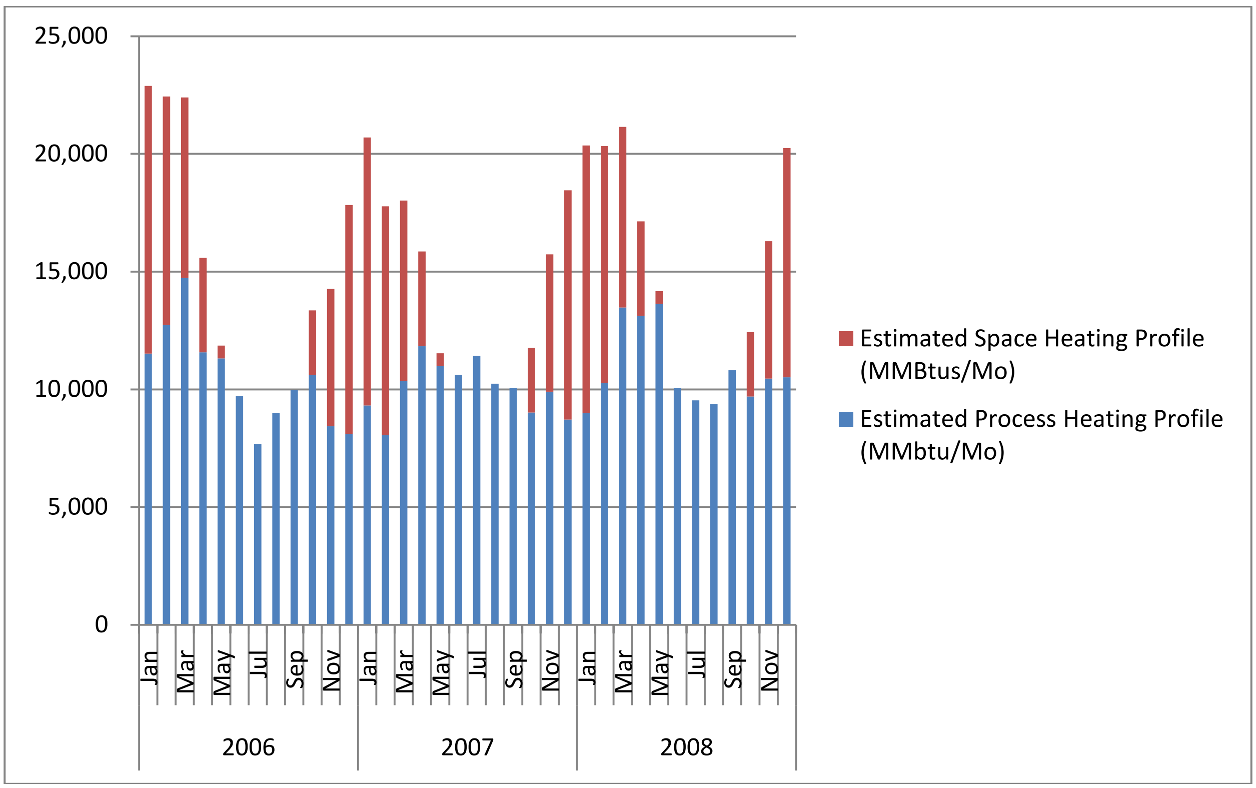
Graph 3.3.1 WI WPCP Digester Gas Produced vs. Flared

4. BASELINE CONDITIONS – STEAM & DIGESTER GAS PROFILES

4.1 Heating Requirements

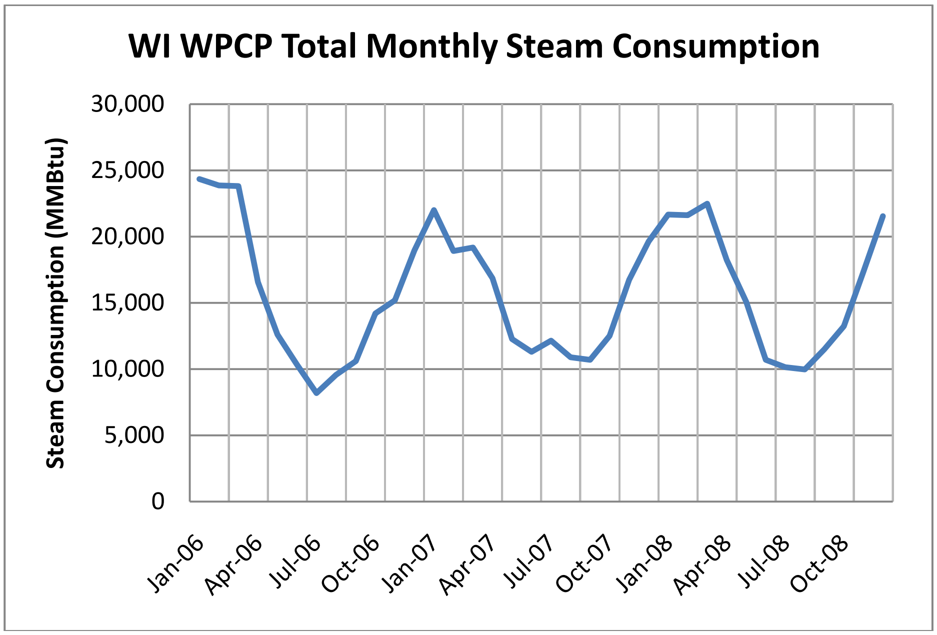
In order to determine the plant's heat requirements, AECOM performed a detailed review of facility mechanical design drawings as well as past steam consumption data supplied by the MPC. In addition, standby boiler oil consumption data supplied by the DEP was reviewed. In order to understand the peak design requirements of the plant, the equipment peak design loads were also compiled for the applicable system.

A review of the aforementioned data revealed that the plant steam load consists of both space heating and process steam. In order to differentiate between the two, AECOM applied monthly historical weather data to the total design peak load developed for the facility's HVAC equipment. The historical estimated monthly HVAC heat load was then subtracted from the total monthly historical facility heat load in order to estimate the portion associated with monthly process loads. This analysis provided an estimate of the monthly process loads. The following graph illustrates historical heating and process load distribution for the past three years.



Graph 4.1.1 Estimated Heating and Process Loads Based on 3-Year Historical Data

Historical consumption data supplied by the MPC consists of daily steam consumption totals from 2006 to 2008, as well as minimum and maximum hourly steam consumption for the monthly time periods. However, it should be noted that these hourly steam consumption figures are not indicative of total facility consumption due to the fact that a standby boiler was also being utilized during the same time period. Considering the fact that the oil consumption data supplied by the DEP contained monthly oil consumption figures, it is still unclear as to how much additional steam was being generated on an hourly basis by the standby boiler. The remaining analysis assumes that the monthly steam consumption quantities are added to the monthly oil consumption quantities (converted to steam quantities) in order to establish a total monthly heating consumption.



Graph 4.1.2 WI WPCP Total Monthly Steam Consumption

Looking at the 2006 through 2008 historical steam consumption data, the facility's steam requirement peaks from January through March. During this period, the consumption varies between 17,768 MMBtu and 22,884 MMBtu, per month. This peak is due to the additional building heating load. During the summer months, steam consumption drops to around 10,000 MMBtu per month. As the winter months approach again, the steam consumption returns to about 20,000 MMBtu per month.

The total steam consumption during the 2007 calendar year was lower than the other years due to decreased process demand in February and March. During these months, the steam consumption was significantly less than previous years, while surprisingly; ambient temperatures were markedly colder than in other years.

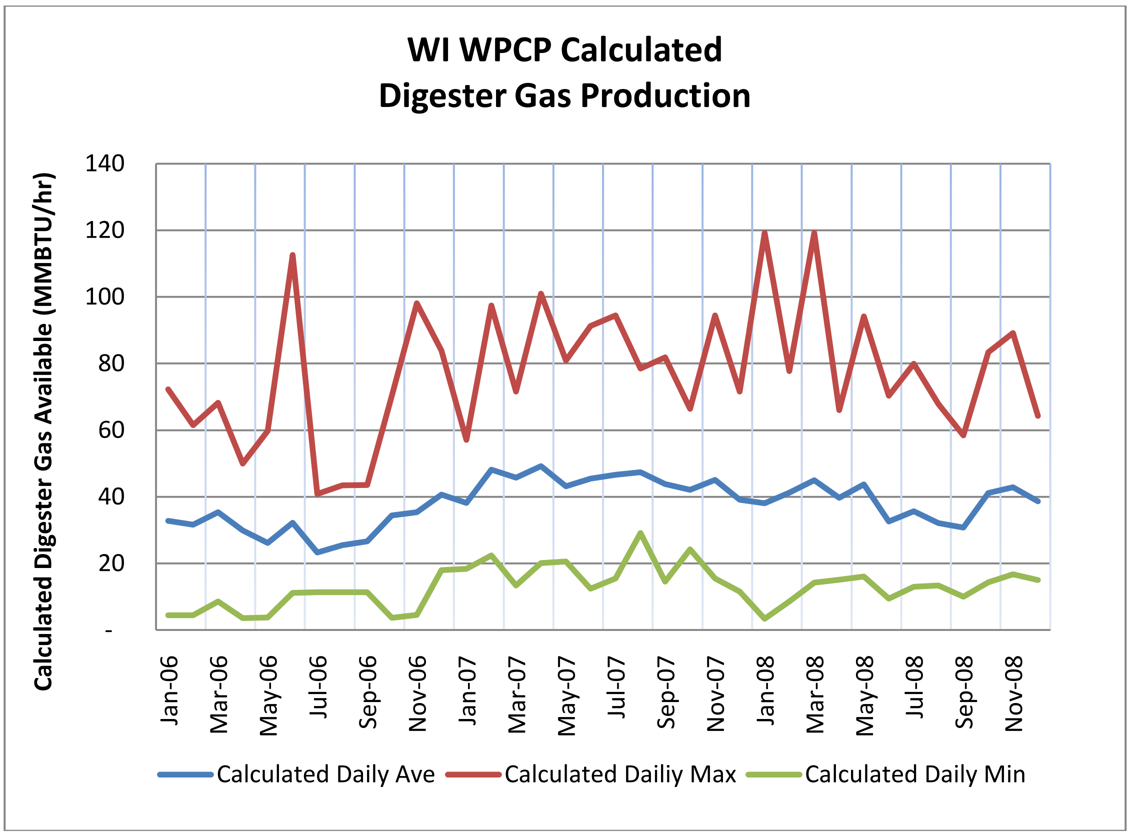
4.2 Digester Gas Production

Due to unreliable digester gas metering, the historical production numbers provided to AECOM were calculated by the plant, with daily records kept. Digester gas production has been calculated based on the volatile suspended solids in the activated sludge sent to the digester.

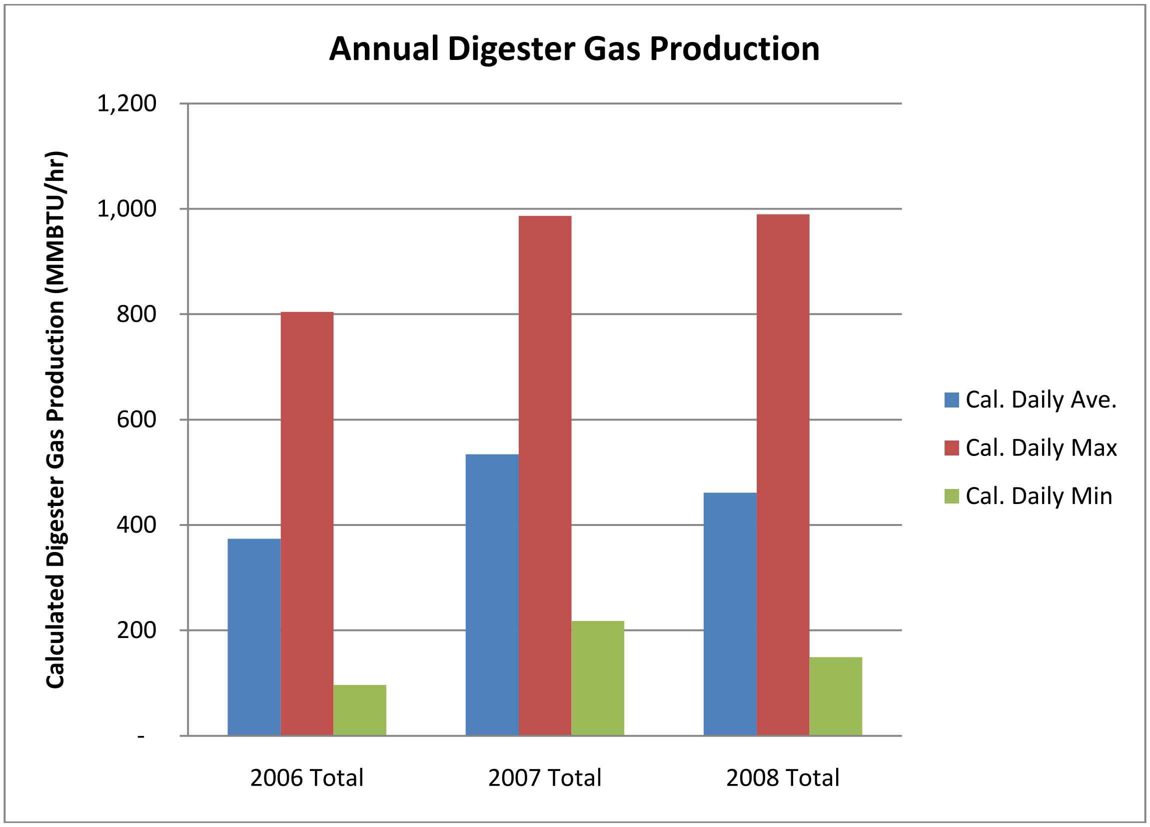
During 2006, the plant produced a total of 4,499,100 cubic feet of digester gas with an estimated total heat content of 269,946 MMBtu, based on an assumption of 600 Btu/cu. ft. The monthly production varied with a maximum output in December of 503,940 cubic feet and a minimum output in July of 288,540 cubic feet.

During 2007, the plant produced a total of 6,368,445 cubic feet of digester gas at an estimated total of 382,107 MMBtu for the calendar year. This production exceeded the previous year by about 30%. The maximum monthly output occurred in August at 569,070 cubic feet, with a minimum output in January of 472,815 cubic feet.

The 2008 digester gas production data only covers January through October. During this period the facility produced a total of 4,444,215 cubic feet of digester gas at an estimated equivalent total of 266,653 MMBTU. The maximum output was in October at 509,805 cubic feet, with the minimum output of 369,240 cubic feet in September.



Graph 4.2.1 WI WPCP Historical Digester Gas Production



Graph 4.2.2 WI WPCP Annual Digester Gas Production

4.3 New Heating Plant Baseline

This section covers the analysis required to establish baseline heating design requirements for the proposed heating plant alternatives. It establishes the peak load conditions and fuel requirements of the proposed facility.

