3.0 Part 2: Energy Audit

AKTPEERLESS

Rental Assistance Demonstration (RAD):
PART 2: ENERGY AUDIT

1020-1042 Pennsylvania Avenue, Ann Arbor, Michigan 48103
HILLSIDE MANOR

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

ON BEHALF OF The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8359E-2-96

PIC # MI064

DATE October 7, 2013

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AKT Peerless Project No. #8359E-2-96

1.0 Executive Summary

This report presents the findings and recommendations from an RPCA Energy Audit conducted at Hillside Manor located at 1020 - 1042 Pennsylvania Avenue in Ann Arbor, Michigan. 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 an estimated $3,781 on utilities at the subject property. Tenants spent an estimated $10,942 on utilities.

AKT Peerless identified five separate Energy Conservation Measures (ECMs) and one Water Conservation Measure (WCM). The annualized savings of all recommendations totals $3,832 (at current energy and water prices), with the potential to reduce total energy consumption and GHG emissions by 30%. If fully implemented, the payback period from annual energy savings for these ECMs is estimated to be 5.1. Measures associated with common areas (PHA expenses) and measures specific to tenant units have been separated 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 11-12 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.

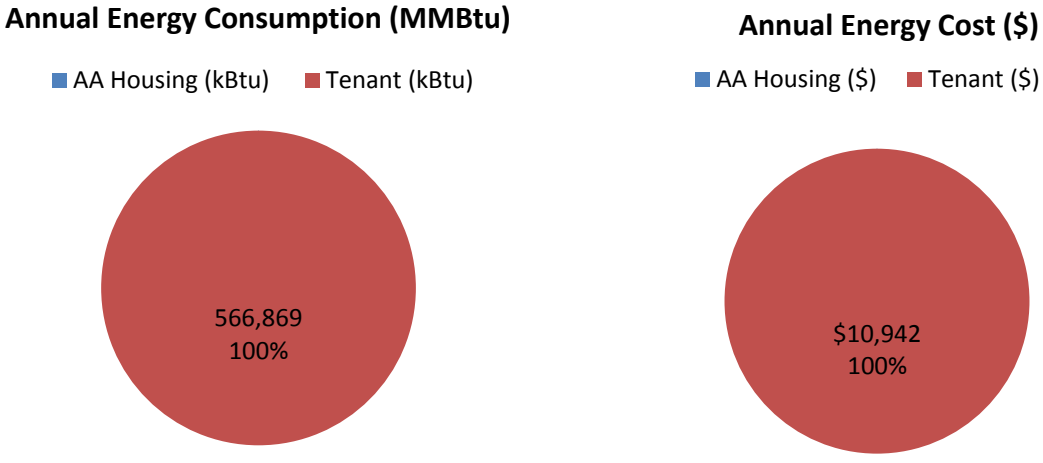


Figure 1. Historical Annual Energy Consumption and Cost

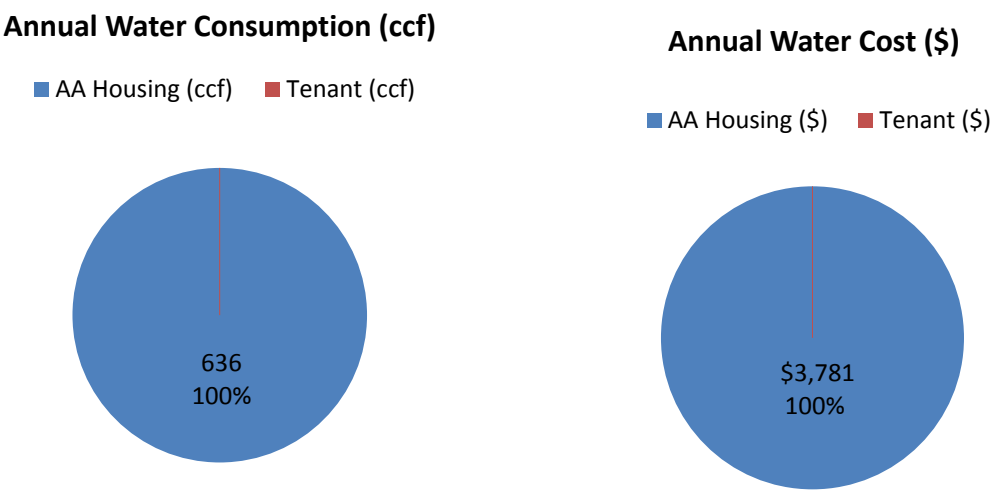


Figure 2. Historical Annual Water Consumption and Cost

The implementation costs and annual savings estimates for each proposed Energy and Water Conservation Measure 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 Energy Conservation Measures (Owner)

Energy or Water Conservation Measure	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	WCM1	$3,350	$871	3.8
Exterior Lighting Retrofit	ECM1	$2,625	$561	4.7
	Totals	**$5,975**	**$1,442**	**4.1**

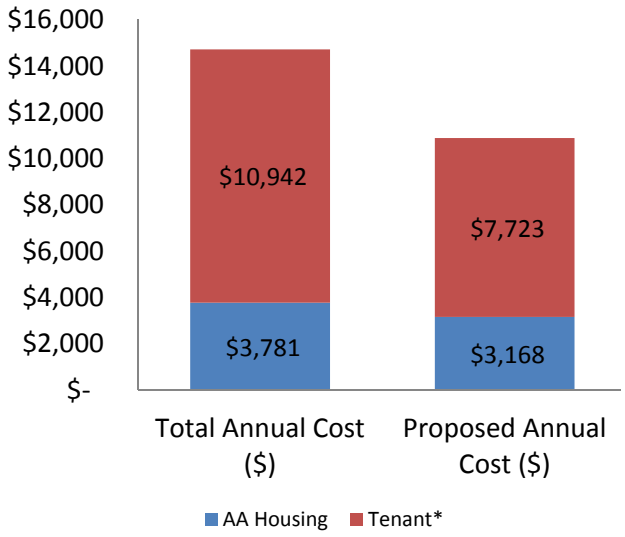
The following ECMs are recommended specifically for tenant spaces. Due to separate billing for tenants, the following energy and cost savings will only benefit the tenants.

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

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Replace Incandescent Lamps with CFLs Tenant Apartments	ECM2	$329	$919	0.4
Install Programmable Thermostats	ECM3	$2,100	$271	7.7
Control Air Leakage	ECM4	$3,600	$518	6.9
Replace Older Refrigerators with Energy Star Models	ECM5	$2,295	$232	3.4
Upgrade Insulation in Crawl Space	ECM6	$5,250	$450	11.7
	Totals	**$13,574**	**$2,390**	**5.7**

Table 3. Impact Summary

% Energy Savings	33%
% Water Savings	16%
% Cost Savings	26%
Annual Cost Savings ($)	$3,832
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tonnes)	30%



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 Hillside Manor located at 1020-1042 Pennsylvania Avenue in Ann Arbor, Michigan.

