3.0 Part 2: Energy Audit

3.1 Acknowledgements of Part 2: Energy Audit

The Energy Audit Report and Excel RPCA Model were completed by Jason Bing and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 2.1 (Version 2, December 2013).

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Date: February 10, 2014

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Date:___________________________

AKTPEERLESS

Rental Assistance Demonstration (RAD):

PART 2: ENERGY AUDIT

800-890 South Maple Street, Ann Arbor, Michigan 48103

MAPLE MEADOWS

PREPARED FOR Norstar Development USA, LP
733 Broadway
Albany, NY 12207

AND The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8207E-2-96

PIC # MI064

DATE February 10, 2014

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Maple Meadows

800-890 South Maple Road
Ann Arbor, Michigan 48108

for

Ann Arbor Housing Commission

727 Miller Ave
Ann Arbor, Michigan 48103

AKT Peerless Project No. #8207e-2-96

1.0 Executive Summary

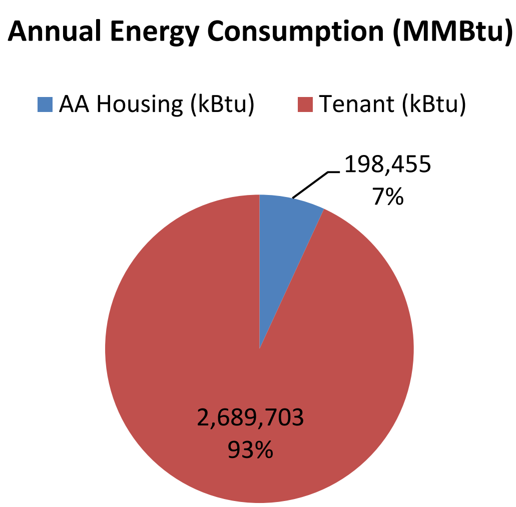
This report presents the findings and recommendations from an RPCA Energy Audit conducted at the Ann Arbor Housing Commission's development, Maple Meadows. Maple Meadows is located at 800-890 South Maple Road, Ann Arbor, MI. The Energy Audit follows industry standards and acceptable practice for assessing energy and water performance of commercial and multi-family buildings. The audit has been conducted by AKT Peerless and has involved a coordinated effort between AKT Peerless, the Client and building operating staff.

Documents were provided for review, interviews and field investigations were conducted, and building systems were analyzed. In the year analyzed (March 2012 to February 2013) the Ann Arbor Housing Commission spent $22,558 on all utilities at the subject property. Tenants spent an estimated $47,761 on utilities.

AKT Peerless identified six (6) separate Energy Conservation Measures (ECMs) and two (2) Water Conservation Measures (WCMs). The annualized savings of all recommendations totals $12,590 (at current energy and water prices), with the potential to reduce total energy consumption and GHG emissions by 20%. If fully implemented, the payback period from annual energy savings for these ECMs is estimated to be 3.3 years. Measures associated with common areas (PHA expenses) and measures specific to tenant units have been separated in this executive summary for planning purposes.

Measures best suited for implementation at the End of Useful Life (EUL), advanced ECMs, and measures recommended for further evaluation have been identified and are included in Sections 10-11 of this report.

A preliminary energy use assessment was conducted prior to the cost reduction measure analysis. The figure below describes the historical annual energy consumption and cost for the subject property.



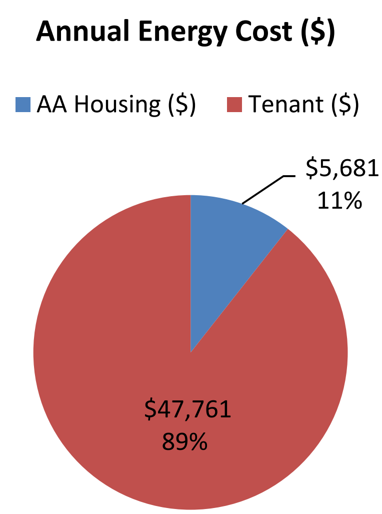
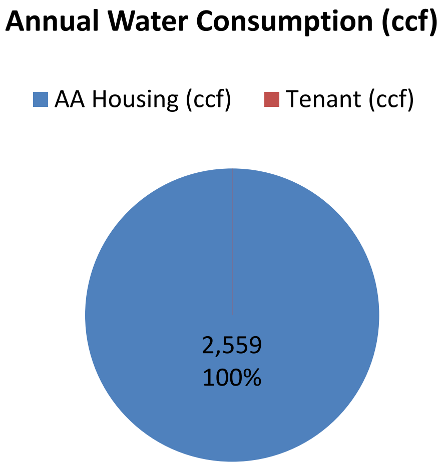


Figure 1. Historical Annual Energy Consumption and Cost

A preliminary water use assessment was conducted prior to the cost reduction measure analysis. The figure below describes the historical annual water consumption and cost for the subject property.



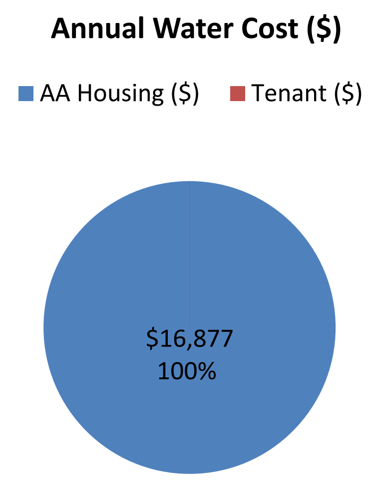


Figure 2. Historical Annual Water Consumption and Cost

The implementation costs and annual savings estimates for each proposed Energy and Water Conservations Measures are presented in Table 1 and Table 2. Table 1 outlines ECMs and WCMs that will directly impact the owner's annual costs.

Table 1. Financial Summary of All Conservation Measures (Owner)

Energy and Water Conservation Measures	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install Low-Flow Toilets	WCM1	$3,375	$917	3.7
Install Low-Flow Faucet Aerators & Showerheads	WCM2	$300	$1,936	0.2
Exterior Lighting Retrofit	ECM1	$10,110	$2,338	4.3
Owner Totals		**$13,785**	**$5,191**	**2.7**

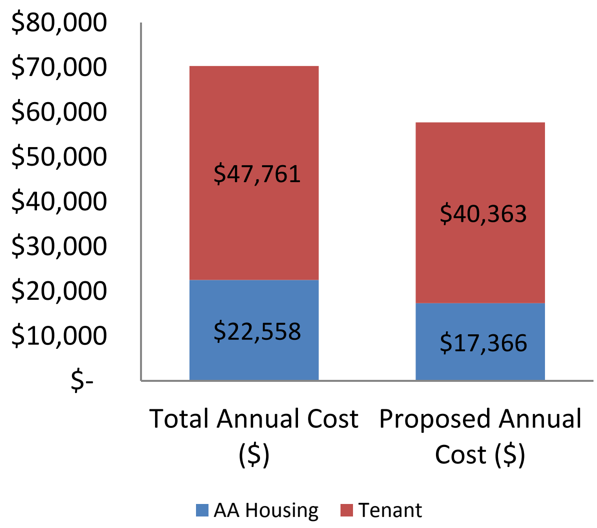
The following ECMs are recommended specifically for tenant spaces. Due to separate billing for tenants, energy and cost savings will primarily benefit the tenants; however, the reduction in energy bills can impact the tenant's decision to continue residing in the building. Furthermore, at times of turnover, and vacancy, the housing authority is responsible for individual unit costs and would capture the benefit associated with these improvements at those times.

Table 2. Financial Summary of All Conservation Measures (Tenant)

Energy and Water Conservation Measures	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Replace Incandescent Light Bulbs with CFLs	ECM2	$420	$1,204	0.3
Install Programmable/Setback Thermostats	ECM3	$1,500	$794	1.9
Control Air Leakage	ECM4	$9,000	$3,717	2.4
Insulate and Seal Rim/Band Joist	ECM5	$4,700	$514	9.1
Insulate Attic Space to R-49	ECM6	$12,000	$1,168	10.3
Tenant Totals		**$27,620**	**$7,398**	**3.7**

Table 3. Impact Summary (Total)

% Energy Savings	26%
% Water Savings	14%
% Cost Savings	18%
Annual Cost Savings ($)	$12,590
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	20%



2.0 Purpose and Scope

Norstar Development USA, LP, on behalf of the Ann Arbor Housing Commission (the Client), retained AKT Peerless Environmental & Energy Services (AKT Peerless) to conduct a RPCA Energy Audit of Maple Meadows located at 800-890 South Maple Road in Ann Arbor, Michigan.

AKT Peerless' scope of work for this Energy Audit is based on its proposal PE-14248, dated January 9, 2013 and revised March 13, 2013 and authorized by Norstar Development USA, LP on behalf of the Ann Arbor Housing Commission (the Client), and the terms and conditions of that agreement.

The purpose of this report is to assist the Client in evaluating the current energy and water use and energy and water cost of the subject property relative to other, similar properties; and also to identify and develop modifications that will reduce the energy and water use and /or cost of operating the property. This report will identify and provide the savings and cost analysis of all practical measures that meet the client's constraints and economic criteria, along with a discussion of any changes to operation and maintenance procedures. It may also provide a listing of potential capital-intensive improvements that require more thorough data collection and engineering analysis, and a judgment of potential costs and savings. Additionally, this report will identify the feasibility of green energy technologies, as well as, determine if further analysis is recommended.

Relevant documentation has been requested from the client that could aid in the understanding of the subject property's historical energy use. The review of submitted documents does not include comment on the accuracy of such documents or their preparation, methodology, or protocol. The following documents were available for review while performing the analysis:

- Energy Utility Bills
- 2009 United States Greenhouse Gas Inventory, Annex 2
- USEPA Climate Leaders Calculator for Low Emitters
- HUD Residential Energy Benchmark Tool
- HUD Residential Water Use Benchmarking Tool
- National Oceanic Atmospheric Administration "Normal Monthly Heating Degree Days (Base 65)" and "Normal Monthly Cooling Degree Days (Base 65)"

3.0 Additional Scope Considerations

In addition to fully satisfying the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Procedures for Commercial Building Energy Audits, Second Edition 2011, Level II guidelines, this report includes all the necessary requirements of an Energy Audit as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2). These items are identified as follows:

- Heating and cooling systems sized according to the methodology proposed in the Air Conditioning Contractors of America (ACCA) Manual J guide. (See Section 11.1)
- Hot water heater analysis of existing size of individual hot water heater and the appropriate efficiency replacement sizing using First Hour Rating or another professionally recognized sizing tool. (See Section 11.2)
- An initial assessment of the potential feasibility of installing alternative technologies for electricity, heating and cooling systems, and hot water heating at the property. (See Section 13.0)
- An expected end of useful life study for all recommended energy and water efficiency measures.
- Recommendations of any additional professional reports needed (including, for example alternative energy system feasibility studies, air infiltration tests for energy loss and ventilation needs, blower door tests, infrared imaging, duct blasting, etc.)

4.0 General Information

4.1 Audit Team

This audit is the result of a collaborative process between the following AKT Peerless and client personnel:

Table 4. Audit Team

Name	Organization	Title
Jason Bing	AKT Peerless	Building Energy Analyst
Henry McElvery	AKT Peerless	Building Energy Analyst
Lance Mitchell	Ann Arbor Housing Commission	Facilities & Maintenance Property Manager
Jennifer Hall	Ann Arbor Housing Commission	Executive Director

4.2 Audit Process

AKT Peerless collected historical energy data and floor plans for the building, when available. The square footage of all spaces was determined and the size and location of pertinent mechanical equipment was documented. AKT Peerless conducted a walk-through survey of the building on November 2, 2012 and then on May 9, 2013, collecting specific information on the mechanical, electrical, and plumbing systems as well as occupancy, scheduling, and use patterns.

AKT Peerless utilized industry accepted measuring devices, including but not limited to: a blower door to quantify air infiltration, an infrared camera to visually identify areas of potential energy loss, and a ballast discriminator to identify existing T12 lighting. Light levels were measured using a light meter in various areas to compare to Illuminating Engineering Society of North America (IESNA) recommended levels.

A visual inspection of the mechanical equipment, lighting systems, controls, building envelope and plug loads was performed. Mechanical equipment nameplate data was recorded and the specifications and performance data were reviewed and used in this analysis.

4.3 Energy Calculations Methodology

The primary methods of energy calculation for this analysis were simplified manual and spreadsheet tabulations based on professional standards. Actual calculation methods are discussed in each applicable section.

The end use consumption breakdown, found later in this report, is based on the 2003 Commercial Buildings Energy Consumption Survey (CBECS) data for Lodging Buildings. Modifications were made to customize energy end types applicable to Maple Meadows and the local climate in Ann Arbor.

AKT Peerless used the HUD Energy Benchmarking Tool to evaluate the energy consumption data for the property. This tool allows the input of historic utility data of a facility to be compared to normalized data of a large database of facilities of its peers. The results will yield some information that can be used for general building evaluation. As part of the data used in the HUD model, the building was considered to have thirty (30) resident units with an average floor area of 982 square feet.

A blower door test was conducted on one of the units during the site visit. The blower door test was used to quantify air leakage by determining the 50-pascal airflow rate. This blower door reading, expressed in cubic feet per minute (CFM50) is the actual flow rate measured at 50 Pascals of house pressure. CFM50 is the most direct measurement of the airtightness of a building.

5.0 Property Description

The multi-family family residential property has five two-story buildings containing 36,775 square feet in 30 apartments. The site area is approximately 3.43 acres. Construction of the property was completed in 1970. Significant renovations were performed in 1986 (storm sewers), 1989 (Concrete and entry awnings, siding), 2001 (Community Center addition), 2001 (Interior renovation and mechanical replacements) and 2005 (Parking lot replacement).

5.1 Location

The subject property is located in ASHRAE Climate Zone 5A. According to National Oceanic and Atmospheric Administration recording of heating and cooling degree days, on an annual basis Ann Arbor, MI is expected to experience an average of 6,818 heating degree days (HDD) and 840 cooling degree days (CDD) with a basepoint temperature of 65 degrees Fahrenheit.

5.2 Property Characteristics

General information pertaining to the subject building is summarized in the following table:

Table 5. Property Characteristics

Primary Building Type / Occupancy	Multi-Family (General)
Region	ASHRAE 5A
Date of Construction	1970
Number of Detached Buildings	Five (5)
Approximate Total Square Footage	47,876

The subject property Primary Building Type is designated as Multi-Family. For all energy performance comparisons presented in this report the subject building will be compared to similar buildings of the same Primary Building Type.

5.3 Property Spaces

The complex is divided into five (5) approximately identical buildings containing thirty (30) two-story apartments. Spaces refer to the building as a whole and the rooms that comprise the building. Typically, the various space types will serve specific functions within the facility. The following table identifies the space types for the subject building.

Table 6. Summary of Property Spaces

Space	Use	Sq Footage (sf)	% of Total Area
Ten (10) 2-bdr units	Residential Apartments	1,020 sf/unit	27%
Fourteen (14) 3-bdr units	Residential Apartments	1,300 sf/unit	51%
Five (5) 4-bdr units	Residential Apartments	1,675 sf/unit	22%

5.4 Building Occupancy

Occupancy schedule has a significant impact on a facilities energy usage. In fact, the relationship between occupancy and system operating schedules and setpoints are typically more important than equipment efficiencies. The occupancy schedules for the subject building as follows:

Table 7. Building Occupancy Schedule

Day	Time	Use	Average Population
Sunday-Saturday	24/7	Primary Residence	2-4/unit

5.5 Building Envelope

This section summarizes physical characteristics of the subject building envelope.

5.5.1 Walls and Wall Insulation

The typical above grade wall construction appears to be a standard wood framed structure built on a poured concrete foundation with vinyl siding to the outside mechanically fastened to an exterior grade board on 2x4 wood studs. Limited amounts of face brick and cement board siding create a decorative finish on around the main entries and porch entries on the first level. The overall 5” wide assembly is finished with painted drywall on the interior. Fiberglass insulation was observed in at least one exterior wall location and is assumed to be located throughout the perimeter at each building. Depth of insulation could not be determined but is assumed at 3.5” and rated at R-11. This is generally considered standard efficiency.