4.3.1 Heating Load Requirements

In order to determine the heating load requirements of a proposed heating plant for the WI WPCP, the peak design loads for each piece of equipment and process at the facility were obtained from design drawings and/or estimated. Due to the nature of the systems at the facility, the design loads were compiled based on whether the heating medium is steam and/or hot water. Based on this data, the total peak load requirement for the facility was determined. Table 4.1 shown below provides a summary of the peak heating load requirement for the plant.

Cognizant of the fact that not all of the systems at the WI WPCP facility will operate coincidentally at peak conditions, a design diversity of 90% was applied to the peak load data to obtain a true heating plant design baseline for the facility.

A review of mechanical system drawings indicated that both hot water and steam heating systems are utilized throughout the plant. While the plant depends solely upon steam, several heat exchangers are used to convert steam to hot water for the use in terminal units. The table below illustrates the breakdown of the design loads in MBH. These figures were used to establish the size of a potential boiler plant. For those options where multiple boiler plants are suggested, the loads were broken up into smaller zones located within that particular boiler plant’s service.

Wards Island WPCP Heating Loads				
	HVAC Loads		WPCP Process Loads	
Zone/Building	Steam Load	HW Load	Stm Load	HW Load
Zone 1				
Old Administrative Bldg	388 MBH	- MBH	- MBH	- MBH
New Administrative Bldg	975 MBH	888 MBH	- MBH	- MBH
Garage	635 MBH	- MBH	- MBH	- MBH
Back-up Boiler Bldg	- MBH	- MBH	- MBH	- MBH
Total	1,997 MBH	888 MBH	- MBH	- MBH
Zone 2				
Office/Storage Bldg	730 MBH	- MBH	- MBH	- MBH
Fuel Oil Storage Facility and Tanks	265 MBH	- MBH	- MBH	- MBH
Sludge Storage Tanks	821 MBH	- MBH	- MBH	- MBH
Docking Stations	- MBH	- MBH	1,680 MBH	- MBH
Total	1,816 MBH	- MBH	1,680 MBH	- MBH
Zone 3				
Boiler Bldg	- MBH	- MBH	- MBH	- MBH
Pump and Blower House Building	849 MBH	- MBH	- MBH	- MBH
Solids Handling Facility	1,865 MBH	14,000 MBH	- MBH	44,100 MBH
Primary Settling Tank Pumping Station 1	- MBH	- MBH	- MBH	- MBH
Primary Settling Tank Pumping Station 2	911 MBH	- MBH	- MBH	- MBH
Primary Settling Tank Pumping Station 3	- MBH	- MBH	- MBH	- MBH
Primary Settling Tank Pumping Station 4	911 MBH	- MBH	- MBH	- MBH
Primary Settling Tank Pumping Station 5	- MBH	- MBH	- MBH	- MBH
Waste Gas Burner Building	120 MBH	- MBH	- MBH	- MBH
South Return Sludge Pump Station	2,078 MBH	- MBH	- MBH	- MBH
North Return Sludge Pump Station	2,078 MBH	- MBH	- MBH	- MBH
Return Sludge Pump Station	- MBH	2,250 MBH	- MBH	2,520 MBH
Total	8,812 MBH	16,250 MBH	- MBH	46,620 MBH
WPCP Total Heat Loads	**12,625 MBH**	**17,138 MBH**	**1,680 MBH**	**46,620 MBH**
Peak Design Load	**29,764** MBH Total HVAC Design Load		**48,300** MBH Total Process Design Load	
Total Peak Design Load	**78,064 MBH Peak Design Load**	**or**	**2,334 Boiler HP**	
Total Peak Design Load (90% Diversity)	**70,257 MBH Peak Design Load**	**or**	**2,101 Boiler HP**	

Table 4.3.1.1 WI WPCP Design Peak Loads

The following table provides a breakdown of the proposed design loads for each of the independent load zones for the facility.

Zone	Load	Diversified Load	Peak Design Boiler HP Requirement
1	2,885	2,597	78
2	3,496	3,147	94
3	71,682	64,514	1,929

Table 4.3.1.2 WI WPCP Design Peak Loads per Zone

Subsequent to this review, it was determined that approximately 2,100 HP will be required to satisfy the needs of the equipment currently in service at the facility. A certain level of redundancy is also recommended and further details will be specified in Chapter 5.

4.3.2 Digester Gas Requirements

The digester gas is currently piped to the MPC boiler plant as part of an energy agreement in which the WI WPCP receives steam for heat and process loads. For approximately two years, the digester gas supply was interrupted due to lightning damage to a digester storage tank, pipeline corrosion, and rupture issues. These items are being repaired and upgraded and digester gas supply has recently been resumed to the MPC boiler plant. The upgrade also includes the installation of (4) hermetically sealed gas boosters to maintain steady gas supply pressure at 3.8 psig for future use. As part of this project, the current digester gas supply to MPC will be eliminated. Instead, all of the produced digester gas will be available to the proposed plant. The gas will be utilized as the primary fuel to produce the facility's heating requirements and then any excess gas will be sent to the flares. Specific details on estimated potential digester gas usage and other operational costs are located in Attachment C.

Based upon steam consumption requirements, the following table summarizes the projected digester gas requirement for each of the proposed options.

Projected Digester Gas Requirement	
Option	Digester Gas (Million ft^3 / Year)
Option 1	378
Option 2A	370
Option 2B	370
Option 3	370
Option 4	355
Option 5	355
Option 6	355

Table 4.3.2.1 Projected Digester Gas Requirements

4.3.3 Fuel Oil Requirements

The fuel oil requirements of the seven options discussed in the next section can be broken down into three categories. Specific details on estimated potential fuel usage and other operational costs are located in Attachment C. The three fuel oil requirement categories for the DEP's consideration are:

1) Fuel oil (No. 6) requirement associated with the operation of the MPC Plant, Option 1.
2) Fuel oil (No. 2) requirements associated with the operation of the new centralized plant options (i.e. – options 2, 3 & 5).
3) Fuel oil (No. 2) requirements associated with the operation of the new decentralized plant options (i.e. – options 4 & 6).

Based upon steam consumption requirements, the following table summarizes the projected supplemental fuel oil requirements for each of the proposed options.

Projected Supplemental Fuel Oil Requirements		
Option	No. 2 Oil (Gallons/Year)	No. 6 Oil (Gallons/Year)
Option 1	N/A	382,278
Option 2A	35,775	N/A
Option 2B	35,775	N/A
Option 3	35,775	N/A
Option 4	100,028	N/A
Option 5	100,030	N/A
Option 6	100,028	N/A

Table 4.3.3.1 Projected Supplemental Fuel Oil Requirements

Option 1 involves operation of the MPC boiler plant to meet the steam needs of the plant. The MPC plant will consume mostly digester gas, with approximately 10% pilot No. 6 fuel oil.

For Options 2 through 6, No. 2 fuel oil will be the backup fuel for the boiler plant and the anticipated use will be for supplemental production should the digester gas service be interrupted or insufficient for steam production.

The WI WPCP is currently equipped with (3) standby turbine generators and a 400-HP standby boiler which all utilize No. 2 fuel oil. The turbine generators consume an average of 2,900 gallons annually, while being exercised. Due to the instability of the MPC steam service the 400-HP boiler records indicate annual oil consumption averaging 163,412 gallons a year over the last 3 years. With the proposed upgrade, the 400 HP boilers will be placed in standby mode and will consume less than 500 gallons of fuel oil annually. This consumption reflects the occasional testing of the oil firing system as required by standard operating procedures.

4.3.4 Natural Gas Requirements

During the development of this study, AECOM was informed by the facility that Con Edison was in the process of installing a natural gas line to service the needs of the WPCP. Initial contact with the utility confirmed that the Con Edison was in the process of providing gas to the Island. Based on these initial discussions, AECOM assumed that natural gas will be available as the secondary fuel for any new plant construction.

During the duration of the study, AECOM noted that lengths of HDPE natural gas piping were brought on to the Island and stored on the sides of the access roads. In follow up conversations with Con-Edison, it was discovered that the pipeline was installed for another project on the Island and that due to financial constraints the gas service project and the pipeline connection to the Bronx gas feeder was suspended. Since the Island is a non-franchised zone, Con Edison was not prepared to commit its funds to the project.

Con Edison confirmed that it will need approximately $2 million to complete the connection to the Bronx feeder and provide the necessary service to the Island. Based on this information, AECOM resolved to No 2 fuel as the secondary fuel, while natural gas could eventually be provided as the tertiary fuel. A natural gas pipeline, acting as a secondary fuel will be a better option for the facility if the financial constraint faced by Con Edison is eventually resolved. The proposed boiler plant would require natural gas in the 3 psig range to operate properly.

During the initial feasibility report review at the facility on October 9th, 2009, the DEP expressed its desire to have natural gas as a secondary fuel rather than fuel oil. The DEP stated it will avoid initial installation costs involved with the use of fuel oil tanks and the facility will avoid significant annual costs associated with maintenance, repair inspection and recurring certification requirements for a fuel oil storage system.

Based on these discussions the DEP provided direction that natural gas be considered as the backup fuel for the project. As such, AECOM was directed by NYPA to include a $2 Million base material and labor budget as part of the cost estimate for the proposed options. Pending final decision by the DEP, NYPA has instructed that the cost estimate for the fuel system also be left in the project budget.

5. HEATING SYSTEM OPTIONS

5.0 Introduction

As discussed earlier in this report, the Wards Island WPCP is dependent on steam service from the MPC boiler plant for building and process heating needs. To supplement this service, a 400-HP high pressure standby boiler, installed by the DEP, provides partial support for the heating requirements. The MPC steam supply agreement will end by 2011, at which point the DEP will need to satisfy its own heating requirements.

This section discusses the various options available to the DEP for providing a heating system independent of OMH control. The basis behind each of the options is outlined and the requirements to facilitate the deployment of each of the options are also outlined prior to determining the associated economic benefits. For each of the options explored, the basic assumption is that it will strictly provide capacity only to the DEP facility and not to any other occupants of the island.

To address the WI WPCP's search for a cost effective, reliable and environmentally friendly solution, AECOM developed the following alternatives for DEP and plant personnel consideration.

5.1 Option 1: Permanently Take Over the Manhattan Psychiatric Center Boiler Plant

5.1.1 General Overview

This option explores the feasibility of the DEP purchasing the MPC facility upon OMH's departure from the plant. The option assumes that when the DEP receives ownership of the plant, it will utilize the steam output from the plant for the sole use of the WI WPCP and will not - at the onset - provide steam services to the remaining non–OMH agencies currently receiving steam service from the plant. As part of this option, the DEP will also need to consummate a contract for ownership of the plant with the NYS OMH as well as to transfer the air permit for the facility into its jurisdiction.

Another consideration under this option is that the DEP will provide trained staff to take over around the clock operation of the plant. Air permitting issues related to this option are provided in Section 7.

In considering the purchase of the MPC plant, several other contractual factors will need to be carefully studied by the DEP prior to making its conclusive determination regarding the benefit of this option. For instance, issues such as the MPC plant's land lease, the continuation of steam services to other Agencies currently served by OMH, the continued maintenance requirements of the electrical feeder services, as well as the chiller plant located within the plant will have to be further evaluated.

5.1.2 Plant Conditions and Upgrade Requirements

As outlined in Section 2.2 of this study, certain components of the MPC plant were upgraded within the past twelve years to preserve the continued integrity of the plant. According to documents provided by the NYS-OMH consultant, over $17 million has been spent on upgrades to the burners, selective re-tubing, burner controls, improvements to the digester gas firing system, and other boiler plant related improvements.

Although these expenditures have helped maintain the boiler system, and its associated components remain in serviceable condition, there is still considerable concern regarding the age of the boilers; and other service and age related issues that still need to be addressed. For example; due to their age, the facility personnel noted that there are several areas in which there is uncontrolled air filtration on the fire side of the boilers. Also, the retrofitted COEN burners have required continuous adjustment to optimize the output efficiency of the boilers. Additionally, the boiler controls are antiquated and replacement parts are no longer available. All of these issues are contributing to the inadequate performance of the plant. They will have to be addressed to preserve the integrity of the plant.

Of the (2) 10-inch steam supply pipes feeding WI WPCP, only one is functioning. Due to several leaks in the piping, the second line has been out of commission, leaving the WI WPCP with no redundant service. Should this remaining piping fail, the DEP plant would be dependent on the 400-HP standby unit. The 10-inch pipe runs about 1,200 feet from the MPC plant to the WI WPCP Administration Building tie-in point. This defective piping will have to be repaired as part of the work accomplished under this option.

5.1.3 Operational Requirements

The MPC boiler plant is operated by (4) stationary engineers and (1) fireman during the week. On weekends, the plant is manned by a minimum of (1) engineer and (1) fireman around the clock. When the plant is taken over by the DEP, not all of the boiler capacity will be required. Only two of the four boilers will be required, with one unit able to meet most of the Wards Island load requirements, while the second unit is operated on hot standby. The operators will run the lead boiler at a 2:1 to 3:1 turndown ratio for most of the year to meet the production requirements. During peak demand periods, two boilers may be required.

Due to this lower capacity requirement, operating the plant under DEP control will require less staff. For the analysis, it was assumed that one operating engineer would man the plant at all times, with 1 fireman providing support around the clock, daily. Additionally, we have estimated that the staff will have an operator provide maintenance support on two of the three daily shifts for the upkeep of the plant.

Regarding the chiller plant, it has been assumed that this section of the plant will be decommissioned and the chillers taken out of service, since the NYS OMH will build a replacement chiller plant within the proximity of its long-term buildings. We have assumed that the electrical feeder service will remain active but will remain under the control of the MPC.

5.1.4 Maintenance Requirements

Much of the existing MPC boiler plant equipment is original. Although the equipment is operational and appears to be reasonably well maintained, it has performed well beyond its normal service life. Despite the consistent maintenance of the boiler plant equipment, there are obvious signs of aging from our field inspections that will affect the continued peak efficiency of the plant.

For instance, the boilers are noted as having fireside leaks, a condition which can introduce uncontrolled amounts of excess air into the boiler combustion chamber and adversely affect the combustion process, thus reducing the overall efficiency. Other issues, such as internal boiler refractory cracking and refractory wall spalling due to burner flame impingement and heavy fuel oil surface caking, will need to be addressed to preserve the life of the boilers. An internal inspection of boiler No. 3 indicated some refractory cracking across from the firing gun, likely caused by uneven expansion and high burner ramp-up rates.

The electric, forced-draft fans on each of the units that replaced the original steam turbine drives appear to be in good condition. The No. 6 fuel oil delivery system appears to be operating properly, with the pumps and heater in the middle of their service lives. Notwithstanding the age of the boilers, the COEN burners also operate quite well.

The Preferred Rimcor PCCII sensor technology controls in use at the plant are antiquated. This product has been out of manufacture for some years, and replacement parts are no longer available. The operators report that many of the steam pressure reducing valves are original and will require upgrade. The boiler plant stack is also original and will require progressive maintenance.

