Agenda Item #:____________________________

Staff Report
City of Manhattan Beach

TO: Honorable Mayor Ward and Members of the City Council

THROUGH: Richard Thompson, Interim City Manager

FROM: Jim Arndt, Director of Public Works
Juan Price, Maintenance Superintendent
Clay Curtin, Management Analyst

DATE: March 2, 2010

SUBJECT: Study Session: Consideration of Level III Energy Audit and Recommendations

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RECOMMENDATION:
Receive and File. No decisions are required as the information received will assist the City Council in subsequent CIP deliberation in the FY2010-2011 budget process.

BACKGROUND:
As part of the City's overall environmental strategy, the City Council directed staff to initiate a Level III Energy Audit and on January 6, 2009, the City Council awarded a professional services contract to PE Consulting to perform this audit.

The deliverables, as spelled out in the agreement, included identifying anticipated carbon emission offsets, the cost per ton to achieve these offsets, simple payback, and specific recommendations regarding energy efficiency measures (EEM). Additionally, the agreement called for:

- Recommended EEMs to lighting inventory, including all athletic fields, security lighting, perimeter lighting, and interior lighting at all facilities.
- The retrofitting of existing lighting, including city-owned streetlights, with recommendations regarding the use of LED, induction, or solar alternatives.
- Current condition of all HVAC equipment, anticipated remaining useful life, and EEMs.
- Use of photovoltaic arrays (solar panels).

Information received from the audit was provided to the City's Environmental Task Force (ETF) Climate Action subcommittee in October 2009. The subcommittee used the information in their recommendation of projects for reducing CO_2, which will be reported to Council at the March 16, 2010, meeting.

The consultant's work was presented in its entirety and all recommendations were unranked. The consultant provided a breakdown of the individual EEMs, grouped by facility. For example, the Joslyn Center group included recommended EEMs such as lighting, HVAC, water heater, and solar components. While specific EEMs were identified for each facility, none of the EEMs were prioritized. Per staff's initial instruction to PE Consulting, ranking or implementation phasing was not part of the scope of work.

<u>Project Matrix</u>

The comprehensive report (attached) included a matrix detailing the recommended EEMs. For each of the sixty-four (64) recommended EEMs, PE Consulting identified thirteen (13) factors for consideration, including annual savings, lifecycle payback in years, and total tonnes of CO_2 reduced. The narrative portion of the report also included other technical issues including, a summary of lighting choices, such as LED, inductive lighting retrofits, and the proposed use of photovoltaic arrays (solar panels) of varying types and sizes at different locations. PE Consulting estimated a cost of $7.4 million for all improvements, well beyond the $1 million budgeted in the 2009-2010 CIP for energy-related capital improvement projects.

After initial analysis, it was apparent that the volume of data would make it very difficult to identify actionable projects. The analysis revealed that projects were, by necessity, linked together because of the nature of construction. In addition, projects were categorized and given specific/defined criteria in order to better prioritize and rank them. Therefore, staff identified a condensed set of parameters for use in project analysis and relative comparisons.

Because source of funding is important in implementing any project, EEMs were placed in categories of funding source for the purpose of prioritizing and funding projects within their funding source. They include:

- General Fund CIP
- General Fund Operations
- Restricted Use and Enterprise Funds (Pier, Parking, and Water)
- Grant and/or Third-Party Funding

Next, General Fund CIP items were grouped by facility with consideration to interrelated projects. The reasoning was that to replace an existing HVAC system at the same time as related items such as lighting retrofits, insulation, programmable thermostats, and occupancy sensors, would be the best way to achieve the full energy savings and avoid costly duplication of work.

Finally, a matrix using a subset from PE Consulting's larger data set was created; which included six (6) criteria for evaluation:

- Initial Cost
- Return on Investment

- Annual Savings
- Weighted Lifecycle Payback (yrs)
- Metric Tonnes of CO_2 reduced
- Dollars Per Tonne of CO_2 reduced (added by the Climate Action subcommittee)

Additionally, the final column in the matrix gives a relative priority of the projects from a staff maintenance perspective, added information on remaining useful life, and included a maintenance priorities ranking. The ranking and recommendations from staff considered the estimated remaining useful life, likely future continued use of the building or infrastructure, cost savings, and population served.

Involvement by Climate Action Subcommittee

The Climate Action subcommittee received the staff-produced matrix for review, discussion, final revisions, and subcommittee prioritization of projects on January 14, 2010. The full ETF heard and approved the Climate Action subcommittee presentation on the Level III Energy Audit and suggested prioritization of EEMs at its January 21, 2010, meeting. The ETF will be presenting all Climate Action recommendations, including the Energy Audit findings, at the March 16, 2010, City Council meeting.

Staff will use the information from the consultant and ETF recommendations in developing the proposed FY2010-2015 CIP budget. City Council had previously identified and approved $1,000,000 for energy-related CIP projects in 2010 and $500,000 in 2011 for Public Works Facility improvements.

Energy Efficiency Grant

Additionally, the U.S. Department of Energy awarded the City a $155,800 Energy Efficiency and Conservation Block Grant (EECBG), to retrofit City owned street lighting. Staff will be installing and retrofitting street lighting with inductive or LED fixtures and retrofit kits as appropriate for identified sites.

SUMMARY

Through the Level III Energy Audit, the City of Manhattan Beach has identified practical energy efficiency measures, associated implementation costs, and the environmental benefits of these proposed measures. The ETF, through the Climate Action subcommittee, has further refined the recommended EEMs into smaller projects that reflect a phased implementation. The projects have been prioritized and grouped by funding source.

Staff will walk through the information in the matrix during the study session this evening to help familiarize the City Council with the information.

This will assist the City Council in understanding the basis for the facility CIP projects they will consider in the budget process, as well as provide background for the ETF recommendations they will receive on March 16, 2010.

Attachments:
1. Comprehensive Energy Audit Report from PE Consulting
2. Final Energy Audit Matrix

ATTACHMENT #1

Comprehensive Energy Audit

for

City of Manhattan Beach

13 October 2009

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DISCLAIMER

This Engineering Analysis package includes data that was produced by PE Consulting, Inc for the City of Manhattan Beach. The information contained within this report is the property of the City of Manhattan Beach and PE Consulting, Inc, and may not be reproduced or distributed without prior written approval from either party.

This study is for budgeting and planning purposes only. As such the engineering analyses and recommendations are schematic in nature and NOT FOR CONSTRUCTION. Additional design and engineering is required before bidding or construction activities are pursued.

1.0 EXECUTIVE SUMMARY

The City of Manhattan beach seeks to reduce its greenhouse gas emissions to 7% below 1990 levels by 2012. PE Consulting is pleased to present this Comprehensive Energy Audit to the City. This audit identifies upgrades that will substantially reduce operating costs and the city's carbon footprint while improving building occupant comfort, security and safety.

The scope of this project included engineering surveys of all City buildings, collection of detailed equipment nameplate and operating conditions, available original design specifications and building structures. From there, comprehensive building energy models were balanced against historical (baseline) energy bills. With this information, strategies to reduce energy use were identified and analyzed for energy savings and cost effectiveness. Implementation of the recommended energy efficiency measures (EEMs) in this report will help the City of Manhattan Beach achieve their carbon reduction goals. A summary of the recommendations follows:

Baseline kBTU Energy use (CO2 tonnes)	20,232,293	(1,784)
Baseline kW Demand	2,138	
Projected kBTU Savings (%)	8,536,634	(42%)
Projected kW Demand Reduction (%)	391	(18%)
Upgrade Cost	$7.805,728	
Incentives and Rebates (%)	$1,632,391	(21%)
1st Year Annual Savings (%)	$390,082	(44%)
Net Inflation Adjusted Payback (ROI)	15 yrs	**(6.7%)**

Notes: Baseline demand is average power demand (kW), not annual peak nor maximum potential connected load. Net payback assumes conservative 6% *average* annual utility escalation rate.

PE Consulting applauds the City of Manhattan Beach for its proactive approach in reducing greenhouse gas emissions. The City's actions will not only assist in meeting its Climate Action Plan goals but also positions the City as a role model for other communities to cost effectively reduce emissions. We look forward to discussing this energy audit with the City of Manhattan Beach stakeholders and answering any questions the City may have as well as assisting with successful implementation including design, project management, commissioning, certification and performance validation of this project.

2.0 INTRODUCTION

2.1 Background

The City of Manhattan Beach is located 19 miles southwest of Los Angeles on the south end of Santa Monica Bay. The city is known for its pristine beaches and year-round sunshine, with the average temperatures ranging from 70°F in the summer to 55°F in the winter. With over 30,000 residents and tourism year-round, it is essential that the city be as environmentally responsible as it can be to protect and preserve the area for future generations.

To ensure Manhattan Beach remains a beautiful place to live and a tourist hot spot, the City Council made sustainability a priority. They have organized a Green Team and developed a Climate Action Plan in which the City pledges to cut carbon emissions by at least 7% below 1990 levels by 2012. To assist in achieving this goal, the City Council invested in this Comprehensive Energy Audit.

PE Consulting completed this Comprehensive Energy Audit for the City to identify energy efficiency and renewable energy upgrades to help meet their goals. The last major retrofit project at the City was completed in 1990 by Honeywell. At the time, Honeywell retrofit/replaced lighting HVAC, pumping equipment and controls, and various electric motors. Since this equipment is reaching the end of its useful life and equipment efficiencies have increased over the last 19 years, the City has requested that PE Consulting complete a comprehensive energy audit for all of its current facilities.

The following paper reports on the findings from PE Consulting's Comprehensive Energy Audit. The report details existing conditions and suggests cost effective measures that will reduce energy use and costs as well as help the City of Manhattan Beach meet their emissions reduction target.

2.2 Understanding this Report

This is a Comprehensive Energy Audit (CEA) report. It includes a detailed building and survey analysis that includes an analysis of recent energy usage patterns, data-logging of existing equipment and systems, review of operation and maintenance procedures, evaluation of the condition of existing equipment and systems, and energy modeling. Energy modeling was completed using both E-Quest building simulation software and ASHRAE engineering algorithms via proprietary software. In this report we have also exceeded level 3 requirements with renewable energy analyses and other environmentally sustainable modeling

Also, as requested by the City, this report includes information about anticipated carbon emission offsets and cost per ton to achieve these carbon offsets. Some recommended measures require further engineering prior to final budgeting. For additional engineering or design assistance, please refer to www.peconsulting.com > Services.

The following report is divided into the following sections:

1. **Executive Summary** – Provides an overview of the project, the findings, and the recommendations. City Council and other decision makers can read this section to get a good basic understanding of the steps we suggest the City implement to go green.

2. **Introduction** - Provides information about the purpose of the report and the format of this report.

3. **Energy Use Analysis** - This section provides information about the site visit and the utility bill analysis. It establishes the baseline energy used by the city.

4. **Existing Conditions and Recommendations –** For each site, this section provides a discussion about the existing conditions and a list of recommendations to improve the energy efficiency.

5. **Summary** – Suggests an approach to implement the energy efficiency measures identified and summarizes the energy savings and cost to implement these measures.

6. **Appendices** – Provides additional information such as building lists, meter lists, lighting and mechanical equipment lists, etc.

3.0 ENERGY USE ANALYSIS

3.1 Site Visit

A city-wide site analysis was completed during the week of July 6, 2009. During the site visit, PE Consulting engineers met with city managers and facilities maintenance to discuss the energy issues concerning the city. In addition, PE Consulting engineers toured over 20 sites in the city, including City buildings, parks, community centers, reservoirs, lift stations, and more. At each site, detailed information was collected about the energy use and existing conditions.[1]

A comprehensive list of the sites audited including detailed: occupancy, building envelope, mechanical, lighting and appliance data is provided in the Appendices.

3.2 Baseline Energy Use

Following the site visit, electric and natural gas utility meter information that was collected while on-site and provided by the City was matched to the Southern California Edison and Southern California Gas utility meter data. Monthly electric and gas data for the past 24 months was analyzed and benchmarked for each meter at each site.

Using the baseline energy data for each individual meter, we compiled the data to develop a baseline[2] energy use and carbon footprint for all of the buildings in the city shown below.

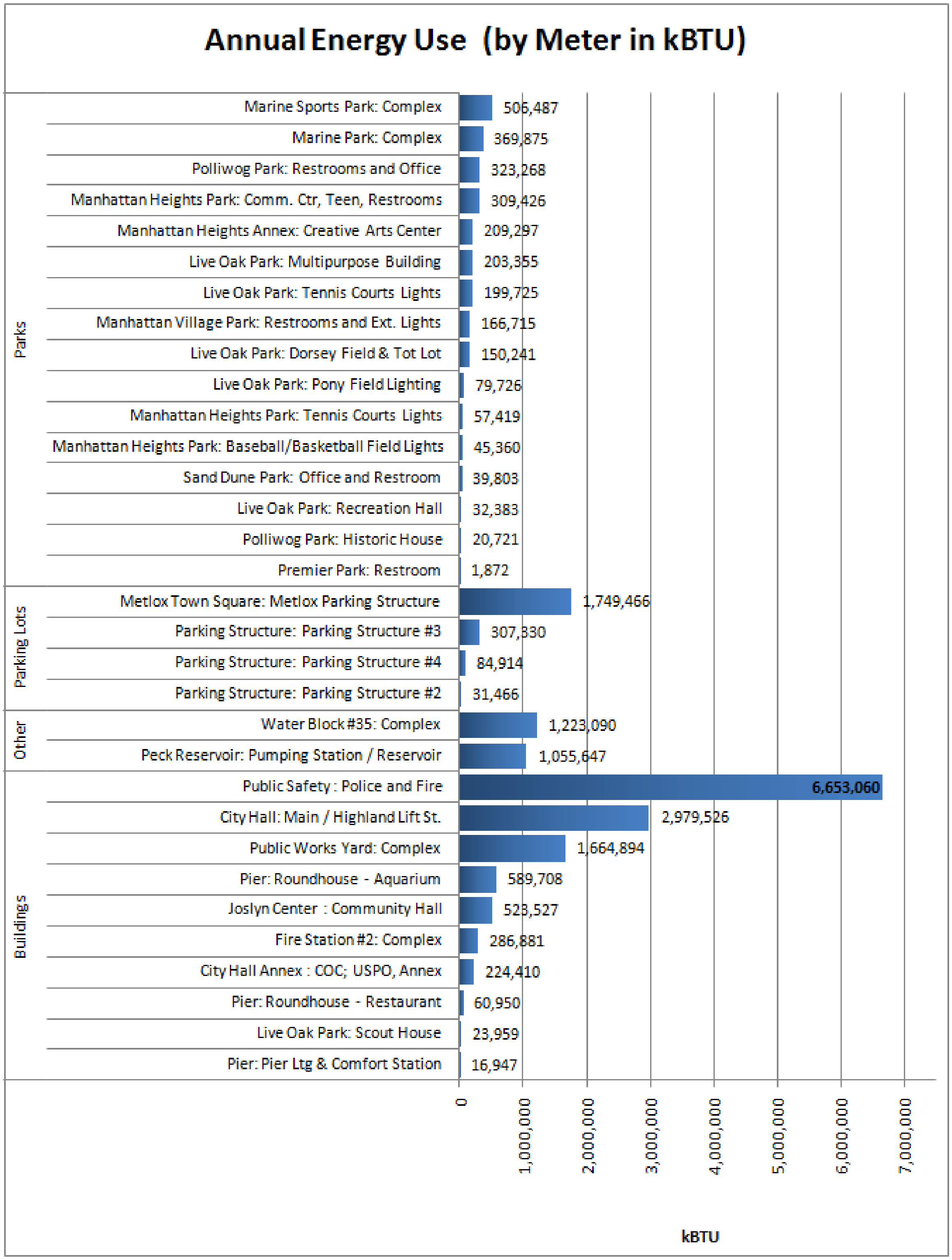
Baseline Energy Use by the City of Manhattan Beach

kW_exist	kWh_exist	$ Elec	therms	$ Nat Gas	kBtu	Annual Energy Cost	CO2 (tonnes)
2,138	**4,817,884**	**$703,530**	**38,033**	**$40,139**	**20,232,293**	**$743,669**	**1,784**
Note: Street light meter data was not available, thus not included above.							

[1] For example, at office buildings, information about occupancy hours and the number of employees was gathered. Then, information about the building envelope (roof, windows, and walls) [1], mechanical, electrical, and lighting equipment were inventoried and specifications (manufacturer, model number, condition, etc) were documented.

[2] The baseline energy use for the entire City is the sum of the average (24 month) baseline for all of the meters in the scope of work for this audit. For a comprehensive list of the meters analyzed, please see utility data in the appendices.

The largest energy users are Public Safety, City Hall and Public Works which deserve the most attention (see chart below).

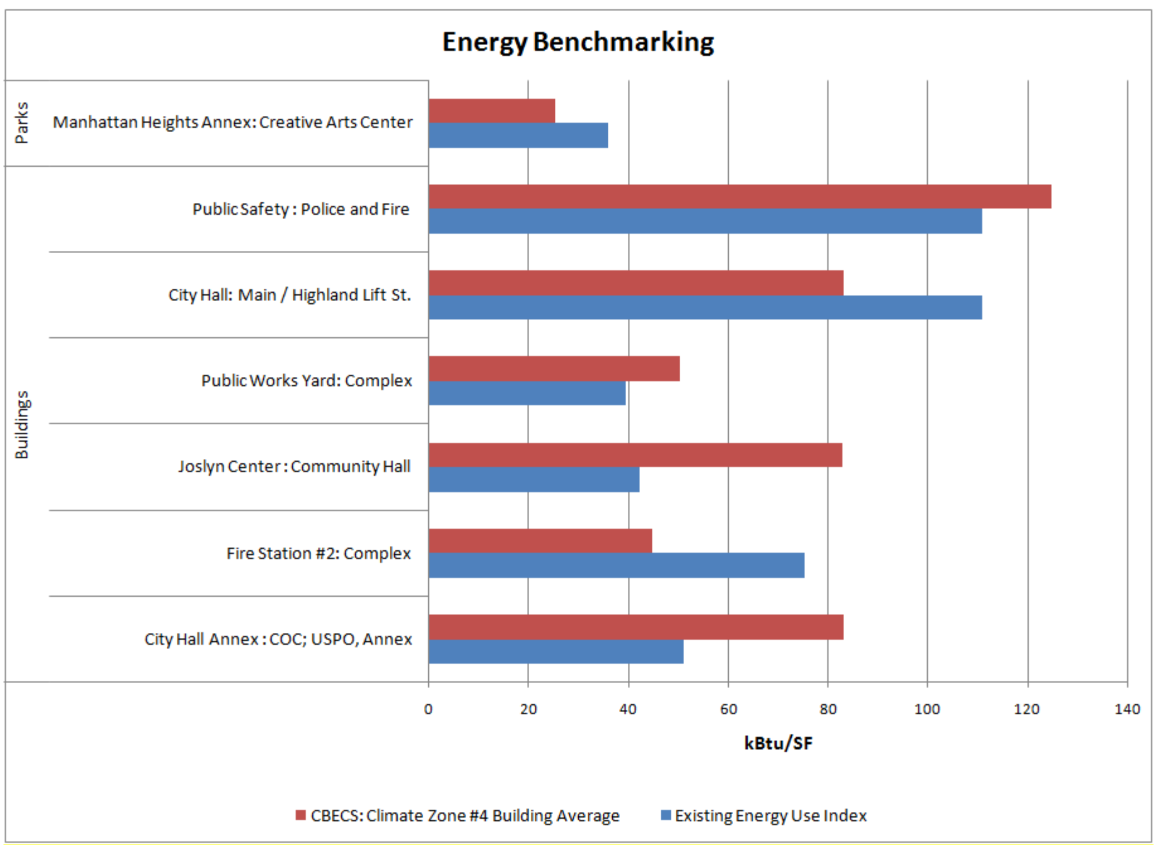


3.3 Energy Benchmarking

The purpose of benchmarking is to rank energy use between facilities and compare them to similar facilities (such as your own) and those of your peers within similar climate zones and building codes (such as beach communities in Southern California) in order to help prioritize improvement efforts.

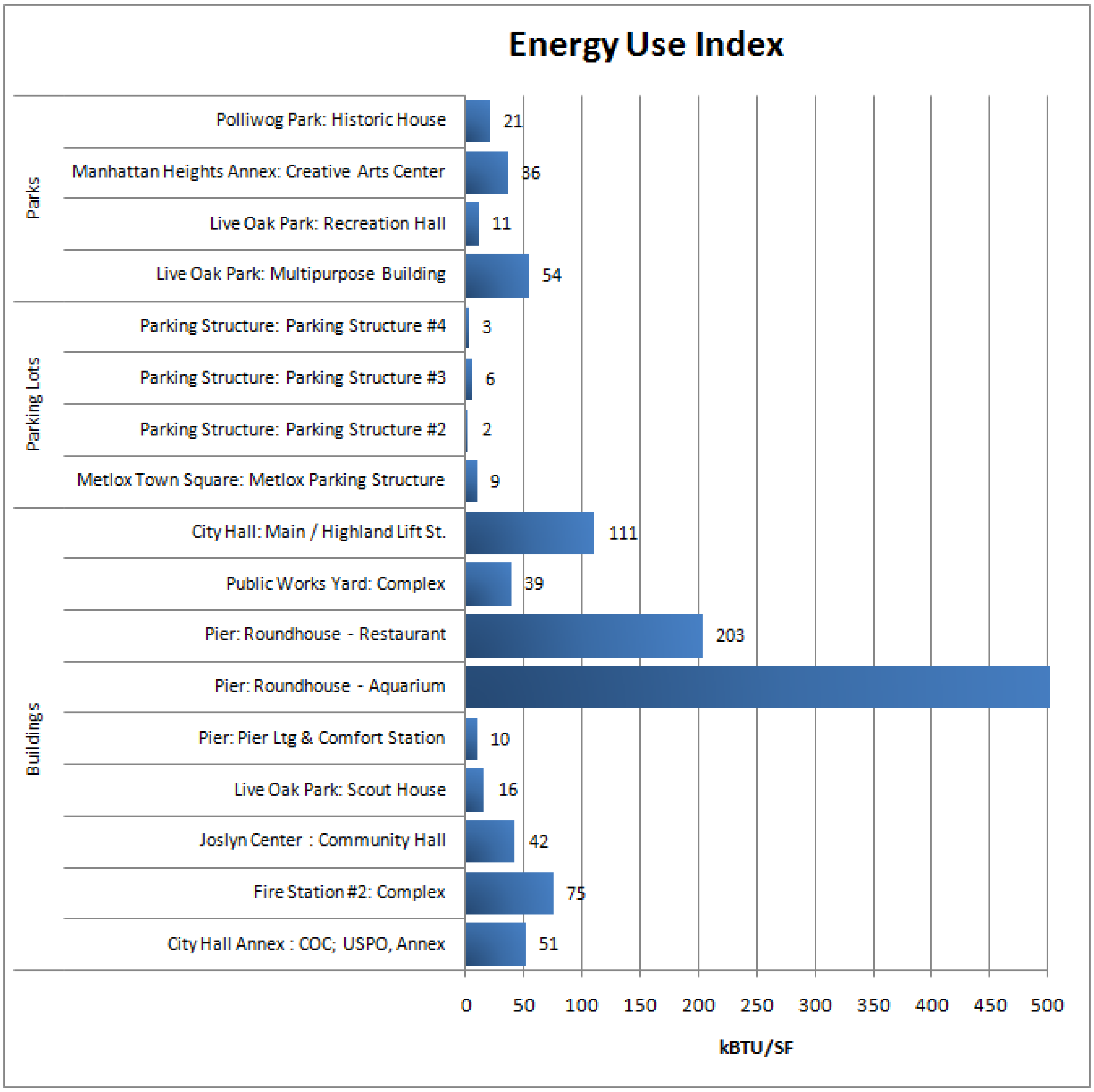
Common benchmarking metrics used for office space is total energy use and cost per square foot. In this case, total energy use is electric (kWh) and natural gas (therms) combined into common British Thermal Units per square foot (Btu/SF). Other metrics that may influence comparisons include: cost and power demand (kW), and over time: occupancy, operating hours, average local temperatures, etc.

For the buildings where benchmarking data was available, we utilized data from the Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) database. According to EIA statistics, the City of Manhattan Beach falls into Climate Zone #4. This means the city has fewer than 2,000 Cooling Degree Days (or hours when air conditioning is needed) and fewer than 4,000 Heating Degree Days (or hours when heating is needed). In simple terms, the City of Manhattan Beach has a mild climate, so we compared the energy use of the larger buildings to others in similar climate. This approach is more relevant than simply using national averages.



The benchmarks above illustrate the inefficiency of some of the city's larger buildings compared to regional averages. While some buildings are more efficient than "average" buildings, this in no way means the city's buildings are efficient or green buildings. Given the mild climate, the city's goal should be towards net zero energy use.

Following is a comparison of city-owned buildings relative to each other on a square foot basis. It is important to recognize that the Aquarium and Restaurant are unique w/in the city and expected to be less efficient than office buildings due to their operations and density of plug load equipment such as the fish tanks and water coolers in the Aquarium.



3.4 Energy Costs and Forecasts

Prior to 1999, energy prices in the US were easily forecasted to grow at moderate 3-4% growth rates. Since that time, we have clearly outstripped our domestic fossil fuel capacity and are currently very dependent on global fuel prices. As such, we can count on volatile prices going forward. While the current recession may keep fuel costs temporarily suppressed, increased domestic and global demand will surely increase the escalation rate of natural gas and electricity. Overlaid with a renewed national responsibility to reduce air pollution and particularly CO2, fossil fueled electric and natural gas prices are sure to escalate much faster than they ever have historically. As an example, last year, electric prices rose an average of 9% across California. While unlikely to rise that much in 2009, high single digit and even double digit rate increases will not be uncommon in the near future in the US.

3.5 Energy Balance

In order to ensure that our energy models were accurate, we compare our estimated or simulated energy consumption for each building to actual historical energy use. Similar to an accounting analysis, when the two match closely, we can be assured that our models are accurate and this projected energy savings will be accurate as well.

For this project, our building energy models balanced within 10% of historical baseline energy consumption. Detailed results are illustrated in the Appendices.

4.0 EXISTING CONDITIONS & RECOMMENDATIONS

4.1 OVERVIEW

The following section provides detailed discussion of the existing conditions and the energy efficiency measures recommended for each site. A summary of the recommended energy efficiency measures follows. The energy savings and financial analysis is provided in Section 5.

Site Information		Energy Efficiency Measures		
Site	Building	Cat. [1]	Type	Description
City Hall	City Hall / Highland Lift	EE	All	Install: solar controlled glass, new ceiling, new fixtures, controls, ltg on EMS
City Hall	City Hall / Highland Lift	EE	Misc.	Data Center and PC's (rough est.)
City Hall	City Hall / Highland Lift	RE	Solar	Rooftop: 32.5 kW DC Solar PV
City Hall Annex	COC; USPO, Annex	EE	Ltg	Skylights, Retrofit 8' ltg, Delamp, Induction Pkg Lamps
City Hall Annex	COC; USPO, Annex	EE	HVAC**	Replace Chamber of C. Heat Pump & Programmable Thermostats
City Hall Annex	COC; USPO, Annex	EE	Other	New DHW Heater
Fire Station #2	Complex	EE	Ltg	Delamp, CFLs, Occ. Sensors
Fire Station #2	Complex	EE	HVAC**	Replace Bryant E/G Package Unit with SEER 13-15 Package Unit
Fire Station #2	Complex	EE	HVAC**	Install Infrared Radiant Tube Heater in the Fire Truck Garage
Joslyn Center	Community Hall	EE	Ltg	Delamp; Incan to CFL; Occ Sensors
Joslyn Center	Community Hall	EE	HVAC**	Replace 4 E/G Package Units with High Efficiency Units
Joslyn Center	Community Hall	EE	DHW	New DHW Heater
Joslyn Center	Community Hall	RE	Solar	Rooftop: 45.1 kW DC Solar PV
Live Oak Park	Scout House	EE	Ltg	Delamp; Occ. Sensors, Photocell Sensors
Live Oak Park	Scout House	EE	Env	Blow-In Attic Insulation
Live Oak Park	Dorsey Field & Tot Lot	EE	Ltg	Induction Lamps
Live Oak Park	Multipurpose Building	EE	Ltg	Skylights; Occupancy Sensors; Induction for Batting Cage
Live Oak Park	Multipurpose Building	EE	HVAC**	Replace 3 and 4 ton Carrier units w/ high efficiency package units
Live Oak Park	Multipurpose Building	RE	Solar	Rooftop: 21.1 kW DC Solar PV
Live Oak Park	Pony Field Lighting	EE	Ltg	Induction Fixtures
Live Oak Park	Recreation Hall	EE	Ltg	Occ. Sensors
Live Oak Park	Recreation Hall	RE	Solar	Rooftop: 2.1 kW DC Solar PV
Live Oak Park	Tennis Courts Lights	EE	Ltg	Induction Tennis Ltg
Manh. Heights Annex	Creative Arts Center	EE	Ltg	Arch. Ltg update; Occ Sensors; Induction Ext. Lamps
Manh. Heights Annex	Creative Arts Center	EE	HVAC**	Replace 25 ton package unit
Manh. Heights Annex	Creative Arts Center	EE	DHW	Install high efficiency DHW Heater
Manh. Heights Annex	Creative Arts Center	RE	Solar	Covered Parking: 18 kW DC Solar PV

Cont'd next page

Site Information		Energy Efficiency Measures		
Site	Building	Cat.[1]	Type	Description
Manh.Heights Park	Tennis Courts Lights	EE	Ltg	Induction Tennis Ltg
Manh.Heights Park	Baseball/Basketball Lights	EE	Ltg	Induction Basketball Ltg
Manh.Heights Park	3 Structures: CC/TR/PG	EE	Ltg	Delamp; Occupancy Sensors
Manh.Heights Park	3 Structures: CC/TR/PG	EE	HVAC**	Replace existing gas packs with (4) high eff. gas packs
Manh.Heights Park	3 Structures: CC/TR/PG	RE	Solar	Covered Parking: 26.9 kW DC Solar PV
Manh. Village Park	Restrooms and Ext. Lights	EE	Ltg	Lighting
Marine Park	Complex	EE	Ltg	Delamp; Induction Ext. Lamps
Marine Park	Complex	EE	Other	New DHW Heater
Marine Sports Park	Complex	EE	Ltg	Occupancy Sensors
Metlox Town Square	Metlox Parking Structure	EE	Ltg	70W Induction Garage Ltg / 40W Induction Wallpacks
Parking Structure	Parking Structure #2	EE	Ltg	40W Induction Garage Ltg w/ PC
Parking Structure	Parking Structure #2	RE	Solar	Covered Parking: 3 kW DC
Parking Structure	Parking Structure #3	EE	Ltg	40W Induction Garage Ltg w/ PC
Parking Structure	Parking Structure #3	RE	Solar	Covered Parking: 37.4 kW DC Solar PV
Parking Structure	Parking Structure #4	EE	Ltg	40W Induction Garage Ltg w/ PC & Exterior Ind. Poles
Parking Structure	Parking Structure #4	RE	Solar	Covered Parking: 15 kW DC Solar PV
Peck Reservoir	Pumping Station / Reservoir	EE	Ltg	Occupancy Sensors
Peck Reservoir	Pumping Station / Reservoir	RE	Solar	Water Tank Mounted: 189 kW DC Solar PV
Pier	Pier Ltg & Comfort Station	EE	Ltg	Occupancy Sensors
Pier	Roundhouse - Aquarium	EE	Ltg	Induction / Sensors
Pier	Roundhouse - Restaurant	EE	Ltg	New Fixt. in Restaurant. and Induction Ext. Fixt.
Pier	Roundhouse - Restaurant	EE	Misc.	Energy Star (1 refrigerator; 1 freezer;
Polliwog Park	Historic House	EE	Ltg	Replace Incan. w/ CFL; Occ Sensors
Polliwog Park	Restrooms and Office	EE	Ltg	Occ. Sensors; Induction Ext. Lamps
Premier Park	Restroom	EE	Ltg	Occupancy Sensors
Public Safety	Facility	Cx	Oth	Commissioning
Public Safety	Facility	EE	Ltg	Install Induction Pkg Fixtures; Ltg to EMS
Public Safety	Facility	EE	HVAC	Ice Storage for City Hall and Public Safety
Public Safety	Facility	RE	Solar	Covered Parking: 112.2 kW DC
Public Works Yard	Complex	EE	Ltg	Delamp Fixtures; Induction Ltg
Public Works Yard	Complex	EE	HVAC**	2 new, 3 ton, high efficiency heat pumps
Public Works Yard	Complex	EE	HVAC**	Replace unit heaters with radiant tube heaters
Public Works Yard	Complex	RE	Solar	Rooftop: 87.2 kW DC Solar PV
Sand Dune Park	Office and Restroom	EE	Ltg	Retrofit T12 fixture; Induction Ext. Ltg
Water Block #35	Complex	EE	Ltg	Occ Sensors; Induction Ltg
Water Block #35	Complex	RE	Solar	Water Tank Mounted: 148.2 kW DC Solar PV
Street/Walk Lighting	Varies	EE	Ltg	Induction Walk and Street Lighting Retrofit

1. *Cat - Category (EE-Energy Efficiency; DR-Demand Response; RE-Renewable Energy; Cx-Commisssioning; OM-Operation and Maint.)*

4.2 BUILDINGS

4.2.1 City Hall

Building Information
City Hall was constructed in 1975. It is a 26,900 square foot, two story building located at 1400 Highland Avenue. The building houses the City Council offices, Council Chambers, Finance Department, and the Engineering Department.