The basement walls appear to be 8” cast-in-place concrete with a poured slab floor. The walls and floor slab appear to be uninsulated. The rim band, or band joist, appears to be insulated with loose fitting fiberglass insulation stuffed in between floor joists at the perimeter. Insulation was visibly missing in some cavities, and the effective R-value of the band joist insulation is limited due to the installation technique. This is generally considered substandard efficiency.

5.5.2 Roof and Roof Insulation

The typical roof design on the five apartment buildings is a gabled, passively vented roof. Approximately 16” overhangs with continuous soffits run parallel to the ridge and balance a continuous ridge vent. The roof assembly is asphalt shingled roof (grey) over felted wood substrate mechanically fastened to prefabricated or site built 2x wood trusses. The typical attic appears to have 3.5” batts of R-11 insulation laid on the ceiling with approximately 3” of blown fiberglass insulation on top of the batts. The insulation observed onsite appeared to be poorly placed with the blown insulation often unevenly distributed. It was also noted that areas around the stairwell were missing insulation. This uneven distribution of insulation results in a lower effective insulation value in the attic. Overall, this insulation would be considered standard efficiency at best, or in some cases substandard efficiency (<R-21).

It was noted that the end units (3-br apartments) have an approximately 5’x15’ overhanging space on the second floor. The audit team was unable to determine if insulation exists in the floor joist cavities and believe this could be an area of heat loss for these units.

5.5.3 Windows and Other Fenestrations

All observed windows were aluminum frame fixed and slider style. There were both single glazed windows with storm windows and dual glazed thermal pane windows on the home inspected.

5.5.4 Doors

The exterior doors on the unit inspected were insulated hollow metal doors in good condition, complete with weather stripping.

5.5.5 Air Leakage

The audit team conducted a calibrated “blower door” test on a sample 2-bdr unit to determine the apartment’s airtightness. This test, utilizing several gauges for quantifying the analysis, pulls air out of the residential unit, lowering air pressure inside. This allows the (higher) outside air pressure to flow into the apartment through all unsealed cracks and openings.

The test recorded an infiltration rate of 1,750 cubic feet per minute (cfm) at 50 Pascals of pressure. Given the unit conditioned volume (approximately 8,160 cubic feet) this equates to 12.8 air changes per hour at 50 Pascals (ACH50), or approximately 0.87 natural air changes per hour (NaCH). Most standards recommend a target natural air change rate of 0.35 NaCH or less (if mechanically ventilated). This represents an infiltration rate of 60% more than the target.

5.6 Heating, Ventilation, and Air Conditioning (HVAC)

Each apartment is equipped with a natural gas-fired up-flow furnace, located in the basement. None of the units have central air conditioning. The furnaces are typically Carrier brand units, Model #88PAV090 with an input rating of 88,000 Btu/h and an output capacity of 71,000 Btu/h for an overall efficiency of 80%. These units appear to have been installed in 2001 and are considered standard efficiency units. Each furnace appears to be controlled by one non-programmable thermostat.

Heat to the apartment is supplied through sheet metal ducts, with no visible mastic for duct sealing. Return air is ducted to the furnace. Fresh air appears to be supplied by operable windows and natural infiltration. Mechanical exhaust is limited to the bathrooms, with overhead exhaust fans ducted to the outside.

Some apartments are cooled by window air-conditioning units supplied by the residents.

Domestic Hot Water

Hot water is supplied by a natural gas-fired hot water storage tank located in each unit. Typical tank size is a 40 gallon tank, with a 34,000 Btu/h input rating. The ages of the tanks may vary in each unit, with some installed between 1990 and 2000 and others installed after 2000. The older tanks are at or nearing the end of the useful life and are approximately 20-30% less efficient than current standard efficiency models.

5.7 Lighting

This section describes this property's interior and exterior lighting.

5.7.1 Interior Lighting

Interior Lighting in the observed 2 BR residential unit consisted of the following:

Living/Bedroom/Bath

- Standard socket (A lamp) 13W Compact Fluorescent Lamp (CFL) - (8)
- Standard socket (A lamp) 20W CFL - (1)

Basement

- Standard socket (A lamp) 60W Incandescent - (3-4)

The incandescent lamps in the basement are considered substandard efficiency lamps. Most are pull string switches, and can often be left on for extended periods of time.

5.7.2 Exterior Lighting

Exterior lighting for the Maple Meadows apartments consists of the following:

- 35-50W High Intensity Discharge (HID) wall-mounted porch light (60 total)
- 150W HID wall-pack security lighting (10 total)

HID technology is considered standard efficiency and can be upgraded. The lighting appears to be operated by photo-sensors.

There are five (5) light poles on site, providing additional site lighting. These poles are estimated to house 250W metal halide HID lamps (1 each). This technology can be replaced with more efficient alternatives.

5.8 Other Equipment (Energy)

Typical apartment unit kitchens include a refrigerator, microwave and range hood for the natural gas-fired stove. Equipment is generally considered standard efficiency equipment. The range hood appears to only circulate air, and is not vented to the outside.

Each apartment unit also supplies an electric hook up (vent, water, and electricity) for a washer and dryer in the basement. Typical washers and dryers observed during field investigations were standard or substandard efficiency units.

5.9 Water Consuming Devices

The observed apartment unit has devices in the kitchen, bath and basement that consume water. Typical apartment unit kitchens appear to have a standard double sink with standard efficiency aerators. Two and three bedroom apartments have one bathroom which has a lavatory, toilet and shower/bath. Four bedroom units have an additional half-bath with another lavatory and toilet. It was reported that most units have low-flow devices installed in each of the bathrooms, including showerheads and faucet aerators, and 1.6 GPF toilets. However, the observed 2BR unit had a 2 GPM faucet aerator and the toilet appeared to be 3.5 GPF.

Each typical basement is equipped with a slop sink and laundry hook-up. Washers and slop sink aerators appear to be standard efficiency/flow units in most apartments.

5.1 Improvements since Previous Audits (2009)

It was reported that DTE has performed CFL lamp replacements and installed low-flow faucet aerators and showerheads in the resident units as part of their direct install program.

6.0 Energy Use Analysis

This section provides information on energy delivery to the subject property.

Energy use and cost indices for each fuel or demand type, and their combined total, have been developed using generally accepted industry methods and benchmarking tools provided by the Department of Housing and Urban Development (HUD) . The Energy Utilization Index (EUI) and cost index of the subject building are compared (benchmarked) with the EUI and cost index of similar buildings evaluated in the Residential Energy Consumption Survey (RECS) and Commercial Building Energy Consumption Survey (CBECS) conducted by the Energy Information Administration (EIA) of the United States Department of Energy.

AKT Peerless analyzed utility bills for the time period covered by provided records. The following figures summarize the most recent annual energy consumption and costs for this property. These graphs reflect the property owner's energy consumption and **estimate tenant contributions to consumption and cost.**

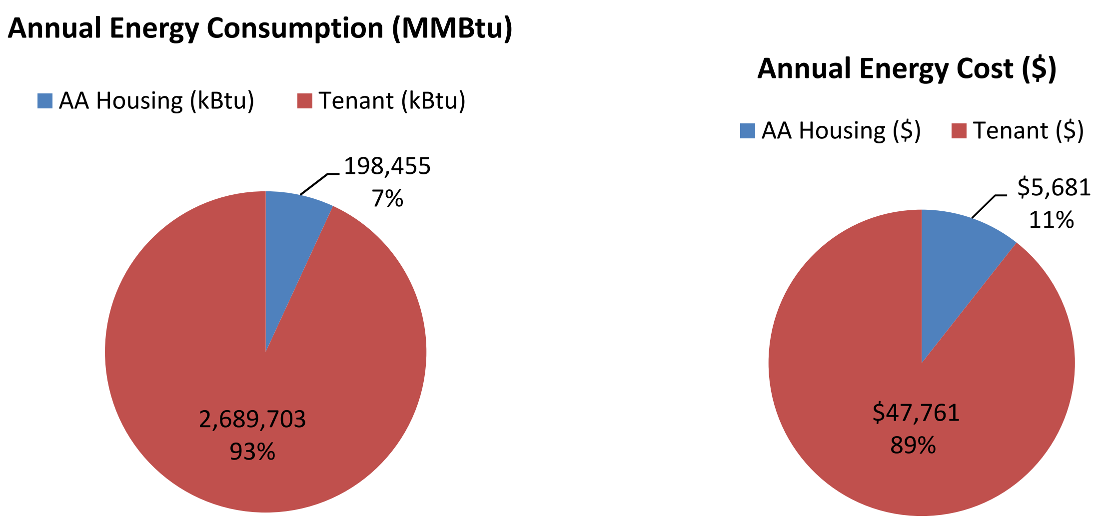


Figure 3. Historical Annual Energy Consumption and Cost

6.1 Electricity

Electricity is supplied and delivered to the subject property by DTE Energy. Historic common area and tenant electrical use is compared to cooling degree days (CDD) in the following figure:

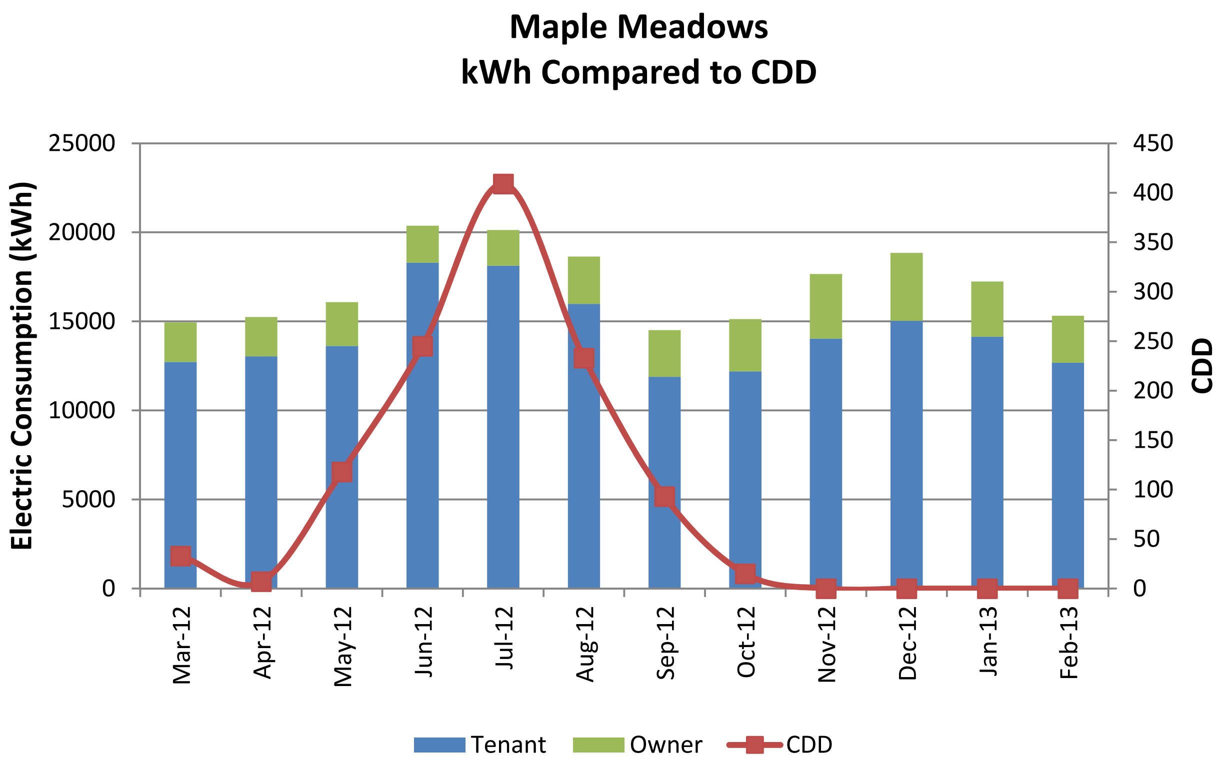


Figure 4. Electricity Consumption Graph

Table 8. Annual Electricity Metrics

	Owner	Tenant
Consumption	32,363 kWh	171,756 kWh
Energy Use Intensity	0.68 kWh / sf	3.59 kWh / sf
MMBtu	110 MMBtu	586 MMBtu

	Owner	Tenant
Cost per kWh	$0.149 / kWh	$0.157 / kWh
Cost per ft^2	$0.10 / sf	$0.56 / sf
Electricity Cost	$4,824	$26,909

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated electricity consumption per end use.

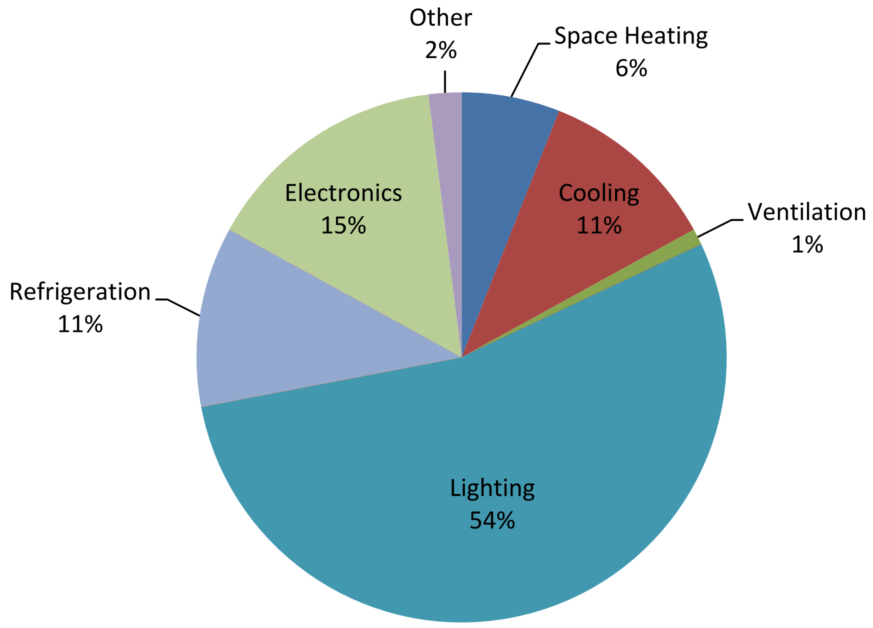


Figure 5. Estimated Electricity Consumption Per End Use

6.2 Natural Gas

Natural gas is supplied and delivered to the subject property by DTE Energy. Historic common area and tenant natural gas use is compared to heating degree days (HDD) in the following figure:

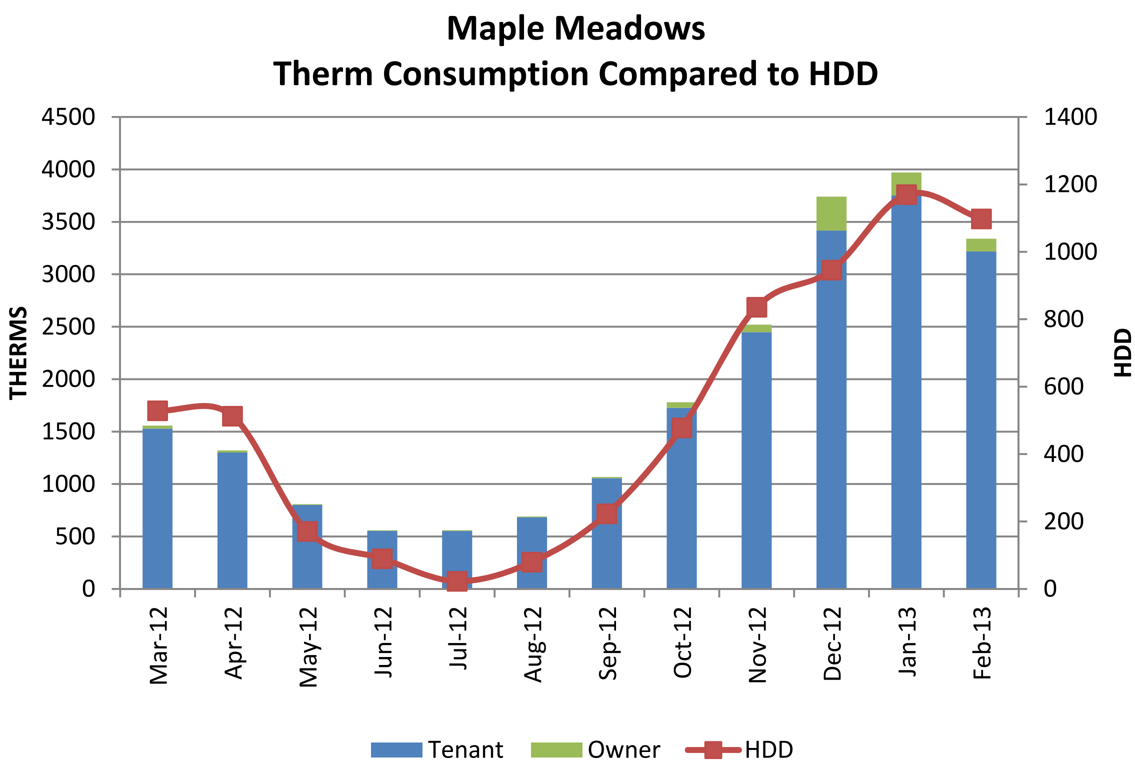


Figure 6. Natural Gas Consumption Graph

Table 9. Annual Natural Gas Metrics

	Owner	Tenant
Consumption	880 therms	21,035 therms
Energy Use Intensity	0.02 therms/ft^2	0.44 therms/ft^2
MMBtu	88 MMBtu	2,104 MMBtu

	Owner	Tenant
Cost per therm	$0.974/therm	$0.991/therm
Cost per ft^2	$0.02/ ft^2	$0.44/ ft^2
Natural Gas Cost	$857	$20,852

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated natural gas consumption breakdown by end use.