The facility has ongoing contracts for water treatment and annual service and adjustment for the burners and controls. All of these contracts, including additional capital upgrades, will be required if the plant is purchased. All operations and maintenance costs for the plant will also be the responsibility of the DEP and will be annualized and presented, for the purposes of this comparison, in the financial section.

5.1.5 Plant Capital Cost

The capital cost associated with ownership of the MPC power plant will include the initial purchase cost of the plant in addition to any capital expenditures necessary to ensure the long-term, efficient operation of the plant. For the basis of analysis for all the options, a twenty-year life cycle comparison of all capital costs was used.

Upon purchase, maintenance as well as operating costs of the plant will become the responsibility of the DEP.

To establish the capital cost for permanent acquisition of the existing MPC boiler plant, AECOM performed an analysis using the following assumptions:

i. The capital cost for the existing plant is established by first determining the replacement cost of an equivalent facility containing similar equipment and systems as the MPC plant.

This replacement cost is then devalued to 20% of its total value to truly reflect the age and condition of the existing facility. This devalued cost represents the capital cost the DEP will pay to purchase the plant.

ii. The present capital cost to perform all required upgrades to the existing plant was also determined. This cost is added to the depreciated value of the plant to compile the total cost outlay for DEP to purchase the plant and update it. It should be noted that part of the update requirements includes cost allocation for replacement of the steam and condensate lines from MPC to WI WPCP.

5.1.6 Steam Distribution System Upgrades

In order to maintain its flexibility and improve the performance of the boiler plant, the second 10-inch steam main serving the WI WPCP will need to be replaced after the plant is purchased. Also, all of the condensate return piping will need to be replaced in its entirety to ensure return of condensate to the plant. The distance from the MPC plant to the WI WPCP steam header tie-in is approximately 1,200 feet. This underground piping replacement cost is included in the capital cost associated with this option.

On the WI WPCP property, the plant personnel noted that there are some underground piping leaks that will need to be addressed as part of a heating system upgrade project. The main portion of this piping is the 10-inch underground steam line running between the existing Administration Building and the Old Boiler Plant. The length of this portion of piping is estimated at 500 ft**.**

Other piping and steam condensate issues to be addressed include the upgrade of the steam supply and condensate return piping and pumps that provide steam service to the docking stations at the eastern waterfront section of the plant. The existing electric well condensate return pumps have been rendered inoperative due to underground flooding. The design phase of this project will investigate potential improvements with the steam and condensate distribution piping. The proposed condensate return pump is estimated to have a capacity of approximately 30 GPM based on an estimated load of 1,500 lbs per hour of steam service to the marine terminal units.

5.1.7 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Section 7 of this study.

5.2 Option 2: Install a New High Pressure Steam Central Plant

5.2.1 General Overview

This option involves the construction of a new high pressure (up to 150 psig) boiler plant to meet the long-term requirements of the WI WPCP. If selected, the DEP will embark in the deployment of this option to ensure the commissioning of the plant for service prior to the closure of the MPC plant. If this schedule will not be feasible, the DEP will have the two interim options to provide intermediate service while the new plant is completed. These interim options are discussed later in this section. There are two potential locations for the construction of the proposed boiler plant. The first option considers utilization of the Old Boiler Building, while the second option considers installation of a new pre-fabricated building located either behind the New Administration Building or next to the Pump & Blower Building.

The new boiler plant would be sized to meet the total load requirements of the facility as outlined in earlier sections of this study. Based on a peak boiler horsepower requirement of 2,190 HP, the high pressure boiler plant will be designed with three 800-HP boilers and two 400-HP boilers. This arrangement allows for some redundancy (n+1) over the maximum demand for the facility. It also allows for versatility in operation of the boilers. A combination of 800-HP boilers and 400-HP boilers can be utilized to provide excellent load matching and operating flexibility to match the load requirements of the plant throughout the year.

The proposed boilers will utilize digester gas as primary fuel. The boilers will also have the capability to burn No. 2 fuel oil and natural gas as secondary fuels. The existing 400-HP high pressure boiler will be serviced and kept in place to provide back up support in case of future emergency.

The new plant will obtain its digester gas service by re-routing the digester gas supply line that presently feeds the MPC boiler plant. Fortunately, the line is already in close proximity to both locations being considered for the new plant. New digester gas cleanout equipment will be provided to ensure the quality of the gas and preserve the life of the new equipment.

The plant will be designed to operate at a maximum steam pressure of 100 psig. The existing plant steam line service is reportedly operated between 20 and 40 psig depending on the steam demand. Facility personnel have reported that steam supply to the property is inconsistent. When coupled with on-site problems such as leaks and faulty distribution equipment, this results in very poor service to end devices. With thorough cleaning and repairs throughout the distribution system and a new boiler plant in place, terminal equipment in each building will receive steam at design pressure, which has not occurred for quite some time.

5.2.2 Option 2A: New Plant in Old Boiler Building

The consideration under this option will be to locate the new boiler plant within the Old Boiler Building, Building 10. This building has essentially been abandoned since the facility discontinued the use of its own boilers. As outlined in earlier sections of this report, the building is still structurally sound but will require some upgrade and restoration work, demolition and hazardous material abatement to prepare it for reuse. The costs associated with all of these requirements are identified and included as part of the analysis for this option.

The obvious advantage to using the Old Boiler Building for the new plant is that it already exists. Available space on the property is very minimal, and the facility will benefit in the future from having re-used the existing structure. The treatment plant will almost certainly require expansion at some point; utilizing the existing structure will afford them more freedom to do so. With high ceilings and large, open spaces, the Old Boiler Building is a suitable location for the new plant and will easily be able to accommodate all of the boilers and associated ancillary equipment. Additionally, utilizing the space will allow the DEP to remediate all legacy environmental issues within the building.

The use of the existing stack will need to be evaluated after a complete inspection by a licensed stack contractor. This inspection would occur early in the design stage. Funds have been allocated to refurbish, modify or replace the existing stack based upon the inspection report results and possibly, Landmark Preservation Commission's approval. With the appropriate approvals, the design could also include the demolition of the stack and provision of a more appropriately sized stack.

5.2.3 Option 2B: New Plant in New Location

The DEP also has the option of installing the new boiler plant in a modular structure, prefabricated and assembled on-site. A new boiler plant building could potentially be located on the open site to the immediate north of the existing New Administration Building. The building footprint would be roughly 80 feet by 60 feet. All of the required underground utilities will be routed from and to the new central plant. As stated previously, both of the potential locations for the new plant are within close proximity to existing services such that there will not be excessive costs associated with the relocation of these services.

The construction of a new building will have the advantages of flexibility in placement of equipment and the ability to accommodate DEP requirements without being limited by existing construction. An additional advantage to the new building is that the abatement of asbestos-containing materials and lead-based paint that is necessary at the Old Boiler Building can be avoided. During various discussions, the facility indicated that it does not want to utilize the remaining green space at the facility for another building. It was recommended that the existing building should be used for any proposed option.

5.2.4 Preliminary Plant Capacity

The new high pressure central plant is preliminarily sized to accommodate the space heating and process heat demands of the WPCP. It is proposed to configure the heating plant with three (3) 800-HP boilers and two (2) 400-HP boilers. The 800-HP boilers will be capable of an 8:1 turn down ratio, while the 400-HP will be capable of a 4:1 turn down ratio. The total boiler plant capacity will be 3,200 HP, not including the existing 400-HP standby boiler.

Table 5.2.4.1 Design Load Requirements

Zones	Load (MBH)	Diversified Load (MBH)	Boiler HP Equivalent	Equipment / Qty	Total Heating Plant HP
All Zones	78,064	70,258	2,100	(3) 800 HP + (2) 400 HP Boilers	3,200 HP

5.2.5 Plant Schematics

The proposed new boiler plant will be housed in a new structure approximately 75 feet by 100 feet located within the green space next to the Blower Building.

5.2.6 Operational Requirements

The proposed boiler plant will operate primarily on digester gas, with No. 2 fuel oil as a secondary fuel source. While the potential total production capacity of digester gas is not known, recent annual records of generated digester gas indicate that the fuel requirements of the plant can very nearly be satisfied utilizing only digester gas. Ongoing construction projects, equipment deficiencies and poor steam service resulting in reduced processing capacity have limited digester gas production in recent years. Until these issues are resolved, an accurate estimate of potential digester gas production cannot be projected. With the boiler sizes being recommended, and with the proposed turndown ratios, the plant will be able to provide stable control for all WI WPCP steam load profiles.

With the boiler plant moving onto the WPCP property, the DEP will be required to provide personnel to monitor and control its operation. New York City Administrative Code section 28-413.1 states that any high pressure steam boiler plant must be operated by or under the direct and continuing supervision of a licensed high pressure boiler operator. Additionally, this licensed operator must be present at all times during the operation of the boiler. For the new plant, we assumed that there will be one certified engineer on duty around the clock, while one additional engineer will also be present around the clock to support the operation. Additional maintenance staff will be present on two of the three shifts to provide operations.

The 400-HP, high pressure, scotch marine boiler located adjacent to the Old Administration Building will be serviced and put on standby to support the plant's operation in an emergency.

5.2.7 Maintenance Requirements

The new boiler plant will require routine maintenance in accordance with standard procedures and manufacturer's recommendations. It is anticipated that due to the installation of all new equipment, the maintenance downtime and requirements for the equipment will be at a minimum. Complete equipment manufacturers training will be offered to the WI WPCP operating staff. The curriculum of this training includes – among other things – boiler operation in manual/automatic modes, daily checklists, preventive maintenance, and cleaning.

5.2.8 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Section 7.

5.3 Option 3: Install a New Low Pressure Steam Central Plant

5.3.1 General Overview

This option involves the installation of a new low pressure steam central boiler plant. A low pressure (LP) steam plant, rated at 15 psig, allows for the majority of the plant's HVAC equipment to remain in service. Currently, high pressure steam is distributed throughout the facility through a number of distribution tunnels and buried conduit piping. At each building, the high pressure steam must pass through a pressure reducing valve (PRV) in order to be reduced to a pressure equal to or less than that which is characteristic of a LP boiler plant. For this reason, it makes sense to produce steam at low pressures, rather than at high pressures which are not required anywhere. An additional benefit from the LP boiler plant is that a round the clock operating engineer is not required. Since the facility is not currently staffed to support this requirement, they will not see a substantial increase in annual labor costs.

The new LP steam boiler plant will be installed in the existing Old Boiler Building. A full restoration of the Old Boiler Building will include the removal of any equipment or concrete structures related to the existing boiler plant, as well as abatement of hazardous lead-based paint and asbestos-containing materials. This initial restoration will update the building to a condition in which it can be used again. The existing chimney – which may be classified as Landmark – will be reused, pending a thorough inspection and analysis of its integrity. Any modifications to the chimney or building exterior may require preliminary approval by the New York City Landmarks Preservation Commission. If approved, the existing chimney may also be demolished to make room for a new unit.

5.3.2 Plant Capacity

The new LP steam central boiler plant will be sized to accommodate the combined process and HVAC loads of the entire facility. This amounts to a required capacity of 2,100 HP. To meet this load, (3) 800-HP boilers and (2) 400-HP boilers will be installed, allowing for either (1) 800-HP or (2) 400-HP units to be out of service at any time without threatening peak load capability.

Through an analysis of existing equipment as seen in design and construction documents as well as during site visits, it has been estimated that the division of the peak load between HVAC and process loads is approximately 750 HP and 1,447 HP, respectively. The process load, accounting for over 65% of the total load, requires steam to be converted to hot water. At the time of this report, the facility is involved in various construction projects, one of which is the installation of new steam-to-hot water heat exchangers in the Solids Handling Facility. If the LP steam option is pursued, the plant will be able to retain these new units, which will integrate very smoothly into the proposed LP steam centralized plant.

Table 5.3.2.1 Design Load Requirements

Zones	Load (MBH)	Diversified Load (MBH)	Boiler HP Equivalent	Equipment / Qty	Total Heating Plant HP
All Zones	78,064	70,258	2,100	(3) 800 HP + (2) 400 HP Boilers	3,200 HP

5.3.3 Plant Schematics

As stated previously, the proposed LP steam centralized boiler plant will be located in the existing Old Boiler Building. In addition to its availability and space, the Old Boiler Building is an ideal location for the new boiler plant because of its proximity to its largest load source; the Solids Handling Facility (SHF).

A completely new low pressure steam distribution piping with associated condensate system will be installed as part of this option. The short pipe run between the two buildings will benefit the construction cost, as the pipe size required to carry the steam for the SHF will be large and, therefore, expensive. From the SHF, the main steam line will split into two smaller branch lines serving the western and eastern sides of the plant. The branch feeding the western end of the plant will supply low pressure steam to Preliminary Pumping Stations 2 and 4, the New and Old Administration Buildings, a garage used for storage, and the Waste Gas Burner Building (via Preliminary Pumping Station #2). The eastern branch will feed the Return Sludge Pump Facility (also known as E-Battery) before splitting once more to provide steam to the North and South Sludge Pump Stations and the remaining loads related to the Marine Terminal buildings. The marine area includes the Fuel Oil Storage Facility & Tanks, an Office/Storage Building, Sludge Storage Tanks, a Temporary Fuel Oil & Lube Oil Storage building and (8) docking stations equipped with steam-heated valves and gooseneck connections for steam supply to docking vessels. While all eight of the docking stations must be equipped to provide steam to the transport vessels, it has been reported that only two of the five DEP-owned sludge transportation vessels actually have the requirement for steam. Therefore, the piping leading to the Marine area (as well as the boiler plant itself) has been sized to accommodate only two ships, each with an 840-MBH peak load.

The steam distribution piping has been arranged to utilize as much of the existing underground infrastructure as possible. Some of the existing piping is buried and will not be useful to the new plant distribution. Such piping will be removed when the new piping is installed. Existing piping installed in tunnels will be far simpler to replace. Pending size constraints, the new distribution piping will be installed in place of the existing piping, once removed.

Currently, the Wards Island condensate recovery system is in poor shape. The new boiler plant will benefit from a newer system with reliable and efficient condensate return equipment. Pumps in each building will feed condensate to branch lines that lead back to the boiler plant, where it can be turned into steam again and redistributed back to the facility. Additional return pumps may be necessary at locations along the larger tunnels, to overcome resistance caused by pipe friction. Condensate from the steam used at the Marine Terminal docking stations for valve warming and ship heating will not be returned to the boiler plant, so make-up water will be introduced into the system to match the amount that is lost at these stations.

Figure 5.3.3.1 shows the approximate steam distribution piping for the proposed LP steam centralized plant option.

