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August 20, 2010

Local Government Energy Program
Energy Audit Final Report

City of Elizabeth
Pumping Station
522 Trenton Avenue
Elizabeth, NJ 07202

Project Number: LGEA57

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EXECUTIVE SUMMARY

The City of Elizabeth Trenton Avenue Pumping Station is a single-story building comprising a total conditioned floor area of 3,118 square feet was originally constructed in 1952 and has not gone through any major addition/renovation project. The building houses an office, lunchroom, controls and pump areas. The following chart provides an overview of current energy usage in the building based on the analysis period of February 2009 through January 2010:

Table 1: State of Building—Energy Usage

	Electric Usage, kWh/yr	Gas Usage, therms/yr	Current Annual Cost of Energy, $	Site Energy Use Intensity, kBtu/sq ft yr	Joint Energy Consumption, MMBtu/yr
Current	882,880	1,413	147,096	986.0	3,154
Proposed	812,324	1,413	134,601	908.8	2,913
Savings	70,556	0	12,495	77.2	241
% Savings	8%	0%	8%	8%	8%

There may be energy procurement opportunities for the City of Elizabeth Trenton Avenue Pumping Station to reduce annual utility costs, which are $12,751 higher, when compared to the average estimated NJ commercial utility rates.

SWA has also entered energy information about the pump station in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This pump station is comprised of non-eligible ("Other") space type and as a result of being a "other" space type, a performance score could not be generated. Although a performance score could not be generated, the software was able to generate site energy use intensity. Compared to a typical commercial building that uses 104.0 kBtu/sqft-yr, the pump station used 986.0 kBtu/sqft-yr. The unusually large difference between the site energy usage of the pump station and a typical commercial building is due to the presence of the process and mechanical equipment necessary to operate the facility.

Based on the current state of the building and its energy use, SWA recommends implementing various energy conservation measures from the savings detailed in Table 1. The measures are categorized by payback period in Table 2 below:

Table 2: Energy Conservation Measure Recommendations

ECMs	First Year Savings ($)	Simple Payback Period (years)	Initial Investment, $	CO2 Savings, lbs/yr
0-5 Year	230	2.1	475	2,329
5-10 Year	11,387	6.5	74,520	123,668
>10 year	31	11.8	360	333
Total	11,648	6.5	75,355	126,331

SWA estimates that implementing the recommended ECMs is equivalent to removing approximately 10 cars from the roads each year or avoiding the need of 307 trees to absorb the annual CO_2 generated.

The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for City of Elizabeth. Based on the requirements of the LGEA program, City of Elizabeth must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $469.75.

Financial Incentives and Other Program Opportunities

There are various incentive programs that the City of Elizabeth could apply for that could help lower the cost of installing the ECMs. Please refer to Appendix F for details.

SWA recommends that the City of Elizabeth implement all recommended Energy Conservation Measures at the Trenton Avenue Pumping Station. The building should first move forward with the building light upgrades. Lighting typically gives off an amount of heat that will have an effect on the heating and cooling operations of the building. The building would be eligible for the NJ Office of Clean Energy's SmartStart programs. SWA recommends that the building apply to receive incentives from the SmartStart programs.

INTRODUCTION

Launched in 2008, the Local Government Energy Audit (LGEA) Program provides subsidized energy audits for municipal and local government-owned facilities, including offices, courtrooms, town halls, police and fire stations, sanitation buildings, transportation structures, schools and community centers. The Program will subsidize up to 100% of the cost of the audit. The Board of Public Utilities (BPUs) Office of Clean Energy has assigned TRC Energy Services to administer the Program.

Steven Winter Associates, Inc. (SWA) is a 38-year-old architectural/engineering research and consulting firm, with specialized expertise in green technologies and procedures that improve the safety, performance, and cost effectiveness of buildings. SWA has a long-standing commitment to creating energy-efficient, cost-saving and resource-conserving buildings. As consultants on the built environment, SWA works closely with architects, developers, builders, and local, state, and federal agencies to develop and apply sustainable, 'whole building' strategies in a wide variety of building types: commercial, residential, educational and institutional.

For this project, PMK Group, Inc., a business unit of Birdsall Services Group (BSG-PMK), worked as a sub-contractor in conjunction with Steven Winter Associates, Inc. (SWA).

SWA and PMK Group, Inc. performed an energy audit and assessment for the Trenton Avenue Pumping Station at 522 Trenton Ave, Elizabeth, NJ. The process of the audit included facility visits on 3/17 and 3/18, benchmarking and energy bills analysis, assessment of existing conditions, energy modeling, energy conservation measures and other recommendations for improvements. The scope of work includes providing a summary of current building conditions, current operating costs, potential savings, and investment costs to achieve these savings. The facility description includes energy usage, occupancy profiles and current building systems along with a detailed inventory of building energy systems, recommendations for improvement and recommendations for energy purchasing and procurement strategies.

The goal of this Local Government Energy Audit is to provide sufficient information to the City of Elizabeth to make decisions regarding the implementation of the most appropriate and most cost-effective energy conservation measures for the Trenton Avenue Pumping Station.

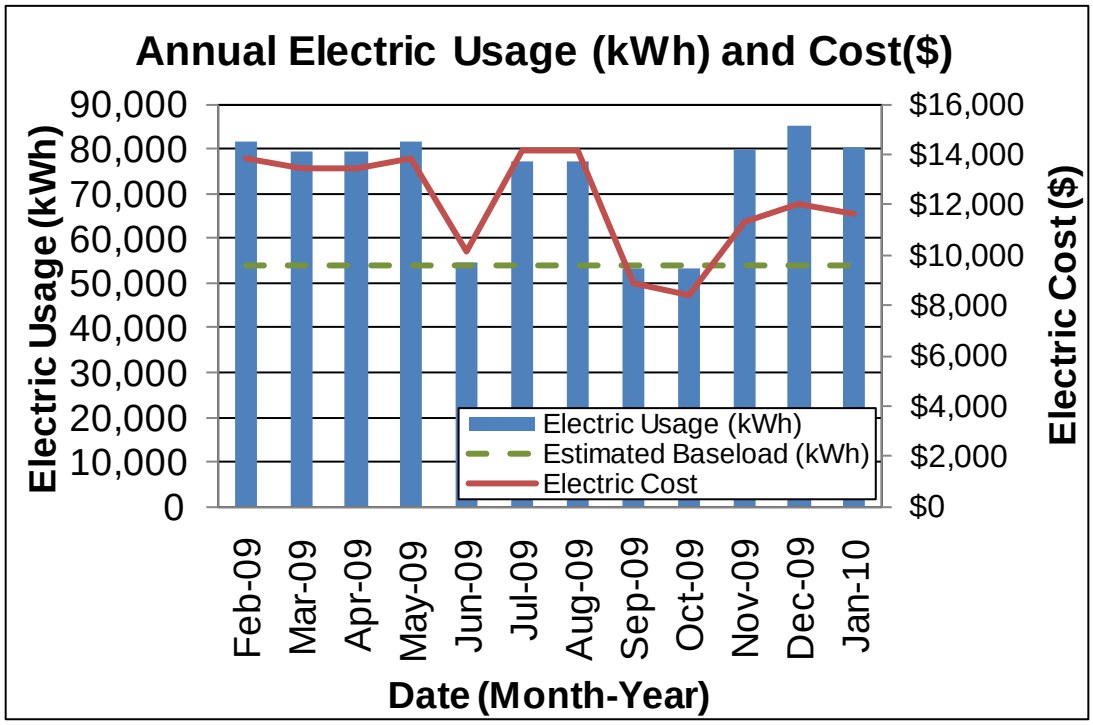
HISTORICAL ENERGY CONSUMPTION

Energy usage, load profile and cost analysis

SWA reviewed utility bills from February 2008 through January 2010 that were received from the utility companies supplying the Trenton Avenue Pumping Station with electric and natural gas. A 12 month period of analysis from February 2009 through January 2010 was used for all calculations and for purposes of benchmarking the building.

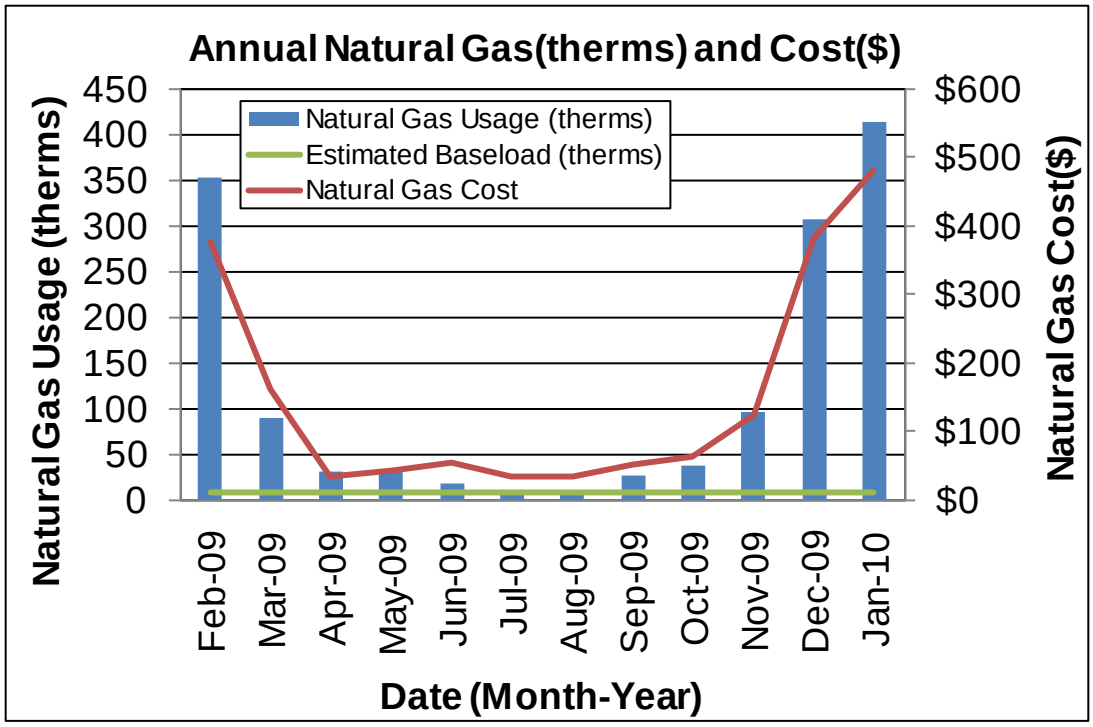
Electricity - The Trenton Avenue Pumping Station is currently served by one electric meter. The Trenton Avenue Pumping Station currently buys electricity from PSE&G at **an average aggregated rate of $0.164/kWh**. The Trenton Avenue Pumping Station purchased **approximately 882,880 kWh, or $145,183 worth of electricity,** in the previous year. The average monthly demand was 218.7 kW and the annual peak demand was 224 kW.