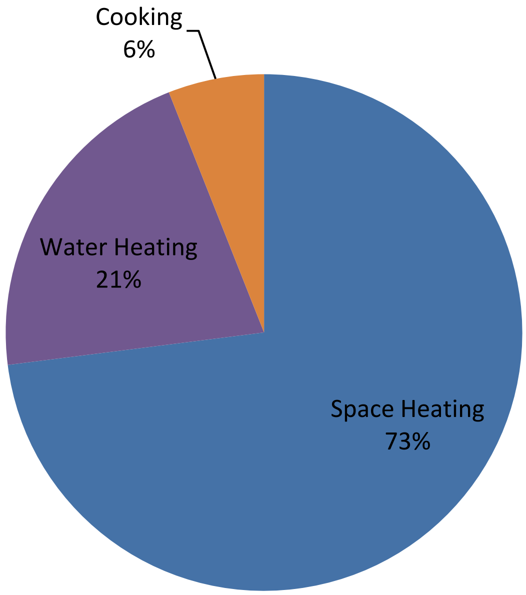


Figure 7. Estimated Natural Gas Consumption Per End Use

6.3 Domestic Water Use

For the time period covered by client provided records, historic domestic water use is summarized in the following figures.

Providers	Number of Meters	Unit of Consumption
City of Ann Arbor	1	100 cubic feet (CCF)

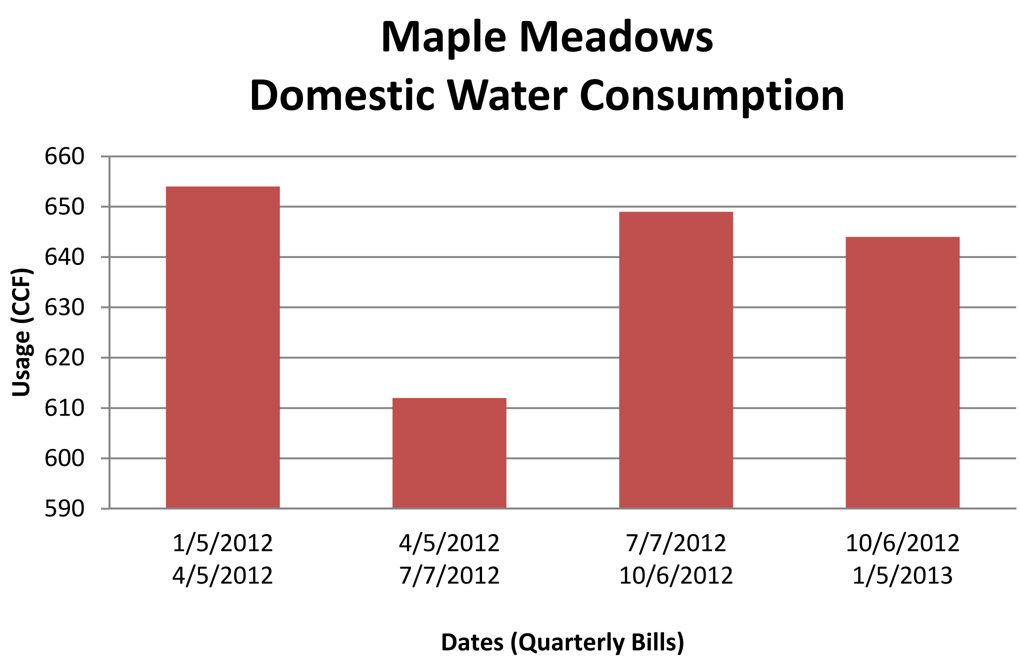


Table 10. Annual Domestic Water Metrics

Consumption	2,559 CCF 1,914,132 gallons		**Cost per 100 gallons**	\$6.59 / CCF \$0.88 / 100 gallons
Water Cost	\$16,877		**Cost per ft^2**	\$0.35 / ft^2

Total annual water consumption was 2,559 CCF. Average cost per CCF for domestic water and sewer on an annual basis is \$6.59. Total annual domestic water and sewer cost is \$16,877.

According to the EPA, residential water use accounts for more than half of the publicly supplied water in the United States. For this reason, the EPA has introduced the WaterSense program to identify possible water efficiency methods and technologies for consumers throughout the country. Considering the responsibility that typically lies with the tenants, multi-family homes are no stranger to excessive water usage. Fortunately, implementation of improved technologies throughout these facilities can impact the water supply as well as the rising overhead costs associated with distribution and collection.

The HUD Energy Benchmarking Tool was used to compare water consumption data for the subject property to typical water consumption data for similar HUD properties. The tool utilizes normalized data from its database of more than 9,100 buildings to provide comparative metrics on domestic water consumption based on a facility's historic water data and design characteristics. Finally, a score is generated for the analyzed building to identify its ranking among similar buildings.

Water bills for this project were limited. The audit team was not able to inspect the specific sewer related costs, but often a significant reduction in water consumption will not translate directly into a significant reduction in costs, due to the percentage of sewer costs within the rate structure.

The Residential End Uses of Water study (REUWS) published in 1999 by the AWWA Research Foundation and the American Water Works Association is a research study that examined where water is used in single-family homes in North America. Conducted by Aquacraft, PMCL, and John Olaf Nelson, the REUWS was the largest study of its kind to be completed in North America and efforts are underway to repeat the effort and obtain updated results. The "end uses" of water include all the places where water is used in a single-family home such as toilets, showers, clothes washers, faucets, lawn watering, etc. The full REUWS final report is available to the public at no charge from the Water Research Foundation (WRF).

Figure 8 below shows the REUWS typical domestic water consumption breakdown by end use.

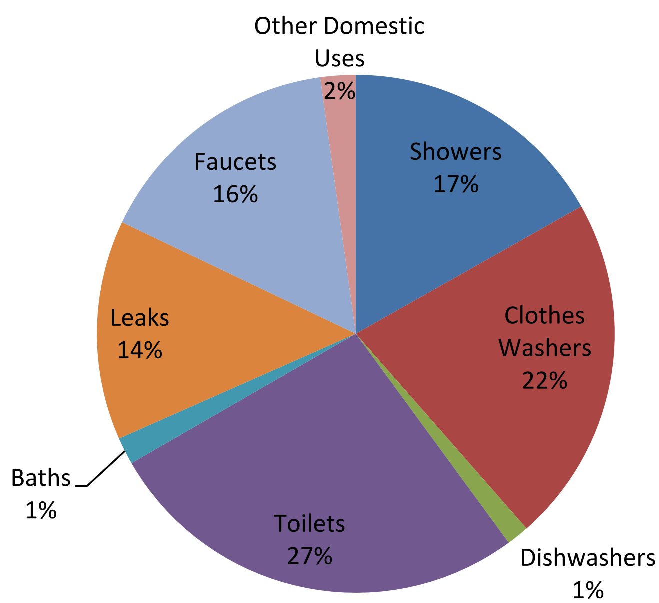


Figure 8. Domestic Water Typical End Use

6.4 Utility Cost Breakdown

The disparate energy types (electricity and natural gas for this facility) and water costs have been aggregated to provide a breakdown of total utility cost into end use components. The breakdown of energy and water cost is based on the energy use breakdown, as described in Section 4.3, Energy Calculations Methodology.

The following table and charts detail the breakdown of energy and water costs. It should be noted that the consumption percentage identified in Section 5.1 Electricity, Section 5.2 Natural Gas, and Section 5.3 Domestic Water Use and the overall cost percentage for each end use are different. This is due to the cost difference for purchasing each energy type.

Ann Arbor Housing Commission currently pays $110.45 per MMBtu of electricity and $9.74 per MMBtu of natural gas, and $0.88 per 100 gallon of water. The tenants at Maple Meadows pay $45.90 per MMBtu of electricity and $9.91 per MMBtu of natural gas.

Table 11. Annual Utility Use Breakdown

Categories	Electricity (MMBtu)	NG (MMBtu)	Total Consumption (MMBtu)	Consumption (%)
Space Heating	42	1,528	1570	59%
Cooling	75	0	75	3%
Ventilation	7	0	7	0%
Water Heating	0	362	362	14%
Lighting	370	0	370	14%
Cooking	0	78	78	3%
Refrigeration	75	0	75	3%
Office Equipment	0	0	0	0%
Electronics	113	0	113	4%
Other	14	0	14	1%
TOTAL	**696**	**2,192**	**2,665**	**100%**

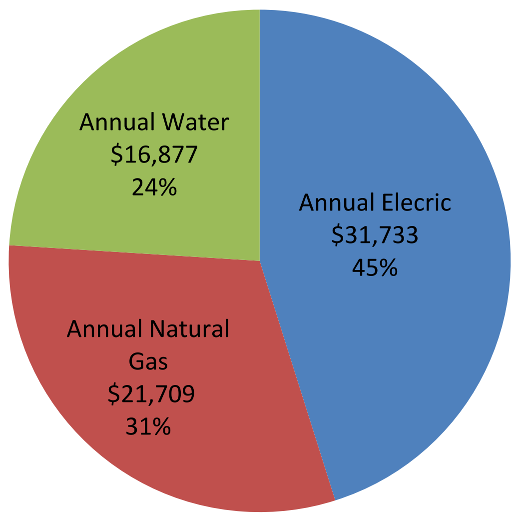


Figure 9. Annual Utility Cost by Type

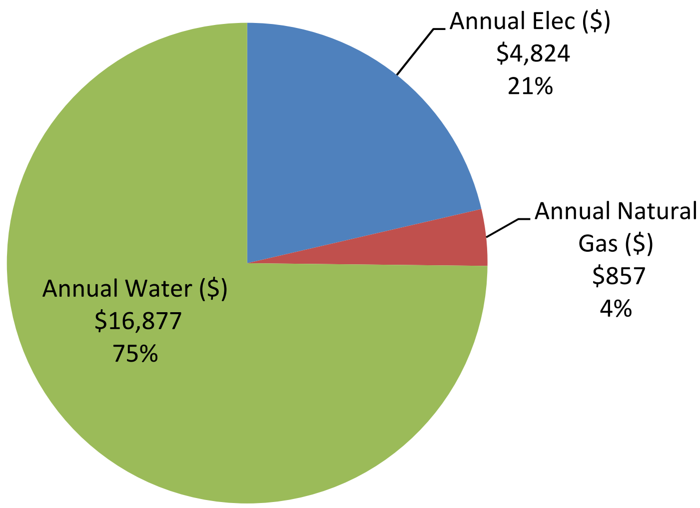


Figure 10. Annual Utility Cost by Type (Owner)

7.0 Energy Performance Benchmark

A benchmark is a standard by which something can be measured. Energy Benchmarking is the comparison of one building's energy consumption to the use of energy in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the Energy Benchmarking Tool to establish if a building's energy consumption is higher or lower than expected energy usage for similar buildings. AKT Peerless utilized the HUD Energy Benchmarking Tool to quantify the performance of the subject building relative to the family of HUD residential buildings.

This statistical analysis of the HUD tool is based on filters for the building's location, gross square footage, total number of units and year of construction (refer to the appendix for more information regarding dataset filters). This filtered data set is used to calculate the benchmarks for an overall benchmark Energy Use Intensity (EUI) as well as the Energy Cost Intensity (ECI). The benchmarks shown in the portfolio summary are derived from the statistical analysis described in this section.

The following table compares the building energy performance of the subject property and the established benchmark.

Table 12. HUD Residential Energy Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	79	50
EUI (Energy Use Index)	60.3 kBtu/ft^2	88.2 kBtu/ft^2
$ ECI (Energy Cost Index)	1.12 $ / ft^2	1.63 $ / ft^2

7.1 Estimated Energy Star Score

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy dedicated to helping all building owners save money and protect the environment through energy efficient products and practices.

Results are already adding up. Americans, with the help of ENERGY STAR, saved enough energy in 2010 alone to avoid greenhouse gas emissions equivalent to those from 33 million cars — all while saving nearly $18 billion on their utility bills.

Because a strategic approach to energy management can produce twice the savings — for the bottom line and the environment — as typical approaches, EPA's ENERGY STAR partnership offers a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements.

EPA provides an innovative energy performance rating system which businesses have already used for more than 200,000 buildings across the country. EPA also recognizes top performing buildings with the ENERGY STAR.

Energy Star certification is based on your building's performance against typical energy performance of similar buildings. A target efficiency rating of 75 is required to qualify for the Energy Star. Because the audit team does not have all the utility bills for the entire facility, and the energy performance utilized in this investigation is based on estimates generated through best practice software results, the facility at the subject property is not currently eligible for the Energy Star.

If the building owner would like to pursue Energy Star certification in the future, our audit team can work with ownership and tenants/lessees to establish an accurate benchmark and determine the necessary steps towards efficiency improvements required for the certification.

Energy Star Leaders Program

In addition to the Energy Star certificate for individual facilities, the Energy Star program recognizes ENERGY STAR partners who demonstrate continuous improvement organization-wide, not just in individual buildings. Organizations that achieve portfolio-wide energy efficiency improvements of 10%, 20%, 30% (or more) reductions may qualify for recognition as ENERGY STAR Leaders.

Ann Arbor Housing Commission may be eligible for this program. For more information on the program and eligibility, please visit: http://www.energystar.gov/index.cfm?c=leaders.bus_leaders#s2

8.0 Water Performance Benchmark

Water Benchmarking is the comparison of one building's water utilization to the use of water in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the preliminary benchmarking tool to establish if a building's water utilization is higher or lower than normal usage for similar buildings.

In order to develop the water consumption benchmarking tool, water consumption data was collected through voluntary release of information from thousands of buildings in nearly 350 PHAs nationwide. Regression analyses were performed on these datasets to see which of over 30 characteristics were most closely linked to water conservation.

Your building will score from 0 - 100, where 0 means water consumption is probably excessive and 100 means that the building probably uses water very efficiently. Important: this is a whole-building tool. Water use inputs include resident-paid consumption, when applicable/available.

The table below quantifies the performance of a use-defined building relative to the family of HUD residential buildings.

Table 13. HUD Residential Water Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	86	50
WUI (Water Use Intensity)	40.0 gal/ft^2	145.1 gal/ft^2
WCI (Water Cost Intensity)	0.35 $ / ft^2	1.28 $ / ft^2

9.0 Operations and Maintenance (O&M) Opportunities

Operation and maintenance make up the largest portion of the economic and environmental life cycle of a building and have become primary considerations of building owners and operators. Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency. Inadequate maintenance of energy-using systems is a major cause of energy waste in both the Federal government and the private sector. Improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.

The following recommendations are believed to have the opportunity to reduce energy and water consumption for the facility.

9.1 Develop a Preventative Maintenance Plan for Equipment

The Facilities & Maintenance Property Manager (Lance Mitchell) has already begun a preventative maintenance plan for equipment. *Planned* or preventative maintenance is proactive (in contrast to reactive) and allows the maintenance manager control over when and how maintenance activities are completed. When a maintenance manager has control over facility maintenance, budgets can be established accurately, staff time can be used effectively, and the spare parts and supplies inventory can be managed more efficiently.