The building maintenance personnel arrive by 7 am, Monday through Friday and the building is open to the public from 8 am to 5 pm. It is closed on the weekends and federal holidays. The cleaning crew works from approximately 9:30 to 11 pm nightly.

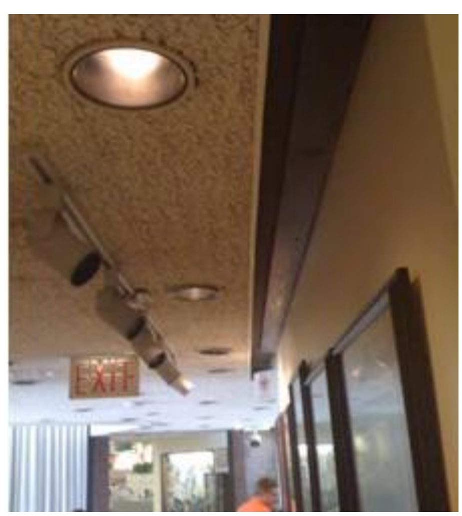
The Energy Use Index (EUI) of the building is quite high; almost double the Federal Guidelines for office buildings.

Utility Meters
There is one electric meter and one gas meter at this site.

View of Exterior Walls and Windows

Envelope
The City Hall building is of masonry construction. The upper floor walls are constructed of reinforced clay block and do not have any insulation. The lower floor, where exposed, is of 8-inch reinforced concrete with brick veneer. The roof deck is constructed of 1-1/2” steel decking with concrete topping, 1-1/2” rigid insulation, and single-ply membrane roofing. Windows throughout are single pane with bronze tinting.

Lighting
Lighting in City Hall is primarily, 2-lamp (L) T8 32 W recessed, ventilating fixtures with electronic ballasts. Many desks throughout the facility have 2X1 17W single lamp T5 fixtures with electronic ballasts built-in as task lights. Lighting is controlled by switches in the majority of the spaces.



At the west City Hall reception desk entryway, there are 28 recessed “can” lamp fixtures with 9W CFLs. These lamps are too high in the cans, so the majority of the lighting is not being cast into the space, thus wasting light energy. These lights are controlled by switches and are turned on during office hours and off late in the evening when the cleaning crew is finished.

The Council Chamber lighting is outdated and needs replaced. In the chambers, there are an estimated 28 1L 40W T12 fixtures with magnetic ballasts. In addition there are several 1L 65 incandescent lamps. When all the fixtures are turned on in this room, the room is still quite dark and the light quality is poor. These fixtures need replacement immediately. Recommended changes are provided in the energy efficiency measure section below.

Council Chamber Lighting

Exterior lighting is a mixture of 26W compact fluorescent (CFL) and 150W, 175W, and 250W metal halide fixtures. These fixtures are controlled by photocells and are on from dusk until dawn daily.

HVAC

The basic components of the original air handling systems still serve the building. These are composed of three air handling units, general distribution ductwork and duct volume dampers to control flow. Over the years some modifications have been made to the basic system as a result of operating problems.

The first floor is served by a roof-top heating and air conditioning unit with a chilled water cooling coil and a hot water heating coil. Each individual space has a thermostatically controlled duct damper to regulate the flow to that space, and each exposure has a separate duct run with a heating coil that provides heated air to control temperatures within each exposure. The duct temperatures are set by exposure and not by individual space temperatures. Because of control problems inherent in the design, this unit is turned on several hours before the space is occupied; sometimes as early as Sunday afternoon when the weather is hot.

The Council Chambers and surrounding conference and auxiliary offices are also served by a roof-top heating and air conditioning unit that has a control arrangement similar to that of the first floor. This unit, however, is only operated on the days that the Council Chambers will be occupied.

A third unit, located in a basement mechanical room, serves the south portion of the basement level, which houses the engineering department and a portion of the finance department. This unit has a hot water coil for heating and a separate air-cooled condensing unit located in an adjacent areaway. Within the last few years, a portion of the basement has housed the City computer room, which requires air conditioning on a 24/7 basis, thus necessitating that this unit run continuously.

City Hall Mechanical Room

Heating hot water for the heating system is provided by a relatively new gas-fired boiler located in a small boiler room at the roof level. Chilled water for cooling is provided by an air-cooled chiller located on the roof adjacent to the two roof-top air conditioning units.

Domestic Hot Water

Two domestic water heaters serve the building. A 50 gallon gas-fired water heater is located in the boiler room on the roof and a 40 gallon electric water heater is located in the north-east corner of the south wing on the lower level.

Miscellaneous Loads

Typical office plug loads, such as computers, monitors, printers, copiers, scanners, fax machines, and multi-function devices are found throughout this facility. A list of all these devices may be found in the appendix.

Renewable Energy

There is no renewable energy at this site at this time.

Data Logging
Data loggers were placed at this site to monitor lighting and motor energy use. For information about these loggers, please see the Appendix.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures are recommended:

Envelope Measures:
In general, the building can be classified as a "heavy mass" building, since it is of masonry and concrete construction. The exception is the west and east exposures, which are lined with almost continuous 11' high single-glazed tinted windows. This glass does little to protect against the low solar exposures during the afternoons and early evenings, and it's this glass that dictates not only the supply duct temperatures, but also the system operating schedules. Two separate glass measures, along with additional roof insulation were investigated.

1. Replace West-Facing Glass: Replace west-facing single-pane glass with energy efficient, low-e, solar control, double pane windows. This retrofit measure will have a significant effect on the overall cooling load of the building and will even allow a later start time for the air handling system serving the first floor. This will result in reduced fan energy and heating and cooling requirements.

   In addition, natural ventilation of the spaces could be accomplished by adding operable sections to the new window assemblies, and "wind-turbine" gravity ventilators to the attic space. These would need to be interlocked with the building automation system such that when the windows are open, heating or cooling of the space is limited.

Lighting Measures:
Two major lighting measures were analyzed (using the eQUEST computer model).

2. The existing lighting system, although retrofitted some years ago to T8 fixtures, is a very inefficient design. The fixtures are "return air" fixtures with openings into the cavity above the ceiling and as a result, a significant amount of light is projected upwards into the cavity where it is wasted. Also, the ceiling is dark, absorbing much of the down light component. As a result, the light intensity levels are much higher than permitted by the current version of Title 24, the State Energy Code. Many spaces exceed 2 watts / sq. ft. light intensity.

   This measure proposes removing the existing ceiling and replacing it with a new, light colored acoustic tile T-bar system. New light fixtures will be provided. Suspended 2-lamp fixtures with a significant portion of the light directed upward to bounce off the ceiling are proposed. With good design, the new light intensity level should be no more than 0.8 watts / sq. ft. with today's standards.

3. Add General Lighting Controls to New EMS System: Presently, private offices are individually switched and open office areas are area-switched. It was reported that, in general, the lights were turned off when employees leave, or sometime between 5 and 6 pm, and then turned back on when the cleaning crews arrive, sometime between 10

and 11 pm. However, our lighting loggers indicated that quite often, the lights are left on after the employees have left and are not turned off until the cleaning crews leave.

This measure proposes connecting the lighting panels to a new building automation system that will initiate lighting sweeps every hour or two hours, starting at 5:30. This will ensure that all lights are turned off whenever the building is unoccupied (such as between intermittent uses).

Note: Use of a certified lighting designer, experienced in energy efficient design will ensure the lighting scheme provides good lighting levels *and* light quality in hallways, offices, and common areas., especially areas such as the City Hall entrance and Council Chambers.

4. Other miscellaneous measures that are recommended include:
   - Installation of LEDs under the cabinets of the cubicles in the Finance Department
   - Installation of occupancy sensors in all stairwells and offices
   - Replace T8 fixtures in the display cabinetry with LED fixtures
   - Replace the flagpole light with an LED flagpole fixture.
   - Replace other Metal Halide and Mercury Vapor exterior fixtures with induction fixtures.

Mechanical Measures:

The basic mechanical system was designed in 1973 and is a very early vintage variable air volume (VAV) system. It suffers from the same drawbacks as other VAV systems of the same early vintage. The systems were not designed and controlled to respond adequately to the building mass and the microclimate in which it is located. Thus, our analysis quickly discovered that the west-facing glass drove the operation and set points of the air handling system, irrespective of what the rest of the building required.

A couple of attempts have been made over the years to correct the problem; however, they were mostly “band-aid” attempts, since no attempt actually addressed the main issue – the west facing windows. This set of mechanical measures, when coupled with controlling the west solar heat gain, should make significant improvement in the comfort and energy efficiency of the building.

5. Redesign Basement HVAC System: A few years ago, the City’s data center system was installed in a space located in the southeast corner of the building. It was connected to the 15-ton split system air conditioning system serving the basement; however the computer space requires cooling 24 hours per day, 7 days per week. Thus, this unit has to run continuously, even though 90% of the space it serves is only occupied 8 am to 5 pm, 5 days per week.

   This measure recommends installing a new split, dedicated air conditioning system for the computer room and freeing the existing basement supply unit for use just to serve the regular office spaces in the basement. It is recommended that a duct connection remain, however, to serve as a backup should the dedicated unit go down for maintenance. The existing basement system should be re-designed to include standard variable volume terminals with hot water reheat coils. This will be a much easier system to control.

6. Redesign First Floor HVAC System: The current design, with variable volume dampers in each of the run-outs and a separate heating duct with a reheat coil is a difficult arrangement to control and operate. Within the constraints of the present system, the only way it can be accomplished is to cool the air as low as possible and then reheat it by exposure to the temperature required wherever the heating thermostat is located, and then re-cooling it in other spaces where the occupants want a cooler temperature. This effectively eliminates the advantages of the individual room control.

   This measure recommends replacing the existing individual zone dampers with variable air volume reheat terminals with hot water coils. This also will require eliminating the hot duct around the perimeter and connecting all registers to their respective zone ducts. The system would then operate as a standard VAV system with reheat.

   While in and of itself, this measure doesn't result in appreciable energy savings, it will permit implementation of high performance building control strategies, such as duct pressure optimization and duct temperature optimization under the proposed new building automation system.

7. Install New Building Automation System (BAS): The present Novar BAS is very outdated. It is limited in its capabilities and is unable to perform many of the simple control strategies that are necessary for efficient operation of building mechanical and electrical systems.

   It is recommended that the Honeywell building automation system serving the Public Safety Building next door be extended to City Hall and be utilized to provide a very high level of automation and control. . This new system should be able to accomplish necessary control strategies for optimization of building energy systems, such as fan energy, cooling energy, and heating energy. It should be able to identify and pinpoint building equipment failures and problems. It should be readily accessible and operable by building maintenance personnel and be able to give a complete picture of the operating conditions of all building systems at any time. Operating strategies should include, but not be limited to

   - Optimize duct static pressure.
   - Optimize duct temperature
   - Optimize economizer settings
   - Control on-demand ventilation.
   - Multiple lighting sweeps.
   - Optimize chiller settings
   - Optimize capacity of ice storage system.

Data Management / Plug Load Measures:
Note: A detailed assessment of the data centers was outside the scope of this audit. Nonetheless, we included rough estimate of probable costs and savings based on the (outdated) inventory provided at the time of the audit. We recommend including the following potential

upgrades as part of the budget process and concluding a more accurate assessment during the design development phase. Details of our assumptions are in the Appendix.

8. Data Center Servers: The present data center servers appear to be older and not utilizing virtualization techniques. Virtualization on newer servers enables one server to operate to its full potential and bandwidth and thus reducing the number of servers (and hence plug loads and supporting cooling loads) needed. This may also enable elimination of the "overflow" server rack located in the west stairwell that may also be an emergency egress hazard. Employing recent advancements will enable deployment of workstation clients and reduce the size of the standalone cooling system recommended above.

9. Workstation Clients: Personal Computers in the workplace account for up to 30% of building energy use, tremendous software upgrade costs and significant security vulnerabilities. The Workstation Client (such as Sun's Sun Ray) is a simple, low-cost, low power device that enables just a few system administrators to manage up to thousands of workstations. The Sun Ray client does not have a local operating system, so the clients do not need to be upgraded when new applications are introduced. Data and applications are centralized on a server where they can be easily backed up and made secure against theft and attacks.

   Users access their session on the Sun Ray client with a smart card. The smart card can be inserted into any Sun Ray client on the network, enabling users to move from one place to another and call up their session simply by inserting their smart card. This "hot desking" capability allows you to move from your office to a conference room, accessing your session easily. It also significantly reduces: software costs, energy costs, data loss from insufficient backups and replacement costs while improving security and privacy.

Renewable Energy Measures:

10. Install a solar structure on the roof of City Hall.
    a. For more detailed information about the solar photovoltaic installation, please see the Appendix.

Interactive Measures:

With the exception of the moveable shades and the additional roof insulation, it is recommended that all of the above measures be implemented. While this results in a substantial project investment, building efficiency, comfort and staff productivity would be greatly improved.

ANALYZED BUT NOT RECOMMENDED

1. Add Exterior Blinds: An additional measure proposing moveable exterior vertical blinds was also investigated. This would involve adding motorized vertical blinds, approximately 6" in width, to the outside of the west window sections. These would be controlled by the location of the sun at any point in time, rotating to ensure the direct sunlight is not on the windows, while yet permitting at least partial view out the windows. While this would be somewhat effective, it proved to have a relatively long payback.

2. Add Roof Insulation: The building is of “heavy mass” construction and the roof has a concrete slab over a 1-1/2” metal pan roof deck. There is 1-1/2” of rigid insulation over this assembly, which in terms of today’s building standards doesn’t seem to be much. However when coupled with the concrete deck and mild temperatures, it makes for a relatively efficient roof system. Thus, when we analyzed the effect of adding R-19 insulation to the space between the roof deck and the ceiling, the result was a very long payback measure. Thus this measure is not recommended at this time.

3. Install New Chiller, Ice Storage System: The existing Trane 80-ton air-cooled chiller was installed in 1994 as part of the Garage Conversion and First Floor Renovation project. It is an R-22 reciprocating machine and technology has rendered it obsolete, even though it runs well.

   This measure analyzed replacing the existing chiller with a new, 70 or 80 ton R-410a machine that is even capable of producing chilled water at 20 deg. F for use in an ice-storage system. This chiller would operate at night, storing ice in large drums for use as a cooling medium during the daytime peak periods. This is especially effective during the summer peak demand periods when the chiller can be run at night during off-peak periods. This would effectively reduce the building peak demand by about 50 kW per month.

   Subsequently, under the Public Safety Building portion of the audit, it was decided to connect the City Hall to the new ice storage array recommended at the Public Safety Building chiller plant, thus creating a virtual central plant to serve both facilities. Since there is more than enough time to create and store the 800 to 900 ton-hours needed to cool both buildings during the day, this saved the cost of installing a new chiller in City Hall.

4.2.2 Public Safety

Building Information

The Public Safety Building was constructed in 2006. It is a 60,000 square foot two story building located at 400 and 420 15th Street. It houses the Manhattan Police Department and the main Fire Station.

The building is occupied 24 hours per day, 7 days per week; however it is only open to the public from 8 am to 5 pm, Monday through Friday. It is closed to the public on weekends and federal holidays. The cleaning crew works from approximately 9:30 to 11 pm nightly.

The Energy Use Index (EUI) of the building is average for a 24/7 facility, at about 111 kBtu/SF/year.

Utility Data

There is one electric meter and two gas meters serving this building. One gas meter serves the miscellaneous loads in the building, while the second gas meter serves the Central Plant.

Building Envelope

The Public Safety Building is primarily steel frame construction. The upper floor walls are constructed of 6-inch steel studs. It is finished with cement plaster over gypboard on the exterior and gypboard on the interior. It has R-19 batt insulation. The walls of the lower floor, most of which are below grade, are of reinforced concrete. The roof deck is constructed of 1-1/2" steel decking a single-ply membrane roofing and R-30 insulation on the underside of the decking. Windows throughout are double pane with solar control tinting.

Lighting

Lighting throughout the building hallways, office spaces, conference rooms, and restrooms is primarily 4' 2L 32W surface mounted fluorescent T8 fixtures with electronic ballasts. There are also several 2X2 16cell parabolic 40W T5 Biax fluorescent fixtures with electronic ballasts. Under counter task lights which are found at the reception desks of the main lobby to the fire and police department are surface mounted 2' 1L 17W T5 fixtures and these are controlled by switches.

In both the public parking garage and the employee parking garage there are groups of two, 4' 32W T8 fixtures with electronic ballasts in tandem. These fixtures are only a few years old and are in good condition.

Lighting is controlled by occupancy sensors throughout the entire building. However, occupants in the Fire Station dormitory mentioned to us that they do not think that the occupancy sensors are calibrated correctly. Occupants surveyed in other areas of the building mentioned that they have seen the occupancy sensors automatically shut fixtures off. It is apparent that some of the occupancy sensors are not calibrated correctly and need to be tuned. This should be done to all occupancy sensors in the building, as recommended below.

Police and Fire Lighting

Exterior lighting is a mixture of parking lot/safety lighting and architectural lighting. The majority of the exterior parking lot lights are 400W Metal Halide shoebox fixtures mounted on poles and controlled by photocells.

In the plaza, there are 50W Metal Halide well lights and pole lights as well as 9-23W compact fluorescent step lights, path lighting, tree uplights and other area accent lights. These fixtures are controlled by photocells and turn on at dusk / off at dawn.

HVAC

Heating and air conditioning for most of the building is provided by three rooftop single duct reheat air handling units with chilled water cooling coils (AHU-2 through AHU-4). Space control is provided by variable air volume (VAV) terminals; some with hot water reheat coils and some without. Reheat coils are typically in the terminals serving perimeter spaces.

A fourth single-duct VAV reheat system (AHU-1) serves the north end of the Ground Floor. The upper floor of the north end (also Fire Department), comprising the residential and sleeping quarters, as well as the radio room, is served by individual units commonly called “Ductless Split” units. These have individual condensing units on the roof piped to fan coil units in the room served.

Chilled water is provided to the four air handling units from a central chiller plant located at the south end of the building (Police Department end). The plant contains (2) Carrier 30HXC096 nominal 80 ton screw-type water cooled chillers. These chillers utilize R-134a refrigerant and are designated as “environmentally friendly”. Condenser water is provided by (2) Delta fiberglass cooling towers located on the roof of the Public Safety building in the same equipment well and AH-2, -3, and -4. Duplex chilled water and condenser water pumps, both equipped with variable frequency drives, are also located in the chiller room. The coils in the air handling units are equipped with 2-way modulating valves.

Heating hot water is provided by (2) gas-fired hot water boilers located in a separate boiler room adjacent to the chiller room. The hot water is distributed throughout the building to the reheat coils by a heating hot water piping system. Duplex heating hot water pumps, each with a variable frequency drive are also located in the boiler room. The reheat coils are equipped with 2-way modulating valves.

Temperature controls throughout the building are provided by a Honeywell Building Automation System. This system is very comprehensive and its capabilities are limited only by the extent of the programming and the complexity of the graphics. We could not find anything immediately handy for maintenance personnel that detailed the control sequences for operation of the systems, nor was there any indication that the system operation had been optimized at startup.

Domestic Hot Water

Two gas-fired domestic water heaters serve the building. A Lochinvar 300 PMF-7 with an input of 315 Mbh and a rating of 313 GPH at a 100 deg. F temperature difference, coupled with a 318 gal storage tank serves the south half (Police) of the building. A Lochinvar 200 PMF-7 with an input of 200 Mbh and a rating of 198 GPH at a 100°F temperature difference, coupled with a 200 gallon storage tank serves the north half (Fire Department) of the building.

Miscellaneous Loads

Typical office plug loads, such as computers, monitors, printers, copiers, scanners, fax machines, and multi-function devices are located throughout this facility. A list of all these devices may be found in the appendix.

Renewable Energy

There is no renewable energy at this site at this time.

Data Logging

Two lighting loggers were placed in this building. For information about these loggers, please see the Appendix.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures are recommended:

Envelope Measures:

In general, the building can be classified as a "light steel frame" building, since it is of steel studs and joists construction. The building is also well-insulated with R-19 insulation in the wall cavities and R-30 insulation under the roof deck.

Due to the high security nature of the facility, the amount of window area is very limited, with a few windows in the general office areas and large window areas only in the entries to the building. All glass is double-glazed and treated for solar control.

The building is in compliance with the current edition of California Title 24, the State Energy Code, and was well-designed for energy efficiency, so there are no building envelope measures recommended.

Lighting Measures:

1. Replace Exterior Metal Halide Fixtures with Induction Fixtures: Retrofit the 250 and 400 W Metal Halide fixtures with equivalent wattage induction fixtures.

2. Add General Lighting Controls to EMS System: This measure proposes connecting the lighting panels to the existing building automation system that will initiate lighting sweeps every hour or two hours, starting at 5:30. This will ensure that all lights are turned off when daytime building occupants leave for the evening. Areas that are occupied 24 hours per day can be bypassed if it becomes a problem.

Mechanical Measures:

3. Basic Mechanical System Performance Validation: The basic mechanical system was designed in conformance with the Title 24 in force at the time, which has not varied much in the three years since then. The systems are variable air volume with reheat coils for the perimeter zones. The control sequences include some provision for temperature reset, but the drawings aren't clear as to the scope and limits of the reset. The systems were commissioned at the time of completion of the building; however, it appears that they may be in need of additional validation. Also, some changes need to be made to the reset controls to improve occupant comfort and to move this building toward "High Performance Building" standards.

   Commissioning is a method of systematically ensuring that the mechanical and electrical systems are performing as they were designed to do. Theoretically, a commissioning agent is an integral part of the design team from earliest conception of the project and provides input into system design, control and operation. Once the installation work is complete, the commissioning agent runs all systems through their complete control cycles to confirm that equipment and controls are performing as designed. However, it is not uncommon that previously commissioned systems change gradually over the years and need to be periodically re-commissioned. The level of the Energy Use Index of this building indicates that this may be the case.

   This measure proposes "performance validation" of the building; a process by which the systems and control settings are adjusted and calibrated to provide the optimum in both comfort and energy efficiency. The first step in this process would be to create a commissioning plan, then deploy a contractor to perform this function.

4. Modify Control Sequences for Energy Efficiency: The current design employs duct static pressure sensors to set the speed of the variable frequency drives on the supply and return fans. These sensors control the fans to maintain a fixed air pressure at a point down the duct and thus, move only the amount of air that is necessary to satisfy the variable volume terminals. While this has good energy efficiency characteristics, new, high performance control sequences involve the use of utilizing the control signal from the box requiring the most pressure to reset the duct pressure sensor. Since all these components are already connected to the Honeywell building automation system, this is not a difficult retrofit to undertake.

In addition, it is further recommended that the Honeywell system be upgraded to make it more user-friendly. This would include upgraded graphics and touch-screen technology for user access. It should also include advanced operator training for the use of the system. Trained operators should have full web-based access to the system to enable them to troubleshoot from any location.

Central Plant:

5. This measure proposes creating a central plant utilizing the (2) Carrier chillers in the Public Safety Chiller Room to serve both the Public Safety Building and City Hall. This will be accomplished by the following steps.
    a. De-activate and remove the existing 80-ton air-cooled chiller on the roof of City Hall and the 15 ton air-cooled condenser in the areaway at the southeast corner of City Hall.
    b. Install (6) Calmac ice storage tanks with a total capacity of 900 ton-hours of ice. Provide new piping and connections to existing Carrier chillers. Provide required control modifications to existing Carrier chillers.
    c. Install new chilled water loop between the Public Safety chiller plant and the City Hall. Provide pumping, valves and controls as an independent circuit from the chilled water supply to the Public Safety air handling units.
    d. Replace the direct expansion coil in the basement air handler in City Hall with a new, chilled water coil. Connect the City Hall air handlers to the new chilled water loop from the Public Safety chiller plant.
    e. The new chiller plant arrangement will operate by running the chillers during the off-peak hours, thereby eliminating demand charges. They have enough capacity to charge 900 ton-hours of ice at 21 deg. F over a 10-hour period. During the peak hours of the day, chilled water will be provided by the ice tanks to satisfy the cooling loads of both the Public Safety building and City Hall.

Renewable Energy Measures:

6. Install a solar parking lot structure in the parking lot between City Hall and the Public Safety Building and two rows of parking lot structures in the back parking lot near the animal control space. For more detailed information about the solar photovoltaic installation, please see the Appendix.

Answers to Building Performance Concerns

1. **Design Modifications:** During our site visits, we were shown a couple of problem areas in the building that the occupants would like corrected. We have studied these areas and have the following recommendations.

    a. Fan Room in North End of Building: This room was designed as a return air plenum. The return duct is open to the space and open to the air handling unit. This is a technique sometimes used when space is a premium and there is inadequate room for a full, ducted return air system. The problem arises in that the space then is maintained at a negative pressure, sometimes in excess of ½" water gauge. This makes it difficult to open the door to the space, should someone need to get in there. In this case, it results in a sudden influx of air, since the space is suddenly open to the equipment room. One solution is to provide a fully ducted return to the air handling unit. It would appear that there is adequate space in this room to accomplish this. The other, far less expensive, option is to place a permanent note on the door stating something like, "Maintenance Room or Fan Room. This room is a return air plenum for the HVAC system. Please open slowly to relieve negative air pressure. When not in use, door to remain closed".

b. There have been complaints in the Detective's office area that the room is "stuffy" and "inadequately ventilated". In reviewing the space on site and on the drawings, it was found that the air supply to the space is designed for an air supply index of 0.75 cfm / sq. ft., which is marginal for an active office space. This space is served by two VAV terminals, one of which has a reheat coil. Since this is a windowless area, it is typically affected by internal loads only. The supply duct temperature is set to satisfy the areas with exterior exposure, especially glass. Thus, when they are calling for full cooling, one VAV terminal of the two serving the Detective offices will be practically shut down, resulting in a very low air supply index. The solution to this problem is to revise the air supply system to increase the amount of air to the space by increasing the temperature of the supply air. This can be done by either adding a reheat coil in the second VAV terminal, or changing the terminal out to a Fan-powered terminal while still providing the necessary dehumidification. This upgrade is recommended.

4.2.3 Civic Center Annex


Civic Center Annex

The Civic Center Annex, also known as the City Hall Annex, was constructed in 1970. It is a 4,394 square foot, single story building located at 425 15th Street across from the Public Safety and Fire facility. It houses a small U.S. Post Office, the Chamber of Commerce, and some city offices. People begin arriving at the building between 7:30 and 8 am and leave around 5 pm.

Approximately 15 people work inside the building daily and several people come in and out of the building visiting the Post Office and Chamber of Commerce.

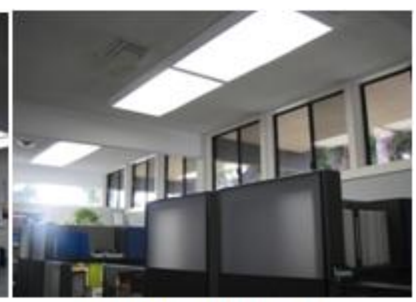
Utility Meters
There is one electric meter and one gas meter at this site.

Envelope
The building is frame construction with face-brick exterior. The windows are single pane and operable. The roof is of plywood decking with single ply roofing material, and is in good condition.

Lighting
Lighting throughout this facility varies greatly since the facility is occupied by three different tenants. A description for each area is provided below.

Main Lobby. The fixtures in the Post Office section are primarily 2L 32 W with electronic ballasts. Just off of the lobby are two small restrooms, each with a single 13W CFL fixture outside the door, a single 4L 32W T8 fixture, and a single 2L 17W T8 fixture.

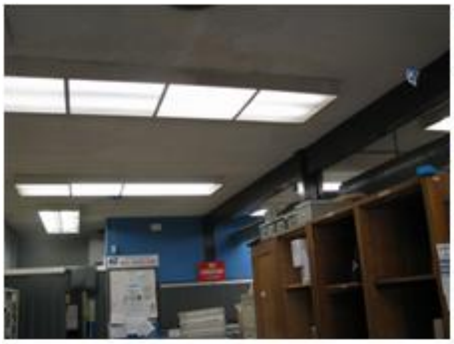

Lobby Lighting


Chamber of Commerce Office

Chamber of Commerce. The fixtures in the Chamber of Commerce are primarily 4-lamp 32W T8 fixtures with electronic ballasts. There are two switches for these lights and they are split up so only half of the fixtures need to be on during the day. The Chamber of Commerce room is surrounded with windows on three sides, so there is significant natural daylight during operating hours. The fixtures appear in good condition.

City Hall Annex Offices. The fixtures in this part of the building are primarily 1X4 2L 32 W T8 fixtures with electronic ballasts. There is also a single 2' T12 fixture in the hallway and an 8' T8 fixture in the small kitchen.

Post Office. Lighting in this area is primarily 1X8 T8 2L 59W fixtures. Approximately half of the fixtures in the back half of the post office are left on 24 hours a day.


Post Office


Exterior Lighting

Exterior. Outside the City Hall Annex there are 13 and 15W CFL lamps in breadboxes and spot lights. There is also a one lamp 150W Metal Halide fixture. The parking lot also has four 1-lamp 250W Metal Halide parking lot lights on 16' poles. The majority of outside lighting is controlled by photocells. The exception is a motion light with a switch that is just outside the post office backroom door for mailmen who come to pick up and drop off mail after dark.

HVAC
Three 3-ton package units provide a total of 9 tons of cooling to this building. A Carrier unit located on the roof serves the Chamber of Commerce, a second Carrier unit located on the ground at the back of the building serves the City's Crime Prevention Office, and a BDP Company unit located on the ground at the front of the building services the U.S. Post Office. The two units on the ground are relatively new and in good condition, while the roof-mounted unit is at least 15 years old and has reached the end of its estimated service life.

The fans appear to run only when the thermostat calls for heating or cooling. Note that California Codes require continuous ventilation any time the buildings are occupied.

Domestic Hot Water
Domestic hot water is provided to the building by gas water heaters.

Renewable Energy
There is no renewable energy at this site.

Data Loggers
A motor data logger was placed on the Carrier 3-ton package unit on the community services patio to the north of the building. For information about this logger, please see the Appendix.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures are recommended for this site:

1. Install skylights in the main lobby and the post office lobby. In each space, add a photocell to dim the light fixtures in these spaces as the natural lighting level varies.
    a. The roof in this facility is also only one story, so skylights can easily be installed to provide natural light to the main lobby and the post office of this building.

   b. The skylights should be paired with fixtures with dimmable ballasts so that the artificial lighting will only be used when natural lighting is not adequate. Information about the fixture retrofits is discussed below.
   c. It is estimated that 8-12 skylights can be installed in the main lobby and two skylights can be installed in the post office.

2. Delamp 4-lamp fixtures while also making fixture types more consistent city-wide by retrofitting 8' T8 fixtures with 4' T8 fixtures.
   a. By using a retrofit kit to replace 8' T8 fixtures with 4' T8 fixtures while at the same time delamping 4-lamp fixtures to 3-lamp fixtures lighting energy will be saved.
      i. Note: If skylights are installed, the fixtures in the main lobby should have dimmable ballasts and a photocell so that they can be adjusted as the natural light levels change.
   b. This is recommended because 8' T8 lamps are becoming difficult to purchase. In addition, the length makes them difficult to stock and handle.
   c. This will also be an aesthetic improvement since some of these fixtures are in poor condition.

3. Install occupancy sensors in the restrooms, main lobby, and offices
   a. Wall occupancy sensors should be installed in the restrooms and offices so that the lights are automatically shut off after the room is unoccupied for 3-5 minutes.
   b. Two ceiling occupancy sensors should be installed in the main lobby/post office box area of the building to turn off 50% of the lighting when no one has passed through the lobby for 3-5 minutes. This will lower overall lighting levels and energy use during quiet times in the building.

