BROOKDALE COMMUNITY COLLEGE

LINCROFT CAMPUS

EXECUTIVE SUMMARY

Schoor DePalma has been requested by Brookdale Community College to evaluate the HVAC, Electrical and Plumbing/Fire Protection for its Long Branch, Lincroft and Western Monmouth Campus in conjunction with its **Facilities Master Plan 2015**.

This report concentrates only on the underground utilities serving the Lincroft Campus located on Newman Springs Road in Lincroft, New Jersey. Utilities accessed include:

- ❑ Chilled Water
- ❑ Heating Hot Water
- ❑ Domestic/Fire Water
- ❑ Natural Gas
- ❑ Emergency Electric Power

The Lincroft campus is approximately 230 acres with 14 main buildings. The campus building's utilities are either fed directly from the utility company as is the case with the natural gas and electric or by one master meter located at the street as is the case with the domestic and fire water or from the central power plant as is the case with the chilled and heating water piping.

I. PURPOSE AND SCOPE

The purpose of this report is to give Brookdale Community College an in-depth review of the condition, age and remaining life of systems and associated equipment. It will serve as a guide in budgeting as well as determining the ability of these systems and equipment to support future campus growth.

This report provides information, recommendations, and probable estimated construction costs for supporting the present facilities that will meet the current building codes and student population for the campus.

II. METHODOLOGY

The following methods were employed during the course of this report:

- ❑ On site observation of the HVAC, plumbing, electrical and fire protection systems on August 3, 2005.
- ❑ Utilization of standard reference sources, including but not limited to the New Jersey Uniform Construction Code with amendments, International Building code, 2000 edition as adopted by the State of New Jersey, The National Standard Plumbing Code, 2003 edition, International Fuel Gas Code, 2003 edition, International Mechanical Code, 2003 edition, and the National Electric Code, 2002 edition.
- ❑ Cost estimates were based on R.S. Means Construction Cost Data and recent projects similar in scope of work.

- ❑ WaterCAD computer modeling software.
- ❑ Good professional engineering judgment.
- ❑ Water flow test performed by Allied Fire and Safety Company.
- ❑ Site interview with New Jersey Natural Gas, August 12, 2005.

III. OBSERVATIONS

A. HVAC

The Lincroft College campus is heated and air conditioned with a multitude of HVAC systems and equipment throughout the campus. The central plant serves the Megastructure, Gymnasium, Student Commons and Performing Arts building and wings with chilled water and heating hot water piping systems that feed all the air handling units located in the buildings. The central plant's hot water system also serves the CVA and Larrison Hall (no chilled water) buildings.

The Megastructure includes the following connected wings and buildings:

a. Natural and Applied Sciences (NAS)

b. Advanced Technology Center (ATC)

c. Inst Materials Center (IMC)

d. Main Academic Complex (MAC, MAN, MAE)

e. Library (LIB)

The other buildings connected to the central plant include:

a. Gymnasium (GYM)

b. College Commons (COM)

c. Performing Arts (PAC)

d. CVA (heating only)

e. Larrison Hall (heating only)

The remaining buildings on the Lincroft Campus are heated and air conditioned with self-contained air conditioning units including direct expansion-DX cooling coils and gas-fired heating. These units are not connected with the central plant system and therefore, are not included in this report.

The following information is based on Schoor DePalma's survey, equipment vendors and a review of the *1996 Campus Wide Utility Plant Study.*

1. Central Plant

The central plant consists of a chiller plant, boiler plant, chilled water and hot water primary/secondary pumping and piping systems, electrical switchgear and electrical power equipment, emergency systems for the central plant equipment. The chilled water and hot water piping systems are distributed throughout the Megastructure, Gymnasium, Student

Commons and the Performing Arts building and wings. CVA and Larrison Hall have heating and hot water only.

The central plant's HVAC equipment including chillers and boilers that have integral controllers for maintaining chilled water or hot water temperature setpoints and include their own safeties for protection of the equipment. The equipment controllers are interlocked with the central plant's building automation control system called Carrier Comfort Network (CCN) which in turn is also interlocked with all the thermostats and HVAC equipment in the buildings. The network has a fiber optic transmission line throughout the buildings served by the central plant.

2. Chiller Plant

The chiller plant consists of two (2) 1,000 ton York chillers, and one (1) 825 ton Broad gas fired absorption chiller. The original central plant was renovated in 1974 with engine-driven chillers, boilers and cooling towers, but has been since replaced with newer equipment in the 1980s.

The total connected load for all 3 chillers at 100% capacity is 2,825 tons of cooling capacity. The 2 York electric chillers, which were retrofitted with variable speed drives in 2002 for improving efficiencies at part-load capabilities, are centrifugal type that contain R-11 refrigerant and were installed in the 1980s. R-11 refrigerant is no longer manufactured due to its environmental impact but can be purchased commercially is very expensive and supplies are limited. The units can be retrofitted with R-123 or other low pressure refrigerants but will reduce the cooling capacities by approximately 10% or more.

