LEVEL II ENERGY AUDIT

A Bureau Veritas Group Company

Sacramento City Unified School District
5735 47th Avenue
Sacramento, California 95824

DLR Group
1050 20th Street, Suite 250
Sacramento, California 95986

ZERO NET ENERGY ASHRAE LEVEL II AUDIT

WILL C. WOOD MIDDLE SCHOOL

6201 Lemon Hill Avenue

Sacramento, California 95824

PREPARED BY:
EMG / A Bureau Veritas Company
10461 Mill Run Circle, Suite 1100
Owings Mills, Maryland 21117
800.733.0660
www.emgcorp.com

EMG CONTACT:
Kaustubh Anil Chabukswar
Program Manager
800.733.0660 x7512
kachabukswar@emgcorp.com

EMG PROJECT #:

136988.19R000-087.268

DATE OF REPORT:

October 24, 2019

ONSITE DATE:

October 2-4, 2019

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Certification

EMG has completed an Energy Audit of Will C. Wood Middle School located at 6201 Lemon Hill Avenue in Sacramento, CA. EMG visited the site on October 2-4, 2019.

The assessment was performed at the Client's request using methods and procedures consistent with ASHRAE Level II Energy Audit and using methods and procedures as outlined in EMG's Proposal.

This report has been prepared for and is exclusively for the use and benefit of the Client identified on the cover page of this report. The purpose for which this report shall be used shall be limited to the use as stated in the contract between the client and EMG.

This report, or any of the information contained therein, is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of EMG. Any reuse or distribution without such consent shall be at the client's or recipient's sole risk, without liability to EMG.

Estimated installation costs are based on EMG's experience on similar projects and industry standard cost estimating tools including *RS Means and Whitestone CostLab*. In developing the installed costs, EMG also considered the area correction factors for labor rates for Sacramento, CA. Since actual installed costs may vary widely for particular installation based on labor & material rates at time of installation, EMG does not guarantee installed cost estimates and shall in no event be liable should actual installed costs vary from the estimated costs herein. We strongly encourage the owner to confirm these cost estimates independently. EMG does not guarantee the costs savings estimated in this report. EMG shall in no event be liable should the actual energy savings vary from the savings estimated herein.

EMG certifies that EMG has no undisclosed interest in the subject property and that EMG's employment and compensation are not contingent upon the findings or estimated costs to remedy any deficiencies due to deferred maintenance and any noted component or system replacements.

Any questions regarding this report should be directed to Kaustubh Anil Chabukswar at 800.733.0660, ext. 7512.

Prepared by: Beth A. Stauffer
Project Team

Reviewed by:

Bhaskar Ale, CEM

Technical Report Reviewer for

Kaustubh Anil Chabukswar, CEM CRM
Program Manager

1. Executive Summary

The purpose of this Energy Audit is to provide Sacramento City Unified School District and Will C. Wood Middle School with a baseline of energy usage and the relative energy efficiency of the facility and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal & Utility grants towards energy conservation, support performance contracting, justify a municipal bond funded improvement program, or as a basis for replacement of equipment or systems.

BLDG. #	STRUCTURES ASSESSED	BUILDING TYPE	EMG CALCULATED AREA (SF)	ESTIMATED OCCUPANCY
1	00A, Library, Classrooms	School Building	10,815	80 - 90
2	00B Admin, Classrooms	School Building	24,257	180 - 200
3	00C Classrooms	School Building	7,803	55 – 65
4	00D Gymanasium	School Building	19,685	145 – 165
5	00E Classrooms	School Building	12,850	95 – 105
6	00F MPR, Kitchen	School Building	13,586	100 – 115
7	00G Classrooms	School Building	5,736	40 – 50
8	P01 – P06 Classrooms	School Building	5,760	40 – 50
9	P07 – P09 Classrooms	School Building	3,840	25 - 35

The study included a review of the building's construction features, historical energy and water consumption and costs, review of the building envelope, HVAC equipment, heat distribution systems, lighting, and the building's operational and maintenance practices.

1.1. Energy Conservation Measures

EMG has identified five Energy Conservation Measures (ECMs) for this property. The savings for each measure is calculated using standard engineering methods followed in the industry, and detailed calculations for ECM are provided in Appendix for reference. A 10% discount in energy savings was applied to account for the interactive effects amongst the ECMs. In addition to the consideration of the interactive effects, EMG has applied a 15% contingency to the implementation costs to account for potential cost overruns during the implementation of the ECMs.

The following table summarizes the recommended ECMs in terms of description, investment cost, energy consumption reduction, and cost savings.

Summary of Financial Information for Recommended Non-Renewable Energy Conservation Measures

ITEM	ESTIMATE
Net Initial ECM Investment *(Current Dollars Only)*	$ 156,898 *(In Current Dollars)*
Estimated Annual Cost Savings *(Current Dollars Only)*	$ 25,615 *(In Current Dollars)*
ECM Effective Payback	6.13 years
Estimated Annual Energy Savings	15.81%

ITEM	ESTIMATE
Estimated Annual Energy Utility Cost Savings *(Excluding Water)*	17.25%
Estimated Annual Water Cost Saving	4.55%

Solar Photovoltaic (PV) Screening for Will C. Wood Middle School

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS	
Estimated Number of Panels	903
Estimated KW Rating	284 KW
Potential Annual kWh Produced	438,463 kWh
% of Current Electricity Uses	84.6%
FINANCIAL SUMMARY	
Investment Cost	$995,400
Estimated Energy Cost Savings	$70,154
Payback without Incentives	14.2 Years
Incentive Payback but without SRECs	8.6 Years
Payback with All Incentives	8.6 Years

Key Metrics to Benchmark the Subject Property's Energy Usage Profile

- Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.
- Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.
- Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.
- Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

SITE ENERGY USE INTENSITY (EUI)	RATING
Current Site Energy Use Intensity (EUI)	36 kBtu/ft^2
Post ECM Site Energy Use Intensity (EUI)	30 kBtu/ft^2
SOURCE ENERGY USE INTENSITY (EUI)	**RATING**
Current Source Energy Use Intensity (EUI)	77 kBtu/ft^2
Post ECM Source Energy Use Intensity (EUI)	64 kBtu/ft^2
BUILDING COST INTENSITY (BCI)	**RATING**
Current Building Cost Intensity	$1.02/ft^2

BUILDING COST INTENSITY (BCI)	RATING
Post ECM Building Cost Intensity	$0.84/ft^2

Summary of the Greenhouse Gas Reductions from Recommended Non-Renewable Energy Conservation Measures

The following table provides a summary of the projected Greenhouse Gas Emissions reductions as a result of the recommended Energy Conservation Measures:

GREENHOUSE GAS EMISSIONS REDUCTION	
Estimated Annual Thermal Energy Reduction	545 MMbtu
Total CO_2 Emissions Reduced	45.63 MtCO_2/Yr
Total Cars Off the Road (Equivalent)*	8
Total Acres of Pine Trees Planted (Equivalent)*	10

**Equivalent reductions per DOE emissions calculation algorithms*

Zero Net Energy Analysis for Renewable and Non-Renewable Recommended Measures

ZERO NET ENERGY ANALYSIS	
Building Annual Net Energy Consumption	3,766,023 kBtu
Total Annual Energy Savings for Non-Renewable Energy Measures	595,358 kBtu
Total Annual Energy Savings from Renewable Energy Measures	1,496,036 kBtu
Total Annual Energy Savings	2,091,394 kBtu
Net Energy Consumption from Grid Post Implementation	1,674,629 kBtu
% Energy Reduction (Annual Energy-Net Energy) / (Annual Energy)	56%

Energy Conservation Measures Screening:

EMG screens ECMs using two financial methodologies. ECMs which are considered financially viable must meet both criteria.

1. Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates. ECMs with a payback period greater than the Expected Useful Life (EUL) of the project are not typically recommended, as the cost of the project will not be recovered during the lifespan of the equipment. These ECMs are recommended for implementation during future system replacement. At that time, replacement may be evaluated based on the premium cost of installing energy efficient equipment.

$$Simple\ Payback = \frac{Initial\ Cost}{Annual\ Savings}$$

2. Savings-to-Investment Ratio (SIR) – The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value over the estimated useful life (EUL) of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy efficiency recommendations should be based on a calculated SIR, with larger SIRs receiving a higher priority. A project is typically only recommended if SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

$$SIR = \frac{Present\ Value\ (Annual\ Savings, i\%, EUL)}{Initial\ Cost}$$

List of Recommended Energy Conservation Measures For Will C. Wood Middle School

ECM #	Description of ECM	Projected Initial Investment	Estimated Annual Energy Savings		Estimated Annual Water Savings	Estimated Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Simple Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
			Natural Gas	Electricity								
		$	Therms	kWh	kgal	$	$	$	Years		$	Years
Capital Cost Recommendations												
1	Install Low Flow Faucet Aerators Location: Will C. Wood Middle School - Classroom And Restroom Sinks	$1,249	422	0	59	$1,121	$0	$1,121	1.11	7.66	$8,314	10.00
2	Install Low Flow Shower Heads Location: Will C. Wood Middle School	$1,522	479	0	58	$1,173	$0	$1,173	1.30	6.58	$8,488	10.00
3	Reduce HVAC Hours of Operation Location: Will C. Wood Middle School - All Buildings	$14,373	2,104	13,924	0	$4,816	$0	$4,816	2.98	4.00	$43,118	15.00
4	Upgrade Building Lighting to LED and Install Automatic Lighting Controls Location: Building Interior And Exterior	$73,102	0	91,892	0	$14,463	$2,689	$17,153	4.26	2.80	$131,663	15.00
5	Install Low Flow Tankless Restroom Fixtures Location: Will C. Wood Middle School	$46,186	0	0	420	$4,199	$0	$4,199	11.00	1.09	$3,936	15.00
Total For Capital Cost		**$136,433**	**3,005**	**105,817**	**537**	**$25,772**	**$2,689**	**$28,461**	**4.79**			
	Interactive Savings Discount @ 10%		-300	-10,582	-54	-$2,577	-$269	-$2,846				
	Total Contingency Expenses @ 15%	$20,465										
Total for Improvements		**$156,898**	**2,704**	**95,235**	**483**	**$23,195**	**$2,420**	**$25,615**	**6.13**			

In addition to the above measures, EMG has identified the following measure(s) but has not recommended as they fail to meet the above-mentioned financial criteria of SIR>1.0. Thus, EMG has classified the measure(s) as recommended for consideration.

List of Recommended For Consideration Energy Conservation Measures For Will C. Wood Middle School

ECM #	Description of ECM	Initial Investment	Annual Energy Savings		Annual Water Savings	Cost Savings	Estimated Annual O&M Savings	Total Estimated Annual Cost Savings	Payback	S.I.R.	Life Cycle Savings	Expected Useful Life (EUL)
		$	Natural Gas	Electricity	kgal	$	$	$	Years		$	Years
1	Replace Existing Water Heater With New Energy Efficient Units Location: Will C. Wood Middle School	$4,862	0	1,204	0	$189	$0	$189	25.66	0.54	-$2,256	18.00
2	Replace External Windows Location: Will C. Wood Middle School - All Buildings	$407,172	1,299	19,898	0	$4,752	$48	$4,800	84.83	0.21	-$323,596	25.00
3	Replace Rooftop Package Unit Location: Will C. Wood Middle School - 4 Ton Through 8 Ton Units	$473,000	1,356	20,235	0	$4,876	$244	$5,120	92.38	0.16	-$396,824	20.00
Total for Improvements		**$885,034**	**2,655**	**41,337**	**0**	**$9,818**	**$291**	**$10,109**	**87.55**			

2. Introduction

The purpose of this Energy Audit is to provide Will C. Wood Middle School and Sacramento City Unified School District with a baseline of energy usage, the relative energy efficiency of the facility, and specific recommendations for Energy Conservation Measures. Information obtained from these analyses may be used to support a future application to an Energy Conservation Program, Federal and Utility grants towards energy conservation, as well as support performance contracting, justify a municipal bond-funded improvement program, or as a basis for replacement of equipment or systems.

The energy audit consisted of an onsite visual assessment to determine current conditions, itemize the energy consuming equipment (i.e. Boilers, Make-Up Air Units, DWH equipment); review lighting systems both exterior and interior; and review efficiency of all such equipment. The study also included interviews and consultation with operational and maintenance personnel. The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

The following is a summary of the tasks and reporting that make up the Energy Audit portion of the report.

ENERGY AND WATER USING EQUIPMENT

- EMG has surveyed the common areas, office areas, rooms, maintenance facilities and mechanical rooms to document utility-related equipment, including heating systems, cooling systems, air handling systems and lighting systems.

BUILDING ENVELOPE

- EMG has reviewed the characteristics and conditions of the building envelope, checking insulation values and conditions. This review also includes an inspection of the condition of walls, windows, doors, roof areas, insulation and special use areas

RECOMMENDATIONS FOR ENERGY SAVINGS OPPORTUNITIES

- Based on the information gathered during the on-site assessment, the utility rates, as well as recent consumption data and engineering analysis, EMG has identified opportunities to save energy and provide probable construction costs, projected energy/utility savings and provide a simple payback analysis.

ANALYSIS OF ENERGY CONSUMPTION

- Based on the information gathered during the on-site assessment, EMG has conducted an analysis of the energy usage of all equipment, and identified which equipment is using the most energy and what equipment upgrades may be necessary. As a result, equipment upgrades, or replacements are identified that may provide a reasonable return on the investment and improve maintenance reliability.

ENERGY AUDIT PROCESS

- Interviewing staff and review plans and past upgrades
- Performing an energy audit for each use type
- Performing a preliminary evaluation of the utility system
- Analyzing findings, utilizing ECM cost-benefit worksheets
- Making preliminary recommendations for system energy improvements and measures
- Estimating initial cost and changes in operating and maintenance costs based on implementation of energy efficiency measures
- Ranking recommended cost measures, based on the criticality of the project and the largest payback

REPORTING

The EMG Energy Audit Report includes:

- A comprehensive study identifying all applicable Energy Conservation Measures (ECMs) and priorities, based on initial cost and payback
- A narrative discussion of building systems/components considered and a discussion of energy improvement options;
- A summary of ECMs including initial costs and simple paybacks, based on current utility rates and expected annual savings.