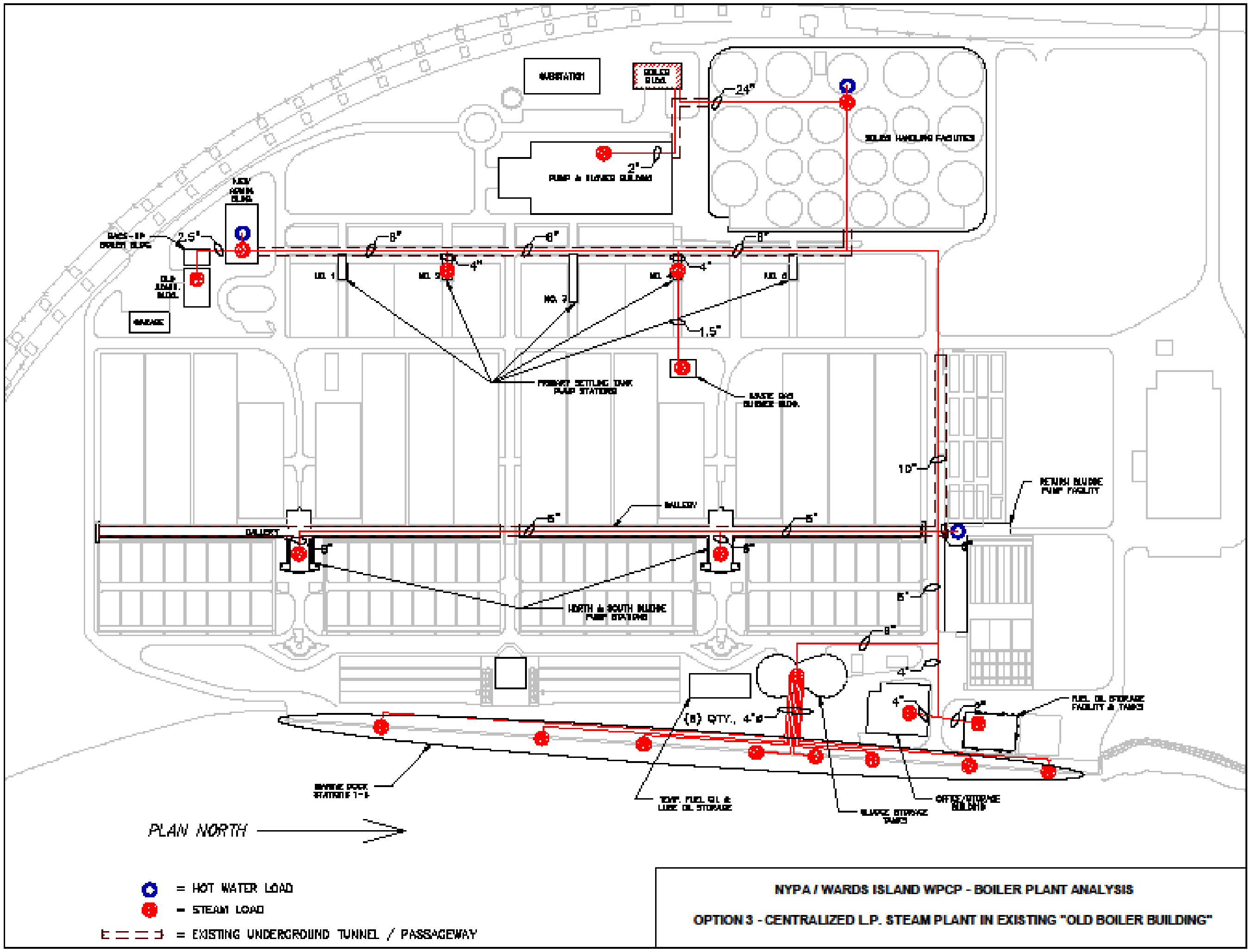


Figure 5.3.3.1 – New Low Pressure Steam Centralized Plant

5.3.4 Operational Requirements

The proposed LP steam centralized boiler plant will be designed to utilize as much of the plant's digester gas for fuel as is possible. When digester gas supply does not meet the demands of the plant, No. 2 fuel oil will be used to supplement. With turn-down ratios up to 8:1, the new boilers that will be installed will be able to operate efficiently at reduced capacities, so the digester gas can be used regardless of its quantity. In the event that fuel requirements cannot be achieved by the digester gas alone, certain boilers will operate on fuel oil. A storage tank will be installed close to the Old Boiler Building to provide this supplemental fuel oil. Figure 5.3.3.1, above, shows the layout of the proposed LP steam centralized boiler plant, consisting of (3) 800-HP boilers and (2) 400-HP boilers.

5.3.5 Maintenance Requirements

Since the existing equipment and distribution system uses steam, the facility personnel are already familiar with the basic procedures involved in maintaining steam equipment. However, they will have to adopt the additional maintenance requirements necessary for operating the boilers. Fortunately, LP steam boiler plants require less maintenance than high pressure steam plants. A new condensate return system will mean that less make-up water will need to be used to maintain proper volume in the distribution system. This benefits the longevity of the plant, since the make-up water must be chemically treated before being introduced into the system. Even with all of the leaks repaired, the facility will still need a rigorous chemical treatment regimen to ensure the longevity of the proposed system.

5.3.6 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Section 7.

5.4 Option 4: Install Three New Low Pressure Steam Decentralized Plants

5.4.1 General Overview

This option involves the installation of three low pressure steam boiler plants. This option shares the benefits of installing low pressure steam that were outlined in the previous section describing the centralized plant. The three plants, located in the Old Boiler Building (Zone 3), Garage (Zone 1), and Fuel Oil Storage Facility (Zone 2, Marine Terminal), will provide steam service for process and HVAC loads located in their respective proximities. Benefits of this particular arrangement include increased local control of steam distribution.

The Marine Terminal, for example, does not require steam for any process loads. The boiler plant for this portion of the plant will be located in a spare room in the Fuel Oil Storage Facility, where it will generate steam for that building, as well as the adjacent Office/Storage Building, Sludge Storage Tanks, and the eight docking stations that require steam for shipping vessel heating as well as valve heating. During the cooling season, this plant can be completely shut down. The buildings will not require heat, nor will the shipping vessels or the valves at each docking station. The marine terminal boiler plant also eliminates the problem of poor steam quality at the associated load centers. Facility personnel have reported that this is a constant source of grief, which is likely due to the long pipe runs that the steam must pass through to get to the marine area.

5.4.2 Plant Capacity

While the total plant load is the same for each of the available boiler plant options, their respective, unique layouts force the combined plant capacities to vary. A single, centralized plant – as outlined in the previous section – will have a maximum capacity of 3,200 HP for a peak load of 2,197 HP. The decentralized steam plants will share that same 2,197-HP peak load, but will have a combined maximum capacity of 3,300 HP. The largest of the three plants will be that which serves – among other things – the Solids Handling Facility. This plant will be located in the Old Boiler Building, and will consist of (3) 700-HP and (2) 350-HP boilers, for a maximum capacity of 2,800 HP. In addition to the SHF, this plant will provide steam service for the Pump & Blower House, Return Sludge Pumping Facility (E-Battery), Waste Gas Burner Building, and Primary Settling Tank Pump Stations 2 and 4. Of these, only the SHF and Return Sludge Pumping Facility require steam throughout the year for process loads. The rest of the buildings can be isolated from the plant during non-heating months.

The remaining two boiler plants will be much smaller. For service to the Marine Terminal area of the facility, (2) 150-HP boilers will be installed to accommodate a 105-HP peak load. Installing two of these boilers allows for maintenance and/or repairs to occur on one boiler without a loss of service. Likewise, the plant installed in the Garage will feature (2) 100-HP boilers to be used to accommodate a 67-HP peak load. This plant will provide steam for the New and Old Administration Buildings. Unlike the marine plant, the garage plant will not be shut down during non-heating months. During the cooling season, this plant will operate to produce steam for the absorption chiller located in the New Administration Building.

Table 5.4.2.1 Design Load Requirements

Zones	Load (MBH)	Diversified Load (MBH)	Boiler HP Equivalent	Equipment / Qty	Total Heating Plant HP
Zone 1	2,885	2,597	78	(2) 100 HP Boilers	200
Zone 2	3,496	3,147	94	(2) 150 HP Boilers	300
Zone 3	71,682	64,514	1,929	(3) 750 HP + (2) 350 HP Boilers	2,950

5.4.3 Plant Schematics

Like the centralized steam plant option in the previous section, the decentralized low pressure steam option will require all new adequately sized piping. The Old Boiler Building plant will be using digester gas as a primary fuel; and because of the tunnel extending along the Primary Settling Tank Pump Stations, it would be relatively simple to install digester gas distribution piping to feed the Old Garage plant. The Marine plant, however, would require roughly 1,000 ft of new buried piping, in addition to new piping in tunnels and through buildings. Since the Marine Terminal boiler plant will not operate outside of the heating season, it is not cost effective to provide digester gas supply to this location. The Garage plant, even though it is smaller than the Marine plant, will be operating year-round because of the absorption chiller. The year-round operation of the garage plant makes it an ideal candidate for digester gas use, especially since there will likely be excess digester gas when building heating loads do not need to be satisfied.

Condensate return for the decentralized plant would be very similar to that of the centralized plant. Three independent condensate loops will be installed as port of the scope of work. The marine docking stations would still be excluded from the condensate return loop, so the marine area boiler plant would only receive condensate from the Sludge Storage Tanks, Office/Storage Building and Fuel Oil Storage Facility. City water would be chemically treated and introduced to the distribution loop as make-up water. Each building would need its own condensate return pump; however there would be less of a need for additional return pumps along the way.

Figure 5.4.3.1, below, shows an approximate steam distribution piping for the proposed LP steam distribution system.

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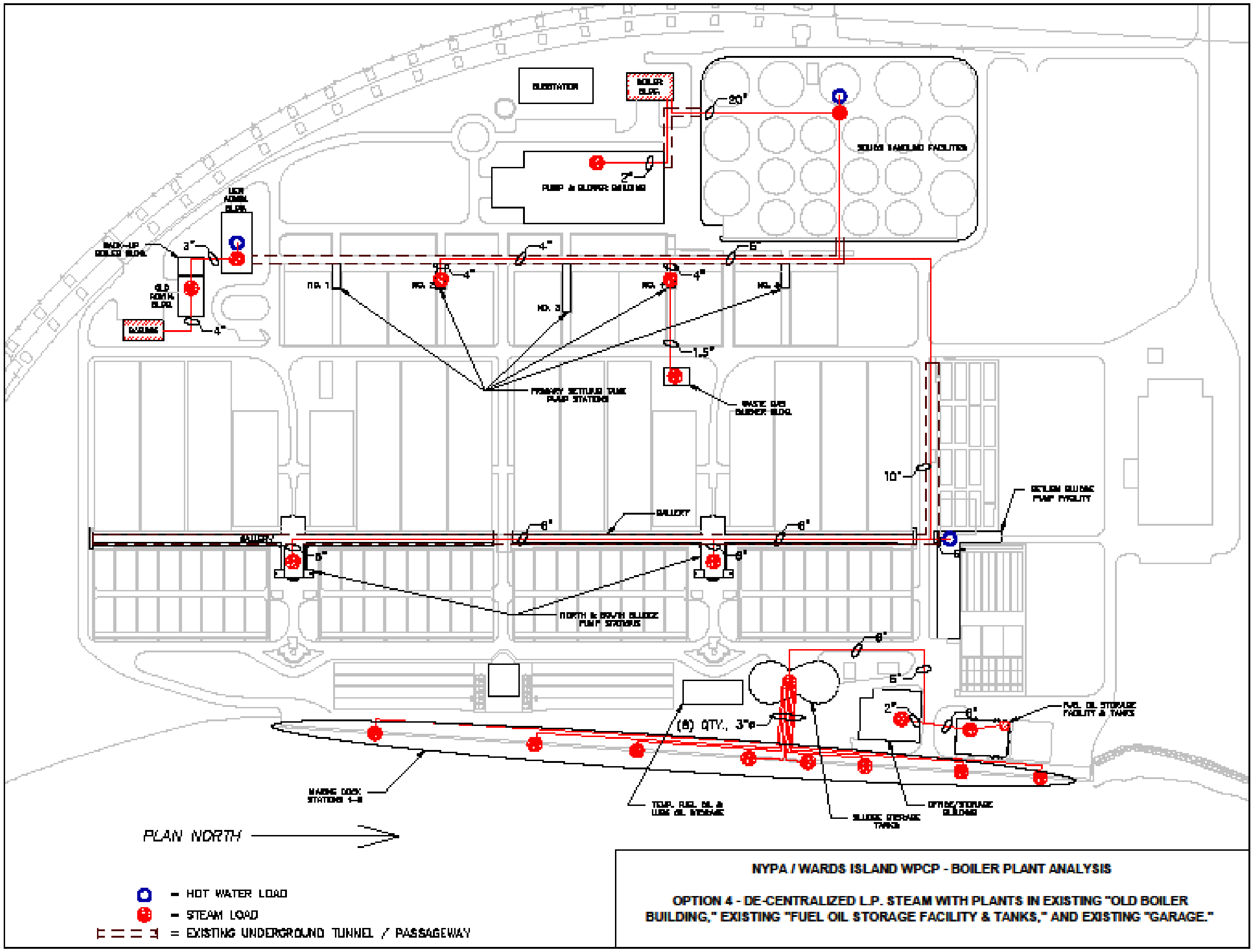


Figure 5.4.3.1 – New Low Pressure De-Centralized Steam Boiler Plants

5.4.4 Operational Requirements

The three boiler plants proposed in this option will each require a supply of No. 2 fuel oil. For the Marine plant, this will not be an issue since the boiler plant will be installed within the fuel oil storage facility. The Old Boiler Building will have a new fuel oil storage tank installed nearby, as will the Garage boiler plant.

5.4.5 Maintenance Requirements

The decentralized boiler plants will involve more maintenance than the centralized options. In this case, three boiler plants will require regular maintenance, as opposed to only one. This translates to a larger staff of engineers and maintenance personnel. Since the proposed system will operate at low pressure, there will not be a requirement for around the clock staff.

5.4.6 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Section 7.

5.5 Option 5: Install a New Hot Water Central Plant

5.5.1. General Overview

This option involves the installation of a new low temperature hot water (LTHW) boiler plant in the Old Boiler Building. A low temperature system operating at below 250°F and 160 psig will be installed under this option. This plant would provide hot water everywhere except the Marine Terminal area. The Marine area must have steam for the transport vessels and valve heaters, and therefore must have its own boiler plant to supply the required steam. As outlined earlier, in order to produce steam, a high pressure hot water plant will be required. The steam plant capacity for the Marine area in this option will be identical to that which was outlined in Option 4; (2) 150-HP low pressure steam boilers.