The 3 chillers are connected to primary/secondary pumping systems that distribute the chilled water out to the Megastructure wings and buildings through piping mains in the tunnels. The tertiary chilled water pumps inside the buildings and tunnels serve the air handling units for those buildings and draw the chilled water supply and return from the mains in the tunnels. Refer to Schoor DePalma's sketch SK-H-1, dated 11/8/05, denoting the existing chiller plant equipment, pumps and piping configuration.

Each of the 3 primary chilled water pumps are connected to their respective chillers and operate when the chiller is energized. The pumps are constant volume. The chilled water pumps for both the York chillers are rated at 2,400 gallons per minute (gpm) while the 3rd pump for the Board Absorption chiller is rated at 2,200 gpm.

The 3 secondary chilled water pumps distribute chilled water out to the buildings and wings through a tunnel system. The three pumps are rated at 1,500 gpm each and operate at a constant volume. The tertiary chilled water pumps, with total rated flows of approximately 3,500 gpm, are located in the buildings or in the tunnel and distribute the chilled water to the buildings air handling units. According to the source of the *1996*

Campus Wide Utility Plan Study, there are approximately 22 tertiary pumps which serve all the air handling units in the buildings.

The pump controls for the chilled water system are set up with the original controls for starting and stopping the pumps. When the 1st chiller is called for cooling, the 1st primary chilled water pump starts which automatically send signals to start the secondary pumps and the tertiary chilled water pumps in the buildings which are served by the central plant.

The pump controls for the hot water system are also original and are similar to the primary, secondary and tertiary pumps for the chilled water system.

The 3 chillers contain water-cooled condensers and each chiller has a respective condenser water pump. Condenser water is pumped to the cooling towers located on the roof of the central plant building. The 2 condenser water pumps for both of the York chillers are rated at 3,000 gpm while the condenser water pump for the Broad chiller is rated for 3,500 gpm.

The cooling towers for the condenser water system are on the roof. There are 4 cooling tower cells. The 2 newer towers (2002) are Baltimore Aircoil Co. model 33520, and are rated at 500 tons (net capacity for the chiller evaporators) each with condenser water at 1,540 gpm each. The older tower cells are similar in size and capacities. The chiller plant including the cooling towers and all pumps are under control of the plant control system. Each chiller has their controller that maintains temperature, safeties, etc., and can receive a remote signal from the central plant controls to change the temperature setpoints for chilled water.

There were no refrigerant detectors seen in the mechanical room including the chillers.

There are intake air fans in the outside wall and exhaust fans for ventilation of the central plant mechanical building.

3. Boiler Plant

The boiler plant consists of three (3) 300 horsepower (HP) hot water boilers, 2 of which are Superior (1971/1988) and 1 is International Boiler Works (1995). The Broad boiler is used for the absorption chiller and is connected to the hot water system. It can be used also as a back-up boiler. Refer to Schoor DePalma's sketch, SK-H-2 dated 11/8/05, denoting the existing boiler plant equipment, pumps and piping configuration.

The primary hot water pumps are connected to their respective boilers and operate when the boiler is energized. The pumps are constant volume. The 3 primary hot water pumps for the 3 boilers are rated at 800 gpm. The 4th hot water pump for the Broad boiler (absorption chiller) is rated for 1,100 gpm.

The 3 secondary hot water pumps distribute hot water out to the Megastructure buildings and wings, including CVA, Larrison Hall, Performing Arts and College Commons through a tunnel system. Two pumps are rated at 1,100 gpm and the 3rd is rated at 800 gpm.

The tertiary hot water pumps are located in the buildings or in the tunnel and distribute hot water to the buildings. According to the source of the *1996 Campus Wide Utility Plant Study*, there are approximately 24 tertiary hot water pumps which serve all the air handling units in the buildings. The total hot water flows to the buildings is approximately 1,540 gpm.

The pump controls for the hot water system are also original and are similar to the primary, secondary, tertiary pumps for the chilled water system.

The buildings and wings of the Megastructure, Performing Arts and the Commons building are heated and air conditioned with air handling units located in the buildings and serve their respective zones. The air handling units contain hot water heating coils and chilled water cooling coils. The tertiary chilled water and hot water pumps distribute the water to the coils of all the air handling units. The heating and cooling coils have either 2-way and 3-way temperature control valves and control the zone or space temperatures. The air handling units in the buildings are either Carrier or Trane units. There are approximately 55 air handling units in the Megastructure buildings and wings which are either horizontal ceiling unit type or vertical floor-mounted units and were installed around 1975. We have no information for the air handling units in the Performing Arts and Student Commons buildings.

Buildings CVA and Larrison Hall contain air handling units with DX cooling coils and hot water heating coils, their ages are unknown.

The air handling units are on their own local controls thus maintaining their respective space or room temperature setpoints for heating and cooling.