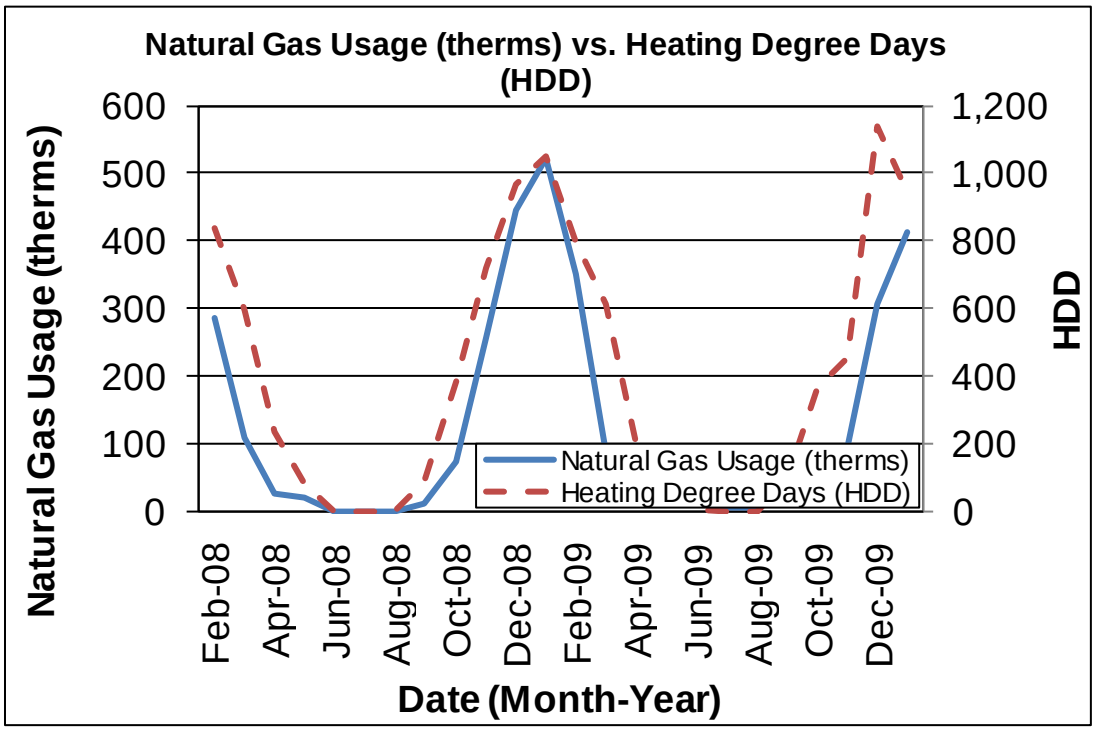
The chart below shows the monthly electric usage and costs. The dashed green line represents the approximate baseload or minimum electric usage required to operate the Trenton Avenue Pumping Station.



Natural gas - The Trenton Avenue Pumping Station is currently served by one meter for natural gas. The Trenton Avenue Pumping Station currently buys natural gas from Elizabethtown Gas at **an average aggregated rate of $1.355/therm**. The Trenton Avenue Pumping Station purchased **approximately 1,413 therms, or $1,913 worth of natural gas,** in the previous year.

The chart below shows the monthly natural gas usage and costs. The green line represents the approximate baseload or minimum natural gas usage required to operate the Trenton Avenue Pumping Station.

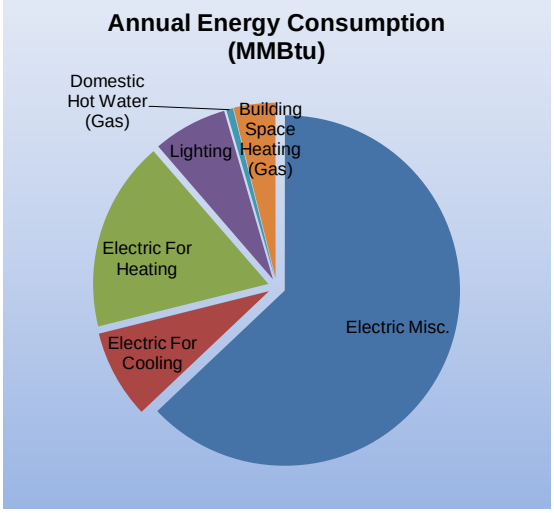


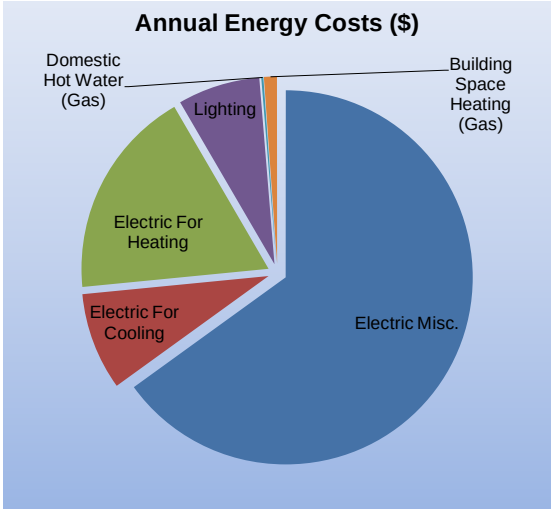


The chart above shows the monthly natural gas usage along with the heating degree days or HDD. Heating degree days is the difference of the average daily temperature and a base temperature, on a particular day. The heating degree days are zero for the days when the average temperature exceeds the base temperature. SWA's analysis used a base temperature of 65 degrees Fahrenheit.

The following graphs, pie charts, and table show energy use for the Trenton Avenue Pumping Station based on utility bills for the 12 month period. Note: electrical cost at $48/MMBtu of energy is almost 4 times as expensive as natural gas at $14/MMBtu

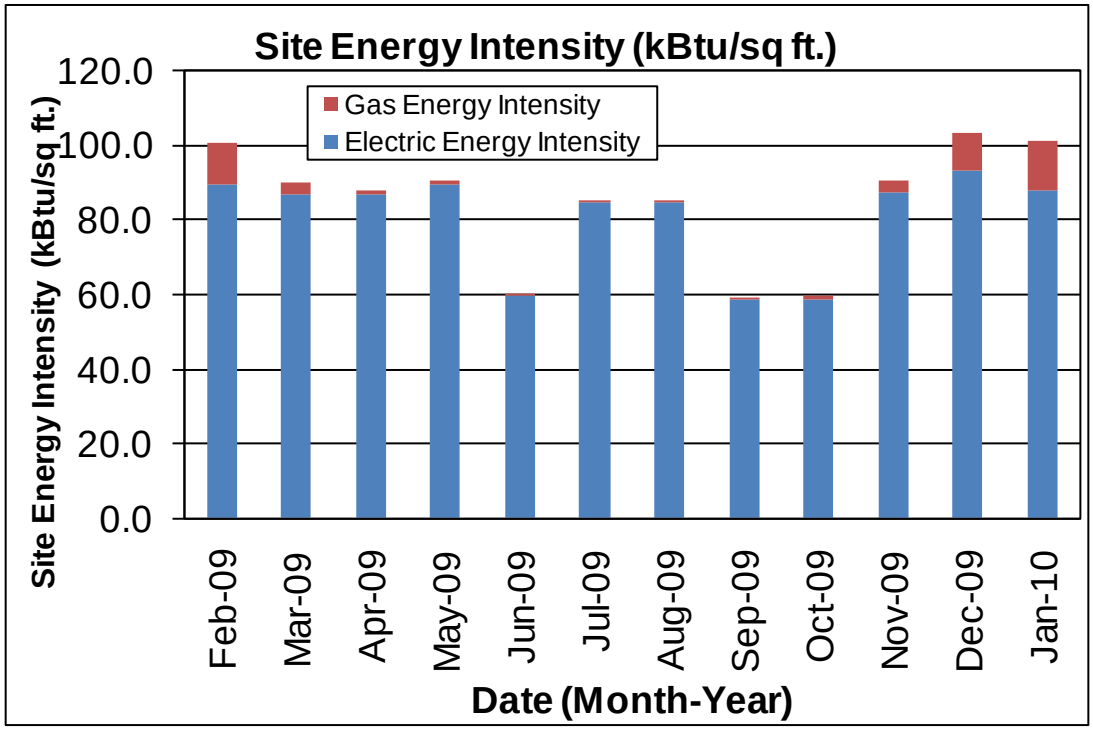
Annual Energy Consumption / Costs					
	MMBtu	% MMBtu	$	% $	$/MMBtu
Electric Miscellaneous	1,985	63%	$95,656	65%	48
Electric For Cooling	257	8%	$12,393	8%	48
Electric For Heating	554	18%	$26,705	18%	48
Lighting	216	7%	$10,429	7%	48
Domestic Hot Water (Gas)	20	1%	$268	0%	14
Building Space Heating	121	4%	$1,645	1%	14
Totals	3,154	100%	$147,096	100%	
Total Electric Usage	3,013	96%	$145,183	99%	48
Total Gas Usage	141	4%	$1,913	1%	14
Totals	3,154	100%	$147,096	100%	





Energy benchmarking

SWA has also entered energy information about the pump station in the U.S. Environmental Protection Agency's (EPA) *ENERGY STAR® Portfolio Manager* energy benchmarking system. This pump station is comprised of non-eligible ("Other") space type and as a result of being a "other" space type, a performance score could not be generated. Although a performance score could not be generated, the software was able to generate site energy use intensity. Compared to a typical commercial building that uses 104.0 kBtu/sqft-yr, the pump station used 986.0 kBtu/sqft-yr. The unusually large difference between the site energy usage of the pump station and a typical commercial building is due to the presence of the process and mechanical equipment necessary to operate the facility.