4. Remove existing 3-ton Carrier 50HS heat pump that serves the Chamber of Commerce and replace it with a new 3-ton heat pump with a SEER between 13 and 15.
   a. A new heat pump, such as the Carrier 50TCQ, will reduce the total cooling and heating power required to operate the unit as well as reduce the total annual energy use.

5. Install 3 programmable thermostats and program these 3 thermostats.
   a. Programmable thermostats that communicate with each heat pump will allow for better comfort and control in this building. The post office, city hall offices, and chamber of commerce can each have their heat pump programmable thermostat set to the operating hours of the space to control both heating and cooling.
   b. The heat pump should default to the "Auto" setting while maintaining continuous fan operation any time the building is occupied. The thermostat will initiate the appropriate sequence when either heating or cooling is desired. End switches in the operable windows will turn the heat pump off any time the windows are opened.

6. Install a new domestic hot water heater.
    a. Replace the existing gas water heaters with new, high efficiency water heaters with efficiencies in the 90% (+) range.
    b. With the higher levels of insulation, the standby losses will be reduced considerably.
    c. Wire the water heater through a 365-dqy programmable time clock to turn the water heaters off when the building is unoccupied.

4.2.4 Fire Station #2

Fire Station #2 is located at 1400 Manhattan Beach Blvd. There are two buildings onsite: the Firehouse and a detached garage which is used as a workout room.

Side view of Fire Station #2

Fire Station #2

Utility Meters
There is one electric and one gas meter at this location.

Building Envelope
Firehouse Building. The Firehouse is a 3,286 square foot brick building that was constructed in 1954. It contains the fire truck bay as well as the living quarters for the fireman. The original windows were replaced several years ago with double pane windows to help reduce traffic noise for the fireman. The roof is pitched, well insulated, and is covered with composite shingles.

Workout Garage. The garage is a 528 square foot wood frame building that was originally built in 1967. A few years ago the garage was converted a workout gym. The retrofit work included adding gypsum board to the inside of the garage walls as well as dropping the ceiling, adding insulation, and then adding a suspended lighting.

Lighting
Firehouse Building. Lighting throughout the house is a mixture of 2L and 4L 32 Watt T8 fixtures with electronic ballasts. The fixtures are controlled by switches. The women's restroom has 8 75W incandescent lamps and one of the bedrooms has a ceiling fan with four incandescent lamps. Shower areas also have recessed square fixtures with 13W CFL lamps. Lighting in the fire truck bay is 8' 4L 32W T8 fixtures with electronic ballasts. Lighting is controlled by manual switches throughout the entire facility.

Workout Garage. The garage has a suspended ceiling with 10 2L 32W 4' T8 fixtures which are controlled by switches.

Exterior. Exterior lighting is a mixture of incandescent and CFL lamps controlled by switches.

HVAC

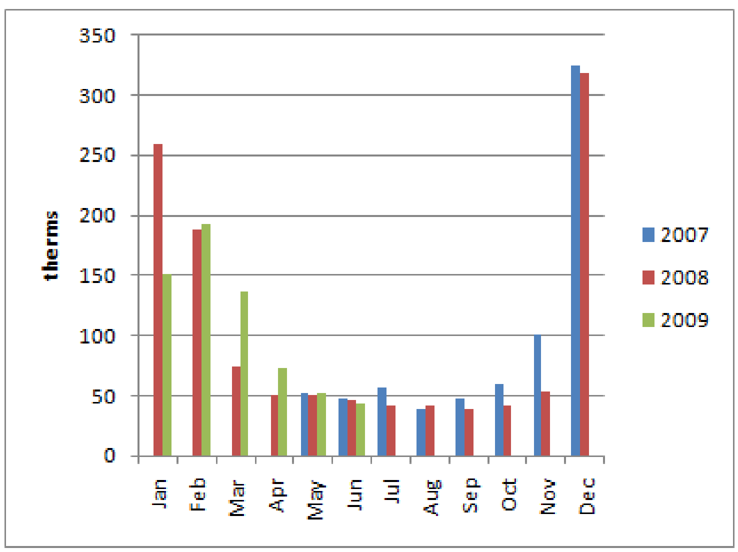
Heating and air conditioning is provided to the Firehouse by a 5-ton Bryant package unit. It serves the main house only. The unit is in fair condition and should last another 7 - 8 years. However, it is a 10 SEER[3] unit, which is inefficient compared to today's standards. Since this is a 24 hour facility, replacement with a 13-15 SEER unit should be considered. This is discussed further in the energy efficiency measures below.

The fire truck bay has a gas-fired Dayton unit heater, which is used to heat the garage. The use of a unit heater is inefficient for this space since the fire truck garage doors are frequently open when the heater is on. When this happens, the warm air produced by the heater escapes out the garage door.

Fire Truck Bay / Exhaust Fan

Evidence that this heater wastes a lot of gas is illustrated in the gas consumption chart below. The chart shows natural gas usage at Fire House #2 from May 2007 – June 2009. Notice how gas consumption follows an inverse bell shaped curve. Gas consumption is greatest in the winter months, when the need for gas for space heating is needed most often, and lowest in the summer months, when gas for space heating is not needed. (The gas use in the summer months is primarily for domestic hot water.)

This trend is typical; however, the fact that gas consumption in December (300 therms) is 500% greater than the average summertime gas consumption (50 therms) is alarming. It indicates that gas heat is being wasted, and the only place in this building where significant gas heat could be wasted is the fire bay garage. In this space, the unit heater could be on high heat while the fire truck bay doors are wide open. The heat would provide the occupants of the garage some comfort from the winter air; however, the warm air would immediately disperse into the out-of-doors, providing no long-term comfort conditions in the garage.



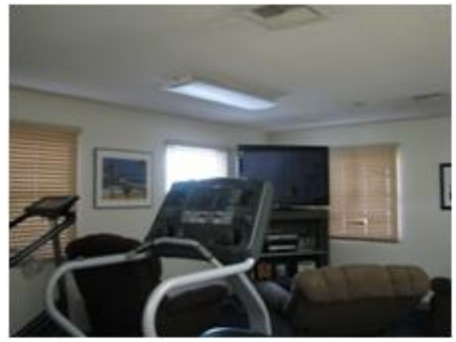
Gas Consumption at Fire Station #2

[3] SEER stands for "Seasonal Energy Efficiency Ratio". It's the ratio of total seasonal cooling output in BTUs to total seasonal energy input in watt-hours. Seasonal means the rating is averaged to include not only performance at peak conditions but also performance at part load conditions. The higher the SEER rating, the more efficient the air conditioning (electric/gas package unit and/or a heat pump).

Options to help mitigate wasted heater energy in the fire truck garage are discussed in the energy efficiency measures section below.

Domestic Hot Water
Domestic hot water is provided by a gas water heater.

Miscellaneous Loads
Firehouse. Since this building is used as a home for the fireman, it also has typical home appliances including an oven, refrigerator, microwave, coffeemaker, dishwasher, a plasma television, a few small conventional televisions, washer and a dryer, a treadmill, and a few personal computers/laptops. In addition, in the fire truck bay there are some plug-in tools. One of the larger plug-loads in the bay is the battery chargers for the fire trucks. In general, the trucks are plugged in while they are in the garage.


Main House Living Room

Workout Garage. The workout garage has two televisions and a radio.

Renewable Energy
There is no renewable energy at this location at this time.

Data Logging
Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Delamp 4-lamp T8 fixtures to 3-lamp fixtures.
    a. Four lamp fixtures are unnecessary in a building such as this one where the ceilings are low and fixtures are relatively close together. Delamping the fixtures will reduce overall lighting energy.

2. Replace 8’ T8 fixtures in the garage with 4’ T8 fixtures.

3. Replace both interior and exterior incandescent bulbs with CFL lamps.

4. Install occupancy sensors in the restrooms, washer/dryer room, workshop, workout garage, and fire truck bay.
    a. Wall switches should be installed in the smaller rooms such as the restrooms and washer/dryer room
    b. Ceiling sensors should be installed in the larger rooms such as the workout garage and fire truck bay. Placement of the sensors must be carefully done to ensure the lights do not turn off when someone is working with a piece of shop equipment in the garage or an occupant is lifting heavy weights in the garage. Place the sensor in a central location in the room and/or down main walkways in the space to ensure the sensors can see anyone in the space.

5. Replace the 5-ton rooftop electric/gas package unit with a new, high efficiency (SEER 13-15) unit. A new, high efficiency package unit will reduce the total cooling and heating power and energy required.

6. Replace the Dayton heater in the fire truck bay garage with an infrared radiant heater that is turned on locally by a switch and turned off automatically using an occupancy sensor.
   a. As mentioned above, it appears as if there is significant gas used at Fire House #2 by the unit heater serving the fire truck bay garage. To help minimize this energy waste, it is recommended that the existing unit heater be replaced with a radiant heater.
   b. How it works.
      - An infrared radiant heater is a hot surface heating appliance that emits radiant wave energy to surfaces below. When the radiant energy hits surfaces, the energy converts into heat and warms the surrounding air. It is a lot like our sun, which emits radiant energy to the surface of the earth, where the radiant energy becomes heat energy, and warms our air.
   c. Mounting.
      - In general, radiant heaters are suspended from the ceiling with the radiant emitters pointed toward the floor below and spaced evenly around the garage to provide uniform heating and optimum comfort to the surfaces below. At Fire Station #2, the location and spacing of the heaters will depend on the location of the fire trucks and other obstructions in the garage.
   d. Benefits.
      - Infrared energy heats from the ground up. When the radiant energy hits the surface of the floor, the energy is turned into heat. This heats the floors and then the heat from the floor transfers to the air near the floor and the bodies standing on the floor.
      - This is more efficient than the unit heaters which heat the air in the garage. When the air is warmed, it rises. The air at the top of the garage is warmed first, and layer by layer, the air is warmed from the top to the bottom of the garage, resulting in cold floors and cold occupants until all the air in the entire garage is warmed. In a space with high ceilings, like the fire truck bay, it takes a long time to heat the air from the ceiling to the floor.
   e. In summary, infrared heaters are a more efficient way to provide a comfortable garage workspace compared to conventional forced air heating systems. They heat spaces more quickly and thus use less energy than forced air systems.
   f. If the City chooses to forego installing a radiant heater, another option that will help minimize waste heat but won't necessarily save any gas usage is to install a sensor that automatically turns off the unit heater when the fire truck bay garage doors are open. This prevents gas from being wasted when the garage doors are open; however, it does not prevent the heat in the garage from escaping when the garage doors are opened.

4.2.5 Joslyn Community Hall

The Joslyn Center Community Hall was constructed in 1965. It is a 12,400 square foot, single story building located at 1601 Valley Drive north of the City Hall Annex. It is a multi-use building. The seniors use it to play cards, dance classes are held in one of the large open rooms, high school dances and theatrical performances, as well as police training, are held in the auditorium, and other rooms are used for meetings. This building also houses some of the recreation planning offices.

Joslyn Community Center

Location	Open	Close
Joslyn CC Hall	7 am	10 pm

Utility Meters

There is one electric meter and one gas meter at this site.

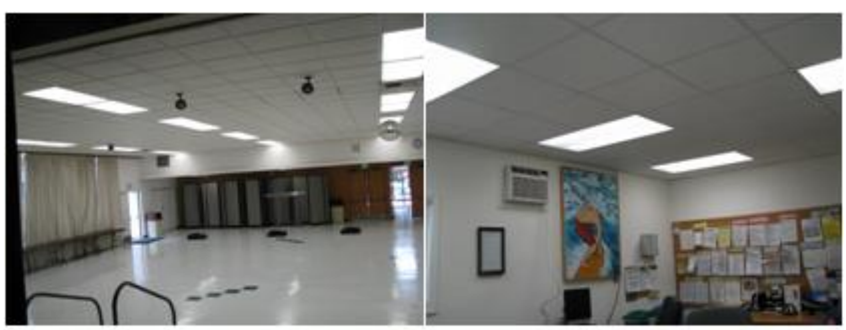
Envelope

This building has 2x4 stud walls with R-11 insulation and plywood deck roof over open web joists with R-19 insulation. It also has single-glazed windows with inside curtains.

Attic Space in Joslyn C.C.

Lighting

Lighting in the Joslyn Community Center is a mixture of 2 and 4-lamp 32W T8 fixtures with electronic ballasts and low wattage CFLs. Even though natural daylight is brought into the lobby and the oasis room of the facility, lighting levels remain high because it is used as a senior center and the lights are on for their safety. Lighting is controlled by switches throughout this facility.



Joslyn Typical Lighting

Joslyn Exterior Lighting

On the outside of the building there are over 25 1L 23W CFL fixtures that are controlled by photocells.

HVAC

The Joslyn Center Community Hall is heated and cooled by four rooftop package units. There is a total of 28 tons of cooling for four zones, including the auditorium (15 tons), southwest room (4 tons), north rooms (5 tons), and southeast rooms (4 tons).

These units are in fair condition and are expected to last another five years. However, the efficiencies of these units are relatively low when compared with units currently available. The sealant used on the supply ductwork located on the roof is breaking down and should be cleaned out and replaced within the next year or two.

Domestic Hot Water

Gas water heaters provide domestic hot water to this building.

Miscellaneous Energy Use

The three offices in this building each have typical office loads, such as a few personal computers, printers, and a small refrigerator. In the Oasis Room there is also a few standard size refrigerators and microwaves. In addition, there are a few television sets around the facility. The dance studio has a radio/sound system. Refer to this list of miscellaneous building loads in the appendix.

Renewable Energy

There is no renewable energy at this location at this point in time.

Data Logging

A motor logger was placed on the auditorium package unit and a lighting logger was placed in a fixture in the Oasis Room. For additional information about these loggers, please see the Appendix.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were considered for this site:

1. Delamp the 4-lamp T8 fixtures. During the site visit, city staff informed us that this building requires higher than normal lighting because of the senior citizens who are in and out of the building frequently. By reducing the four lamp fixtures to three lamp fixtures, the lighting levels should remain adequate for occupants. Also, lighting demand and energy use will be reduced.

2. Install occupancy sensors in the offices, conference rooms, kitchen, and restrooms. Since the rooms in this building are used intermittently by various groups, it is recommended that occupancy sensors be installed on the wall in smaller rooms (meeting rooms, offices, and restrooms) and on the ceiling in larger rooms (auditorium and Oasis Room). The fixtures should be wired to turn off all of the lighting in the space with the exception of the emergency fixtures, if lighting level safety is a concern.

3. To make lamp types more consistent, the fluorescent, Circlite 22W fluorescent lamps should be replaced with a 13W CFLs. This will reduce the lighting demand, energy use while also making replacing lamps easier.

4. Remove all four Lennox rooftop gas packs and replace with equivalent high efficiency rooftop gas packs. Although still in relatively good working condition, all four existing gas packs should be removed and replaced with equivalent tonnage units that have a SEER of 13-15. This will require removing the existing units and install in adaptor curbs to modify the duct connections to suit the new units. These new units should be connected to a remote sensing and monitoring station to improve operating control and ease of monitoring.

5. Replace existing gas-fired water heater with a new, high efficiency water heater. Gas-fired water heaters are now available with 90%(+) efficiency and high efficiency insulation. Replacing the present water heater with a new, high efficiency water heater will save gas not only because of the higher efficiency, but also because the standby losses will be substantially reduced, especially if the water heater is wired through a 365-day time clock.

6. Install a solar photovoltaic system on the roof of the building.
    a. The building has a large, fairly open, roof to install a solar photovoltaic system. It is recommended that a 52 kW high efficiency polycrystalline solar photovoltaic system be installed at a 0 – 5 degree tilt.
    b. A summary of the proposed solar photovoltaic systems and the photovoltaic analysis is provided in the Appendix.

4.2.6 Scout House

Scout House

The Scout House is between the Joslyn Community Center and Live Oak Park at 1617 N. Valley Drive. The building is the original Boy Scout building for the city. It has a few ping pong tables, a small kitchen, restrooms, a small game room, and a storage closet. The building has no insulation and is thought to be one step away from becoming a historical building.

The building is used frequently for Boy Scout troop meetings and can also be unlocked for people to use it to play ping pong in the main hall.

Utility Meters
There is one electric meter and one gas meter at this site.

Envelope
The Scout House date of construction was not provided. It appears to be 1950s or 60s vintage. It is a wood frame building with no insulation in the walls or attic. The windows are single pane with no shades, but the porch overhang and nearby trees shade the building from direct sunlight the majority of the time. The roof is wood frame with composition tile shingles.

Attic Space in the Scout House

Lighting
At the Scout House, lighting is a mixture of 2 and 4-lamp 32W T8 fixtures with electronic ballasts and 13W CFLs. In the storage closet there is an original 22W circle fixture. The lighting for the front porch is a mixture of 13W and 22W CFLs. The main front porch fixture is controlled by a switch on the inside of the building. Facility personnel constantly find this fixture on during the daytime. It is desirable to rewire this fixture so that it is connected to a photocell instead of the interior fixture.

HVAC
There are two unit heaters providing heat to the Scout House: a Dayton 3E368E and a Modine PA30A. These heaters are in good condition, and since they aren't used much, should be left as is and only changed when it becomes necessary.

Scout House Lighting

Domestic Hot Water
Gas heaters provide domestic hot water to the Scout House.

Miscellaneous Energy Use

The Scout House has a small kitchen with a gas stove, fume hood, refrigerator, and microwave. There are no other miscellaneous loads in this facility. A full list of the miscellaneous equipment is included in the appendix.

Renewable Energy

There is no renewable energy at this site at this point in time.

Data Logging

There were no data loggers placed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were considered for this site:

1. Lay insulation in the attic space. This would keep the building more comfortable on hot summer days and cool winter nights while also reducing the amount of energy needed to heat the building in the winter. It is recommended that the City do the installation, thus reducing the cost of the project. (Note: We assumed the City will do the work; therefore, only the cost for the insulation is included in the cost estimate.)

2. Delamp the 4-lamp T8 fixtures and install occupancy sensors in the restrooms, kitchen, and side rooms.

3. Install a photocell sensor for the switch on the front door fixture. We were informed that the outdoor fixture outside the front door is frequently accidently switched on when the building is occupied. To reduce unnecessary lighting energy use by this fixture, it should be connected to a photocell and the switch inside the door of the Scout House should be deactivated.

4.2.7 Manhattan Heights Annex (Creative Arts Center)

The Manhattan Heights Annex, also known as the Creative Arts Center, is located at 1560 Manhattan Beach Blvd. It is a 5,832 square foot facility that was built in 1962.

Manhattan Heights Annex
Creative Arts Center

The building is open from 2-6 pm Tuesday and Thursday, 4-8 pm Wednesday, and 1-4 pm on Saturday. During these hours, the public is welcome to come and view the art display in the main hall and/or take visual art classes that are offered. The building is closed to the public Sunday, Monday and Friday. Employees frequently occupy the building even when the building is not open to the public.

Utility Meters
There is one electric meter and one gas meter on site.

Envelope
It is a round-shaped building with lots of natural daylight, mainly through the gallery area. The classrooms receive natural light both through a few, narrow windows and from clerestory windows into the gallery. The walls are 8” brick with brick also on the inside. The building has single pane windows, skylights, and Tremco roll roofing.

The main gallery cuts through the center of the building. The north side of the building has two art classrooms and the south side of the building has the restrooms, a small kitchen, and an office.

Lighting
The gallery space down the center of the building has ample natural lighting through skylights and large glass windows and doors at both ends. There are also 2’ wide, floor-to-ceiling windows in the two art classrooms. Classroom lighting is supplemented by clerestory windows which permit the light from the central gallery into the classrooms.

During the site visit, there were three employees in the building, and all of the lighting inside the facility was off with the exception of the kitchen where there was an occupant and there is not any natural daylight. Occupants informed us that the lights remain off for the majority of the day when the building is not open to the public. When the building is open to the public, the main gallery lights are typically on showcasing the artwork on the walls. The classroom lights are on typically only during classes, which is intermittently throughout the week.


Main Hall with Natural Daylighting


Art Room

Overhead lighting in the facility is primarily 1L and 2L 32W 4' T8 fixtures with electronic ballasts. However, there are also some architectural lamps throughout the facility including some interesting pyramidal shaped fixtures each with a 13W CFL bulb. In the main gallery, artwork is showcased using 50W PAR 20 track lighting.

An oddity in the lighting is that a switch in the sound system turns on eight 360W spot lights that shine toward the double-glass side doors. The fixtures do absolutely nothing for lighting the facility. Building employees informed us that the sound system is typically on for 2-4 hours per day, 5 -7 days per week. Assuming the fixtures are on only 5 days a week for two hours, these useless fixtures use 1,440 kWh per year and cost the city approximately $355/year (at current electric rates).

Outside the building there are round pole fixtures each with 2L 13W CFLs that are controlled by photocell sensors. In addition, there are a few 14W uplights and five 42W CFL security lamps.


Exterior Lighting


Parking Lot Lighting

HVAC

One 25 ton Trane YCH300 electric cooling and gas heating package unit serves the entire facility. It's a low-heat model that is equipped with a variable frequency drive (VFD) and the system is a variable air volume system. It has electric reheat coils. The best we could determine, the unit is approximately 10 years old, which puts it about 5 years from the end of its expected service life, according to ASHRAE. The efficiency of the unit has probably degraded to an EER of approximately 8.0, while new, high efficiency units have an EER of 10.5 or better.

Domestic Hot Water
Domestic hot water is provided by a gas-fired hot water heater.

Miscellaneous Loads
There is a small kitchen in the building which has a refrigerator and a microwave. The front desk and office each have a personal computer and a printer. Other possible miscellaneous loads could include craft tools such as electric glue guns, etc that are used when classes are in session.

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Two data loggers were installed at this site: a motor logger and a lighting logger. For additional information about these loggers, please see the Appendix.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Abandon or replace 350W spot lights in the main hall with LEDs and rewire fixtures to have their own switch. As mentioned above, there are eight 350W spot lights that do not provide useful light in the facility that are controlled by the building's sound system switch. These fixtures should be either abandoned or retrofit with LED bulbs. If retrofit, each fixture should be rewired to have its own switch so that the lighting is only on when building occupants are using those fixtures for display lights for artwork and/or architectural lighting.

2. Install a photocell sensor in the main gallery. Skylights provide natural daylighting to the main hall, so during daylight hours, task lighting should be dimmed or turned off via photocell sensors when there is adequate daylight

3. Install occupancy sensors in the art rooms, kitchen, and restrooms.
    a. Install wall sensors in the kitchen and restrooms and set these sensors to turn off the fixtures after the space is unoccupied for 3-5 minutes.
    b. Install ceiling occupancy sensors in the art rooms and set these sensors to turn off the fixtures after the space is unoccupied for 3-5 minutes.

4. Replace existing 175W Metal Halide Parking light posts with 100W induction fixtures.

5. Replace existing 70W High Pressure Sodium bollards with 40W induction lamps.

6. Replace 25-Ton Air Conditioning Unit. This unit is at least 10 years old and the Energy Efficiency Ratio (EER), a standard measure of efficiency for larger packaged equipment, is substantially below that of units presently available. Also, with an estimated service life of 15 years, significant major maintenance expenses can be expected over the next few years.

Prior to selecting any new equipment, it will be necessary to perform heat gain / heat loss calculations on the building to verify the optimum unit size.

7. Replace existing gas-fired water heater with a new, high efficiency water heater. Gas-fired water heaters are now available with 90%(+) efficiency and high efficiency insulation. Replacing the present water heater with a new, high efficiency water heater will save gas not only because of the higher efficiency, but also because the standby losses will be substantially reduced, especially if the water heater is wired through a 365-day time clock.

8. Install a solar parking lot structure in the parking lot to the north of the building to serve not only the Creative Arts Center but also the Manhattan Heights Park Community Center meter.
    a. The Manhattan Heights Annex (Creative Arts Center) shares a common parking lot with the Manhattan Heights Park. As such, it is recommended that solar covered parking structures be installed in the parking lot. The solar energy produced can be used to offset electricity use by both the arts center and the community center next door.
    b. For more detailed information about the solar photovoltaic installation, please see the Appendix.

4.2.8 Public Works Yard

Building Description

The Public Works yard is located at 3621 Bell Avenue. There are numerous buildings on the site, with a total of 35,284 SF of floor space. The ages and floor areas of buildings vary, as shown in the table below.

	Area (SF)	Year
Total Area:	**35,284**	
Public Services:	5,656	-
Maint. Shop:	12,000	1967
Hopper:	675	1967
Tool Storage:	3,025	2003
Serv. Gar. 2:	12,968	1967
Storage:	960	2000

Public Works Yard
Photo courtesy of Bing Maps

The facility is occupied by approximately 50 employees, many of whom are on and offsite throughout the day. Occupancy hours are Monday – Friday from 8 am – 4:30 pm. There are occasionally people on site during the weekends.

Utility Meters

There is one electric meter and one gas meter at this site.

Envelope

The majority of the buildings at Public Works have a steel structure with corrugated steel walls and a steel sheet roof. Some, but very few, of the garage bays have skylights. Within the walls of the steel structures, frame walls with wall board and drop down walls have been constructed for office space.

Public services is the only building of stick and stucco construction with insulation. It has 2 x 4 lay-in tile ceilings with a tar and gravel roof. Windows are single pane and operable.

Lighting

Interior lighting at the Public Works Yard is a mixture of 1, 2, 3, and 4-lamp, 4 foot, 32W T8 fixtures with electronic ballasts and some 2 and 4-lamp, 8 foot, 59W lamps with electronic ballasts. The Public Works Department is experimenting with a few other types of fixtures and currently also has approximately 20 - 250W Metal Halide fixtures suspended from the ceilings in the welding shop, mechanical shop, and tire shop. The mechanical shop also has 1 - 6 lamp T5 fixture installed for testing for light quality. Only one occupancy sensor was found during the site visit; all other fixtures are controlled by manual switches. CFL fixtures are found in the restrooms and storage closets.

Sample Fixtures
250W Mercury Vapor and T5 Fixtures

Exterior fixtures are a mixture of 150 W Metal Halide, 250W Mercury Vapor, and 150W High Pressure Sodium fixtures. These fixtures are controlled by photocell sensors so are on from dusk until dawn daily.

Paint Booth

Suspended 8' T8 Fixtures

Conference Room

Restroom

Employee Break Room

HVAC

Consistent with the number and diverse occupancies of the buildings, the site has several heating and air conditioning or heating only units of diverse ages and conditions. The Public Works Office building is served by a 2-1/2 ton Carrier split system that is new and a 5-ton packaged Carrier heat pump located on the ground adjacent to the building.

The Utilities Office is served by a 3-ton packaged Carrier heat pump located on the ground on the east end of the building. The Parts / Warehouse Office is served by a 2-1/2 ton Carrier heat pump located on the roof. All of the packaged heat pumps date back to approximately 1995 and have nominal SEER's of 10.0. This means they would have a remaining service life of 3 to 5 years.

The shop and garage areas are all heated by gas-fired unit heaters of 130.0 to 200.0 Mbh input. These unit heaters are suspended front the ceiling and are controlled by integrally-mounted thermostats along with wall-mounted switches.

There are also through-wall heat pump air conditioners located in the Main Office and the Utilities office.

Room #	Rm Type	Eqpt Type	Manf	Model #	Size	Unit
Location	*conf, office, mens*					
Building C Public Works Office	Office	Split HP Outdoor Unit	Carrier	38YMA030	2.5	Ton
Building C Public Works Office	Office	Split HP Indoor Unit	Carrier	FK4CNF003	1/2	Hp
Building C Public Works Office	Office	Packaged Heat Pump	Carrier	50TJQ006---B501GA	5	Ton
Building C Public Works Office	Locker Room	Unit Heater	Dayton	GGHS 060	60	Mbh Input
Shop Bay - Building B	Shop	Unit Heater	Reznor	F130-E	130	Mbh Input
Shop Bay - Building B	Shop	Unit Heater	Reznor	XL-140	140	Mbh Input
Shop Bay - Building B	Shop	Unit Heater	Reznor	F130-E	130	Mbh Input
Shop Bay - Building B	Carpenter's Shop	Unit Heater	Reznor	F130-E	130	Mbh Input
Shop Bay - Building B	Garage Workroom	Furnace	Carrier	58SSB383-CC	95	Mbh Input
Utilities Office	General Office	Ground-Mount Pack Unit	Carrier	50TJQ004	3.5	Ton
Utilities Office	Building A Meter Shop	Unit Heater	Reznor	F50-E	50	Mbh Input
Utilities Office	Building B Warehouse / Office	Roof-top Gas Pack	Carrier	50HS030---511AB	2.5	Ton
Utilities Office	Building B Warehouse	Unit Heater	Reznor	No Data	50	Mbh Input
Utilities Office	Building B Parks Garage	Unit Heater	Reznor	No Data	50	Mbh Input
Utilities Office	Building B Spray Booth	Unit Heater	Reznor	XL-140	140	Mbh Input
Building C Public Works Office	Building C Kevins Garage	Unit Heater	Reznor	F50-E	50	Mbh Input

Domestic Hot Water
Domestic hot water is provided by both electric and gas hot water heaters.

Miscellaneous Loads
There are two main types of spaces at this site: office space and workshop/garage space. The office space has typical office loads including computers, printers, copiers, scanners, telephones, etc. The workshop/garage spaces have numerous power tools, ranging from plug in drills to paint sprayer booths to compressed air tanks. The workshop loads are used on an as needed basis and can vary greatly from month to month.

Renewable Energy
None.

Datalogging
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were analyzed for the Public Works Yard:

1. Replace exterior 150W Metal Halide fixtures with 70W Induction fixtures.

2. Replace exterior 250W Metal Halide fixtures with 100W Induction fixtures

3. Replace exterior 150W High Pressure Sodium fixtures with 70W Induction fixtures

4. Install induction lighting and occupancy sensors in the garage spaces used most often and occupancy sensors in all of the office spaces.
    a. Induction fixtures should be installed in the shops and warehouses. Installation of induction lighting will have a nominal energy savings, but the life of the fixtures is 4 to 5 times as long as T5 or T8 lighting. We have included an estimate to replace all light fixtures in our analysis.
    b. To help reduce unnecessary lighting energy use at this facility, it is highly recommended that the induction fixtures be paired with occupancy sensors.

5. Replace the two 3-ton heat pumps serving the Utilities Office and the Parts / Warehouse Office. These two units are in poor condition and should be replaced.

6. Replace the unit heaters in the garage bays with infrared radiant tube heaters that are turned on locally by a switch and turned off automatically using an occupancy sensor. For additional information about infrared radiant tube heaters, please see the radiant heater discussion in the energy efficiency measures section for Fire Station #2.

7. Install a rooftop solar photovoltaic system on the south-facing roofs of the buildings in the yard. Detailed information about the sizing and specifications of the solar photovoltaic system are provided in the Appendix.

4.3 PARKS

4.3.1 Live Oak Park

Live Oak Park

Live Oak Park is located at 1601 N. Valley Drive. The approximately nine acre park has six lighted tennis courts, several picnic areas, as well as four structures including the multi-function building (tennis, playground, ceramics), kiln room, recreation hall, and a snack shack. *Note: We were not provided access to the snack shack during the site visit.*

The park is open from 8 AM to dusk daily. The recreation hall can be rented from Monday – Friday 8 – 10 am and Saturday and Sunday from 8 am - 8 pm. In the summer months, the building is used for summer camps.

The multipurpose building has three main functions: a tennis office, a playground room, and a ceramics room. The tennis office is open daily from 7 am to 8 pm/10 pm. The ceramics room is open when classes are in session. Just behind the ceramics room is a small shed with a kiln. This room is used only when the ceramics group is using the kiln for projects. The playground room is open a few hours after school during the academic year and Monday – Friday 7 am – 6 pm during the summer for summer camps.

Utility Meters
There are five utility meters serving this site, as outlined in the table in the Appendix. A utility bill analysis and energy balance was completed for each meter individually. As such, the energy efficiency recommendations, discussed below, are also outlined by meter.

Building Envelope
Multipurpose Building. This is a lathe and plaster building with stucco exterior, operable, single pane windows, and a combination of Tremco roll roofing and mission tile roofing. The kiln building, next door, is an 8" block building with open, chain link fence windows over the window openings and a steel roof.

Recreation Hall

Recreation Hall. This is a lathe and plaster building with stucco exterior, operable, single pane windows, and Tremco roll roofing.

Dorsey Field and Tot Lot. N/A

Pony Field Lighting. N/A

Tennis Court Lighting. N/A

Lighting

Multipurpose Building. The ceramics room has a combination of skylights, 2L 32W 4’ T8 fixtures with electronic ballasts, and unused 13W CFL fixtures above the back counter. Occupants expressed the desire for additional skylights because natural light improves an artist’s ability to experiment with colors.