AKT Peerless' scope of work for this Energy Audit is based on its proposal PE-14790 C-1, dated June 26, 2013 and revised July 31, 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 October 2012 (Version 1). 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 13.1)
- 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 11.1)
- 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 14.0)
- 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
Linnea Fraser	AKT Peerless	Energy Engineer
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 February 13th, 2013 and then on August 14, 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 any existing T12 lighting, if applicable. 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. Additionally, a blower door test was performed on one of the units to determine the air tightness of the apartment units, as well as identify areas of infiltration.

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 2003 Commercial Buildings Energy Consumption Survey (CBECS) data for lodgings of relatively similar scale and age.

5.0 Property Description

This section summarizes physical characteristics and general use of the subject property.

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	1996
Number of Detached Buildings	Three (3)
Approximate Total Square Footage	6,432 sq ft (1,072 per unit)

The subject property Primary Building Type is designated as Multi-Family (General). 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

This complex is divided into three (3) approximately identical buildings. 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	% of Total Area
Six (6) 3-bdr units	Residential Apartments	1,072 sf/unit	100%

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	3-5/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 two-story standard wood framed structure (duplex) built on a poured concrete crawl space. The exterior is clad with light beige vinyl siding to the outside mechanically fastened to an exterior grade board over 2x4 wood studs. Face brick (1/4" or 1/2") is utilized to create a decorative finish at the lower level. The 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 3-5/8" and rated at R-13. This is generally considered standard efficiency.

These duplexes sit on a passively ventilated crawl space. The crawl was not accessible in the subject property, as the hatch was covered by a mechanical lift unit in the laundry room. The first floor was reported to be insulated underneath with fiberglass batting, assumed to be 5.5" or approximately R-19.

5.5.2 Roof and Roof Insulation

The typical roof design on the three duplex buildings is a gabled, passively vented roof. Approximately 8-10" overhangs with non-continuous soffits run parallel to the ridge and balance a semi-continuous ridge vent. The roof assembly is asphalt shingled roof (medium to light brown) over felted wood substrate mechanically fastened to prefabricated or site built 2x wood trusses. The typical attic appears to have 10-12" of blown fiberglass insulation on the ceiling.

The estimated R-value of the attic is R-22 to R-27. This is generally considered standard efficiency for age of construction.

5.5.3 Windows and Other Fenestrations

The apartment windows appear to be white vinyl clad aluminum, double hung, double pane glazing with decorative muntin bars between glazing at each sash. These windows appear to be thermally broken and in fair condition.

These windows are generally considered standard efficiency for age of construction. It was noted that the double hung windows with operable sash have allowed residents to utilize window air conditioners, and it appears that most leave their units installed throughout the winter months.

5.5.4 Doors

The exterior entrance doors appear to be standard insulated metal doors set in aluminum frames with lever hardware. Storm doors are installed at front entries. A new, higher quality and more efficient storm door was installed in Unit 1020.

The tenant at 1020, who is required to spend most of her day in a hospital bed near the porch entry, keeps the front entrance door open during the day in order to see outside. There may be an opportunity to install an insulated exterior door with large, clear insulated glazing, which could provide greater efficiency and comfort for the tenant. Currently, the storm door serves this purpose, and is not designed to prevent heat transfer/loss between the interior and exterior of the home.

5.5.5 Air Leakage

A blower door test was conducted at sample units of similar building types. The audit team used these samples to approximately quantify air leakage by analyzing the 50-Pascal airflow rate of similar units. This blower door reading, expressed in cubic feet per minute (CFM_{50}), is the actual flow rate measured at 50 Pascals of house pressure. CFM_{50} is the most direct measurement of the airtightness of a building. For the subject property, Hillside Manor, the blower door airflow rate was estimated at 2,325 CFM_{50}.

Using standard industry practice (accounting for wind speed, shielding of the building by external elements, and the buildings height and size), the estimated natural air change rate was calculated to be 1.10 air changes per hour (ACH_n).

5.5.6 Minimum Ventilation Requirement (MVR)

Either air leakage or a whole-house ventilation system must provide acceptable indoor air quality. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) set minimum ventilation requirements (MVRs) to ensure acceptable indoor air quality in homes. The older ASHRAE Standard 62-1989 recognizes air leakage as a legitimate ventilation strategy. The newer ASHRAE Standard 62.2-2007 requires a whole-house mechanical ventilation system.

ASHRAE Standard 62-1989 requires that air leakage must provide at least 15 CFM per person or 0.35 air changes per hour, whichever is greater. For the subject property, Hillside Manor, the MVR was calculated to be 60 CFM (=0.35 ACH) per average unit. This equates to a building tightness limit (BTL) of 888 CFM_{50} per average unit.

The analysis determined that air leakage is likely providing excessive ventilation to these units.

5.6 Heating, Ventilation, and Air Conditioning (HVAC)

The HVAC system provides the primary heating, cooling and ventilation needs of the facility. The three (3) buildings at Hillside Manor Apartments have a decentralized HVAC system in place, with equipment located and zoned for each individual apartment.

Each of the units is heated by one (1) gas-fired, down-flow forced-air furnace. One of the units has a Lennox brand, GHR26 series furnace rated at 50 kBtu/h input and 47 kBtu/h with a 92% AFUE. The remaining units contain a Goodman brand, two-stage or multi-speed gas furnace rated at 45 kBtu/h input and 43kBtu/h with a 93% AFUE. Heated supply air generated from the furnace (located in the laundry room) is delivered under-floor through the crawl and return air is distributed through ductwork in a ceiling plenum. Upstairs units deliver heat through insulated ducts in the attic. It was not possible to observe what level of insulation may or may not be present on the supply air ducting in the crawl space. The heating for each unit is controlled by a single non-programmable dial thermostat. The subject unit observed utilized a Honeywell, manual stat with the heating setpoint @ 78 °F – this is a potential consequence of this tenant being visually impaired – and is discussed further in this report.

During the cooling season, five of the tenants use personal window air conditioning units to supply cold air to the units, but there is no evaporator coil (central cooling) installed at any apartments. Currently, there are ten window air conditioners in the subject property. Three of the tenant units have one air conditioner, one of the tenants has three air conditioners, and the other tenant has four air conditioners within the tenant space. These air conditioners are considered standard efficiency units and are approximately 3 years old. It is believe that most of the units are rated at 1 to 1.5 tons and operate throughout the summer months.