3. Facility Overview and Existing Conditions

3.1. Building Occupancy and Point of Contact

FACILITY SCHEDULE	
Hours of Operations / Week	40
Operational Weeks / Year	37
Estimated Facility Occupancy	817
% of Male Occupants	50%

POINT OF CONTACT	
Point of Contact Name	Liz
Point of Contact Title	Plant Manager
Point of Contact – Contact Number	916.207.0227

3.2. Building Heating, Ventilating and Air-Conditioning (HVAC)

Description:

Heating and cooling are mainly provided by rooftop packaged units. There are also Heat Pumps, Spilt systems and furnaces. The Mechanical Equipment Schedule in Appendix contains a summary of the HVAC Equipment at the property.

BUILDING CENTRAL HEATING SYSTEM	
Primary Heating System	Rooftop Package Units
Secondary Heating System	Heat Pump System
Hydronic Distribution System	NA
Primary Heating Fuel	Natural Gas
Heating Mode Set-point	69 °F
Heating Mode- Set-back Temperature	53 °F

BUILDING COOLING SYSTEM	
Primary Cooling System	Rooftop Package Unit
Secondary Cooling System	Heat Pump System
Hydronic Distribution System	NA
Cooling Mode Set-point	73 °F

BUILDING COOLING SYSTEM	
Cooling Mode- Set-back Temperature	93 °F

AIR DISTRIBUTION SYSTEM	
Building Ventilation	Roof Top Exhaust Fans
On-Demand Ventilation System in Use?	No
Energy Recovery Wheel / Enthalpy Wheel Exhaust Fans	No

DOMESTIC HOT WATER SYSTEM	
Primary Domestic Water Fuel	Electricity and Natural Gas

3.3. Lighting

Description:

The lighting in the school building primarily consists of T8 linear fluorescent lamp fixtures in classrooms and hallways. The fixtures were observed to be operating on bi-level mode in the classrooms. The exterior lights were primarily High Intensity Discharge (HID) fixtures.

The detailed lighting schedule and the proposed LED alternative is provided in Appendix.

4. Utility Analysis

Establishing the energy baseline begins with an analysis of the utility cost and consumption of the building. Utilizing the historical energy data and local weather information, we evaluate the existing utility consumption and assign it to the various end-uses throughout the buildings. The Historical Data Analysis breaks down utilities by consumption, cost and annual profile.

This data is analyzed, using standard engineering assumptions and practices. The analysis serves the following functions:

- Allows our engineers to benchmark the energy and water consumption of the facilities against consumption of efficient buildings of similar construction, use and occupancy.
- Generates the historical and current unit costs for energy and water
- Provides an indication of how well changes in energy consumption correlate to changes in weather.
- Reveals potential opportunities for energy consumption and/or cost reduction. For example, the analysis may indicate that there is excessive, simultaneous heating and cooling, which may mean that there is an opportunity to improve the control of the heating and cooling systems.

By performing this analysis and leveraging our experience, our engineers prioritize buildings and pinpoint systems for additional investigation during the site visit, thereby maximizing the benefit of their time spent on-site and minimizing time and effort by the customer's personnel.

Based upon the utility information provided about the Sacramento City Unified School District, the following energy rates are utilized in determining existing and proposed energy costs.

Utility Rates used for Cost Analysis

ELECTRICITY (BLENDED RATE)	NATURAL GAS	WATER / SEWER
$0.16 /kWh	$1.25 /therm	$ 10.00/kGal

The data analyzed provides the following information: 1) breakdown of utilities by consumption, 2) cost and annual profile, 3) baseline consumption in terms of energy/utility at the facility, 4) the Energy Use Index, or Btu/sq ft, and cost/sq ft. For multiple water meters, the utility data is combined to illustrate annual consumption for each utility type.

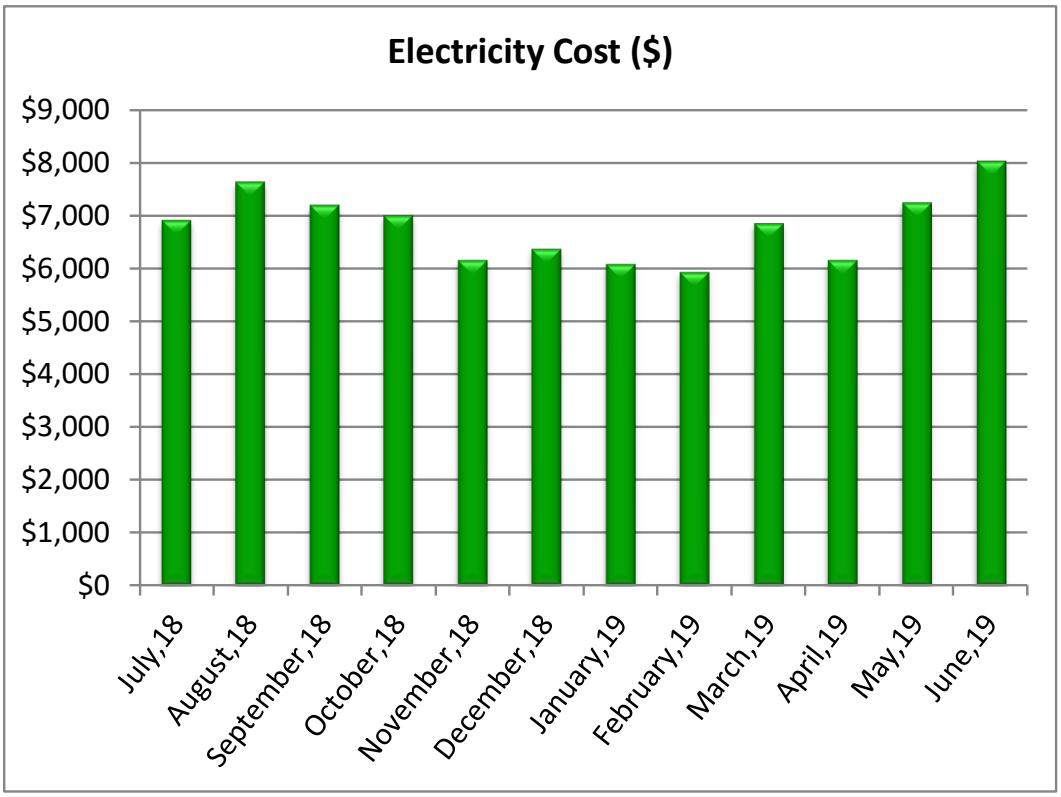
4.1. Electricity

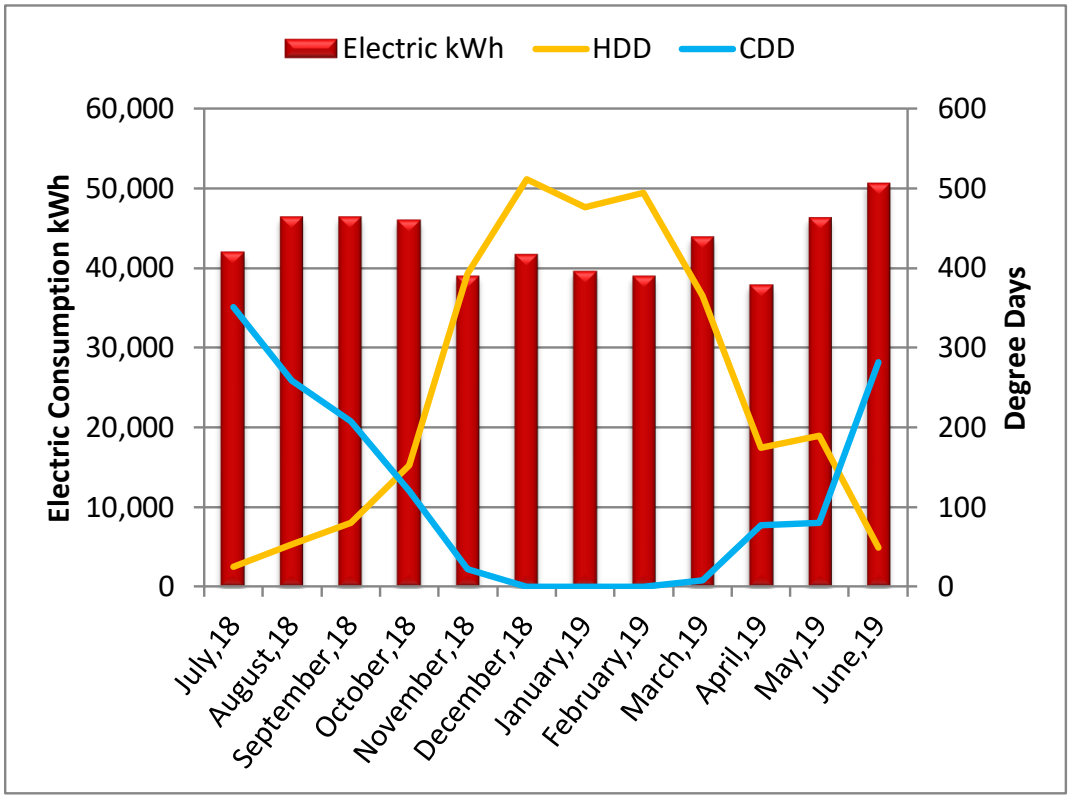
SMUD satisfies the electricity requirements for the facility. The primary end uses for electric utility compromises of lighting, cooling, office/school equipment, and appliances in the break room.

The table below provides the electric use for the period of twelve continuous months.

Electric Consumption and Cost Data

Billing Month	Electricity Consumption (kWh)	Unit Cost/kWh	Total Cost
July,18	41,947	$0.16	$6,907
August,18	46,381	$0.16	$7,631
September,18	46,297	$0.16	$7,191
October,18	45,940	$0.15	$7,000
November,18	38,888	$0.16	$6,154
December,18	41,663	$0.15	$6,364
January,19	39,526	$0.15	$6,073
February,19	38,931	$0.15	$5,933
March,19	43,794	$0.16	$6,853
April,19	37,858	$0.16	$6,159
May,19	46,274	$0.16	$7,241
June,19	50,591	$0.16	$8,036
Total	**518,090**	**$0.16**	**$81,544**


Electricity Cost ($)
$9,000
$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Electric kWh
HDD
CDD
Electric Consumption kWh
60,000
50,000
40,000
30,000
20,000
10,000
0
Degree Days
600
500
400
300
200
100
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

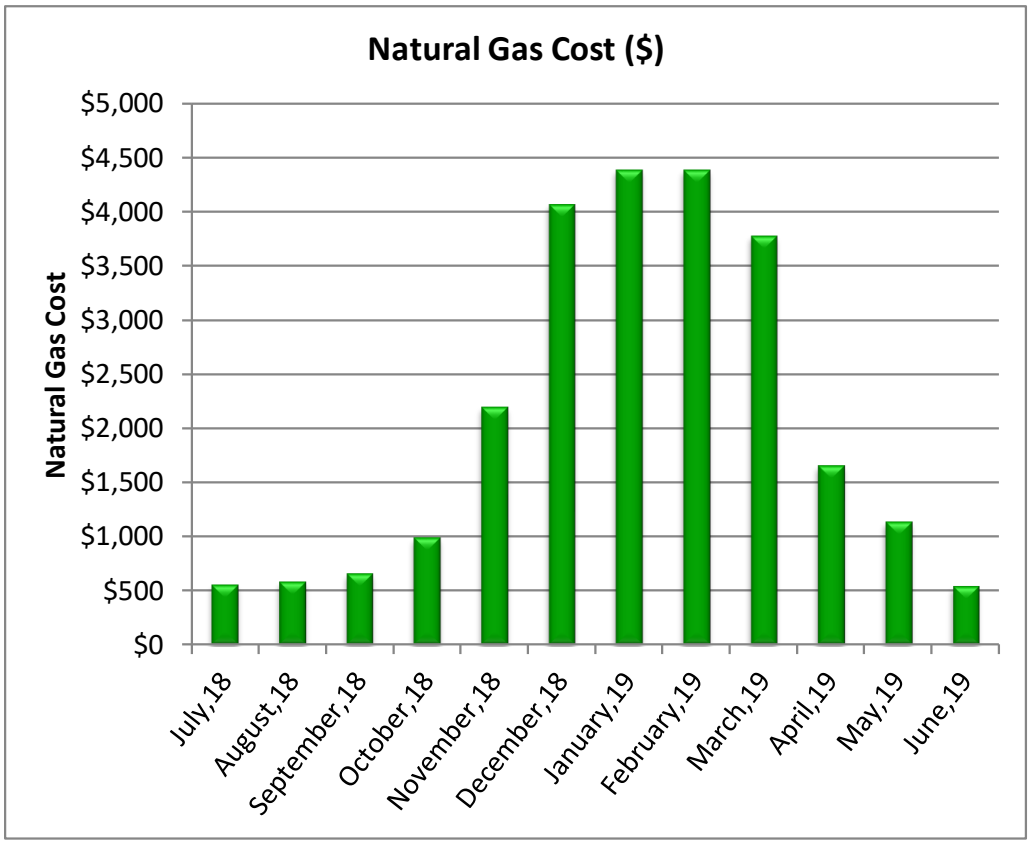
4.2. Natural Gas

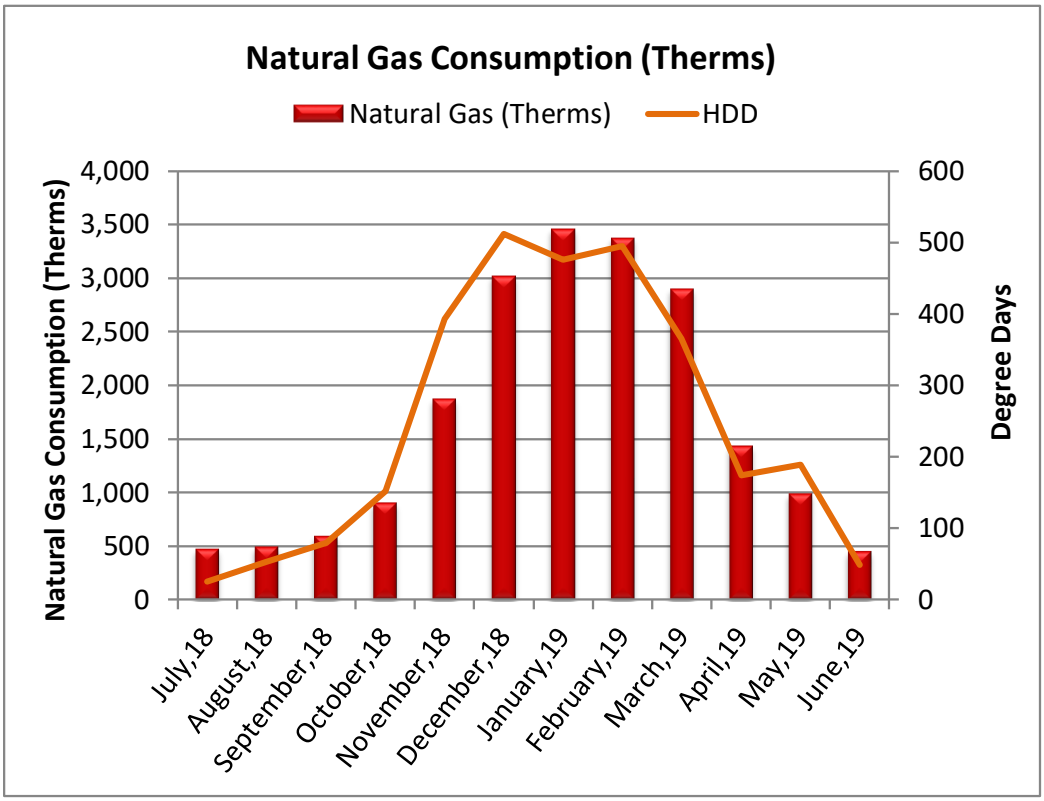
PGE satisfies the natural gas requirements of the facility. The primary end use of natural gas is for building heating, domestic water heating, and cooking in the cafeteria.