Ceramics Room with Skylight

The tennis section of this facility has a gamut of fixtures, including one outdated 22W circle fixture, 14 CFL track lights, and a single 2L 32W 4’ T8 fixture with an electronic ballast. The CFL track lighting was on during the site visit despite the fact that there are windows on three sides of this building allowing ample natural light to be introduced to the space. A photocell sensor in conjunction with an occupancy sensor would help reduce unnecessary lighting load in this space.

The playground section of this room has a skylight in addition to five 2L 32W 4’ T8 fixtures with electronic ballasts controlled by switches. This room would also benefit by having an additional skylight paired with a photocell sensor and an occupancy sensor.

The batting cage fixtures for the adjacent baseball field are also on this meter.

Kiln Room. This building has four 2L 32W 4’ T8 fixtures with electronic ballasts controlled by a switch.

Recreation Hall. The main hall of the recreation hall has 2L 32W 4’ T8 fixtures with electronic ballasts. The hallway and restrooms have 4L 32W 4’ T8 fixtures with electronic ballasts. There are also a few 13W CFLs. All fixtures are controlled by switches. The exterior of the building has 13W CFL wall packs, controlled by photocell sensors.

Dorsey Field and Tot Lot. Dorsey Field is a baseball park with 44 – 1500W Metal Halide fixtures on 60 foot poles. The lamps are used on an as-needed basis. The Tot Lot is a small playground area for children. It has 5 – 1L 100W Metal Halide fixtures on posts. The fixtures are on from dusk until dawn year-round. These fixtures consume an estimated 2,300 kWh of energy per year, costing the city over $1100 per year.

Pony Field. Pony Field is a baseball park with 33 – 1L 1000W Metal Halide fixtures that are used on an as-needed basis. In addition, there is a basketball court with 16 – 1L 400W Metal Halide fixtures on this meter. The basketball court lighting is on from dusk until approximately midnight nightly.

Tennis Courts. There are 48 - 1L 1000W Metal Halide lamps providing light to the tennis courts. The tennis court lighting is on from dusk until 8 to 10 pm nightly, year round. Based on the utility bill data, it is expected that these fixtures are on an average of 3 hours per night 365 days per year.

HVAC
Only the Multipurpose Building and Recreation Hall have mechanical equipment.

Recreation Hall. A Dayton 3E36E gas-fired unit heater provides heating to the Recreation Hall. The unit is in fair-to-good condition. There is no cooling provided to this building.

Multipurpose Building –Two Carrier 50NQ rooftop gas packs (a 4 ton and a 3 ton unit) provide heating and cooling to the Multipurpose Building. The units are in poor condition and need to be replaced. The wiring inside the 4-ton unit shows significant deterioration of the insulation covering.

Domestic Hot Water
Gas water heaters provide domestic hot water to the recreation hall and multipurpose building at Live Oak Park.

Miscellaneous Loads
Recreation Hall. There is a small kitchen in this building.

Multipurpose Building. In the tennis office there is a computer and in the ceramics studio there are a few arts tools that are plug loads. There are also three kilns: 2 electric and one gas. The kilns are used when needed by the ceramics class.


Kiln

Dorsey Field and Tot Lot. N/A
Pony Field. N/A
Tennis Courts. N/A

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers.
A lighting data logger was installed in the south side of the main room in the Recreation Hall. For additional information about this logger, please see the Appendix.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were evaluated for this site:

Multipurpose Building.

1. Install 6 high efficiency manual venting skylights in the ceramics room. Pair skylights and artificial lighting using photocells so that artificial lighting levels adjust depending on the natural lighting levels. Also add occupancy sensors to turn off lighting when the space is unoccupied for 3-5 minutes.
    - Assuming operable skylights are installed, automatic controls to shut off the mechanical heating and cooling equipment to the space when the skylights are open are needed. This will eliminate mechanical energy waste when the skylights are open.

- Currently the lighting in the ceramics room and playground room is in good condition and does not need replacing. These fixtures do not have dimming ballasts. As such, to reduce lighting levels according to natural daylight condition, fixtures will need to be turned on or off.
- High efficiency manual venting skylights cost approximately $700/skylight installed. In the ceramics room, which is used an estimated 1250 hours per year, the energy and cost savings from the skylights does make installation cost effective. However, the occupants did express desire to have additional skylights installed and this may justify installation.

2. Install 2 high efficiency non-operable skylights in the playground room. Pair skylights and artificial lighting using photocells so that artificial lighting levels adjust depending on the natural lighting levels.

3. Install wall occupancy sensors in the restrooms

4. Install ceiling occupancy sensors in the tennis office.

5. Replace the 1000W Metal Halide lamp in the Batting Cage with 2 - 250W Induction lamps.

6. Replace the 3 and 4 ton rooftop gas packs with new, high efficiency gas 3 and 4 ton rooftop gas packs.

7. Offset the remaining energy load with solar photovoltaic energy produced from a solar system mounted on the roof of the Recreation Hall.
   a. For more information about this system, see the Recreation Hall energy efficiency measures below.

Recreation Hall.

1. Install wall occupancy sensors in the restrooms.

2. Install two ceiling occupancy sensors in the main hall of the building and a third ceiling occupancy sensor in the back room of this building.

3. Install a solar photovoltaic system on the roof.
   a. The rooftop area on the Recreation Hall will be sufficient to offset the energy use for both the Multipurpose Building and the Recreation Building (after the recommended energy efficiency measures are implemented).
   b. To do this, it is recommended that the electric loads from both buildings be combined. In other words, instead of each building having its own utility meter, only one electric meter should be used to meter energy use by both buildings. This will need approved by Southern California Edison; however, we do not think it will be a problem since the buildings are in close proximity. This is advantageous for a number of reasons:
      i. When a solar photovoltaic system is installed, a new, bi-directional electric meter also needs to be installed. A bi-directional meter spins

backwards when the solar panels produce more electricity than needed in the building and spins forward when the building consumes more electricity than the solar photovoltaic system is installed. Generally, the customer is required to pay for the bi-directional meter, so combining loads and paying for only one utility meter will help lower the cost of the system.

ii. In addition, the electric company charges a meter charge for every meter every month. Meter charges generally range from $50 - $150 per month. Currently, the City pays $107/month for the meter at the Multipurpose Building and $0.64/meter/day, or $20/month, for the meter at the Recreation Hall. By eliminating a meter, the City can reduce its utility bill by at least $200 per year.

c. *Note: A shading analysis should be done prior to installing the solar array because the building is located at the east side of a hill. As such, in the afternoon, as the sun starts to move west in the sky, the hillside, along with the homes and vegetation on that hillside, will start to shade the roof of the building, cutting back on the hours of direct sunlight the solar system will absorb.*

As mentioned above, metal halide lamps are used for the majority of the exterior fixtures. Metal Halide lamps are a type of High Intensity Discharge (HID) lamps, meaning they produce a high light output. They are compact and powerful and provide a good light quality for sports field and court lighting. A disadvantage is that metal halide lamps have a lamp life of approximately 10,000 hours. As such, if the fixture is on from dusk until dawn daily, the lamp will only last three years.

Until recently, use of metal halide lamps for tennis courts, basketball courts, and baseball fields was the best option because of the great light quality and power. However, recent advancements in lighting technology now allow for lower wattage (<1000W Metal Halide) and shorter pole (<40 feet) fixtures to be retrofit with induction lighting. In brief, induction lighting provides equivalent light quality at a lower wattage. In addition, the lamps have approximately 10 times longer lamp life, rated to last 80,000 to 100,000 hours.

Note: We have provided a detailed discussion on the advantages and disadvantages of induction and LED lighting in the Appendix. Please refer to the Appendix for additional information.

As such, this allows tennis court and basketball court lights to be retrofit with lower wattage, longer lasting induction lamps without compromising light quality. Baseball field lighting, which typically has 1500W metal halide lamps on 60 foot poles, cannot be replaced with induction lamps. A summary of the recommended measures for the exterior lighting fixtures is below.

Dorsey Field and Tot Lot.

1. Replace the 100W Metal Halide lamps in the Tot Lot with 40W Induction lamps.

Pony Field.

1. Replace the 400W Metal Halide lamp in the Basketball Court with 1 - 200W Shoebox induction lamps.

2. Replace the 1000W Metal Halide fixture in the Batting Cage with 2 - 250W Induction fixtures.

Tennis Courts.

1. Replace each 1000 W Metal Halide fixture with 2 - 250 W Induction fixtures.

4.3.2 Manhattan Heights Park

Manhattan Heights Park is located at 1560 Manhattan Beach Blvd. It has three main buildings: a recreation center, a playground room/office with exterior access restrooms, and a teen center for watching television. There is also a baseball field, tennis courts, and a basketball court at this site.

Utility Meters
There are three electric meters and one gas meter at this site.


Manhattan Heights Park Recreation Center

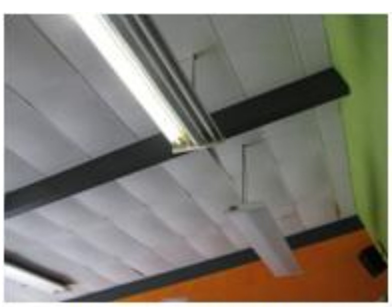
Building Envelope
Community Center. The construction for this building is wood framing with stucco and gypsum on the inside walls. Windows are single-pane and the roof is a plywood deck with composite shingles, R-19 insulation, and a t-bar ceiling.


Restroom /Playground Bldg

Teen TV Room. This building has 8” concrete block walls with single pane operable windows and a wood roof with composite shingles.

Restroom/Playground Room. This building has 8” concrete block walls with single pane operable windows and a wood roof with composite shingles.

Lighting
Community Center. The lighting in the Community Center is outdated. The majority of the fixtures are 8’ 4L 59W T8 fixtures controlled by switches. Several of the lighting lenses are broken and yellowed. There are some 4’ 2L and 4L 32W T8 fixtures with electronic ballasts in the restroom, main office, and the front foyer. The exterior lights are a mixture of 13W CFL recessed fixtures and flood lights.


Recreation Center Lighting

Teen TV Room. This building only has three 4L 32W 4’ T8 fixtures controlled by a manual switch.

Restroom/Playground Room. This building has both men's and women's restrooms and a playground shed/office where playground equipment is kept. There are two 14W CFL fixtures in each restroom. In the playground shed/office there is a 14W CFL fixture, two 23W CFLs, along with 1 inefficient 4L 6' T12 fixture. Outside this facility there are ten 13W CFLs fixtures.


Restroom Bldg/Playground Room


Teen TV Bldg

Baseball Field and Basketball Courts. The baseball fields have 1500W Metal Halide fixtures and the basketball courts have 1000W Metal Halide fixtures.

Tennis Courts. The tennis courts have 1000W Metal Halide fixtures.

HVAC

Community Center. – Heating and cooling is provided to the recreation room by the following units. These units were installed in 1992 and so have exceeded their useful life. ASHRAE lists the estimated service life of packaged roof top equipment as 15 years. However these units are in relatively good condition so could be expected to last an additional 2 or 3 years.

Building	Room #	Unit. No.	Rm Type	Eqpt Type	Manf	Model #	Size	Unit
Manhattan Heights	Roof	AC-1	Auditorium	Roof Top Gas Pack	Carrier	48 DJD008530	7.5	Ton
Manhattan Heights	Roof	AC-2	Rooms 3 & 4	Roof Top Gas Pack	Carrier	48DJD006550	5	Ton
Manhattan Heights	Roof	AC-3		Roof Top Gas Pack	Carrier	48 DJD008530	7.5	Ton
Manhattan Heights	Roof	AC-4	Room 2	Roof Top Gas Pack	Carrier	48DJD006550	5	Ton

Teen TV Room. N/A
Restroom/Playground Room. N/A
Baseball Field and Basketball Courts. N/A
Tennis Courts. N/A

Domestic Hot Water

A gas hot water heater provides domestic hot water to this facility.

Miscellaneous Loads

Community Center. The community center has an outdoor cold beverage and a dry vending machine. In addition, the inside offices have a few personal computers and a printer. There are also a few televisions in the teen room.

Teen TV Room. This building has several televisions; however, the facility is rarely used and the majority of the televisions are not plugged in.


Miscellaneous

Restroom/Playground Room. There no any miscellaneous loads in this building.

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Two data loggers were installed at this site. A motor logger was placed on the rooftop auditorium package unit and a lighting logger was placed on a fixture in the teen room in the community center. For additional information about these loggers, please see the Appendix.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were evaluated for this site:

Community Center, Teen TV Room, and Restroom/Playground Room

1. Delamp 4-lamp fixtures while also making fixture types more consistent city-wide by retrofitting 8’ T8 fixtures with 4’ T8 fixtures.
    a. By using a retrofit kit to replace 8’ T8 fixtures with 4’ T8 fixtures while at the same time delamping 4-lamp fixtures to 3-lamp fixtures lighting energy will be reduced.
    b. This is recommended because 8’ T8 fluorescent tubes are becoming difficult to purchase. In addition, the length makes them difficult to stock and handle.
    c. This will also be an aesthetic improvement since some of these fixtures are in poor condition.

2. Install occupancy sensors in the restrooms, main lobby, and offices
    a. Wall occupancy sensors should be installed in the restrooms and offices so that the lights are automatically shut off after the room is unoccupied for 3-5 minutes.
    b. Ceiling occupancy sensors should be installed in the larger rooms including the two teen rooms, the auditorium, and the playground shed. The sensors should be set so that the lights will turn off automatically after the space is vacant for 3 to 5 minutes. Don’t set the occupancy sensors on too short of a time because frequent fluctuation of lighting levels from on to off can shorten lamps life. This will lower overall lighting levels and energy use during quiet times in the building.

3. Replace all 4 Electric/Gas Package Units with high efficiency units. It is recommended that all four units be replaced because these units have exceeded their projected service life and could fail and / or result in excessive maintenance costs. Purchasing all four units at one time would result in lower costs and consistent service. Also, the energy savings alone, since the existing units probably had a SEER or EER rating less than 2/3 of the units presently available, will be substantial.

4. Replace existing gas-fired water heater with a new, high efficiency water heater. Gas-fired water heaters are now available with 90%(+) efficiency and high efficiency insulation. Replacing the present water heater with an new, high efficiency water heater will save gas not only because of the higher efficiency, but also because the

standby losses will be substantially reduced, especially if the water heater is wired through a 365-day time clock.

5. Install a solar parking lot structure in the parking lot to the west of the building, in the Manhattan Heights Annex (Creative Arts Center) parking lot. The solar energy produced will be used to offset electricity use not only at the Manhattan Heights Park Community Center meter but also at the Creative Arts Center.
    a. The Manhattan Heights Annex (Creative Arts Center) shares a common parking lot with the Manhattan Heights Park. As such, it is recommended that solar covered parking structures are installed in the parking lot. The solar energy produced can be used to offset electricity use by both the arts center and the community center next door.
    b. For more detailed information about the solar photovoltaic installation, please see the Appendix.

Tennis Courts

1. Replace each 1000 W Metal Halide lamp with 2 - 250 W Induction fixtures.

Baseball Field and Basketball Courts

1. Replace the 1000W Metal Halide lamp in the Basketball Court with 2 - 250W Induction fixtures.

4.4 Polliwog Park (Historical House and Park Facilities)

Polliwog Park

Polliwog Park is located at the corner of Redondo Avenue and Manhattan Beach Boulevard. The 18 acre park was developed in 1964 and expanded in 1975. There are three main structures on the site: the Manhattan Beach Historical Society, an old restroom facility that has been converted into an office/storage facility and a new restroom. The site also has three gazebos and an amphitheatre.

The historical society is open on Saturday and Sunday from 12 pm – 3 pm, otherwise by appointment. The restroom facility is open from dawn until dusk daily and the small, single office and storage area requires a key to enter and is only used by City employees off and on during the week.

Utility Meters

There are two utility meters serving Polliwog Park. One electric meter monitors the electric loads from the Historic House and the other meter monitors the electric loads from the rest of the park (office, restroom, storage, exterior lights).

Building Envelope

Historic House. The Historical Society makes its home in the City's oldest beach cottage which was relocated to Polliwog Park in 1970 and refurbished. The 984 square foot house is of wood frame construction with no insulation. The windows are old, single warped-pane glass. The roof is wood frame with shingles.

Historical Society

Old Restroom/New Office & Storage Building. The original 767 square foot restroom built in 1980 is of concrete block construction and has metal chain (no glass) openings for ventilation. The roof is flat with tar and gravel. The restroom facilities have been removed from the building and now the building is used as the Park Patrol office and summer camp / Historical Society storage facility.

Old Restroom turned into Offices and Storage

New Restroom. The new (2003), 1400 square foot restroom is of concrete block construction, has metal chain openings for ventilation, and a metal roof.

New Restroom Facility

Lighting

Historic House. Track and recessed lighting has been installed in the original home to provide display lighting for the museum items found throughout the historic building. Currently, these fixtures have 13W CFLs. The small historical society administration office has one 2-lamp 4' T8 fixture with an electronic ballast, and the restroom has a single 60W incandescent fixture. All of the interior lights are controlled by switches. Just outside the home there are two 13W CFL fixtures controlled by a motion sensor and the fountain has a 14W CFL fixture with a photocell sensor.

Old Restroom/New Office & Storage Building. This building has primarily 2L 32W 4' T8 fixtures with electronic ballasts that are controlled by switches. The exterior of the facility has 4 breadbox 13W CFL fixtures that are controlled by photocell sensors.

New Restroom. The new restroom has ten 42W CFL fixtures mounted in the eve of the outside of the building. Inside each restroom there are five 2L 32W 4' T8 fixtures with electronic ballasts.

Exterior. Along the sidewalks at the park there are 34 - 175 W Metal Halide fixtures controlled by photocell sensors. In addition, there are six 150W High Pressure Sodium security lights near the restroom. Since these fixtures are for security and are on from dusk until dawn daily, it would be highly beneficial to reduce the wattage of these lights using LED or induction lamps. A more detailed discussion of recommended below. Also, for specific information about induction and LED lighting, please see the Appendix.

HVAC

Historic House. Outside of the north end of the house, there is a Carrier 50ZH-036 heat pump. The unit is in excellent condition and should last another 12 - 15 years. Since this building is only used intermittently, for a few hours per week, replacement is not recommended at this time.

Old Restroom/New Office & Storage Building. None

New Restroom. None

Domestic Hot Water

Hot water is provided to the historical society building and the park by an electric hot water heater.

Miscellaneous Loads

Miscellaneous loads in the Historical Society building include a computer and a printer. There are water fountains scattered across the site.

Renewable Energy

There is no renewable energy at this site at this time.

Data Logging

Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were analyzed for this site:

Historic House.

1. Install CFL lamps in place of the existing incandescent bulbs.

2. Install four occupancy sensors in the building: main hall, side room 1, side room 2, and restroom. Installing occupancy sensors in each of these rooms will minimize light energy use when rooms in the house are unoccupied during operating hours. This would also eliminate the need for employees to shut off the lights before they lock up and leave.

Old Restroom/New Office & Storage Building.

1. Install wall occupancy sensors in the offices in the old restroom building that is currently used as storage and office space.

2. Install two ceiling occupancy sensors in the new restroom building. One sensor should be installed in the men’s restroom and one occupancy sensor should be installed in the women’s restroom.

3. Replace existing 175 Watt Metal Halide walkway security lights with 40W Induction lamps.

4. Replace the existing 150 W High Pressure Sodium restroom security lamps with 70W Induction lamps.

4.4.1 Premier Park

Premier Little League Field is located adjacent to Polliwog Park at the corner of 18th and Herrin Avenue. The field has a scorer's booth, restroom, and some storage sheds. The buildings are locked at all times, unless there is a game in progress. Use of the facilities is by reservation only.

During the site visit we only had access to the restroom facility and one of the storage sheds. The Little League managers are the only ones with keys to the scorer's booth and other storage shed.

Utility Meters
There is one electric meter at this site.

Building Envelope
The 348 square foot restroom, constructed in 1986, at Premier Park is of concrete block construction with a wood roof with tar and gravel. The windows have metal chain link with no glass.

One storage shed is of concrete block construction with no windows. The walls and roof of the second storage shed are of wood construction. It also does not have any windows

Premier Park Restroom

Park Storage Sheds

Lighting
Lighting inside the scorer's booth is unknown since we did not have access to that building. The fixtures in each restroom were 2L 32W 4' T8 fixtures with electronic ballasts controlled by switches. The lights were off during the site visit. Each storage shed has 2L 32W 4' T8 fixtures with electronic ballasts controlled by switches.

HVAC
There is no heating or cooling at this site.

Miscellaneous Loads
It is presumed that the scorer's booth has some miscellaneous loads including a refrigerator, freezer, and a microwave for the snack bar food.

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Install an occupancy sensor in both storage sheds and the restroom. To reduce unnecessary lighting energy use, install an occupancy sensor in each space and program the sensors to automatically shut off the lights when the space is unoccupied for more than 3-5 minutes.

4.4.2 Marine Avenue Park

Marine Avenue Park

Marine Avenue Park is located at 1625 Marine Avenue. The park, which was developed in 1986/87, encompasses over 7.5 acres. Amenities at the park include a full size baseball field, a soccer field, basketball courts, picnic tables, and a recreation activity building, a scorer's building, and a storage shed.

The park is open from 8 am to 10 pm daily. Reservations are required to use the recreation hall, which was being used for a summer camp during the site visit. The scorer's booth and snack shack is only used during games. The storage shed requires key entry and is only occupied when sports equipment is being brought in and out of the shed.

Utility Meters
There is one electric meter and one gas meter tracking energy use at this site.

Building Envelope
The three main buildings at Marine Avenue Park were investigated: the Recreation Hall, Scorer's Booth/Snack Shack, and Storage Shed.

Recreation Hall

Recreation Hall. This 2,604 square foot building was constructed in 1986. The walls are 8" concrete block and the windows are tinted and single pane. The roof is sloped, has R-19 insulation, and is covered with composite tiles. Since this building is oriented closely to the baseball park, several baseballs have hit the roof, resulting in holes in the roof. When it rains, the leaks penetrate down into the office below, damaging the insulation and suspended ceiling, as shown below.

Roof Leaks due to Baseballs

Scorer’s Booth/Snack Shack. This two-story 480 square foot building was also constructed in 1986. The bottom floor is the snack shack and the second floor is the scorer’s booth. The walls are 8” block with operable single pane windows and a metal roof.

Storage Shed. The 600 square foot storage shed, constructed in 1986, is used for sports equipment. The walls are 8” block. It does not have any windows; however, it has two rollup garage doors as well as a side door that provide access to the equipment. The roof is sloped and is covered with composite tiles.

Scorer’s Booth

Storage Shed

Lighting

Recreation Hall. The fixtures in the recreation hall are primarily 2L 32W 4’ T8 fixtures with electronic ballasts that are controlled via switches. During the site visit, a few of the rooms were unoccupied and all the fixtures were turned on. Occupancy sensors would be beneficial in this space. On the outside of the building there are 14W CFLs that are controlled by photocell sensors.

Recreation Hall Lighting

Scorer’s Booth/Snack Shack. The fixtures in this building are primarily 2L 32W 4’ T8 fixtures with electronic ballasts that are controlled via switches. During the site visit, this building was locked and the fixtures were all off.

Storage Shed. The fixtures in this shed are outdated and inefficient. There are currently two 2L 40W 4’ T12 fixtures controlled by switches. The exterior of this building has two, very yellowed, wallpack fixtures with HPS bulbs (wattage unknown) controlled by photocells.

Exterior Park Lighting. There are also exterior lights throughout the park, including several inefficient 70-150W High Pressure Sodium Sidewalk and Security Walk Lights and 1000 - 1500W Metal Halide Lights. These fixtures operate from dusk until dawn daily.

HVAC

Heating is provided to the recreation room by a 40,000 Btuh Lennox gas furnace. It is a modern, high efficiency furnace and has a life expectancy of several more years.

Domestic Hot Water

A gas water heater provides domestic hot water to the site.

Miscellaneous Loads

In the meeting room there is an electrical hot water dispenser, a 19 inch TV/VCR, and a PC with a printer. The scorer's booth and snack shack has a refrigerator and freezer as well as a microwave.

Renewable Energy

There is no renewable energy at this site at this time.

Data Loggers

Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were evaluated for this site:

1. Delamp existing 4' 4L 32W T8 fixtures by 1 lamp to reduce lighting energy demand and consumption

2. In the Recreation Hall building, install wall occupancy sensors in the offices and restrooms and install a ceiling sensor in the main room.
    a. The occupancy sensors will reduce electric demand and usage in the rooms when the rooms are unoccupied.
    b. The occupancy sensors should be programmed to shut off the fixtures after 3-5 minutes of undetected movement in the space.

3. Replace existing 70W and 150W High Pressure Sodium and 100W and 1000 W Metal Halide fixtures with equivalent induction fixture counterparts.
    a. Replace 70W HPS fixtures with 40W Shoebox fixture
    b. Replace 150 HPS fixture with 70W Induction Shoebox fixture
    c. Replace 100W MH fixture with a 40W Induction fixture
    d. Replace 1000W MH fixtures with two 250W induction fixtures

4. Replace existing gas-fired water heater with a new, high efficiency water heater. Gas-fired water heaters are now available with 90%(+) efficiency and high efficiency insulation. Replacing the present water heater with a new, high efficiency water heater will save gas not only because of the higher efficiency, but also because the standby losses will be substantially reduced, especially if the water heater is wired through a 365-day time clock.

5. It is further recommended that the City suspend a metal screening, similar to a chain-link fence over the roof of the recreation hall to prevent further damage from baseballs. This would eliminate the problem of roof leaks from damage.

4.4.3 Marine Avenue Sports Park

Smaller Scorer's Booth

Marine Sports Park, developed in 2001, is located at 1600 Marine Avenue. The park is primarily used for baseball and soccer. There are two main structures on the site which include two, two-story scorer's booths with snack shack and restrooms. Next to each of these booths is a small storage shed. The floor areas of the scorer's booths are not known.

The parks are used during baseball and soccer season for practice and games. In general, the restrooms are open during practice and games. Some equipment is stored in the scorer's booths, but these are typically only occupied during games. The snack shacks are only open during games.

Utility Meters
There is one electric meter at this site.

Building Envelope
Both of the scorer's booths are two-story, 8" concrete block structures with single pane, operable windows and metal roofs. The two small storage sheds are also 8" concrete block structures with a single metal door, no windows, and a metal roof.

Lighting
Lighting in the scorer's booth, snack shacks, and restrooms is primarily 4' 2L 32W T8 fixtures with electronic ballasts controlled by switches. Above the scorer booth table, there are also some recessed 2L 13W CFL fixtures to provide direct overhead lighting.

On the exterior of these buildings there is a combination of 26W CFL fixtures covered by circular lenses below the roofline and 32W CFL wallpack fixtures around the outside of the building. Exterior lighting in the baseball fields is provided by 1500W Metal Halide fixtures. These fixtures are turned on and off for games and practices as needed.

Scorer's Booth Operable Windows and Snack Shack Lighting

Larger Scorer's Booth / Exterior Lighting

Exterior Lighting

HVAC
There is no HVAC at this site.

Domestic Hot Water
Electric water heaters provide domestic hot water to the site.

Miscellaneous Loads
Miscellaneous loads at this site include the refrigerators, freezers, microwaves, and other kitchen equipment found in both snack shacks as well as the microphone equipment in the scorer's booths.

Snack Shack Plug Loads

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were evaluated for this site:

1. Install occupancy sensors in the scorer's booths and restrooms to reduce electric demand and usage when the spaces are unoccupied.

Note 1: Baseball Field Lighting.

Because this is a baseball park, the existing 1500W Metal Halide 60' field lights need to remain to provide adequate lighting levels and light quality for baseball players. To date, induction lighting cannot throw light far enough to make induction lighting an appropriate retrofit option for baseball field fixtures.

Note 2: Renewable Energy Opportunities

Renewable energy, such as solar, was not recommended for this site because:

1. Installing polycrystalline modules in close proximity to the baseball field is not recommended because most modules are made of glass. The modules would break if hit with a baseball.

4.4.4 Sand Dune Park, Office, and Restroom

Sand Dune Park

Sand Dune Park is located at Bell and 31st Place. The three-acre park was developed in 1964 and is known for the 100-foot high sand dune which attracts children, local athletes, and even professional sports teams for training. The park is open from 6 am – 8/9 pm. During this time, the site is monitored by park crew to make certain the sand dune is not destroyed and to maintain quietness in this residential neighborhood.

Utility Meters
There is a single electric meter serving this site.

Building Envelope
The site only has one 675 square foot building restroom/office facility. The restroom, built in 1965, is constructed of concrete block and has a few no-glass windows. It has a Tremco, roll roof with no insulation. The office side of the building is an add-on. The walls are wood frame with plywood and sheetrock. There are four-single pane windows in this section of the building.

Restroom/Office

Lighting
There is very little interior lighting load at this site. Each restroom has a single 2L 14W CFL, the office area has a 4' 1L T12 fixture, 4 - 14W CFLs, and a 4' 2L T8 fixture. Also, there are two - 50W Low Pressure Sodium fixtures on the exterior of this building.

Near the lower parking lot there are also two post fixtures, one of which has two 50W metal halide fixtures and the other has a single 27W four tube CFL fixture. Lighting is controlled by photocells.

There is also a staircase that goes up the hill to the top of the sand dune. The staircase has 10 post fixtures controlled by photocells. The type of lamp in these fixtures is unknown, so for the calculations it is assumed that each fixture has a 100W Metal Halide lamp.

HVAC
There is no heating or cooling at this site.

Domestic Hot Water
There is no domestic hot water serving this site.

Miscellaneous Loads
There is a small refrigerator and microwave, inside the office.

Renewable Energy
There is no renewable energy at this site at this time.

Data Logging
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site

1. Retrofit the 4’ 2L T12 fixture with a 4’ 2L T8 fixture to reduce electric demand and energy consumption.

2. Replace the two 50W Metal Halide post lamp with two 40W induction fixtures.

3. Replace the estimated 100W Metal Halide stairwell fixtures with 40W shoebox induction fixtures.

4.4.5 Manhattan Village Park

Manhattan Village Park, which was developed in 1985, is located at 1300 Parkview Avenue. The site has a full size soccer field, a children's play area, picnic tables, and a restroom facility. The facility restrooms are open from dawn to dusk daily, but reservations are required to use the field.


Manhattan Village Park Restroom

Utility Meters
There is only one electric meter at this site.

Building Envelope
The restroom facility is of concrete block construction with metal grate windows, and a sloped, wooden roof with composite singles and four skylights.

Lighting
Inside each restroom there are two skylights as well as one 4' 2L 32W T8 fixture with an electronic ballast. The lights are controlled by switches. During the site visit, the lighting in the restrooms was off; the skylights provided adequate light.


Restroom Skylights

On the outside of the building there is a single 27W 4-tube CFL as well as two 2L 14W CFLs on a time clock with a photocell.

The soccer field has 28 1500W Metal Halide fixtures. These fixtures are on demand with a late end timer. There are also seven 400W Metal Halide parking lot fixtures and five 150W Hi Pressure Sodium security fixtures that are on photocells so are on dusk until dawn nightly.

HVAC
There is no HVAC at this site.

Domestic Hot Water
There is no domestic hot water at this park.

Miscellaneous Loads
There are no miscellaneous loads at this site.

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES:
The following energy efficiency measures were evaluated for this site:

1. Replace the five 150W Hi Pressure Sodium security fixtures with 70w Induction Shoe Box Parking fixtures.

2. Replace the seven 400W Metal Halide parking lot fixtures with 250W Induction Shoe Box Parking fixtures.

Note 1: Soccer Field Lighting
The 1500W Metal Halide soccer field fixtures cannot be replaced with induction fixtures without compromising light intensity and quality.

Note 2: Renewable Energy
A solar photovoltaic system was not recommended at this park for the following reasons:

1. There is not any rooftop space, so the system would need to be either a parking structure or a ground-mount system.

2. At a city park, both of these types of solar systems can be more costly because of the prevention measures needed to be placed to prevent vandalism. This might include adding fencing around a ground-mount system or adding security cameras on top of solar parking structures.

4.5 PARKING LOTS

4.5.1 Parking Lot #2

Parking Lot #2

Parking Lot #2 is located at 12th and Bayview, east of the beach by two blocks.

Utility Meters
There is one electric meter at this site.

Building Envelope
The 2-story, 17,100 square foot, concrete and steel structure was built in 1974 and is open for parking 24/7. The first level is at grade, the second level is open to the air. The garage is open to the out-of-doors, obviating the need for ventilation.