It should be noted that in Unit 1020, the filter located in the return air duct was likely older than 9 months.

Ventilation for the units is supplied by both natural ventilation in window openings and a ceiling exhaust fan in each bathroom. The bathroom exhaust fan may require maintenance to better remove contaminated air. Additionally, the kitchen has a ductless range hood fan that circulates air with a manual switch.

The domestic hot water for each unit is supplied by a dedicated tank-style, gas-fired, switch ignition, power ventilated water heater located in the laundry room.

Table 8. Domestic Hot Water Tanks

Unit	DHW Manufacturer	Tank Size	Input Rating (Btu/h)	Year Installed
1020	Lochinvar	40 gallons	40,000	1995
1022	Lochinvar	40 gallons	34,000	1997
1030	Bradford White	40 gallons	40,000	2012
1032	Lochinvar	40 gallons	34,000	1997
1040	Lochinvar	40 gallons	40,000	1997
1042	Lochinvar	40 gallons	34,000	2010

Four of the tanks appear to be original to the unit and are nearing the end of their useful life.

5.7 Lighting

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

5.7.1 Interior Lighting

Interior Lighting in each of the typical residential units consists of the following fixture types:

Kitchen/Living/Bath/Laundry/Bedroom/Hall

- Standard socket (A lamp) 4 Lamp Ceiling Fan 60W Incandescent (1)
- Standard socket (A lamp) 2 Lamp Overhead 60-75W Incandescent (3)
- Standard socket (A lamp) 1 Lamp Overhead 60-75W Incandescent (4)
- Standard socket (A lamp) 2 Lamp Overhead 13W CFL (1)

The subject unit surveyed appears to have replaced 2 incandescent lamps with CFL lamps, but the remainder of the lighting is incandescent. It is assumed the adjacent tenant fixtures have not been updated. Any fixtures still housing incandescent lamps are considered inefficient, and are candidates for replacement.

5.7.2 Exterior Lighting

Exterior lighting for the Hillside Manor apartments consists of the following for each of the typical three (3) buildings:

- 50W High Intensity Discharge (HID) wall-mounted porch light (5 each, 15 total)

HID technology is considered standard efficiency and can be upgraded.

It appears that this lighting is not functioning properly. The tenants at the unit investigated have observed that exterior lighting is not on in the evening, often creating challenges for in-home nursing assistants trying to find the unit at night.

5.8 Other Equipment (Energy)

Typical apartment unit kitchens include a refrigerator, microwave and a natural gas stove. Equipment is generally considered standard efficiency equipment. In the subject unit investigated, the owners reported purchasing their own unit, which appears to be more efficient than other units installed at Hillside Manor.

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

5.9 Water Consuming Devices

Each typical apartment unit has devices in the kitchen and bath that consume water. Typical apartment unit kitchens appear to have a standard double sink with standard efficiency aerators. The typical three bedroom apartments have one bathroom which has a lavatory, toilet and shower/bath. It appears most units have standard efficiency flow devices installed in each of the bathrooms, including showerheads and faucet aerators (2.5 gpm showerhead, 2.0 gpm faucet aerator). Toilets are 1.6 gpf units. There are higher efficiency alternatives available for these devices.

Each laundry room 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.

It should be noted that there may be a persistent leak in the bathroom above unit 1020, as there is signs of moisture which is degrading the ceiling and could cause additional problems for the Owner and tenant if leak is not addressed.

5.10 Improvements since Previous Audits (2009)

The audit team believes the following equipment replacements/upgrades have taken place since the previous energy/water audits were conducted in 2009:

- New (high efficiency) furnace(s) installed in 2011
- New efficient storm door installed at subject unit investigated in last two years
- New refrigerator installed in subject unit investigated in last two years

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 HUD Residential Energy Benchmark Tool.

The following figures summarize the most recent annual energy consumption and costs for this property.