The analysis of the 12 months of consumption is provided below.

Natural Gas Consumption and Cost Data

Billing Month	Natural gas Consumption (Therms)	Unit Cost/therm	Total Cost
July,18	472	$1.18	$557
August,18	496	$1.17	$582
September,18	598	$1.10	$659
October,18	904	$1.10	$994
November,18	1,873	$1.17	$2,196
December,18	3,024	$1.34	$4,066
January,19	3,463	$1.27	$4,388
February,19	3,377	$1.30	$4,390
March,19	2,900	$1.30	$3,774
April,19	1,434	$1.15	$1,653
May,19	989	$1.15	$1,135
June,19	454	$1.19	$538
Total	**19,983**	**$1.25**	**$24,930**


Natural Gas Cost ($)
Natural Gas Cost
$5,000
$4,500
$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19


Natural Gas Consumption (Therms)
Natural Gas (Therms)
HDD
Natural Gas Consumption (Therms)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
600
500
400
300
200
100
0
Degree Days
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

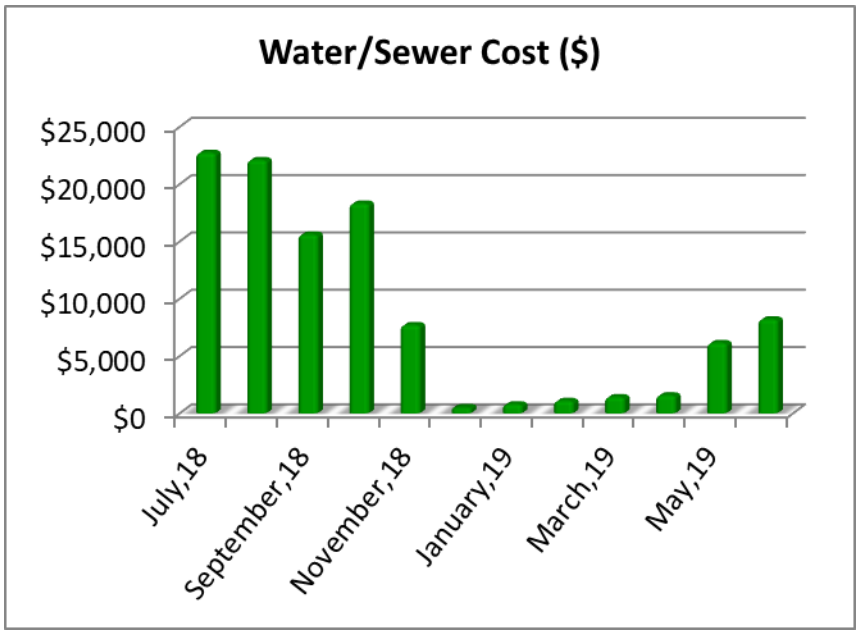
4.3. Water and Sewer

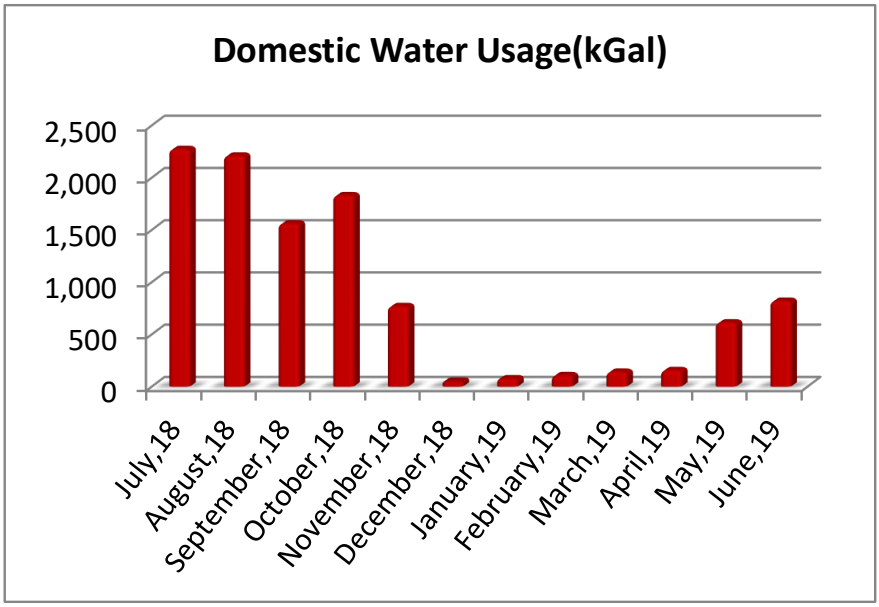
The City of Sacramento satisfies the water requirements for the facility. The primary end use of water is the plumbing fixtures such as staff showers, water closets, and lavatories. The table below provides the twelve continuous months' worth of consumption and cost for water in kGal for the facility.

Note: The utility rate was assumed to be at $10.00/kgal based on other similar sites within the school portfolio.

Water and Sewer Consumption and Cost Data

Billing Month	Consumption (kGal)	Unit Cost ($/kGal)	Total Cost
July,18	2,274	$10.00	$22,740
August,18	2,211	$10.00	$22,109
September,18	1,561	$10.00	$15,612
October,18	1,831	$10.00	$18,313
November,18	770	$10.00	$7,705
December,18	52	$10.00	$516
January,19	79	$10.00	$785
February,19	109	$10.00	$1,092
March,19	142	$10.00	$1,421
April,19	158	$10.00	$1,578
May,19	614	$10.00	$6,142
June,19	821	$10.00	$8,209
Total	**10,622**	**$10.00**	**$106,223**


Water/Sewer Cost ($)
$25,000
$20,000
$15,000
$10,000
$5,000
$0
July,18
September,18
November,18
January,19
March,19
May,19


Domestic Water Usage(kGal)
2,500
2,000
1,500
1,000
500
0
July,18
August,18
September,18
October,18
November,18
December,18
January,19
February,19
March,19
April,19
May,19
June,19

5. Renewable Energy Discussions

5.1. Rooftop Solar Photovoltaic Feasibility

Solar Energy Feasibility

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current electricity via the photovoltaic effect. The power that one module can produce is seldom enough to meet requirements of a home or a business, so the modules are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can plug into the existing infrastructure to power lights, motors, and other loads. The modules in a PV array are usually first connected in series to obtain the desired voltage; the individual strings are then connected in parallel to allow the system to produce more current. Solar arrays are typically measured by the peak electrical power they produce, in watts, kilowatts, or even megawatts.

When determining if a site is suitable for a solar application, two basic considerations must be evaluated:

- At minimum, the sun should shine upon the solar collectors from 9 AM to 3 PM. If less, the application may still be worthwhile, but the benefit will be less.
- The array should face south and be free of any shading from buildings, trees, rooftop equipment, etc. If the array is not facing directly south, there will be a penalty in transfer efficiency, reducing the overall efficiency of the system.

SOLAR PV QUESTIONNAIRE	RESPONSE
Does the property have a south, east, or west facing roof or available land of more than 250 square feet per required Solar Array Panel?	Yes
Is the area free from any shading such as trees, buildings, equipment etc. throughout the whole day?	Yes
Can the panels be mounted at an incline of roughly 25-45 degrees? (equal to latitude of property)	Yes
Is the property in an area with acceptable average monthly sunlight levels?	Yes
Has the roofing been replaced within the past 3-5 years?	No
Is the roof structure sufficient to hold solar panels?	Additional Study Required
Is the property located in a state eligible for net metering?	Yes

A solar feasibility analysis of the Will C. Wood Middle School site has resulted in the building containing more than sufficient amount of roof area for solar electricity generation. The analysis through the use of National Renewable Energy Laboratory's solar photovoltaic software assisted in calculating the potential electricity generated from the allocated land and roof area set for solar photovoltaic installment. The allocated roof area was through looking at the roof and surrounding areas at a bird's eye view. Also detailed in the report are incentives and rebates that can potentially bring down the installation cost of the ECMs and result in a higher return on investment and quicker payback period.

The approach taken in the solar photovoltaic (PV) roof analysis begins with surveying the roof and determine areas on the roof where solar PV panels can potentially be installed.

1) Conducting a preliminary sizing of solar PV panels on the roofs and on the ground and its potential electricity production for its first year of installment using the National Renewable Energy Laboratory (NREL) PV WATTS Version 2 Software.

2) Calculate energy and cost savings for the site as a sole proprietor of the system capable of collecting state, local, and federal tax credits and incentives and interconnecting and selling the renewable energy electrical production to the building.

SOLAR ROOFTOP PHOTOVOLTAIC ANALYSIS	
Estimated Number of Panels	903
Estimated KW Rating	284 KW
Potential Annual kWh Produced	438,463 kWh
% of Current Electricity Uses	
FINANCIAL SUMMARY	
Investment Cost	$995,400
Estimated Energy Cost Savings	$70,154
Payback without Incentives	14.2 Years
Incentive Payback but without SRECs	8.6 Years
Payback with All Incentives	8.6 Years

A photovoltaic array is a linked collection of photovoltaic modules, which are in turn made of multiple interconnected solar cells. The cells convert solar energy into direct current. Modules of cells are linked together to form an array. Most PV arrays use an inverter to convert the DC power produced by the modules into alternating current that can connect to existing AC infrastructure to power lights, motors, and other loads.

Cost of production has fallen years with increasing demand and through production and technological advances. The cost dropped from $8–10/watt in 1996 to $4–7/watt in 2006. The market is diversifying with new types of panels suited to unique installation methods including stick on sheets and PV spray coating. The solar PV cost used in the analysis was set at $7.0/Watt which includes design, construction, administration, and installation and maintenance cost throughout the life of the solar panels.

One breakthrough for PV is “Net Metering”. When more PV electric power is generated than is consumed on site, the electric service meter reverses to “sell” the excess power directly back onto the power grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

A kilowatt-hour costing $0.15 might be valued at $0.30 when produced by PV and sent to the grid. The economics of PV for commercial industrial installations become attractive when coupled with incentives from Federal and state agencies, as well utility companies.

The low payback period is highly dependent on the marketing potential of selling Solar Renewable Certificates to electricity generated providers who are under state regulations to contain a certain percentage of their electricity generation derived from renewable energy such as wind and solar.

Solar facilities are encouraged to sell their SRECs on the market (either spot market or through long-term contracts). Utilities may use SRECs for compliance under the state RPS for the year in which they are generated. Utilities may purchase up to 10% more SRECs than they require for compliance and "bank" those surplus SRECs for compliance during the following two years. Any SRECs pricing can range from $300 - $450/MWh and can be sold across state borders to other utility providers looking to purchase SRECs. EMG has selected to use the market value of $300/MWh minus 5% administrative fee in the analysis.

A number of states and corresponding electrical utility supplier are required under regulation to have a certain percentage of its electricity be produced by solar energy. To offset that they allow other utility companies to buy Renewable Energy Credits (REC) credit off their customers and facilities that produce their own solar energy. Typically, the national market, the utility market is $400 per MWh to Utility Suppliers for not meeting this standard percentage so these REC credits are sold for $350 per MWH. (1 REC credit = 1 MWH).

State charges these utility companies to meet their state compliance of 0.2% of the entire electricity consumption from solar energy by 2022 (from.005% in 2008 aggregated up to 0.2% by 2022). The REC credits correspond to these percentages as they aggregate each year.

6. Operations and Maintenance Plan

The quality of the maintenance and the operation of the facility's energy systems have a direct effect on its overall energy efficiency. Energy-efficiency needs to be a consideration when implementing facility modifications, equipment replacements, and general corrective actions. The following is a list of activities that should be performed as part of the routine maintenance program for the property.

Building Envelope

- ✓ Ensure that the building envelope has proper caulking and weather stripping.
- ✓ Patch holes in the building envelope with foam insulation and fire rated caulk around combustion vents
- ✓ Inspect building vents semiannually for bird infestation
- ✓ Inspect windows monthly for damaged panes and failed thermal seals
- ✓ Repair and adjust automatic door closing mechanisms as needed.