Lighting
The first story of the two story parking garage is covered. On this floor, there are 21, 2-lamp 4' T8 fixtures with electronic ballasts. During the first site visit at approximately 7 pm, the west facing, outer row of fixtures was off. During the second site visit at approximately 8 am a few weeks later, the outside row of fixtures was turned on. It was foggy that morning but there was adequate daylight. Assuming this row of fixtures is controlled by a photocell, it is recommended that the photocell be calibrated and/or replaced to ensure unnecessary lighting is off during daylight hours. There were not any City-owned, outdoor fixtures on the roof of this garage. There were, however, two SCE-owned street lamps. The lighting at this site is in poor condition and should be replaced in the next few years. .

Upper Level

Lower Level

HVAC
None.

Domestic Hot Water
None.

Miscellaneous Loads
None.

Renewable Energy
None.

Data Logging

Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were analyzed for this site:

1. Remove the existing T8 fixtures and replace with 40W induction garage box fixtures.
    a. Next time several of the garage T8 lamps need to be replaced, remove the T8 fixtures and install 40W shoebox style induction lighting in the garage.
    b. For every one T8 fixture, one new induction fixture should be installed.

2. Install a new photocell sensor to turn off the outer row of fixtures from dawn until dusk.
    a. Recalibrate or replace the photocell controlling the outer row of fixtures in this garage so that the outer row of fixtures shuts off during daylight hours.

3. Install a solar photovoltaic parking structure on the roof of the garage.
    a. For detailed information about the proposed solar photovoltaic system sizes, tilts, and costs, please see the Appendix.

4.5.2 Parking Lot #3

Parking Lot #3 is located at 12th & Morningside Drive, just west of Metlox Town Square.

Parking Lot #3

Utility Meters
There is one electric meter at this site.

Envelope
The 3-story, 53,900 square foot, concrete and steel structure was built in 1974 and is open for parking 24/7. The first level is at grade, the second level is one story above ground, and the third story is open to the air. Three sides of the garage are open to the out-of-doors, obviating the need for ventilation.

Lighting
The first two stories of the three story parking garage are covered. On these floors, there are a total of 420 4’ 1L 32W T8 fixtures. The fixtures are wired in tandem in sets of 4, as shown in the photographs below. All but one row of 24 lamps were on during the site visit. This row was in the middle of the garage, so it should not be controlled by a photocell sensor. There were also about 10-20 lamps out on each floor of the parking garage. The uncovered fixtures are in poor condition, are covered in rust, and appear as if they have not been maintained in long time. The expected remaining life of these fixtures is one to two years.


Dark Garage with Rusty Fixtures

HVAC
None.

Domestic Hot Water
None.

Miscellaneous Loads
None.

Renewable Energy
There is no any renewable energy at this site at this time.

Data Logging
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Remove the existing T8 fixtures and replace with a 40W induction garage box fixture.
    a. Several of the lamps are burned out in this garage, so instead of replacing the T8 lamps, remove the T8 fixtures and install 40W shoebox style induction lighting in the garage.
    b. For every two 1L T8 fixtures, one new induction fixture should be installed.

2. Install a new photocell sensor to turn off the outer row of fixtures from dawn until dusk. To reduce the lighting load at this site, photocell sensors should be installed around the perimeter row of fixtures. These fixtures do not need to be on during daylight hours since sunlight provides adequate light to this perimeter area of the parking garage.

3. Install a solar photovoltaic parking structure on the roof of the garage. For detailed information about the proposed solar photovoltaic system sizes, tilts, and costs, please see the Appendix.

4.5.3 Parking Lot #4

Parking Lot #4 is located at the intersection of Rosecrans & Highland.

Utility Meters
There is one electric meter at this site.

Building Envelope
The 2-story, 30,000 square foot, concrete and steel structure was built in 1976 and is open for parking 24/7. The first level is at grade, the second level is open to the air. Three sides of the garage are open to the out-of-doors, obviating the need for ventilation.

Lighting
The first story of the two story parking garage is covered. On this floor, there are 58, 2-lamp 4' T8 fixtures with electronic ballasts. All but one outside row of 13 fixtures were on during the site visit. The fixtures are controlled by a photocell sensor.

On the upper floor of the lot, there are two 20' poles with shoebox style fixtures with yellowed lenses. The type of lamp could not be identified so are assumed to be 250W High Pressure Sodium.

HVAC
None.

Domestic Hot Water
None.

Miscellaneous Loads
None.

Renewable Energy
There is no any renewable energy at this site at this time.

Data Logging
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Remove the existing T8 fixtures and replace with a 40W induction garage box fixture.
    a. Next time several of the garage T8 lamps need to be replaced, remove the T8 fixtures and install 40W shoebox style induction lighting in the garage.
    b. For every one T8 fixture, one new induction fixture should be installed.

2. Replace the existing parking lot lamps on the top floor of the garage with induction lamps.

   a. We presume that the two parking lot fixtures on the roof of the garage have 250W HPS lamps. If so, one way to cost effectively reduce the energy use by these fixtures is to replace the lamp with 120W induction lamps.

3. Install a new photocell sensor to turn off the outer row of fixtures from dawn until dusk.

4. Install a solar photovoltaic parking shade structure on the roof of the garage. For detailed information about the proposed solar photovoltaic system sizes, tilts, and costs, please see the Appendix.

4.5.4 Metlox Parking Garage and Town Square

Metlox Town Square is located just south of the City Hall. It is a complex that is owned by the City. It has several, attached buildings with a 3-story parking garage on the underside. Tenants lease the spaces on the street level. Shopping includes restaurants, shops, and a fancy hotel. The City pays the utility bill for only the parking garage and the exterior, non-architectural fixtures.

The facility was built in 2003. The area of the parking garage is 188,344 square feet and the square is approximately 45,000 square feet. The parking garage and town square are open 24/7.

Metlox Town Square

Utility Meters
Metlox Town Square has two utility meters that the City is responsible for. The first is for the exterior lighting in the main square at Metlox. The meter number is 3416-032602. We did not receive this meter data from Southern California Edison, as such, a utility bill analysis and financial analysis was not completed for this meter. The second meter is for the parking structure, as shown in the table in the appendix.

Building Envelope
The parking garage is of concrete and concrete-block and steel construction. The town square is primarily concrete but is landscaped with trees and fountains and is surrounded by the town square buildings.

Lighting
Lighting in the parking garage is primarily 2L 32W T8 fixtures with electronic ballasts controlled at the panel. The fixtures are spaced at even intervals and there are two fixtures linear to each other at each interval. The lighting in the garages remains on 24/7. The stairwells in the garage are 1L 32W 4' T8 fixtures. They are also on 24/7 for security purposes.

Parking Structure

One location where lighting is particularly difficult to replace is in the wooden/glass cover above the escalator. As illustrated in the photograph, there are six 1L 32W 4' T8 fixtures mounted between these decorative wooden boards. Since these fixtures are directly above the escalator, they are difficult to access, and since they are fluorescent fixtures that are on 24/7, they need to be changed frequently. The City requested that a more sustainable, long lasting fixture be recommended for this location. LEDs are a good alternative, which we describe in the energy efficiency section below.

Escalator Fixtures

Above the parking garage, in the Metlox Town Square there are hundreds of architectural fixtures in the form of uplights, fountain lights, spot lights, landscape lights, etc. The lamps in these fixtures range from efficient 14W CFLs to inefficient incandescent, MR16s and PAR36s.

HVAC

Ventilation is provided to the parking garage by four 30 hp exhaust fans with Variable Frequency Drives (VFDs). They do not operate 24 hours per day since they have carbon monoxide sensors so that they shut down if the carbon monoxide levels are below a threshold setting.

Domestic Hot Water

Domestic hot water to the restrooms is provided by gas water heaters.

Miscellaneous Loads

The major miscellaneous loads at Metlox include the elevators, four escalators (5.5 kW) and the pumps for the fountains in the plaza.

Renewable Energy

There is no renewable energy at this site at this time.

Data Loggers

Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES

The following energy efficiency measures were evaluated for this site:

Parking Garage

1. Next time a major lamp replacement for the existing T8 lamps becomes necessary, replace the fixtures with 70W Induction fixtures. For every two 4’ 2L T8 fixture, one induction fixture will be needed.
    a. The induction lamps should last 5 times longer than the existing T8 lamps.

2. Replace the stairwell 4’ 2L 32W T8 fixtures with 40W Induction wall-pack fixtures.

3. Replace the 150W Metal Halide fixtures in the parking garage entrance and exit with 40W Induction wall-pack fixtures.

4. To save energy on the escalators, consider implementing one to all of the following measures:
    a. Turn the escalator off early at night and turn it on later in the morning.
    b. Reduce energy use by either:
        i. Installing a variable frequency drive along with sensors to reduce the speed of the escalator when no one is on it, making them intermittently run, or
        ii. Installing an energy-saving soft start on each escalator.
            1) Energy saving soft starts do not change the speed of the escalator but instead reduce the energy consumed by the escalator as the number of people on the escalator changes. To read more about a motor soft start controller, see http://www.powerefficiency.com/technology.php.
    c. Install a control system that obviates the need for employees to come to the site to turn on and off the escalators.
    d. City employees mentioned that it is difficult getting someone to start and stop the escalators in the morning and shut them off late at night. As such, at some points in time, the escalators are left on all night and or have extended operating hours. One option to mitigate this problem is provide escalators with sensors that start them when someone steps on and stops them when there is nobody on them. This could be operative between the hours of 9 pm and 7 am. During the day they would operate continuously. This is done in Europe, but local Code would need to be investigated

Metlox Plaza

Energy savings were not quantified and costs were not estimated for the following measures because we never received the utility bill data for this meter from SCE. We do, however, recommend that the following measures be considered to help reduce energy consumption and costs.

1. Replace the T8 fixtures above the escalator with either 40W Induction fixtures or LED fixtures.
    a. These fixtures are currently very difficult to access, especially when lamp replacement is needed every two or less years. As such, it is recommended that either LED fixtures or induction lamps be installed above the escalators to extend lamp life from approximately 20,000 hours to 100,000 hours.

2. Replace the 150W High Pressure Sodium fixtures above the generator with 40W Induction wall-pack fixtures.

3. Replace other 40W and higher Halogen fixtures with 40W Induction fixtures.

4. Install induction and/or LED wall pack fixtures throughout Metlox plaza to extend lamp life and reduce maintenance.

5. In the courtyard between Metlox Plaza and the hotel, eliminate the lamps built into the cement that shine light directly up into the night sky. These lamps do not provide adequate or aesthetic architectural lighting; they only produce night sky pollution. We predict that no one will even notice that the fixtures are removed.

6. If the fountain pumps have a motor rating greater than 7.5 horsepower and the existing motors are of standard efficiency, replace the motors with premium efficiency motors. If the existing motors are standard efficiency, and the motor efficiencies are consistent with standard efficiency motors as listed by the National Electrical Manufacturers Association (NEMA) Standard MG-1. New motors are available with efficiencies at least 5% higher than standard. In particular, it is recommended that the standard efficiency motors that range in size from 7.5 hp to 50 hp be replaced with premium efficiency motors.

4.6 OTHER

4.6.1 Peck Reservoir

Peck Reservoir is located at 1800 Peck Avenue. The City reservoir is here along with an 800 square foot office building/chlorine station that was built in 1958.

Peck Reservoir

Utility Meters
There is one electric meter at this site.

Building Envelope
The building is of stucco and plaster construction with single pane windows and composite shingle roof.

Lighting
There are four fixtures inside the main office, which are all 8' 2L 59W T8 fixtures controlled by switches. The new chlorine tank room has two 4' 4L 32W T8 fixtures with electronic ballasts controlled by switches.

Exterior Lighting

On the outside of the building there is a mixture of 2L 14W CFLs and 1L 14W CFL fixtures controlled by photocells.

HVAC
There is no HVAC in this facility.

Domestic Hot Water
An electric water heater provides domestic hot water to the building.

Miscellaneous Energy
Miscellaneous energy use at this facility includes a wall heater and a few typical office-type plug loads.

Renewable Energy
There is no renewable energy at this site at this time.

Data Loggers
Data loggers were not installed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were evaluated for this site:

1. Install three occupancy sensors in the three rooms used most frequently at this site. Since this building is occupied intermittently, it is recommended that a few occupancy sensors are installed to reduce the frequency in which lights may be left on.

2. Install a Thin Film PV System on the cover of the water tank
    a. The cover of the water tank at Peck Reservoir provides a greater opportunity to offset electric use with a large thin film solar photovoltaic system.
    b. About Thin Film.
        i. In contrast to typical glass polycrystalline modules, thin film is a flexible solar material that adheres directly to the surface on which it is mounted. This means that the module material can be directly integrated into the cover of the water tank.
        ii. Since it is flexible and does not have any class components, it is also more rigorous than other photovoltaic modules.
        iii. It has a relatively low energy output per square foot (5.8W/SF) due to the materials used to make it; however, part of this is made up for because Thin Film is a "low-light" technology. This means that the module is able to produce energy for more hours per day because it can absorb radiation and generate electricity when the sun is low on the horizon (early morning and evening).
        iv. Tends to be less expensive than other types of modules
    c. For detailed information about the proposed solar photovoltaic system sizes, tilts, and costs, please see the Appendix.

Energy Efficiency Measures Analyzed by Not Recommended

1. Replace 8’ T8 fixtures with 4’ T8 fixtures. We also looked into replacing the 8’ 2L 59W T8 fixtures with 4’ 2L 32W T8 fixtures to eliminate the use of the hard to find and difficult to handle 8’ lamps; however, retrofit is not cost effective since this building is only used a few hours a day per week. The City should keep this in mind as they standardize the types of lighting they have throughout the City though.

4.6.2 Water Block #35

Water Block 35 is located at the intersection of 6th and Rowell in Manhattan Beach. The site has the City's water tower. There are three structures on the site: the pumping station/office, the chlorine station, and the generator vault. All three buildings were built in 2000.

At this complex, there is at least one employee on the clock 24/7; however, the employee is not always at the facility.

Utility Meters
There is one electric meter at this site.

Building Envelope
The pumping station is a 2,308 SF facility that houses the water pumps and piping. It also has a small kitchen, restroom, and a separate, walled-off office with an indoor heat pump on the ceiling. The building is of concrete block construction, surrounded by single-pane windows and a metal roof with skylights.

The chlorine station houses the chlorine tank. The 360 SF building is of concrete block construction. It has single pane, operable windows. The roof is wood deck with composite singles.


Chlorine Station


Roof of Chlorine Station and Pumping Station

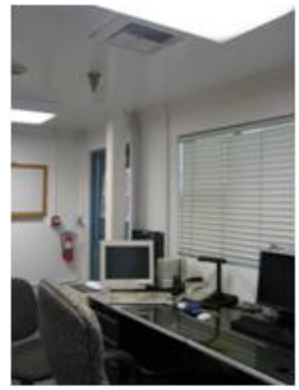
Lighting
All of the fixtures inside the pumping station are T8 fixtures, primarily 3L 4X2 T8 fixtures with electronic ballasts. Since the building has both windows and skylights, there is adequate natural light in the main pump room to obviate the need for artificial lighting during daylight hours. The fixtures are controlled by switches.


Pumping Station Daylighting

The chlorine room, which is rarely occupied, has four 2L 4' T8 fixtures with electronic ballasts that are controlled via a switch.
Access was not provided to the generator vault.
Exterior fixtures were a mixture of 100W metal halide security fixtures, 13W CFL flood lamps, and, several metal halide fixtures around the water tank, estimated to be 1000W. These fixtures are controlled by photocell sensors.

HVAC
In the pumping station there is a Carrier FB 4ANF018, 1.5 hp split system unit serving the office. The unit is controlled by a wall thermostat. It is in good condition and should last another 12 - 15 years.

The chlorine station has a single fan to vent the fumes from the chlorine tank.


Pumping Station Office

Domestic Hot Water
An electric water heater provides domestic hot water to the building.

Miscellaneous Loads
The main miscellaneous loads at Water Block #35 are the pumps for the water tower. These were out of our scope of work, so we did not collect any addition information about these pumps.

Renewable Energy
There is no renewable energy at this site at this time.

Data Logging
Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES
The following energy efficiency measures were analyzed for this site:

1. Install wall occupancy sensors in the kitchen, restroom, and office in the main building.
    a. The occupancy sensors will automatically shut off the lighting in the spaces when the space is unoccupied for a set amount of time. It is recommended that the occupancy be programmed to shut off the fixtures after 3-5 minutes.

2. Install a wall sensor in the Chlorine Building.
    a. Same as above.

3. Install two ceiling sensors in the pump room in the main building.
    a. Same as above.

4. Replace existing 100W MH lamps around the perimeter of the buildings with 40W induction fixtures.

5. Replace the two existing 250W (*wattage estimated*) Metal Halide spot fixtures found on the ground of Water Block #35 with 100W induction spot light fixtures.

6. Install a solar photovoltaic system on top of the water tank.
    a. For detailed information about the proposed solar photovoltaic system sizes, tilts, and costs, please see the Appendix.

4.6.3 Pier, Roundhouse, and Beach Restrooms

The Manhattan Beach pier is located at the end of Manhattan Beach Boulevard. The pier was first built in 1901 and has undergone numerous changes over the years. Today, the scenic 928-foot pier is lined with globe lamps, and at the end of the pier is a 1991 replica of the original 1920s Roundhouse. Though originally a tackle store, the Roundhouse is now a Marine Studies Lab and Aquarium that has a Shark Tank, Touch Tank, and several other tanks housing sea creatures. The Roundhouse also has a small restaurant and restrooms. A small swim changing/ restroom facility is located just north of the pier for beach-goers.

The pier is a popular tourist location and people can be found on the pier and the surrounding beach year-round at all times of day.

Roundhouse


Beach and Restroom Facility

Operating Hours

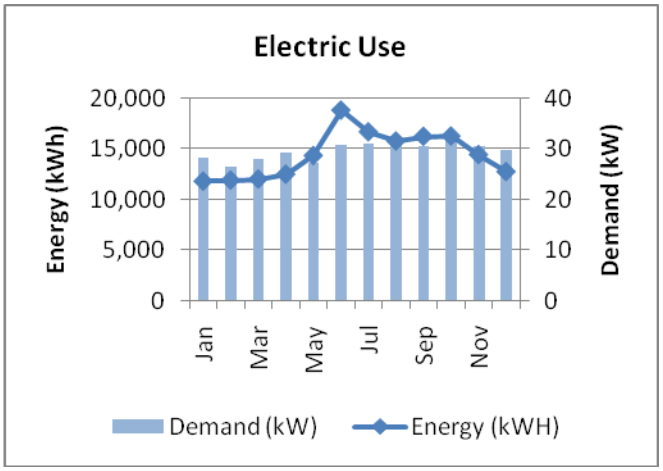
Location	Hours
Roundhouse	Monday-Friday: 3 pm-sunset, Saturday-Sunday 10 am-sunset
Beach Restrooms	
Pier	24/7

Utility Meters

There are three electric meters serving the electric loads at the Pier. These include a meter to monitor loads at the Aquarium, at the restaurant, and the Pier lighting.

After analyzing the utility bills for each of these meters, we created an energy balance to model how the equipment in the building is used and match it with the utility bills. This proved to be a difficult task for the Aquarium because the electric demand and consumption change frequently due to changing exhibits and research. Based on the information we collected during the site visit, there was approximately 11 kW of load by the Aquarium pumps and coolers and another 13-14 kW of lighting, HVAC, and miscellaneous loads. Thus, total calculated electric demand for the Aquarium was 24kW. However, from the utility bills, actual demand over the past (baseline) year was between 27kW and 32kW during the baseline year. As such, our energy model is only

75% accurate for demand. To balance the energy consumption, we assumed the aquarium equipment to be running at 85% load, 24 hours a day, 365 days per year.



Actual Aquarium Electric Demand and Energy Use

Lighting

Roundhouse Aquarium. Interior lighting in the aquarium section of the roundhouse includes 30 – 32W 2L 4' T8 fixtures with electronic ballasts and controlled by switches for general lighting as well as 7 1L 250W 1L Metal Halide spot lamps and approximately 10 2' 24W T5 lamps for the aquarium lighting. During the site visit, the aquarium was open and all of the interior lighting was turned on. Aquarium employees informed us that they are environmentally conscious and shut off the lights when the facility is unoccupied. According to staff at the aquarium, specialized lighting is used for the health of the specimens. The existing lamps are inefficient and should be considered for replacement.

Damaged Pier Globe Lights

The restrooms in the Roundhouse each had 2- 1L 32W T8 fixture, each with its own switch. During the site visit, only one switch in each restroom was on.

Roundhouse Restaurant. The restaurant in the Roundhouse has track lighting with three fixtures. Only one of the three fixtures had a bulb in it, and the bulb was a 60 W incandescent bulb. The lights were off since the restaurant window was open and the door was also propped open.

Roundhouse Exterior. Four 100 W Metal Halide breadbox fixtures, controlled by photocell sensors, are mounted on the roof of the building.

Pier Lighting and the Comfort Station. The pier is lit by 36 - 70 Watt High Pressure Sodium lamps on 16 foot posts with the historic imitation globe fixtures. These fixtures are controlled by a photocell sensor and are on from dusk until dawn.

In addition, the plastic casing on the outside of several of the fixtures is cracked and broken. We were informed that fixture casing are replaced often because they are broken due to fisherman overcastting and hitting their poles against the plastic casing. Replacing these fixtures frequently is unsustainable.

Beach Restroom Daylighting

The beach restrooms are located to the north of the start of the pier walkway. The restrooms have skylights which, along with the windows, provide natural light to the inside during daylight hours. During the site visit at approximately 11 AM, the men and women's lights were turned off. Photocells turn the lights on when there is not adequate daylight.

HVAC

Roundhouse Aquarium. There are two Carrier FB4AW036 unit ventilators serving this building. These units are assumed to date back to the 1991 construction, so are estimated to be over 15 years old and so are approaching their expected service life of 20 years.

Roundhouse Restaurant. N.A

Pier Lighting and Comfort Station. N/A

Domestic Hot Water

Roundhouse Aquarium. N/A

Roundhouse Restaurant. N/A

Pier Lighting and Comfort Station. N/A

Miscellaneous

Roundhouse Aquarium. The fish tanks in the aquarium are cooled to keep the water at the appropriate temperature for the sea creatures. There is also a freezer and refrigerator. There are also some typical office plug loads including a printer and some computers.

Roundhouse Restaurant. The restaurant has a mini-fridge, freezer, ice maker, microwave, and drink dispenser.

Renewable Energy

This site has no renewable energy at this time.

Data Loggers

Data loggers were not placed at this site.

ENERGY EFFICIENCY MEASURES

Roundhouse Aquarium.

1. Install occupancy sensors in the side rooms of the aquarium.

2. Retrofit the existing 250W Metal Halide fixtures above the aquatic tanks with more efficient lamps, such as induction lamps or LEDs. The lamp replacement will depend on the requirements of the aquatic creatures in the tanks. We attempted to contact the staff at OTS to help us understand the requirements by the fish in each tank, but were unable to reach them. We have used induction fixtures in our recommendations since these fixtures have a low dollar per watt value. However, we insist the City check with staff at the aquarium before making any changes.

Roundhouse Restaurant.

3. Install occupancy sensors in the restrooms and restaurant.

4. Install Energy Star products in the restaurant. The existing refrigerator, ice maker, and dishwasher should be replaced with the energy efficient counterparts.

4.6.4 Street Lighting

The City's street lighting was also surveyed and analyzed. A large representative sampling of the street lights, found throughout the city, were surveyed including: Downtown Street and Sidewalk lights, the Walk Street Lights, The Strand Lights, and Veterans Parkway Lighting. From this the savings were projected from the street light inventory provided by the City. The majority of the streetlights are controlled by photocells and are on from dusk until dawn, nightly.

Lighting
The existing street and security fixtures are a mix of high pressure sodium, low pressure sodium, and metal halide fixtures ranging in wattage from 30W to 250W.

ENERGY EFFICIENCY MEASURES
We analyzed three cost effective options for the street lighting.

1. **Light Emitting Diode (LED) Retrofit** – For the LED retrofit, the existing lamp in the fixture is removed and a LED retrofit kit is used to provide the existing fixture with the LED equivalent lamp. LEDs are beneficial over conventional Metal Halide, Mercury Vapor, and High Pressure Sodium lamps because of the extended lamp life (approximately 60,000 hours), reduced wattage (typically about 50% reduction), and environmentally friendliness (no mercury).

   Note: Southern California Edison (SCE) does not rebate LEDs for streetlights at the present time. We verified this for both the Express Efficiency and SPC programs.

2. **LED with Solar Retrofit** – For the LED with solar retrofit, not only is the existing lamp in the fixture removed and replaced with an LED but a solar panel, battery, and a microprocessor battery control board is installed. The addition of the solar system typically provides an additional 20% energy savings over the LED only option; however, these added components approximately double the price.

   As noted above, these LEDs are not eligible for SCE rebates.

3. **Induction Lighting Retrofit** – For the induction lighting retrofit, the existing fixture is removed and an induction retrofit fixture retrofit kit is installed. The rated lamp life of induction fixtures is 100,000 hours and the ballast life is 60,000 hours. The induction fixtures are eligible for SCE rebates.

As such, we recommend Induction over both LED applications for street lighting applications primarily because current induction fixtures are half the price of LED fixtures and have approximately twice the rated lamp life (100,000 hours) as LEDs (and ten times the rated lamp life as most metal halide and mercury vapor lamps).

Furthermore, the color quality (CRI) of induction lighting is much better than current LED lighting. Even though LED street lights are slightly more efficient (lumens/watt) than induction lights and contain no mercury, the city already manages waste disposal of mercury (for fluorescent lighting). The longer life and lower costs compared to LEDs and other technologies, make induction street lighting and some building exterior lighting the most sustainable and cost effective choice at this time.

Background. Recognizing that induction and LED technologies are improving rapidly, we spoke with several vendors about the *current* state of technology. We then weighed current energy, application costs, and environmental benefits for both and found the following:

- Induction fixtures have a broader application base for exterior lighting than LED because they provide greater light throw and thus can be used not only for street and security lighting but also some sports field lighting. Note: induction lamps can be used for sports field lighting with wattages equal to or less than 1000W and pole heights equal to or less than 40 ft. However, at greater heights or equivalent lumen requirements, induction lamps cannot produce enough light to make the light quality acceptable at field level. Thus, there is not a good replacement for baseball field lighting (at this point in time.)

- Most HID lamps, such as metal halide, have a life of 10,000 hours. LED lamps have a life of 50,000 – 60,0000 hours. Induction lamps have a life of 100,000 hours (effectively 10 – 100 times others). This is because induction lamps do not have electrodes, which is the component that burns out in an incandescent, HID or linear fluorescent lamp. Instead, induction lamps rely on magnetic induction to ignite the phosphors, that are essentially self-regenerating.

- Induction lamps are approximately half the cost of LED lamps.

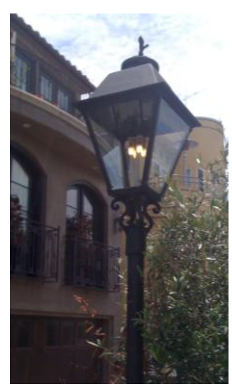
- LED lamps are more environmentally friendly because they do not contain mercury as other lamps do such as: induction, fluorescent and metal halide lamps.

  In general, we recommend replacing most exterior fixtures including streetlights, some security lights, parking lot lights, and sports field/court lights under 1,000w and 40' pole height with induction lighting.

  A lighting designer should be included during design development to provide additional expertise on any lighting upgrades as well as orchestrate pre-qualified vendors to install samples prior to final selection.

Further analyses is in the lighting section of the appendices.

4.6.5 Neighborhood Walkway Lighting



The City's natural gas lamps were not in our scope, but requested for review. We surveyed a sampling of the neighborhood lamps. Although retrospective, the lamps provide no functional value. The gas lamps, on their own, provide very little light output. Most homes in the neighborhoods have, by code, more than adequate exterior light for safety already. In fact, the neighborhoods are substantially over lit. As such gas lamps are functionally unnecessary given the local "light pollution" as defined by the US Green Building Council.

Lighting
The gas lamps are fueled by natural gas with 4 wicks in each lamp and currently operate 24x7.

ENERGY EFFICIENCY MEASURES

We offer three recommendations in order of priority:

1. Turn off the natural gas connection to all gas lamps and leave the lamps in place.
2. Disconnect and remove all gas lamps to avoid energy and future maintenance or vandalism costs.
3. Turn over ownership of all gas lamps to homeowners or HOAs (if existing) to allow homeowners the option of maintaining and energizing the lamps themselves.

   Options analyzed but not recommended:

4. Install solar powered photocell sensors on the main gas line feeding the lamps and send a worker around each night to ignite the wicks. This would be highly impractical and costly to the city.
5. Disconnect and cap off the gas lines and retrofit the lamps with battery-powered LEDs customized to match the appearance of the wicks. The batteries would have to be replaced on a regular basis or recharged by DC solar panels that could be wired to a remote location on each home. This would be very costly to retrofit en masse, but may be more practical if implemented by individual homeowners.
6. Retrofit the fixtures with LEDs and solar collectors on each fixture or pole. This would be impractical since the poles are short, often shaded by trees, shrubs or buildings and would alter the architecture of each pole beyond its aesthetic appeal.

4.7 Water Efficiency

4.7.1 Plumbing Fixture Retrofits

Though water efficiency was not in the scope of this study, it is important to note that water rates are escalating similarly to energy rates. As such, it is becoming increasingly important for building owners to seek water efficiency in their facilities. Methods to reduce water usage range from adding faucet flow regulators and aerators to replacing toilet fixtures with low-flow flush fixtures and urinals with water-less urinals.

Existing conventional water closets should be replaced with Low Flow or Ultra-Low Flow Water Closets. While only the flush valve needs to be replaced, it is usually recommended that the bowl also be replaced because the bowl design affects how well the flush out cleans the bowl when dealing with low flow water fixtures. Advancements in low flow technology have improved flush capability so problems with flushing waste is rarely an issue.

Figure 1: Low Flow Toilet Fixtures and Bowls

Conventional urinals should be removed and replaced with waterless urinals. Waterless urinals offer a zero water use fixture. The picture below shows a typical waterless fixture. When used, liquid waste passes into the drain and through a debris-catching strainer and a sealing liquid. The sealing liquid is less dense than the liquid waste and so allows the liquid waste to pass through it. The sealing liquid settles near the drain and seals itself across the opening of the trapway, providing a barrier to block odors from the liquid waste below. The liquid waste below is routed into a waste pipe.

The fixtures are easy to retrofit. Most fixtures are designed to connect to the existing waste pipe and existing urinal collar. Daily cleaning maintenance requires typical cleaning. A bi-weekly flush out should also be done. This requires the system to be purged using water and urinal cleaner and then the sealing liquid must be replenished to ensure odors remain isolated.

Figure 2: Waterless Urinals

Lavatory and kitchen faucets should also be replaced with low flow faucets. These will reduce water use by approximately 28% compared to the conventional sink fixture.

In summary, the fixtures allow more water flow than necessary to complete simple tasks such as washing one's hands or flushing the toilet. Water is a precious commodity, so as the demand for water increases, supply will diminish and prices will rise. Therefore, it is becoming increasingly important to utilize fixtures like these that reduce water consumption. Also, note that fixture replacements also reduce energy consumption because less hot water is used thus reducing energy use to produce hot water. Rebates for the flush fixtures (toilets and urinals) are available through the Save Water Save a Buck Program.

4.7.2 Water Recycling

There are also several opportunities to recapture water use throughout the buildings and use it for landscaping. Cooling towers that are paired with electric chillers in the Public Safety Building have to be flushed or "blown down" occasionally to clear out some of the internals. Normal practice is to flush this water down the drain; however, we have designed living water treatment systems to catch this water, treat it with natural vegetation and provide significant landscape irrigation. This is an industry innovation and fully code permissible.

4.8 Building Certification

In addition to the measures discussed above, it is also recommended that building certification be sought as a means of benchmarking and monitoring building performance, but also illustrating the City's commitment to building energy efficiency and sustainability.

The two most recognized efficiency and green building certifications are EPA Energy Star and USGBC LEED™ Certification. An overview of each and steps the city would need to take to become LEED™ certified are provided below.

4.8.1 EPA ENERGY STAR CERTIFICATION

The ENERGY STAR is the national symbol for energy efficiency in America. More than 50 different kinds of products as well as thousands of new homes, commercial and industrial facilities have earned the ENERGY STAR for superior energy performance.

Commercial and industrial facilities account for half of all energy consumption in the U.S. at a cost of over $200 billion per year, more than any other sector of the economy. These facilities are also responsible for nearly half of U.S. greenhouse gas emissions, which contribute to climate change.