The local controls for the air handling units are also interlocked with the central control system (CCN) for seasonal changeover, stop/start, sensors alarms, and changing temperature set points in the zones or rooms. The central control system also controls stop/start of the tertiary pumps (chilled water or hot water) based on the season and the primary pump controls.

B. Plumbing Systems

1. Domestic Water System

Brookdale's Lincroft campus is fed off a New Jersey American Water 12" water main in Newman Springs Road (Monmouth County Route 520). The 12" main in Newman Springs Road is directly connected to a 24" transmission main also located in Newman Springs Road. An 8" main delivers water from the 12" main in Newman Springs Road to a meter near the property line on the Brookdale Campus. A 10" water main exits the meter pit and travels to the area of the administration building. At this location there is a tee and the main then transitions to 8" and travels separately both down toward the High Tech High school and also toward the Center for Visual Arts, then traveling south towards the Robert A. Collins Arena. There is a 2" feed from the 10" line that serves the police station, mail center, print shop, Stryker house and maintenance building. The maintenance building, mail center and Stryker house do not have sprinkler systems.

There is a connection to a water main on Phalanx Road that provides irrigation to the sports fields at the rear of the Lincroft campus. This irrigation line does not connect to the rest of the Brookdale water system. The exact locations and sizes of these mains could not be confirmed. The sizes of these mains were assumed from old mapping provided, and conversations with Brookdale Community College's facilities staff. Several valves are stuck in the open position, which makes it difficult to isolate sections of the system for repair.

2. Natural Gas System

The College is fed natural gas via a 4 inch high pressure line (40 to 60 PSIG) that enters the site near the main entrance on Newman Springs Road. According to the New Jersey Natural Gas Company (NJNG), this service is fed from a "transmission" gas line that has 800± PSIG available. The 4 inch site natural gas service main loops around the site serving buildings that require natural gas. Each building that does require natural gas is independently metered and regulated to normal house pressure (1/2 PSIG) except for the power house which has three (3) different natural gas services with varying pressures ranging from 1/2 PSIG to 2 PSIG. The natural gas line eventually ties into the utility company's service line located in Phalanx Road. According to the representatives of NJNG, and the extensive experience and knowledge of the natural gas main on the site, they believe the piping system to be in excellent condition.

NJNG went on to add that there was a 4 inch section of the pipe located in front of the Administrative Building near parking lot #3 that reduces down to 2 inches and then again increases back to 4 inches. NJNG felt this reduction in pipe size should not affect the gas supply or pressure as the site system is fed from 2 sources.

C. Electrical System

1. Electrical Power Distribution System

The electrical power distribution system at Lincroft campus consists of electric utility-owned 15kV feeders (Jersey Central Power and Light – JCP&L), primary service disconnect switches (Oil and Air), step-down power transformers, 15kV switchgear, low-voltage switchboards, and low-voltage power distribution panelboards.

There are currently low-voltage service entrance equipment at twenty six (26) different locations. With exception of two locations, “Central Receiving & Mail” and “Barn”, all other twenty four locations are supplied from one set of 15kV electric utility-owned feeders.

The 15kV electric utility-owned feeders supply the line side of primary service disconnect switches. As part of a separate project, these 15kV Oil disconnect switches are being replaced with 15kV Air disconnect switches. The load side of these 15kV disconnect switches supplies the primary side of step-down power transformers. The secondary side of the step-down power transformers feed each location’s respective service entrance equipment (switchboards, power distribution panelboards, metering, etc).

IV. EVALUATION AND ANALYSIS

A. HVAC

1. General

The previous *1996 Campus Wide Utility Plant Study* included heating and cooling load calculations that determined the peak load (demand) conditions. The set of calculations in the study included outside air requirements in accordance with the 1993 BOCA Mechanical Code. This code had higher outside air requirements than that used for the sizing of the original HVAC equipment in the 1970s.

The total cooling load was calculated at 2,159 tons whereas the total heating load was calculated at 18,097 MBH (540 boiler HP). The calculations were based on 3.45 watts per square foot of lighting, most buildings having double-pane windows, equipment/internal loads of 1.0 watts per square foot, having approximately 2,000 occupants on the campus, and allowing 8.33 cfm of outside air per student based on the Code at the time of the 1996 study.

The 1996 study indicated that the total cooling load in the Summer could exceed the total available capacity of both 1,000 ton York chillers at the time. In 1996, there appears that there were only 2 York chillers in the chiller plant as the original engine-driven chillers were removed and replaced with 2 York chillers.

The 1996 study also indicated that the 3 – 300 HP boilers were sufficient to meet the maximum heating load requirements in the winter.

The Brookdale Community Facilities Master Plan 2015 indicates that more students, personnel, and new buildings may be added in the future. This will necessitate the need for an up-to-date Campus Wide Utility Study that will verify if the present central plant and building HVAC equipment will meet the present demand and what the needs will be of future requirements, additional outside air requirement (15 cfm per student), additional buildings and classrooms.