Regardless of which strategy is used, maintenance should be seen as a way to maximize profit and/or reduce operating costs. From this perspective, the main functions of a maintenance department/staff are as follows:

- Control availability of equipment at minimum cost
- Extend the useful life of equipment
- Keep equipment in a condition to operate as economically and energy efficiently as is practical

The maintenance department/staff would be responsible for the following tasks:

- Maintenance planning
- Organizing resources, including staffing, parts, tools, and equipment
- Developing and executing the maintenance plan
- Controlling maintenance activities
- Budgeting

At the time of the assessment, the Facilities Director indicated that a plan is currently being established for the housing authority. It is recommended this continue. Additional considerations for the future plans should include, but not be limited to:

- Energy efficiency for vacant apartments at move-out
- Tenant education
- Tenant support maintenance program

- Tenant incentives program

9.2 Institute an Energy Star Purchasing Policy

Energy costs associated with electrical plug loads should be minimized where possible. Plug loads are electrical devices plugged into the building's electrical system and generally include things like appliances, computers, printers, and office equipment such as fax machines and copiers. When purchasing appliances, computers, and office equipment, the U.S. EPA ENERGY STAR standards should be specified. Manufacturers are required to meet certain energy efficiency criteria before they can label a product with the ENERGY STAR emblem, so these products represent your best energy saving value.

9.3 Water Heater Tank and Pipe Insulation

A water heater keeps water continually heated to a specific, set temperature. As the water loses heat through the tank walls during periods of non-use, the burner or heating element has to reheat the water. An insulation jacket will reduce the heat loss and, as a result, the energy required to maintain the hot water temperature and the water heater will not need to cycle as often. The insulation jacket enables the heater to bring the water up to temperature quicker, too, saving additional energy. Certain manufacturers may prohibit this on newer models. Please consult the tank manufacturer for newer models.

During periods of non-use, the heated water will rise to the top of the tank. The pipes can actually draw heat out of the tank, like a *wick*, and should be insulated. The first ten feet of hot and cold piping, if accessible, should be wrapped. If the water heating system is located in an unconditioned (cold) area, all accessible piping should be insulated.

9.4 Change Furnace Filters on a Regular Basis

The furnace filter in the inspected home had far surpassed its intended life. The filter was built up with dust and other contaminants, restricting airflow through the furnace unit. This filter was changed during the site visit, but the filters at the remaining homes should be inspected.

As furnace filters get dirty, they become more efficient at catching dust up to a certain point. Then, if the furnace filter is not changed, it will begin to restrict airflow. This causes your furnace to work much harder to heat and cool your home because it must run longer, thus using more electricity.

A furnace filter pulls a majority of unwanted particles from the indoor air. Examples are mold spores, pet dander, household dust, smoke, pollen, dust mites and smog. Regular filter change is an easy way to reduce energy consumption. A dirty filter will force your system to work harder to push air through the filter, while a clean one will allow the air travel more freely. The filter also keeps the coils and the heat exchanges in your system clean, minimizing maintenance issues and extending the life of the equipment. It will also help maintain peak performance of the furnace or air conditioner.

A clean furnace filter helps the occupants breathe the cleanest air possible by pulling all those unwanted particles from the air. Changing your furnace filters at the recommended time frames will help keep occupants healthy and prevent airborne sickness and diseases. A clean furnace filter is a great way to help people with allergies and asthma live a healthier life by pulling aggravating allergens from the air.

A basic fiberglass furnace filter should be changed about every 30 days, while a pleated furnace filter lasts longer and should be changed about every 90 days.

9.5 Adequately Seal Doors and Windows

Infiltration is the flow of air through openings in a building. In order to reduce infiltration, the cracks and holes in a building must be adequately sealed. Maintaining caulking and weather stripping in good condition saves both money and energy. It also preserves the building and improves the comfort of its occupants. Verify that all doors and windows are adequately sealed. Verify that doors in existing vestibules are being closed to prevent unnecessary infiltration. Also, inspect the exterior of the buildings for cracks or other damage.

Older windows can be a major source of heat loss and air leakage, and can greatly impact the heating load on a building. A detailed engineering study is generally required to determine the best way to upgrade windows. However, be sure to consider low-e high performance glazing when window replacement becomes necessary. The additional cost will usually be paid for in energy savings in less than ten years.

Solutions to increase the efficiency of high use doors/doorways near the warehouse should be investigated. Additionally, any abandoned (exhaust or other equipment) openings in the roof should be identified. Further analysis would be required to identify a cost savings for sealing the perimeter openings.

10.0 Proposed Energy Conservations Measures (ECMs) and Water Conservation Measures (WCMs)

This analysis identified and included three primary types of ECM/WCMs:

- ECM/WCMs impacting the Owner (the Client) costs; and
- ECM/WCMs impacting the Tenant(s) costs; and
- ECM/WCMs to be implemented at the End of Useful Life (EUL) of equipment (includes both Owner and Tenant impacts)

The energy and water audit of the facility identified six (6) energy conservation measures (ECMs) and two (2) water conservation measures. These ECMs are estimated to provide approximately $12,590 in annual savings. The investment required to implement all of the measures before the inclusion of applicable utility incentives is estimated to be $41,405. These savings measures are summarized within this section.

Incentives are not included in the calculation of payback times and savings calculations. Utilizing available incentives is expected to reduce project costs and decrease simple payback.

Table 14. Financial Summary of ECMs and WCMs

Energy and Water Conservation Measures	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install Low-Flow Toilets	WCM1	$3,375	$917	3.7
Install Low-Flow Faucet Aerators & Showerheads	WCM2	$300	$1,936	0.2
Exterior Lighting Retrofit	ECM1	$10,110	$2,338	4.3
Replace Incandescent Lamps with CFLs	ECM2	$420	$1,204	0.3
Install Programmable/Setback Thermostats	ECM3	$1,500	$794	1.9
Control Air Leakage	ECM4	$9,000	$3,717	2.4
Insulate and Seal Rim/Band Joist	ECM5	$4,700	$514	9.1
Insulate Attic Space to R-49	ECM6	$12,000	$1,168	10.3
Totals		**$41,405**	**$12,590**	**3.3**

Table 15. Summary of Energy Savings for ECMs and WCMs

Energy or Water Conservation Measure	kWh Annual Savings (kWh)	Therm Annual Savings (Therms)	Water Annual Savings (ccf)	GHG Reduction (Metric Tons)
Install Low-Flow Toilets	0	0	139	-
Install Low-Flow Faucet Aerators & Showerheads	0	485	222	2.58
Exterior Lighting Retrofit (entire campus)	15,688	0	0	11.61
Replace Incandescent Light Bulbs with CFLs	7,688	0	0	5.69
Install Programmable/Setback Thermostats	0	801	0	4.25
Control Air Leakage	0	3750	0	19.91
Insulate and Seal Rim/Band Joist	0	519	0	2.76
Insulate Attic Space to R-49	0	1178	0	6.26
Totals	**23,376**	**6,733**	**361**	**53.05**

Table 16. Measures for Consideration at the End of Useful Life (EUL) of Equipment

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install High Efficiency Furnaces	ECM7	$21,000	$1,933	10.9
Replace Hot Water Heaters with Energy Star Models	ECM8	$7,500	$476	15.8
Totals		**$28,500**	**$2,409**	**11.8**

10.1 WCM1 - Install Low-Flow Toilets

Summary				
# of Toilets Replaced	**Cost to Implement**	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Water Savings (gal/yr)**
15	$3,375	$917	3.7	104,025

Recommendation Description

In some areas, water and sewer rates have increased dramatically over the past few years and are rivaling the cost of energy. Reducing water use through conservation strategies can generate significant cost savings. These strategies include implementing low-flush volume toilets.

Significant advances in technology over the past decade have resulted in the availability of reliable, high-quality water-saving toilets on the market. Older toilets (pre-1994) typically have a flush volume of 3.5 gallons per flush (GPF) or greater. The current standard for new toilets is 1.6 GPF.

It is recommended that all older toilets (3.5 GPF / pre-1994) be replaced with new toilets meeting the 1.6 GPF criteria (minimum) or better. Toilets certified with the WaterSense label consume only 1.28 GPF (recommended). Such toilets use 20 percent less water than the current federal standard, while still providing equal or superior performance. WaterSense, a program sponsored by the U.S. Environmental Protection Agency (EPA), is helping consumers identify high performance water-efficient toilets that can reduce water use in the home and help preserve the nation's water resources.

Assumptions

Calculation of savings is based on replacing 15 toilets using 3.5 GPF with new toilets using 1.6 GPF (1.28 GPF fixtures recommended). A value of 5 flushes per toilet per day (from the REUWS survey referenced in Section 5.3) was used. This method produced a water savings of 104,025 gallons per year.

Incentives

AAHC should contact their water supplier to inquire on current incentives available.

Expected Useful Life Study

Toilets have an expected useful life of approximately 20 years. It is believed that the older toilets at Maple Meadows are approximately 20 years old and should be replaced soon.

10.2 WCM2 - Install Ultra Low-Flow Showerheads and Faucet Aerators

Summary						
# of units	Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gal/yr)
15	$300	$1,936	0.2	0	485	165,990

Recommendation Description

In some areas, water and sewer rates have increased dramatically over the past few years and are rivaling the cost of energy. Reducing water use through conservation strategies can generate significant cost savings. These strategies include implementing low flow shower heads and faucet aerators.

Site observations revealed that the existing showerhead was rated at 2.5 GPM and existing faucet aerators appeared to be rated at 2.2 GPM (most common). It was reported that low-flow showerheads and faucet aerators had been implemented in many of the units, but a definitive count was not available.

It is recommended to install an ultra-low-flow shower head (1.5 GPM) and ultra low-flow faucet aerators (1 GPM) in the bathrooms of all units which have not been retrofit (estimated at 15). This conservation measure will save both water and energy used for heating water.

Assumptions

Calculation of savings is based on replacing fifteen (15) showerheads using 2.5 GPM with ultra low-flow shower heads (1.5 GPM). An average shower duration of eight (8) minutes per occupant per day (from the REUWS survey referenced in Section 5.3) was used, assuming two (2) occupants in each unit. This method produced a water savings of 87,360 gallons per year.

Calculation of savings is based on replacing fifteen (15) faucet aerators using 2.2 GPM with ultra low-flow faucet aerators (1 GPM). An average faucet usage time of 6 minutes per capita per day (from the REUWS survey referenced in Section 5.3) was used, assuming two (2) occupants in each unit. This method produced a water savings of 78,630 gallons per year.

The natural gas savings was calculated using the assumption that 50% of the water used at shower and faucets was hot water.

Incentives

DTE Energy's Multifamily program currently offers incentives for low-flow shower heads and low-flow faucet aerators.

Expected Useful Life Study

Faucet aerators and showerheads have an expected useful life of ten years. It is believed that the faucets and showerheads were installed approximately 10 years ago and are need of replacement.

10.3 ECM1 - Replace Exterior HID Wall Pack Lighting with LED Lighting

Summary					
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$10,110	$2,338	4.3	15,688	0	11.61

Recommendation Description

The outside grounds of the Maple Meadows property are illuminated throughout the evening hours for safety and security. There are exterior lighting (wall pack) fixtures located near the front and rear entrance doors of each home. These wall packs are of the high intensity discharge (HID) type with high pressure sodium (HPS) lamps that appeared to be 35 watts each. There are also larger flood lights installed on the gable ends (mostly) to light the grounds. These flood lights are of the high intensity discharge (HID) type with high pressure sodium (HPS) lamps that appeared to be 150 watts each. The site visit light count total was 60 of the smaller wall packs and 10 of the larger flood lights.

The existing HID exterior lighting is outdated, and significantly more efficient lighting options are readily available. For this application, it is recommended that exterior lighting be retrofitted with more efficient light emitting diode (LED) lighting.

Along with significant electrical savings at equivalent lumen output, maintenance will be greatly reduced as the LED lights proposed have an L_{70} lifespan of 100,000 hours. L_{70} is an industry standard to express the useful lifespan of an LED. It indicates the number of hours before light output drops to 70% of initial output. Maintenance reduction is not factored into the savings calculated for this report. LED lighting is considered a green technology due to the high fixture efficacy and the absence of mercury, arsenic, and ultraviolet (UV) light.

This ECM analysis was based on replacing the existing wall pack fixtures with 12 watt high performance LED wall packs. The existing flood lights are replaced with model #FFLED39 (RAB Lighting) **or equivalent**, 39 watt high performance LED flood. The specification sheet for the analyzed model is included in the appendix.

The initial cost of this project is the material cost for 60 wall packs and 10 flood lights. The fixtures have provisions for junction box and surface mount for recessed box applications, and are assumed to be installed by in-house maintenance staff. Again, the additional savings associated with reduced maintenance costs are not included in the calculated savings.

Assumptions

Installation of new LED wall packs would be performed by in-house maintenance staff at no additional labor cost.

It is assumed that the proposed fixtures will provide adequate light level for safety and security purposes. The lighting calculator spreadsheet result is included in the appendix.

The existing wall packs contain 35 watt high pressure sodium (HPS) lamps and have an input wattage of 46 watts each.

The existing flood lights contain 150 watt high pressure sodium (HPS) lamps and have an input wattage of 188 watts each.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives

DTE Energy's Multifamily Program is offering incentives for replacing existing HID exterior lighting with LED lighting. Existing lighting must operate more than 3,833 hours per year and replacement must result in at least a 40% power reduction. In addition, the replacement lamp must have an efficacy of at least 35 lumens per watt. The application and specifications for these incentives is included in the appendix.

Expected Useful Life Study

Lamps in the exterior light fixtures were installed in 2009 and have an expected useful life of six years. It is believed that the lamps will need to be replaced in two years. The expected useful life of an LED replacement fixture is typically around 15 years.

10.4 ECM2 - Replace Incandescent Bulbs with CFLs

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (metric tons)**
$420	$1,204	0.3	7,688	0	5.69

Recommendation Description

A total of four (4) incandescent lamps, in various fixtures, were observed in the subject unit during the site visit. The majority of the incandescent lamps were 60 watt, with some 75 watt lamps observed. It is recommended that **all** remaining incandescent lamps be upgraded to compact fluorescent lamps (CFLs). The existing incandescent lamps are inefficient and require unnecessary amounts of energy. The incandescent lamps are a mix of 60 watt and 75 watt, which have 16 watt and 19 watt CFL replacements respectively.

Compact fluorescent lamps are a great alternative to incandescent bulbs. On average, CFLs use seventy-five percent less electricity than incandescent bulbs and have a lifetime that is 10 times longer. Advances in technology over the past few years have brought great improvements to CFLs in terms of light quality and appearance, and they are available in a variety of shapes and sizes.

Assumptions

This ECM is calculated using a replacement total of 120 CFLs (4 CFLs per unit x 30 units). Lamps are assumed to operate 1,456 hours per year (4 hours per day each). It is assumed all of the existing lamps are 60 watt incandescent, and they will be replaced with 16 watt CFLs. The lighting calculator spreadsheet result is included in the appendix.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives

DTE Energy has incentives available through their Multifamily Program for the replacement of incandescent lamps with CFLs.

Expected Useful Life Study

Incandescent lamps have an expected useful life of 1-2 years. Alternatively, compact fluorescent lamps have an expected useful life of 6-8 years, depending on the amount of usage per day.

10.5 ECM3 - Install Programmable Thermostats

Summary					
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$1,500	$794	1.9	0	801	4.25

Recommendation Description

Currently, control of the furnace heat in each home is by a manual thermostat located in the living room. Please note that although the thermostat observed during the site visit (possibly others) is electronic with a digital display, it is not programmable.

It is recommended that a programmable thermostat is installed to control the heat. The programmable thermostats would allow a nighttime setback to be employed, thereby saving energy on heating during overnight hours.

Because the thermostat is controlled by the resident, a "tamper-proof" type design should be considered. Tenant or resident energy education is crucial when replacing manual thermostats with temperature limiting programmable thermostats. At the time of installation, tenants and residents should be informed about why the thermostats were selected and how they operate. Recommended temperature settings are included below.

	Heating Daytime Setting	Heating Nightime Setback
Current Setpoints (estimated)	72 °F	72 °F
Proposed Setpoints	72 °F	68 °F

Calculations

Calculations were performed using an energy savings calculator that was developed by the U.S. EPA and U.S. DOE for estimating purposes. The calculator was modified to more closely represent the actual building heating load. Weekday and weekend typical usage pattern used an 8 hour nighttime setback of 68 degrees and a regular setpoint of 72 degrees.