Since the existing terminal equipment utilizes steam, this option requires a complete overhaul of the entire facility heating distribution systems, such as main heat exchangers, air handling units, etc. (excluding the marine terminal). All of the terminal devices would have to be replaced with equivalent equipment that uses hot water. This includes the brand new steam-to-hot water heat exchangers that were installed in the SHF as part of Contract 74G. They would have to be replaced with HW-to-HW heat exchangers, as would two heat exchangers in the Return Sludge Pumping Facility and another steam-to-hot water heat exchanger that provides hot water to approximately 161 fan coil units in the New Administration Building

5.5.2 Plant Capacity

The new LTHW boiler plant will be sized to the same capacity as the centralized LP steam plant; (3) 800-HP boilers and (2) 400-HP boilers. As stated previously, the Marine Terminal area will feature a 300-HP plant consisting of (2) 150-HP, low pressure steam boilers.

Table 5.5.2.1 Design Load Requirements

Zones	Load (MBH)	Diversified Load (MBH)	Boiler HP Equivalent	Equipment / Qty	Total Heating Plant HP
Zone 2	3,496	3,147	94	(2) 150 HP Boilers	300
Zones 1 & 3	74,567	67,110	2,007	(3) 800 HP + (2) 400 HP Boilers	3,200

5.5.3 Plant Schematics

The LTHW boiler plant will be located in the Old Boiler Building, where it will receive digester gas from the adjacent SHF and No. 2 fuel oil from a storage tank for secondary fuel. The low pressure steam boiler plant for the Marine area will be located in the Fuel Oil Storage Facility. Likewise, it will feature its own condensate recovery system for each load center except for the docking stations and valve warmers. In place of condensate recovery equipment for the rest of the facility, this system will feature return water piping and associated pumping equipment. Unlike the steam options which required condensate return lines much smaller than the steam distribution lines, this plant will require full-size lines to bring the used hot water back to the plant, resulting in a significant increase in distribution piping installation costs over the steam options.

Figure 5.5.3.1, below, shows the proposed layout of the centralized LTHW and LP steam plants.

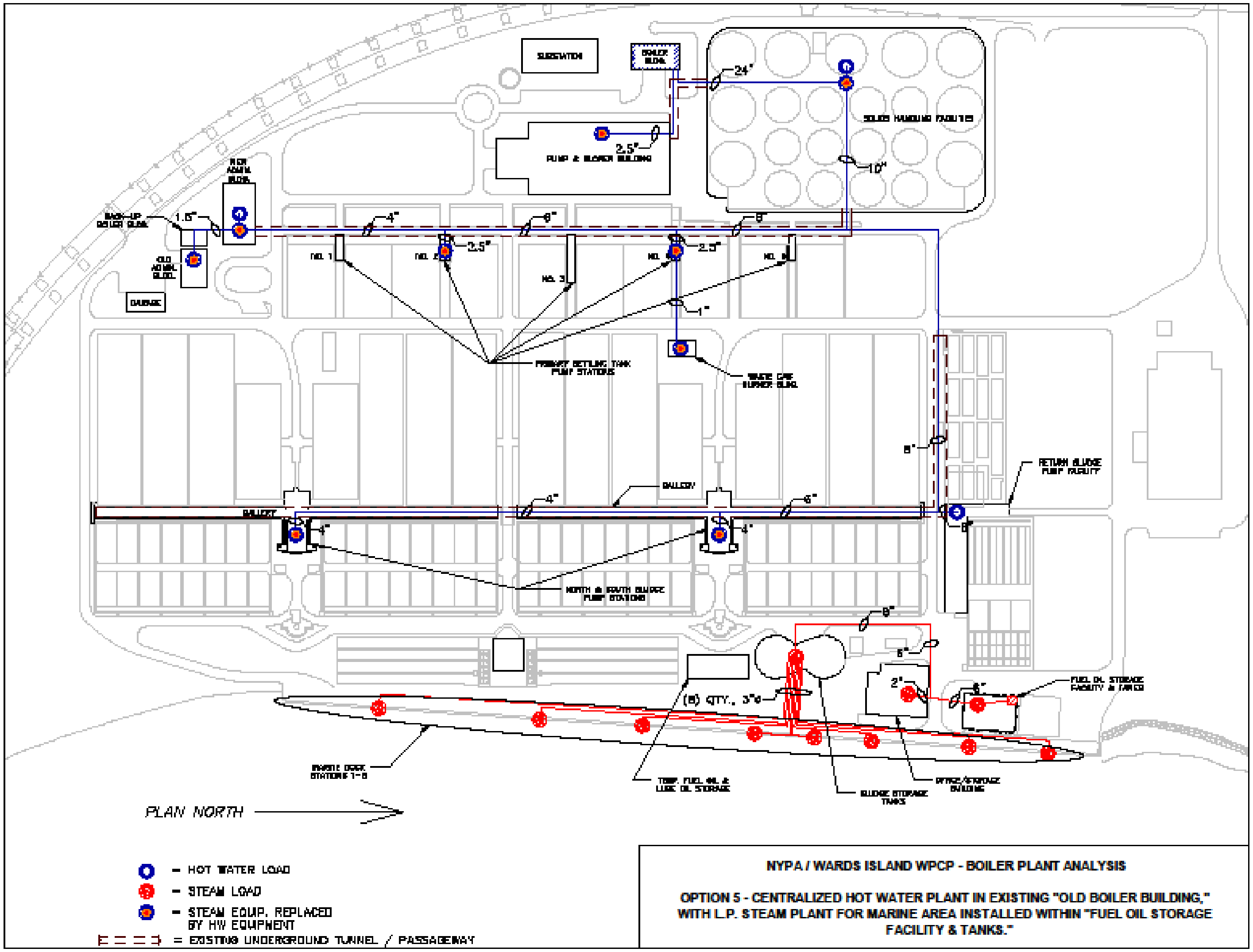


Figure 5.5.3.1 – New Centralized LT Hot Water and Low Pressure Steam Plants

5.5.4 Operational Requirements

Operational requirements remain much the same for the hot water plant as they are for the steam plants. Digester gas will be used as the primary fuel, with No. 2 fuel oil available as a secondary fuel. The digester gas, however, creates a disadvantage to the hot water system. Where most hot water boilers can utilize economizers that direct return water through the exhaust stack to preheat before entering the boiler, this plant will not have that ability. The exhaust fumes resulting from combustion of digester gas contain highly corrosive sulfuric acid, which could eventually destroy the economizer. The steam boiler plant for the Marine area will utilize No. 2 fuel oil as its only fuel.

5.5.5 Maintenance Requirements

Facility personnel will have to be trained to maintain a hot water distribution system, as well as the new hot water and steam plants. One benefit to this system is that it greatly reduces the number of steam traps that will need regular maintenance. Since the proposed system is a low pressure system, around the clock operating engineers will not be required to oversee the operation of the plant.

5.5.6 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Chapter 7.

5.6 Option 6: Install New Hot Water Decentralized Plants

5.6.1 General Overview

This option involves the installation of two low temperature hot water boiler plants and one low pressure steam boiler plant. This arrangement provides the same flexibility that is offered by the decentralized steam plant option, Option 4, with the benefits of a hot water distribution system offered by Option 5. For the same reasons as were stated in Option 5, the Marine area must operate on steam, and will do so with its own low pressure steam boiler plant.

5.6.2 Plant Capacity

The hot water boiler plant located in the Old Boiler Building will provide medium temperature hot water to the SHF, Pump & Blower Building, Primary Settling Tank Pump Stations, Waste Gas Burner Building, Return Sludge Pump Facility, and North & South Sludge Pump Stations and Gallery. This amounts to a total boiler requirement of 2,025 HP, which will be provided by (3) 700-HP and (2) 350-HP hot water boilers. The boiler plant in the Garage will provide LTHW to the New and Old Administration Buildings – a total requirement of 67 HP – using (2) 100-HP hot water boilers. The Marine area will feature the same (2) 150-HP steam boilers present in Options 4 and 5.

Table 5.6.2.1 Design Load Requirements

Zones	Load (MBH)	Diversified Load (MBH)	Boiler HP Equivalent	Equipment / Qty	Total Heating Plant HP
Zone 1	2,885	2,597	78	(2) 100 HP Boilers	200
Zone 2	3,496	3,147	94	(2) 150 HP Boilers	300
Zone 3	71,682	64,514	1,929	(3) 750 HP + (2) 350 HP Boilers	2,950

5.6.3 Plant Schematics

The layout of this option is very much the same as that of Option 4, except that the distribution loops for the Old Boiler Building and Garage plants will require return water piping and pumps, rather than condensate return equipment. As was stated in Section 5.6.3, the return water piping will be much larger than the coinciding condensate return piping.

Figure 5.6.3.1, below, shows the proposed layout of the decentralized hot water and low pressure steam plants.

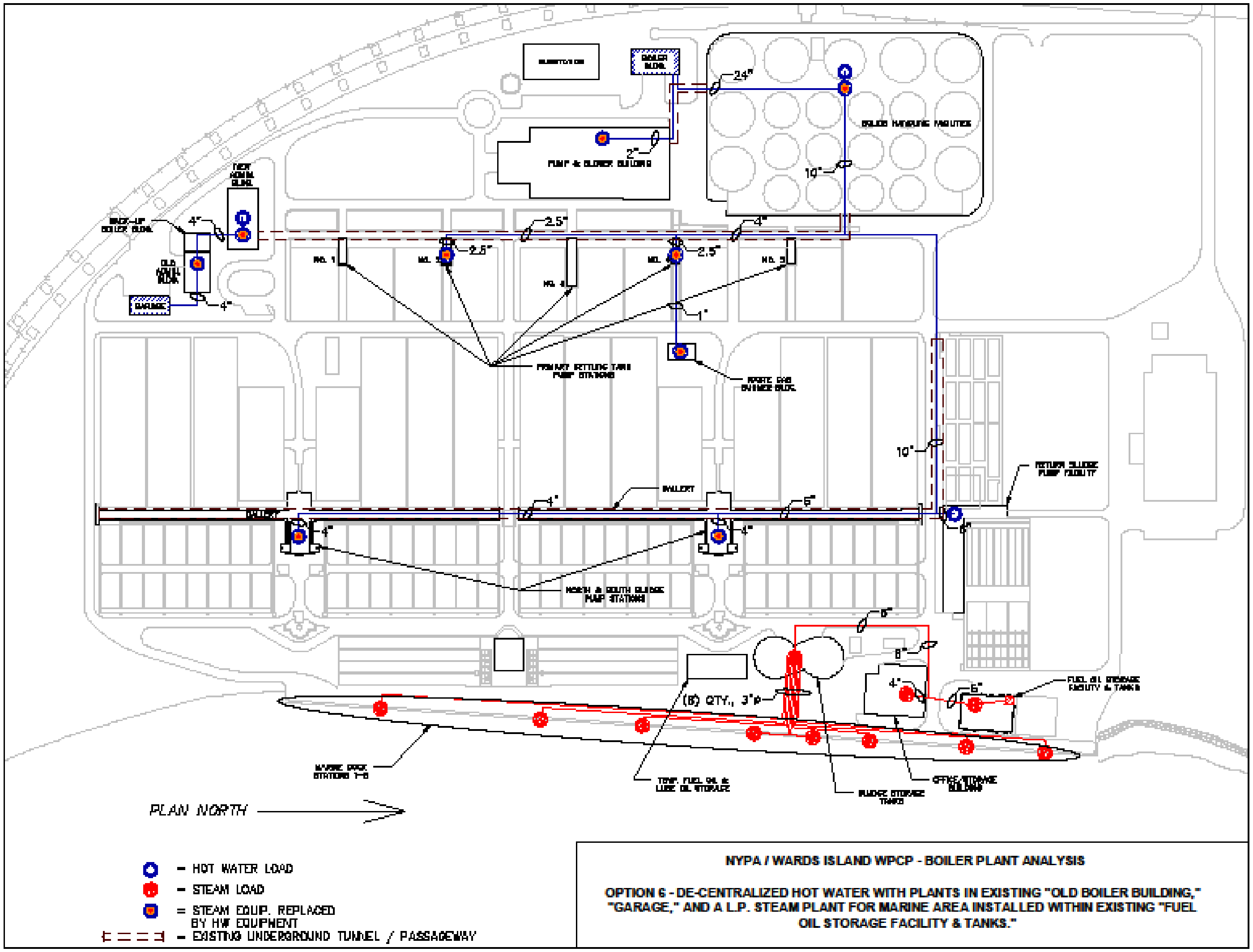


Figure 5.6.3.1 – Decentralized LTHW and LP Steam Plants

5.6.4 Operational Requirements

The two hot water boiler plants will require both digester gas and No. 2 fuel oil, while the Marine area steam plant will only require the latter. These needs will be satisfied using the same arrangement as is explained in Option 4. As was mentioned in Option 5, the hot water boiler plants will not be able to take advantage of the common economizer utilization that is present in many hot water boiler plants.

5.6.5 Maintenance Requirements

For this option, as is the case for Option 4, the facility will require staffing and budget allocation to accommodate the maintenance needs of three boiler plants rather than one. Since these plants will be operating at low pressure, their operational requirements will still be lower than operating a high pressure plant which requires around the clock operators. As was mentioned in Option 5, fewer steam traps will need regular cleaning, however the facility would have to deal with rigorous chemical treatment programs for two large volumes of water, as well as that which is present in the Marine steam plant.

5.6.6 Plant Permitting & Emissions Considerations

For plant permitting and emissions considerations applicable to this option, refer to Chapter 7.

5.7 Temporary Heating Alternatives

This section discusses options for interim heating provision available to the DEP if the new plant is not in service by the end of 2011. For this analysis, AECOM assumed that the DEP will deploy an interim measure beginning from fall 2011 to ensure no interruption of heating service to the WI WPCP until the new plant is fully commissioned. We have also assumed that the interim option, once deployed, will be in service for a year and possibly up to two years, pending completion of the new heating plant.

One of the three options under consideration for this measure are for the DEP to enter into a temporary agreement to continue to operate the MPC boiler plant and deliver the steam requirements of the WI WPCP until the new plant is operational. It is anticipated that the duration of this temporary arrangement will not exceed two full years. The second option entails the rental of a trailer mounted steam boiler delivered to the facility and connected to the distribution loop at a major connection point to provide all steam requirements; while the third interim option includes the DEP's purchase of the temporary boilers.

To reduce the operating cost of this option to the DEP, we have assumed both of the temporary boiler scenarios will operate utilizing available digester gas. AECOM confirmed with the boiler rental companies that rental units can be set up to burn digester gas.

5.7.1 Option 7A: Temporarily Take Over Manhattan Psychiatric Hospital Boiler Plant

Under this option, the DEP will make arrangements with the NYS-OMH to take over the plant for a temporary period of up to two years and supply its own staff to operate and maintain the facility to provide the required steam needs for the WI WPCP. In order to ensure the continued reliable performance of the plant, this study assumed that in addition to the interim purchase price (i.e., lease price) to be paid to the OMH, the DEP will need to conduct some immediate repairs to preserve the reliability of the plant for the duration of the lease.