2. Chiller Plant

The calculated peak total cooling load (peak demand) for the buildings on the chiller plant was 2,160 tons, based on the *1996 Campus Wide Utility Plant Study*. The operating capacity of the chiller plant is approximately 2,100 tons and therefore, is not sufficient to meet present and any future demand requirements.

The peak cooling loads for the present requirements of the chilled water system and the buildings they serve are still unknown because of the addition of computers, additional outside air, and more occupants than were anticipated in 1996. It is recommended the Brookdale Community College have an updated Campus Wide Utility Plant Study be developed to determine and evaluate the outside air requirements and the cooling loads for all the buildings of the chilled water system based on the latest Code requirements for 2006 requirements, and the future requirements of the Brookdale Community College's Facilities Master Plan 2015.

The chiller plant presently includes 3 chillers with a total connected capacity of 2,850 tons, all operating at 100%, and the cooling tower system. It is recommended that the 3 chillers not operate beyond 75% of their rated capacity which is approximately a total of 2,100 tons of cooling capacity. The York chillers are almost 20 years old and will soon exceed their economic life expectancy and operating beyond 75% of chiller capacity will increase the frequency of equipment failures and unnecessary shutdowns.

The cooling towers have 4 cells, each having a capacity of approximately 500 tons. The total cooling capacities for all 4 tower cells are 2,000 tons and the total condenser water flows to all 4 towers are 6,000 gpm. There is only sufficient capacity of the 4 towers to operate with <u>either</u> the 2 York chillers (2,000 tons total), or 1 York and the absorption chiller (8,825 tons). According to the equipment ratings, there is not sufficient capacity of all 4 towers to operate the 3 chillers at once.

Presently the plant is operating with most of the outside dampers of the air handling units closed; therefore, indications of present usage (less than 2,100 tons) could be misleading. When the outside dampers are open to meet the required outside air quantities, the cooling demand will exceed the available operating capacity of the chillers.

The chilled water pumping systems should be further evaluated in order to improve the operating procedures, controls, efficiencies during part-load condition and the hydraulics of the entire piping system. Different pumping arrangements and adding pumps for the additional chillers and cooling towers should be considered for the present and future requirements of the Facilities Master Plan 2015.

One concern for the pumping system operation includes operating the 3 secondary pumps and only 1 primary chilled water pump (1 chiller at partial load). This condition of pumping more to the buildings than the primary pumps can handle could cause mixing of chilled water return, 61°F, and supply, 45°. This will raise the chilled water supply temperature and thus lower the cooling capacities of the air handling units in the buildings. The 3 secondary pumps must operate at all times so that the tertiary pumps will receive sufficient flow at all times.

Other concerns are for the occupant safety in the chiller plant. During our survey we did not see any refrigerant detectors in the plant. Detectors and exhaust ventilation systems shall be in accordance with the International Mechanical Code (IMC), Chapter 11 and the International Fire Code. R-11 which has a low concentration limit allowance (1,100 ppm) compared to R-22 (25,000 ppm) and R-123 (9,100 ppm). It is recommended to have an evaluation performed of the required ventilation systems (exhaust and make-up air equipment), refrigerant and oxygen detectors required and machinery room limitations due to the International Mechanical Code. There must be provisions for preventing any refrigerant leaks in the mechanical/machinery room that may be drawn into the combustion air fans of the boilers and into the boilers due to its toxicity.

3. Boiler Plant

The present boiler plant includes 3 hot water boilers all rated at 300 boiler HP for a total connected load of 900 HP all operating at 100% capacity. The operating capacity of the 3 boilers should not exceed approximately 75% of their capacities which would be a total of 675 HP of operating capacity based on their age and conditions. Therefore, the available operating capacity of the 3 boilers is approximately 25% higher to what the peak heating loads (540 HP) would be as was determined in 1996.

It is recommended that Brookdale Community College have the heating loads for all the buildings of the hot water system be evaluated based on 2005 requirements and the future requirements of the Brookdale Community College Facility Master Plan 2015. These evaluations will provide the necessary information to evaluate the present and future requirements for the heating plant equipment and HVAC equipment at the buildings.

Boilers 1 and 3 are old and need replacement whereas boiler 2 is only 10 years old and is in fair condition. The Broad boiler for the absorption chiller is fairly new and is in good condition and it can be used as a back-up boiler if one of the others are not available for service. The primary, secondary, tertiary hot water pumps are 20 years old, are in fair condition, and should be replaced in the near future.

There are no hot water temperature control valves for outside air reset controls. Three-way temperature control (mixing) valves in the hot water supply lines would provide means of lowering the hot water supply temperature when the outside air rises. This will save energy by means of using less energy to heat the hot water in mid weather, and shutting down unnecessary boilers.