Assumptions

The subject energy savings calculator assumes the following:
Savings per Degree of Setback (Heating Season) = 3% based on Industry Data 2004

The baseline energy consumption for heating dedicated to the building was estimated using a

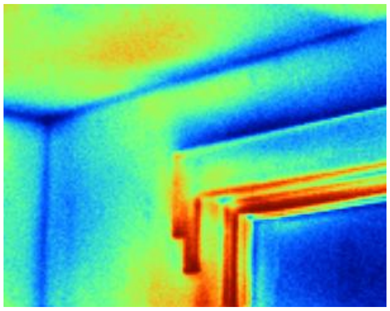
combination of the consumption profiles in Section 5.2 and the auditor's judgment. Resultant consumption was 1,996.3 MMBtu for heating. A reduction of 4 degrees (nighttime setback of 68 degrees) for an 8 hour setback every night was assumed.
Incentives
DTE Energy has incentives available through their Multifamily Program for the installation of Energy Star rated programmable thermostats.
Expected Useful Life Study
Manual thermostats have an expected useful life of 15 years. At the time of replacement, it is recommended that the manual thermostats be replaced with programmable thermostats with the same expected useful life.

10.6 ECM4 - Control Air Leakage

Summary					
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$9,000	$3,717	2.4	0	3,750	19.91

Recommendation Description

Air leakage through holes, gaps, cracks, penetrations, and electrical receptacles is a major source of heat loss from a dwelling unit. Controlling this air leakage through a combination of weather stripping and strategic sealing can significantly reduce the amount of heat lost to the outside, thus reducing the amount of energy needed to heat the dwelling unit. Insulation also can help reduce air leakage.


Infrared image – possible leakage at window header

In addition to saving energy, controlling air leakage can reduce moisture problems and reduce the influx of odors and contaminated air from the basement and other units, while increasing the overall comfort of the residents.

But reducing air leakage through air-sealing techniques is more complicated than simply weather-stripping and caulking. Two important principles must be understood. First, even if a building is full of holes, air will not move through those holes unless there is a difference in pressure between indoors and outdoors. This pressure differential depends on the difference between indoor and outdoor temperatures, wind speed and direction, and mechanical ventilation. If there is no pressure differential, the air stands still and does not leak in or out. This is important because sealing a hole where there is no pressure differential will not save energy. Pressure tends to be highest on upper and lower floors and in basements. In the heating season, hot air rises and pushes on the ceiling, creating high positive pressure and eventually leaking out. When it does leak out, it is replaced by cold air coming into the lower part of a building, where the pressure is negative from all the warm air moving upward. This force is called the “stack effect.”

The second important principle is that air sealing can affect air quality. Air leakage is the primary source of ventilation in many buildings. Tightening a building by reducing air leakage can endanger the health of the occupants in buildings with no mechanical ventilation. This risk is highest in buildings with significant sources of indoor air pollution, such as back drafting from gas appliances or high occupancy levels. If a building does not have mechanical ventilation, it is recommended that a ventilation system be installed before any significant air leakage is significantly reduced.

For the subject property, Maple Meadows: (see Section 5.5.5 and 5.5.6 for details)

The blower door test determined that air leakage is adequate for ventilation.
The blower door airflow rate was 1,750 CFM50.
The building tightness limit (BTL) is 704 CFM50.

Therefore, an air leakage reduction limit of 60% should not be exceeded.

Air Sealing Strategy:

Air seal the home to the minimum ventilation rate (MVR) for air leakage, but **not** below.

Window areas are cause of drafts. All interior window casing should be sealed with caulk (outside of the casing to the wall, inside of the casing to the jamb extensions, and the jamb extensions to the window frame). Products such as Dap's Seal & Peal (removable weather-strip caulk provides a watertight and weatherproof seal to temporarily seal out drafts and save energy / peels away when removal is desired / won't damage painted surfaces) can be used to air seal the leaks between the slider units and window frame. The tested unit had weather stripping at the entry doors (complete jambs and new threshold sweep), but all units should be checked for the same.

Floor to wall joints have air leakage. Base molding and shoe molding should be caulked complete at floor and wall.

Wall penetrations have air leakage. Plumbing pipes under sinks, electrical outlets, and other wall and ceiling penetrations should be sealed.

Air seal the attic as necessary. This would include ceiling and top plate penetrations (electrical and plumbing vent stack); also, the perimeter furring cavity is likely to have significant air leakage.

Assumptions

Air sealing would cost $300 per unit ($9,000 total for the facility) to achieve 60% reduction in air leakage. This is difficult to predict, and it is highly recommended to air seal a sample unit while conducting periodic "post" blower door tests to track air sealing progress and verify scope of work. This method should result in a scope of work that will provide a predictable reduction in air leakage.

Calculations

See Section 5.5.5 and 5.5.6 for details.
The sensible heat loss due to excess air leakage was estimated based on a 60% reduction of existing air leakage (118 CFM). This preserves the MVR detailed in the recommended description above. Equation used for estimation was: Q = 1.08 * (118 cfm) * (6,818 HDD) * 24 hr/day = 12,284,255 Btu (approx. 125 therms) per unit.

Incentives

DTE Energy's Multifamily program does not offer incentives for air sealing at this time.

Expected Useful Life Study

Depending on the applied location, the life expectancy of caulks and sealants can be in the range of five to ten years. It is believed that the areas identified with air leakage have either never been sealed in the past or need to be resealed.

10.7 ECM5 - Insulate and Seal the Rim/Band Joist

Summary					
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$4,700	$514	9.1	0	519	2.76

Recommendation Description

In order to improve the comfort, efficiency, durability and healthfulness of buildings, it's necessary to control the movement of heat, air and moisture within and through a building envelope. Attention to insulation and air-sealing details throughout a house is critical. One area that is commonly overlooked or undervalued is the rim or band joist, located in the basement and between floors.

The typical residential unit at Maple Meadows was observed to have Kraft-faced, R-11 insulation tucked into rim cavities in the basement. Almost all areas were poorly installed and many areas were missing insulation completely. Stuffing fiberglass batts between floor joists is a common method of insulating the rim joist in many homes, but it's a flawed technique. Fiberglass works best in an enclosed space where it can trap air (between drywall and the exterior sheathing of a stud wall, for example). In a typical (poorly) insulated fiberglass installation, as observed tenant units, air moves freely around the batts, as well as through the fiberglass itself.

As an alternative, relatively new to the market, two-component spray-foam kits offer a quick, effective solution to tricky insulating problems. The kit consists of two liquid chemicals that mix together in the tip of a gun, and then expand once they hit the surface. The foam is highly adhesive, so it sticks and stays in place as it expands to fill gaps. Once cured, the foam provides an effective air seal as well as insulation.

This ECM analyzes the removal of existing fiberglass batts, and the application of 1-2 inches of closed cell foam in the rim/band joist cavity. Fiberglass could be set aside and properly reinstalled/reapplied after the closed cell foam application has fully cured in place. It is assumed that after reapplication of fiberglass, the effective R-value would be targeted at R-19.

The International Residential Code (IRC) allows the exposed use of spray foam at rim joists (i.e., without a 15-minute thermal barrier such as drywall), as long as the thickness is less than 3-¼".
High density (closed cell, 2 PCF) spray foams were approved in the 2003 IRC, and low density (open cell, 0.5 PCF) foams were approved in the 2009 IRC, as well as any intermediate densities.

Calculations

The conductive heat loss due through the ceiling was estimated based comparing an R-6 or less rim/band joist area with an R-19 rim/band joist area. Equation used for estimation was the standard heat loss:

$$Q = U * A * (6{,}818\ HDD) * 24\ hr/day$$

Heat loss due to air leakage was estimated at 2 times the conductive heat loss.

Incentives

DTE Energy's Multifamily program does not offer incentives for air sealing or insulation at this time.

Expected Useful Life Study

Aside from potential exposure to environmental elements, insulation, for the most part, has an expected useful life of over fifty years. Adding insulation to the existing layer should be considered when the existing insulation is still in good condition and is sufficient to fulfill code requirements.

10.8 ECM6 - Increase Attic Insulation to R-49

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (metric tons)**
$12,000	$1,168	10.3	0	1,178	6.26

Recommendation Description

Attic insulation reduces the amount of heat that flows from a dwelling unit through the attic to the cold outside air. By reducing this heat loss, attic insulation reduces the amount of energy needed to heat the dwelling unit in the winter. In the summer, attic insulation saves on cooling costs and keeps buildings more comfortable by reducing the conduction of heat from the hot attic through the ceiling and into the unit.

A material's resistance to heat flow is measured in units of "R-value". The higher the R-value, the better the insulating property. The R-value of insulation depends on the type of insulation and its thickness. Optimal R-value for attic insulation depends on the existing insulation, fuel costs, and climate.

The typical attic appears to have 3.5" (nominal) batts of R-11 insulation laid on the ceiling with approximately 3" of blown fiberglass insulation on top of the batts. The estimated R-value of this insulation type and level is R-19 (loose fill fiberglass, 0.6 lb/ft^3, horizontal application, open blow, R-value 2.8 per inch. The insulation observed onsite appeared to be poorly placed with the blown insulation often unevenly distributed. It was also noted that areas around the stairwell were missing insulation. This uneven distribution of insulation results in a lower effective insulation value in the attic. Overall, this insulation would be considered standard efficiency at best, or in some cases substandard efficiency (<R-21).

This ECM explored adding an additional insulation level of R-30, bringing the total to R-49, which is the target Energy Star recommended insulation level (R-49) for retrofitting wood-framed buildings in this climate zone.

It was noted that the end units (3-br apartments) have an approximately 5'x15' overhanging space on the second floor. The audit team was unable to determine if insulation exists in the floor joist cavities and believe this could be an area of heat loss for these units.

If the attic insulation is increased, be sure to do any required air sealing first. Also, rafter vents (insulation baffles) will likely be required to achieve the desired insulation depth near the eaves. The following is from the Energy Star website regarding rafter vents:

To completely cover your attic floor with insulation out to the eaves you need to install rafter vents (also called insulation baffles). Complete coverage of the attic floor along with sealing air leaks will ensure you get the best performance from your insulation. Rafter vents ensure the soffit vents are clear and there is a channel for outside air to move into the attic at the soffits and out through the gable or ridge vent. To install the rafter vents, staple them directly to the roof decking. Rafter vents come in 4-foot lengths and 14-1/2 and 22-1/2 inch widths for different rafter spacings. Rafter vents should be placed in your attic ceiling in between the rafters at the point where your attic ceiling meets your attic floor.

Once they are in place, you can then place the batts or blankets, or blow insulation, right out to the very edge of the attic floor. Note: Blown insulation may require an additional block to prevent insulation from being blown into the soffit. A piece of rigid foam board placed on the outer edge of the top plate works very well for this.

Assumptions

A cost of $0.82 per square foot (from RS Means) of approximately 6” of blown loose -fill cellulose insulation was used for this estimate. Total estimated area to be insulated was 14,730 square feet.

Calculations

The conductive heat loss due through the ceiling was estimated based comparing an effective insulation value of R-12 in the ceiling area with an R-49 ceiling area. Equation used for estimation was the standard heat loss: $Q = U * A * (6{,}818\ HDD) * 24\ hr/day$

Incentives

DTE Energy’s Multifamily program does not offer incentives for insulation at this time.

Expected Useful Life Study

Aside from potential exposure to environmental elements, insulation, for the most part, has an expected useful life of over fifty years. Adding insulation to the existing layer should be considered when the existing insulation is still in good condition and is sufficient to fulfill code requirements.

11.0 ECMs for Replacement at End of EUL

The following are ECMs for which the calculated payback period exceeds the useful life of the product, when considered for immediate replacement. However, these ECMs have a viable payback period when the replacement occurs at the end of the product's estimated useful life (EUL), since the item would be replaced at this time in any case. In order to demonstrate the benefit of upgrading to an energy efficient product, only the premium cost for upgrading to the energy efficient product is considered in the initial investment. The premium cost is the difference between the cost of the energy efficient item and the standard replacement item.

11.1 EUL1 - Install High-Efficiency Furnaces (x30)

Summary

Premium Cost	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$14,940	$1,933	10.9	0	1,950	10.35

Recommendation Description

Replacing the old heating plant in a building can generate considerable savings if the existing equipment is inefficient and/or the fuel source is expensive compared to other options. A furnace near the end of its useful life is a particularly good candidate for replacement with high-efficiency equipment. It is recommended that the AAHC replace the existing standard efficiency (80%) furnaces with high efficiency furnaces at their end of EUL. **This opportunity is approaching,** as the existing furnaces are 12 years into an estimated useful life of 15 years.

Because of technology advances, new furnaces are much more efficient than they used to be, presenting opportunities for significant savings on heating costs. Existing furnaces have a designed efficiency of 80-81%. Replacement units are available with efficiencies of up to 95%. Significant energy savings can be realized with the installation of more efficient units.

This ECM is calculated for replacing the all thirty (30) existing furnaces with high efficiency (Goodman model #GKS90703CX - 92% AFUE) over standard efficiency (Goodman model #GMS80703AN - 80% AFUE).

Calculations

Natural gas consumption of existing furnaces is equal to 73% of total consumption (19,963 therms for furnace heating). Efficiency gain from 80% to 92% with high efficiency units.

Base cost of $1,900 for standard efficiency Goodman model #GMS80703AN (80% AFUE).
Base cost of $2,400 for standard efficiency Goodman model # GKS90703CX (92% AFUE).
Additional labor cost of $200 per furnace for high efficiency installation. This is for the cost of installing necessary PVC venting runs through the exterior wall.

Incentives

DTE Energy's Multifamily Program is not offering incentives for high efficiency furnaces at this time.

Expected Useful Life Study

Furnaces have an expected useful life of 15 years. The existing units were installed at different dates. The following lists the furnaces per tenant unit and their installed date:

Tenant Unit #	Model	Installed Date
800, 806, 810, 820, 824, 826, 830, 840, 844, 846, 860, 864, 866, 870, 884, 886, 890	GMS80703AN	2011
802, 822, 842, 848, 862, 868	GMS80453AN	2011
804, 808, 828, 850, 880, 882, 888	58PAV090-14	2001
880 Waiting Room	58STA070-10112	2002

Units 804, 808, 828, 848, 862, 868 and the waiting room in 880 have furnaces that are near expected useful life. At the time of replacement, it is recommended to install high efficiency furnaces.

Manual J Calculations

To confirm appropriate sizing of the recommended heating equipment, AKT Peerless performed calculations in accordance with Air Conditioning Contractors of America (ACCA) Manual J guidelines. An industry accepted software program, HVAC-Calc Residential 4.0.58c, was used to calculate the heat loss and heat gain in a unit. A detailed report of the Manual J calculations is included in the appendix of this report.

Tenant Unit #	Heat Gain (Btu/h)	Heat Loss (Btu/h) w/ 25% factor
800, 850	10,859	28,766
802, 808, 842, 848, 882, 888	8,195	18,235
804, 844, 884	10,723	24,466
806, 846, 886	11,226	24,416
810, 840, 890	10,721	28,376
820, 870	10,148	28,778
822, 828, 862, 868	6,130	17,906
824, 864	8,354	20,144
826, 866	8,692	24,491
830, 860	10,116	28,406
880 Community Center	14,947	41,959

Overall values for the heat loss within the software are often increased by a factor of 25% to account for averages used in the winter design temperatures. It should be noted that these calculations have assumed previously recommended ECMs have already been implemented. Because high-efficiency furnaces are not typically manufactured with a rating below 45kBtu/h, it is believed that the existing furnace size is appropriate for all of the units.

11.2 EUL2 - Replace Hot Water Heaters with Energy Star Models (x30)

Summary					
Premium Cost	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (metric tons)
$7,500	$476	15.8	0	480	2.55

Recommendation Description

Usually, a water heater is replaced only when it fails. But if the existing water heater is at least ten years old, it is near the end of its useful life, and it may make sense to replace it before it fails. By replacing the water heater before it stops working, the Housing Authority may enjoy significant energy savings, in addition to avoiding a situation in which residents are without hot water while a new system is being selected. Replacements of old water heaters that are oversized will generally yield higher savings than if the old system is appropriately sized. In any case, if the old water heater is leaking or shows signs of heavy rust or water streaking in the combustion chamber, it should be replaced (Weingarten and Weingarten 1996).