Per the LGEA program requirements, SWA has assisted the City of Elizabeth to create an *ENERGY STAR® Portfolio Manager* account and share the Trenton Avenue Pumping Station facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager account information with the City of Elizabeth (user name of "CityofElizabeth" with a password of *"CITYOFELIZABETH")* and TRC Energy Services (user name of "TRC-LGEA").

Tariff analysis

As part of the utility bill analysis, SWA evaluated the current utility rates and tariffs. Tariffs are typically assigned to buildings based on size and building type.

Tariff analysis is performed to determine if the rate that a municipality is contracted to pay with each utility provider is the best rate possible resulting in the lowest costs for electric and gas provision. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot water boiler units. Some high gas price per therm fluctuations in the summer may be due to high energy costs that recently occurred and low use caps for the non-heating months. Typically, electricity prices also increase during the cooling months when electricity is used by the air conditioner.

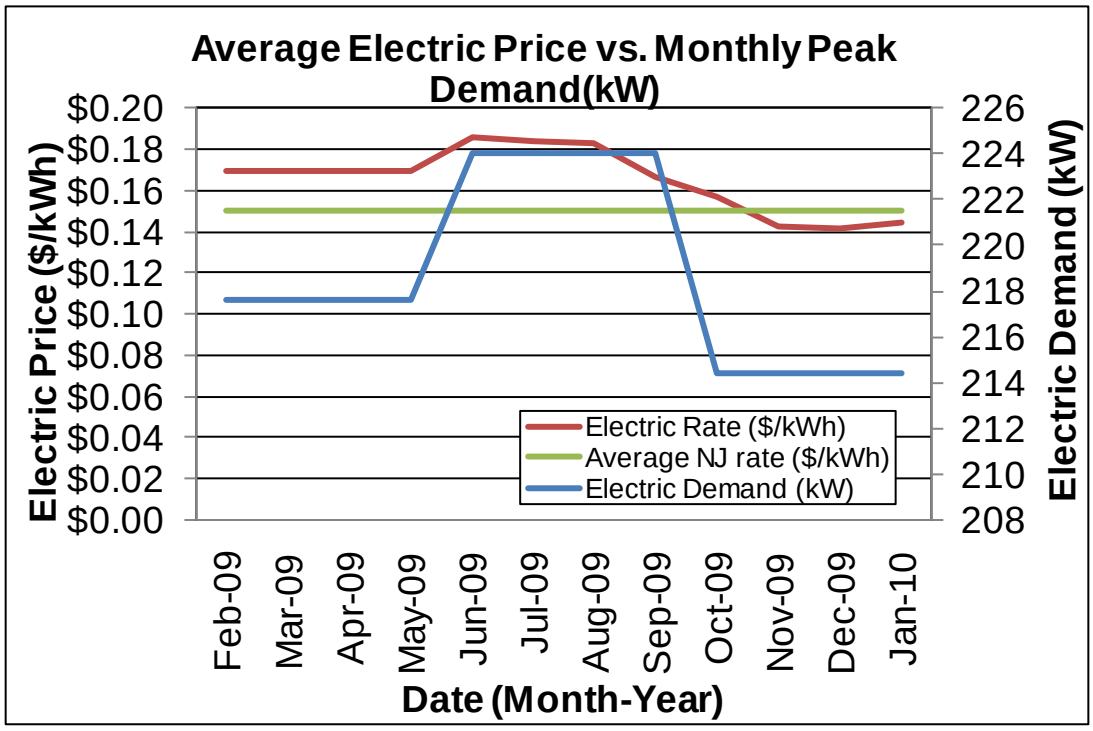
The supplier charges a market-rate price based on use, and the billing does not break down demand costs for all periods because usage and demand are included in the rate. Currently, the City of Elizabeth is paying a general service rate for natural gas. Demand is not broken out in the bill. Thus the building pays for fixed costs such as meter reading charges during the summer months. The building is direct metered and currently purchases electricity at a general service rate for usage with an additional charge for electrical demand factored into each monthly bill. The general service rate for electric charges is market-rate based on usage and demand.

Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year.

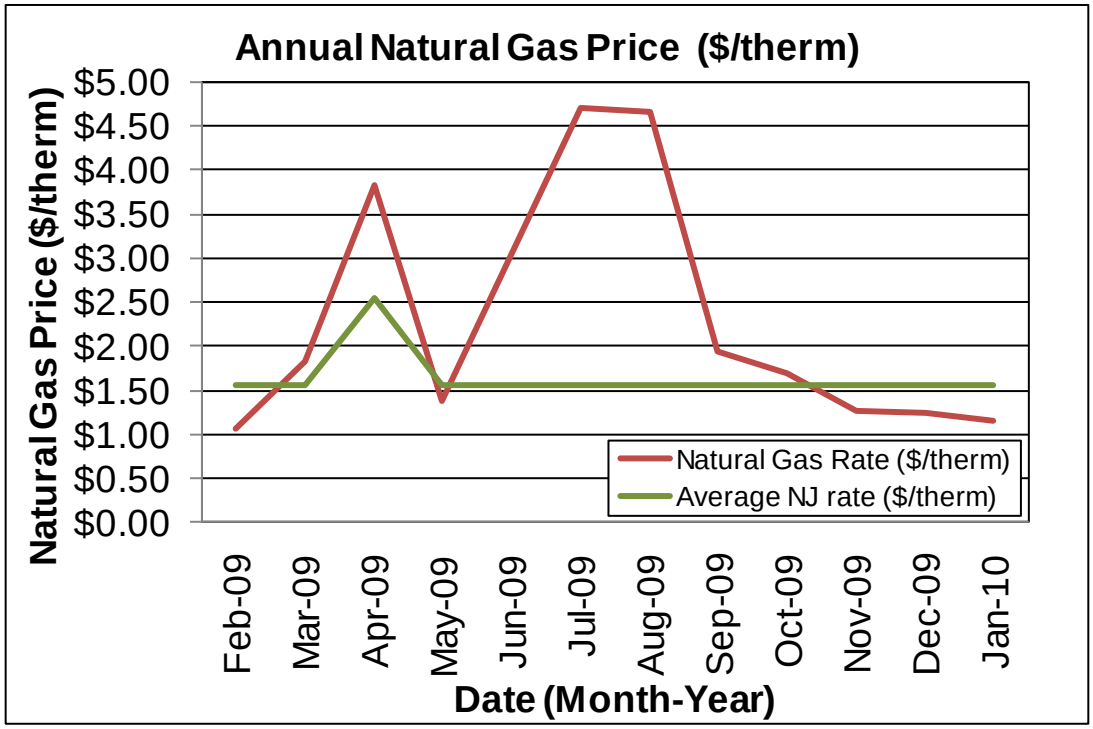
Energy Procurement strategies

Billing analysis is conducted using an average aggregated rate that is estimated based on the total cost divided by the total energy usage per utility per 12 month period. Average aggregated rates do not separate demand charges from usage, and instead provide a metric of inclusive cost per unit of energy. Average aggregated rates are used in order to equitably compare building utility rates to average utility rates throughout the state of New Jersey.

The average estimated NJ commercial utility rates for electric are $0.150/kWh, while the Trenton Avenue Pumping Station pays a rate of $0.164/kWh. The Trenton Avenue Pumping Station annual electric utility costs are $12,750.85 higher, when compared to the average estimated NJ commercial utility rates. Electric bill analysis shows fluctuations up to 24% over the most recent 12 month period.



The average estimated NJ commercial utility rates for gas are $1.550/therm, while the Trenton Avenue Pumping Station pays a below market rate of $1.355/therm. Natural gas bill analysis shows fluctuations up to 77% over the most recent 12 month period.



Utility rate fluctuations may have been caused by adjustments between estimated and actual meter readings; others may be due to unusual high and recent escalating energy costs.

SWA recommends that the Trenton Avenue Pumping Station further explore opportunities of purchasing both natural gas and electricity from third-party suppliers in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Trenton Avenue Pumping Station. Appendix C contains a complete list of third-party energy suppliers for the City of Elizabeth service area.

EXISTING FACILITY AND SYSTEMS DESCRIPTION

This section gives an overview of the current state of the facility and systems. Please refer to the Proposed Further Recommendations section for recommendations for improvement.

Based on visits from SWA on Tuesday, March 16, 2010 and Wednesday, March 17, 2010 the following data was collected and analyzed.

Building Characteristics

The essentially single-story, (with 3 partial below-grade levels), 3,118 square feet Trenton Avenue Pump Station Building was originally constructed in 1952 and has not gone through any major addition/renovation project. The building houses an office, a lunchroom controls and pump areas.

Front Façade

Right Side Façade

Building Occupancy Profiles

Its occupancy is usually one person not more than 1 hour a day, Monday through Friday.

Building Envelope

Due to unfavorable weather conditions (min. 18 deg. F delta-T in/outside and no/low wind), no exterior envelope infrared (IR) images were taken during the field audit.