Since the ENERGY STAR for commercial buildings was first introduced in 1999, thousands of buildings across the country have earned the ENERGY STAR rating and are saving billions in energy costs. The first class of manufacturing plants to earn the ENERGY STAR was announced in 2006, adding another valuable tool for sustaining momentum in a corporate energy program.

The energy performance of commercial and industrial facilities is scored on a 1-100 scale and those facilities that achieve a score of 75 or higher are eligible for the ENERGY STAR, indicating that they are among the top 25% of facilities in the country for energy performance. Commercial buildings that have earned the ENERGY STAR use on average 35% less energy than typical similar buildings and generate one-third less carbon dioxide. Increasing concern about the financial and environmental risks associated with climate change is driving more organizations to strive for the ENERGY STAR for their buildings, as it is seen as a symbol of an organization that is working to reduce global warming and its impacts.

The City of Manhattan Beach is required to benchmark building performance through the Energy Star benchmarking system starting in 2010, as described below.

> *"Section 432 amends Section 543 of NECPA and establishes a framework for facility project management and benchmarking. Each facility energy manager will be responsible for: …. Entering energy use data for each metered building into a benchmarking system, such as the ENERGY STAR® Portfolio Manager. DOE must select or develop the benchmarking system and issue guidance for its use." (Energy Independence and Security Act, U.S. DOE)*

"A new California law, Assembly Bill 1103, requires all commercial building owners or operators to disclose their buildings' benchmarking data and Portfolio Manager performance rating to prospective buyers, lessees of entire buildings, or lenders starting in 2010. The state also has broken new ground by requiring all state-owned buildings to be benchmarked with Portfolio Manager." *(California Builds on Its Success with ENERGY STAR: California Becomes First State to Mandate Disclosure of Energy Use at Time of Building Transaction, U.S. EPA ENERGY STAR News, Spring 2008)*

Note: Certification can be expedited since we have taken the initiative of uploading much of the data already through our benchmarking process.

4.8.2 USGBC LEED™ CERTIFICATION

As concerns about energy usage and costs escalate, there is also increasing concern about future water and natural resource availability, air quality, and conservation of the natural environment. As such, the importance of having a sustainable building is increasingly important. To encourage sustainable building practices, the United States Green Building Council (USGBC) has developed the Leadership in Energy and Environmental Design (LEED™) Rating System. This rating system quantifies how efficient a building is using a credit rating system. For existing buildings (LEED™ EB), credits can be awarded in the topical categories of Sustainable Sites, Energy and Atmosphere, Materials and Resources, Water Efficiency, Indoor Environmental Quality, and Innovation and Design Process.

PE Consulting encourages its clients to become LEED™ Certified for the following reasons:

- ✓ Certification by the USGBC as a green building provides credibility that the building provides for a healthy, productive working environment
- ✓ The certification process provides a way to verify achievement of sustainability and a reduced carbon footprint through quality assurance and performance verification
- ✓ Becoming certified demonstrates a building owner's commitment to sustainability
- ✓ Certification aids in qualification for incentives and potential tax benefits.

Depending on the number of credits awarded, a building can receive one of four certification levels: Certified, Silver, Gold, or Platinum.

Table 1: LEED™ Version 3 2009 for Existing Buildings

Certification Level	Point Required
Certified	40-49
Silver	50-59
Gold	60-79
Platinum	80-110

The City could seek LEED™ Certification under the LEED™ 2009 for Existing Buildings: Operation and Maintenance category for this facility. This would require the facility to dedicate itself to sustainability in the seven categories including: sustainable sites, water efficiency, energy efficiency, materials and resources, indoor environmental quality, innovation in design, and regional priority.

LEED™ Certification will require the city to adopt sustainable purchasing, recycling, and energy management policies and plans. In addition, since the building is old, the energy conservation measures recommended would need to be implemented to minimize energy consumption to acceptable levels by LEED™. Other credit categories that may require additional attention and planning are sustainable sites (landscaping policies, pest management policies, etc), water efficiency (landscaping water use), material usage policies (purchase sustainable products including office consumable products and durable products) and green cleaning policies.

LEED™ Certification is a good idea for the city to help benchmark building performance and ensure that the building continues to operate well. Studies show LEED™ certified buildings operate approximately 30% more efficiently over the long term than buildings that are not certified.

5.0 SUMMARY

5.1 Recommended Measures

The measures we recommend include: Building envelope and weatherization, Central Plant, HVAC and building automation retrofits, Daylighting and interior lighting retrofits, Exterior and street lighting retrofits, Solar power generation and Data Center improvements as summarized below:

Site Information		Energy Efficiency Measures			Utility Savings				Financials							CO2 Offsets	
Site	Building	Cat.[1]	Type	Description	kW	kWh	Therms	kBtu	First Cost	Rebates & Incentives[2]	**Net Cost**	Annual Savings[3]	Eqpt. Life (yrs)	Lifecycle Savings[4]	Lifycycle Payback (yrs)[5]	Tonnes	Dollars per Tonne
City Hall	City Hall / Highland Lift	EE	All	Install: solar controlled glass, new ceiling, new fixtures, controls, ltg on EMS	99	264,080	4,299	1,330,413	$905,205	$50,225	**$854,980**	$37,012	18	$1,143,887	15	110	$7,803
City Hall	City Hall / Highland Lift	EE	Misc.	Data Center and PC's (rough est.)	8	67,759	0	231,057	$180,614	$0	**$180,614**	$10,244	5	$57,748	>eq. life	22	$8,115
City Hall	City Hall / Highland Lift	RE	Solar	Rooftop: 32.5 kW DC Solar PV		41,990	0	143,186	$210,438	$57,558	**$152,880**	$5,689	25	$312,137	17	14	$11,085
City Hall Annex	COC; USPO, Annex	EE	Ltg	Skylights, Retrofit 8' ltg, Delamp, Induction Pkg Lamps	2	15,518	0	52,915	$25,036	$1,022	**$24,015**	$2,365	23	$111,144	9	5	$4,712
City Hall Annex	COC; USPO, Annex	EE	HVAC**	Replace Chamber of C. Heat Pump & Programmable Thermostats	1	4,301	0	14,667	$6,410	$449	**$5,961**	$599	15	$13,946	9	1	$4,220
City Hall Annex	COC; USPO, Annex	EE	Other	New DHW Heater	0	-	6	571	$1,554	$6	**$1,548**	$18	25	$1,008	>eq. life	0	$51,062
Fire Station #2	Complex	EE	Ltg	Delamp, CFLs, Occ. Sensors	1	2,632	0	8,974	$3,212	$184	**$3,028**	$372	23	$17,501	7	1	$3,503
Fire Station #2	Complex	EE	HVAC**	Replace Bryant E/G Package Unit with SEER 13-15 Package Unit	2	8,953	0	30,530	$10,360	$981	**$9,379**	$1,267	15	$29,489	7	3	$3,189
Fire Station #2	Complex	EE	HVAC**	Install Infrared Radiant Tube Heater in the Fire Truck Garage	0	-	111	11,070	$10,360	$111	**$10,249**	$111	21	$4,427	>eq. life	1	$17,434
Joslyn Center	Community Hall	EE	Ltg	Delamp; Incan to CFL; Occ Sensors	2	12,047	0	41,079	$14,128	$834	**$13,295**	$1,632	23	$76,707	7	4	$3,360
Joslyn Center	Community Hall	EE	HVAC**	Replace 4 E/G Package Units with High Efficiency Units	5	20,053	0	68,381	$59,570	$2,343	**$57,227**	$2,717	15	$63,241	15	7	$8,688
Joslyn Center	Community Hall	EE	DHW	New DHW Heater	0	-	33	3,270	$1,554	$33	**$1,521**	$40	25	$2,197	21	0	$8,760
Joslyn Center	Community Hall	RE	Solar	Rooftop: 45.1 kW DC Solar PV		58,208	0	198,490	$291,717	$79,789	**$211,928**	$7,887	25	$432,696	17	19	$11,085
Live Oak Park	Scout House	EE	Ltg	Delamp; Occ. Sensors, Photocell Sensors	0	415	0	1,414	$1,632	$41	**$1,590**	$59	23	$2,750	17	0	$11,680
Live Oak Park	Scout House	EE	Env	Blow-In Attic Insulation	0	-	16	1,567	$1,943	$16	**$1,927**	$16	25	$860	>eq. life	0	$23,148
Live Oak Park	Dorsey Field & Tot Lot	EE	Ltg	Induction Lamps	1	2,314	0	7,891	$4,197	$223	**$3,974**	$637	23	$29,915	6	1	$5,228
Live Oak Park	Multipurpose Building	EE	Ltg	Skylights; Occupancy Sensors; Induction for Batting Cage	1	2,177	0	7,423	$9,461	$174	**$9,287**	$370	23	$17,371	16	1	$12,989
Live Oak Park	Multipurpose Building	EE	HVAC**	Replace 3 and 4 ton Carrier units w/ high efficiency package units	4	9,025	0	30,775	$16,835	$1,203	**$15,632**	$1,223	15	$28,462	10	3	$5,274
Live Oak Park	Multipurpose Building	RE	Solar	Rooftop: 21.1 kW DC Solar PV		27,283	0	93,034	$136,730	$37,397	**$99,332**	$3,697	25	$202,808	17	9	$11,085
Live Oak Park	Pony Field Lighting	EE	Ltg	Induction Fixtures	1	1,013	0	3,453	$20,384	$160	**$20,223**	$1,407	23	$66,101	11	0	$60,805
Live Oak Park	Recreation Hall	EE	Ltg	Occ. Sensors	0	946	0	3,227	$1,256	$74	**$1,182**	$134	15	$3,109	8	0	$3,804
Live Oak Park	Recreation Hall	RE	Solar	Rooftop: 2.1 kW DC Solar PV		2,698	0	9,201	$13,523	$3,699	**$9,824**	$381	25	$20,896	17	1	$11,085
Live Oak Park	Tennis Courts Lights	EE	Ltg	Induction Tennis Ltg	31	34,164	0	116,499	$57,554	$4,828	**$52,726**	$9,258	23	$435,076	6	11	$4,699
Manh. Heights Annex	Creative Arts Center	EE	Ltg	Arch. Ltg update; Occ Sensors; Induction Ext. Lamps	3	4,618	0	15,746	$7,117	$540	**$6,576**	$1,023	23	$48,059	6	2	$4,336
Manh. Heights Annex	Creative Arts Center	EE	HVAC**	Replace 25 ton package unit	0	2,971	0	10,132	$38,850	$267	**$38,583**	$684	15	$15,928	>eq. life	1	$39,535
Manh. Heights Annex	Creative Arts Center	EE	DHW	Install high efficiency DHW Heater	0	-	16	1,635	$1,554	$16	**$1,538**	$16	20	$601	>eq. life	0	$17,709
Manh. Heights Annex	Creative Arts Center	RE	Solar	Covered Parking: 18 kW DC Solar PV		24,953	0	85,091	$139,487	$31,793	**$107,694**	$3,381	25	$185,493	19	8	$13,140

cont'd next page.

Site Information		Energy Efficiency Measures			Utility Savings				Financials							CO2 Offsets	
Site	Building	Cat.[1]	Type	Description	kW	kWh	Therms	kBtu	First Cost	Rebates & Incentives[2]	Net Cost	Annual Savings[3]	Eqpt. Life (yrs)	Lifecycle Savings[4]	Lifycycle Payback (yrs)[5]	Tonnes	Dollars per Tonne
Manh.Heights Park	Tennis Courts Lights	EE	Ltg	Induction Tennis Ltg	13	9,750	0	33,248	$23,981	$1,788	**$22,193**	$2,814	23	$132,263	7	3	$6,930
Manh.Heights Park	Baseball/Basketball Lights	EE	Ltg	Induction Basketball Ltg	5	2,028	0	6,915	$9,592	$621	**$8,971**	$872	23	$40,985	9	1	$13,468
Manh.Heights Park	3 Structures: CC/TR/PG	EE	Ltg	Delamp; Occupancy Sensors	3	7,042	0	24,013	$13,999	$651	**$13,348**	$954	15	$22,208	11	2	$5,771
Manh.Heights Park	3 Structures: CC/TR/PG	EE	HVAC**	Replace existing gas packs with (4) high eff. gas packs	9	15,226	82	60,106	$48,563	$2,310	**$46,253**	$2,145	15	$49,923	15	5	$8,509
Manh.Heights Park	3 Structures: CC/TR/PG	RE	Solar	Covered Parking: 26.9 kW DC Solar PV		37,430	0	127,636	$209,231	$47,689	**$161,541**	$5,071	25	$278,239	19	12	$13,140
Manh. Village Park	Restrooms and Ext. Lights	EE	Ltg	Lighting	2	9,859	0	33,620	$6,820	$718	**$6,102**	$1,977	23	$92,904	3	3	$1,884
Marine Park	Complex	EE	Ltg	Delamp; Induction Ext. Lamps	9	15,917	0	54,278	$28,086	$1,743	**$26,343**	$4,010	23	$188,437	6	5	$5,039
Marine Park	Complex	EE	Other	New DHW Heater	0	-	12	1,182	$1,554	$12	**$1,542**	$19	20	$716	>eq. life	0	$24,564
Marine Sports Park	Complex	EE	Ltg	Occupancy Sensors	0	242	0	824	$1,049	$12	**$1,037**	$33	15	$762	>eq. life	0	$13,066
Metlox Town Square	Metlox Parking Structure	EE	Ltg	70W Induction Garage Ltg / 40W Induction Wallpacks	16	137,742	0	469,701	$210,431	$8,518	**$201,913**	$26,368	23	$1,239,187	7	45	$4,463
Parking Structure	Parking Structure #2	EE	Ltg	40W Induction Garage Ltg w/ PC	1	4,755	0	16,214	$6,906	$300	**$6,606**	$958	23	$45,029	6	2	$4,230
Parking Structure	Parking Structure #2	RE	Solar	Covered Parking: 3 kW DC		4,159	0	14,182	$23,248	$5,299	**$17,949**	$587	25	$32,206	18	1	$13,140
Parking Structure	Parking Structure #3	EE	Ltg	40W Induction Garage Ltg w/ PC	1	13,593	0	46,351	$136,103	$798	**$135,305**	$18,493	23	$869,075	7	4	$30,307
Parking Structure	Parking Structure #3	RE	Solar	Covered Parking: 37.4 kW DC Solar PV		51,986	0	177,272	$290,598	$66,235	**$224,363**	$7,044	25	$386,443	19	17	$13,140
Parking Structure	Parking Structure #4	EE	Ltg	40W Induction Garage Ltg w/ PC & Exterior Ind. Poles	2	12,997	0	44,319	$20,618	$827	**$19,791**	$2,726	23	$128,133	7	4	$4,636
Parking Structure	Parking Structure #4	RE	Solar	Covered Parking: 15 kW DC Solar PV		20,794	0	70,909	$116,239	$26,494	**$89,745**	$2,935	25	$161,032	18	7	$13,140
Peck Reservoir	Pumping Station / Reservoir	EE	Ltg	Occupancy Sensors	0	72	0	245	$233	$4	**$230**	$11	15	$245	15	0	$9,737
Peck Reservoir	Pumping Station / Reservoir	RE	Solar	Water Tank Mounted: 189 kW DC Solar PV		244,188	0	832,681	$1,223,775	$390,701	**$833,074**	$35,886	20	$1,320,083	15	80	$10,387
Pier	Pier Ltg & Comfort Station	EE	Ltg	Occupancy Sensors	0	20	0	69	$155	$1	**$154**	$2	23	$115	>eq. life	0	$23,078
Pier	Roundhouse - Aquarium	EE	Ltg	Induction / Sensors	1	12,347	0	42,103	$3,738	$750	**$2,988**	$1,482	23	$69,630	2	4	$737
Pier	Roundhouse - Restaurant	EE	Ltg	New Fixt. in Restaurant. and Induction Ext. Fixt.	0	1,200	0	4,092	$2,829	$87	**$2,742**	$328	23	$15,418	7	0	$6,956
Pier	Roundhouse - Restaurant	EE	Misc.	Energy Star (1 refrigerator; 1 freezer;	0	698	0	2,379	$4,632	$0	**$4,632**	$98	20	$3,623	>eq. life	0	$20,211
Polliwog Park	Historic House	EE	Ltg	Replace Incan. w/ CFL; Occ Sensors	0	352	0	1,202	$466	$26	**$440**	$50	15	$1,158	8	0	$3,801
Polliwog Park	Restrooms and Office	EE	Ltg	Occ. Sensors; Induction Ext. Lamps	11	47,663	0	162,530	$38,908	$3,458	**$35,450**	$9,656	23	$453,799	4	16	$2,264
Premier Park	Restroom	EE	Ltg	Occupancy Sensors	0	134	0	458	$311	$7	**$304**	$19	14	$398	12	0	$6,897
Public Safety	Facility	Cx	Oth	Commissioning	0	167,121	5,006	1,070,466	$77,700	$5,006	**$72,694**	$20,657	5	$116,446	4	81	$892
Public Safety	Facility	EE	Ltg	Install Induction Pkg Fixtures; Ltg to EMS	6	27,879	0	95,066	$11,963	$2,030	**$9,932**	$4,438	23	$208,549	3	9	$1,085
Public Safety	Facility	EE	HVAC	Ice Storage for City Hall and Public Safety	100	-	0	0	$332,815	$37,500	**$295,315**	$24,474	25	$1,342,732	10	0	N/A
Public Safety	Facility	RE	Solar	Covered Parking: 112.2 kW DC		155,958	0	531,817	$871,794	$249,533	**$622,261**	$23,966	25	$1,314,869	17	51	$12,148
Public Works Yard	Complex	EE	Ltg	Delamp Fixtures; Induction Ltg	9	28,998	0	98,884	$87,282	$2,376	**$84,906**	$7,004	23	$329,170	10	10	$8,914
Public Works Yard	Complex	EE	HVAC**	2 new, 3 ton, high efficiency heat pumps	1	9,595	0	32,718	$11,655	$965	**$10,690**	$1,323	15	$30,803	7	3	$3,392
Public Works Yard	Complex	EE	HVAC**	Replace unit heaters with radiant tube heaters	0	-	3,279	327,936	$22,897	$3,279	**$19,618**	$3,228	21	$129,087	6	17	$1,126
Public Works Yard	Complex	RE	Solar	Rooftop: 87.2 kW DC Solar PV		112,668	0	384,196	$564,646	$180,268	**$384,378**	$15,265	25	$837,525	16	37	$10,387
Sand Dune Park	Office and Restroom	EE	Ltg	Retrofit T12 fixture; Induction Ext. Ltg	1	3,961	0	13,507	$5,848	$289	**$5,560**	$1,175	23	$55,223	5	1	$4,273
Water Block #35	Complex	EE	Ltg	Occ Sensors; Induction Ltg	2	10,271	0	35,024	$9,629	$725	**$8,904**	$2,403	23	$112,936	4	3	$2,639
Water Block #35	Complex	RE	Solar	Water Tank Mounted: 148.2 kW DC Solar PV		191,478	0	652,940	$959,613	$306,365	**$653,248**	$28,140	20	$1,035,132	15	63	$10,387
Street/Walk Lighting	Varies	EE	Ltg	Induction Walk and Street Lighting Retrofit	37	160,076	0	545,859	$257,141	$11,658	**$245,482**	$41,234	20	$1,516,821	6	53	$4,669
				Savings:	**391**	**2,126,315**	**12,859**	**8,536,634**	**$7,805,728**	**$1,633,008**	**$6,172,720**	**$390,082**		**$ 15,884,860**		**767**	**$8,051**

Utility Escalation Rate 6%

Maintenance Escalation Rate 3%

1 *Cat - Category (EE-Energy Efficiency; DR-Demand Response; RE-Renewable Energy; Cx-Commisssioning; OM-Operation and Maint.)*

2 *Rebates and incentives are not guaranteed and are subject to change.*

3 *Annual Savings = Annual Utility Bill Savings + Annual Maintenance Savings*

4 *Lifecycle Savings = total projected savings over the life of the equipment, including future value, utility escalation rate, annual utility and maintenance savings and the equipment life.*

5 *Lifecycle Payback = Net Cost / Lifecycle Savings / Equipment Life*

*HVAC** *These are major system replacements for air conditioning and refrigeration systems. These measures are eligible for $0.15/kWh rebate.*

*HVAC*** *These are measures that reduce operation or load such as controls, building shell retrofits, or components retrofits. These measures are eligible for $0.09/kWh rebate.*

Note 1: *Pricing does not include City Administration Costs.*

Note 2: *Rebates were calculated using the rebate amounts for SCE's Standard Performance Contract.*

Note 3: *CO2 Emissions were calculated using EPA's Clean Energy eGRID2007 V1.1 Year 2005 GHG Annual Output Emission Rates for the CAMX WECC California.*

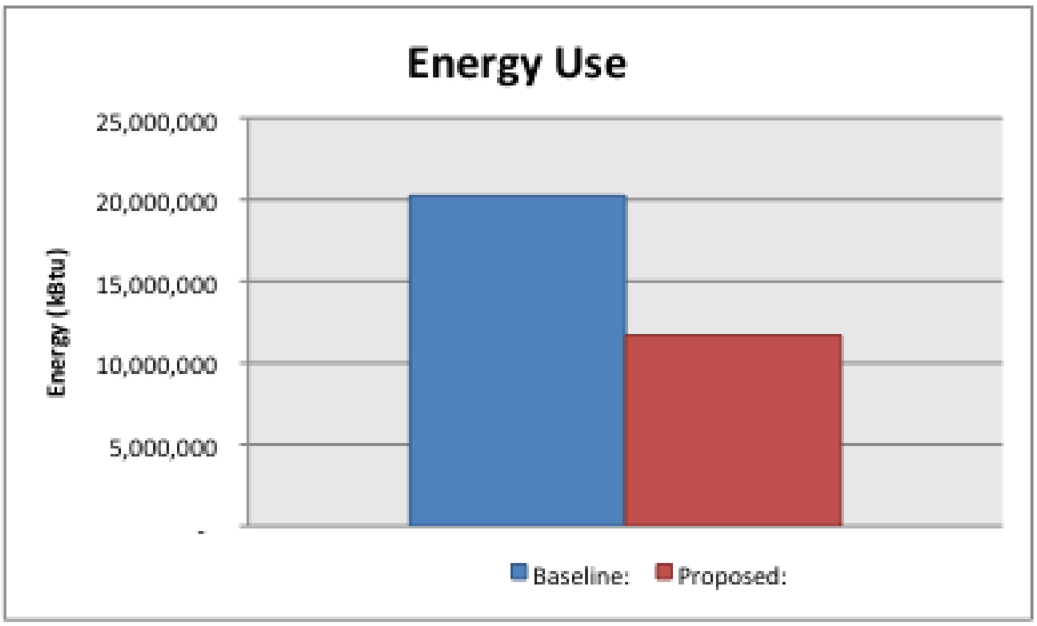
Conversion Factors: 724.12 lbs CO2/MWh of electricity, 117.08 lbs CO2/Mbtu of Natural Gas. 1 met. tonne = 2204.62 lbs. CO2. http://www.eia.doe.gov/oiaf/1605/coefficients.html and http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html

5.2 Energy and Carbon

Implementing all of the recommended improvements are expected to reduce the City's energy use and carbon footprint as follows:

	Energy				Carbon
	Demand (kW)	Energy (kWh)	Energy (Therms)	Energy (kBtu)	CO2 offset (met. Tons)
Existing:	2,138	4,817,884	38,033	20,232,293	*1,784*
Proposed:	*1,747*	*2,691,568*	*25,174*	*11,695,659*	*1,018*
Savings:	391	2,126,315	12,859	8,536,634	767
% Savings	***18%***	***44%***	***34%***	***42%***	***43%***
% Remaining:	82%	56%	66%	58%	57%

Note: Demand (kW) is max power demand (*not* connected load used for equipment sizing).



5.3 Energy Savings and Financial Analysis

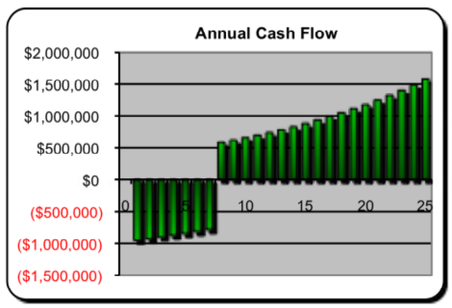
An energy savings and financial cost analysis is provided below. The financial analysis includes our best engineering judgment of the total first cost to install the equipment as well as the rewards (or annual utility bill savings) that would result.

Project Cost Estimate:		
	Design	$482,207
	Constr Admin	$180,828
	Constr / Bonds	$7,022,141
	CX/Training	$120,552
	Energy Monitoring	TBD
	EPA/LEED Cert	TBD
Total Project Cost		**$7,805,728**
Incentives and Cost Offsets:		
	Capital Contr.	$0
	Rebates/Incentives	$1,633,008
	Tax Credits (year 0)	$0
Net Project Cost		**$6,172,720**

Finance Factors:	
Finance Term (years)	7
Finance rate	4.85%
Energy Escalation	6.0%
Maint. Escalation	3.0%

Projected Annual Savings:	
Energy Savings (yr 1)	$334,009
Maint Savings (yr 1)	$56,072
Total Annual Savings	**$390,082**

Life Cycle Benefits:		
Cost Savings	**$21,401,640**	
Demand Reducti	391	kW
Energy Savings	2,126,315	kWh
Nat Gas Savings	12,859	Therms
Water Savings	-	Gallons
GHG Reduction	767	tonnes CO2



Pro Forma

YR	ENERGY SAVINGS	MAINT. SAVINGS	INCENTIVES & TAX CREDITS	AVOIDED CAPITAL	TOTAL SAVINGS	PAYMENTS	CASHFLOW	CUMULATIVE SAVINGS (EXPENSES)
0	$0	$0	$0	$0	$0	$0	$0	$0
1	$334,009	$56,072	$0	$0	$390,082	($1,341,661)	($951,579)	($951,579)
2	$354,050	$59,437	$0	$0	$413,487	($1,341,661)	($928,174)	($1,879,753)
3	$375,293	$63,003	$0	$0	$438,296	($1,341,661)	($903,365)	($2,783,118)
4	$397,810	$66,783	$0	$0	$464,594	($1,341,661)	($877,067)	($3,660,185)
5	$421,679	$70,790	$0	$0	$492,469	($1,341,661)	($849,191)	($4,509,376)
6	$446,980	$75,037	$0	$0	$522,017	($1,341,661)	($819,643)	($5,329,019)
7	$473,799	$79,540	$0	$0	$553,338	($1,341,661)	($788,322)	($6,117,342)
8	$502,226	$84,312	$0	$0	$586,539	$0	$586,539	($5,530,803)
9	$532,360	$89,371	$0	$0	$621,731	$0	$621,731	($4,909,072)
10	$564,302	$94,733	$0	$0	$659,035	$0	$659,035	($4,250,037)
11	$598,160	$100,417	$0	$0	$698,577	$0	$698,577	($3,551,460)
12	$634,049	$106,442	$0	$0	$740,491	$0	$740,491	($2,810,969)
13	$672,092	$112,829	$0	$0	$784,921	$0	$784,921	($2,026,048)
14	$712,418	$119,598	$0	$0	$832,016	$0	$832,016	($1,194,032)
15	$755,163	$126,774	$0	$0	$881,937	$0	$881,937	($312,095)
16	$800,473	$134,381	$0	$0	$934,853	$0	$934,853	$622,759
17	$848,501	$142,444	$0	$0	$990,945	$0	$990,945	$1,613,703
18	$899,411	$150,990	$0	$0	$1,050,401	$0	$1,050,401	$2,664,105
19	$953,376	$160,050	$0	$0	$1,113,425	$0	$1,113,425	$3,777,530
20	$1,010,578	$169,653	$0	$0	$1,180,231	$0	$1,180,231	$4,957,761
21	$1,071,213	$179,832	$0	$0	$1,251,045	$0	$1,251,045	$6,208,806
22	$1,135,486	$190,622	$0	$0	$1,326,107	$0	$1,326,107	$7,534,913
23	$1,203,615	$202,059	$0	$0	$1,405,674	$0	$1,405,674	$8,940,587
24	$1,275,832	$214,182	$0	$0	$1,490,014	$0	$1,490,014	$10,430,601
25	$1,352,382	$227,033	$0	$0	$1,579,415	$0	$1,579,415	$12,010,016
Σ	**$18,325,256**	**$3,076,384**	**$0**	**$0**	**$21,401,640**	**($9,391,624)**	**$12,010,016**	

Note: This is not an offer to finance. It is an estimated projection of project cash flow

5.4 Next Steps

We recommend that the City of Manhattan Beach seriously consider investing in the sustainable, energy efficient improvements recommended in this report. These improvements will permanently improve the indoor air quality and health of the building while lowering operating costs and the city's environmental footprint. Next steps involve preliminary design of the measures that most closely meet the owner's goals to determine the best benefits and return on investment. As an energy project, the city has the flexibility of procuring these solutions in several ways: design/bid/build design/build, power purchase agreements or a combination of all. Regardless of the contracting process chosen, a highly qualified design team along with skilled commissioning and customer training are critical to long term, efficient and sustained performance.

About PE Consulting. PE Consulting is a multi-disciplinary engineering and consulting firm. We provide sustainable, energy and resource efficient solutions. In addition to energy auditing and retro-commissioning, our capabilities include energy efficient sustainable design, project management, commissioning and startup, training and sustainable building certification. PE Consulting is an EPA Energy Star Partner and USGBC Member with highly skilled LEED™ accredited professionals, design engineers, project managers, commissioning agents and measurement and verification technicians. Using our unbiased services as the client's Engineer, we will help ensure the best value for your company. We would be excited to act as your lead A&E firm developing this retrofit program from the conceptual ideas illustrated in this report and turning those into reality.

Distinguished by our bundling of innovative solutions and customer-centric approach, PE Consulting has a solid reputation for managing projects with practical quality and team synergy unmatched in the industry. We serve a wide range of clientele ranging from medium sized businesses and municipalities to Fortune 50 conglomerates and the US government, as shown on our website.

6.0 APPENDICES

APPENDIX A. Utility Bill Data

Below is a list of utility meters (electric and gas) by site for the City. Following that is a utility bill analysis and energy model for each meter. The utility bill analysis for each meter includes the following:

Electric Baseline - Provides a monthly average of the last 24 months of electric demand, usage and costs.

Gas Baseline - Provides a monthly average of the last 24 months of gas usage and costs.

Energy Use Baseline - Provides a monthly average of the last 24 months of electric and gas usage combined and calculated in common energy units, British Thermal Units or kBtu, to establish a total energy use baseline for the building so energy benchmarking with other similar buildings could be done.[4]

Energy Intensity Analysis - Provides a benchmarking value in kBtu/square foot which is used to compare energy use at the site with other similar buildings.

Below is a summary of the electric and gas meter information by site. Separate benchmarking data follows the summary.

[4] Benchmarking is the process of comparing energy use, energy use per square foot, cost, and cost per square foot of a building compared to other similar buildings. Energy use information about similar buildings, such as offices, warehouses, industrial buildings, etc have been accumulated and statistically analyzed using information from the Energy Information Administration's (EIA) Commercial Buildings Energy Consumption Survey (CBECS).