The energy factor (EF) indicates a water heater's overall energy efficiency based on the amount of hot water produced per unit of fuel consumed over a typical day. This includes the following:

- Recovery efficiency – how efficiently the heat from the energy source is transferred to the water
- Standby losses – the percentage of heat loss per hour from the stored water compared to the heat content of the water (water heaters with storage tanks)
- Cycling losses – the loss of heat as the water circulates through a water heater tank, and/or inlet and outlet pipes.

A new standard efficiency 40-gallon gas water heater has a current minimum Energy Factor of 0.59, due to inefficiencies of combustion, a central flue carrying heat away with combustion exhaust, and a continuous gas pilot light, as well as standby losses through insulation and thermo-siphoning.

This ECM recommends Energy Star qualified gas water heaters (Energy Factor of 0.67 or greater). This represents a 14% percent savings compared to a standard efficiency gas water heater. In addition to reducing standby losses with added insulation and anti-thermo-siphon device (heat traps), these improved efficiencies can be achieved for very little added cost by using electronic ignition instead of a pilot light, having automatic draft dampers, and reducing losses out the flue by recovering more of the heat first.

Energy Star Qualifying Models: Residential High-Efficiency Gas Storage Water Heaters
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WGS

- Minimum Energy Factor (EF) of 0.67 as of September 1st, 2010.
- Minimum First Hour Rating (FHR) of 67 gallons
- Annual energy savings of 14% (Based on the National Gas Average Energy Cost and a comparison to a conventional gas water heater with an EF rating of 0.59)

Calculations

Data used in this ECM are from a cost comparison study conducted by the American Council for an Energy-Efficient Economy (ACEEE). http://aceee.org/about

Incentives

DTE Energy's Multifamily Program is not offering incentives for replacing older hot water heaters with Energy Star models at this time.

Expected Useful Life Study

Hot water heaters have an expected useful life of ten years. The existing hot water heaters were installed at different times. The following lists the hot water heaters per tenant unit and their installed date:

Tenant Unit #	Tank Size	Installed Date
826	40 gallon	2013
800, 888	40 gallon	2012
820, 884	40 gallon	2010
808, 810	40 gallon	2009
824	40 gallon	2008
804, 802, 806, 822, 828,830, 840, 842, 844, 846, 848, 850, 860, 862, 864, 866, 868, 870, 880, 882, 886, 890	40 gallon	2002

Most of the tenant units have hot water heaters that are at their expected useful life and are recommended for replacement in the near future.

First Hour Rating Calculation

Use	Avg. Gal. of Hot Water Use		Times used during 1 hour		Gallons used in 1 hour
Shower (8 minutes avg.)	10	x	# of tenants	=	10/20
Shaving (.05 gpm)	2	x	1	=	2
Hand Dishwashing or Food prep (2 gpm)	4	x	1	=	4
Clothes Washer (one load)	7	x	1	=	7
Total Peak Hour Demand				=	23/33

Depending on the anticipated number of tenants in a unit, the recommended size for replacement hot water heaters is 30 gallon tanks. Some of the existing tank sizes in units are adequate for standard replacements; however, it is recommended that any existing 40 gallon tanks be replaced with 30 gallon tanks at the end of their useful life.

12.0 Advanced ECMs and/or ECMs Recommended for Further Evaluation

The following capital intensive measures may be feasible but would require an additional, detailed engineering analysis.

12.1 FE1 - Replace/Invest in Energy Star Clothes Washers

Recommendation Description
Because the Owner of the property is responsible for paying the water utility, the audit team believes an investigation into high efficiency clothes washers may be a sound investment for the Ann Arbor Housing Commission. Typically, residents are responsible for providing their own washers and dryers. This reduces a first cost for the housing commission – however, residents appear to be installing/utilizing the cheapest functioning units available. These units are often very old, and extremely inefficient. This results in high electrical energy consumption, but even greater water consumption. In the past few years, the change in design and operation of the clothes washer units has allowed the consumer to reduce water usage and drying time. Typical high-efficiency washers use 27 gallons of water per load. In contrast, conventional models that were built from 1980 to the late nineties consumed between 43 and 51 gallons of water per load. In addition to a reduction in water usage, many of the energy efficient washers will minimize the amount of hot water use by utilizing cold water as much as possible. The faster cycle on the efficient washers also minimizes the time needed to dry clothes, which overall minimizes the electrical consumption for laundry. The existing washers at the subject property were identified to be Maytag residential units that are over 10 years old. It is assumed that all tenant units are occupied; however, the typical usage of the laundry units is unknown and would require additional analysis to properly determine the savings from installing Energy Star rated washing machine units. Additionally, converting the existing washing machines to only using a cold rinse can also provide substantial savings based on tenant usage. Presently, DTE Energy's Multifamily Program is not offering any incentives to install Energy Star products. Because the Owner is responsible for water consumption, and water costs continue to rise, the team recommends a further life cycle investigation into funding and installing Owner-supplied (cold rinse) Energy Star units.
Incentives
Presently, DTE Energy's Multifamily Program is not offering incentives for installing Energy Star products at this time.

Expected Useful Life Study
With typical use, the average clothes washing machine has an expected useful life of 14 years. It is believed that the existing units are at or near the end of their useful life.

13.0 Feasibility Assessment of Green Technologies

The following Green Energy Technologies were evaluated for their application at the subject property:

13.1 Photovoltaic for Electricity

Implementing photovoltaic panels for electricity at the subject property has been considered by the Ann Arbor Housing Commission. The south-facing orientation of each of the roofs at this property provides optimal solar energy collection. Unfortunately, renewable energy incentives are not currently available to the Client to reduce high installation costs.

13.2 Solar Thermal for Hot Water Heating

Hot water usage at the subject property is not high enough to justify initial costs of solar heating therefore the property is not a viable candidate of solar thermal for hot water heating. Further study is not recommended.

13.3 Wind Turbine

The property is not a viable candidate of installing wind turbines due to insufficient wind power in this geographic area. Further study is not recommended.

13.4 Combined Heat and Power

The property has less than 80 units (a rule of thumb for minimum number of units for feasibility) and does not have a central power source. The property is not a viable candidate of implementing combined heat and power and further study is not recommended.

13.5 Fuel Cells

Due to the high initial costs associated with fuel cells, implementation is not recommended at the subject property. Further study is not recommended.

14.0 Recommendations & Impact

Based on the analysis described in this report, AKT Peerless believes substantial energy conservation opportunities are available, and recommends implementation of all proposed ECMs.

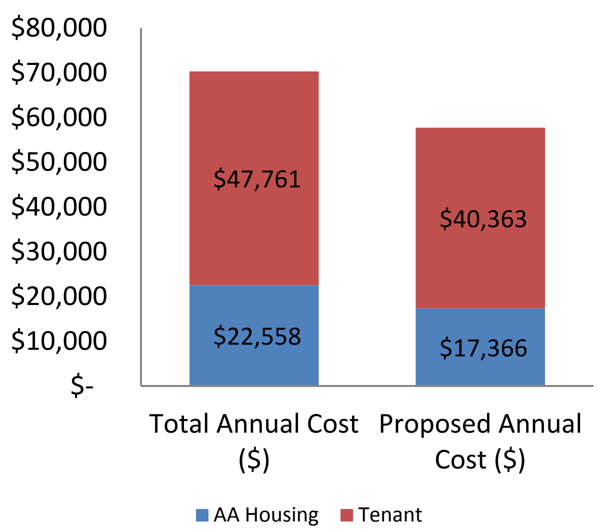
The combined annual EUI for the subject building is 60.33 kBtu per square foot per year. The annual energy cost index is $1.12 per square foot per year. Reduction of fuel (non-electrical) and electrical energy consumption through the implementation of recommended ECMs will potentially result in a reduced EUI of 44.60 kBtu per square foot per year, a potentially reduced annual cost index of $0.85 per square foot per year, and potential total annual energy cost savings of $12,590 per year.

An additional result of implementing the recommended ECMs would be the reduction of greenhouse gas (GHG) emissions by 53.05 metric tons. Measurements of greenhouse gas emissions are based on data gathered from the United States Environmental Protection Agency (USEPA) eGRID database.

The subject building is located in eGRID electric utility sub-region RFCW. Greenhouse gas emissions from electrical consumption are based on emissions data measured at the electrical generating facilities serving consumers located in the specified eGRID utility sub-region, and therefore greenhouse gas emissions and the estimated reduction in greenhouse gas emissions reflect the mix of fuel sources used by the regional electrical utilities serving the subject property. Emissions factors for natural gas consumption are based on data gathered from the 2009 United States Greenhouse Gas Inventory, Annex 2.

Table 17. Impact Summary

% Energy Savings	26%
% Water Savings	14%
% Cost Savings	18%
Annual Cost Savings ($)	$12,590
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	20%



15.0 Limitations

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained in herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, third parties, or the secondary information sources cited in this report is complete or accurate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

ASHRAE *Procedures for Commercial Building Energy Audits* recommends that the Energy Analyst apply a consistent definition of building square footage to both the subject building and to similar buildings used for energy performance comparisons. AKT Peerless cannot evaluate the accuracy or consistency of building square footage measurements of similar buildings included in the comparison database.

The Energy Analyst has not verified the accuracy of building floor area as reported by the building owner/operator and has not verified that the building owner/operator's definition of building usage is consistent with the definitions used in the CBECS.

The Energy Analyst has not evaluated the potential financial savings from changing to a different utility price structure.

Also, the Energy Analyst has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to the energy analyst and information not reported to the energy analyst may influence the findings of report. Information provided by the owner/operator of the subject building or other client representatives is summarized in the appendix, including utility bills and other energy invoices.

16.0 Signatures

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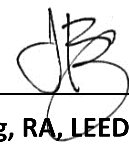

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NATURAL GAS UBA									
AAHC Site:	Maple Meadows (Common)								
Meter #:	9050710 09								
Month	Start	End	Days	HDD	Consumption Therms	Actual (0) Estm. (1)	Delivery $	Gas $	Total $
Mar-12	3/14/2012	4/13/2012	30	529	28	0	$ -	$32.70	$33
Apr-12	4/13/2012	5/15/2012	32	513	20	0	$ -	$26.37	$26
May-12	5/15/2012	6/15/2012	31	171	9	0	$ -	$16.24	$16
Jun-12	6/15/2012	7/14/2012	29	90	7	0	$ -	$16.05	$16
Jul-12	7/14/2012	8/13/2012	30	23	7	0	$ -	$15.87	$16
Aug-12	8/13/2012	9/12/2012	30	80	8	0	$ -	$16.67	$17
Sep-12	9/12/2012	10/10/2012	28	223	11	0	$ -	$18.99	$19
Oct-12	10/10/2012	11/9/2012	30	478	54	0	$ -	$52.99	$53
Nov-12	11/9/2012	12/11/2012	32	478	71	0	$ -	$81.97	$82
Dec-12	12/11/2012	1/14/2013	34	478	323	0	$ -	$270.82	$271
Jan-13	1/14/2013	2/13/2013	30	478	220	0	$ -	$190.77	$191
Feb-13	2/13/2013	3/14/2013	29	478	122	1	$ -	$117.45	$117
					880				**$857**
									$0.974 $/Therm

NATURAL GAS UBA									
AAHC Site:	Maple Meadows (Tenant)								
Month	Start	End	Days	HDD	Consumption Therms	Actual (0) Estm. (1)	Delivery $	Gas $	Total $
Mar-12	3/14/2012	4/13/2012	30	529	1529	0	$ -	$1,597.62	$1,598
Apr-12	4/13/2012	5/15/2012	32	513	1301	0	$ -	$1,406.09	$1,406
May-12	5/15/2012	6/15/2012	31	171	800	0	$ -	$944.40	$944
Jun-12	6/15/2012	7/14/2012	29	90	553	0	$ -	$753.56	$754
Jul-12	7/14/2012	8/13/2012	30	23	552	0	$ -	$755.84	$756
Aug-12	8/13/2012	9/12/2012	30	80	683	0	$ -	$872.32	$872
Sep-12	9/12/2012	10/10/2012	28	223	1056	0	$ -	$1,180.35	$1,180
Oct-12	10/10/2012	11/9/2012	30	478	1726	0	$ -	$1,752.55	$1,753
Nov-12	11/9/2012	12/11/2012	32	478	2449	0	$ -	$2,364.45	$2,364
Dec-12	12/11/2012	1/14/2013	34	478	3417	0	$ -	$3,040.74	$3,041
Jan-13	1/14/2013	2/13/2013	30	478	3751	0	$ -	$3,319.60	$3,320
Feb-13	2/13/2013	3/14/2013	29	478	3218	1	$ -	$2,864.76	$2,865
				4019	**21,035**				**$20,852.28**
									$0.931 $/Therm

ELECTRICAL UBA

AAHC Site: **Maple Meadows (Common Areas)**

Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Demand kW	Consumption Charges ($)	Demand Charges ($)	Total Charges ($)
Mar-12	3/14/2012	4/13/2012	30	529	33	0	2223		$341.95	$0	$341.95
Apr-12	4/13/2012	5/15/2012	32	513	7	0	2210		$342.37	$0	$342.37
May-12	5/15/2012	6/15/2012	31	171	118	0	2462		$336.64	$0	$336.64
Jun-12	6/15/2012	7/14/2012	29	90	245	0	2077		$326.31	$0	$326.31
Jul-12	7/14/2012	8/13/2012	30	23	409	0	2001		$310.50	$0	$310.50
Aug-12	8/13/2012	9/12/2012	30	80	233	0	2656		$398.60	$0	$398.60
Sep-12	9/12/2012	10/10/2012	28	223	93	0	2614		$393.41	$0	$393.41
Oct-12	10/10/2012	11/9/2012	30	478	15	0	2935		$437.16	$0	$437.16
Nov-12	11/9/2012	12/11/2012	32	478	15	0	3630		$531.84	$0	$531.84
Dec-12	12/11/2012	1/14/2013	34	478	15	0	3813		$550.81	$0	$550.81
Jan-13	1/14/2013	2/13/2013	30	478	15	0	3095		$456.67	$0	$456.67
Feb-13	2/13/2013	3/14/2013	29	478	15	0	2647		$397.46	$0	$397.46
							32,363	**#DIV/0!**	**$4,824**	**$0**	**$4,823.72**
								0	**$0.149**	**#DIV/0!**	**$0.149**
								Avg & Max	**$ / kWh**	**$ / kW avg**	**Blended $/kWh**

ELECTRICAL UBA

AAHC Site: **Maple Meadows (Tenant)**

Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Demand kW	Consumption Charges ($)	Demand Charges ($)	Total Charges ($)
Mar-12	3/14/2012	4/13/2012	30	529	33	0	12721		2049.37	$0	$ 2,049
Apr-12	4/13/2012	5/15/2012	32	513	7	0	13037		2115.77	$0	$ 2,116
May-12	5/15/2012	6/15/2012	31	171	118	0	13622		1811.42	$0	$ 1,811
Jun-12	6/15/2012	7/14/2012	29	90	245	0	18296		2924.13	$0	$ 2,924
Jul-12	7/14/2012	8/13/2012	30	23	409	0	18130		2843.63	$0	$ 2,844
Aug-12	8/13/2012	9/12/2012	30	80	233	0	15984		2511.75	$0	$ 2,512
Sep-12	9/12/2012	10/10/2012	28	223	93	0	11893		1904.7	$0	$ 1,905
Oct-12	10/10/2012	11/9/2012	30	478	15	0	12194		1964.94	$0	$ 1,965
Nov-12	11/9/2012	12/11/2012	32	478	15	0	14031		2240.77	$0	$ 2,241
Dec-12	12/11/2012	1/14/2013	34	478	15	0	15032		2375.47	$0	$ 2,375
Jan-13	1/14/2013	2/13/2013	30	478	15	0	14141		2174.44	$0	$ 2,174
Feb-13	2/13/2013	3/14/2013	29	478	15	0	12675		1992.44	$0	$ 1,992
							171,756	**#DIV/0!**	**$26,909**	**$0**	**$26,908.83**
								0	**$0.157**	**#DIV/0!**	**$0.136**
								Avg & Max	**$ / kWh**	**$ / kW avg**	**Blended $/kWh**