Heating and Cooling

- ✗ Pilots lights on furnaces and boilers be turned off in summer
- ✓ All preventive maintenance should be performed on all furnaces and boilers, which would include cleaning of burners and heat exchanger tubes.
- ✓ Ensure that the combustion vents exhaust outside the conditioned space and the vent dampers are functional
- ✓ Ensure that the control valves are functioning properly before start of every season
- ✗ Ensure steam traps are functional before start of each heating season
- ✗ Ensure use of chemical treatment for boiler make up water
- ✗ Ensure boiler outside temperature re-set is set to 55F
- ✗ Ensure use of chemical treatment for Colling tower water to prevent corrosion
- ✓ Ensure the duct work in unconditioned space is un-compromised and well insulated
- ✓ Duct cleaning is recommended every 10 years. This should include sealing of ducts using products similar to 'aero-seal'
- ✓ Ensure use of economizer mode is functional and used
- ✓ Ensure that the outside air dampers actuators are operating correctly
- ✓ Ensure air coils in the AHU and FCA's are pressure washed annually
- ✓ Return vents should remain un-obstructed and be located centrally
- ✓ Temperature settings reduced in unoccupied areas and set points seasonally adjusted.
- ✓ Evaporator coils and condenser coils should be regularly cleaned to improve heat transfer
- ✓ Refrigerant pipes should be insulated with a minimum of ¾" thick Elastomeric Rubber Pipe Insulation
- ✓ Ensure refrigerant pressure is maintained in the condensers
- ✓ Change air filters on return vents seasonally. Use only filters with 'Minimum Efficiency Rating Value'(MERV) of 8

Central Domestic Hot Water Heater

- ✓ Never place gas fired water heaters adjacent to return vents so as to prevent flame roll outs
- ✓ Ensure the circulation system is on timer to reduce the losses through re-circulation
- ✓ Ensure all hot water pipes are insulated with fiberglass insulation at all times
- ✓ Replacement water heater should have Energy Factor (EF)>0.9
- ✗ Tank-type water heaters flushed monthly

Lighting Improvements

- ✓ Utilize bi-level lighting controls in stairwells and hallways.
- ✓ Use LED replacement lamps
- ✓ Clean lighting fixture reflective surfaces and translucent covers.
- ✓ Ensure that timers and/or photocells are operating correctly on exterior lighting
- ✓ Use occupancy sensors for offices and other rooms with infrequent occupancy

Existing Equipment and Replacements

- ✓ Ensure that refrigerator and freezer doors close and seal correctly
- ✓ Ensure kitchen and bathroom exhaust outside the building and the internal damper operates properly
- ✓ Ensure that bathroom vents exhaust out
- ✓ Office/ computer equipment either in the “sleep” or “off” mode when not used

7. Appendices

APPENDIX A: Glossary of Terms

APPENDIX B: Mechanical Equipment Inventory

APPENDIX C: Lighting System Schedule

APPENDIX D: ECM Checklist

APPENDIX E: ECM Calculations

APPENDIX F: Solar PV

APPENDIX A:
Glossary of Terms

Glossary of Terms and Acronyms

ECM – Energy Conservation Measures are projects recommended to reduce energy consumption. These can be No/Low cost items implemented as part of routine maintenance or Capital Cost items to be implemented as a capital improvement project.

Initial Investment – The estimated cost of implementing an ECM project. Estimates typically are based on R.S. Means Construction cost data and Industry Standards.

Annual Energy Savings – The reduction in energy consumption attributable to the implementation of a particular ECM. These savings values do not include the interactive effects of other ECMs.

Cost Savings – The expected reduction in utility or energy costs achieved through the corresponding reduction in energy consumption by implementation of an ECM.

Simple Payback Period –The number of years required for the cumulative value of energy or water cost savings less future non-fuel or non-water costs to equal the investment costs of the building energy or water system, without consideration of discount rates.

EUL – Expected Useful Life is the estimated lifespan of a typical piece of equipment based on industry accepted standards.

RUL – Remaining Useful Life is the EUL minus the effective age of the equipment and reflects the estimated number of operating years remaining for the item.

SIR - The savings-to-investment ratio is the ratio of the present value savings to the present value costs of an energy or water conservation measure. The numerator of the ratio is the present value of net savings in energy or water and non-fuel or non-water operation and maintenance costs attributable to the proposed energy or water conservation measure. The denominator of the ratio is the present value of the net increase in investment and replacement costs less salvage value attributable to the proposed energy or water conservation measure. It is recommended that energy-efficiency recommendations be based on a calculated SIR, with larger SIRs receiving a higher priority. A project typically is recommended only if the SIR is greater than or equal to 1.0, unless other factors outweigh the financial benefit.

Life Cycle Cost - The sum of the present values of (a) Investment costs, less salvage values at the end of the study period; (b) Non-fuel operation and maintenance costs: (c) Replacement costs less salvage costs of replaced building systems; and (d) Energy and/or water costs.

Life Cycle Savings – The sum of the estimated annual cost savings over the EUL of the recommended ECM, expressed in present value dollars.

Building Site Energy Use Intensity - The sum of the total site energy use in thousands of Btu per unit of gross building area. Site energy accounts for all energy consumed at the building location only not the energy consumed during generation and transmission of the energy to the site.

Building Source Energy Use Intensity – The sum of the total source energy use in thousands of Btu per unit of gross building area. Source energy is the energy consumed during generation and transmission in supplying the energy to your site.

Building Cost Intensity - This metric is the sum of all energy use costs in dollars per unit of gross building area.

Greenhouse Gas Emissions - Although there are numerous gases that are classified as contributors to the total for Greenhouse Emissions, the scope of this energy audit focuses on carbon dioxide (CO_2). Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement).

APPENDIX B:
Mechanical Equipment Inventory

Mechanical Inventory						
System	Make	Model	Serial Number	Input Capacity	Location	Location- Floor
Domestic Boiler	Ajax Boiler, Inc.	B15G	63037	1,200 MBH	Will C. Wood Middle School / 00E Classrooms I22-I26	Boiler room, 00E-B001
Domestic Boiler	Ajax Boiler, Inc.	B15G	62006	1,200 MBH	Will C. Wood Middle School / 00E Classrooms I22-I26	Boiler room, 00E-B001
Domestic Circulation/Booster Pump	Chicago Pump Co.	Illegible	Illegible	7.5 HP	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Custodial room, S09B
Water Heater	A. O. Smith	DVE 52 917	MF98-0749901-917	50 GAL (54 KW)	Will C. Wood Middle School / 00B Admin, Classrooms	Restrooms
Water Heater	A. O. Smith	EES 30 915	GF95-2333739-S06	30 GAL	Will C. Wood Middle School / 00G Classrooms M27-M29	Utility closet
Water Heater	Rheem / Ruud	ELD40-B	Q471435369A	40 GAL	Will C. Wood Middle School / 00B Admin, Classrooms	Utility closet
Water Storage Tank	Ajax Boiler, Inc.	SW2405	24235	140 GAL	Will C. Wood Middle School / 00E Classrooms I22-I26	Boiler room, 00E-B001
Air Compressor	Champion	OEH418	123792	3 HP	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22-I26
Condensing Unit/Heat Pump	Trane	2TTB2060A1000AA	31226B73F	5 TON	Will C. Wood Middle School / 00G Classrooms M27-M29	00M Classrooms M27-M29
Condensing Unit/Heat Pump	Trane	2TTB2060A1000AA	31226F73F	5 TON	Will C. Wood Middle School / 00G Classrooms M27-M29	00M Classrooms M27-M29
Condensing Unit/Heat Pump	Trane	2TTB2060A1000AA	31522753F	5 TON	Will C. Wood Middle School / 00G Classrooms M27-M29	00M Classrooms M27-M29
Ductless Split System	United Technologies Carrier	38AN012320	5204Y21101	1 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22-I26
Ductless Split System	Mitsubishi	MUY-GL12NA	81C13921	1 TON	Will C. Wood Middle School / 00B Admin, Classrooms	Site-canopy roof
Make-Up Air Unit	Reznor	HCRGB300	EBCH66J8NO8098	12,000 CFM	Will C. Wood Middle School / 00F MPR, Kitchen	Roof
Exhaust Fan	Jenn-Aire	40 HRV		No tag/plate found	Will C. Wood Middle School / 00E Classrooms I22-I26	Roof
Exhaust Fan	Jenn-Aire	27 3CK		No tag/plate found	Will C. Wood Middle School / 00E Classrooms I22-I26	Roof
Exhaust Fan	Greenheck	G-121-AX-QD	03627400	2,001 CFM	Will C. Wood Middle School / 00C Classrooms H18-21	Roof
Exhaust Fan	Greenheck	6-121-AX-QD	03618608	2,001 CFM	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Exhaust Fan	Greenheck	6-121-AX-QD	03618602		Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Exhaust Fan	Greenheck	6-121-AX-QD	03618601		Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Exhaust Fan	Greenheck	G-121-AX-QD	03618603	2001 CFM	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Exhaust Fan	Greenheck	6-141-BX-QD	03H16801	2,001 CFM	Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Exhaust Fan	Greenheck	6-141-BX-QD	03H16803		Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Exhaust Fan	Greenheck	6-141-BX-QD	03H16796	2,001 CFM	Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Exhaust Fan	Greenheck	095-DGEX-QD	03H19630	CFM	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Exhaust Fan	Greenheck	6-095-DGEX-QD	03H19633	2,001 CFM	Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Furnace	Trane	Inaccessible	Inaccessible		Will C. Wood Middle School / 00G Classrooms M27-M29	Classroom 27
Furnace	Trane	TUX080C960D307	4091LS17G	80 MBH	Will C. Wood Middle School / 00G Classrooms M27-M29	00M Classrooms M27-M29
Furnace	Trane	TUX080C960D307	4091LS37G	80 MBH	Will C. Wood Middle School / 00G Classrooms M27-M29	00M Classrooms M27-M29
Heat Pump	Bard	HH421-A05VP4XXX	126D082484599-02	3.5 TON	Will C. Wood Middle School / P07-P09 Classroom BG7, BG8	BG7
Heat Pump	Bard	WH421-A05VP4XXX	126D082484591-02	3.5 TON	Will C. Wood Middle School / P07-P09 Classroom BG7, BG8	BG8
Heat Pump	Bard	WH421-A05VP4XXX	126J011657268-02	3.5 TON	Will C. Wood Middle School / P07-P09 Classroom BG7, BG8	Headstart
Heat Pump	Bard	WH421-A05UP48XX	126D082484600-02	3.5 TON	Will C. Wood Middle School / P07-P09 Classroom BG7, BG8	Headstart

Mechanical Inventory						
System	Make	Model	Serial Number	Input Capacity	Location	Location- Floor
Heat Pump	MarvAir	VAI36HPA-05N0-GYF95	303	3 Ton	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	BG1
Heat Pump	MarvAir	VAI36HPA-05N0-GYF95	300	3 Ton	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	BG2
Heat Pump	MarvAir	VAI36HPA05N-2000	HF4304	3 Ton	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	BG6
Heat Pump	Illegible	Illegible	Illegible	No tag/plate found	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	P01-P06 Classrooms BG-4
Heat Pump	Illegible	Illegible	Illegible	3.5 Ton	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	P01-P06 Classrooms BG-5
Heat Pump	Bard	WH361-A00VP4XXX	125J082535809-02	3 TON	Will C. Wood Middle School / P01-P06 Classrooms BG1-BG6	P01-P06 Classrooms BG-3
Packaged Unit (RTU)	Aaon, Inc.	RK-30-3-EO-212	200307-AKGS50275	30 TON	Will C. Wood Middle School / 00F MPR, Kitchen	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-04-3-E0-222	200309-AKGC50171	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-04-3-E0-222	200309 AKGC50168	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-04-3-E0-222	200309 AKGC50174	4 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	Illegible	Illegible	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-04-3-E0-222	200309 AKGC50170	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-004-E0-222	200309-AKGC50175	4 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-04-3-E0-222	200309-AKGC50169	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-05-3-E0-222:	200309-AKGD50162	4 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK 0503 E0-222	200309-AKGD50165	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-05-3-00-232	200309-AKGD50194	5 TON	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Packaged Unit (RTU)	Aaon, Inc.	RK-06-3-E0222	200309-AKGD50156	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-05-3-00- 232	200309-AKGD50195	5 TON	Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Packaged Unit (RTU)	Aaon, Inc.	RK 10 3-00 332	200309-AKGJ50133	5 TON	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Packaged Unit (RTU)	Aaon, Inc.	AK-05-3-EO-222	200309-AKGD50163	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-05-3-E0-222	200309 AKGD50164	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-06-3-E0-222	200309 AKGE50187	6 TON	Will C. Wood Middle School / 00C Classrooms H18-21	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-06-3-E0-222	20030-AKGE58185	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-06-3-EO-222	200309-AKGE50176	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-06 5-EO-222	200309 AKGE50198	6 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	Roof
Packaged Unit (RTU)	Aaon, Inc.	AK-06-3-EQ-222	200309 AKGES0173	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	Aaon, Inc.	RK-08-3-E0-212	200309-AKGH50131	8 TON	Will C. Wood Middle School / 00C Classrooms H18-21	Roof
Packaged Unit (RTU)	Aaon, Inc.	NK-08-3-E0-212	200309-AKGH50135	8 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	Roof
Packaged Unit (RTU)	Aaon, Inc.	RK-08-3-E0-212	200309-AKGH50136	8 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	Roof
Packaged Unit (RTU)	Aaon, Inc.	Rk-06-3-E0-222	200309A...	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance, Classrooms 2-Story
Packaged Unit (RTU)	AAON, Inc.	47696	200309-AKGD50183	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 202
Packaged Unit (RTU)	AAON, Inc.	47702	200309-AKGD50182	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 203
Packaged Unit (RTU)	AAON, Inc.	47704	200309-AKGE50180	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 204
Packaged Unit (RTU)	AAON, Inc.	47699	200309-AKGC50178	4 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 205