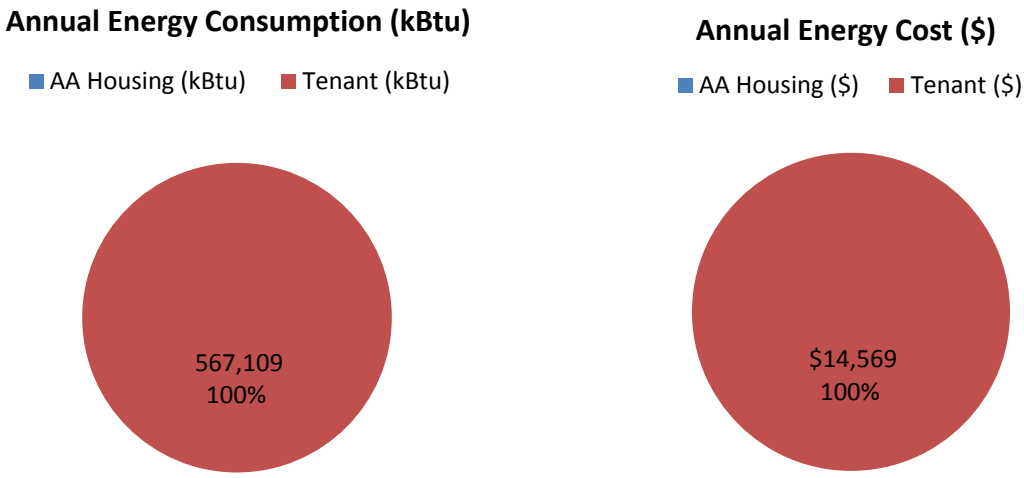


Figure 3. Historical Annual Energy Consumption and Cost

6.1 Electricity

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

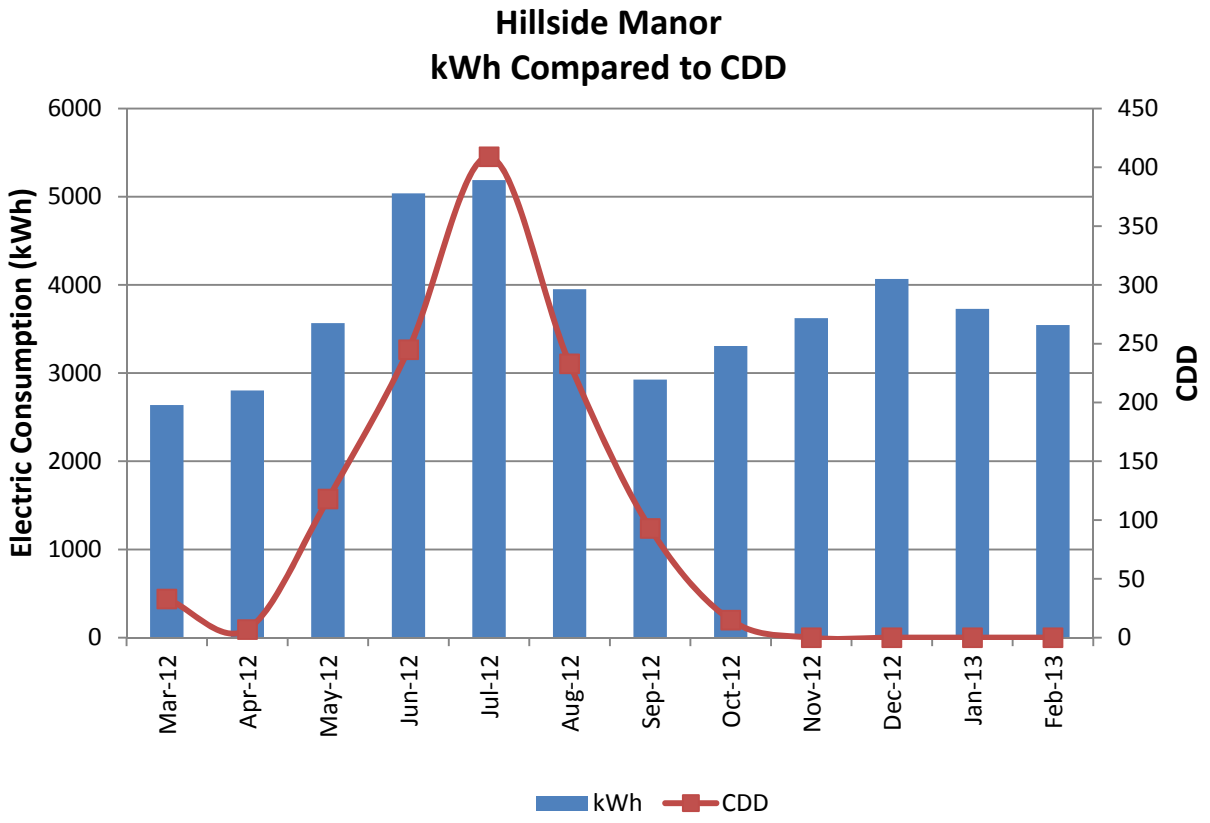


Figure 4. Electricity Consumption Graph

Table 9. Annual Electricity Metrics

	Tenant
Consumption	44,380 kWh
Energy Use Intensity	6.90 kWh / sf
MMBtu	151 MMBtu

	Tenant
Cost per kWh	$0.153 / kWh
Cost per ft²	$1.05 / sf
Electricity Cost	$6,769

Based on the method described in Section 3.3, Energy Calculations Methodology, the following figure shows the estimated electricity consumption per end use.

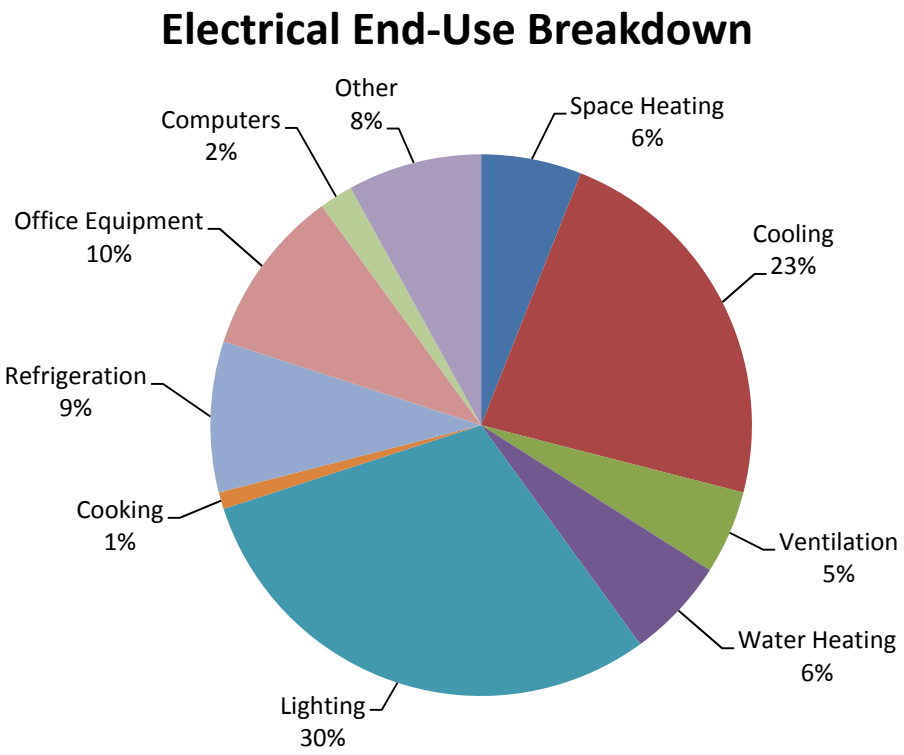


Figure 5. Estimated Electricity Consumption Per End Use

6.2 Natural Gas

Natural gas is supplied and delivered to the subject property by DTE Energy. Historic natural gas use is summarized in the following figures:

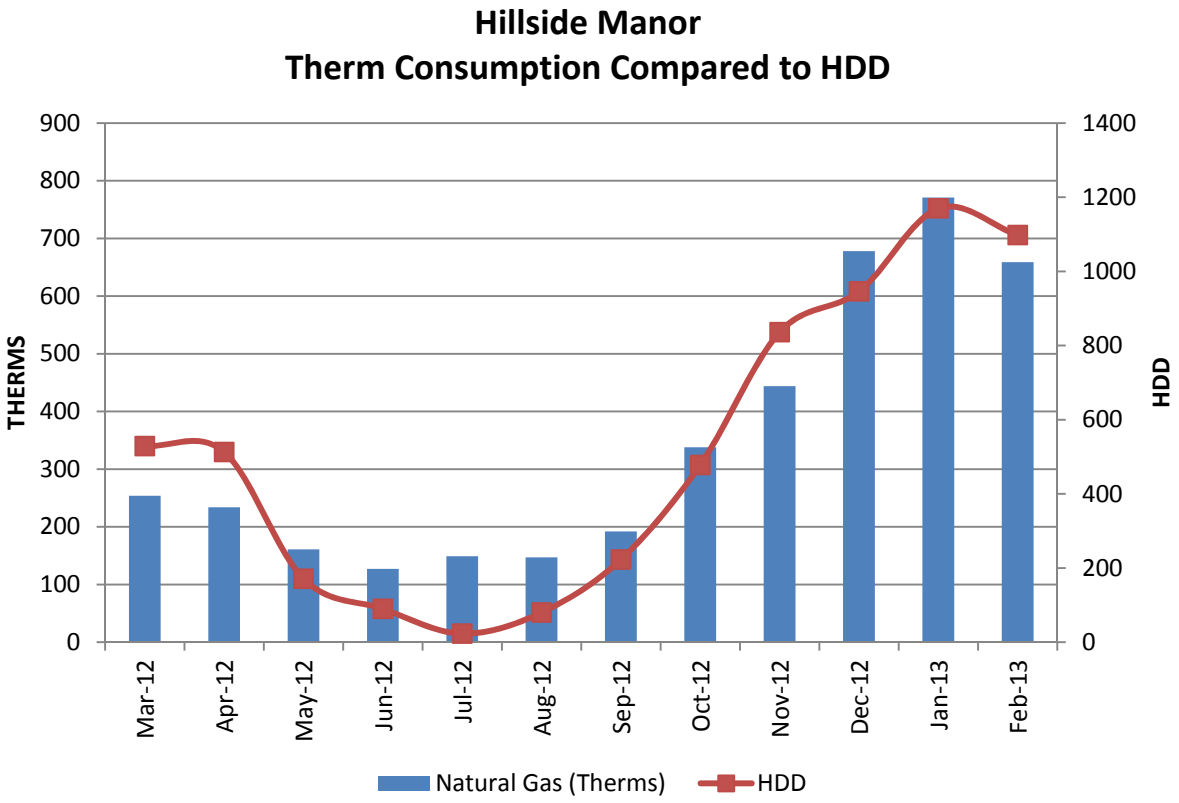


Figure 6. Natural Gas Consumption Graph

Table 10. Annual Natural Gas Metrics

	Tenant
Consumption	4,154 therms
Energy Use Intensity	0.65 therms / ft^2
MMBtu	415 MMBtu

	Tenant
Cost per therm	$1.004 / therm
Cost per ft^2	$0.65 / ft^2
Natural Gas Cost	$4,173

Based on the method described in Section 3.3, Energy Calculations Methodology, the following figure shows the estimated Natural Gas consumption breakdown by end use.

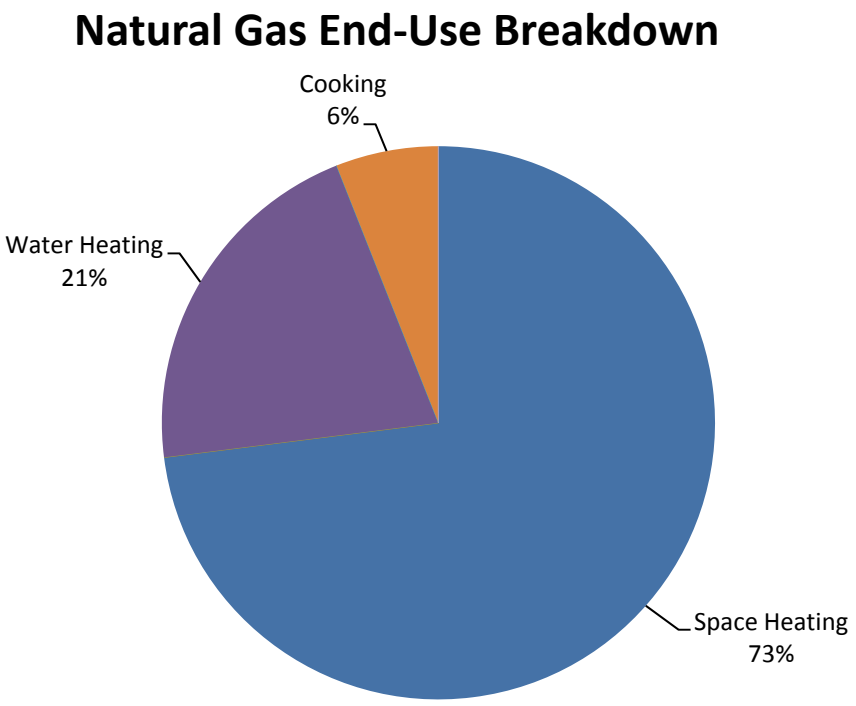


Figure 7. Estimated Natural Gas Consumption Per End Use

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 Provided	Unit of Consumption
City of Ann Arbor	4	CCF

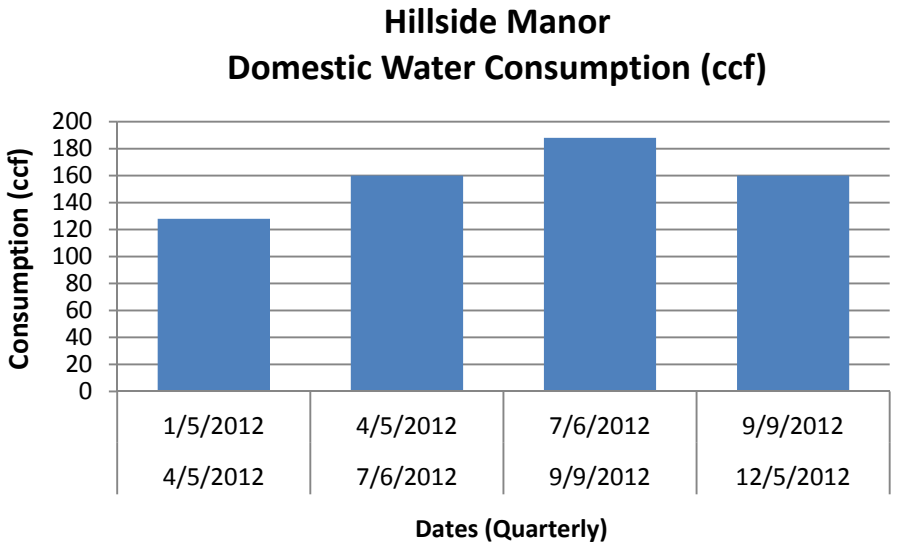


Figure 8. Domestic Water Consumption Graph (Owner)

Table 11. Annual Domestic Water Metrics

Consumption	636 CCF	**Cost per ccf**	$5.94 / CCF
Water Cost	$3,781	**Cost per ft^2**	$0.59 / ft^2

The provided annual water consumption was 636 CCF. Average cost per CCF for domestic water and sewer on an annual basis is $5.94. Total annual domestic water and sewer cost is $3,781.

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.

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.