One concern for the hot water pumping system is that the 3 second hot water pumps will be operating and only 1 primary hot water pump (1 boiler operating at partial load) will be operating. Pumping more to the buildings than the primary pumps can handle could cause mixing of hot water return, 150°F, and supply, 180°F. This will lower the hot water supply temperature and thus lower the heating capacities of the air handling units in the buildings. The 3 secondary pumps must operate at all times so that the tertiary pumps will receive sufficient flow at all times. A system evaluation of the pumping system could alleviate this problem.

4. Building HVAC System

The buildings and wings of the Megastructure and the other buildings that are connected to the central chilled water and hot water systems have tertiary pumps and air handling units that were installed in the 1970s. The HVAC equipment is old and will require replacement in the near future.

The air handling units are not sized for the present International Mechanical Code, 2003 edition, requirements for outside air and the additional internal heat loads in the spaces from computers, printers, etc.

Replacement of the HVAC equipment should be considered after the updated Utility Plant Study has been performed. The study should include determining the outside air requirements for the spaces and buildings and the building cooling and heating loads for the proper sizing of the air handling units, tertiary pumps, and control valves.

B. Plumbing Systems

1. Domestic Water Systems

The Brookdale water system was analyzed using a WaterCAD computer model. The existing main sizes and location were input along with domestic demands and available flow at Newman Springs Road. Attached at the end of this report is a hydrant flow test performed by Allied Fire and Safety Equipment Co, Inc. near the Main Academic East building as well as a hydrant flow test performed by NJAWC near the entrance to the Brookdale campus on Newman Springs Road. These tests were used to calibrate the computer model. The computer model was then used to determine available flow at 20 psi at several locations along the water mains. ISO calculations were also done for the Robert A. Collins arena and the fitness center to determine needed fire flow. Both of these buildings do not have sprinkler systems and appeared to be the worst cases for needed fire flow. The ISO calculations were done by estimating the sf of the buildings and construction materials. The existing mains do not appear to be adequate to provide the needed fire flow for these buildings. Since the mail center building, Stryker house and maintenance building do not have sprinkler systems, the 2" main feeding them is not adequate to provide the required fire flow.

2. Natural Gas Systems

The site is fed from a 800 PSI transmission line in Newman Springs Road. According to the New Jersey Natural Gas Company (NJNG), if the College requires additional capacity, they can accommodate their requirements by increasing the gas pressure at the main regulator on Newman Springs Road. Also, according to NJNG, the gas mains are in excellent condition and they do not require or recommend any pipe replacements.

C. Electrical System

1. Electrical Power Distribution Capacity

(See Attached One-Line Diagram)

The available electric service supplied by JCP&L utility to each service entrance equipment locations is calculated. This available electric service is then compared to the connected electrical load at each location. In order to measure the maximum connected load, all associated lighting and HVAC equipment in each of the twenty six locations were turned on prior to reading the steady-state electrical load (amperes). The following is a breakdown of each location:

a. Power House / Central Plant:

15kV overhead (utility pole) feeders supply Power House / Central Plant with 15kV electrical power. This voltage is stepped down by a 1500 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 1500 kVA

ii. Existing connected load: 890.4 kVA

iii. Available spare capacity: 609.6 kVA (41%)

b. Computer Center:

15kV feeders supply the Computer Center from Manhole No. 1. This voltage is stepped down by a 500 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 500 kVA

ii. Existing connected load: 94.2 kVA

iii. Available spare capacity: 405.9 kVA (81%)

c. Day Care:

15kV feeders supply the Day Care from Manhole No. 1. This voltage is stepped down by a 225 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 225 kVA

ii. Existing connected load: 44.1 kVA

iii. Available spare capacity: 180.9 kVA (80%)

d. Lot 4 Lighting:

15kV feeders supply Lot 4 Lighting from a Manhole (manhole number not available). This voltage is stepped down by a 100 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 100 kVA

ii. Existing connected load: 38 kVA

iii. Available spare capacity: 62 kVA (62%)

e. High School:

15kV feeders supply the High School from a Manhole (manhole number not available). This voltage is stepped down by a 300 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 300 kVA

ii. Existing connected load: 205.3 kVA

iii. Available spare capacity: 94.7 kVA (32%)

f. ATEC Building:

15kV feeders supply the ATEC Building from Manhole No. 10. This voltage is stepped down by a 750 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 750 kVA

ii. Existing connected load: 137.7 kVA

iii. Available spare capacity: 612.3 kVA (82%)

g. Gym and Lots 6 & 7 Outdoor Lighting:

15kV feeders supply the Gym and Lots 6 & 7 Outdoor Lighting from Manhole No. 9. This voltage is stepped down by a 750 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 332.5 kVA

ii. Existing connected load: 162.4 kVA

iii. Available spare capacity: 170.2 kVA (51%)

h. PAC Buildings:

15kV feeders supply the PAC Buildings from Manhole No. 3. This voltage is stepped down by a 500 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 500 kVA

ii. Existing connected load: 128.3 kVA

iii. Available spare capacity: 371.7 kVA (74%)

i. Museum:

15kV feeders supply the Museum from Manhole No. 3. This voltage is stepped down by a 500 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 500 kVA

ii. Existing connected load: 66.5 kVA

iii. Available spare capacity: 433.5 kVA (87%)

j. CVA Building:

15kV feeders supply the CVA Building from a Manhole (manhole number is not available) that is located between Manhole Nos. 2 & 3. This voltage is stepped down by a 1000 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 1000 kVA

ii. Existing connected load: 204.8 kVA

iii. Available spare capacity: 795.2 kVA (80%)

k. LAH Building:

15kV feeders supply the LAH Building from a Manhole (manhole number is not available) that is located between Manhole Nos. 2 & 3. This voltage is stepped down by a 2000 kVA, 15kV/480Y-277V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 2000 kVA

ii. Existing connected load: 554.2 kVA

iii. Available spare capacity: 1445.8 kVA (72%)

l. B-Barn:

15kV feeders supply the B-Barn from Manhole No. 2. This voltage is stepped down by a 150 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 150 kVA

ii. Existing connected load: 68.2 kVA

iii. Available spare capacity: 81.8 kVA (55%)

m. Administration Business Complex:

15kV feeders supply the Administration Business Complex from Manhole No. 2. This voltage is stepped down by a 150 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 150 kVA

ii. Existing connected load: 101.7 kVA

iii. Available spare capacity: 48.3 kVA (32%)

n. Library:

15kV feeders supply the Library from Manhole No. 4. This voltage is stepped down by a 750 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 750 kVA

ii. Existing connected load: 303.7 kVA

iii. Available spare capacity: 446.3 kVA (60%)

o. MAN/MAC Building:

15kV feeders supply the MAN/MAC Building from Manhole No. 6. This voltage is stepped down by a 1000 kVA, 15kV/480Y-277V, outdoor step-down power transformer. This voltage is further stepped down to 208Y/120V by a 300kVA indoor transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 750 kVA

ii. Existing connected load: 303.7 kVA

iii. Available spare capacity: 446.3 kVA (60%)

p. MAE Building:

15kV feeders supply the MAE Building from Manhole No. 5. This voltage is stepped down by a 1000 kVA, 15kV/480Y-277V, indoor step-down power transformer, in one switchgear lineup, while a 300 kVA, 15kV/208Y-120V, indoor transformer steps the 15kV voltage down to 208Y/120-V, in the second switchgear lineup. The following is the electrical characteristics of this location:

**480Y/277-V Switchgear Lineup:

i. Existing electrical capacity: 1000 kVA

ii. Existing connected load: 9.1 kVA

iii. Available spare capacity: 990.9 kVA (99%)

**208Y/120-V Switchgear Lineup:

i. Existing electrical capacity: 300 kVA

ii. Existing connected load: 12.4 kVA

iii. Available spare capacity: 287.6 kVA (96%)

q. SLC Building:

15kV feeders supply the SLC Building from Manhole No. 6. This voltage is stepped down by two 750 kVA, 15kV/208Y-120V, outdoor step-down power transformers, which supplies two individual 208Y/120-V switchgear lineups. The following is the electrical characteristics of this location:

**208Y/120-V Switchgear Lineup (for elevators only):

i. Existing electrical capacity: 750 kVA

ii. Existing connected load: 15.7 kVA

iii. Available spare capacity: 734.3 kVA (98%)

**208Y/120-V Switchgear Lineup (remaining SLC Building loads):

i. Existing electrical capacity: 750 kVA

ii. Existing connected load: 240.8 kVA

iii. Available spare capacity: 509.2 kVA (68%)

r. NAS Building 'B':

15kV feeders supply the NAS Building 'B' from Manhole No. 10. This voltage is stepped down by a 1500 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 1500 kVA

ii. Existing connected load: 222.8 kVA

iii. Available spare capacity: 1277.2 kVA (85%)

s. NAS Building 'A':

15kV feeders supply the NAS Building 'A' from Manhole No. 6. This voltage is stepped down by a 1000 kVA, 15kV/480Y-277V, indoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 1000 kVA

ii. Existing connected load: 270.2 kVA

iii. Available spare capacity: 729.8 kVA (73%)

t. Central Receiving and Mail:

15kV overhead (utility pole) feeders supply Central Receiving and Mail with 15kV electrical power. This voltage is stepped down by a 75 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 75 kVA

ii. Existing connected load: 18 kVA

iii. Available spare capacity: 57 kVA (76%)

u. Barn:

15kV overhead (utility pole) feeders supply Police/Maintenance Shop/Barn/Print Shop (Barn) with 15kV electrical power. This voltage is stepped down by a 150 kVA, 15kV/208Y-120V, outdoor step-down power transformer. The following is the electrical characteristics of this location:

i. Existing electrical capacity: 150 kVA

ii. Existing connected load: 26.8 kVA

iii. Available spare capacity: 123.2 kVA (82%)