General Note: All findings and recommendations on the exterior envelope (base, walls, roofs, doors and windows) are based on the energy auditors' experience and expertise, on construction document reviews (if available) and on detailed visual analysis, as far as accessibility and weather conditions allowed at the time of the field audit.

Exterior Walls

The exterior wall envelope is mostly constructed of brick veneer with a lime stone base over concrete block with 1 inch of fiberglass batt cavity insulation. The interior is mostly glazed CMU (Concrete Masonry Unit).

Note: Wall insulation levels *could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.*

Exterior and interior wall surfaces were inspected during the field audit. They were found to be in overall poor condition with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues detected on all facades.

The following specific exterior wall problem spots and areas were identified:


Un-caulked/un-sealed exterior wall penetrations and damaged window sills

Roof

The building's roof is predominantly a flat and parapet type over steel decking, with a built-up asphalt finish and reflective coating. It is original and has never been replaced. Zero inches of acoustic tile applied fiberglass batt ceiling insulation, and one inch of foam board roof insulation were recorded. This roof is original and has never been replaced.

Note: Roof insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

Roofs, related flashing, gutters and downspouts were inspected during the field audit. They were reported to be in overall poor condition, with some signs of uncontrolled moisture, air-leakage and other energy-compromising issues.

The following specific roof problem spots were identified:


Signs of standing water/pooling, standing water 4 inches high, and signs of water damage on interior finishes.

Base

The building's base is composed of a slab-on and below-grade floor with a perimeter foundation and no detectable slab edge/perimeter insulation.

Slab/perimeter insulation levels could not be verified in the field or on construction plans, and are based upon similar wall types and time of construction.

The building's base and its perimeter were inspected for signs of uncontrolled moisture or water presence and other energy-compromising issues. Overall the base was reported to be in acceptable condition with no signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

Windows

The building contains basically one type of window:

1. Double-hung type windows with an aluminum clad frame, clear single glazing and no interior or exterior shading devices. The windows are original and have never been replaced

2. Single-hung type windows with a vinyl frame clear double glazing and no interior or exterior shading devices. The windows are located in the rake area and have been replaced three years age

Windows, shading devices, sills, related flashing and caulking were inspected as far as accessibility allowed for signs of moisture, air-leakage and other energy compromising issues. Overall, the windows were found to be in poor condition.

The following specific window problem spots were identified:

Air-leakage at sleeved window/wall air-conditioning units in outdated single glazed windows units

Exterior doors

The building contains basically only one type of exterior door:

1. Glass with aluminum/steel frame type exterior doors. They and are original and have never been replaced.

All exterior doors, thresholds, related flashing, caulking and weather-stripping were inspected for signs of moisture, air-leakage and other energy-compromising issues. Overall, the doors were found to be in acceptable condition with only a few signs of uncontrolled moisture, air-leakage and/ or other energy-compromising issues.

The following specific door problem spots were identified:

Missing/worn weather-stripping

Building air-tightness

Overall the field auditors found the building to be reasonably air-tight with only a few areas of suggested improvements, as described in more detail earlier in this chapter.

The air tightness of buildings helps maximize all other implemented energy measures and investments, and minimizes potentially costly long-term maintenance, repair and replacement expenses.

Mechanical Systems

Heating

Heating in the pump room is supplied by a 250 MBH, 80% efficient Reznor gas-fired unit heater, installed in 1996. The main office, break room, and restroom are each heated by 30 MBH Comfort Glow natural gas space heaters, installed in 1996.

Reznor Gas Fired Boiler

Cooling

The Main Office and Break Room are the only areas of the facility that are cooled. The office has a 9,800 Btu Comfort-Aire window air-conditioner, with an Energy Efficiency Ratio (EER) rating of 9.8 from 1999. The Break Room has a 14,500 Btu Maytag window air-conditioner, with an Energy Efficiency Ratio (EER) rating of 10.7 from approx. 2003


Through The Wall Air Conditioner

Ventilation

The motor/switchgear area and the screening room each receive ventilation from one of two (2) Penn Ventilator exhaust fans.

Domestic Hot Water

The domestic water heater is a gas fired storage water heater.

Electrical systems

Lighting

A complete inventory of all interior, exterior, and exit sign light fixtures were examined and documented in Appendix B of this report including an estimated total lighting power consumption. The facility consists primarily of 175W compact fluorescent fixtures. There are also several T12 florescent fixtures with magnetic ballasts and incandescent lamps as in use.

Appliances and process

SWA has conducted a general survey of larger, installed equipment. Appliances and other miscellaneous equipment account for a significant portion of electrical usage within the building. Typically, appliances are referred to as “plug-load” equipment, since they are not inherent to the building’s systems, but rather plug into an electrical outlet. Equipment such as process motors, computers, computer servers, radio and dispatch equipment, refrigerators, vending machines, printers, etc. all create an electrical load on the building that is hard to separate out from the rest of the building’s energy usage based on utility analysis. When compared to the average electrical consumption of older equipment, Energy Star equipment results in a large savings. Building management should select Energy Star label appliances and equipment when replacing: refrigerators, printers, computers, copy machines, etc.

More information can be found in the “Products” section of the Energy Star website at: http://www.energystar.gov. The building is currently equipped with energy vending miser devices for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

Appliances:

In the break room, there is a Hot Point refrigerator and a Sharp microwave. Both units should be replaced with new Energy Star rated appliances.

Air Compressor:

A 35 PSI Speedaire air compressor is located in the basement. The system was found to in good condition, functioning, and maintaining pressure.

Pumps:

Five (5) pumps are in the pump room, which serve the city’s sanitary pumping system. All pumps are 480V and 3 phases. Pumps 1, 2 and 5 were installed in 1955 and Pumps 3 and 4 were installed in 1986. Pump #1 is a 75 HP, 700 RPM, constant-speed GE pump. Pump #2 and Pump #5, also GE pumps, are rated at 100 HP and 580 RPM, and are the only two of the five pumps that are equipped with variable frequency drives (VFDs). Pump #3 and Pump #4 are Continental Electro-Power pumps, rated at 100 HP and 585 RPM they are operated via Flow Master Control logic.

Storm Water Pump Motors

Elevators

The Trenton Avenue Pumping Station does not have an installed elevator.

RENEWABLE AND DISTRIBUTED ENERGY MEASURES

Renewable energy is defined as any power source generated from sources which are naturally replenished, such as sunlight, wind and geothermal. Technology for renewable energy is improving, and the cost of installation is decreasing, due to both demand and the availability of state and federal government-sponsored funding. Renewable energy reduces the need for using either electricity or fossil fuel, therefore lowering costs by reducing the amount of energy purchased from the utility company. Technology such as photovoltaic panels or wind turbines, use natural resources to generate electricity on the site. Geothermal systems offset the thermal loads in a building by using water stored in the ground as either a heat sink or heat source. Solar thermal collectors heat a specified volume of water, reducing the amount of energy required to heat water using building equipment. Cogeneration or CHP allows you to generate electricity locally, while also taking advantage of heat wasted during the generation process.

Existing systems

Currently there are no renewable energy systems installed in the building.

Evaluated Systems

Solar Photovoltaic

Photovoltaic panels convert light energy received from the sun into a usable form of electricity. Panels can be connected into arrays and mounted directly onto building roofs, as well as installed onto built canopies over areas such as parking lots, building roofs or other open areas. Electricity generated from photovoltaic panels is generally sold back to the utility company through a net meter. Net-metering allows the utility to record the amount of electricity generated in order to pay credits to the consumer that can offset usage and demand costs on the electric bill. In addition to generation credits, there are incentives available called Solar Renewable Energy Credits (SRECs) that are subsidized by the state government. Specifically, the New Jersey State government pays a market-rate SREC to facilities that generate electricity in an effort to meet state-wide renewable energy requirements.

Based on utility analysis and a study of roof conditions, the Trenton Ave. Pump Station is not a good candidate for a Solar Panel installation. As a result of our study, the roof and grounds of the Trenton Ave. Pump Station building have been identified as inappropriate for the application of a Photovoltaic (PV) system. There is not enough unobstructed southern exposure on the roof or the grounds at the property. Also, the area on the roof that has unobstructed exposure is too close to the edge of the building for a PV installation.

Solar Thermal Collectors

Solar thermal collectors are not recommended due to the low amount of domestic hot water use throughout the building.

Wind

Wind power production is not appropriate for this location because required land is not available for the wind turbine. Also, the available wind energy resource is very low.

Geothermal

Geothermal is not applicable to this project because it would require modifications to the existing heat distribution system, which would not be cost effective.

Combined Heat and Power

Combined Heat Power is not applicable to this project because of the HVAC system type and limited domestic hot water usage.

PROPOSED ENERGY CONSERVATION MEASURES

Energy Conservation Measures (ECMs) are recommendations determined for the building based on improvements over current building conditions. ECMs have been determined for the building based on installed cost, as well as energy and cost-savings opportunities.

Recommendations: Energy Conservation Measures

ECM#	Description of Highly Recommended 0-5 Year Payback ECMs
1	Lighting Upgrades
	Description of Recommended 5-10 Year Payback ECMs
2	Replace Pumps #2 and #5 with premium efficiency pumps
	Description of Recommended >10 Year Payback ECMs
3	Replace window air conditioner
4	Install 2 occupancy sensors

ECM#1: *Lighting Upgrades*

On the days of the site visits, SWA/BSG-PMK completed a lighting inventory of the City of Elizabeth Trenton Ave. Pump Station (see Appendix B). The existing lighting consists of mostly T12 fluorescent fixtures with magnetic ballasts. SWA/BSG-PMK recommends retrofitting the T12 fixtures with T8 lamps and electronic ballasts. SWA/BSG-PMK also recommends replacing one exterior Probe Start Metal Halide fixture with Pulse Start Metal Halide technology. There are also several incandescent fixtures. The labor in all these installations was evaluated using prevailing electrical contractor wages. The City of Elizabeth may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings.