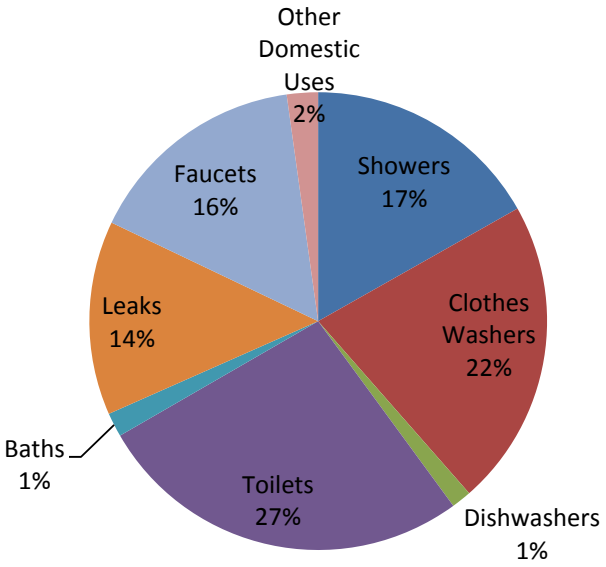


Figure 9. Domestic Water Typical End Use

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 3.3, 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.

Currently, the tenants pay $44.83 per MMBtu of electricity and $10.06 per MMBtu of natural gas.

Table 12. Annual Utility Use Breakdown

Categories	Electricity (MMBtu)	NG (MMBtu)	Total Consumption (MMBtu)	Consumption (%)
Space Heating	9	303	312	55%
Cooling	35	0	35	6%
Ventilation	8	0	8	1%
Water Heating	9	87	96	17%
Lighting	45	0	45	8%
Cooking	2	25	27	5%
Refrigeration	14	0	14	2%
Office Equipment	15	0	15	3%
Computers	3	0	3	1%
Other	12	0	12	2%
TOTAL	**151**	**415**	**566**	

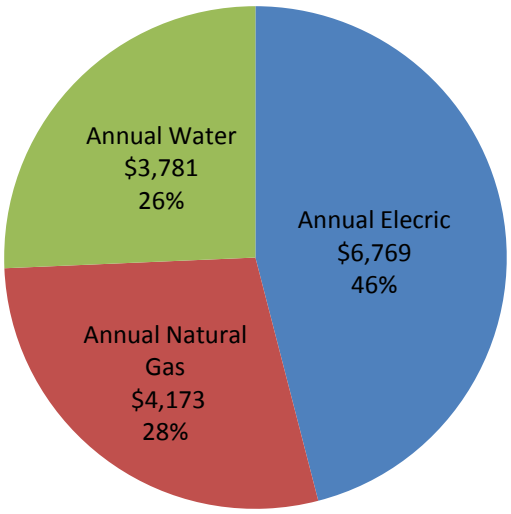


Figure 10. Annual Utility Cost by Type (Owner + Tenant)

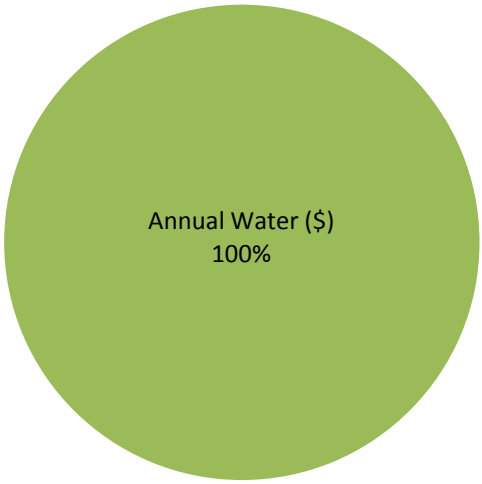


Figure 11. Annual Utility Cost by Type (Owner)

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 13. HUD Residential Energy Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	33	50
EUI (Energy Use Index)	88.1 kBtu/ft^2	73.5 kBtu/ft^2
$ ECI (Energy Cost Index)	1.70 $ / ft^2	1.42 $ / ft^2

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 14. HUD Residential Water Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	58	50
WUI (Water Use Intensity)	74.0 gal/ft^2	84.9 gal/ft^2
WCI(Water Cost Intensity)	0.59 $ / ft^2	0.67 $ / 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

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 and fixtures. When purchasing appliances and fixtures, 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 Utilize Setback/Programmable Thermostats (Accessibility: see ECM3)*

Heating requirements in residential buildings will typically depend on the comfort level of the occupants. Generally speaking, residents should try to keep the temperature at the lowest possible level while still maintaining comfort for all its occupants. Natural gas savings for this measure can be significant (5%-20%).

Recommended heating temperatures for residential buildings is in the range of 68-72°F. These temperatures apply to occupied daytime hours; a reduction to 55°F is recommended when homes are unoccupied or occupants are asleep.

Even a minor temperature setback during unoccupied building hours can produce a substantial savings. Owners should consider reviewing current heating temperatures in comparison to recommended levels with their residents. Significant energy savings can often be achieved for FREE by adjusting thermostats.

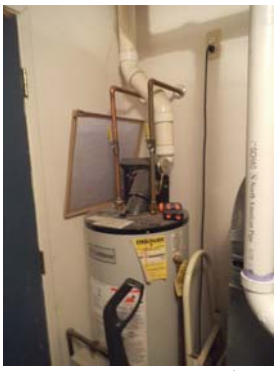
The recommended cooling temperature for residential buildings is 76°F during daytime hours. When air conditioning a building, you should try to keep the cooling temperature at the highest possible setting while still maintaining comfort. The savings can be quite significant for this measure. For example, it can cost up to *36% more* to cool spaces to 72°F rather than 76°F.

(Ideally, the air conditioning should be shut off when the building is unoccupied, but studies have shown that over half of the savings available are achieved with just a 5-degree increase. Even minor temperature increases during unoccupied hours can produce a good savings).

*NOTE: In the subject unit inspected (1020 Pennsylvania) there is a unique accessibility challenge that should be addressed to allow the tenant to properly utilize a thermostat/setback schedule. One of the tenants is bed-ridden, while the other tenant, her husband, is blind. The thermostat located in the hallway of the unit is a digital thermostat that can only be reached by the husband. However, it is not designed to meet the needs of the visually impaired.

9.4 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



Uninsulated HW pipe/tank

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.

9.5 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 entrance hallways 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.

A solution to infiltration from the bathroom exhaust fan involves installing a backdraft damper in the vent to restrict the flow of unwanted air into the building while still allowing the fan to properly exhaust unwanted air.

9.6 Regularly Clean Heating Equipment and Ductwork

A typical problem with multifamily properties is the presence of uneven heating within each unit. This is often attributed to the distribution system as well as the maintenance of the heating equipment. Heating systems that are not maintained can begin to collect debris in places like filters or the interior of the ductwork where it interferes with the flow of conditioned air from the furnace. This misdirected flow can cause a temperature differential between the rooms in the apartment and influence the occupants to adjust the appropriate thermostat set point.