Mechanical Inventory						
System	Make	Model	Serial Number	Input Capacity	Location	Location- Floor
Packaged Unit (RTU)	AAON, Inc.	47704	200309-AKGE50184	6 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Attendance
Packaged Unit (RTU)	AAON, Inc.	K-10-3-00-332	200309-AKGJ50134	10 Ton	Will C. Wood Middle School / 00D Gymnasium	Roof boys locker
Packaged Unit (RTU)	AAON, Inc.	47718	200309-AKGB50199	3 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22B
Packaged Unit (RTU)	AAON, Inc.	47711	200309-AKGN50255	20 TON	Will C. Wood Middle School / 00D Gymnasium	Roof girls locker
Packaged Unit (RTU)	Aaon, Inc.	RK-20-3-00-322	200309-AKGN50256	20 Ton	Will C. Wood Middle School / 00D Gymnasium	Gymnasium
Packaged Unit (RTU)	AAON, Inc.	47695	200309-AKGD50190	5 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22A
Packaged Unit (RTU)	AAON, Inc.	47697	200309-AKGC50191	4 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22B
Packaged Unit (RTU)	AAON, Inc.	47718	Illegible	6 TON	Will C. Wood Middle School / 00E Classrooms I22-I26	00E Classrooms I22B
Packaged Unit (RTU)	AAON, Inc.	47695 RK-05-3-EQ-222	200309-AKGD50159	5 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	00A Library 1
Packaged Unit (RTU)	AAON, Inc.	47695 RK-05-3-EQ-222	200309-AKGD50160	5 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	00A Library 2
Packaged Unit (RTU)	Aaon, Inc.	RK-05-3-E0-222	200309-AKGD50193	5 TON	Will C. Wood Middle School / 00F MPR, Kitchen	Roof
Packaged Unit (RTU)	AAON, Inc.	47707	200309-AKGB50192	3 TON	Will C. Wood Middle School / 00F MPR, Kitchen	Roof
Packaged Unit (RTU)	AAON, Inc.	47707	200309-AKGB50191	3 TON	Will C. Wood Middle School / 00F MPR, Kitchen	Roof
Packaged Unit (RTU)	AAON, Inc.	47695	200309-AKGD50181	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 1
Packaged Unit (RTU)	AAON, Inc.	47695 RK-05-3-06-222	200309-AKGD50158	5 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	Roof
Packaged Unit (RTU)	AAON, Inc.	47696	200309-AKGD50167	5 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	00A Classroom 11
Packaged Unit (RTU)	AAON, Inc.	47695 RK-05-3-EQ-222	200309-AKGD50161	5 TON	Will C. Wood Middle School / 00A Library, Classrooms 4-14	00A Classroom 14
Packaged Unit (RTU)	AAON, Inc.	47702	200309-AKGD50179	5 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 2
Packaged Unit (RTU)	AAON, Inc.	47697	200309-AKGC50177	4 TON	Will C. Wood Middle School / 00B Admin, Classrooms	00B Classroom 3
Packaged Unit (RTU)	AAON, Inc.	47698	200309-AKGE50188	6 TON	Will C. Wood Middle School / 00C Classrooms H18-21	00C Classrooms H18-21
Packaged Unit (RTU)	AAON, Inc.	47698	200309-AKGE50189	6 TON	Will C. Wood Middle School / 00C Classrooms H18-21	00C Classrooms H18-21
Packaged Unit (RTU)	AAON, Inc.	47717	200309-AKGK50132	13 TON	Will C. Wood Middle School / 00F MPR, Kitchen	Roof

APPENDIX C:
Lighting System Schedule

									Lamp Details				Fixture Details				Existing Consumption	
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	LUX	Control Quantity	Existing Control	Technology	Sub-Technology	Lamp Type	Total Lamps	Fixture Type	Fixture Quantity	24x7 Fixture Count	Fixture Height	Annual Hours	Existing Annual kWh
1	00G	Interior	1	ESTROOM - PRIVAT	T29B	115	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	12	1,110	142
2	00G	Interior	1	CLASSROOM	WM27	476	9	Light Switch	Linear Fluorescent	T8	4' 32W T8	54	Industrial	9	0	12	1,480	2,557
3	00G	Interior	1	CLASSROOM	WM27	476	9	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	Industrial	6	0	12	1,480	3,410
4	00G	Interior	1	CLASSROOM	WM27	476	9	Light Switch	Linear Fluorescent	T8	4' 32W T8	216	Industrial	12	0	12	1,480	10,230
5	00F	Interior	1	CAFETERIA	U015	390	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	201	2x4 Prism Troffer	67	0	16	1,480	9,519
6	00F	Interior	1	CAFETERIA	U015	390	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	9	2x4 Prism Troffer	3	0	19	1,480	426
7	00F	Interior	1	ESTROOM - PRIVAT	T001	228	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	1,110	71
8	00F	Interior	1	OPEN OFFICE	D013	268	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	9	1,480	379
9	00F	Interior	1	OFFICE	I014	400	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	6	0	9	1,480	568
10	00F	Interior	1	OFFICE	C001	172	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	1x4 Prism Troffer	12	0	10	1,480	1,137
11	00E	Interior	1	MECHANICAL	B001	213	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	36	1x4 Prism Troffer	18	0	12	925	1,066
12	00B	Interior	1	OPEN OFFICE	C002	296	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	9	1,480	379
13	00B	Interior	1	OPEN OFFICE	C002	296	1	Wall-Mounted Sensor	CFL	CFL - 4 Pin	CFL26	1	Surface Mount Can	1	0	8	1,480	38
14	00B	Interior	1	OPEN OFFICE	C002	296	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	16	1x4 Prism Troffer	8	0	8	1,480	758
15	00B	Interior	1	OPEN OFFICE	C002	296	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	Industrial	4	0	9	1,480	379
16	00B	Interior	1	OFFICE	Principal	337	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Industrial	4	0	9	1,480	379
17	00B	Interior	1	HALLWAY	H024	500	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	9	1,480	379
18	00B	Interior	1	HALLWAY	C008	430	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	Industrial	1	0	9	1,480	379
19	00B	Interior	1	ESTROOM - PRIVAT	T020	250	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	1,480	379
20	00B	Interior	1	OPEN OFFICE	C013	293	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	Industrial	3	0	9	1,480	568
21	00B	Interior	1	OPEN OFFICE	C013	293	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	8	1,480	379
22	00B	Interior	1	OFFICE	C005	459	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	1,480	284
23	00B	Interior	1	OFFICE	C009	264	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	8	1,480	379
24	00B	Interior	1	OFFICE	C003	276	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	1,480	284
25	00B	Interior	1	OFFICE	C014	557	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	2x4 Prism Troffer	3	0	9	1,480	1,137
26	00B	Interior	1	OFFICE	C021	670	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	2x4 Prism Troffer	4	0	9	1,480	568
27	00B	Interior	1	OFFICE	C018	474	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	2x4 Prism Troffer	2	0	8	1,480	284
28	00B	Interior	1	CLASSROOM	O001	261	5	Light Switch	Linear Fluorescent	T8	4' 32W T8	270	Industrial	15	0	9	1,480	12,787
29	00A	Interior	1	CLASSROOM	O004	261	16	Light Switch	Linear Fluorescent	T8	4' 32W T8	432	Industrial	24	0	9	1,480	20,460
30	00A	Interior	1	CLASSROOM	O011B	718	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	Industrial	4	0	9	1,480	3,410
31	00A	Interior	1	CLASSROOM	S09A	180	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	Industrial	1	0	9	1,480	189
32	00A	Interior	1	LIBRARY	X012	479	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	126	Industrial	7	0	9	1,480	5,967
33	00B	Interior	1	RESTROOM	T001	342	2	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	24	1x4 Prism Troffer	12	0	9	1,480	1,137
34	00B	Interior	1	ESTROOM - PRIVAT	T003	-	2	Wall-Mounted Sensor	Linear Fluorescent	T5	2' 17W T5	2	1x4 Prism Troffer	2	0	8	925	31
35	00B	Interior	1	CLASSROOM	O017	300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	6	Industrial	3	0	9	1,480	284
36	00B	Interior	1	CLASSROOM	O017	300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	Industrial	2	0	9	1,480	758
37	00B	Interior	1	CLASSROOM	O017	300	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	12	Industrial	1	0	9	1,480	568
38	00D	Interior	1	LOCKER ROOM	R004	435	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	60	Surface Mount w Lense	15	0	14	1,480	2,842
39	00D	Interior	1	LOCKER ROOM	R004	435	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	28	Surface Mount w Lense	14	0	14	1,480	1,326
40	00D	Interior	1	LOCKER ROOM	R004	435	2	Timer	LED	-	-	6	Flood Light	3	0	9	1,480	-
41	00D	Interior	1	OFFICE	C001	128	1	Wall-Mounted Sensor	Linear Fluorescent	T5	2' 17W T5	4	Surface Mount w Lense	2	0	8	1,480	101
42	00D	Interior	1	LOCKER ROOM	T002	285	2	Wall-Mounted Sensor	Linear Fluorescent	T5	2' 17W T5	8	Surface Mount w Lense	4	0	8	1,480	201
43	00D	Interior	1	OFFICE	C017	325	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	8	1,480	189
44	00D	Interior	1	LOCKER ROOM	R018	361	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	92	Surface Mount w Lense	23	0	14	1,480	4,357
45	00D	Interior	1	LOCKER ROOM	R018	361	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	26	Surface Mount w Lense	13	0	14	1,480	1,231
46	00D	Interior	1	LOCKER ROOM	R018	361	2	Timer	LED	-	-	8	Flood Light	4	0	9	1,480	-
47	00D	Interior	1	GYMNASIUM	G001	736	2	Timer	Linear Fluorescent	T8	4' 32W T8	100	Industrial	25	0	22	1,480	4,736
48	00D	Interior	1	GYMNASIUM	G001	736	2	Timer	LED	-	-	6	Flood Light	3	0	10	1,480	-
49	00D	Interior	1	GYMNASIUM	V002	262	2	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	48	Industrial	12	0	23	1,480	2,273
50	00D	Interior	1	STORAGE	J006	138	1	Wall-Mounted Sensor	Linear Fluorescent	T5	4' 28W T5	1	Strip Fixture	1	0	8	1,480	41
51	00C	Interior	1	CLASSROOM	OH20	147	4	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	324	Industrial	12	0	9	1,480	15,345
52	00C	Interior	1	RESTROOM	Restroom	344	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	1,480	95
53	00C	Interior	1	STORAGE	S018	331	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	4	0	9	1,480	379
54	00E	Interior	1	LIBRARY	O122	185	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	16	2x4 Prism Troffer	8	0	11	1,480	758
55	00E	Interior	1	ESTROOM - PRIVAT	T002	110	1	Timer	Linear Fluorescent	T5	2' 17W T5	1	Surface Mount w Lense	1	0	9	925	16
56	00E	Interior	1	ESTROOM - PRIVAT	T002	110	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	10	925	118
57	00E	Interior	1	CLASSROOM	N124	331	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	288	2x4 Prism Troffer	96	0	11	1,480	13,640
58	00F	Interior	1	KITCHEN	K008	455	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	4	1x4 Prism Troffer	2	0	10	1,480	189
59	00F	Interior	1	KITCHEN	K008	455	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	104	1x4 Prism Troffer	26	0	10	1,480	4,925

60	00F	Interior	1	OFFICE	C008	310	1	Wall-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	2	1x4 Prism Troffer	1	0	9	1,480	95
61	P03	Interior	1	ESTROOM - PRIVAT	T001	232	1	Light Switch	Linear Fluorescent	T8	4' 32W T8	2	2x4 Prism Troffer	1	0	9	1,480	95
62	P03	Interior	1	RESTROOM	T003	236	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	8	2x4 Prism Troffer	4	0	9	1,480	379
63	P04	Interior	1	CLASSROOM	O0B8	-	4	Light Switch	Linear Fluorescent	T8	4' 32W T8	72	2x4 Prism Troffer	24	0	9	1,480	3,410
64	Healthy Start	Interior	1	OPEN OFFICE	Healthy Start	490	2	Light Switch	Linear Fluorescent	T8	4' 32W T8	30	2x4 Prism Troffer	10	0	9	1,480	1,421
65	Healthy Start	Interior	1	OFFICE	Office	383	8	Light Switch	Linear Fluorescent	T8	4' 32W T8	24	2x4 Prism Troffer	8	0	9	1,480	1,137
66	P01	Interior	1	CLASSROOM	O0B1	280	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	90	2x4 Prism Troffer	45	0	9	1,480	4,262
67	P02	Interior	1	CLASSROOM	O0B6	231	6	Light Switch	Linear Fluorescent	T8	4' 32W T8	90	2x4 Prism Troffer	45	0	9	1,480	4,262
68	00B	Interior	2	CLASSROOM	O201	412	12	Light Switch	Linear Fluorescent	T8	4' 32W T8	432	Industrial	24	0	9	1,480	20,460
69	00B	Interior	1	CLASSROOM	O025	262	3	Light Switch	Linear Fluorescent	T8	4' 32W T8	162	Industrial	9	0	9	1,480	7,672
70	00B	Interior	2	RESTROOM	T202	335	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	12	1x4 Prism Troffer	3	0	9	1,480	568
71	00B	Interior	2	ESTROOM - PRIVAT	T203	101	1	Light Switch	Linear Fluorescent	T5	2' 17W T5	1	Surface Mount w Lense	1	0	9	1,480	25
72	00B	Interior	2	RESTROOM	T201	294	1	Ceiling-Mounted Sensor	Linear Fluorescent	T8	4' 32W T8	8	1x4 Prism Troffer	2	0	9	1,480	379
73	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH450	1	Wallpack-Horizontal	1	0	12	2,220	999
74	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH450	2	Wallpack-Horizontal	2	0	9	2,220	1,998
75	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	Incan/H/MR	Incan	I75-A19	12	Jelly Jar-vert	12	0	7	2,220	1,998
76	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	CFL	CFL - 4 Pin	CFL26	3	Surface Mount Can	3	0	11	2,220	173
77	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	CFL	CFL - 4 Pin	CFL26	42	Surface Mount Can	42	0	10	2,220	2,424
78	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH450	2	Wallpack-Horizontal	2	0	11	2,220	1,998
79	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH450	1	Wallpack-Horizontal	1	0	15	2,220	999
80	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH100	5	Surface Mount	5	0	22	2,220	1,110
81	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH100	5	Surface Mount	5	0	9	2,220	1,110
82	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	Incan/H/MR	Incan	I75-A19	3	Jelly Jar-vert	3	0	8	2,220	500
83	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH250	2	Wallpack-Horizontal	2	0	16	2,220	1,110
84	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL26	65	Surface Mount Can	65	0	8	2,220	3,752
85	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL26	4	Surface Mount Can	4	0	14	2,220	231
86	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	HID	MH	MH250	2	Wallpack-Horizontal	2	0	7	2,220	1,110
87	Exterior	Exterior	1	Exterior	Exterior	-	1	Timer	CFL	CFL - 2 Pin	CFL26	8	Surface Mount Can	8	0	7	2,220	462
	Totals											3,981		872			136,900	198,951