Installation cost:

Estimated installed cost: $475 (estimated $183 labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	475	1,301	0.3	0	1.4	17	230	15	3,455	2.1	627%	42%	48%	2,236	2,329

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The replacements for each lighting fixture, the costs to replace or retrofit each one, and the rebates and wattages for each fixture are located in Appendix B.

Rebates/financial incentives:

- *NJ Clean Energy – T8 fluorescent fixture ($15 per fixture)*
- *NJ Clean Energy – Metal Halide with Pulse Start ($25 per fixture)*

Please see Appendix F for more information on Incentive Programs.

ECM#2: *Replace Pumps #2 and #5 with premium efficiency pumps*

On the days of the site visits, SWA/BSG-PMK completed a mechanical inventory of the City of Elizabeth Trenton Ave. Pump Station (see Appendix A). The Trenton Ave. Pump Station has five (5) pumps serving the city's storm-water system. Due to advancements in motor efficiency, SWA/BSG-PMK recommends the replacement of the pump motors for Pumps #2 and #5. The motors for Pumps #2 and #5 are 100 HP, 480V, 3 PH, 580 RPM, manufactured by GE and were installed in 1955. The motor nameplates did not indicate the existing motors' efficiencies. The existing motors' efficiencies were assumed to be 92% based on industry standards. Efficiencies were adjusted to compensate for re-winding and are estimated to be 85%. Premium efficient motors are available having efficiencies of 94.1% or more.

Installation cost:

Estimated installed cost: $74,120 (estimated $10,500 labor)
Source of cost estimate: Contractor

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
2	74,120	68,802	17.2	0	75.3	60	11,344	20	226,871	6.5	206%	10%	13%	59,360	123,190

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. Existing efficiency was estimated to be 85%. A new efficient pump motor was assumed to be 94.1%. The horsepower ratings of the two motors were converted to kW by multiplying by a factor of 0.746. Between April, 2009 and April, 2010, the total hours of operation for the pumps were 3,702 hours for Pump #2 and 5,835 hours for Pump #5. These pumps were assumed to have a diversity factor of 1.0. The savings for each pump were calculated using the following equations:

$$\text{Electric consumption(kWh)} = \frac{\text{HP} \times 0.746\frac{\text{kW}}{\text{HP}} \times \text{Diversity Factor} \times \frac{\text{Hours}}{\text{Year}}}{\text{Efficiency}}$$

Rebates/financial incentives:

- *NJ Clean Energy – Premium Motor Incentive ($360 per 100HP motor)*

Please see Appendix F for more information on Incentive Programs.

ECM#3: *Replace window air conditioner*

On the days of the site visits, SWA/BSG-PMK completed a mechanical inventory of the City of Elizabeth Trenton Ave. Pump Station (see Appendix A). The main office in the building is cooled by a 9,800 BTU window air conditioner. This unit has surpassed its useful lifetime and should be replaced, as more energy efficient models are now available. Current window units have Energy Efficiency Ratios (EERs) of 10.8; the EER of the existing unit was 9.8 at the time of its purchase, but based on its age and condition, it can be estimated that the EER has decreased by 10%, to 8.8.

Installation cost:

Estimated installed cost: $400 (estimated $30 labor)
Source of cost estimate: Vendor

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
3	400	267	0.1	0	0.3	0	44	10	438	9.1	9%	1%	2%	-30	478

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. EER values, as stated above, are 8.8 for the current units and 10.8 for the proposed ones. 1,024 cooling degree-days and a 0.4% dry-bulb temperature of 93°F were used for calculations; this data was provided by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE). The desired indoor temperature during the cooling season was assumed to be 74°F.

The following equation, the degree-day equation for cooling systems, was used to calculate the electric consumptions of the current and proposed air-conditioners:

$$\frac{\text{Capacity}\times\text{Degree-Days}\times 24\ \frac{\text{hours}}{\text{day}}}{1{,}000\times\text{SEER}\times\left(\text{Temp.}_{0.4\%}-\text{Temp.}_{\text{indoor}}\right)}=\text{Electric Consumption (in kWh)}$$

Rebates/financial incentives:

- *None*

Please see Appendix F for more information on Incentive Programs.

ECM#4: *Install 2 occupancy sensors*

On the days of the site visits, SWA/BSG-PMK completed a lighting inventory of the City of Elizabeth Trenton Ave. Pump Station (see Appendix B). The existing lighting consists of mostly T12 fluorescent fixtures with magnetic ballasts that are controlled by manual switches in each room. SWA/BSG-PMK recommends that occupancy sensors are installed in the office area as well as the break room. These areas are used sporadically throughout the day and could benefit from having an occupancy sensor that was capable of turning off the lights when no motion is detected for a set period of time.

Installation cost:

Estimated installed cost: $360 (estimated $60 labor)
Source of cost estimate: RS *Means; Published and established costs, NJ Clean Energy Program*

ECM	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
4	360	186	0.1	0	0.2	0	31	10	305	11.8	-15%	-2%	-3%	-102	333

Assumptions: SWA calculated the savings for this measure using measurements taken the days of the field visits and using the billing analysis. The replacements for each lighting fixture, the costs to replace or retrofit each one, and the rebates and wattages for each fixture are located in Appendix B.

Rebates/financial incentives:

- *NJ Clean Energy – Wall-mounted occupancy sensor ($20 per sensor)*

Please see Appendix F for more information on Incentive Programs.

PROPOSED FURTHER RECOMMENDATIONS

Capital Improvements

Capital Improvements are recommendations for the building that may not be cost-effective at the current time, but that could yield a significant long-term payback. These recommendations should typically be considered as part of a long-term capital improvement plan. Capital improvements should be considered if additional funds are made available, or if the installed costs can be shared with other improvements, such as major building renovations. SWA recommends the following capital improvements for the Trenton Avenue Pumping Station:

- Replace the three Comfort Glow space heaters, as they have surpassed their useful lives. Replacement units will have same efficiency and this would not be considered an Energy Conservation Measure.

- Replace the exhaust fans on an as-fail basis.

Operations and Maintenance

Operations and Maintenance measures consist of low/no cost measures that are within the capability of the current building staff to handle. These measures typically require little investment, and they yield a short payback period. These measures may address equipment settings or staff operations that, when addressed will reduce energy consumption or costs.

- Maintain roofs - SWA recommends regular maintenance to verify water is draining correctly. Coordinate location of roof leaks with instances of ceiling tile damage.

- Maintain downspouts and cap flashing - Repair/install missing downspouts and cap flashing as needed to prevent water/moisture infiltration and insulation damage.

- Provide weather-stripping/air-sealing - SWA observed that exterior door weather-stripping was beginning to deteriorate in places. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. The perimeter of all window frames should also be regularly inspected, and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.

- Provide water-efficient fixtures and controls - Adding controlled on/off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and/or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures/appliances will reduce energy consumption for water heating, while also decreasing water/sewer bills.

- SWA recommends that the building considers purchasing the most energy-efficient equipment, including ENERGY STAR® labeled appliances, when equipment is installed or replaced. More information can be found in the “Products” section of the ENERGY STAR® website at: http://www.energystar.gov.

- Use smart power electric strips - in conjunction with occupancy sensors to power down computer equipment when left unattended for extended periods of time.

Note: The recommended ECMs and the list above are cost-effective energy efficiency measures and building upgrades that will reduce operating expenses for the City of Elizabeth. Based on the requirements of the LGEA program, the City of Elizabeth must commit to implementing some of these measures, and must submit paperwork to the Local Government Energy Audit program within one year of this report's approval to demonstrate that they have spent, net of other NJCEP incentives, at least 25% of the cost of the audit (per building). The minimum amount to be spent, net of other NJCEP incentives, is $469.75.

APPENDIX A: EQUIPMENT LIST

Trenton Avenue Pump Station							
Building System	Description	Locations	Model #	Fuel	Space Served	Year Installed	Estimated. Remaining Useful Life %
Heating	Unit heater, 250 MBH, 80% efficient	Pump room	Reznor, M# F250-E, S# AZJ66Q3N85218X	Natural gas	Pump room	2006	33%
Heating	Space heater, 30 MBH	Main office	Comfort Glow, M# CGN30TB, S# 7973857	Natural gas	Main office	1999	0%
Heating	Space heater, 30 MBH	Boiler room	Comfort Glow, M# CGN30TB	Natural gas	Break room	1999	0%
Heating	Space heater, 30 MBH	Boiler room	Comfort Glow, M# CGN30TB	Electricity	Bathroom	1999	0%
Cooling	Window air-conditioner, 9,800 BTUH, 9.8 EER	Main office	Comfort-Aire, M# RAD-101A, S# EEV 99404	Electricity	Main office	1999	0%
Ventilation	Exhaust fan	Roof	Penn Ventilator, M# FMX-30 B	Electricity	Motor / Swithgear area	Not found	15%
Ventilation	Exhaust fan	Roof	Penn Ventilator, M# FMX-36 B	Electricity	Screening Room	Not found	0%
Process Equipment	Air compressor, 35 PSI	Basement	Speedaire, M# WW6600-2, S# D006590	Electricity	Process	1990	20%
Pumping	Pump #1: Constant speed, 75 HP, 700 RPM, 3 phase	Pump room	GE, M# 5K6323XC15A, S# XMJ1004012	Electricity	Storm water	1955	0%
Pumping	Pump #2:Variable speed, 100 HP, 580 RPM, 3 phase Allen Bradley VFD	Pump room	GE, M# 5K6333XC4A, S# XMJ1011023	Electricity	Storm water	1955	0%
Pumping	Pump #3: Flow Master Controled, 100 HP, 585 RPM, 3 phase	Pump room	Continental Electro-Power, M# SNV586P, S# H86021	Electricity	Storm water	1986	0%

Pumping	Pump #4: Flow Master Controled, 100 HP, 585 RPM, 3 phase	Pump room	Continental Electro-Power, M# SNV586P, S# H86022	Electricity	Storm water	1986	0%
Pumping	Pump #5: Variable speed, 100 HP, 580 RPM, 3 phase with Allen Bradley VFD	Pump room	GE, M# 5K6333XC4A, S# XMJ1011022	Electricity	Storm water	1955	0%
Appliances	Refrigerator	Break room	Hot Point, M# CTX14CYXKRWH, S# MR780827	Electricity	Break room	1984	50%
Appliances	Microwave	Break room	Sharp, M# R-420AW, S# 167886	Electricity	Break room	1998	50%

Note: The remaining useful life of a system (in %) is the relationship between the system manufactured and/or installed date and the standard life expectancy of similar equipment based on ASHRAE (2003), ASHRAE Handbook: HVAC Applications, Chapter 36.