AECOM estimated that since the lifecycle analysis was conducted for a 20-year period, the price to be paid per year of usage will be one twentieth of the depreciated value to be paid in the permanent purchase option, Option 1. Additionally, AECOM accounted for initial costs to be incurred to repair the steam and condensate service. Together, these values represent the total cost that the DEP will incur to take temporary ownership of the plant.

The operations and maintenance requirements of this temporary option will be identical to those outlined in Option 1. The staffing requirements and fuel usages of the plant will be the same as the first year of the permanent purchase option.

5.7.2 Option 7B: Provide Rental Mobile Trailer-Mounted Boiler Plant

In this alternative option, temporary boilers of adequate capacity will be rented and installed at the site for a period of at least one year, starting in the fall 2011, to meet the facility's heating requirements. The temporary units will be installed at a location from which their output can easily be discharged through a temporary connection point within the distribution system. Temporary fuel distribution and delivery systems will be installed to provide fuel for the temporary boilers.

Three boilers, each rated at 800 HP, would be installed at the WI WPCP facility. Total available boiler capacity would be 2,400 HP. Temporary steam and condensate piping will need to be installed and connected to existing steam distribution system along with temporary fuel oil and/or digester gas piping. It is anticipated to place the temporary boiler trailers in the open lawn area north of the existing New Administration Building due to proximity of existing steam and condensate lines. The temporary boilers would be mounted on 53-ft long trailers. The trailer width is 8 ft-6 in. Each trailer should be separated by 10 ft and have 10 ft of clearance at each trailer end. The boiler operator will require a separate operation trailer of approximately 12 ft x 30 ft. Therefore, it is anticipated that an area of approximately 80 ft x 120ft will be required to accommodate the temporary installation.

The minimum plant output required to support the WI WPCP is 2,400 HP. The three boiler trailers can be mounted side by side. These boilers are equipped with deaeration and feed water support equipment internal to the trailer. Tri-fuel capability between digester gas and No. 2 fuel oil and/or natural gas is available.

5.7.3 Option 7C: Purchase Mobile Trailer-Mounted Boiler Plant

This option is identical to the previous option except for the fact that it recommends the purchase of the temporary boilers. This option will most likely be beneficial to the DEP should the interim period require temporary boilers for a duration of more than two years. The costs associated with the purchase of the temporary boilers have been outlined in this section. One issue the DEP will have to deal with is what to do with the units once the permanent installation is completed. With most of their facilities moving away from high pressure steam, the DEP may have to put the used temporary boilers up for sale. From a practical standpoint, though, if the temporary units are going to be required for an extended period of time, then it will be more economical.

6. ECONOMIC ANALYSIS

6.1 Current Energy Cost Analysis

6.1.1 No. 2 Fuel Oil

The Wards Island WPCP consumes No. 2 fuel oil in the 400 HP Cleaver Brooks "Standby" boiler located behind the Administration Building. During 2006, 2007 and 2008, this boiler consumed 185,223, 187,907 and 203,727 gallons respectively. The average consumption is 192,286 gallons per year. The WPCP facility has other small independent boilers operating on No. 2 fuel oil for the dewatering facility. The consumption for these units was not available and is not included in this report. The current cost of No. 2 fuel oil utilized by the site is $1.903/gallon. The average annual cost of the described No. 2 fuel oil is $365,920

Table 6.1.1.1: Annual No. 2 Fuel Oil Usage and Cost

Year	Gallons	Estimated Cost
2006	185,223	$352,479
2007	187,907	$357,587
2008	203,727	$387,692
Average	192,286	$365,920

6.1.2 No 6 Fuel Oil

To compute the fuel cost associated with the production of steam for the Ward Island WPCP, AECOM obtained the average cost of No 6 from the NYS–OMH. Based on the data provided, the average cost of No 6 fuel oil is estimated at $1.71/gallon. This rate will be used to calculate steam generation cost associated with the MPC plant. Until recently, the MPC Boiler Plant relied solely on No 6 oil for steam generation. In order to provide the steam needs for the DEP-WPCP, the MPC plant consumed 1,553,341, 1,503,212, and 1,582,692 gallons of No. 6 fuel oil respectively during 2006, 2007 and 2008. The average consumption is 1,546,415 gallons per year. The average annual fuel cost to the MPC plant of the described No. 6 fuel oil is $2,644,370 at a rate of $1.71/gallon.

Table 6.1.2.1: Average Historical MPC Steam Production Cost

Year	Gallons	Estimated Cost
2006	1,553,341	$2,656,213
2007	1,503,212	$2,570,493
2008	1,582,692	$2,706,403
Average	1,546,415	$2,644,370

6.1.3 Manhattan Psychiatric Center Imported Steam

The Wards Island WPCP consumes steam from the MPC plant as part of an agreement wherein the WPCP exports digester gas as fuel for the MPC boilers. Until recently, the DEP was incapable of exporting the digester gas due to the system being re-commissioned. At the time of this report the digester gas export capability has become operational again. During 2006, 2007 and 2008, the DEP-WPCP consumed a total of 167,823, 162,407 and 170, 994 MMBTU (million BTU) respectively of imported steam per year. The average consumption is 167,075 MMBTU per year. The current cost for the MPC plant to produce the steam per the Office of Mental Health records varies monthly but has an annual average cost of $19.10/MMBTU. This includes fuel and monthly operating costs.

Table 6.1.3.1: Annual Steam Consumption and Estimated Cost

Year	Steam Consumption	Estimated Cost
2006	167,823	$3,205,419
2007	162,407	$3,101,974
2008	170,994	$3,265,985
Average	167,075	$3,191,133

6.2 Preliminary Project Cost and Savings

This section outlines the cost and savings associated with each of the options studied in this report. **Further breakdown of the costs for each of the options is included in Attachment C.**

6.2.1 Option 1: Permanently Take Over Manhattan Psychiatric Hospital Power Plant

To establish the capital cost associated with the takeover of the MPC plant, AECOM estimated the purchase cost of the plant using the following key assumptions:

1. The residual (i.e., purchase price) of the plant is based on the replacement cost of an equivalent facility with similar equipment and capacity. This cost is discounted to 20% to reflect the present age and condition of the plant.
2. The cost of all needed equipment upgrades was subsequently added to the depreciated value to determine overall cost outlay required by DEP
3. The cost to repair steam supply and condensate returns from the MPC boiler plant to the WI WPCP was also included in the capital cost.
4. The cost to replace sections of failing underground piping and to upgrade the steam supply and condensate problems by the Marine Terminal was also included in the capital budget cost for this option.

The cost savings for WI WPCP plant under this option accrues from the following:

1. With the re-establishment of the digester gas service to the MPC plant, the DEP will be able to take advantage of defraying the cost of No 6 fuel oil to generate most of the steam required for its operation. This action will represent cost savings above current practice of burning No 6 oil, when the digester gas piping was out of service.
2. Any additional cost spent to purchase No 6 fuel oil for steam production is also applied against the savings
3. The net cost savings is the cost savings accruing from the use of digester gas minus the cost to purchase the balance of No 6 oil to meet the WI WPCP steam load.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.1.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 1	$24,313,525	$39,779,212	$1,963,803

6.2.2 Option 2: Install New High Pressure Boiler Plant

The capital cost of the construction for this option is based on the installation of two 400 BHP, three 800 BHP boilers, ancillary support equipment, fuel oil storage and piping, and connecting steam and digester gas piping. For option 2A, the cost of work further includes the preparation work within the Old Boiler Building to house all purchased equipment. For Option 2B, the cost of a pre-engineered building was included in the scope to house the new boilers.

Additional capital cost incurred as part of this option includes the cost to replace sections of failing underground piping and to correct steam distribution and condensate piping problems by the Docking Stations.

The savings for this Option will be generated from the following items:

1. The cost savings associated with the use of "free" digester gas in the new boiler to generate the heating requirements of the WI WPCP.
2. The increase in efficiency of the new boilers in producing steam, thereby reducing their fuel usage.
3. Reduction of cost associated with purchase of supplementary fuel to match the required steam consumption at any point during the year.

Additional savings will also accrue for the elimination of existing piping leaks and heat losses. This additional savings is not included as part of this analysis.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.2.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 2A – Old Boiler House	$21,351,920	$35,848,808	$2,992,359
Option 2B – New Location	$23,544,215	$39,165,722	$2,992,359

6.2.3 Option 3: Install New Low Pressure Steam Boiler Plant

The capital cost for this measure encompasses the installation of a low pressure steam boiler plant in order to meet the steam needs of the WI WPCP. The key to this and each of the other options is the maximum utilization of digester gas as the primary fuel.

The common elements of this option will include the installation of (2) 400 BHP boilers and (3) 800 BHP boilers in the Old Boiler Building. The cost includes ancillary support equipment, fuel oil storage and piping, and connecting steam and digester gas piping. To allow for the installation of natural gas service to the Island, the cost also includes a $2 million budget for Con Edison to accomplish the required services. Space preparation for the Old Boiler Building is also included.

Other capital cost included in this scope of work includes the cost to replace all distribution and condensate return piping. A new condensate return pumping station will also be provided as part of the installation.

The savings for this Option will be generated from the following items:

1. The cost savings associated with the use of "free" digester gas in the new boiler to generate the heating requirements of the WI WPCP.
2. The increase in efficiency of the new boilers in producing steam, thereby reducing their fuel usage.
3. Reduction of cost associated with purchase of supplementary fuel to match the required steam consumption at any point during the year.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.3.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 3 – Centralized LP Steam Boiler Plant	**$39,573,743**	**$65,665,915**	**$2,992,359**

6.2.4 Option 4: Three New Low Pressure Steam Decentralized Boiler Plants

The capital cost for this measure involves the installation of three low pressure steam boiler plants in order to meet the steam needs of the WI WPCP. Once again, this option utilizes digester gas as the primary fuel.

This option will include the installation of three low pressure steam boiler plants. The main plant will contain (3) 700 HP and (2) 350 HP low pressure steam boilers. The administration buildings will be served by a satellite low pressure steam boiler plant that will contain (2) 100 HP boilers. Finally, another satellite low pressure steam boiler plant will be installed within the Fuel Oil Storage Facility and Tanks building that will contain (2) 150 HP boilers. The cost also includes space preparation, ancillary support equipment, fuel oil storage and piping, and connecting steam and digester gas piping. Note that the cost of installing digester gas distribution piping to the marine terminal boiler plant is not included.

Other capital cost included in this scope of work includes the cost to replace all distribution and condensate return piping.

The savings of this option is generated based on the fact that the use of digester rather than No. 2 oil will allow the facility to virtually eliminate fuel oil costs.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.4.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 4 – Decentralized LP Steam Boiler Plant	$44,235,703	$73,426,488	$2,938,167

6.2.5 Option 5: Install a New Hot Water Central Plant

The capital cost for this measure involves the installation of a hot water boiler plant in order to meet the heating needs of the WI WPCP. As part of this scope of work, a low pressure steam boiler plant will be installed as specified in the previous option to serve the Marine Terminal section. As with all of the proposed options, this option offers maximum utilization of digester gas as the primary fuel.

This option will include the installation of (2) 400 BHP boilers and (3) 800 BHP boilers in the Old Boiler Building. In addition, another satellite low pressure steam boiler plant will be installed within the Fuel Oil Storage Facility and Tanks building that will contain (2) 150 HP boilers. The cost also includes space preparations, ancillary support equipment, fuel oil storage and piping, and connecting steam, hot water and digester gas piping. Note that the cost of installing digester gas distribution piping to the Marine Terminal boiler plant is not included.

Other capital cost included in this scope of work includes the cost to install new supply and return hot water piping as well as new steam supply and condensate return piping for the Marine Terminal boiler plant. Also included is an additional cost of converting existing terminal devices from steam to hot water systems.

Savings within this option are generated based on the fact that the use of digester rather than No. 2 oil will allow the facility to virtually eliminate fuel oil costs.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.5.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 5 – Centralized HW Boiler Plant	$58,890,059	$97,370,266	$2,938,163

6.2.6 Option 6: Decentralized HW Boiler Plants

The capital cost for this measure involves the installation of two hot water boiler plants and one low pressure steam boiler plant in order to meet the heating needs of the WI WPCP. Once again, this option utilizes digester gas as the primary fuel.

This option will include the installation of two hot water boiler plants and one low pressure steam boiler plant. The main plant will contain (3) 700 HP and (2) 350 HP hot water boilers. The administration buildings will be served by a satellite hot water boiler plant that will contain (2) 100 HP boilers. Finally, another satellite low pressure steam boiler plant will be installed within the Fuel Oil Storage Facility and Tanks building that will contain (2) 150 HP boilers.

The cost also includes ancillary support equipment, fuel oil storage and piping, and connecting steam, hot water and digester gas piping. It should be noted that the cost of installing digester gas distribution piping to the Marine Terminal boiler plant is not included.

Other capital cost included in this scope of work includes the cost to install new supply and return hot water piping, as well as, new steam supply and condensate return piping for the Marine Terminal boiler plant. Also included is an additional cost of converting terminal devices from steam to hot water systems.

The savings of this option is generated based on the fact that the use of digester rather than No. 2 oil will allow the facility to virtually eliminate fuel oil costs.

The following table summarizes the capital cost and energy savings estimates.

Table 6.2.6.1: Estimated Total Construction Cost and Annual Energy Savings

Option No	Escalated Labor & Material Cost	Total Project Cost	Annual Energy Savings
Option 6 – Decentralized HW Boiler Plant	$58,714,812	$97,115,772	$2,938,167

6.2.7 Options 7A, 7B & 7C: Interim Boiler Services

This option provides three interim options available to the DEP to continue to provide heating to the WI WPCP once the NYS-OMH terminates its steam supply agreement to the facility by the fall of 2011. The economic analysis for these three options was conducted for a one year period; however, the proposed schedule anticipates a total deployment time requirement of two years. The annual costs presented in this section will have to be doubled to obtain the total cost for two years with the exception of the capital cost.

To determine the benefits of the first Option 7A, AECOM determined the one year purchase price of the MPC plant by adopting the one year value to be equal to one twentieth of the permanent purchase price assuming a twenty year life cycle.

The second option involves the cost of providing temporary trailer mounted boilers consisting of three 800 HP boilers for a one year period.

The third option includes the purchasing rather renting of the temporary boilers. This option could be more cost effective if the interim period extends beyond one year.

Each of the costs for these options was tallied to determine which of these two options represents better value to the WI WPCP. The main savings benefit for all of these options is the ability to burn free digester gas and avoid the need to pay for fuel oil.

The following table summarizes the capital costs of each interim heating option.

Table 6.2.7.1: Estimated Total Construction Costs (Two year period)

Cost Item	Interim Option 7A	Interim Option 7B	Interim Option 7C
Escalated Labor and Material	$4,052,191	$4,054,551	$5,049,298
Total Project Cost	$6,563,075	$6,566,896	$8,178,025

6.3 Economic Summary

6.3.1 Total Implementation Cost

The table on the following page provides the breakdown of the development of the implementation cost for the options for this project.