								Fixture Details						Existing Consumption				Proposed- Post Retrofit				
Line No.	Building Name	Interior/ Exterior	Floor	Space Type	Room No.	Existing Control	Control Quantity	Technology	Sub-Technology	Lamp- Fixture	Fixture Quantity	Total Lamps	Fixture Height	Annual Hours	Existing Annual kWh	ECM	ECM Type	Recommended Sensor	LED Lamp Retrofit	Annual Hours of Operation	Proposed Annual kWh	Annual Savings From LED Retrofit
																						kWh
1	00G	Interior	1	RESTROOM - PRIVATE	T29B	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	12	1,110	142	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,110	75	67
2	00G	Interior	1	CLASSROOM	WM27	Light Switch	9	Linear Fluorescent	T8	4' 32W T8; Industrial	9	54	12	1,480	2,557	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	1,359	1,199
3	00G	Interior	1	CLASSROOM	WM27	Light Switch	9	Linear Fluorescent	T8	4' 32W T8; Industrial	6	72	12	1,480	3,410	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	1,812	1,598
4	00G	Interior	1	CLASSROOM	WM27	Light Switch	9	Linear Fluorescent	T8	4' 32W T8; Industrial	12	216	12	1,480	10,230	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	5,435	4,795
5	00F	Interior	1	CAFETERIA	U015	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	67	201	16	1,480	9,519	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	5,057	4,462
6	00F	Interior	1	CAFETERIA	U015	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	9	19	1,480	426	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	226	200
7	00F	Interior	1	RESTROOM - PRIVATE	T001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	1,110	71	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,110	38	33
8	00F	Interior	1	OPEN OFFICE	D013	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
9	00F	Interior	1	OFFICE	I014	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	6	12	9	1,480	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	302	266
10	00F	Interior	1	OFFICE	C001	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	12	24	10	1,480	1,137	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	604	533
11	00E	Interior	1	MECHANICAL	B001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	18	36	12	925	1,066	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	925	566	500
12	00B	Interior	1	OPEN OFFICE	C002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
13	00B	Interior	1	OPEN OFFICE	C002	Wall-Mounted Sensor	1	CFL	CFL - 4 Pin	CFL26; Surface Mount Can	1	1	8	1,480	38			Retain Existing Controls				
14	00B	Interior	1	OPEN OFFICE	C002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	8	16	8	1,480	758	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	403	355
15	00B	Interior	1	OPEN OFFICE	C002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; Industrial	4	8	9	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
16	00B	Interior	1	OFFICE	Principal	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	4	8	9	1,480	379	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	201	178
17	00B	Interior	1	HALLWAY	H024	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	201	178
18	00B	Interior	1	HALLWAY	C008	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	1	8	9	1,480	379	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	201	178
19	00B	Interior	1	RESTROOM - PRIVATE	T020	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
20	00B	Interior	1	OPEN OFFICE	C013	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; Industrial	3	12	9	1,480	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	302	266
21	00B	Interior	1	OPEN OFFICE	C013	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
22	00B	Interior	1	OFFICE	C005	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	8	1,480	284	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	151	133
23	00B	Interior	1	OFFICE	C009	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	8	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
24	00B	Interior	1	OFFICE	C003	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	8	1,480	284	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	151	133
25	00B	Interior	1	OFFICE	C014	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	3	24	9	1,480	1,137	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	604	533
26	00B	Interior	1	OFFICE	C021	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	12	9	1,480	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	302	266
27	00B	Interior	1	OFFICE	C018	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	2	6	8	1,480	284	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	151	133
28	00B	Interior	1	CLASSROOM	O001	Light Switch	5	Linear Fluorescent	T8	4' 32W T8; Industrial	15	270	9	1,480	12,787	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	6,793	5,994
29	00A	Interior	1	CLASSROOM	O004	Light Switch	16	Linear Fluorescent	T8	4' 32W T8; Industrial	24	432	9	1,480	20,460	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	10,869	9,590
30	00A	Interior	1	CLASSROOM	O011B	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	4	72	9	1,480	3,410	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	1,812	1,598
31	00A	Interior	1	CLASSROOM	S09A	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	1	4	9	1,480	189	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	101	89
32	00A	Interior	1	LIBRARY	X012	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Industrial	7	126	9	1,480	5,967	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	3,170	2,797
33	00B	Interior	1	RESTROOM	T001	Wall-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	12	24	9	1,480	1,137	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	604	533
34	00B	Interior	1	RESTROOM - PRIVATE	T003	Wall-Mounted Sensor	2	Linear Fluorescent	T5	2' 17W T5; 1x4 Prism Troffer	2	2	8	925	31	ECM	RB - Replace Bulb	Retain Existing Controls	2' 8W LED T5	925	15	17
35	00B	Interior	1	CLASSROOM	O017	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	3	6	9	1,480	284	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	151	133
36	00B	Interior	1	CLASSROOM	O017	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	2	16	9	1,480	758	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	403	355
37	00B	Interior	1	CLASSROOM	O017	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; Industrial	1	12	9	1,480	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	302	266
38	00D	Interior	1	LOCKER ROOM	R004	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Surface Mount w Lense	15	60	14	1,480	2,842	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	1,510	1,332
39	00D	Interior	1	LOCKER ROOM	R004	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Surface Mount w Lense	14	28	14	1,480	1,326	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	704	622
40	00D	Interior	1	LOCKER ROOM	R004	Timer	2	LED	-		3	6	9	1,480				Wall Mounted				
41	00D	Interior	1	OFFICE	C001	Wall-Mounted Sensor	1	Linear Fluorescent	T5	2' 17W T5; Surface Mount w Lense	2	4	8	1,480	101	ECM	RB - Replace Bulb	Retain Existing Controls	2' 8W LED T5	1,480	47	53
42	00D	Interior	1	LOCKER ROOM	T002	Wall-Mounted Sensor	2	Linear Fluorescent	T5	2' 17W T5; Surface Mount w Lense	4	8	8	1,480	201	ECM	RB - Replace Bulb	Retain Existing Controls	2' 8W LED T5	1,480	95	107
43	00D	Interior	1	OFFICE	C017	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	8	1,480	189	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	101	89
44	00D	Interior	1	LOCKER ROOM	R018	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Surface Mount w Lense	23	92	14	1,480	4,357	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,315	2,042
45	00D	Interior	1	LOCKER ROOM	R018	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; Surface Mount w Lense	13	26	14	1,480	1,231	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	654	577
46	00D	Interior	1	LOCKER ROOM	R018	Timer	2	LED	-		4	8	9	1,480				Wall Mounted				
47	00D	Interior	1	GYMNASIUM	G001	Timer	2	Linear Fluorescent	T8	4' 32W T8; Industrial	25	100	22	1,480	4,736	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,516	2,220
48	00D	Interior	1	GYMNASIUM	G001	Timer	2	LED	-		3	6	10	1,480				Wall Mounted				
49	00D	Interior	1	GYMNASIUM	V002	Ceiling-Mounted Sensor	2	Linear Fluorescent	T8	4' 32W T8; Industrial	12	48	23	1,480	2,273	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	1,208	1,066
50	00D	Interior	1	STORAGE	J006	Wall-Mounted Sensor	1	Linear Fluorescent	T5	4' 28W T5; Strip Fixture	1	1	8	1,480	41	ECM	RB - Replace Bulb	Retain Existing Controls	4' 15W LED T5	1,480	22	19
51	00C	Interior	1	CLASSROOM	OH20	Ceiling-Mounted Sensor	4	Linear Fluorescent	T8	4' 32W T8; Industrial	12	324	9	1,480	15,345	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	8,152	7,193
52	00C	Interior	1	RESTROOM	Restroom	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	1,480	95	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	50	44
53	00C	Interior	1	STORAGE	S018	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	201	178
54	00E	Interior	1	LIBRARY	O122	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	16	11	1,480	758	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	403	355
55	00E	Interior	1	RESTROOM - PRIVATE	T002	Timer	1	Linear Fluorescent	T5	2' 17W T5; Surface Mount w Lense	1	1	9	925	16	ECM	RB - Replace Bulb	Wall Mounted	2' 8W LED T5	925	7	8
56	00E	Interior	1	RESTROOM - PRIVATE	T002	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	10	925	118	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	925	63	56
57	00E	Interior	1	CLASSROOM	N124	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	96	288	11	1,480	13,640	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	7,246	6,394
58	00F	Interior	1	KITCHEN	K008	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	4	10	1,480	189	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	101	89
59	00F	Interior	1	KITCHEN	K008	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	26	104	10	1,480	4,925	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,617	2,309
60	00F	Interior	1	OFFICE	C008	Wall-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	1	2	9	1,480	95	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	50	44
61	P03	Interior	1	RESTROOM - PRIVATE	T001	Light Switch	1	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	1	2	9	1,480	95	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	50	44
62	P03	Interior	1	RESTROOM	T003	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	4	8	9	1,480	379	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	201	178
63	P04	Interior	1	CLASSROOM	O0B8	Light Switch	4	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	24	72	9	1,480	3,410	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	1,812	1,598
64	Healthy Start	Interior	1	OPEN OFFICE	Healthy Start	Light Switch	2	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	10	30	9	1,480	1,421	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	755	666
65	Healthy Start	Interior	1	OFFICE	Office	Light Switch	8	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	8	24	9	1,480	1,137	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	604	533
66	P01	Interior	1	CLASSROOM	O0B1	Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	45	90	9	1,480	4,262	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,264	1,998
67	P02	Interior	1	CLASSROOM	O0B6	Light Switch	6	Linear Fluorescent	T8	4' 32W T8; 2x4 Prism Troffer	45	90	9	1,480	4,262	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	2,264	1,998
68	00B	Interior	2	CLASSROOM	O201	Light Switch	12	Linear Fluorescent	T8	4' 32W T8; Industrial	24	432	9	1,480	20,460	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	10,869	9,590
69	00B	Interior	1	CLASSROOM	O025	Light Switch	3	Linear Fluorescent	T8	4' 32W T8; Industrial	9	162	9	1,480	7,672	ECM	RB - Replace Bulb	Wall Mounted	4' 17W LED T8	1,480	4,076	3,596
70	00B	Interior	2	RESTROOM	T202	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	3	12	9	1,480	568	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	302	266
71	00B	Interior	2	RESTROOM - PRIVATE	T203	Light Switch	1	Linear Fluorescent	T5	2' 17W T5; Surface Mount w Lense	1	1	9	1,480	25	ECM	RB - Replace Bulb	Wall Mounted	2' 8W LED T5	1,480	12	13
72	00B	Interior	2	RESTROOM	T201	Ceiling-Mounted Sensor	1	Linear Fluorescent	T8	4' 32W T8; 1x4 Prism Troffer	2	8	9	1,480	379	ECM	RB - Replace Bulb	Retain Existing Controls	4' 17W LED T8	1,480	201	178
73	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH450; Wallpack-Horizontal	1	1	12	2,220	999	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	155	844
74	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH450; Wallpack-Horizontal	2	2	9	2,220	1,998	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	311	1,687
75	Exterior	Exterior	1	Exterior	Exterior	Timer	1	Incan/H/MR	Incan	I75-A19; Jelly Jar-vert	12	12	7	2,220	1,998			Retain Existing Controls				
76	Exterior	Exterior	1	Exterior	Exterior	Timer	1	CFL	CFL - 4 Pin	CFL26; Surface Mount Can	3	3	11	2,220	173			Retain Existing Controls				
77	Exterior	Exterior	1	Exterior	Exterior	Timer	1	CFL	CFL - 4 Pin	CFL26; Surface Mount Can	42	42	10	2,220	2,424			Retain Existing Controls				
78	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH450; Wallpack-Horizontal	2	2	11	2,220	1,998	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	311	1,687
79	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH450; Wallpack-Horizontal	1	1	15	2,220	999	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	155	844
80	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH100; Surface Mount	5	5	22	2,220	1,110	ECM	RF - Replace Entire Fixture	Retain Existing Controls	40W LED Flood	2,220	444	666
81	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH100; Surface Mount	5	5	9	2,220	1,110	ECM	RF - Replace Entire Fixture	Retain Existing Controls	40W LED Flood	2,220	444	666
82	Exterior	Exterior	1	Exterior	Exterior	Timer	1	Incan/H/MR	Incan	I75-A19; Jelly Jar-vert	3	3	8	2,220	500			Retain Existing Controls				
83	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH250; Wallpack-Horizontal	2	2	16	2,220	1,110	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	311	799

84	Exterior	Exterior	1	Exterior	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL26; Surface Mount Can	65	65	8	2,220	3,752			Retain Existing Controls				
85	Exterior	Exterior	1	Exterior	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL26; Surface Mount Can	4	4	14	2,220	231			Retain Existing Controls				
86	Exterior	Exterior	1	Exterior	Exterior	Timer	1	HID	MH	MH250; Wallpack-Horizontal	2	2	7	2,220	1,110	ECM	RF - Replace Entire Fixture	Retain Existing Controls	70W LED Wallpack	2,220	311	799
87	Exterior	Exterior	1	Exterior	Exterior	Timer	1	CFL	CFL - 2 Pin	CFL26; Surface Mount Can	8	8	7	2,220	462			Retain Existing Controls				
	Totals											3,981									97,481	91,892

APPENDIX D:
ECM Checklist

NA	In Place	Evaluate	ECM Description
			Add Reflective Coating To Exterior Windows
		✓	Replace External Windows
✓			Upgrade Insulation
✓			Control External Air Leakage In Commercial Buildings
✓			Install Reflective Insulation Between Radiators And External Wall
✓			Replace Existing Motors With High Efficiency Motors
✓			Install On-Demand Ventilation on Air Handlers
		✓	Reduce HVAC Hours of Operation
✓			Install Variable Frequency Drives (VFD)
✓			Install Outside Air Temperature Reset Controls For Hot Water Boilers
✓			Install Chilled Water Reset Control
			Install Timers On Exhaust Fans
✓			Install Energy Savers on Vending, Snack Machines
✓			Install Building Energy Management System and Replace Terminal Units
✓			Re-Commission The Building & Its Control Systems
✓			Replace Inefficient Heating Plant
✓			Replace Inefficient Cooling Plant
	✓		Replace Existing Air Conditioners with Energy Star Air Conditioners
✓			Replace Unit Electric Heaters with Natural Gas Fired Unit Heaters
	✓		Convert From Gas Pilot to Electronic Ignition for Boilers
			Insulate Hot Water Pipes
	✓		Insulate Refrigerant Lines
	✓		Insulate Hot Surfaces And Tanks
	✓		Insulate Air Ducts
✓			Replace Defective Steam Traps
	✓		Upgrade Electric Heating System To Heat Pumps
	✓		Replace Inefficient Furnace System
		✓	Replace Rooftop Package Unit
	✓		Install Energy Recovery Wheel on Air Handling Unit
		✓	Replace Existing Water Heater With New Energy Efficient Units
		✓	Replace Incandescent/Halogen Lamps With Energy Efficient Lamps
		✓	Upgrade Inefficient Linear Fluorescent Lamps And Fixtures
			Upgrade EXIT SIGNS With LED EXIT Signs
		✓	Bilevel and Tandem Linear Fluorescent Lighting ECM
		✓	Replace High Intensity Discharge (HID) Lamps With Energy Efficienct Lamps
	✓		Replace Existing Refrigerator(s) With Energy Star Certified Refrigerator(s)
	✓		Replace Existing Freezers With High Efficiency Freezers
		✓	Install Low Flow Shower Heads
		✓	Install Low Flow Faucet Aerators
✓			Install Low Flow Restroom Flush Tank Toilets
		✓	Install Low Flow Tankless Restroom Fixtures

APPENDIX E:
ECM Calculations

UIC	Reduce HVAC Hours of Operation
EAC3	Location: Will C. Wood Middle School - All Buildings

No of Programmable Thermostats To Be Installed : 9 Qty.