LIGHTING ANALYSIS

Township of Elizabeth
Trenton Ave. Pump Station
522 Trenton Ave

BIRDSALL SERVICES GROUP
ENGINEERS & CONSULTANTS

Upgrade Code	Upgrade Description	Existing Fixture	Existing Watts	Proposed Fixture	Proposed Watts	Lighting: Total # of Upgrades	Lighting: Cost per Upgrade ($)	Lighting: SmartStart Rebate per Upgrade
1	175W Compact Fluorescent Screw-in Lamps	175W CF	175	175W CF	176	28	$0.00	$0.00
2	Retrofit the 4' Hanging Fixture by replacing the T12 Lamps and Magnetic Ballast(s) with T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	2	$80.00	$15.00
3	Replace 100W Incandescnet Lamp with a 26W Compact Fluorescent	100W Incandescent	100	26W CF/SI	28	2	$10.00	$0.00
4	Retrofit the 4' Surface Mounted Open Channel Fixture by replacing the T12 Lamps and Magnetic Ballast with T8 Lamps and an Electronic Ballast	2L8' EE/STD	138	2L8' T8/ELEC	118	2	$80.00	$15.00
5	Retrofit the 2x2 Recessed Fixture by replacing the T12 U-Tube Lamps and Magnetic Ballastwith T8 Lamps and an Electronic Ballast	2L22" STD/STD	94	2L22"	82	1	$80.00	$15.00
6	Retrofit the 4' Surface Mounted Wrap Around Fixture by replacing the T12 Lamps and Magnetic Ballast with T8 Lamps and an Electronic Ballast	2L4' EE/STD	80	2L4' T8/ELEC	61	2	$80.00	$15.00
7	Replace the 40W Lamps in theWall Mounted Vanity Fixture with a Globe Shape Compact Fluorescents	40W Incandescent	40	15W CF/SI	15	1	$10.00	$0.00
8	150W Metal Halide Exterior Fixture	150W MH/BALLAST	195	No Upgrade	195	7	$0.00	$0.00
9	Retrofit the Exit Sign by replacing the incandescent Lamp(s) with LED Technology	15W EXIT	15	LED	2	3	$40.00	$10.00
10						0	$0.00	$0.00
11						0	$0.00	$0.00
12						0	$0.00	$0.00

Summary

	Lighting (Only)	Sensors (Only)	Complete Lighting Upgrade
Cost	$610.00	$400.00	$1,010.00
Rebate	$195.00	$40.00	$175.00
Net Cost	$475.00	$360.00	$835.00
Savings (kWh)	1,301	186	1,437
Savings ($)	$208.17	$29.74	$229.84
Payback	2.3	12.1	3.6

Variables:

$0.16	Avg. Electric Rate ($/kWh)
	Avg. Demand Rate ($/kW)
2080	Operating Hours/Year
8	Operating Hours/Work Day

Assumptions:

25%	Occupancy Sensor Savings (Avg)
40%	Occupancy Sensor Savings(>Avg)

Notes:

Seq. #	Upgrade Code	Room/Area	Hrs/ Work Day	Hrs/ Year	Existing: Fixture	Existing: Qty.	Existing: Watts	Existing: Foot Candles	Proposed: Fixture	Proposed: Qty.	Proposed: Watts	kW Reduction	Lighting: Energy Savings, kWh	Lighting: Cost ($)	Lighting: Savings ($)	Lighting: Payback (yrs)	Controls: Type	Controls: Qty.	Occupancy Sensors (ONLY): Energy Savings, kWh	Occupancy Sensors (ONLY): Cost ($)	Occupancy Sensors (ONLY): Savings ($)	Occupancy Sensors (ONLY): Payback (yrs)	SmartStart Rebate: Lighting	SmartStart Rebate: Sensors	Lighting & Occupancy Sensors: Energy Savings, kWh	Lighting & Occupancy Sensors: Post-Rebate Cost ($)	Lighting & Occupancy Sensors: Savings ($)	Lighting & Occupancy Sensors: Payback (yrs)
		Totals:					7240				6884	0.356	1301	$610.00	$208.17	2.9			186	$400.00	$29.74	13.4	$135.00	$40.00	1437	$835.00	$229.84	3.6
1	1	Main Motor & Control Room	12	3120	175W CF	9	1575		175W CF	9	1575	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
2	2		12	3120	2L4' EE/STD	2	160		2L4' T8/ELEC	2	122	0.038	119	$120.00	$18.97	6.3			0	$0.00	$0.00		$30.00	$0.00	119	$90.00	$18.97	4.7
3	3		12	3120	100W Incandesce	2	200		26W CF/SI	2	56	0.144	449	$20.00	$71.88	0.3			0	$0.00	$0.00		$0.00	$0.00	449	$20.00	$71.88	0.3
4	4		12	3120	2L8' EE/STD	2	276		2L8' T8/ELEC	2	236	0.04	125	$160.00	$19.97	8.0			0	$0.00	$0.00		$30.00	$0.00	125	$130.00	$19.97	6.5
5	5	Office	10	2600	2L22" STD/STD	1	94		2L22"	1	82	0.032	83	$80.00	$13.31	4.5	OSW	1	61	$200.00	$9.78	20.5	$15.00	$20.00	124	$225.00	$19.78	11.4
6	6	Break Room	12	3120	2L4' EE/STD	2	160		2L4' T8/ELEC	2	122	0.038	119	$120.00	$18.97	6.3	OSW	1	125	$200.00	$19.97	10.0	$30.00	$20.00	214	$270.00	$34.20	7.9
7	1	Restroom	10	2600	175W CF	1	175		175W CF	1	175	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
8	7	Restroom	10	2600	40W Incandescen	1	40		15W CF/SI	1	15	0.025	65	$10.00	$10.40	1.0			0	$0.00	$0.00		$0.00	$0.00	65	$10.00	$10.40	1.0
9	1	Sub Level 1	8	2080	175W CF	7	1225		175W CF	7	1225	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
10	1	Sub Level 2	8	2080	175W CF	7	1225		175W CF	7	1225	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
11	1	Stairway	8	2080	175W CF	4	700		175W CF	4	700	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
12	8	Rear Screen Room	1	260	150W MH/BALLA	6	1170		No Upgrade	6	1170	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
13	8	Lower Level	1	260	150W MH/BALLA	1	195		No Upgrade	1	195	0	0	$0.00	$0.00				0	$0.00	$0.00		$0.00	$0.00	0	$0.00	$0.00	
14	9	Exit	24	8760	15W EXIT	3	45		LED	3	6	0.039	342	$120.00	$54.66	2.2			0	$0.00	$0.00		$30.00	$0.00	342	$90.00	$54.66	1.6

APPENDIX C: THIRD PARTY ENERGY SUPPLIERS

http://www.state.nj.us/bpu/commercial/shopping.html

Third Party Electric Suppliers for PSEG Service Territory	Telephone & Web Site
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
American Powernet Management, LP 437 North Grove St. Berlin, NJ 08009	(877) 977-2636 www.americanpowernet.com
BOC Energy Services, Inc. 575 Mountain Avenue Murray Hill, NJ 07974	(800) 247-2644 www.boc.com
Commerce Energy, Inc. 4400 Route 9 South, Suite 100 Freehold, NJ 07728	(800) 556-8457 www.commerceenergy.com
ConEdison Solutions 535 State Highway 38 Cherry Hill, NJ 08002	(888) 665-0955 www.conedsolutions.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446	(888) 635-0827 www.newenergy.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450	(212) 538-3124 www.creditsuisse.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
FirstEnergy Solutions 300 Madison Avenue Morristown, NJ 07926	(800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Metro Energy Group, LLC 14 Washington Place Hackensack, NJ 07601	(888) 536-3876 www.metroenergy.com
Integrys Energy Services, Inc. 99 Wood Ave, South, Suite 802 Iselin, NJ 08830	(877) 763-9977 www.integrysenergy.com
Liberty Power Delaware, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(866) 769-3799 www.libertypowercorp.com
Liberty Power Holdings, LLC Park 80 West Plaza II, Suite 200 Saddle Brook, NJ 07663	(800) 363-7499 www.libertypowercorp.com

Pepco Energy Services, Inc. 112 Main St. Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions 581 Main Street, 8th Floor Woodbridge, NJ 07095	(877) 273-6772 www.semprasolutions.com
South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Strategic Energy, LLC 55 Madison Avenue, Suite 400 Morristown, NJ 07960	(888) 925-9115 www.sel.com
Suez Energy Resources NA, Inc. 333 Thornall Street, 6th Floor Edison, NJ 08837	(888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com

Third Party Gas Suppliers for Elizabethtown Gas Co. Service Territory	Telephone & Web Site
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109	(800) 628-9427 www.cooperativenet.com
Direct Energy Services, LLC 120 Wood Avenue, Suite 611 Iselin, NJ 08830	(866) 547-2722 www.directenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701	(800) 805-8586 www.gesc.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057	(856) 273-9995 www.ugienergyservices.com
Great Eastern Energy 116 Village Riva, Suite 200 Princeton, NJ 08540	(888) 651-4121 www.greateastern.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640	(877) 569-2841 www.glacialenergy.com
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095	(800) 437-7872 www.hess.com
Intelligent Energy 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024	(800) 724-1880 www.intelligentenergy.org
Metromedia Energy, Inc. 6 Industrial Way Eatontown, NJ 07724	(877) 750-7046 www.metromediaenergy.com
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 08837	(800) 375-1277 www.mxenergy.com
NATGASCO (Mitchell Supreme) 532 Freeman Street Orange, NJ 07050	(800) 840-4427 www.natgasco.com
Pepco Energy Services, Inc. 112 Main Street Lebanon, NJ 08833	(800) 363-7499 www.pepco-services.com
PPL EnergyPlus, LLC 811 Church Road Cherry Hill, NJ 08002	(800) 281-2000 www.pplenergyplus.com

South Jersey Energy Company One South Jersey Plaza, Route 54 Folsom, NJ 08037	(800) 756-3749 www.southjerseyenergy.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928	(800) 225-1560 www.spragueenergy.com
Woodruff Energy 73 Water Street Bridgeton, NJ 08302	(800) 557-1121 www.woodruffenergy.com

APPENDIX D: GLOSSARY AND METHOD OF CALCULATIONS

Net ECM Cost: The net ECM cost is the cost experienced by the customer, which is typically the total cost (materials + labor) of installing the measure minus any available incentives. Both the total cost and the incentive amounts are expressed in the summary for each ECM.