Table 6.3.1 Total Estimated Implementation Cost Comparison

IMPLEMENTATION COSTS	OPTION 1	OPTION 2A	OPTION 2B	OPTION 3	OPTION 4	OPTION 5	OPTION 6	Int Opt 7A	Int Opt 7B	Int Opt 7C
Current L+M Costs (2009)	$22,479,220	$19,741,050	$21,767,950	$36,588,150	$40,898,394	$54,447,170	$54,285,144	$3,746,479	$3,748,660	$4,668,360
Escalated L+M Costs (2011) @ 4% per Yr.	$24,313,525	$21,351,920	$23,544,215	$39,573,743	$44,235,703	$58,890,059	$58,714,812	$4,052,191	$4,054,551	$5,049,298
Current ACM Abatement Costs (2009)	$0	$600,000	$422,600	$600,000	$686,500	$625,000	$686,500	$0	$0	$0
Escalated ACM Abatement Costs (2011)*	$0	$648,960	$457,084	$648,960	$742,518	$676,000	$742,518	$0	$0	$0
Permitting	$272,311	$192,167	$233,123	$395,737	$441,963	$647,791	$606,524	$31,612	$28,747	$32,693
Controlled Inspection	$173,142	$146,919	$163,872	$277,016	$309,739	$418,190	$411,004	$17,830	$20,273	$24,464
Environmental Contingency	$367,159	$314,949	$348,104	$593,606	$662,651	$883,950	$880,750	$40,522	$41,056	$55,542
Construction Contingency	$5,025,227	$4,530,983	$4,949,280	$8,297,813	$9,278,515	$12,303,198	$12,271,122	$828,431	$828,925	$1,032,399
Construction Sub Total	$30,151,364	$27,185,898	$29,695,678	$49,786,875	$55,671,089	$73,819,188	$73,626,729	$4,970,585	$4,973,552	$6,194,396
Design and CM Fees	$5,331,903	$4,673,050	$5,157,010	$8,669,024	$9,690,218	$12,912,129	$12,865,554	$884,173	$884,606	$1,100,937
Asbestos Design Fees	$0	$116,813	$82,275	$116,813	$133,653	$121,680	$133,653	$0	$0	$0
Program Cost	$3,015,136	$2,718,590	$2,969,568	$4,978,688	$5,567,109	$7,381,919	$7,362,673	$497,059	$497,355	$619,440
SubTotal Including Fees	$38,498,404	$34,694,351	$37,904,530	$63,551,400	$71,062,070	$94,234,916	$93,988,610	$6,351,816	$6,355,514	$7,914,773
Bonds	$452,270	$407,788	$445,435	$746,803	$835,066	$1,107,288	$1,104,401	$74,559	$74,603	$92,916
IDC	$828,538	$746,669	$815,757	$1,367,712	$1,529,352	$2,028,063	$2,022,762	$136,700	$136,779	$170,337
Project Total Cost*	$39,779,212	$35,848,808	$39,165,722	$65,665,915	$73,426,488	$97,370,266	$97,115,772	$6,563,075	$6,566,896	$8,178,025
Project Energy Savings	$1,963,803	$2,992,359	$2,992,359	$2,992,359	$2,938,167	$2,938,163	$2,938,167			
Simple Payback (yrs)	20.3	12.0	13.1	21.9	25.0	33.1	33.1			

6.3.2 Life Cycle Cost Analysis

A life-cycle cost analysis (LCCA) was performed in order to make an economic evaluation of the proposed project. Life-cycle cost analysis evaluates all the costs arising from implementing a project as well as owning, operating, and maintaining the equipment over a given study time period with all costs adjusted (discounted) to reflect the time-value of money. The ultimate goal of this type of analysis is to determine which alternative has the lowest life-cycle cost (LCC) and therefore is the most economical in the long run.

The analysis was carried out using Building Life-Cycle Cost (BLCC) 5.3 software developed by the National Institute of Standards and Technology under the Federal Energy Management Program (FEMP). The software methodology complies with ASTM standards related to building economics as well as FEMP guidelines for economic analysis of building projects.

The analysis compares the LCC of each of the proposed projects.

The following table summarizes the present value life cycle cost analysis results of each options considered compared to the baseline.

Table 6.3.2.1: 20 yr - Present-value Life Cycle Cost Comparison

Options	Total Implementation Cost	Energy Life Cycle Cost	O&M Life Cycle Cost	Total Present Value Life Cycle Cost
Option 1	$ 39,779,212	$ 25,700,308	$ 40,889,410	$ 95,568,510
Option 2A	$ 35,848,808	$ 1,812,862	$ 39,294,787	$ 64,651,621
Option 2B	$ 39,165,722	$ 1,812,862	$ 39,294,787	$ 67,065,491
Option 3	$ 65,665,915	$ 1,812,862	$ 16,130,336	$ 63,205,388
Option 4	$ 73,426,488	$ 5,068,818	$ 26,772,870	$ 82,707,444
Option 5	$ 97,370,266	$ 5,068,919	$ 18,927,806	$ 92,313,865
Option 6	$ 97,115,772	$ 5,068,818	$ 26,663,219	$ 99,129,472

6.3.3 Electric Utility Service and Tariff

While data collected regarding electric utility consumption and billing was not required for the purpose of the revised feasibility study, this information was left for reference.

The Wards Island WPCP receives electrical service production from the New York Power Authority under their rate tariff 098 time-of-day service. Distribution is through the Consolidated Edison distribution network under Service Classification No. 9 – General Large. The NYPA tariff charges include different on-peak and off peak energy charges ($/kWh) and a flat demand charge ($/kW). The Con-Edison charge consists of a summer and winter layered demand charge (1st 900 kW, etc…) and a low flat summer and winter energy charge.

During 2008, the blended on-peak winter energy charge averaged $0.067/kWh, while the summer on-peak averaged $0.087/kWh. The blended off-peak winter energy averaged $0.023/kWh while the summer off-peak charge averaged $0.043/kWh. Added to the energy charges are the demand charges which are also blended. The blended peak demand charges average $19.16/kW for winter demand and $20.67/kW for summer demand.

During 2006, 2007 and 2008 the facility consumed 97,140,499 kWh, 97,613,611 and 100,758,400 kWh respectively. The total electrical costs were $6,898,334, $8,198,475 and $8,231,390 respectively. The 3 year average consumption of 98,504,170 kWh per year, the average electric costs is $7,776,066. The annual electrical costs include all cost adjustments. The total annual costs are indicated in Table 6.1.1.

Table 6.3.3.1: WI WPCP Annual Electric Consumption and Cost

Year	kWh	Energy Cost	Demand Cost	Total Cost
2006	97,140,499	$3,654,111	$3,244,223	$6,898,334
2007	97,613,611	$4,905,287	$3,293,188	$8,198,475
2008	100,758,400	$4,845,602	$3,385,788	$8,231,390
Average	98,504,170	$4,683,333	$3,307,733	$7,776,066

7. AIR PERMITTING AND EMISSIONS CONTROL REGULATION ANALYSIS

7.1 Overview

The applicability of air quality control regulations is a significant consideration for the proposed projects. The following regulations are of particular concern, due to their potential impact on the cost and implementation schedule for the Project:

- Federal Prevention of Significant Deterioration (PSD) air permitting regulation.
- Federal Nonattainment New Source Review (NNSR) air permitting regulation.
- Federal New Source Performance Standards (NSPS) emissions control regulations.
- New York State Department of Environmental Conservation (NYSDEC) air permitting and emissions control regulations.
- City of New York Department of Environmental Protection (DEP) air permitting and emissions control regulations.

Accordingly, an evaluation was performed to determine the applicability of these regulations.

7.2 Overview of Air Regulations

7.2.1 Attainment Status

PSD applies to pollutants for which the location of a source of air pollutant emissions is in attainment of the National Ambient Air Quality Standards (NAAQS), and conversely, NNSR applies to pollutants for which the location is in nonattainment. The Wards Island WPCP site is currently designated as being in nonattainment of the NAAQS for the following pollutants:

- Ozone (O_3).
- Fine Particulate Matter with a mean diameter of 2.5 microns or less ($PM_{2.5}$).

For Ozone nonattainment, USEPA and NYSDEC regulate both Nitrogen Oxides (NOx) and Volatile Organic Compounds (VOCs) as the nonattainment pollutants. For $PM_{2.5}$ nonattainment, currently both USEPA and NYSDEC regulate only $PM_{2.5}$ itself or, on a surrogate basis, PM_{10}.

7.2.2 Current Permit Status and Permit Conditions

The WPCP currently operates as a “non-major” source facility, under a State Facility Permit. The permit was modified most recently on August 27, 2007. There is no expiration date for the permit. The most notable conditions of the permit are as follows:

- Annual facility-wide emissions limits:
  - NOx 22.5 tons per year (TPY), on a rolling 12 calendar month basis
  - VOCs 22.5 TPY, on a rolling 12 calendar month basis
- A Sulfur content limit of 0.2%, by weight for #2 oil fired at the facility.

7.3 Applicability of Air Permitting Regulations

Determining which air permitting regulations apply to any project to be implemented at an existing non-major source facility in New York involves answering the following series of questions:

(1) Does the project involve a physical change or a change in the method of operations? If not, then the project is not considered a "modification," and neither PSD nor NNSR applies. If the project does involve a physical change or a change in the method of operations, then proceed to question (2).

(2) If the project involves a physical change, does it qualify as routine maintenance, repair, or replacement (RMRR) or is it otherwise exempt? If so, then the project is not considered a "modification," and neither PSD nor NNSR applies. If the RMRR exclusion is not applicable, then proceed to question (3).

(3) If the project qualifies as a modification, will the "project emissions potential" (PEP) exceed "major source" thresholds? If not, then neither PSD nor NNSR applies. The PEP is defined in the Title 6 of the New York Code of Rules and Regulations (6 NYCRR), Chapter III, Section 231-7, as the sum of the following:

(a) For each new emissions unit, the potential to emit (PTE).

(b) For each existing emissions unit at a non-major emission source facility, the difference between the baseline actual emissions and the PTE of the unit.

(4) If the project qualifies as a modification but is not subject to PSD or NNSR, It may still require a NYSDEC permit modification under 6NYCRR Part 201, the state's air permitting regulations.

For the Wards Island WWTP, the major source thresholds are as follows:

Table 7.3.1 Nonattainment Pollutants – for NNSR Applicability

Pollutant	Allowance (Tons Per Year)
NOx	25 TPY
VOCs	25 TPY
$PM_{2.5}$	100 TPY

Table 7.3.2 Attainment Pollutants – for PSD Applicability

Pollutant	Allowance (Tons Per Year)
CO	250 TPY
SO_2	250 TPY
PM_{10}	250 TPY

7.3.1 Applicability of NYSDEC Permit Modification Regulations

As noted previously, the Wards Island WPCP currently holds a non-major State Facility Permit. Independent of whether the project triggers NNSR or PSD, a determination must be made as to whether the permit must be modified under the Part 201 regulations.

If a project is subject to PSD or NNSR, or if a facility must accept an emission cap to avoid triggering those regulations the facility must seek a significant permit modification. As specified in 6NYCRR 201-6.7(d), a significant permit modification also is required if a change involves significant changes to existing monitoring, reporting or recordkeeping requirements in the permit.

7.3.2 Applicability of NSPS, BACT, LAER, and State Emissions Standards

NSPS are technology-based standards that apply to new, reconstructed and modified sources in specific source categories based on the date that the source was originally installed or modified and on other criteria. NSPS for boilers are set forth in 40 CFR 60, Subparts D, Da, Db, and Dc.
For projects that trigger PSD, Best Available Control Technology (BACT) must be applied to control emissions of each pollutant for which the project is major.

BACT is a technology-forcing requirement, determined through a top-down approach that starts with the technology/emissions limit combination that the agency determines is achievable for the particular emissions unit or units. An applicant is required to employ that combination unless they provide a demonstration that satisfies the agency that it is either not technically feasible for the specific application, or would involve unacceptable environmental, energy, or economic impacts. If the top-rated combination is not employed, the applicant is required to employ the next-best option unless a similar demonstration is made. The technology capable of meeting the most stringent emissions limit that the agency finds does not have unacceptable associated environmental, energy, and/or economic impacts is specified as BACT.

For projects that trigger NNSR, the Lowest Achievable Emission Rate (LAER) must be applied to control emissions of each pollutant for which the project is major. In contrast to BACT, LAER is not strictly a technology-forcing requirement, because LAER must be based on what has been demonstrated in practice for what the agency considers a similar application (note that this doesn't mean the exact same type of application, but in practice the agencies tend not to require consideration of as wide a range of technology options as they do for BACT). An applicant is required to employ the technology/emissions limit combination that the agency determines is achievable for the particular emissions unit or units unless they provide a demonstration that satisfies the agency that it is not technically feasible for the specific application. In contrast to the BACT requirement, the

LAER requirement does not permit consideration of environmental, energy, or economic impacts. If the agency determines that a technology/emissions limit combination has been demonstrated in practice for a similar application, it is required as LAER.
NYSDEC regulations specify a number of technology-based standards applicable to specific source categories, including those applicable to boilers and stationary internal combustion engines.

7.4 Preliminary Permit Findings

7.4.1 Permitting Requirements

For the proposed project, all of the options under consideration qualify as a “modification” and not “RMRR,” and therefore there is no question that the project will require at least a Significant Permit Modification to the current NYSDEC air permit. The key question regarding this project is whether it will also trigger PSD and/or NNSR.

As indicated under Question (3) above, because the Wards Island WPCP is an existing non-major source facility, the applicability of PSD and/or NNSR to the project is based on a comparison of future (post-project) PTE with baseline actual emissions. For an existing non-major facility such as the Wards Island WPCP that is in an area with relatively low major source thresholds for NOx and VOCs and which has actual emissions that are generally relatively close to those thresholds, this highly conservative “apples-to-oranges” test sets a tough standard for projects involving installation of new combustion units.

Estimates of PEP were derived for each of the six feasibility options including the interim options. Documentation of these estimates can be found in Attachment I.

Based on estimates of baseline actual and future post-project PTE, it was determined that as currently conceptualized, each of the seven options under consideration would trigger NNSR for NOx. The estimates indicated that NNSR would not be triggered for VOCs or $PM_{2.5}$, and that PSD would not be triggered for any pollutant.