Scheduled cleaning maintenance of the heating equipment and distribution system will not only ensure the occupant's continued comfort, but will also reduce the unnecessary energy consumption from increased temperature settings. Additionally, the proper maintenance will increase the lifetime of the equipment.

9.7 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.


Filter @ 1020 Pennsylvania

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.

9.8 Remove Window AC Units in Heating Season/Utilize Covers

The audit team observed several window air conditioners installed in tenant apartments windows. Because it was February when the team visited the subject property, and because these units are intended to provide cooling in the summer months, it is assumed these units are in place all year round.
Removing these units during the heating season is recommended to reduce the overall heat loss and air infiltration through these units. As they are not intended to be installed in cold climates year round, they are sources of inefficiency during the winter. Moreover, they can cause comfort issues for the tenants, and increase the tendency to turn up the thermostat. Some may not have been tightly sealed on the initial installation and this will only exaggerate the condition.


Second floor AC unit

However, because the audit team recognizes that this may not be realistic for each tenant, the team recommends utilizing insulated window air conditioner covers. There are two types of covers, indoor and outdoor. The outdoor covers protect air conditioners from insects, rodents, and other animals, in addition to sealing the unit and preventing drafts and excessive heat loss. These outdoor covers are preferred, as they will protect the units and increase their overall efficiency if they are well-maintained.


Sample indoor cover for second story

These units may not be appropriate for tenants living on the second floor, as this would require the use of a ladder and a more sophisticated handyperson. For these units the team recommends utilizing an indoor insulated cover. These indoor covers can be installed in tandem with exterior covers when applicable.

At the end of their useful life, these window air conditioners should be replaced with appropriately sized Energy Star labeled units.

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 one (1) water conservation measure (WCM). These ECMs are estimated to provide approximately $3,832 in annual savings. The investment required to implement all of the measures before the inclusion of applicable utility incentives is estimated to be $19,549. 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 15. Financial Summary of ECMs and WCMs

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	WCM1	$3,350	$881	3.8
Exterior Lighting Retrofit	ECM1	$2,625	$561	4.7
Replace Incandescent Lamps with CFLs Tenant Apartments	ECM2	$329	$919	0.4
Install Programmable Thermostats	ECM3	$2,100	$271	7.7
Control Air Leakage	ECM4	$3,600	$518	6.9
Replace Older Refrigerators with Energy Star Models	ECM5	$2,295	$232	9.9
Upgrade Insulation in Crawl Space	ECM6	$5,250	$450	11.7
Total		**$19,549**	**$3,832**	**5.1**

Table 16. Summary of Energy Savings for ECMs and WCMs

ECM Description	kWh Annual Savings (kWh)	Therm Annual Savings (Therms)	Water Annual Savings (ccf)	GHG Reduction (Metric Tonnes)
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	0	268	103	1.42
Exterior Lighting Retrofit	3,675	0	0	2.72
Replace Incandescent Lamps with CFLs Tenant Apartments	6,022	0	0	4.46
Install Programmable Thermostats	0	270	0	1.43
Control Air Leakage	0	516	0	2.74
Replace Older Refrigerators with Energy Star Rated Models	1,521	0	0	1.13
Upgrade Insulation in Crawl Space	0	448	0	2.38
Totals	**11,218**	**1,502**	**103**	**16.28**

Table 17. 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 Tankless On-Demand Water Heaters	EUL1	$600	$108	5.6
Total		**$600**	**$108**	**5.6**

10.1 WCM1 - Install Low-Flow Showerheads and Faucet Aerators (entire campus)

Summary

Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gal/yr)
$3,350	$881	3.8	0	268	77,044

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.


Showerhead @ 1020

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.

It is recommended to install a low-flow faucet aerator (0.5 GPM) in each bathroom on the entire campus. Additionally, it is recommended to replace every showerhead with a low-flow showerhead (1.5 GPM).

It should be noted that in the unit visited by the audit team, the residents at the subject unit require a wand, or hand held type showerhead. These are available from a number of manufacturers, including, but not limited to Waterpik, Delta and Moen.

Assumptions

Calculation of savings is based on replacing six (6) showerheads currently using 2.5 GPM with a new showerhead using 1.5 GPM. A value of 8 min of shower use per occupant per day (from the REUWS survey referenced in Section 5.3) was used, assuming four occupants or greater in each house.

Lavatory water savings calculation were based on replacing six (6) faucet aerators using 2.2 GPM with a low-flow faucet aerator (>0.5 or equal to 1 GPM) in each of the residential unit bathrooms. In total, the analysis of replacing showerheads and faucet aerators produced a water savings of greater than or equal to 15,288 gallons per household annually (6 total households).

Incentives

At the present time, DTE Energy's Multifamily Program does offer a direct install incentive for low-flow aerators and showerheads. The application for this program is included in the appendix of this report.

Expected Useful Life Study

Faucet aerators and showerheads have an expected useful life of ten years and toilets have an expected useful life of 20 years. It is believed that faucets and showerheads were installed approximately 10 years and are need of replacement.

10.2 ECM1 - Exterior Lighting Retrofit

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$2,625	$561	4.7	3,675	0	2.72

Recommendation Description

Exterior lighting on the building façade and around the building is outdated. Significantly more efficient lighting options exist. Therefore, it is recommended that exterior lighting be retrofitted with more efficient lighting. Specifically, light emitting diode (LED) lighting.

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.

The initial cost of this project is the material cost for fifteen (15) of the exterior wall packs at entries and stairs. Again, the additional savings associated with reduced maintenance costs are not included in the calculated savings.

Assumptions

It is assumed that all the lighting is used at night and is property owned.

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.

Calculations

This ECM analysis was based on replacing the existing wall pack fixtures with 10 watt high performance LED wall packs. Specification sheets for the analyzed models are included in the appendix.

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

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 2007 and have an expected useful life of six years. It is believed that the lamps will need to be replaced next year. The expected useful life of an LED replacement fixture is typically around 15 years.

10.3 ECM2 - Replace Incandescent Lamps to CFLs (entire campus)

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$329	$919	0.4	6,022	0	4.46

Recommendation Description

There are a number of lamps used in the building which should be updated. The current, outdated, incandescent lamps are inefficient and require unnecessary amounts of energy. The subject unit (2674 S Main) was recently updated with new overhead fixtures, utilizing compact fluorescents. All other lamps were observed to be incandescent.

Compact fluorescent lamps are a good 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.

It is recommended to upgrade the remaining incandescent bulbs in the home to compact fluorescent lamps.

Assumptions

This ECM is calculated using a replacement total of 85 CFLs (16 CFLs on avg. per three bedroom unit and 5 additional for 2674 S Main). Lamps are assumed to operate approximately 4 hours per day each. It is assumed all of the existing lamps are 60, 65, or 75 watt incandescent, and they will be replaced with 13 or 19 watt CFLs.