Annual Energy Cost Savings (AECS): This value is determined by the audit firm based on the calculated energy savings (kWh or Therm) of each ECM and the calculated energy costs of the building.

Lifetime Energy Cost Savings (LECS): This measure estimates the energy cost savings over the lifetime of the ECM. It can be a simple estimation based on fixed energy costs. If desired, this value can factor in an annual increase in energy costs as long as the source is provided.

Simple Payback: This is a simple measure that displays how long the ECM will take to break-even based on the annual energy and maintenance savings of the measure.

ECM Lifetime: This is included with each ECM so that the owner can see how long the ECM will be in place and whether or not it will exceed the simple payback period. Additional guidance for calculating ECM lifetimes can be found below. This value can come from manufacturer's rated lifetime or warranty, the ASHRAE rated lifetime, or any other valid source.

Operating Cost Savings (OCS): This calculation is an annual operating savings for the ECM. It is the difference in the operating, maintenance, and / or equipment replacement costs of the existing case versus the ECM. In the case where an ECM lifetime will be longer than the existing measures (such as LED lighting versus fluorescent) the operating savings will factor in the cost of replacing the units to match the lifetime of the ECM. In this case or in one where one-time repairs are made, the total replacement / repair sum is averaged over the lifetime of the ECM.

Return on Investment (ROI): The ROI is expresses the percentage return of the investment based on the lifetime cost savings of the ECM. This value can be included as an annual or lifetime value, or both.

Net Present Value (NPV): The NPV calculates the present value of an investment's future cash flows based on the time value of money, which is accounted for by a discount rate (assumes bond rate of 3.2%).

Internal Rate of Return (IRR): The IRR expresses an annual rate that results in a break-even point for the investment. If the owner is currently experiencing a lower return on their capital than the IRR, the project is financially advantageous. This measure also allows the owner to compare ECMs against each other to determine the most appealing choices.

Gas Rate and Electric Rate ($/therm and $/kWh): The gas rate and electric rate used in the financial analysis is the total annual energy cost divided by the total annual energy usage for the 12 month billing period studied. The graphs of the monthly gas and electric rates reflect the total monthly energy costs divided by the monthly usage, and display how the average rate fluctuates throughout the year. The average annual rate is the only rate used in energy savings calculations.

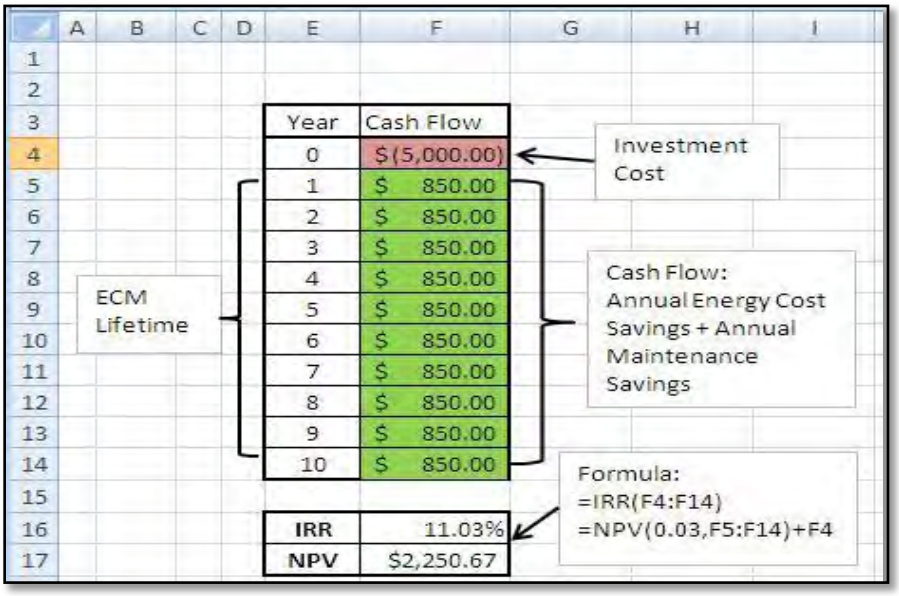
Calculation References

Term	Definition
ECM	Energy Conservation Measure
AOCS	Annual Operating Cost Savings
AECS	Annual Energy Cost Savings
LOCS*	Lifetime Operating Cost Savings
LECS	Lifetime Energy Cost Savings
LCS	Lifetime Cost Savings
NPV	Net Present Value
IRR	Internal Rate of Return
DR	Discount Rate
Net ECM Cost	Total ECM Cost – Incentive
LECS	AECS X ECM Lifetime
AOCS	LOCS / ECM Lifetime
LCS	LOCS+LECS
Simple Payback	Net ECM Cost / (AECS + AOCS)
Lifetime ROI	(LECS + LOCS – Net ECM Cost) / Net ECM Cost
Annual ROI	(Lifetime ROI / Lifetime) = [(AECS + OCS) / Net ECM Cost – (1 / Lifetime)]

* The lifetime operating cost savings are all avoided operating, maintenance, and/or component replacement costs over the lifetime of the ECM. This can be the sum of any annual operating savings, recurring or bulk (i.e. one-time repairs) maintenance savings, or the savings that comes from avoiding equipment replacement needed for the existing measure to meet the lifetime of the ECM (e.g. lighting change outs).

Excel NPV and IRR Calculation

In Excel, function =IRR (values) and =NPV (rate, values) are used to quickly calculate the IRR and NPV of a series of annual cash flows. The investment cost will typically be a negative cash flow at year 0 (total cost - incentive) with years 1 through the lifetime receiving a positive cash flow from the annual energy cost savings and annual maintenance savings. The calculations in the example below are for an ECM that saves $850 annually in energy and maintenance costs (over a 10 year lifetime) and takes $5,000 to purchase and install after incentives:



Solar PV ECM Calculation

There are several components to the calculation:

Costs:	Material of PV system including panels, mounting and net-metering + Labor
Energy Savings:	Reduction of kWh electric cost for life of panel, 25 years
Incentive 1:	NJ Renewable Energy Incentive Program (REIP), for systems of size 50kW or less, $1/Watt incentive subtracted from installation cost
Incentive 2:	Solar Renewable Energy Credits (SRECs) – Market-rate incentive. Calculations assume $600/Megawatt hour consumed per year for a maximum of 15 years; added to annual energy cost savings for a period of 15 years. (Megawatt hour used is rounded to nearest 1,000 kWh)
Assumptions:	A Solar Pathfinder device is used to analyze site shading for the building and determine maximum amount of full load operation based on available sunlight. When the Solar Pathfinder device is not implemented, amount of full load operation based on available sunlight is assumed to be 1,180 hours in New Jersey.

Total lifetime PV energy cost savings =
kWh produced by panel * [$/kWh cost * 25 years + $600/Megawatt hour /1000 * 15 years]

ECM and Equipment Lifetimes

Determining a lifetime for equipment and ECM's can sometimes be difficult. The following table contains a list of lifetimes that the NJCEP uses in its commercial and industrial programs. Other valid sources are also used to determine lifetimes, such as the DOE, ASHRAE, or the manufacturer's warranty.

Lighting is typically the most difficult lifetime to calculate because the fixture, ballast, and bulb can all have different lifetimes. Essentially the ECM analysis will have different operating cost savings (avoided equipment replacement) depending on which lifetime is used.

When the bulb lifetime is used (rated burn hours / annual burn hours), the operating cost savings is just reflecting the theoretical cost of replacing the existing case bulb and ballast over the life of the recommended bulb. Dividing by the bulb lifetime will give an annual operating cost savings.

When a fixture lifetime is used (e.g. 15 years) the operating cost savings reflects the avoided bulb and ballast replacement cost of the existing case over 15 years minus the projected bulb and ballast replacement cost of the proposed case over 15 years. This will give the difference of the equipment replacement costs between the proposed and existing cases and when divided by 15 years will give the annual operating cost savings.