Site Information	ELECTRIC			GAS		
Site Description	E-Rate	eMeter#	Service Address	gAccount #	gMeter#	gService Address
City Hall: Main / Highland Lift St.	GS-2	PO276-011666	1400 HIGHLAND AVE	45-605-1900	12428410	1400 HIGHLAND
City Hall Annex : COC; USPO, Annex	GS-2	TP881-008598	425 15TH ST	182-105-1900	3027507	425 15TH ST
Fire Station #2: Complex	GS-2	708-022342	1400 MANHATTAN BEACH BLVD 2	159-804-2200	12638420	1400 MBB FS #2
Fire Station #2: Main House/Station	-	-	-	-	-	
Fire Station #2: Gym/Garage	-	-	-	-	-	
Joslyn Center : Community Hall	GS-2	PO376-002925	1601 N VALLEY DR	47-705-2100	11469571	1601 N. VALLEY DR / REC
Live Oak Park: Multipurpose Building	GS-2/GS1	TP355-001261	1901 N VALLEY DR	85-805-7900	11615369	1901 N VALLEY/KILN
Live Oak Park: Ceramics Room	-	-	-	-	-	
Live Oak Park: E-Gen Shed	-	-	-	-	-	
Live Oak Park: Kiln Enclosure	-	-	-	-	-	
Live Oak Park: Playground Room	-	-	-	-	-	
Live Oak Park: Tennis Room	-	-	-	-	-	
Live Oak Park: Recreation Hall	GS-1	708-041910	LIVE OAK PARK	85-805-7900	11615369	1901 N VALLEY/KILN
Live Oak Park: Dorsey Field & Tot Lot	GS-1	85-803603	20TH PL/VALLEY DR	N/A	-	
Live Oak Park: Two Meters		343M-006365	Valley/19th	N/A	-	
Live Oak Park: Pony Field Lighting	GS-2/GS1	TP881-011338	LIVE OAK PARK	N/A	-	
Live Oak Park: Tennis Courts Lights	GS2T-B	349M-007843	1601 N VALLEY DR	N/A	-	
Live Oak Park: Scout House	GS-1	207-120740	1617 N VALLEY DR	49-805-2100	3589832	1617 N VALLEY DR
Manhattan Heights Annex: Creative Arts Center	GS-2	249-000525	1560 MANHATTAN BEACH BLVD	180-703-8775	5540434	1560 MBB
Manhattan Heights Park: Comm. Ctr, Teen, Restrooms	GS-2	P721-010422	1600 MANHATTAN BEACH BLVD	182-803-8700	6435587	1600 MBB
Man. Heights Park: Community Center	-	-	-	-	-	
Man. Heights Park: Storage (Teen TV Room)	-	-	-	-	-	
Man. Heights Park: Playground Room/RR	-	-	-	-	-	
Manhattan Heights Park: Baseball/Basketball Field Lights	GS2T-B	342M-012646	1631 11TH ST	-	-	
Manhattan Heights Park: Tennis Courts Lights	GS2T-B	342M-012193	11TH ST W/O RDNDO	-	-	
Manhattan Village Park: Restrooms and Ext. Lights	GS-2	TP355-000479	1212 PARK VIEW	-	-	
Marine Park: Complex	GS-2	PO726-010302	1625 MARINE AVE	196-104-2100	4558705	1625 MARINE AVE
Marine Park: Pavilion	-	-	-	-	-	
Marine Park: Recreation Hall	-	-	-	-	-	
Marine Park: Snack Bar	-	-	-	-	-	
Marine Park: Storage Garage	-	-	-	-	-	
Marine Sports Park: Complex	GS-2/GS1	PO726-095326	1801 MARINE	N/A		
Marine Sports Park: Scorers Bldg 1	-	-	-	-	-	
Marine Sports Park: Scorers Bldg 2	-	-	-	-	-	
Marine Sports Park: Storage 1	-	-	-	-	-	
Marine Sports Park: Storage 2	-	-	-	-	-	
Metlox Town Square: Metlox Main Square	N/A	3416-032602	N/A	581 84 4886	12428410	1200 MORNINGSIDE/KILN
Metlox Town Square: Metlox Parking Structure	GS-2	349-002791	1210 MORNINGSIDE DR	N/A	-	
Parking Structure: Parking Structure #2	GS-1	8-520424	BAYVIEW/CENTER PLCE LTS	N/A	-	
Parking Structure: Parking Structure #3	GS-2	0805-000308	312 12TH ST	N/A	-	
Parking Structure: Parking Structure #4	GS-1	8-742736	HIGHLND AV/37TH PLCE PKL	N/A	-	

Site Information	ELECTRIC			GAS		
Site Description	E-Rate	eMeter#	Service Address	gAccount #	gMeter#	gService Address
Peck Reservoir: Pumping Station / Reservoir	TOU-PA-B	V345E-001286	PECK/18TH	N/A	-	
Pier: Roundhouse - Restaurant	GS-1	Y728-006419	1 MANHATTAN AVE D	N/A	-	
Pier: Roundhouse - Aquarium	GS-2	Y728-006418	1 MANHATTAN AVE C	N/A	-	
Pier: Pier Ltg & Comfort Station	GS-1	Y728-006420	1 MANHATTAN AVE A	N/A	-	
Public Safety : Police and Fire	TOU-GS3-B	V349N-000088	400 15TH ST	180-005-1975	12693100	420 15TH ST
Public Safety : Police and Fire	-	-		1526706491	12173095	
Polliwog Park: Historic House	GS-1	85-778450	N/WHERRIN/MB BLVD	N/A	-	
Polliwog Park: Restrooms and Office	GS-2	349-009975	1601 MANHATTAN BEACH BLVD	N/A	-	
Polliwog Park: Restrooms	-	-	-	-	-	
Polliwog Park: Storage Room/Office	-	-	-	-	-	
Premier Park: Restroom	GS-1	AE308-411200	HERRIN/18TH	N/A	-	
Public Works Yard: Complex	GS-2	P729-009484	3621 BELL AVE	153-005-7600	12509677	3621 BELL AVE - YARD
Public Works Yard: Hopper	-	-	-	-	-	
Public Works Yard: Maintenance Shop	-	-	-	-	-	
Public Works Yard: Public Services	-	-	-	-	-	
Public Works Yard: Service Garage #1	-	-	-	-	-	
Public Works Yard: Service Garage #2	-	-	-	-	-	
Public Works Yard: Storage #1	-	-	-	-	-	
Public Works Yard: Storage #2	-	-	-	-	-	
Public Works Yard: Tool Storage	-	-	-	-	-	
Public Works Yard: Prefab Metal Bldg - Storage.	-	-	-	-	-	
Sand Dune Park: Office and Restroom	GS-1	307-257859	BELL/31ST	N/A	-	
Water Block #35: Complex	TOU-PA-B	V349E-006383	ROWELL/6TH	N/A	-	
Water Block #35: Chlorine Station	-	-	-	-	-	
Water Block #35: Elevated Tank (300K)	-	-	-	-	-	
Water Block #35: Generator Vault	-	-	-	-	-	
Water Block #35: Pumping Station	-	-	-	-	-	
Water Block #35: Reservoir 2M	-	-	-	-	-	

APPENDIX B. Building Envelope Data

The following table shows a summary of the building envelope conditions at each site.

Site Information	ENVELOPE		
Site Description	Walls	Windows	Roof
City Hall: Main / Highland Lift St.	masonry, no insulation	single pane; bronze tinted	steel deck with no insulation
City Hall Annex : COC; USPO, Annex	concrete block, brick	single pane	metal deck, rigid insulation, single ply roof.
Fire Station #2: Complex			
Fire Station #2: Main House/Station	Brick	double pane for noise control	composite shingle, pitched roof insulation
Fire Station #2: Gym/Garage	T-bar suspended ceiling	N/A	walls are insulated/ construction same as home
Joslyn Center : Community Hall	2x4 stud walls with R-11 insul	plywood deck roof over open web joists with R-19 insulation	Single-glazed windows.
Live Oak Park: Multipurpose Building	lathe,plaster;stucco		combo roll roof and pitched roof w/ mission tile
Live Oak Park: Ceramics Room	-		
Live Oak Park: E-Gen Shed	-	-	-
Live Oak Park: Kiln Enclosure	concrete block w/vents	-	steel roof
Live Oak Park: Playground Room	-	-	-
Live Oak Park: Tennis Room	-	-	-
Live Oak Park: Recreation Hall	lathe and plaster; stucco ext.	Louver operable with screen	No ceiling cavity; small pitch; tremco rolled roofing
Live Oak Park: Dorsey Field & Tot Lot	-	-	-
Live Oak Park: Two Meters			
Live Oak Park: Pony Field Lighting	-	-	-
Live Oak Park: Tennis Courts Lights	-	-	-
Live Oak Park: Scout House	wood frame; no insulation	single pane glass	shingles; no insulation
Manhattan Heights Annex: Creative Arts Center	8" brick; brick veneer through to inside	lots of glass; not tinted; single pane ; all doors propped open during site visit	6' overhang roof; insulation above room Tremco roof
Manhattan Heights Park: Comm. Ctr, Teen, Restrooms			
Man. Heights Park: Community Center	framing with stucco; aud. Has stucco w/ gypsum	single pane; not operable	plywood deck w/ comp. singles; R-19 insul; t-bar ceiling
Man. Heights Park: Storage (Teen TV Room)	8" block brick	operable windows; tilt down and check wire screen	shingle squares; composition
Man. Heights Park: Playground Room/RR	8" block brick	operable windows; tilt down and check wire screen	operable windows
Manhattan Heights Park: Baseball/Basketball Field Lights	-	-	-
Manhattan Heights Park: Tennis Courts Lights	-	-	-
Manhattan Village Park: Restrooms and Ext. Lights	concrete block	window; screen metal	wood with skylights
Marine Park: Complex			
Marine Park: Pavilion	N/A	N/A	N/A
Marine Park: Recreation Hall	Block; Volleyball bldg with metal rollup garage door	1 single pane; smoked	Tile roof; R19 attic insulation
Marine Park: Snack Bar	2 story; 8" block	1 single pane; smoked	Tile roof; R19 attic insulation
Marine Park: Storage Garage	8" block	-	Flat tile with pitch
Marine Sports Park: Complex			
Marine Sports Park: Scorers Bldg 1	8" block	Score windows; rollup door for snack room; single pane operable glass	metal roof
Marine Sports Park: Scorers Bldg 2	8" block	Score windows; rollup door for snack room; single pane operable glass	metal roof
Marine Sports Park: Storage 1	8" block	-	metal roof
Marine Sports Park: Storage 2	8" block	-	metal roof
Metlox Town Square: Metlox Main Square	-	-	-
Metlox Town Square: Metlox Parking Structure	steel and concrete; no insulation	-	-
Parking Structure: Parking Structure #2	steel and concrete; no insulation	-	-
Parking Structure: Parking Structure #3	steel and concrete; no insulation	-	-
Parking Structure: Parking Structure #4	steel and concrete; no insulation	-	-
Peck Reservoir: Pumping Station / Reservoir	stucco with plaster; no insulation	single pane windows	composite single roof

Site Information	ENVELOPE		
Site Description	Walls	Windows	Roof
Pier: Roundhouse - Restaurant	stucco walls	single pane Pella windows	cathedral style roof, insulated between inside and out, covered with mission tile
Pier: Roundhouse - Aquarium	-	-	-
Pier: Pier Ltg & Comfort Station	concrete block	open to exterior, chain	-
Public Safety : Police and Fire	metal stud, insulated	insulating glass	steel deck, rigid insul., single ply roofing
Public Safety : Police and Fire			
Polliwog Park: Historic House	wood frame; no insulation	old, single pane warped glass	unknown
Polliwog Park: Restrooms and Office	*Block*	*metal chain*	*see below*
Polliwog Park: Restrooms	-	-	metal roof
Polliwog Park: Storage Room/Office	-	-	Flat; tar and gravel
Premier Park: Restroom	Block walls	metal chain	Tremco roll roof, flat; no insulation
Public Works Yard: Complex			
Public Works Yard: Hopper	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Maintenance Shop	Gar.: Corr steel; Off: built inside metal structures w/ insul.	Single pane; old; operable	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Public Services	stick and stucco with tar and gravel roof; insulated	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Service Garage #1	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Service Garage #2	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Storage #1	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Storage #2	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Tool Storage	Gar.: Corr steel; Off: built inside metal structures w/ insul.	-	Gar: steel roof, some skylights; Offices: drop down
Public Works Yard: Prefab Metal Bldg - Storage.	N/A	N/A	`
Sand Dune Park: Office and Restroom	conc. block bath & wood frame off. w/ plywood/sheetrock	restroom: metal chain windows; office: (4) 1-pane windows;	Tremco roll roof; almost flat; no insulation
Water Block #35: Complex			
Water Block #35: Chlorine Station	concrete block	single pane	composite shingle
Water Block #35: Elevated Tank (300K)	-	-	-
Water Block #35: Generator Vault	-	-	-
Water Block #35: Pumping Station	concrete block	skylights	steel roof
Water Block #35: Reservoir 2M	-	-	-

APPENDIX C. Lighting Data

Attached is a separate appendix with the lighting analysis for each meter. The only exception is the street lighting analyses, which is provided below. The abbreviations found on the tables include:

Flr	Floor
Qty	Quantity
Fixt. Code	Fixture Code from the Table of Standard Wattages
Lamp Code	Lamp Code from the Table of Standard Wattages
Ballast	Ballast from the from the Table of Standard Wattages
kW/Fixt.	Demand in kW per fixture
CO2 (metric tons)	Carbon Dioxide impact in metric tons
$/yr	Utility (electric bill) cost of the fixture(s) per year
#PC	Quantity of Photocells
#OS	Quantity of Occupancy Sensors, where WS = Wall Sensor, CS= Ceiling Sensor
Annual Utility Savings	Dollars Saved by changing the fixture, installing sensors, etc.
Maint. Savings	Maintenance Savings achieved due to extended lamp life

Street Lighting Analysis

OPTION 1: LED LAMPS

Rebate: $0.00 /kWh saved $0.14 /kWh

EXISTING EXTERIOR FIXTURES							PROPOSED RETROFIT LED LAMPS							ENERGY/COST SAVINGS				
Location	Qty	Lamp Type	W/fixt.	hrs/yr	kW	kWh	Qty	W/fixt.	Installed Cost	SCE SPC Rebates	Adjusted Cost	kW	kWh	kW Saved	kWh Saved	Utility Savings	Maint Savings	Simple Payback
Summary	423				63.709	279,045	423		$ 438,080	$0	$0	14.15	61,959	49.56	217,086	$30,392	$18,824	8.9
El Porto Parking Lot	16	LU70/Mogul Hi Pressure Sodium	0.095	4380	1.52	6,658	16	0.024	$ 12,800			0.38	1,682	1.14	4,976	$697	$712	9.1
Parking Lot #65B	6	LU250/DX Hi Pressure Sodium	0.295	4380	1.77	7,753	6	0.072	$ 10,500			0.43	1,892	1.34	5,860	$820	$267	9.7
Downtown Street Lights	67	MVR250/U Metal Halide	0.295	4380	19.765	86,571	67	0.072	$ 117,250			4.82	21,129	14.94	65,442	$9,162	$2,982	9.7
Downtown Sidewalk Lights	87	M100/U/MED Metal Halide	0.128	4380	11.136	48,776	87	0.024	$ 79,605			2.09	9,145	9.05	39,630	$5,548	$3,872	8.5
Walk Street Lights	18	LPS HPS Med 27k HPS Med	0.046	4380	0.828	3,627	18	0.024	$ 8,460			0.43	1,892	0.40	1,734	$243	$801	8.1
Walk Street Lights	7	LPS HPS Med 27k HPS Med	0.095	4380	0.665	2,913	7	0.024	$ 5,600			0.17	736	0.50	2,177	$305	$312	9.1
Walk Street Lights	4	LPS HPS Med 27k HPS Med	0.046	4380	0.184	806	4	0.024	$ 1,880			0.10	420	0.09	385	$54	$178	8.1
Walk Street Lights	1	LPS HPS Med 27k HPS Med	0.066	4380	0.066	289	1	0.024	$ 585			0.02	105	0.04	184	$26	$45	8.3
The Pier Pier Lights	36	LU/70/MED Hi Pressure Sodium	0.095	4380	3.42	14,980	36	0.024	$ 28,800			0.86	3,784	2.56	11,195	$1,567	$1,602	9.1
The Strand Walkway Sec. Ltg	136	LU/70/MED Hi Pressure Sodium	0.095	4380	12.92	56,590	136	0.024	$ 108,800			3.26	14,296	9.66	42,293	$5,921	$6,052	9.1
Veterans Parkway	8	MH 175W/U/MED	0.215	4380	1.72	7,534	8	0.03	$ 8,800			0.24	1,051	1.48	6,482	$908	$356	7.0
City Hall Walkway Lights	8	MVR175/U Metal Halide	0.215	4380	1.72	7,534	8	0.03	$ 8,800			0.24	1,051	1.48	6,482	$908	$356	7.0
Arbolado Tract: Walkway Ltg	22	MVR250/U Metal Halide	0.295	4380	6.49	28,426	22	0.04	$ 38,500			0.88	3,854	5.61	24,572	$3,440	$979	8.7
Arbolado Tract: Court	7	MVR175/U Metal Halide	0.215	4380	1.505	6,592	7	0.03	$ 7,700			0.21	920	1.30	5,672	$794	$312	7.0

OPTION 2: LED LAMPS WITH SOLAR

Rebate: $0.00 /kWh saved $0.14 /kWh

EXISTING EXTERIOR FIXTURES **PROPOSED RETROFIT LED LAMPS W/ SOLAR**

Location	Qty	Lamp Type	W/fixt.	hrs/yr	kW	kWh	Qty	W/fixt.	Installed Cost	SCE SPC Rebates	Adjusted Cost	kW	kWh	kW Saved	kWh Saved	Utility Savings	Maint Savings	Simple Payback
Summary	**423**				**63.709**	**279,045**	**423**		**$ 876,160**	**$0**	**$876,160**	**14.15**	**49,568**	**49.56**	**229,478**	**$32,127**	**$18,824**	**17.2**
El Porto Parking Lot	16	LU70/Mogul Hi Pressure Sodium	0.095	4380	1.52	6,658	16	0.024	$ 25,600		$25,600	0.38	1,346	1.14	5,312	$744	$712	17.6
Parking Lot #65B	6	LU250/DX Hi Pressure Sodium	0.295	4380	1.77	7,753	6	0.072	$ 21,000		$21,000	0.43	1,514	1.34	6,239	$873	$267	18.4
Downtown Street Lights	67	MVR250/U Metal Halide	0.295	4380	19.765	86,571	67	0.072	$ 234,500		$234,500	4.82	16,903	14.94	69,667	$9,753	$2,982	18.4
Downtown Sidewalk Lights	87	M100/U/MED Metal Halide	0.128	4380	11.136	48,776	87	0.024	$ 159,210		$159,210	2.09	7,316	9.05	41,459	$5,804	$3,872	16.5
Walk Street Lights	18	LPS HPS Med 27k HPS Med	0.046	4380	0.828	3,627	18	0.024	$ 16,920		$16,920	0.43	1,514	0.40	2,113	$296	$801	15.4
Walk Street Lights	7	LPS HPS Med 27k HPS Med	0.095	4380	0.665	2,913	7	0.024	$ 11,200		$11,200	0.17	589	0.50	2,324	$325	$312	17.6
Walk Street Lights	4	LPS HPS Med 27k HPS Med	0.046	4380	0.184	806	4	0.024	$ 3,760		$3,760	0.10	336	0.09	470	$66	$178	15.4
Walk Street Lights	1	LPS HPS Med 27k HPS Med	0.066	4380	0.066	289	1	0.024	$ 1,170		$1,170	0.02	84	0.04	205	$29	$45	16.0
The Pier Pier Lights	36	LU/70/MED Hi Pressure Sodium	0.095	4380	3.42	14,980	36	0.024	$ 57,600		$57,600	0.86	3,027	2.56	11,952	$1,673	$1,602	17.6
The Strand Walkway Sec. Ltg	136	LU/70/MED Hi Pressure Sodium	0.095	4380	12.92	56,590	136	0.024	$ 217,600		$217,600	3.26	11,437	9.66	45,153	$6,321	$6,052	17.6
Veterans Parkway	8	MH 175W/U/MED	0.215	4380	1.72	7,534	8	0.03	$ 17,600		$17,600	0.24	841	1.48	6,693	$937	$356	13.6
City Hall Walkway Lights	8	MVR175/U Metal Halide	0.215	4380	1.72	7,534	8	0.03	$ 17,600		$17,600	0.24	841	1.48	6,693	$937	$356	13.6
Arbolado Tract: Walkway Ltg	22	MVR250/U Metal Halide	0.295	4380	6.49	28,426	22	0.04	$ 77,000		$77,000	0.88	3,084	5.61	25,343	$3,548	$979	17.0
Arbolado Tract: Court	7	MVR175/U Metal Halide	0.215	4380	1.505	6,592	7	0.03	$ 15,400		$15,400	0.21	736	1.30	5,856	$820	$312	13.6

OPTION 3: INDUCTION FIXTURES

Rebate: $0.05 /kWh saved   Energy Price: $0.14 /kWh

Existing Conditions							PROPOSED INDUCTION FIXTURES							ENERGY/COST SAVINGS				
Location	Qty	Lamp Type	W/fixt.	hrs/yr	kW	kWh	Qty	W/fixt.	Installed Cost	SCE SPC Rebates	Adjusted Cost	kW	kWh	kW Saved	kWh Saved	Utility Savings	Maint Savings	Simple Payback
Summary	423				63.7	279,045	423		$198,564	$11,658	$186,906	27.2	118,970	36.5	160,076	$22,411	$18,824	4.8
El Porto Parking Lot	16	LU70/Mogul Hi Pressure Sodium	0.095	4380	1.5	6,658	16	0.044	$6,184	$260	$5,924	0.7	3,084	0.8	3,574	$500	$712	4.9
Parking Lot #65B	6	LU250/DX Hi Pressure Sodium	0.295	4380	1.8	7,753	6	0.134	$2,693	$308	$2,385	0.8	3,522	1.0	4,231	$592	$267	2.8
Downtown Street Lights	67	MVR250/U Metal Halide	0.295	4380	19.8	86,571	67	0.134	$30,070	$3,441	$26,629	9.0	39,324	10.8	47,247	$6,615	$2,982	2.8
Downtown Sidewalk Lights	87	M100/U/MED Metal Halide	0.128	4380	11.1	48,776	87	0.044	$41,756	$2,331	$39,424	3.8	16,767	7.3	32,009	$4,481	$3,872	4.7
Walk Street Lights	18	LPS HPS Med 27k HPS Med	0.046	4380	0.8	3,627	18	0.044	$8,639	$11	$8,628	0.8	3,469	0.0	158	$22	$801	10.5
Walk Street Lights	7	LPS HPS Med 27k HPS Med	0.095	4380	0.7	2,913	7	0.044	$3,360	$114	$3,246	0.3	1,349	0.4	1,564	$219	$312	6.1
Walk Street Lights	4	LPS HPS Med 27k HPS Med	0.046	4380	0.2	806	4	0.044	$1,920	$3	$1,917	0.2	771	0.0	35	$5	$178	10.5
Walk Street Lights	1	LPS HPS Med 27k HPS Med	0.066	4380	0.1	289	1	0.044	$480	$7	$473	0.0	193	0.0	96	$13	$45	8.2
The Pier Pier Lights	36	LU/70/MED Hi Pressure Sodium	0.095	4380	3.4	14,980	36	0.044	$17,278	$586	$16,693	1.6	6,938	1.8	8,042	$1,126	$1,602	6.1
The Strand Walkway Sec. Ltg	136	LU/70/MED Hi Pressure Sodium	0.095	4380	12.9	56,590	136	0.044	$65,273	$2,213	$63,061	6.0	26,210	6.9	30,380	$4,253	$6,052	6.1
Veterans Parkway	8	MH 175W/U/MED	0.215	4380	1.7	7,534	8	0.044	$3,840	$436	$3,403	0.4	1,542	1.4	5,992	$839	$356	2.8
City Hall Walkway Lights	8	MVR175/U Metal Halide	0.215	4380	1.7	7,534	8	0.044	$3,840	$436	$3,403	0.4	1,542	1.4	5,992	$839	$356	2.8
Arbolado Tract: Walkway Ltg	22	MVR250/U Metal Halide	0.295	4380	6.5	28,426	22	0.134	$9,874	$1,130	$8,744	2.9	12,912	3.5	15,514	$2,172	$979	2.8
Arbolado Tract: Court	7	MVR175/U Metal Halide	0.215	4380	1.5	6,592	7	0.044	$3,360	$382	$2,978	0.3	1,349	1.2	5,243	$734	$312	2.8

APPENDIX D. HVAC Data

Attached is a separate appendix with the mechanical analysis for each meter.

APPENDIX E. Plug Load Data

The analysis below is an initial comparison of potential options for improving data management at City Hall. An accurate inventory was not available at the time of this audit. As such, the analyses are rough estimates of potential energy cost savings. Administrative and liability savings are not included.

Traditional System

Item	Qty	Each	Cost	W/unit	kW	hrs/yr	kWh/yr
PC Clients (est).	167	N/A	N/A	61	10.187	8760	89,238
Servers	5	N/A	N/A	155	0.775	8760	6,789
			Total: N/A		**11**		**96,027**

Architecture #1 (higher cost)

Item	Qty	Each	Cost	W/unit	kW	hrs/yr	kWh/yr
Sun Ray 2FS Client	83	$ 599	$ 49,717	8	0.664	8760	5,817
Wyse Thin Client	67	$ 400	$ 26,800	14	0.938	8760	8,217
Diskless Stateless Client	17	$ 647	$ 10,999	31	0.527	8760	4,617
M1000e Blade Enclosure	1	$ 6,000	$ 6,000	0	0	8760	-
PowerEdge M610 Blade	5	$ 1,997	$ 9,985	120	0.6	8760	5,256
Sun Server	1	$ 36,960	$ 36,960	120	0.12	8760	1,051
Desktop software (required for DSC)	17	$ 295	$ 5,015	0	0	8760	-
Citrix Provisioning Server (required for thin clients)	150	$ 150	$ 22,500	0	0	8760	-
Microsoft Server 2008 Licensing	167	$ 119	$ 19,873	0	0	8760	-
Microsoft Terminal Services Licensing	150	$ 34	$ 5,099	0	0	8760	-
		Total:	**$ 192,948**		**2.85**		**24,957**

Architecture #2 (lower cost)

Item	Qty	Each	Cost	kW/unit	kW	hrs/yr	kWh/yr
Wyse Thin Client	150	$ 400	$ 60,000	14	2.1	8760	18,396
Diskless Stateless Client	17	$ 647	$ 10,999	31	0.527	8760	4,617
M1000e Blade Enclosure	1	$ 6,000	$ 6,000		0	8760	-
PowerEdge M610 Blade	5	$ 1,997	$ 9,985	120	0.6	8760	5,256
Desktop software (required for DSC)	17	$ 295	$ 5,015		0	8760	-
Citrix Provisioning Server (required for thin clients)	150	$ 150	$ 22,500		0	8760	-
Microsoft Server 2008 Licensing	167	$ 119	$ 19,873		0	8760	-
Microsoft Terminal Services Licensing	150	$ 34	$ 5,099		0	8760	-
		Total:	**$ 139,471**		**3.23**		**28,269**

					$/kW (non-tou)	$/kWh (avg)	
					$ 11.46	$0.14	
Summary		Cost	kW	kWh	$ kW	$ kWh	Simple Payback
Traditional System			11	96,027	$1,507	$13,011	
Architecture #1 (higher cost)		$ 192,948	2.85	24,957	$392	$3,381	
Architecture #2 (lower cost)		$ 139,471	3.23	28,269	$444	$3,830	
Energy/Cost Savings							
Traditional System --> Architecture #1		$ 192,948	8.11	71,070	$1,116	$9,629	18
Traditional System --> Architecture #2		$ 139,471	7.74	67,759	$1,064	$9,181	14

In the above, the following assumptions were made:

(1) Current video displays are energy-star compliant and compatible with new clients

(2) Current keyboard and mice are compatible with the new clients

(3) Current network infrastructure is compatible with the new clients

If a new video and/or keyboard/mouse suite needs to be purchased, the following prices would be the approximate cost of the purchase:

Viewsonic 17" Energy-Star compliant monitor	1	$130.00	$130.00
Keyboard/Mouse Package	1	$20.00	$20.00

APPENDIX F. Data Logger Data

Motor and/or data loggers were placed at the following locations: City Hall, Public Safety and Fire, City Hall Annex, Joslyn Community Center, Live Oak Park Recreation Hall, Manhattan Heights Annex, Manhattan Heights Park Community Center

The following analyses discusses the data collected by each of the

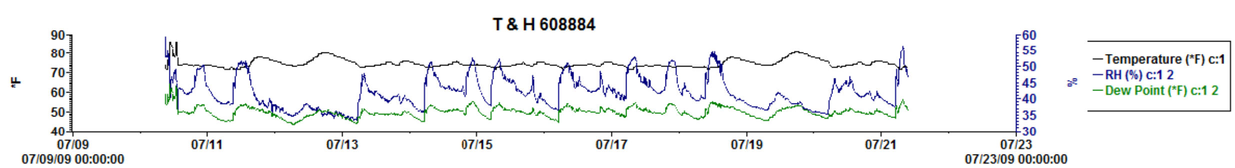
City Hall

Three lighting data loggers and two lighting/relative humidity/temperate data loggers were installed in City Hall. Locations and time period of data collection are shown in the table below.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
City Hall	City Council Chambers, near camera	Lighting	#522310	7/10/2009	1:20 PM	7/29/2009	8:30 AM	
City Hall	City Council Admin Office, reception desk	Lighting	#522316	7/10/2009	1:30 PM	7/29/2009	8:15 AM	
City Hall	Finance Department, cable post	Ltg/RH/Temp	#608884	7/10/2009	1:35 PM	7/29/2009	8:20 AM	
City Hall	Finance Department, front desk	Lighting	#522312	7/10/2009	1:40 PM	7/29/2009	8:20 AM	
City Hall	Computer Room, basement	Ltg/RH/Temp	#608886	7/9/2009	morning	7/29/2009	11:00 AM	Logger Failed

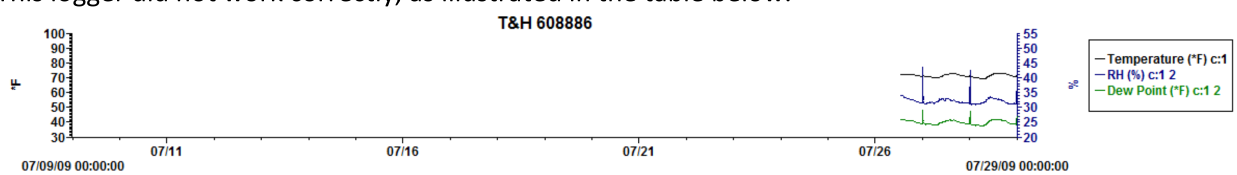
The Lighting, Relative Humidity, and Temperature Logger placed in the Finance Department shows the temperatures were fairly stable at 78-80°F during the data collection period.

Note: The variations in data collection on July 10 are not from data collection in the Finance Department. The logger was launched the morning before it was installed and was carried around in a toolbox for several hours before it was placed at City Hall.



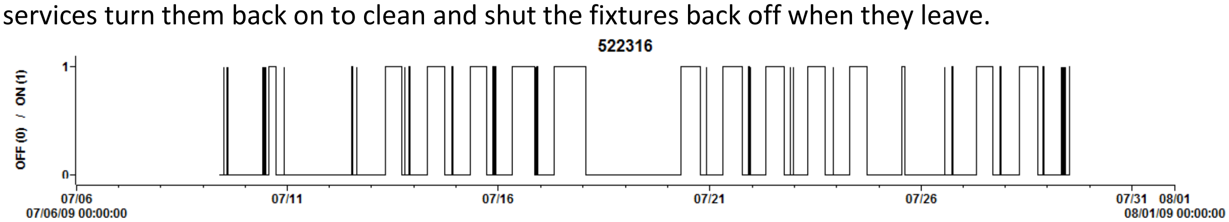
City Hall – Finance Department – Ltg/RH/Temp

This logger did not work correctly, as illustrated in the table below.



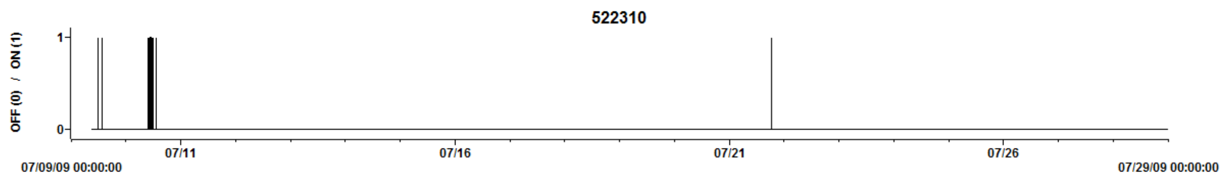
City Hall – Basement Computer Room – Ltg/RH/Temp

The lighting logger installed in the City Council Administration Office was on during building operating hours then turned briefly on a few nights per week for approximately an hour. This indicates that staff shut off the office fixtures when leaving the office at night and janitorial services turn them back on to clean and shut the fixtures back off when they leave.