Select Type of Programmable Thermostat Recommended: Centrally Controlled Thermostats For Multi-Unit Property -(BMS) *(Select)*
(Selection Based on Type of Property)

Heating Load Calculation

Select Type of Heating Fuel: Natural Gas *(Select)*

Estimated Current Annual Energy Consumption For Winter Heating: 10,000 Therms

	Weekdays	Weekends
Day Time Set Back Hours	4.00	9.00
Night Time Set Back Hours	8.00	8.00
Hours Without Set Back	12.00	7.00

Typical Indoor Temp	72.00	°F
Temp Set Point With Set Back During Day Time	69.00	°F
Temp Set Point With Set Back During Night Time	53.00	°F
Average Heating Set Point	64.99	°F
Savings Per Degree Set Back For Heating Season *(Industry Standard, 2004)*	3%	
Estimated Annual Heating Energy Consumption	1,000,000	kBtu
Estimated New Annual Heating Energy Consumption	789,643	kBtu
Estimated Annual Heating Energy Savings	2,104	Therms

Cooling Load Calculation

Select Type of Cooling Fuel: Electric *(Default)*

Estimated Current Annual Energy Consumption For Summer Cooling: 38,000 kWh

	Weekdays	Weekends
Day Time Set Back Hours	4.00	9.00
Night Time Set Back Hours	8.00	8.00
Hours Without Set Back	12.00	7.00

Typical Indoor Temp	74.00	°F
Temp Set Point With Set Back During Day Time	73.00	°F
Temp Set Point With Set Back During Night Time	93.00	°F
Average Cooling Set Point	80.11	°F
Savings Per Degree Set Back For Cooling Season *(Industry Standard, 2004)*	6%	
Estimated Annual Cooling Energy Consumption	129,656	kBtu
Estimated New Annual Cooling Energy Consumption	82,146	kbtu
Estimated Annual Cooling Energy Savings	13,924	kWh

Cost Analysis

Average Annual Cost of Heating Fuel:	$1.25	$/Therm	Estimated Installation Cost Per Thermostats: *(Includes Material, Labor & Installation Costs)* $1,070 $$
Average Annual Cost of Electricity:	$0.16	$/kWh	$14,373 $$
			Total Estimated Cost For All Programmable Thermostats
Estimated Annual Heating Cost Savings:	$2,624	$$	Total Estimated Cost Savings From All Programmable Thermostats $4,816
Estimated Annual Cooling Cost Savings:	$2,192	$$	Estimated Simple Pay Back Period 2.98 Yrs

Type of Recommendation: Capital Cost ECM Recommendation

ECM DESCRIPTION:

Turning off energy-consuming systems when they are not needed is the most basic energy conservation technique. When a building is occupied intermittently, energy savings can be realized by minimizing the time the heating or cooling system is operated when the building is closed. Building control algorithms should be implemented to delay startup until the last moment and to shut down as early as possible.
Because of the thermal inertia of both the building structure and its heating and cooling equipment, preheat or precool time is almost always required to raise or lower the space temperature to the desired level before the occupants return. This start-up time depends on the outdoor environment, the thermal response of the building, and the thermal performance of the space conditioning equipment. Similarly, the thermal inertia of the building maintains the indoor temperature at a comfortable level for a short period of time after the equipment is shut off. It allows the system to be turned off before the end of an occupied period. An optimum start/stop control accounts for these factors.

SUMMARY

Initial Investment: $14,373 Simple Payback Period: 2.98 Yrs
Annual Energy Cost Savings $4,816

UIC	Install Low Flow Shower Heads
EAP1	Location: Will C. Wood Middle School

Total Number of Shower Heads To Be Replaced		48	
No. of Shower Days/Year		37	
No. of Residents		768	
Estimated Time Per Shower		8.10	Mins
GPM of Existing Shower Head		1.8	GPM
GPM of Proposed Shower Head *	*(Select)*	1.50	GPM

**(Federal Law Requires all new shower heads to have a max flow rate of 2.5 GPM)*

Water & Energy Savings Calculations

Property Location in United States		North Central Localities	
Select Type of Water Heater Fuel	*(Select)*	Natural Gas	
Average Hot Water Discharge Temperature		110.00	°F
Annual Water Savings		58	kGal
Energy Factor of Domesitc Hot Water Heater:		0.60	EF
Equivalent Heating Fuel Energy savings:		47,933	kBtu

Cost Savings Calculations

Equivalent Heating Fuel Savings	Natural Gas	479	Therms
Water Tariff ($/1000 Gal)	$10.00	$/kGal	
Annual Cost Savings In Form of Water		$575	$$
Annual Energy Savings From Water Heater		$598	$$
Estimated Total Annual Cost Savings		$1,173	$$

Estimated Installation Costs

Estimated Total Installation Cost		$1,522	$$
Simple Payback Period		1.30	Years
Type of Recommendation		Capital Cost ECM Recommendation	

ECM EXPLANATION:

By reducing the flow of water coming off the shower heads, savings can be generated in the form of reduced water and sewer costs. Additional savings can be realized via reduction in the demand for hot water. Currently Federal law requires all new shower heads to have a maximum flow rate of 2.5 GPM.

EMG recommends replacing the existing shower heads with new low flow shower heads as mentioned above. The proposed ECM shall also result in an annual energy saving in form of reduction in water heating bills.

Summary:

Initial Investment:	$1,522	Simple Payback:	1.30
Annual Cost Savings:	$1,173		

UIC	**Upgrade Building Lighting to LED and Install Automatic Lighting Controls**
EAL10	**Location: Building Interior and Exterior**

	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
Upgrade Lighting to LED	296	724	3,823	91,892	$14,702.76	$2,689.35

Existing Technology	**Sub-Technology**	No. of ECMs	No. of Fixtures	No. of Lamps	KWh Saved	Energy Cost Saving	O & M Savings
CFL	CFL - 2 Pin	0	0	0	0	$0	$0
CFL	CFL - 4 Pin	0	0	0	0	$0	$0
CFL	CFL - Screw-in	0	0	0	0	$0	$0
Circiline	T9	0	0	0	0	$0	$0
Incan/H/MR	H	0	0	0	0	$0	$0
Incan/H/MR	Incan	0	0	0	0	$0	$0
Incan/H/MR	MR	0	0	0	0	$0	$0
HID	HPS	0	0	0	0	$0	$0
HID	MH	8	20	20	7,992	$1,279	$381
HID	MV	0	0	0	0	$0	$0
HID	QL	0	0	0	0	$0	$0
Linear Fluorescent	T8	62	693	693	83,683	$13,389	$2,260
Linear Fluorescent	T12	0	0	0	0	$0	$0
Linear Fluorescent	T8 U	0	0	0	0	$0	$0
Linear Fluorescent	T12 U	0	0	0	0	$0	$0
Linear Fluorescent	T5	6	11	11	217	$35	$48
Linear Fluorescent	T6	0	0	0	0	$0	$0
Linear Fluorescent	T10	0	0	0	0	$0	$0

Proposed Controls	**No. of Controls**		**No. of Controls**
Photo Sensor	0	Ceiling Mounted	0
Wall Mounted	79		

Initial Investment			**Equipment Rentals**	
Material Cost	$24,225.96		Scissor Lift 26' - Interior Spaces	$445.00
Labor Cost	$47,131.51		Bucket Truck - Exterior Spaces	$1,300.00
Local Electric Rate:	$0.16	$/kWh	Estimated Annual Energy Savings:	91,892
Hourly Labor Rate For Electrician:	$82.45		Estimated Annual Energy Cost Savings:	$14,703
Budgeted Initial Investment:	$73,102		Estimated Annual O&M Cost Savings:	$2,689
Estimated Return on Investment: *(Including O&M Savings)*	4.20	Years	Estimated Annual Cost Savings:	$17,392

UIC	Install Low Flow Faucet Aerators
EAP2-b	**Location**: Will C. Wood Middle School - Classroom and Restroom Sinks

Property Type:	Commercial	Estimated No. of Operational Weeks	37
		Number of Occupied Days/Week (Max 7)	5

KITCHEN FAUCETS			BATHROOM FAUCETS		
Number of Occupants Affected By Retrofit	817		Number of Occupants Affected by Retrofit	817	
Do You Want To Replace Kitchen Faucets Aerators	Yes	*(Select)*	Do You Want To Replace Bathroom Faucets Aerators	Yes	*(Select)*
Total Number of Faucet Aerators To Be Replaced	35		Total Number of Faucet Aerators To Be Replaced	47	
Total Number of Faucets To Be Replaced:	0		Total Number of Faucets To Be Replaced:	0	
GPM of Existing Faucet Aerators	2.2	GPM	GPM of Existing Faucet Aerators	2.2	GPM
GPM of Proposed Faucet Aerator	1.5	GPM	GPM of Proposed Faucet Aerator	0.5	GPM
Estimated Number of Uses Per Day	1		Estimated Number of Uses Per Day	2	

Annual Water Savings From Installing Low Flow Aerators: 59.49 kGal

WATER & ENERGY SAVING CALCULATION			COST SAVING CALCULATION		
Select Type of Water Heater Fuel:	Natural Gas	(Select)	Property Location in United States	North Central Localities	
Energy Factor of Domestic Hot Water Heater:	0.60	EF	Heating Fuel Tariff	$1.25	$/Therm
Hot Water Discharge Temperature at Faucet	110.00	°F	Water Tariff ($/1000 Gal)	$10.00	$/kGal
Equivalent Heating Fuel Savings: *Savings Discounted by 15% to Account For Cold Water Use*	422	Therms	Annual Cost Savings In Form of Water	$595	$
Annual Water Savings	59.49	kGal	Annual Energy Savings From Water Heater	$526	$

COST BENEFIT ANALYSIS				
Estimated Total Annual Cost Savings	$1,121	$$	Estimated Total Installation Cost	$1,249 $$
Simple Payback Period	1.11	Years	*Type of Recommendation*	Capital Cost ECM Recommendation

ECM EXPLANATION:

By reducing the flow of water coming from the restroom faucets, aerators can generate energy savings at low cost and with easy installation. The savings generated would be in the form of reduced water and sewer costs and at the same time aerators would save energy by reducing the demand for hot water. The average faucet has a flow rate of about 2 to 4 GPM. Adding a screw-in faucet aerator reduces the flow to 0.5 to 1.5 GPM in the bathroom and 2.2 GPM in the kitchen. In addition to saving energy and water, the "foamier" water that comes from faucet aerators wets objects better than water from a faucet with no aerator, which tends to bounce off the object rather than thoroughly wetting it.

EMG recommends replacing the proposed faucet aerators with new low flow aerators as mentioned above. The proposed ECM shall also result in an annual energy saving in form of reduction in water heating bills.