7.4.2 NSPS

The only potentially applicable NSPS is Subpart Dc, which applies to new boilers that have a heat input capacity of between 10 million British thermal units per hour (MMBtu/hr) and 100 MMBtu/hr. As currently conceptualized, each of the seven options under consideration would trigger NSPS Subpart Dc, as follows:

Table 7.4.1 NSPS Applicability

Option	Reason
Option 1	Each of the two OMH boilers, as they have a heat input capacity of approximately 26 MMBtu/hr.
Option 2	Each of the three 800 horsepower (HP) and two 400 HP boilers, as they have a heat input capacity of approximately 22 MMBtu/hr and 11 MMBtu/hr, respectively.
Option 3	Same as Option 2
Option 4	Each of the three 750 HP and two 350 HP boilers, as they have a heat input capacity of approximately 21 MMBtu/hr and 10 MMBtu/hr, respectively.
Option 5	Same as Option 4
Option 6	Same as Option 4
Option 7	Same as Option 2

Subpart Dc sets forth no requirements applicable to digester gas (or natural gas) combustion. The emissions standards for oil combustion under Subpart Dc are as follows:

Table 7.4.2 NSPS – Emissions Standard for Oil

Pollutant	Concentration	Application
PM	20% opacity	Applies to oil-fired units with a maximum heat input capacity of greater than 30 MMBtu/hr but less than 100 MMBtu/hr.
SO_2	0.50 lb/MMBtu Or 0.5% Sulfur content	Applies to all oil-fired boilers with a maximum heat input capacity of greater than 10 MMBtu/hr but less than 100 MMBtu/hr.

7.4.3 BACT

As indicated above, as currently conceptualized, none of the seven options under consideration would trigger PSD, and accordingly, none would trigger BACT.

7.4.4 LAER

As indicated above, as currently conceptualized, each of the seven options under consideration would trigger NNSR for NOx only, and accordingly, each would trigger LAER for NOx only.
The technologies and limits specified below would have to be considered to meet LAER:

- Natural gas if technically feasible, otherwise ultra-low sulfur distillate oil (i.e., oil with a sulfur content no greater than 15 parts per million, by weight).
- Ultra-low-NOx burner (i.e., burner capable of meeting NOx emissions limits as low as 0.01 lb/MMBtu, more likely closer to 0.035 lb/MMBtu for natural gas combustion, and as low as 0.07 lb/MMBtu, more likely closer to 0.15 lb/MMBtu for distillate oil combustion).
- If technically feasible, selective catalytic reduction (SCR). The feasibility of SCR in this case is questionable because (among possible issues) digester gas has a relatively high sulfur content level that may not be acceptable for the SCR catalyst.

7.4.5 Emissions Offsets

In addition to LAER, the requirements for projects that are subject to NNSR include that emissions reduction credits (ERCS) must be acquired to offset the emissions (in this case, of NOx). The emission offset must exceed the corresponding PEP by a ratio of 1.3:1. In other words, 1.3 ERCs must be obtained for every TPY of PEP emissions.

7.4.6 NYSDEC Emissions Standards

6 NYCRR Part 227 sets forth emissions standards for “stationary combustion installations,” a term defined in 6 NYCRR Part 201 to include boilers, engines, and turbines. These standards would apply to the new equipment being considered under each of the seven (7) options. The NYSDEC standards are generally less stringent than NSPS, and are by definition less stringent than either BACT or LAER (BACT and LAER are defined such that their minimum level of stringency is any other applicable emissions standard). Thus if BACT or LAER or NSPS are triggered, the NYSDEC standards will still apply but will not likely influence the choice of technology and/or operating requirements for the new units. Nevertheless, for this discussion, it is useful to reference the applicable NYSDEC standards for the types of equipment being considered. These are as follows:

Table 7.4.3 NYSDEC – Equipment Standard

Pollutant	Concentration	Application
PM	0.20 lb/MMBtu	Applies to oil-fired units with a maximum heat input capacity of greater than 50 MMBtu/hr but less than 250 MMBtu/hr.

Pollutant	Concentration	Application
NO_x	0.12 lb/MMBtu	Applies to distillate oil-fired boilers with a maximum heat input capacity of greater than 50 MMBtu/hr but less than 100 MMBtu/hr.
NO_x	2.0 g/bhp-hr	Applies to digester gas-fired stationary internal combustion engines with a maximum power output rating greater than 200 BHP

8. GREENHOUSE GAS EMISSIONS

8.1 Option 3 Summary

This section discusses how much greenhouse gas emissions can be reduced by the recommended Option 3 heating plant alternative for the WI WPCP. Implementation of Option 3 would greatly reduce the greenhouse gas emissions at Wards Island WPCP. Due to the elimination of steam exchange from the MPC, maximized utilization of digester gas and decreased fuel oil usage, the greenhouse gas emissions following implementation of Option 3 are expected to be lower than the existing operating conditions. Table 8.1.1 shows projected emissions for baseline conditions and following implementation of Option 3 by anthropogenic (non-biogenic) and biogenic sources. Table 8.1.2 summarizes the greenhouse gas emissions of Option 3 by different pollutants. Emissions are calculated based on ICLEI's September 2008 publication of Local Government Operations Protocol (LGOP) emissions factors, as well as, following recent PlaNYC guidelines and reported as CO_2 equivalents (CO_2e) and separated into biogenic and anthropogenic emissions as per DEP's instruction. Detailed emissions calculations are shown in Attachment J of the Appendix. .

The Wards Island WPCP is expected to see approximately 42% less overall greenhouse gas emissions and 88% reduction in anthropogenic (carbon footprint-related) greenhouse gas emissions from Option 3 implementation. Between the current operation and following the implementation of Option 3, the incremental reduction in CO_2e (CO_2 equivalent) emissions will be 13,835 metric tons per year. The reduction in GHG emissions is due to the eliminated use of steam and reduction in the use of fuel oil. The steam and reduced use of fuel oil is compensated by an increased use of digester gas, which has lower CO_2e emissions for the equivalent amount of energy produced.

Table 8.1.1: Greenhouse Gas Emissions by Sources (metric tons per year)

Emissions from Anthropogenic Sources (metric tons/yr)						
Present	**Units**	**Consumption**	**CO_2**	**CH_4**	**N_2O**	**CO_{2e}**
Steam	Mlbs/yr	167,075	12,600	0.403	0.070	12,630
Fuel Oil	Gallons/yr	153,826	1,561	0.234	0.013	1,570
Total			**14,161**	**0.636**	**0.083**	**14,200**
Post Option 3	**Units**	**Consumption**	**CO_2**	**CH_4**	**N_2O**	**CO_{2e}**
Steam	Mlbs/yr	-	0	0	0	0
Fuel Oil	Gallons/yr	35,775	363	0.054	0.003	365
Total			**363**	**0.054**	**0.003**	**365**
GHG Emissions Reduction						**13,835**

Emissions from Biogenic Sources (metric tons/yr)						
Present	Units	Consumption	Biogenic CO_2	CH_4	N_2O	CO_{2e} based on CH_4 & N_2O
Digester Gas Combusted	cu. ft./yr	-	0	0	0	0
Digester Gas Flared	cu. ft./yr	556,828,333	17,396	68.02	0.022	1,435
Total			**17,396**	**68.02**	**0.022**	**1,435**
Post Option 3	Units	Consumption	Biogenic CO_2	CH_4	N_2O	CO_{2e} based on CH_4 & N_2O
Digester Gas Combusted	cu. ft./yr	369,890,000	11,556	45.19	0.014	953
Digester Gas Flared	cu. ft./yr	186,938,333	5,840	22.84	0.007	482
Total			**17,396**	**68.02**	**0.022**	**1,435**
Emissions from Biogenic Sources Reduction						**0**

Table 8.1.2: Option 3 Greenhouse Gas Emissions Reduction (metric tons per year)

Greenhouse Gas Emissions Savings (metric tons/yr)				
Scope 1	**CO_2**	**CH_4**	**N_2O**	**CO_{2e}**
Fuel Oil	1,198	0.179	0.010	1,205
Digester Gas	N/A	-	-	-
Scope 2	**CO_2**	**CH_4**	**N_2O**	**CO_{2e}**
Steam	12,600	0.403	0.070	12,630
Total Scope 1 & 2 GHG Emissions Reduction	**13,798**	**0.582**	**0.080**	**13,835**
Information Item	**Biogenic CO_2**	**CH_4**	**N_2O**	**CO_{2e}**
Digester Gas	-	N/A	N/A	-

9. IMPLEMENTATION SCHEDULE

9.1 Summary

The proposed scope of work for the recommended option, (i.e., Option 3) is estimated to be completed in about three and a half years from the commencement of initial design activities. Following the approval of the feasibility report, on or about December 1st, 2009, AECOM will commence the development of the 30% Design, followed by a report to be issued on March 1st, 2010. After a 20-day period of reviewing and responding to comments from NYPA and the DEP, AECOM will resume the design process while NYPA shall simultaneously conduct a hazardous materials study. This study and design should be complete on June 7th, 2010.

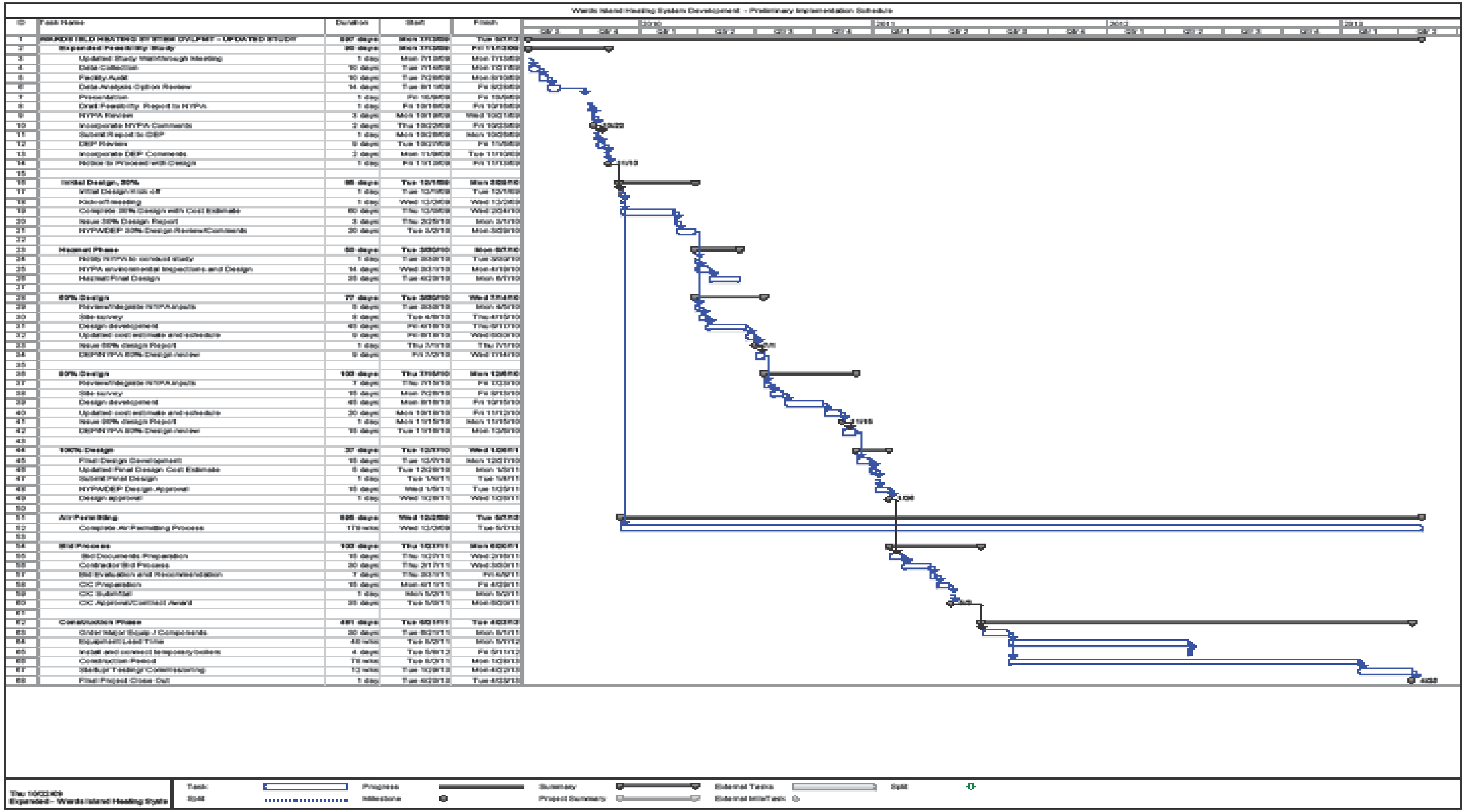
The 60% Design Report from AECOM will follow shortly on July 1st. Throughout each design phase, AECOM will work with NYPA and DEP representatives, as well as Wards Island personnel, to obtain any information necessary to maintain progress through the use of conference calls, meetings and site visits. Constant communication between each party will be critical to ensure that the needs of each party are understood and satisfied.

After receiving the 60% Design comments from NYPA and the DEP, AECOM will begin to integrate them into what will become the 90% Design submittal, to be issued on November 15th, 2010. In addition to the constant communication and gathering of information from all parties, costs, schedule and timeline will constantly be under review. Any changes that are made to either of these items will be reflected in each submittal.

The Final Design submittal, at 100%, will be complete on January 4th, 2011. At this time, NYPA and the DEP will review the design and associated documents to ensure that all previous comments or design changes have been accommodated. Once the design is approved, on January 26th, AECOM will begin to prepare the bid documents. Once the documents are complete, the Bid Packages will be released to bidding contractors on February 17th, 2011. The contractors will be allowed 30 days to prepare their bids, which will be returned to AECOM on March 30th. Following a careful review by AECOM, the award recommendation will be presented to NYPA on April 8th, 2011. At this time, AECOM will begin preparing the Initial Customer Installation Commitment, or CIC. On May 2nd, the DEP will receive the CIC, at which time they will begin a review and submit to the NYC controller for registration. On June 20th, 2011, with the CIC approved, the contract will be awarded.

The construction phase of the project will begin on June 21st, 2011. At this time, all major equipment and components will be ordered. With lead times varying between each component, the delivery dates of major pieces will be pre-arranged to accommodate the construction schedule developed by the contractor. Construction will commence on August 2nd, 2011, while temporary equipment installations are scheduled to follow immediately. This date will allow the facility to operate with minimal service interruptions. Construction will last until January 28th, 2013, at which time all equipment and systems will begin the start-up, testing and commissioning processes. Final project close out is scheduled for April 23rd, 2013. Because of the new equipment that is to be installed as part of this project, the plant will require a renewal and re-evaluation of its air permits. This will begin on December 2nd, 2009, coinciding with the initial design kick off meeting. Following the construction close out, the new permits will be obtained on May 7th, 2013, thus bringing the project to completion.

The project schedule has been inserted on the following page.


Wards Island Heating System Development - Preliminary Implementation Schedule
ID
Task Name
Duration
Start
Finish

AECOM

APPENDICES

Attachment A: Baseline Data

Attachment B: Energy Savings Calculations & Methodology

Attachment C: Cost Estimates

Attachment D: Drawings

Attachment E: Catalog Cut sheets

Attachment F: Old Boiler Building - Structural Inspection Report

Attachment G: Site map of the WI WPCP

Attachment H: Life Cycle Cost Analysis

Attachment I: Air Permitting and Emission Calculations

Attachment J: Greenhouse Gas Emissions Calculations

Attachment K: Proposed Heating Plant Schematics