Photo 1: Front exterior of the complex

Photo 2: Back exterior of the complex

Photo 3: Different door types at complex

Photo 4: Broken soffit vents at complex

Photo 5: Typical exterior wall-mounted lights

Photo 6: Typical exterior flood lights

Photo 7: Glass block basement windows

Photo 8: Typical manual thermostat

Photo 9: Typical unit stove-top oven

Photo 10: Typical unit refrigerator

Photo 11: Typical toilets

Photo 12: Typical vanity and sink

Photo 13: Typical showerhead

Photo 14: Plumbing chase

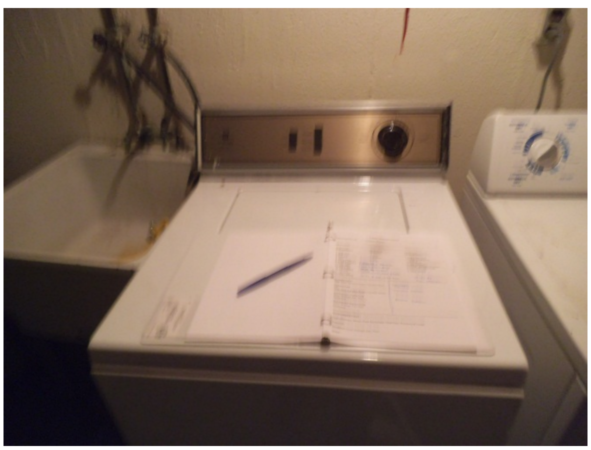


Photo 15: Bathroom Shower Faucet

Photo 16: Typical Bathroom Toilet

Photo 17: Bathroom Exhaust Fan

Photo 18: Basement Furnace

Photo 19: Basement ceiling

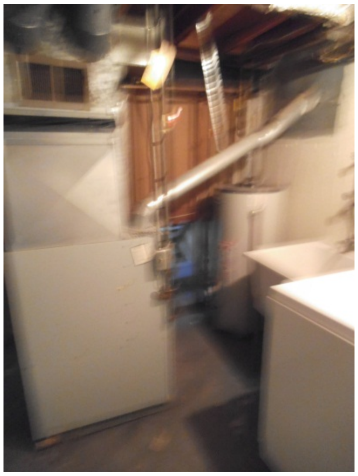


Photo 20: Common Area Furnace and DHW tank

Lighting Summary

Interior Lighting

Zone / Space	Qty	Burn Hours	Existing Fixture Type	Existing Fixture	Input Watts per Fixture	Annual Consumption (kWh)	Proposed Fixture Type	Proposed Fixture	Input Watts per Fixture2	Annual Consumption (kWh)3	Demand Reduction (kW)	Retrofit Cost ($)	Annual Energy Savings (kWh)	Annual Cost Savings ($)	SP (yrs)
All Interior Lighting (30 units	120	1456	Incandescent	Incandescent - 60W	60	10483	CFL	16 watt CFL	16	2796	5.28	$ 420.00	7688	$1,007.09	0.4
										TOTALS	5.28	$ 420.00	7,688	$1,007.09	0.4

Exterior Lighting

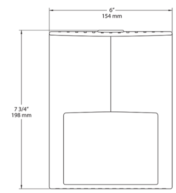
Zone / Space	Qty	Burn Hours	Existing Fixture Type	Existing Fixture	Input Watts per Fixture	Annual Consumption (kWh)	Proposed Fixture Type	Proposed Fixture	Input Watts per Fixture2	Annual Consumption (kWh)3	Retrofit Cost ($)	Annual Energy Savings (kWh)	Annual Cost Savings ($)	SP (yrs)
Exterior Wallpacks	60	4380	HPS35	35 watt High Pressure Sodium	46	12089	ENTRA 12W	RAB 12W LED Wall Pack	12	2621	$7,320.00	9,468	$1,240.31	5.90
Exterior Wallpacks	10	4380	HPS150	250 watt High Pressure Sodium	188	8234	FFLED39	RAB 39W LED Wall Pack	46	2015	$2,790.00	6,220	$814.77	3.42
						20323				4636	$10,110.00	15,688	$2,055.08	4.92

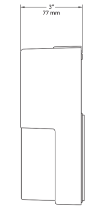
ENTRA12/PC

Affordable, high-performance, low-maintenance LED doorway light. Suitable for mounting heights up to 10', and replaces 70W high pressure sodium. 100,000-Hour LED lifespan. 5-Year warranty.

Color: Bronze

Weight: 3.0 lbs





LED Info

Watts:	12W
Color Temp:	5000K (Cool)
Color Accuracy:	70
L70 Lifespan:	100000
LM79 Lumens:	1,284
Efficacy:	89 LPW

Driver Info

Type:	Constant Current
120V:	0.3A
208V:	N/A
240V:	N/A
277V:	N/A
Input Watts:	14W
Efficiency:	83%

Technical Specifications

UL Listing:
Suitable for wet locations as downlight. Suitable for mounting within 1.2m (4ft) of the ground.

Photocell:
120V Button Photocell Included. Photocell is only compatible with 120V.

IP Rating:
Ingress Protection rating of IP66 for dust and water.

LED:
12W multi-chip, long life LED.

Lifespan:
100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

Driver:
Constant Current, Class 2, 100-277V, 50/60Hz, 4kV Surge Protection, 350mA, 100-240VAC: 0.3 - 0.15 A, 277VAC: 0.15 A, Power Factor: 98.5%.

THD:
9.9% at 120V

Correlated Color Temp. (Nominal CCT):
5000K

Cold Weather Starting:
The minimum starting temperature is -40°F/-40°C.

Ambient Temperature:
Suitable for use in 40°C (104°F) ambient temperatures.

Thermal Management:
Superior thermal management with internal Air-Flow fins and external air vents.

Housing:
Die-cast aluminum.

Lens/Housing Cover:
Vandal resistant polycarbonate molded housing cover and lens.

Mounting:
Heavy die cast aluminum with 1/2" back knockout and mounting template for mounting to 4" box.

Recommended Mounting Height:
Up to 10 ft.

Reflectors (2):
White aluminum reflector topped with vacuum metalized polycarbonate LED reflector.

Gaskets:
High-temperature silicone.

Finish:
Our environmentally friendly polyester powder coatings are formulated for high-durability and long-lasting color, and contains no VOC or toxic heavy metals.

Equivalency:
ENTRA™ 12W replaces 70W high pressure sodium.

ADA Compliant:
ENTRA™ is ADA Compliant.

Color Stability:
LED color temperature is warrantied to shift no more than 200K in CCT over a 5 year period.

Color Consistency:
7-step MacAdam Ellipse binning to achieve consistent fixture-to-fixture color.

Green Technology:
Mercury and UV free, and RoHS compliant.

IESNA LM-79 & LM-80 Testing:
RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy "Lighting Facts" label.

Patents:
The design of the ENTRA™ is protected by patents pending in US, Canada, China, Taiwan and Mexico.

Warranty:
RAB warrants that our LED products will be free from defects in materials and workmanship for a period of five (5) years from the date of delivery to the end user, including coverage of light output, color stability, driver performance and fixture finish. See our full warranty .

Country of Origin:
Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:
This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:
This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010).

Trade Agreements Act Compliant:
This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

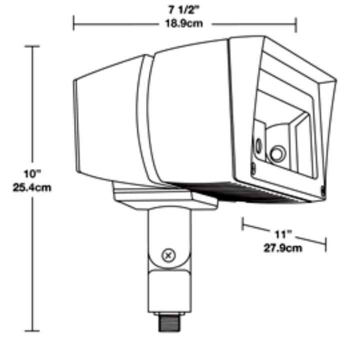
GSA Schedule:
Suitable in accordance with FAR Subpart 25.4.

FFLED39N/PC

Rectangular shaped LED floodlight designed to replace 150W Metal Halide. Patent Pending airflow technology ensures long LED and driver lifespan. Use for building facade lighting, sign lighting, LED landscape lighting and instant-on security lighting.

Color: Bronze

Weight: 12.5 lbs



LED Info

Watts:	39W
Color Temp:	4000K (Neutral)
Color Accuracy:	86
L70 Lifespan:	100000
LM79 Lumens:	2,379
Efficacy:	51 LPW

Driver Info

Type:	Constant Current
120V:	0.4 A
208V:	0.25 A
240V:	0.22 A
277V:	0.19 A
Input Watts:	46W
Efficiency:	84%

Technical Specifications

Lumen Maintenance:
100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

NEMA Type:
7H x 6V Beam Spread

Photocell:
120V Photocell included

LEDs:
Three multi-chip, 13Watt high performance LEDs

Driver:
Constant Current, Class 2, 100 - 277V, 50 - 60 Hz, 100 - 277VAC 0.7-0.55 Amps; 277VAC 0.55 Amps

Fixture Efficacy:
51 Lumens per Watt

Surge Protection:
6 KV

Ambient Temperature:
Suitable for use in 40°C ambient temperatures.

Cold Weather Starting:
The minimum starting temperature is -40°F/-40°C.

Thermal Management Housing:
Superior heat sinking with external Air-Flow fins.

Mounting:
Heavy-duty mounting arm with O ring seal & stainless steel screw

Color Stability:
RAB LED products exceed industry standards for chromatic stability.

Color Accuracy:
86 CRI

Color Temperature (Nominal CCT):
4000K

Color Uniformity:
RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for (SSL) Products, ANSI C78.377-2008.

Reflector:
Semi-specular anodized aluminum

Gaskets:
High-temperature silicone gaskets

Finish:
Chip and fade resistant polyester powder coat finish.

Green Technology:
Mercury and UV free

IESNA LM-79 & LM-80 Testing:
RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy Lighting Facts label.

California Title 24:
FFLED39 complies with California Title 24 building and electrical codes.

Warranty:
RAB LED fixtures give you peace of mind because both the fixture and driver components are backed by RAB's 5 Year Warranty. For more information,

Patents:
The FFLED39 design is protected by Taiwan Patent 01510948 and patents pending in the U.S., Canada, China, and Mexico.

UL Listing:
Suitable For Wet Locations. Suitable for mounting within 1.2M(4FT) of the ground.

Threaded Size:
1/2" threaded arm.

Country of Origin:
Designed by RAB in New Jersey and assembled in the USA by RAB's IBEW Local 3 workers.

Buy American Act Compliant:
This product is a COTS item manufactured in the United States, and is compliant with the Buy American Act.

Recovery Act (ARRA) Compliant:
This product complies with the 52.225-21 "Required Use of American Iron, Steel, and Manufactured Goods-- Buy American Act-- Construction Materials (October 2010)

Trade Agreements Act Compliant:
This product is a COTS item manufactured in the United States, and is compliant with the Trade Agreements Act.

GSA Schedule:
Suitable in accordance with FAR Subpart 25.4

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 800
800 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,734	920	10,654 (1 tons)	22,941
First Floor	6,538	920	7,458	12,161
All Rooms	6,538	920	7,458	12,161
Second Floor	3,037	0	3,037	6,975
All Rooms	3,037	0	3,037	6,975
Basement	159	0	159	3,806
All Rooms	159	0	159	3,806
Whole House	9,734	920	10,654 (1 tons)	22,941

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 802
802 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	7,667	690	8,357 (0.5 tons)	14,561
First Floor	5,371	690	6,061	8,110
All Rooms	5,371	690	6,061	8,110
Second Floor	2,246	0	2,246	4,291
All Rooms	2,246	0	2,246	4,291
Basement	50	0	50	2,160
All Rooms	50	0	50	2,160
Whole House	7,667	690	8,357 (0.5 tons)	14,561

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For: Maple Meadows 804
804 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,803	920	10,723 (1 tons)	19,573
First Floor	5,716	920	6,636	9,429
All Rooms	5,716	920	6,636	9,429
Second Floor	3,571	0	3,571	6,766
All Rooms	3,571	0	3,571	6,766
Basement	516	0	516	3,378
All Rooms	516	0	516	3,378
Whole House	9,803	920	10,723 (1 tons)	19,573

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 806
806 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	10,076	1,150	11,226 (1 tons)	19,533
First Floor	6,016	1,150	7,166	9,429
All Rooms	6,016	1,150	7,166	9,429
Second Floor	3,571	0	3,571	6,766
All Rooms	3,571	0	3,571	6,766
Basement	489	0	489	3,338
All Rooms	489	0	489	3,338
Whole House	10,076	1,150	11,226 (1 tons)	19,533

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 810
810 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,801	920	10,721 (1 tons)	22,701
First Floor	6,431	920	7,351	11,475
All Rooms	6,431	920	7,351	11,475
Second Floor	3,023	0	3,023	7,199
All Rooms	3,023	0	3,023	7,199
Basement	347	0	347	4,027
All Rooms	347	0	347	4,027
Whole House	9,801	920	10,721 (1 tons)	22,701

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For: Maple Meadows 820
820 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,228	920	10,148 (1 tons)	23,022
First Floor	6,040	920	6,960	11,766
All Rooms	6,040	920	6,960	11,766
Second Floor	2,834	0	2,834	7,224
All Rooms	2,834	0	2,834	7,224
Basement	354	0	354	4,032
All Rooms	354	0	354	4,032
Whole House	9,228	920	10,148 (1 tons)	23,022

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 822
822 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	5,440	690	6,130 (0.5 tons)	14,325
First Floor	4,009	690	4,699	8,948
All Rooms	4,009	690	4,699	8,948
Second Floor	1,393	0	1,393	3,683
All Rooms	1,393	0	1,393	3,683
Basement	38	0	38	1,694
All Rooms	38	0	38	1,694
Whole House	5,440	690	6,130 (0.5 tons)	14,325

Residential Heat Loss and Heat Gain Calculation

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 824
824 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	7,434	920	8,354 (0.5 tons)	20,144
First Floor	4,620	920	5,540	9,880
All Rooms	4,620	920	5,540	9,880
Second Floor	2,606	0	2,606	7,101
All Rooms	2,606	0	2,606	7,101
Basement	208	0	208	3,163
All Rooms	208	0	208	3,163
Whole House	7,434	920	8,354 (0.5 tons)	20,144

Residential Heat Loss and Heat Gain Calculation

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 826
826 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	7,542	1,150	8,692 (0.5 tons)	19,593
First Floor	4,784	1,150	5,934	9,429
All Rooms	4,784	1,150	5,934	9,429
Second Floor	2,493	0	2,493	6,766
All Rooms	2,493	0	2,493	6,766
Basement	265	0	265	3,398
All Rooms	265	0	265	3,398
Whole House	7,542	1,150	8,692 (0.5 tons)	19,593

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 830
830 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,196	920	10,116 (1 tons)	22,725
First Floor	6,016	920	6,936	11,538
All Rooms	6,016	920	6,936	11,538
Second Floor	2,827	0	2,827	7,165
All Rooms	2,827	0	2,827	7,165
Basement	353	0	353	4,021
All Rooms	353	0	353	4,021
Whole House	9,196	920	10,116 (1 tons)	22,725

Residential Heat Loss and Heat Gain Calculation

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For:

Maple Meadows 830
830 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	9,196	920	10,116 (1 tons)	22,725
First Floor	6,016	920	6,936	11,538
All Rooms	6,016	920	6,936	11,538
Second Floor	2,827	0	2,827	7,165
All Rooms	2,827	0	2,827	7,165
Basement	353	0	353	4,021
All Rooms	353	0	353	4,021
Whole House	9,196	920	10,116 (1 tons)	22,725

In accordance with ACCA Manual J

Report Prepared By:

AKT Peerless

For: Maple Meadows 880 Community Center
880 South Maple
Ann Arbor, Michigan 48103

Design Conditions: Yipsilanti

Indoor:		Outdoor:	
Summer temperature:	75	Summer temperature:	89
Winter temperature:	70	Winter temperature:	5
Relative humidity:	50	Summer grains of moisture:	22
		Daily temperature range:	Medium

Building Component	Sensible Gain (BTUH)	Latent Gain (BTUH)	Total Heat Gain (BTUH)	Total Heat Loss (BTUH)
Whole House	14,027	920	14,947 (1 tons)	33,567
First Floor	10,497	920	11,417	22,457
All Rooms	10,497	920	11,417	22,457
Second Floor	3,362	0	3,362	7,254
All Rooms	3,362	0	3,362	7,254
Basement	168	0	168	3,856
All Rooms	168	0	168	3,856
Whole House	14,027	920	14,947 (1 tons)	33,567

Tenant Unit Programmable Thermostats (30)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors. The calculator was modified by the auditor as detailed in subject report.