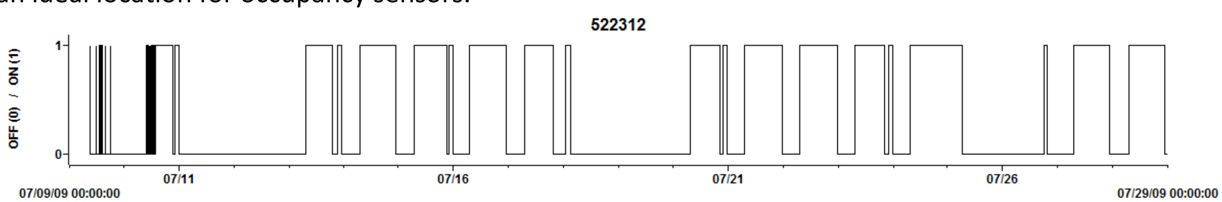
City Hall – City Council Admin Office – Lighting Logger

Based on the data the lighting logger collected in the City Council Chambers, the chambers were not used for a meeting during the data collection period. It only appears as if the room was occupied for a few minutes on July 10 and for a few minutes on July 21st. Occupants appear to have turned on the lighting when entering and shut off the lighting upon exiting.



City Hall – City Council Chambers – Lighting Logger

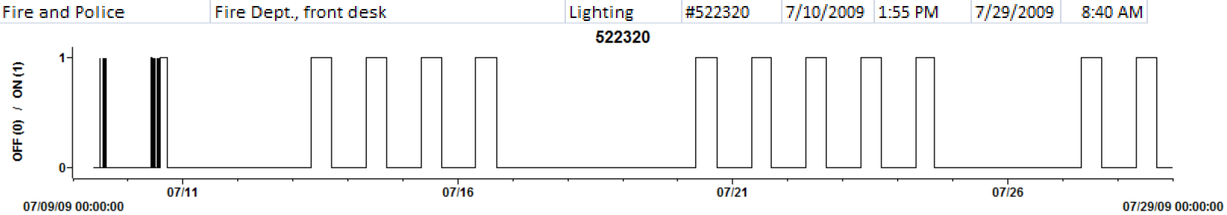
The fixtures in the Finance Department were left on for more hours per day than the fixtures in other areas of the building. This indicates that at the end of the work day, occupants do not shut off the overhead lights in the finance department open office. Instead, they leave the lights on until the janitorial service comes in later in the evening. Late in the evening, around midnight, the lights are shut off by cleaning staff. There is no need to have the lighting on during the time period between the close of the office and the time that the janitors arrive. As such, this room is an ideal location for occupancy sensors.



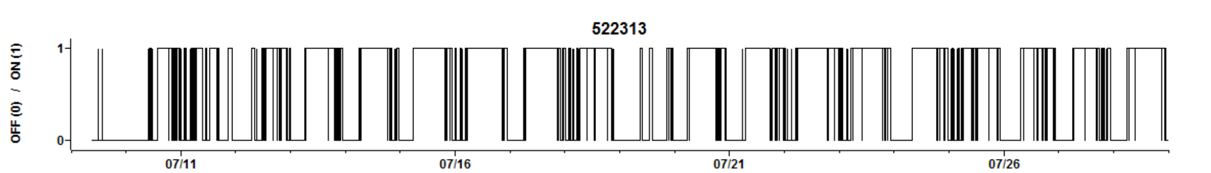
City Hall – Finance Department – Lighting Logger

Public Safety and Fire Department

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End
Fire and Police	Police Dept., Animal control	Lighting	#522313	7/10/2009	1:50 PM	7/29/2009	8:30 AM
Fire and Police	Fire Dept., front desk	Lighting	#522320	7/10/2009	1:55 PM	7/29/2009	8:40 AM



Fire and Police – Fire: Front Desk – Lighting Logger

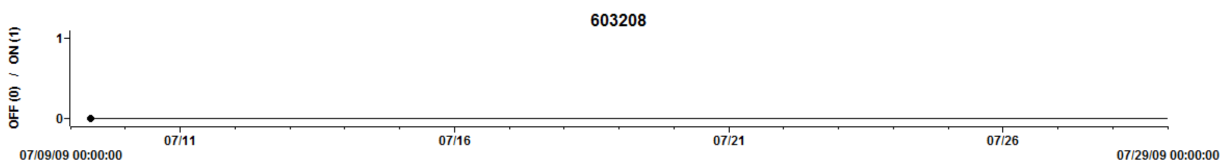


Fire and Police – Police: Animal Control – Lighting Logger

City Hall Annex

A motor data logger was placed on the Carrier 3 ton package unit on the community services patio to the north of the building. Motor data loggers monitor on/off hours of air conditioning units by measuring the vibration of the motor. When the motor is on, the graph below should have a line along the "1" of the y-axis. When the motor is off, the graph below should have a "0" along the y-axis. As illustrated, the graph below shows a "0", or "Off" condition for the entire data collection period. This indicates to us that the data logger did not work properly since we placed the motor logger when the motor was running on July 10, 2009.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
City Hall Annex	Community Service Patio, Carrier unit	Motor	#603208	7/10/2009	1:10 PM	7/29/2009	9:00 AM	logger didn't work



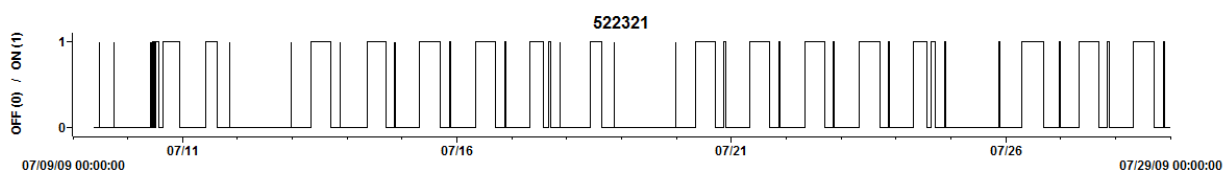
City Hall Annex – Exterior Air Handling Unit – Motor Logger

Joslyn Community Center

A motor logger was placed on the auditorium package unit and a lighting logger was placed in a fixture in the Oasis Room. Unfortunately, the logger placed in the auditorium package unit reset itself in late July and erased all the data collected during the logger data collection period. As such, we did not include the output chart.

The lighting logger placed in the Oasis Room worked. As illustrated below, the lights in the Oasis Room are on several hours per day at least six days per week. This is consistent with what building occupants and maintenance staff informed us. The senior citizens use this room to play cards and visit in this room for several hours per day.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
Josyln Comm. Ctr.	Auditorium unit, roof	Motor	#590387	7/10/2009	11:50 AM	7/29/2009	9:30 AM	
Josyln Comm. Ctr.	Oasis Room, kitchen side	Lighting	#522321	7/10/2009	11:55 AM	7/29/2009	9:20 AM	



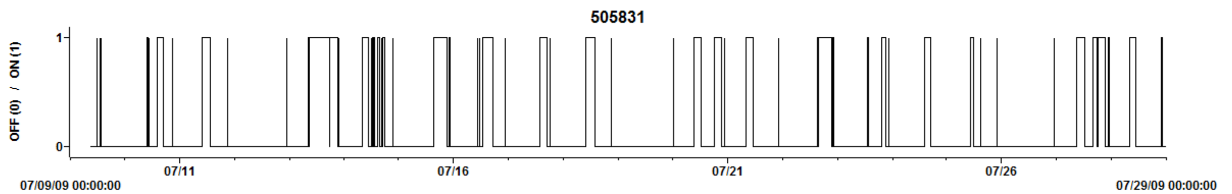
Joslyn Community Center – Oasis Room – Lighting Logger

A motor logger was placed on the 7.5 hp motor on the air handling unit to the south side of the building. A lighting logger was placed on a fixture in the Visual Arts Room inside the building.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
Creative Arts Center	7.5 hp motor AHU, exterior	Motor	#603209	7/10/2009	10:30 AM	7/29/2009	10:15 AM	
Creative Arts Center	Visual Arts Room	Lighting	#505831	7/10/2009	10:30 AM	7/29/2009	10:15 AM	

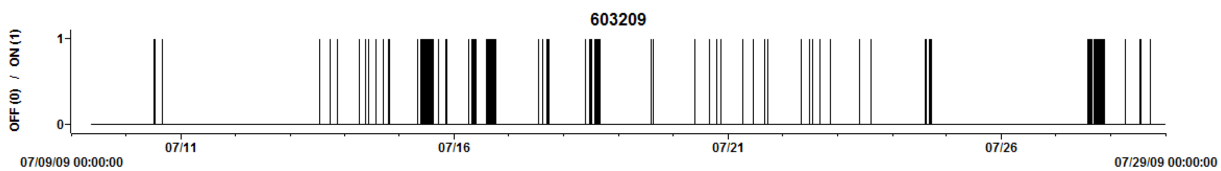
Manhattan Heights Annex – Creative Arts Center

As illustrated in the lighting logger graph below, the lighting in this room was turned on and off a few times a day during the data collection period. Most art classes that take place in the hall are between an hour and two hours long. In most cases, the lights are on for approximately this amount of time. The data indicates that occupants tend to shut off the fixtures when they leave the space.



Creative Arts Center – Visual Arts Room – Lighting Logger

Below is the data from the motor logger. Notice how the unit operated for very few hours during the 19 day data logging period. Two things are immediately clear from this printout. First, the building occupants don't call for cooling very much, even in the middle of July. Second, the unit is not set on continuous fan operation. Continuous fan operation would be necessary to ensure indoor environmental air quality.

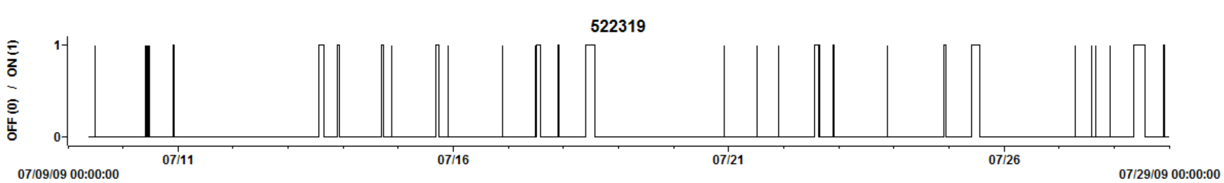


Creative Arts Center – Exterior Air Handling Unit – Motor Logger

Live Oak Park

A lighting data logger was installed in the south side of the main room in the Recreation Hall. As illustrated in figure below, the lights were only used a few hours per day. This was expected since we were informed that this building is used by a few summer programs but is not occupied all day long. In addition, this building has east facing windows that allow natural light into the space, reducing the need for artificial lighting during many hours of the day.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
Live Oak Park: Rec. Hall	Main Room, south side	Lighting	#522319	7/10/2009	11:30 AM	7/29/2009	9:45 AM	



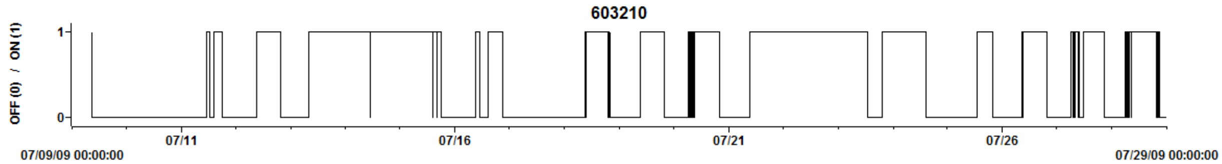
Live Oak Park – Recreation Hall – Lighting Logger

Two data loggers were installed at this site. A motor logger was placed on the rooftop auditorium package unit and a lighting logger was placed on a fixture in the teen room in the community center.

Manhattan Heights Community Center

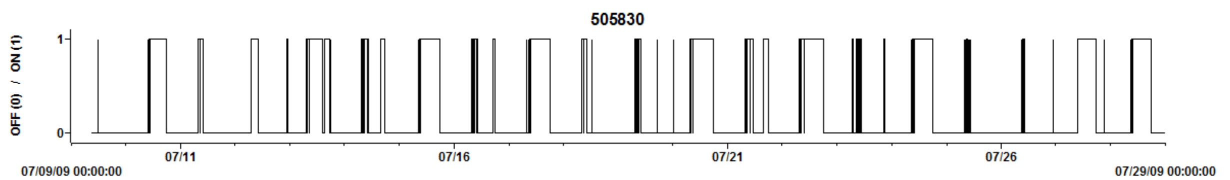
As illustrated in the motor logger plot, the auditorium roof unit was on continuously for in excess of 24 hours on a couple of occasions during the logging period. This can be corrected through the addition of a simple building automation system.

Building	Location	Logger Type	Logger ID #	Date Start	Time Start	Date End	Time End	Notes
Man. Heights Comm. Ctr.	Teen Room w/ pool tables	Lighting	#505830	7/10/2009	11:00 AM	7/29/2009	10:15 AM	
Man. Heights Comm. Ctr	Rec. Hall auditorium unit, roof	Motor	#603210	7/10/2009	11:00 AM	7/29/2009	10:15 AM	



Manhattan Heights Community Center – Auditorium Roof Unit – Motor Logger

As illustrated in the lighting logger plot, the teen room lighting is frequently turned on and off. There are several periods of time where the lighting is on for several hours at a time. There appears to be a trend of the lighting being on around the same time every day, indicating usage during those hours. In addition, the repetitive on-off also could mean that people are good about turning lights off when they leave the room. It also shows that the room is intermittently occupied; thus, a good candidate for occupancy sensors.



Manhattan Heights Community Center – Teen Room – Lighting Logger

APPENDIX G. Renewable Energy Data

Once the energy use at each site is optimized, it is recommended that the installation of solar photovoltaic panels be installed at the sites where installation is feasible. We define feasible solar locations based on:

1. **Roof space, ground space, and/or parking space available** – The availability of space for a system and the space location and orientation is the first step in determining the feasibility of a solar system.
   a. Note: Fixed tilt solar photovoltaic systems perform best when facing south (180 degree azimuth) and tilted at a tilt plus or minus 5° from the latitude of the site. Manhattan Beach is at 33.8° north, so to produce optimal solar energy, the system should face south and be tilted between 28.8° and 38.8° degrees. Typically this orientation is not feasible unless the system is being mounted on the ground because rooftop space constrains the space. More often, the system is oriented south with a 5-20° tilt. This orientation still produces good output and is easier to install, clean, and maintain.

2. **Shading** – Site shading from vegetation and nearby buildings that may degrade performance of the system and orientation of the site.

3. **Safety and security** – It is also important to consider the possibility of vandalism at the site and the need and cost for security, (cameras, fencing, etc).

Using those criteria, we have developed a list of solar energy installation recommendations. We have proposed installation for 11 different solar energy systems to serve 13 different meters.

Below is a summary of the recommended installation at each site. A table summarizing the installations is provided below.

Site Information		PV SYSTEM SPECIFICATIONS							
Site	Building	PV Location	PV Material	PV Loc.	Tilt	Type	Size (kW DC)	Size (kW AC)	Solar Energy (kWh)
City Hall	City Hall / Highland Lift	Roof	Polycrystalline	Roof	0	1,292	32.5	25.0	41,990
Joslyn Center	Community Hall	Roof	Polycrystalline	Roof	0	1,292	45.1	34.7	58,208
Live Oak Park	Multipurpose Building	Roof	Polycrystalline	Roof	0	1,292	21.1	16.3	27,283
Live Oak Park	Recreation Hall	Roof	Polycrystalline	Roof	0	1,292	2.1	1.6	2,698
Manhattan Heights Annex	Creative Arts Center	Parking	Polycrystalline	Pkg	10	1,390	18.0	13.8	24,953
Manhattan Heights Park	3 Structures: CC/TR/PG	Parking	Polycrystalline	Pkg	10	1,390	26.9	20.7	37,430
Parking Structure	Parking Structure #2	Parking	Polycrystalline	Pkg	10	1,390	3.0	2.3	4,159
Parking Structure	Parking Structure #3	Parking	Polycrystalline	Pkg	10	1,390	37.4	28.8	51,986
Parking Structure	Parking Structure #4	Parking	Polycrystalline	Pkg	10	1,390	15.0	11.5	20,794
Peck Reservoir	Pumping Station / Reservoir	Water Tank	Thin Film	Thin Film	0	1,292	189.0	145.5	244,188
Public Safety	Facility	Parking	Polycrystalline	Pkg	10	1,390	112.2	86.4	155,958
Public Works Yard	Complex	Roof	Polycrystalline	Roof	0	1,292	87.2	67.1	112,668
Water Block #35	Complex	Water Tank	Thin Film	Thin Film	0	1,292	148.2	114.1	191,478
							737.6	***567.9***	***973,793***

Polycrystalline modules have:

- Good power to size ratio (approximately 12.8 W/SF)
- Medium priced
- Excellent life span / longevity. Usually also come with 25 yr warranty.
- Ideal for small /medium roof areas

Thin Film modules have a:

- Low efficiency (approximately 5.8 W/SF).
- Expected lifespan is less than crystalline panels.
- Optimal efficiency in hot weather, less effective in cooler conditions.
- 3-6 month 'breaking in' period where long term output is exceeded.
- Requires 2-3 times more panels and surface area for same output as crystalline.
- Flexible and adheres directly to the roof or can be integrated into a new roof, so no racking system is required
- Tends to be less expensive than other types of modules
- It is a "low-light" technology. This means that the module is able to produce energy for more hours per day because it can absorb radiation and generate electricity when the sun is low on the horizon (early morning and evening).

There are currently two ways to finance the solar photovoltaic system, as discussed below.

1. **City-Owned Systems** – If the City purchases the systems, then the City will pay for the system(s) or take a loan for the system(s). The City can expect to pay between $5.50/Watt - $8.00/Watt of solar installed before any rebates or incentives. The City will then receive a rebate from the California Solar Initiative at the current rate depending on the size of the system. Currently, the rebate rate is $2.30/kW for systems under 50 kW AC or $.32/kWh for five years for systems greater than 50 kW AC. The rate will decrease to $1.85/kW for systems under 50 kW AC or $0.26/kWh for five years for systems greater than 50 kW AC after another 58MW of solar is reserved in SCE territory.

   As demonstrated in the financial analysis, this is not a lucrative rebate. Under these conditions, the payback for most solar photovoltaic systems paid for by the City will range from 15 to 20 years.

2. **Energy or Power Purchase Agreement (PPA)** – Another option is for the City to sign into a Power Purchase Agreement, also known as a PPA, with an electricity generator. The electricity generator, also known as the PPA Provider, will secure the funding for the project and build the system. The Provider will then sell the electricity to the City at a contractual price for the length of the contract. The length of PPA contracts vary from 5-25 years, depending on the scope of the project. The PPA provider is able to do this by securing tax credits, rebates, renewable energy credits, and other incentives that non-taxable entities, such as local government, cannot always secure. At the end of the contract, most PPA Providers provide the option for the electricity purchaser (the City) to purchase the solar system and continue to use it until the end of its useful life. Otherwise, the system can be removed.

This method for investing in solar is beneficial because it will allow the City to have clean energy without the burden of paying a loan and/or the hassle of maintenance when a panel breaks. The financial risks, system maintenance, and system energy production are typically the sole responsibility of the PPA Provider. In addition, agreed contractual prices for electricity eliminates the effect and risks of rising, volatile energy prices for the City and while also providing clean, dependable clean energy.

There are other hybrid contracting methods available that PE Consulting would be pleased to assist with.

ATTACHMENT #2

GENERAL FUND ITEMS

CITY OF MANHATTAN BEACH
ENERGY AUDIT MATRIX

Updated: January 22, 2010

				Source: Comprehensive Energy Audit Report (PE Consulting)											City Staff Recommendations	
GENERAL FUND CIP BUDGET ITEMS:	Site Information			Financials						CO2 Offsets			Replacement Needs			
Committee Priority Rank	Site	Building	Project Description	Initial Cost*	ROI	Annual Savings	Annual Savings Rank	Weighted Lifecycle Payback (yrs)	Lifecycle Payback Rank	Metric Tonnes:	Tonnes Rank	Dollars Per Tonne	Remaining Useful Life (yrs)	Replacement Needs Rank	Staff's Recommended Priority	Management Notes
1	Manh.Heights Park	3 Structures: CC/TR/PG	Install high efficiency HVAC	$57,816	3.71%	$2,145	6	15.0	11	5.4	5	$10,635	0.0	1	1	HVAC has little to no useful life remaining. Failure is imminent. If building is going to be retained for next 12 years, it is a good investment
			MANHATTAN HEIGHTS PARK TOTAL:	**$57,816**												
2	City Hall	City Hall / Highland Lift	Install solar controlled glass, light fixtures, new VAV system, controls, connect to EMS	$1,068,725	5.62%	$86,580	1	11.3	10	200.2	1	$7,697	7.5	6	3	Upgrades address deferred maintenance of HVAC and lighting in the City Hall and Annex faciliites. Investment is future-proof as ther eare not any plans in the foreseeable future to demolish buildings. Most CO2 savings among General Fund projects.
	Public Safety	Facility	Adjust HVAC/Facility systems (commissioning)	$90,868												
	Public Safety	Facility	Install induction lighting fixtures, connect lighting to energy management system (EMS)	$12,415												
	Public Safety	Facility	Install Efficient cooling system for City Hall complex (ice storage)	$369,144												
			CITY HALL / PUBLIC SAFETY COMPLEX TOTAL:	**$1,541,152**												
3	Public Works Yard	Complex	Replace unit heaters with infared radiant tube heaters in garage	$24,522	8.02%	$11,555	2	8.8	5	30.1	2	$4,786	4.0	3	5	Permanent, highly used facility. Rehab not probable for many years, payback on investment within 9 years at current rates.
	Public Works Yard	Complex	Install high efficiency HVAC	$13,362												
	Public Works Yard	Complex	Reduce light fixtures, install induction lighting	$106,133												
			PUBLIC WORKS YARD TOTAL:	**$144,017**												
4	Polliwog Park	Restrooms and Office	Install occupancy sensors and induction lighting for perimeter	$44,312	21.79%	$9,656	3	4.0	2	15.7	3	$2,830	15.0	8	9	Higher priority jobs exist.
			POLLIWOG PARK TOTAL:	**$44,312**												
5	Live Oak Park	Multipurpose Building	Install high efficiency HVAC	$19,540	6.26%	$1,223	10	10.0	7	3.0	9	$6,591	0.0	1	2	Warrants further discussion. Many of the buildings are very old. If rehab or demolition is in the works, perhaps a modified scope of work might be considered.
			LIVE OAK PARK TOTAL:	**$19,540**												
6	Marine Park	Complex	Reduce light fixtures, install induction lighting for perimeter	$32,929	12.18%	$4,010	5	6.0	4	5.2	6	$6,298	15.0	8	8	Higher priority jobs exist.
			MARINE PARK TOTAL:	**$32,929**												
7	Manh. Village Park	Restrooms and Ext. Lights	Install induction lighting	$7,627	25.92%	$1,977	7	3.0	1	3.2	8	$2,355	15.0	8	10	Higher priority jobs exist.
			MANHATTAN VILLAGE PARK TOTAL:	**$7,627**												
8	Joslyn Center	Community Hall	Reduce light fixtures, replace incandescent lights with CFLs, install high occupancy sen	$16,618	4.93%	$4,349	4	10.6	8	10.5	4	$8,360	5.0	4	6	Depending on the long-term facility plan, candidate for lighting only.
	Joslyn Center	Community Hall	Install high efficiency HVAC	$71,534												
			JOSLYN CENTER TOTAL:	**$88,152**												
9	Fire Station #2	Complex	Install high efficiency HVAC	$11,723	5.62%	$1,378	9	9.3	6	3.5	7	$6,952	7.5	6	4	Facility is a permanent emergency facility.
	Fire Station #2	Complex	Install infared radiant tube heater in fire truck garage	$12,812												
			FIRE STATION #2 TOTAL:	**$24,535**												
10	Manh. Heights Annex	Creative Arts Center	Arch. lighting update, install occupancy sensors, and induction lighting for perimeter	$8,220	3.02%	$1,707	8	10.7	9	2.5	10	$22,644	5.0	4	7	Relatively light-use building, still have useful life on mechanical equipment.
	Manh. Heights Annex	Creative Arts Center	Install high efficiency HVAC	$48,228												
			MANHATTAN HEIGHTS ANNEX TOTAL:	**$56,449**												
11	Sand Dune Park	Office and Restroom	Retrofit T12 fixtures, install induction lighting for perimeter	$6,949	16.91%	$1,175	11	5.0	3	1.3	11	$5,341	15.0	8	11	Future of facility uncertain.
			SAND DUNE PARK TOTAL:	**$6,949**												
			GENERAL FUND CIP ITEMS TOTAL:	**$2,023,479**		**$125,755**				**280.7**						
GENERAL FUND OPERATING BUDGET ITEMS:																
	City Hall	City Hall / Highland Lift	Data Center and PC's (rough est.)	$225,768	6.79%	$30,295		8.6		50.0		$8,930				
	City Hall Annex	COC; USPO, Annex	Install skylights, retrofit 8' lighting, reduce light fixtures, install induction lighting	$30,019												
	City Hall Annex	COC; USPO, Annex	Install high efficiency water heater	$1,935												
	City Hall Annex	COC; USPO, Annex	Replace Chamber of Commerce HVAC and install programmable thermostats	$7,451												
	Fire Station #2	Complex	Reduce light fixtures, install CFLs and occupancy sensors	$3,785												
	Joslyn Center	Community Hall	Install high efficiency water heater	$1,902												
	Live Oak Park	Dorsey Field & Tot Lot	Install induction lighting	$4,967												
	Live Oak Park	Multipurpose Building	Install skylights, occupancy sensors, and induction lighting for batting cage	$11,609												
	Live Oak Park	Pony Field Lighting	Install induction lighting	$25,279												
	Live Oak Park	Recreation Hall	Install occupancy sensors	$1,478												
	Live Oak Park	Scout House	Reduce light fixtures, install occupancy and photocell sensors	$1,988												
	Live Oak Park	Scout House	Install blow-in attic insulation	$2,409												
	Live Oak Park	Tennis Courts Lights	Install induction lighting for tennis courts	$65,907												
	Manh. Heights Annex	Creative Arts Center	Install high efficiency water heater	$1,922												
	Manh.Heights Park	3 Structures: CC/TR/PG	Reduce light fixtures, install occupancy sensors	$16,685												
	Manh.Heights Park	Baseball/Basketball Lights	Install induction lighting for basketball courts	$11,214												
	Manh.Heights Park	Tennis Courts Lights	Install induction lighting for tennis courts	$27,742												
	Marine Park	Complex	Install high efficiency water heater	$1,928												
	Marine Sports Park	Complex	Install occupancy sensors	$1,296												
	Polliwog Park	Historic House	Replace incandescent lights with CFLs, install occupancy sensors	$550												
	Premier Park	Restroom	Install occupancy sensors	$380												
			GENERAL FUND OPERATING BUDGET ITEMS TOTAL:	**$446,213**		**$30,295**				**50.0**						
			ALL GENERAL FUND ITEMS TOTAL:	**$2,469,692**		**$156,050**				**330.7**						

Initial Cost*= (First Cost minus Rebates and Incentives) plus 25% Project Administration/Mgmt/Design Costs. Rebates and Incentives are not guaranteed and are subject to change.
ROI= Annual Savings / Initial Cost.
Annual Savings= annual utility bill savings plus annual maintenance savings.
Weighted Lifecycle Payback= sum of (line item's lifecycle payback x % of lifecycle savings of the item group).
Dollars per Tonne= Initial Cost* / Metric Tonnes
Remaining Useful Life= projected years remaining of HVAC system; zero means this item is at the end of its useful life currently or has already surpassed its useful life and is deferred maintenance.
Note 1: Rebates were calculated using the rebate amounts for SCE's Standard Performance Contract.
Note 2: Lifecycle Payback = Net Cost / Lifecycle Savings / Equipment Life.
Note 3: Lifecycle Savings = total projected savings over the life of the equipment, including future value, utility escalation rate, annual utility and maintenance savings and the equipment life.
Note 4: CO2 Emissions were calculated using EPA's Clean Energy eGRID2007 V1.1 Year 2005 GHG Annual Output Emission Rates for the CAMX WECC California.
Conversion Factors: 724.12 lbs CO2/MWh of electricity, 117.08 lbs CO2/Mbtu of Natural Gas. 1 met. tonne = 2204.62 lbs. CO2. http://www.eia.doe.gov/oiaf/1605/coefficients.html a

CITY OF MANHATTAN BEACH
ENERGY AUDIT MATRIX

Updated: January 22, 2010

Site	Building	Project Description	Initial Cost*	ROI	Annual Savings	Annual Savings Rank	Weighted Lifecycle Payback (yrs)	Lifecycle Payback Rank	Metric Tonnes:	Tonnes Rank	Dollars Per Tonne	Remaining Useful Life (yrs)	Replacement Needs Rank	Staff Recommended Priority	Management Notes
RESTRICTED AND SPECIAL FUND ITEMS:			Source: Comprehensive Energy Audit Report (PE Consulting)											City Staff Recommendations	
Site Information			Financials						CO2 Offsets			Replacement Needs			
Street/Walk Lighting	Varies	Retrofit street/walk lights with induction lighting	$306,853	13.44%	$41,234		6.0		52.6		$5,835				
		STREET/WALK LIGHTING (FUNDED BY FEDERAL STIMULUS FUNDS) TOTAL:	**$306,853**												
Pier	Pier Ltg & Comfort Station	Install occupancy sensors	$193	14.53%	$1,911		3.8		4.7		$2,805				
Pier	Roundhouse - Aquarium	Install induction lighting and occupancy sensors	$3,735												
Pier	Roundhouse - Restaurant	Install new light fixtures in restaurant and induction lighting for perimeter	$3,427												
Pier	Roundhouse - Restaurant	Install Energy Star rated appliances (1 refridgerator, 1 freezer)	$5,790												
		STATE PIER AND PARKING LOT FUND TOTAL:	**$13,145**												
Peck Reservoir	Pumping Station / Reservoir	Install occupancy sensors	$287	21.14%	$2,414		4.0		3.4		$3,360				
Water Block #35	Complex	Install induction lighting and occupancy sensors	$11,130												
		WATER FUND TOTAL:	**$11,417**												
Metlox Town Square	Metlox Parking Structure	70W induction lighting for garage, 40W induction lighting for perimeter	$252,392	10.68%	$48,545		7.0		55.5		$8,183				
Parking Structure	Parking Structure #2	40W induction lighting for garage with photocells	$8,258												
Parking Structure	Parking Structure #3	40W induction lighting for garage with photocells	$169,132												
Parking Structure	Parking Structure #4	40W induction lighting for garage with photocells and exterior poles	$24,739												
		CITY PARKING FUND TOTAL:	**$454,520**												
MISCELLANEOUS / THIRD-PARTY / GRANT ITEMS:															
City Hall	City Hall / Highland Lift	Rooftop: 32.5 kW DC Solar PV	$191,100	3.14%	$139,928		16.4		319.9		$13,943				
Joslyn Center	Community Hall	Rooftop: 45.1 kW DC Solar PV	$264,910												
Live Oak Park	Multipurpose Building	Rooftop: 21.1 kW DC Solar PV	$124,165												
Live Oak Park	Recreation Hall	Rooftop: 2.1 kW DC Solar PV	$12,280												
Manh. Heights Annex	Creative Arts Center	Covered Parking: 18 kW DC Solar PV	$134,618												
Manh.Heights Park	3 Structures: CC/TR/PG	Covered Parking: 26.9 kW DC Solar PV	$201,926												
Parking Structure	Parking Structure #2	Covered Parking: 3 kW DC	$22,436												
Parking Structure	Parking Structure #3	Covered Parking: 37.4 kW DC Solar PV	$280,453												
Parking Structure	Parking Structure #4	Covered Parking: 15 kW DC Solar PV	$112,181												
Peck Reservoir	Pumping Station / Reservoir	Water Tank Mounted: 189 kW DC Solar PV	$1,041,343												
Public Safety	Facility	Covered Parking: 112.2 kW DC	$777,827												
Public Works Yard	Complex	Rooftop: 87.2 kW DC Solar PV	$480,472												
Water Block #35	Complex	Water Tank Mounted: 148.2 kW DC Solar PV	$816,560												
		MISCELLANEOUS / THIRD-PARTY / GRANT ITEMS TOTAL:	**$4,460,272**												
		ENERGY AUDIT MATRIX TOTAL:	**$7,715,899**		**$390,082**				**766.8**						

Initial Cost*= (First Cost minus Rebates and Incentives) plus 25% Project Administration/Mgmt/Design Costs. Rebates and Incentives are not guaranteed and are subject to change.
ROI= Annual Savings / Initial Cost.
Annual Savings= annual utility bill savings plus annual maintenance savings.
Weighted Lifecycle Payback= sum of (line item's lifecycle payback x % of lifecycle savings of the item group).
Dollars per Tonne= Initial Cost* / Metric Tonnes
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Note 3: Lifecycle Savings = total projected savings over the life of the equipment, including future value, utility escalation rate, annual utility and maintenance savings and the equipment life.
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