New Jersey Clean Energy Program Commercial & Industrial Lifetimes

Measure	Life Span
Commercial Lighting — New	15
Commercial Lighting — Remodel/Replacement	15
Commercial Custom — New	18
Commercial Chiller Optimization	18
Commercial Unitary HVAC — New - Tier 1	15
Commercial Unitary HVAC — Replacement - Tier 1	15
Commercial Unitary HVAC — New - Tier 2	15
Commercial Unitary HVAC — Replacement Tier 2	15
Commercial Chillers — New	25
Commercial Chillers — Replacement	25
Commercial Small Motors (1-10 HP) — New or Replacement	20
Commercial Medium Motors (11-75 HP) — New or Replacement	20
Commercial Large Motors (76-200 HP) — New or Replacement	20
Commercial VSDs — New	15
Commercial VSDs — Retrofit	15
Commercial Comprehensive New Construction Design	18
Commercial Custom — Replacement	18
Industrial Lighting — New	15
Industrial Lighting — Remodel/Replacement	15
Industrial Unitary HVAC — New - Tier 1	15
Industrial Unitary HVAC — Replacement - Tier 1	15
Industrial Unitary HVAC — New - Tier 2	15
Industrial Unitary HVAC — Replacement Tier 2	15
Industrial Chillers — New	25
Industrial Chillers — Replacement	25
Industrial Small Motors (1-10 HP) — New or Replacement	20
Industrial Medium Motors (11-75 HP) — New or Replacement	20
Industrial Large Motors (76-200 HP) — New or Replacement	20
Industrial VSDs — New	15
Industrial VSDs — Retrofit	15
Industrial Custom — Non-Process	18
Industrial Custom — Process	10
Small Commercial Gas Furnace — New or Replacement	20
Small Commercial Gas Boiler — New or Replacement	20
Small Commercial Gas DHW — New or Replacement	10
C&I Gas Absorption Chiller — New or Replacement	25
C&I Gas Custom — New or Replacement (Engine Driven Chiller)	25
C&I Gas Custom — New or Replacement (Gas Efficiency Measures)	18
O&M savings	3
Compressed Air (GWh participant)	8

APPENDIX E: STATEMENT OF ENERGY PERFORMANCE FROM ENERGY STAR®

OMB No. 2060-0347

STATEMENT OF ENERGY PERFORMANCE
City of Elizabeth - Trenton Avenue Pump Station

Building ID: 2250968
For 12-month Period Ending: January 31, 2010[1]
Date SEP becomes Ineligible: N/A
Date SEP Generated: May 27, 2010

Facility
City of Elizabeth - Trenton Avenue Pump Station
522 Trenton Avenue
Elizabeth, NJ 07202

Facility Owner
N/A

Primary Contact for this Facility
N/A

Year Built: 1950
Gross Floor Area (ft²): 3,118

Energy Performance Rating[2] (1-100) N/A

Site Energy Use Summary[3]	
Electricity - Grid Purchase(kBtu)	2,929,941
Natural Gas (kBtu)[4]	145,717
Total Energy (kBtu)	3,075,658

Energy Intensity[5]	
Site (kBtu/ft²/yr)	986
Source (kBtu/ft²/yr)	3187

Emissions (based on site energy use)	
Greenhouse Gas Emissions ($MtCO_2e$/year)	454

Electric Distribution Utility
Public Service Elec & Gas Co

National Average Comparison	
National Average Site EUI	104
National Average Source EUI	213
% Difference from National Average Source EUI	1397%
Building Type	Other

Stamp of Certifying Professional

Based on the conditions observed at the time of my visit to this building, I certify that the information contained within this statement is accurate.

Certifying Professional
N/A

Meets Industry Standards[6] **for Indoor Environmental Conditions:**	
Ventilation for Acceptable Indoor Air Quality	**N/A**
Acceptable Thermal Environmental Conditions	**N/A**
Adequate Illumination	**N/A**

Notes:
1. Application for the ENERGY STAR must be submitted to EPA within 4 months of the Period Ending date. Award of the ENERGY STAR is not final until approval is received from EPA.
2. The EPA Energy Performance Rating is based on total source energy. A rating of 75 is the minimum to be eligible for the ENERGY STAR.
3. Values represent energy consumption, annualized to a 12-month period.
4. Natural Gas values in units of volume (e.g. cubic feet) are converted to kBtu with adjustments made for elevation based on Facility zip code.
5. Values represent energy intensity, annualized to a 12-month period.
6. Based on Meeting ASHRAE Standard 62 for ventilation for acceptable indoor air quality, ASHRAE Standard 55 for thermal comfort, and IESNA Lighting Handbook for lighting quality.

EPA Form 5900-16

APPENDIX F: INCENTIVE PROGRAMS

New Jersey Clean Energy Pay for Performance

The NJ Clean Energy Pay for Performance (P4P) Program relies on a network of Partners who provide technical services to clients. LGEA participating clients who are not receiving Direct Energy Efficiency and Conservation Block Grants are eligible for P4P. SWA is an eligible Partner and can develop an Energy Reduction Plan for each project with a whole-building traditional energy audit, a financial plan for funding the energy measures and an installation construction schedule.

The Energy Reduction Plan must define a comprehensive package of measures capable of reducing a building's energy consumption by 15+%. P4P incentives are awarded upon the satisfactory completion of three program milestones: submittal of an Energy Reduction Plan prepared by an approved Program Partner, installation of the recommended measures and completion of a Post-Construction Benchmarking Report. Theincentives for electricity and natural gas savings will be paid based on actual savings, provided that the minimum 15%performance threshold savings has been achieved.

For further information, please see: http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance/existing-buildings .

Direct Install 2010 Program*

Direct Install is a division of the New Jersey Clean Energy Programs' Smart Start Buildings. It is a turn-key program for small to mid-sized facilities to aid in upgrading equipment to more efficient types. It is designed to cut overall energy costs by upgrading lighting, HVAC and other equipment with energy efficient alternatives. The program pays **up to 80%** of the retrofit costs, including equipment cost and installation costs.

Eligibility:

- Existing small and mid-sized commercial and industrial facilities with peak electrical demand **below 200 kW** within 12 months of applying
- Must be located in New Jersey
- Must be served by one of the state's public, regulated or natural gas companies
    - Electric: Atlantic City Electric, Jersey Central Power & Light, Orange Rockland Electric, PSE&G
    - Natural Gas: Elizabethtown Gas, New Jersey Natural Gas, PSE&G, South Jersey Gas

For the most up to date information on contractors in New Jersey who participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/direct-install

Smart Start

New Jersey's SmartStart Building Program is administered by New Jersey's Office of Clean Energy. The program also offers design support for larger projects and technical assistance for smaller projects. If your project specifications do not fit into anything defined by the program, there are even incentives available for custom projects.

There are a number of improvement options for commercial, industrial, institutional, government, and agricultural projects throughout New Jersey. Alternatives are designed to enhance quality while building in energy efficiency to save money. Project categories included in this program are New Construction and Additions, Renovations, Remodeling and Equipment Replacement.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings.

Renewable Energy Incentive Program*

The Renewable Energy Incentive Program (REIP) provides incentives that reduce the upfront cost of installing renewable energy systems, including solar, wind, and sustainable biomass. Incentives vary depending upon technology, system size, and building type. Current incentive levels, participation information, and application forms can be found at the website listed below.

Solar Renewable Energy Credits (SRECs) represent all the clean energy benefits of electricity generated from a solar energy system. SRECs can be sold or traded separately from the power, providing owners a source of revenue to help offset the cost of installation. All solar project owners in New Jersey with electric distribution grid-connected systems are eligible to generate SRECs. Each time a system generates 1,000 kWh of electricity an SREC is earned and placed in the customer's account on the web-based SREC tracking system.

For the most up to date information on how to participate in this program, go to: http://www.njcleanenergy.com/renewable-energy/home/home.

Utility Sponsored Programs

Check with your local utility companies for further opportunities that may be available.

Energy Efficiency and Conservation Block Grant Rebate Program

The Energy Efficiency and Conservation Block Grant (EECBG) Rebate Program provides supplemental funding up to $20,000 for eligible New Jersey local government entities to lower the cost of installing energy conservation measures. Funding for the EECBG Rebate Program is provided through the American Recovery and Reinvestment Act (ARRA).

For the most up to date information on how to participate in this program, go to: http://njcleanenergy.com/EECBG

Other Federal and State Sponsored Programs

Other federal and state sponsored funding opportunities may be available, including BLOCK and R&D grant funding. For more information, please check http://www.dsireusa.org/.

*Subject to availability. Incentive program timelines might not be sufficient to meet the 25% in 12 months spending requirement outlined in the LGEA program.

APPENDIX G: ENERGY CONSERVATION MEASURES

Energy Conservation Measures																			
ECM #	ECM description	Cost Source	Est. installed cost, $	Est. incentives, $	Net est. cost with incentives, $	kWh, 1st year savings	kW, demand reduction	therms, 1st year savings	kBtu/sq ft, 1st year savings	Est. operating cost, 1st year savings, $	Total 1st year savings, $	Life of measure, years	Est. lifetime energy cost savings, $	Simple payback, years	Lifetime return-on-investment, %	Annual return-on-investment, %	Internal rate of return, %	Net present value, $	CO_2 reduced, lbs/year
1	Lighting upgrades	RS Means	610	135	475	1,301	0.3	0	1.4	17	230	15	3,455	2.1	627%	42%	48%	2,236	2,329
2	Replace Pumps #2 and #5 with premium efficiency pumps	Contractor	74,840	720	74,120	68,802	17.2	0	75.3	60	11,344	20	226,871	6.5	206%	10%	13%	59,360	123,190
3	Replace window air-conditioner	Vendor	400	0	400	267	0.1	0	0.3	0	44	10	438	9.1	9%	1%	2%	-30	478
4	Install 2 occupancy sensors	RS Means	400	40	360	186	0.1	0	0.2	0	31	10	305	11.8	-15%	-2%	-3%	-102	333
	TOTALS		**76,250**	**895**	**75,355**	**70,556**	**17.7**	**0**	**77.2**	**77**	**11,648**	-	**231,069**	**6.5**	-	-	-	**61,463**	**126,331**

APPENDIX H: METHOD OF ANALYSIS

Assumptions and tools

Energy modeling tool:	Established/standard industry assumptions, eQUEST
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE Trenton Avenue Pumping Station SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE Trenton Avenue Pumping Station(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.