Enter your own values in the gray boxes or use our default values.

Number of Units	30
Initial Cost for one programmable thermostat	$51
Initial Cost for one manual thermostat	$1
Unit Fuel Cost (Cooling) ($/kWh)	$0.136
Unit Fuel Cost (Heating) ($/Therm)	$0.91

24 Hour Typical Usage Patterns*

	Weekday	Weekend
Nighttime Set-Back/Set-Up Hours	8	8
Daytime Set-Back/Set-Up Hours	16	16
Hours without Set-Back/Set-Up	0	0

Choose your city from the drop-down menu

City: MI-Detroit

Heating Season*

Typical Indoor Temperature w/o Set-Back	72
Nighttime Set-Back Temperature (Average)	68
Daytime Set-Back Temperature (Average)	72
Heating System Type	Gas Furnace

Cooling Season*

Typical Indoor Temperature w/o Set-Up	75
Nighttime Set-Up Temperature (Average)	82
Daytime Set-Up Temperature (Average)	82
Cooling System Type	None

**All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally nighttime and daytime. Set-up temperature is defined as the higher setpoint temperature for the energy-savings periods during the cooling season, generally nighttime and daytime.*

	30 Programmable Thermostat(s)	30 Manual Thermostat(s)	Savings
Annual Energy Costs			
Heating Energy Cost	$18,428	$19,151	$723
Heating Energy Consumption (MBTU)	*2,036*	*2,116*	*80*
Cooling Energy Cost	$0	$0	$0
Cooling Energy Consumption (MBTU)	*0.0*	*0.0*	*0*
Total	**$18,428**	**$19,151**	**$723**

4.0 Part 3: Utility Consumption Baseline

AKTPEERLESS

4.1 Acknowledgements of Part 3: Utility Consumption Baseline

The Consumption Narrative Report and Utility Consumption – Summary and Utility Consumption – Monthly worksheets in the RPCA Model were completed by Linnea Fraser and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 3.2 (Version 2, December 2013).

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Date: February 10, 2014

Part 3 Consumption Narrative Report and Excel RPCA Model were Received and Reviewed by Owner:

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Date: ___________________________

AKTPEERLESS

Rental Assistance Demonstration (RAD): UTILITY CONSUMPTION BASELINE

800-890 South Maple Street, Ann Arbor, Michigan 48103

MAPLE MEADOWS

PREPARED FOR Norstar Development USA, LP
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Albany, NY 12207

AND The Ann Arbor
Housing Commission
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PROJECT # 8207E-3-90

PIC # MI064

DATE February 10, 2014

Table of Contents

1.0 EXECUTIVE SUMMARY

1.1 Purpose and Scope of Work

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

1.2 Subject Site Description

1.2.1 General Site Description

The subject property contains five (5) multi-family buildings with twenty-nine (29) tenant units and one (1) community center unit. The subject buildings were constructed in 1970 and contain two (2) stories with a basement. The site contains ten (10) two bedroom/one bathroom units, fourteen (14) three bedroom/one bathroom units, and five (5) four bedroom/one and half bathroom units. The subject complex is generally referred to as Maple Meadows.

1.2.2 Site Utilities and Usage

Each unit at the subject property has an electric meter, a natural gas meter, and a water meter. Three common meters for exterior lighting exist at the site. Therefore, there are a total of thirty-three (33) electric meters, thirty (30) natural gas meters, and five (5) water meters at the site.

1.3 Baseline Site Energy Consumption

The Actual Site Energy Use, Energy Use Intensity (EUI), Weather Normalized Site Energy Use and Weather Normalized EUI displayed below are consistent with the ASHRAE Procedures for Commercial Building Energy Audits. This methodology establishes the property's baseline use and cost conditions that are representative of the building's energy performance.

This statistical analysis removes the bias of independent variables such as historic weather, occupancy and operating hours. These calculations have been normalized to the mean values of the independent variables impacting the building's energy performance and represent the most probable performance under actual conditions accounting for weather, occupancy and operating hour variability.

As the subject site has been 100% occupied for the duration of the analysis period, no pro-forma adjustment factors to the consumption have been made.

1.3.1 Actual Site Energy Use and EUI

Actual Site Energy Use	Actual Site Energy Use Intensity (EUI)
2,888,158 kBtu/yr	60.33 kBtu/ ft^2/yr

1.3.2 Weather Normalized Site Energy Use and EUI

Weather Normalized Site Energy Use	Weather Normalized Site Energy Use Intensity (EUI)
3,066,485 kBtu/yr	64.05 kBtu/ft^2/yr

2.0 INTRODUCTION

2.1 Purpose

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

2.2 Scope of Work

AKT Peerless' scope-of-services is based on its proposal PE-14248, dated January 9, 2013 and revised March 15, 2013 and authorized by Norstar Development USA, LP (the Client), and the terms and conditions of that agreement.

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

3.0 SUBJECT SITE DESCRIPTION

3.1 General Site Description

The subject property contains five (5) multi-family buildings with twenty-nine (29) tenant units and one (1) community center unit. The subject buildings were constructed in 1970 and contain two (2) stories with a basement. The site contains ten (10) two bedroom/one bathroom units, fourteen (14) three bedroom/one bathroom units, and five (5) four bedroom/one and half bathroom units. The subject complex is generally referred to as Maple Meadows.

3.2 Current/Planned Use of the Property

The subject property has been used as a multi-family structure and operated by the AAHC since its initial construction in 1970. AAHC is participating in HUD's Rental Assistance Demonstration pilot program and intends to continue operating the building as a multi-family residential facility.

4.0 ENERGY CONSUMPTION ANALYSIS

This section provides information on energy utilities associated with the subject property.

4.1 Electricity

The following figure (Figure 4.1) identifies monthly electrical consumption (kWh) in comparison to cooling degree days (CDD). Cooling Degree Days (CDD) are roughly proportional to the energy used for cooling a building, while Heating Degree Days, (HDD) are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

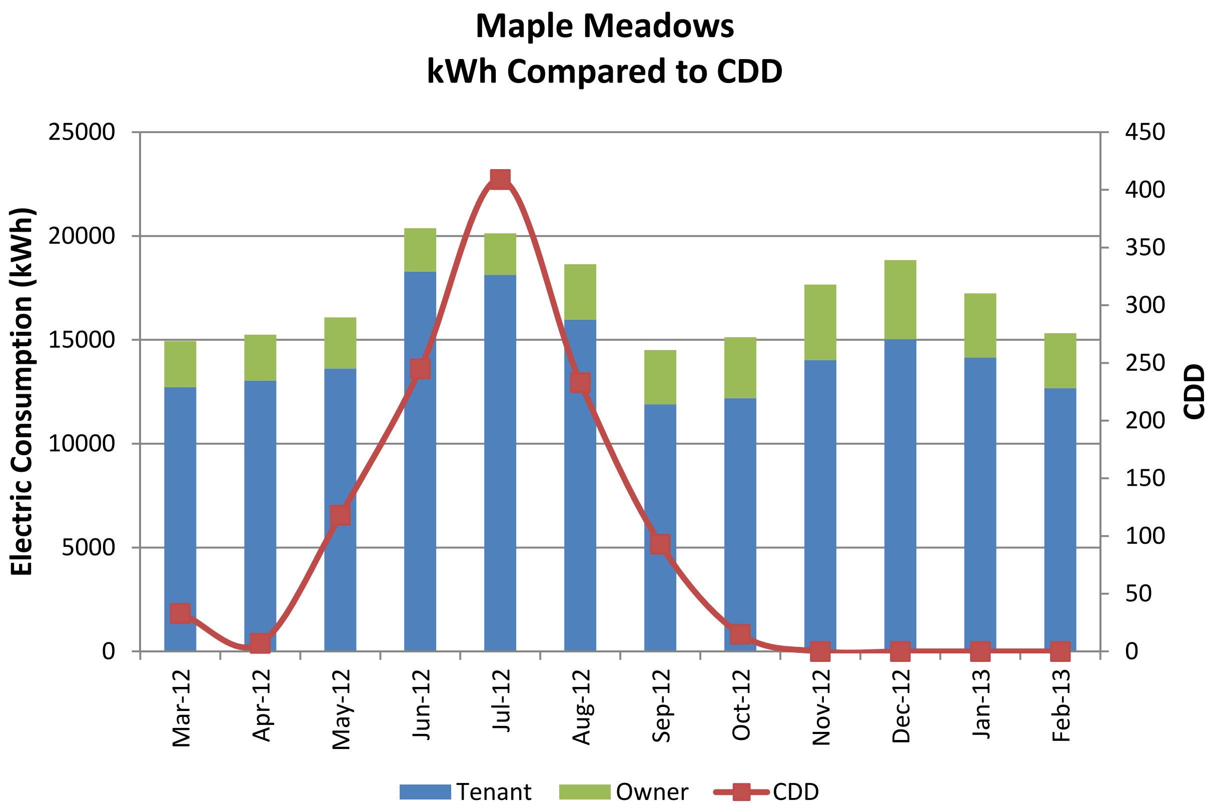

Figure 4.1 Electricity Consumption Graph

The following table (Table 4.1) identifies key information regarding the electric utility associated with the property.

Table 4.1 Annual Electricity Metrics

Vendor	DTE Energy
Meters on Site	Residential - Twenty-nine(29) Non-Residential (Common) - Four (4)
Use for Residential	Lighting, electric appliances, tenant plug loads, tenant ac window units (if present), washing machines, furnace blower and control.
Use for Non-Residential	Exterior lighting, community center lighting, electric appliances, plug loads, ac units, furnace blower and control.
Responsible for Payment	Residential - Tenant Non-Residential - Owner
Rate	Residential - $0.157 / kWh Non-Residential - $0.149 / kWh

Site Consumption	204,119 kWh / year (696,658 kBtu / year)
Energy Use Intensity (EUI)	4.26 kWh / ft^2 (14.55 kBtu / ft^2)
Weather Normalized Site Consumption	200,214 kWh / year (683,332 kBtu / year)
Weather Normalized EUI	4.18 kWh / ft^2 (14.27 kBtu / ft^2)

AKT Peerless received tenant electric bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (kWh). For the subject property, Maple Meadows, monthly electrical data was included from September 2011 to February 2013. The most current twelve (12) months of electrical data provided (March 2012 through February 2013) were used for this analysis and input into the RPCA model.

The actual electric consumption was adjusted to produce a weather-normalized summary of electric consumption. This process involved the following steps:

- CDD for the base year billing periods were calculated. Source for CDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (kWh) and CDD were normalized by number of days in each billing period.
- Relationship between usage (kWh/day) and weather (CDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average CDD per month.

4.2 Natural Gas

The following figure (Figure 4.2) identifies monthly natural gas consumption (therms) in comparison to heating degree days (HDD). HDD are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

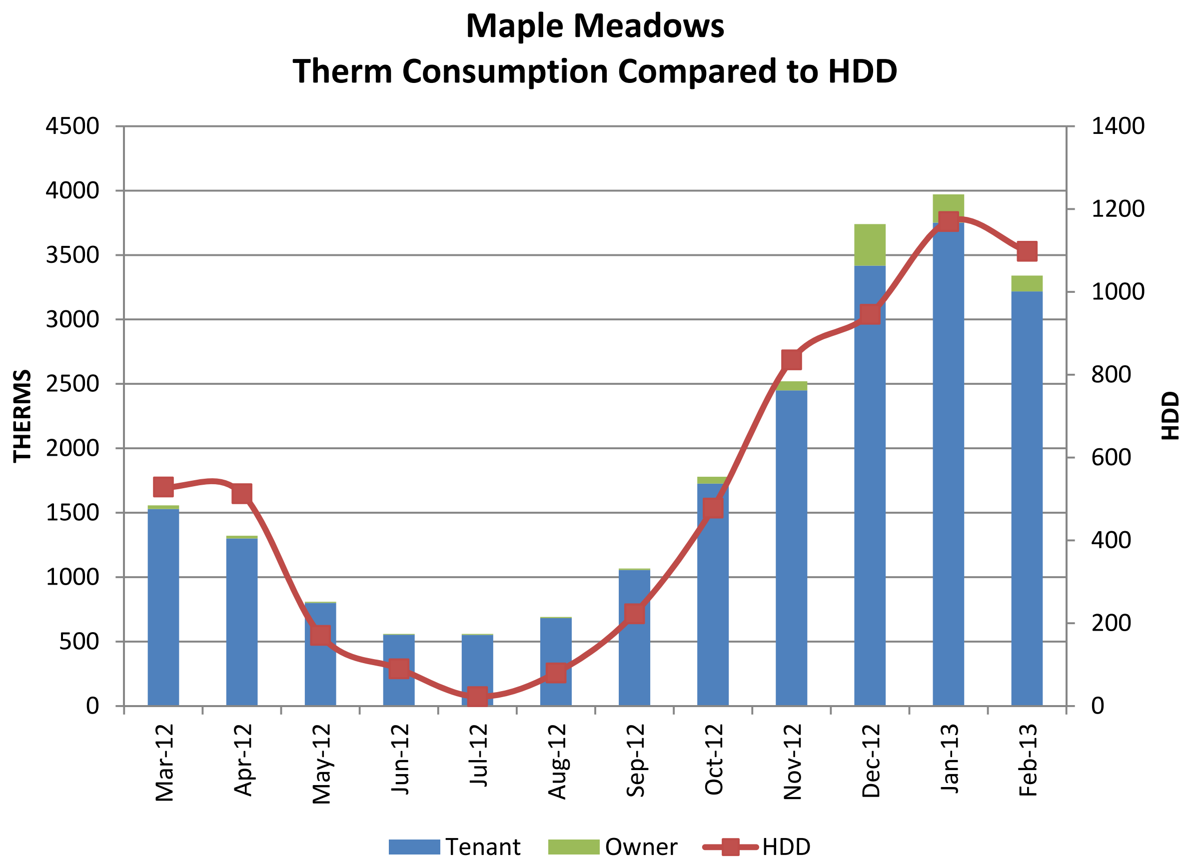

Figure 4.2 Natural Gas Consumption Graph

The following table (Table 4.2) identifies key information regarding the natural gas utility associated with the property.

Table 4.2 Annual Natural Gas Metrics

Vendor	DTE Energy
Meters on Site	Residential – Twenty-nine (29) Non-Residential (Common) – One (1)
Use for Residential	Gas-fired furnaces for space heating, ranges for cooking, dryers for laundry.
Use for Non-Residential	Community center gas-fired furnace for space heating, ranges for cooking
Responsible for Payment	Residential - Tenant Non-Residential - Owner
Rate	Residential - \$0.991 / therm Non-Residential - \$0.974 / therm
Site Consumption	21,915 therms / year (2,191,500 kBtu / year)

Energy Use Intensity (EUI)	45.77 kBtu / ft^2
Weather Normalized Site Consumption	23,832 therms / year (2,383,153 kBtu / year)
Weather Normalized EUI	49.78 kBtu / ft^2

AKT Peerless received tenant natural gas bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (therms). For the subject property, Maple Meadows, monthly natural gas data was included from September 2011 to February 2013. The most current twelve (12) months of natural gas data provided (March 2012 through February 2013) were used for this analysis and input into the RPCA model.

The actual natural gas consumption was adjusted to produce a weather-normalized summary of natural gas consumption. This process involved the following steps:

- HDD for the base year billing periods were calculated. Source for HDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (therms) and HDD were normalized by number of days in each billing period.
- Relationship between usage (therms/day) and weather (HDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average HDD per month.

5.0 LIMITATIONS

5.1 Assumptions

The Ann Arbor Housing Commission (AAHC), the property owner, released utility information to AKT Peerless delivered directly from the utility provider(s), DTE Energy. It is assumed that this monthly usage and cost data is accurate and contains no data gaps or errors.

Information on how the utilities are utilized was generated from conversations with AAHC staff and results of the RPCA through the Energy Audit.

5.2 Limitations and Exceptions

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, owner, third parties, or the secondary information sources cited in this report is complete or accurate.

AKT Peerless has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to AKT Peerless and information not reported to AKT Peerless may influence the findings of report.

AKT Peerless has not verified the accuracy of building floor area as reported by the owner.

Should additional information become available to the Client or Owner that differs significantly from our understanding of conditions presented in this report, AKT Peerless requests that such information be forwarded immediately to our attention so that we may reassess the conclusions provided herein and amend this project's scope of services as necessary and appropriate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

6.0 SIGNATURES

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