V. RECOMMENDATION

A. HVAC

1. Chiller Plant

a. The present chiller plant has a total connected load capacity of 2,850 tons of cooling. Based on operating at 75% capacity the operating capacity is estimated at approximately 2,100 tons of cooling for the Lincroft campus. It is <u>not</u> recommended to operate the HVAC plant at 100% capacity due to the age of the equipment and also for maintaining normal maintenance procedures, and preventing frequent equipment failures and shutdowns.

b. Based on the *1996 Campus Utility Plant Study*, the calculated maximum cooling load (peak demand) for the Megastructure buildings and wings, Performing Arts and Student Commons buildings was 2,160 tons.

c. It is recommended that Brookdale Community College update their Utility Plant Study for present conditions in 2006 and for the future anticipated requirements of the 2015 Master plan for all the buildings as supported by the central plant.

d. Evaluate more efficient pumping systems and modify existing pumping arrangements and piping systems.

e. Replace both York chillers.

f. Replace primary chilled water pumps and associated equipment in the near future.

g. Replace secondary chilled water pumps and associated equipment in the near future.

h. Provide additional chillers, pumps and cooling tower cells as required to meet the future plans.

i. Evaluate ventilation requirements for central plant building and provide additional ventilation equipment, refrigerant detectors and control system.

j. Replace and add isolation valves in the piping mains.

k. Test and evaluate the existing chilled water piping, the valves located in the tunnels and central plant. Consider replacements of the piping mains and valves. Tests should include determining condition of valves, accessories, pipe wall thickness and all joints for leaks. Consider performing hydrostatic pressure testing for leaks.

l. Upgrade existing central plant controls system to include new direct digital control systems in the remaining buildings not served by the central plant for monitoring and remote control of the HVAC equipment and space temperatures.

m. Upgrade central building automation control system to include all the chilled water pumps, cooling towers and condenser water pumps.

2. Boiler Plant

a. Evaluate maximum heating load (peak demand) requirements for all the buildings, as supported by the central plant.

b. Replace 2 boilers.

c. Replace 3 primary pumps and their controls

d. Replace 3 secondary hot water pumps and controls

e. Add new 3-way temperature control valves and temperature reset controls for hot water supply.

f. Replace and add isolation valves in the piping systems for improving building and equipment isolation.

g. Test and evaluate the existing hot water piping, and valves located in the tunnels and central plant. Consider replacement of the piping mains and valves. Consider performing hydrostatic pressure testing for leaks.

h. Upgrade central building automation control system to include the hot water pumps.

3. Building HVAC Systems

a. The recommendations below anticipate that the Lincroft facility will increase in size based on the Brookdale Community College's 2015 Master Plan and also that most of the existing equipment is over 20 years old and is in need of repair and/or replacement.

b. Replace approximately 55 air handing units (AHU) in the Megastructure, Performing Arts Center, the Commons buildings, as supported by the central plant equipment. Sizes of the new air handling units will be based on the results of the updated Utility Plant Study for present and future requirements.

c. Replace approximately 46 hot water and chilled water tertiary pumps for the air handling units.

d. Replace tertiary hot water and chilled water piping associated with the coils, pumps and control valves. The tertiary piping is connected to the mains in the tunnel.

e. Replace all temperature control valves and associated equipment for the hot water and chilled wate coils for all the air handing units.

f. Update supply air and outside air ductwork as required for the air handling units.

g. Replace and add smoke detectors in all return air ductwork as required by Code. Larger AHUs may also require smoke detectors in the supply duct based on code.

B. Plumbing Systems

1. Domestic Water Systems

Based on the results from the computer model and needed fire flow on the site, there are several recommendations to improve flow throughout the site.

a. Additional looping between the Robert A. Collins Arena and the High Tech High School would improve fire flow. While this would improve fire flow conditions, it would still not provide the needed fire flow at the arena or fitness center.

b. Another recommendation is to extend a new 12" main from Newman Springs Road to parallel the existing 10" main and 8" main down to the High Tech High School and over to the arena. This new main would provide the needed fire flow to the arena and the fitness center.

It is recommended that existing valves be exercised, and valves be replaced, or new valves be inserted at locations where valves are not functioning properly. The computer analyses of these improvements are included in the appendix. Extension of a main from Phalanx Road to the High Tech High school would also greatly improve flow to the site by providing another source of water to the site. This would increase flow to the site and also be another supply of water if a break was to occur in the service main coming from Newman Springs Road. This improvement was not evaluated or modeled in the computer analysis because adequate data for the NJAWC main in Phalanx was not available.

2. Natural Gas Systems

No changes are proposed at this time.