Summary:

Initial Investment: $1,249 Estimated Annual Cost Savings: $1,121 Simple Payback Period (Yrs): 1.11

UIC	Install Low Flow Tankless Restroom Fixtures
EAP4	Location: Will C. Wood Middle School

ECM FOR DETERMINING WATER SAVINGS IN COMMERCIAL PROPERTIES

Number of Males	409	
Number of Females	408	
Number of Occupied Days Per Week (Max 7)	5	
Number of Occupied Weeks/Year (Max 52)	37	
Number of Urinals To Be Retrofitted	16	
Number of Water Closets To Be Retrofitted	41	
No. of Water Closets With Separate Flush Tank *(Typical Residential Type)*	0	
Estimated Restroom Usage/Individual/Day *Default is 4 Uses/Day For Residential/Office*	3	(Select)

Urinal Water Savings

Do you Want To Make Any Changes To The Urinals?	Yes	
Estimated Existing Use of Urinal/Day/Man	80%	
Existing Gallons Per Flush Ratings For Urinal Flushes	1.00	GPF
Proposed Urinal	0.125 GPF -Wall Mount	
GPF of Proposed Urinal Flush Valve** ***(1992 EpACT Energy Act Mandates 1.0GPF Max on Urinals)*	0.125	GPF
Estimated Annual Water Savings From Urinal	158.90	kGal

Water Closet Water Savings

Tankless Water Closets

Do The Water Closet Need To Be Retrofitted?	*(Select)*	Yes	
Existing Gallons Per Flush Ratings For Water Closet Flushes		1.60	GPF
Are The Existing Water Closet Being Replaced? *(If No; Then Only The Flush Valve Would Be Replaced With Dual Flush Retrofit Kit)*	*(Select)*	No	
No. of Tankless Water Closets		41	
GPF of Proposed Dual Flush- Water Closet Valve* **(Federal Law Requires All Flushes Not To Exceed 1.6 GPF)*	*Solid Waste (20%)*	1.28	GPF
	Liquid Waste (80%)	0.48	GPF
Estimated Annual Water Savings From Male Users		43.58	kGal
Estimated Annual Water Savings From Female Users		217.38	kGal
Total Water Savings From Water Closets		260.97	kGal

Water & Cost Saving Calculations

Water Savings Calculation

Water Savings By The Use of Low Flow Water Closet Flush Valves/Yr	260.97	kgal
Water Savings By The Use of Low Flow Urinal Flush Valves/ Yr	158.90	kgal
Total Annual Water Savings in kgal	419.86	kgal

Cost Savings Calculations

Enter Water Tariff Rate ($/1000Gal)	$10.00	$$
Estimated Cost Savings From Water	$4,199	$$

Estimated Cost of Retrofit

Cost For Replacing Existing Urinal Fixture With A Low Flow Fixture	$20,806 *(Includes Labor)*	$$
Cost For Replacing Existing Flush Valves With Low Flow - Dual Flush Valves ($80 Per Unit) *(Up For Liquid Waste And Down For Solid Waste)*	$25,381 *(Includes Labor)*	$$
Estimated Total Cost For Retrofit	$46,186	$$
Simple Pay Back Period	11.00	Yrs
Type of Recommendation	Capital Cost ECM Recommendation	

ECM EXPLANATION:

The highest water utilization at any home/office occurs in the restrooms. It is estimated that on an average a normal human being uses the restroom at least four times a day. Keeping with the global water conservation objectives, federal law prohibits use of any new water closet flushes over 1.6 GPF. At the same time the '1992 EpACT' mandates all new Urinals to have a maximum 1.0 GPF flush valves on urinals.

EMG recommends replacing all urinals above 1.0 GPF with a new 0.5 GPF or lesser urinals. At the same time EMG also recommends replacing all the water closets having a GPF rating of 1.6 and over with low flow water closet fixtures equipped with dual flush valves.

In case the property doesn't wish to replace the entire water closet fixtures, EMG recommends retrofitting all the tankless water closet flush fixtures with new dual flush fixtures that would result in a 30% water savings per flush for liquid wastes, while retaining the same flush rate for solid wastes.

SUMMARY:

Initial Investment:	$46,186	Simple Payback Period:	11.00 Yrs
Annual Cost Savings:	$4,199		

UIC	Replace Rooftop Package Unit
EAH12-B	Location: Will C. Wood Middle School - 4 ton through 8 ton units

Estimated Annual Cooling Hours:	350	Hrs	Estimated Annual Heating Hours:	300	Hrs
Units to Replace	Air Conditioning: Yes	Heating System: Yes	Existing Type of Heating Fuel:	Natural Gas	

Existing Package System

	Cooling	Heating	Total Combined Units
Number of Package Units to be Replaced:	43	43	43

Capacity of the air conditioner:	5	Tons	EER of the Existing Air Conditioner:	8.50	
Capacity of Existing Heating System:	90	MBH	Input Existing AFUE for the Furnace:	74%	
Estimated Annual Cooling Consumption: *(For All Units)*	106,235	kWh	Estimated Annual Heating Consumption : *(For All Units)*	15,689	Therms

Proposed Package System

Capacity of the Proposed Air Conditioner:	5	Tons	EER of the Proposed Air Conditioner:	10.50	EER
Capacity of Proposed Heating System:	Gas Fired -100MBH	MBH	AFUE of Proposed Heating System:	90%	%

Estimated Annual Energy Consumption With New Package Units

Annual Electric Fuel Consumption:	86,000	kWh	Annual Heating Fuel Consumption:	14,333	Therms

Energy and Cost Analysis

Average Electric Rate:	$0.16	$/kWh	Average Heating Rate:	$1.25	$/Therm
Estimated Annual Electric Savings : *From All New Package Systems*	20,235	kWh	Estimated Annual Heating Savings : *From All New Package Systems*	135,586	kBtus
Annual Electric Cost Savings: *From All New Package Systems*	$3,185		Annual Electric Cost Savings: *From All New Package Systems*	$1,691	$

Proposed Type of System to be installed: Package Heating and Cooling System

Estimated Material and Labor Cost Including Overheads and Profits For All Units:	$473,000.00	$
Estimated Total Energy Cost Savings From New HVAC System:	$4,876	$
Estimated O&M Savings:	$244	
Estimated Simple Pay Back Period: 92.3791795 Yrs		

Capital Cost ECM Recommendation

UIC	Replace External Windows
EAE2	Location: Will C. Wood Middle School - All Buildings

ENTER EXISTING CONDITIONS

Existing and Proposed Window Properties

Total Sq.Ft window area:	7,104	sq.ft
Approximate number of windows:	496	
Total existing window area:	7,104	Sq.Ft
Select The Existing Window Type	Metal Frame & Double Glazing	*(Select)*
Existing U-value of window: (1/R)	0.87	Btu/ ft²·°F·h
ASHRAE Climatic Zone	Zone-3	
New U-value with Double pane Low E window: (1/R)	0.35	Btu/ ft²·°F·h
AHRAE 90.1 Recommended Value		

Existing & Proposed Air Leakage Through Windows

Insert Existing Estimated Air Change Rate/Hr (ACH 1):	0.80	
(Existing Air Changes Per Hour, 1.5 is very leaky and 0.35 ideal)		
Insert Proposed Estimated Air Change Rate/Hr (ACH 2):	0.52	
Estimated Space Volume Under Consideration	260,830.00	Cu. Ft
Is the Property Cooled ?	Yes	*(Select)*

WINTER

Select Type of Heating Fuel	Natural Gas	*(Select)*
Net heating plant & distribution system efficiency:	74.00	**%**
Annual Heating Hours:	2,963	HDD
Estimated Total Annual Input Heating Energy Savings By Replacing Windows	35.50	Therms
Estimated Total Annual Input Heating Energy Savings Achieved By Controlling Air Leakage Through Windows	1,263	Therms
Estimated Total Input Heating Fuel Savings From Replacing Windows	1,299	Therms

SUMMER

Select Type of Cooling Fuel:	Electric	*(Default)*
Cooling Plant Efficiency **(EER)**:	8.50	**EER**
Annual Cooling Hours:	1,407	CDD
Annual Total Input Cooling Fuel Savings During Summer Season By Replacing Windows	14,675	kWh
Estimated Total Annual Input Cooling Energy Savings Achieved By Controlling Air Leakage Through Windows	5,222	kWh
Estimated Total Input Cooling Fuel Savings From Replacing Windows	19,898	kWh

ENERGY & COST ANALYSIS

Insert Cost of Heating Fuel:	$1.25	$/Therm	Annual Heating Cost Savings:	$1,620.29	$$
Insert Cost of Cooling Fuel:	$0.16	$/kWh	Annual Cooling Cost Savings:	$3,131.79	$$
Total Annual Cost Savings	$4,800		Total Annual Cost Savings From Heating & Cooling:	$4,752	$$
Cost of window upgrade:	$407,172		Estimated Annual O&M Savings	$48	$
Simple payback:	84.83	**Yrs**	*Type of Recommendation*	Capital Cost ECM Recommendation	

ECM DESCRIPTION:

Windows play a major role in the energy use and comfort of an interior space. In the winter, heat in a room is lost when cold outside air infiltrates around the edges of windows. Heat also can be lost by conduction directly through the pane, even if the window fits tightly. Windows with insulated panes, such as those filled with Argon address this issue, while proper caulking and sealant address the infiltration issue. The cold drafts and the chilly windowpane make the room uncomfortable. Windows also can help to heat a room by letting the sun's rays enter. While this solar radiation is beneficial in the winter, it can be a major source of discomfort in hot, summer climates. Energy Star rated windows with Low-E glazing are designed to keep the solar heat gain minimized during the summer months. Choosing a replacement window that fits properly has the desired U-value, and proper glazing characteristics is critical to energy conservation through window upgrades.

Summary:

Initial Investment:	$407,172	Simple Payback	84.83 Yrs
Annual Energy Cost Savings:	$4,800		

UIC	Replace Existing Water Heater With New Energy Efficient Units
EAD3	**Location: Will C. Wood Middle School**

		50 gallon		40 gallon		30 gallon			
Step 1	**Existing Water Heater Details**								
	Number of Water Heaters Being Replaced:	1		1		1			
	Select Existing Hot Water Heater Fuel	Electric		Electric		Electric		Electric	
	Insert Energy Factor of Existing Water Heater	0.86	EF	0.88	EF	0.86	EF		EF
	Input Existing Water Heater Input Rating	5.40	kW	4.80	kW	4.50	kW		kW
	Select One Method For Calculation	Annual Heating Hours		Annual Heating Hours		Annual Heating Hours		Annual DWH Load	
	Insert Average Annual Hours of Operation	1,000	hrs	1,000	hrs	1,000	hrs		kWh
	Annual Water Heater Energy Consumption/Heater	5,400	kWh	4,800	kWh	4,500	kWh	#DIV/0!	hrs
	Total Estimated Annual Energy Consumption For all Heaters	5,400	kWh	4,800	kWh	4,500	kWh	0	kWh
	Total Estimated Annual Operating Energy Costs For all Heaters	$850	$	$755	$	$708	$	$0	$
Step 2	**Proposed New Water Heater**								
	Proposed Hot Water Heater Fuel	Electric		Electric		Electric		Natural Gas	
	Capacity of the Proposed New Water Heater	50-Gal,4.5-kW		40-Gal,4.5-kW		30-Gal,3.5-kW			
	Energy Factor of Proposed Water Heater	0.95	EF	0.95	EF	0.93	EF	0.00	EF
	Proposed Water Heater Input Rating	4.50	kW	4.50	kW	3.50	kW	0.00	kBtuh
	Annual kBtuh Consumption For All The Proposed Water Heaters	16,679	kBtuh	15,171	kBtuh	14,198	kBtuh	#DIV/0!	kBtuh
	Estimated Annual Water Heater Fuel Consumption (All Heaters)	4,888	kWh	4,446	kWh	4,161	kWh	0	Therms
	Estimated Total Annual Energy Costs	$769	$	$700		$655		$0	
Step 3	**Energy & Cost Saving Calculation**								
	Estimated Cost of New Water Heater/Unit	$1,347	$	$1,060	$	$851	$	$0	$
	Total Estimated Installation Cost	$2,010	$	$1,582	$	$1,270	$	$0	$
	Total Estimated Annual Cost Savings	$81	$	$56	$	$53	$	$0	$
	Total Annual Cost Savings:	$189		Total Initial Investment::		$4,862			
	Simple Pay Back Period	25.66							
	Type of Recommendation	Capital Cost ECM Recommendation							

ECM SUMMARY:

Electric resistance is the most expensive method for heating domestic hot water. A natural gas or propane fired water system provide more units of heat with direct burning of fuel while high wattage draw is required for electric water heaters to create resistance heat. This electric usage can be seen with the increase power demand for the site and the additional kWh consumption. The installation process of the gas/propane fired water heater requires additional measures with tying a gas line or fuel tank to the system along with installing an exhaust gas vent. This process is not a costly retrofit if a current gas line or tank is at the site. The hot water exhaust duct can be tied to the existing gas fired furnaces or boilers for an easy retrofit.

SUMMARY:

Initial Investment: $2,010 Simple Payback: 25.66 yrs

Annual Cost Savings: $81

APPENDIX F:
Solar PV

UIC	Install Fixed Tilt Solar Photovoltaic System
EAR-2	Details: Will C. Wood Middle School

Select State: Northern California **Electric Rate:** **$0.16** $/KWH Annual Electric Consumption: **518,090** KWh

Roof No.	Description	Number of Roofs	DC System Size Per Roof	PV System Sizing For All Roofs	Estimated Number of 315 Watt PV Panels:	Total Estimated Annual Electricity Generated/ Roof	Total Estimated Electricity Generated (All Roofs)	Total Cost Savings	Installation Cost: ($3.5/Watt)	Simple Pay Back Period without Incentives	One Time Potential Utility or State Incentives	One Time Potential Federal Incentives	Annual Potential Incentives and Rebates		Simple Pay Back Period with All Incentives
			kW	kW		kWh	kWh			Yrs		Dept. of Treasury Renewable Grant (30%)	Federal REPI Incentive	Solar Renewable Certificates (SRECS)-(~$0/MWH)	Years
												30%	$0.02	$0	
1	Building 1	1	20.10	20	64	30,988	30,988	$4,958	$70,350	14.2	$0	$21,105	$682	$0	8.6
2	Building 2	1	16	16	52	25,284	25,284	$4,045	$57,400	14.2	$0	$17,220	$556	$0	8.6
3	Building 3	1	70	70	221	107,458	107,458	$17,193	$243,950	14.2	$0	$73,185	$2,364	$0	8.6
4	Building 4	1	144	144	456	221,236	221,236	$35,398	$502,250	14.2	$0	$150,675	$4,867	$0	8.6
5	Building 5	1	17	17	52	25,438	25,438	$4,070	$57,750	14.2	$0	$17,325	$560	$0	8.6
6	Building 6	1	18	18	58	28,059	28,059	$4,489	$63,700	14.2	$0	$19,110	$617	$0	8.6
		6		**284**	**903**	**438,463.0**	**438,463**	**$70,154**	**$995,400**	**14.19**	**$0**	**$298,620**	**$9,646**	**$0**	**8.56**

Solar Rooftop Photovoltaic Analysis		
Total Number of Roofs	6	
Estimated Number of Panels	903	
Estimated KW Rating	284	KW
Potential Annual KWh Produced	438,463	KWh
% of Current Electricity Load	84.6%	

Financial Analysis		
Investment Cost	$995,400	
Estimated Energy Cost Savings	$70,154	
Potential Rebates	$298,620	
Potential Annual Incentives	$9,646	
Payback without Incentives	14.2	years
Incentive Payback but without SRECS	8.6	years
Payback with All Incentives	8.6	years