C. Electrical System

In general, the existing electrical power distribution system has sufficient capacity for future expansion. In some locations, where distribution panelboards/switchgear lineups are in close vicinity of one another, the switchgears can be combined to provide more space and less equipment to be maintained. This also reduces the number of failure nodes in the electrical system. Proper safety signage, such as arc flash signage, with safe working distance and proper Personal Protective Equipment (PPE) identified, should be installed at all distribution panelboards. The following are additional recommendations for each power distribution location:

a. Power House / Central Plant:

Install a 2400A main circuit breaker on the line side of the 2400A power distribution panelboard.

b. Computer Center:

None.

c. Day Care:

Install a 600A main circuit breaker on the line side of the 600A power distribution panelboard.

d. Lot 4 Lighting:

None.

e. High School:

None.

f. ATEC Building:

None.

g. Gym and Lots 6 & 7 Outdoor Lighting:

Install a 200A main circuit breaker on the line side of the 200A power distribution panelboard.

h. PAC Buildings:

None.

i. Museum:

None.

j. CVA Building:

None.

k. LAH Building:

None.

l. B-Barn:

None.

m. Administration Business Complex:

Install a 200A main circuit breaker on the line side of the 200A power distribution panelboard.

n. Library:

None.

o. MAN/MAC Building:

None.

p. MAE Building:

None.

q. SLC Building:

Remove the elevators' circuits from the switchgear lineup that is currently used only for the elevators, and re-feed the elevators from the switchgear lineup that feeds the remaining SLC building.

r. NAS Building 'B':

None.

s. NAS Building 'A':

None.

t. Central Receiving and Mail:

None.

u. Police/Maintenance Shop/Barn/Print Shop:

` None.

VI. CONCLUSIONS

A. HVAC

1. Chiller Plant

The present chiller plant does not have adequate operating capacity to meet present and future peak cooling loads (demand). This precludes that the outside air dampers are open to meet 2005 outside air requirements.

It is recommended that the campus wide Utility Plant Study be updated to determine the required present and future cooling demands. The updated Utility Plant Study will provide results for properly sizing the new HVAC equipment.

It is recommended to further evaluate the existing chilled water pumping systems to improve the pump operating efficiencies, and the quantities of pumps in operation. This should include testing and evaluating the existing piping systems for repairs and replacement.

Most of the chiller plant equipment is old and needs to be replaced in the near future (2-5 years). Present and future demands may require system and equipment upgrades, including, but not limited to, additional chillers, cooling towers, pumps and associated equipment.

Brookdale should consider upgrades for the building automation system for the new HVAC equipment, systems and future buildings.

2. **Boiler Plant**

The present boiler plant appears to have sufficient heating capacities with the existing boilers and pumps for present conditions. Further evaluations for future demands will be required to verify equipment upgrades.

3. **Building HVAC Systems**

The air handling units and associated equipment including tertiary pumps, control valves, controls, piping systems were also installed in the 1970s and will require replacement in the near future. The updated Utility Plant Study will provide results for properly sizing of the new HVAC equipment.

B. Plumbing Systems

1. **Domestic Water Systems**

Brookdale's water system has adequate capacity for existing domestic water demands, but not for required fire flow demands. Required fire flow demands for existing and new buildings should be confirmed with the architect responsible for the buildings in order to determine what upgrades to the water system are necessary.

2. **Natural Gas Systems**

The site's natural gas mains are in excellent condition. If the College requires additional capacity, this can easily be accommodated by the utility company's gas mains located in Newman Springs Road.

C. Electrical System

The electrical distribution system has adequate spare capacity for future expansion/growth. The electrical distribution equipment needs to be maintained more often, by routine housekeeping, painting of enclosures, vacuuming motor control center (MCC) cubicles, servicing transformer cooling fans, and other maintenance items related to typical electrical power distribution equipment.

The electrical distribution system lacks proper safety signage. Arc Flash hazard signage shall be present at each power distribution panelboard.

In the SLC Building, where more than one switchgear lineup feeds the same location, combine the loads associated with that location into one switchgear lineup, and eliminate the other switchgear lineup.

VII. BUDGET COST ESTIMATES

DISCIPLINE	FEE
HVAC SYSTEMS	
1.	
2.	
3.	
4.	

	DISCIPLINE	FEE
5.		
6.		
7.		
8.		
	Total HVAC	
ELECTRICAL		
1.	Install a 2400A, a 600A, and two 200A main circuit breakers	$50,000
2.	Safety Signage	$8,000
3.	Miscellaneous Repairs & Maintenance	$130,000
4.	Combining SLC Switchgears and Removing one Switchgear	$15,000
	Total Electrical	***$203,000***
PLUMBING		
1.	Upgrade Domestic Water System	
	Exercise and repair existing valves	$2,000 per valve*
	Insert new valves	$3,000 per valve*
	New on-site looping	$40,000.00
	New Parallel Main from Newman Springs Road	170,000.00
	New connection to Phalanx Road	90,000.00
	Subtotal to Upgrade to Water System	$300,000.00 plus
2.	Natural Gas Systems	$0
	Total Plumbing	***$300,000.00 plus****

VIII. ATTACHMENTS

(Supporting documentation – one line diagrams)