A lighting survey of the property was conducted by AKT Peerless during the walk-through. A table of existing and proposed lighting can be found 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's Multifamily Program is offering incentives for replacing incandescent lamps with CFLs in tenant spaces.

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.

10.4 ECM2 - Install Programmable Thermostats

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$2,100	$271	7.7	0	270	1.43

Recommendation Description

Currently, control of the furnace heat in each home is by a digital thermostat located in the hallway. Please note that although the thermostat observed during the site visit (and 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.

VIP Series Talking Thermostat

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.

In the subject unit inspected (1020 Pennsylvania) there is a unique accessibility challenge that should be addressed to allow the tenant to properly utilize a thermostat/setback schedule. One of the tenants is bed-ridden, while the other tenant, her husband, is blind. The thermostat located in the hallway of the unit is a digital thermostat that can only be reached by the husband. However, it is not designed to meet the needs of the visually impaired. At the time of the site visit the subject unit observed was set to 78 °F. This is exceptionally high, and may be due to the fact that the resident simply "feels" the temperature.

Talking thermostats, designed for persons who are blind or have low vision, can assist these tenants, and those in a similar situation by featuring an audio playback of day, time, indoor temperature, temperature setting and programming instructions so blind and low vision users can precisely and easily manage their indoor comfort.

Recommended temperature settings are included below:

	Heating Daytime Setting	**Heating Nightime Setback**
Current Setpoints (estimated)	74 °F	74 °F
Proposed Setpoints	72 °F	67 °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 67 degrees and a regular set-point of 72 degrees.

A premium cost was applied to the Talking Thermostat, added for unit 1020.

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 243 MMBtu for heating.

A reduction of 5 degrees (nighttime setback of 67 degrees) for an 8 hour setback every night was assumed.

Incentives

DTE Energy's Multifamily Program is offering a direct install incentive for installing programmable thermostats in the individual units.

Expected Useful Life Study

The existing manual thermostats have an expected useful life of 15 years. These thermostats were installed in 1996 and will reach the end of their useful life in 2014. At this time, replacement of the manual thermostats with programmable thermostats, with the same expected useful life, is recommended.

10.5 ECM3 - Control Air Leakage

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$3,600	$518	6.9	0	516	2.74

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.

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 air leakage is significantly reduced.

<u>For the subject property, Hillside Manor:</u> (see Section 5.5.5 and 5.5.6 for details)

The blower door test determined that air leakage is adequate for ventilation, but excessive. **It is highly recommended that air sealing is performed at this property.**
The blower door airflow rate was estimated at 2,325 CFM_{50}.
The building tightness limit (BTL) is 888 CFM_{50}.
Therefore, an air leakage reduction limit of 62% should not be exceeded.

Air Sealing Strategy:

Air seal the home to the minimum ventilation rate (MVR) for air leakage, but **not** below. During the blower test of one representative sample unit, the air leakage was identified to be in the following areas:

1) 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.

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

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

4) 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.

5) There was significant leakage present in the ducts in these units. Please refer to Section 12 – FE3 – Duct Blaster Test and Duct Sealing

Water damage creating air pathways

Assumptions

Air sealing would cost approximately $600 per unit ($3,600 total for the facility) to achieve 50% of the targeted 69% reduction in air leakage (the remainder to be targeted through additional measures – see ECM10 - Duct Blaster Test and Duct Sealing). 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 34% reduction of existing air leakage (49 CFM). This preserves the MVR detailed in the recommended description above. Equation used for estimation was: Q = 1.08 * (66 cfm) * (6,818 HDD) * 24 hr/day = 8,579,403 Btu (approx. 86 therms) per unit.

Incentives

DTE Energy's Multifamily Program is not offering incentives for air sealing at the present 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.

10.6 ECM4 - Replace Older Refrigerators with Energy Star Models

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$2,295	$232	9.9	1,521	0	1.13

Recommendation Description

After lighting, refrigerators are the second largest users of electricity in most households (not including households with electric heat or hot water). Older refrigerators can use up to four times more electricity than the most efficient new models available in the same size.

Replacing these inefficient units with new, more efficient refrigerators can realize substantial energy and cost savings. In many cases, it is cost-effective to replace older refrigerators before scheduled replacement because of the electricity cost savings.

It was believed that these 3 bedroom homes have refrigerators in the range of 18.9 to 21 cu ft. and the units were manufactured between 1997 and 2000. The replacement model used in the ECM calculation is an 18.9 cu ft. model that is estimated to use 343 kWh per year and has an estimated cost of $750 each. This automatic-defrost model is ENERGY STAR® qualified because it is 15 percent more efficient than federal standards require. By contrast, the average refrigerator in that size purchased before 1990 uses around 1,100 kWh, with older units using more than 1,500 kWh per year.

It should be noted that if a smaller refrigerator is deemed appropriate for these homes, replacement models are available in 15.5 cu ft. size (same as community center) that is estimated to use 343 kWh per year and has an estimated cost of $765 each. This would reduce the first cost of this ECM and reduce the payback time.

Assumptions

There exist a total of three (3) refrigerators that were manufactured between 1997-2000 and in the size range of 18.9 to 21 cu ft.

Calculations

The Stanford University Appliance Calculator was used to generate all estimates used in this ECM. The calculator result output is included in the appendix.

The Appliance Calculator Project is part of the Stanford Large-Scale Energy Reductions through Sensors, Feedback & Information Technology Initiative, an Advanced Research Projects Agency for Energy research program (ARPA-e), funded by the Department of Energy http://arpa-e.energy.gov/

Incentives
DTE Energy's Multifamily Program is not offering incentives to install Energy Star products at the present time.
Expected Useful Life Study
The expected useful life of refrigerators is approximately fifteen years. Half of the existing refrigerators are at or near the end of their useful life and are recommended for replacement.

10.7 ECM5 - Upgrade Insulation in Crawl Space

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$5,250	$450	11.7	0	448	2.38

Recommendation Description

Many building science experts argue that crawl spaces should be constructed as mini-basements, and should not be vented. They believe that best-practice efficient crawl space construction includes these under-floor spaces as part of the conditioned space, with a dedicated HVAC supply duct (Energy Efficient Building Association – www.eeba.org).


Crawl Space

However, this method is often dismissed for initial cost of construction when a project is value-engineered. Instead of insulating the foundation from the exterior, builders will insulate the floor cavity between the unheated crawl space and the conditioned space, while providing open venting for natural ventilation through the crawl space (above grade) foundation wall.

This is the condition the audit team found at Hillside Manor Apartments. In this design, often fiberglass batts – R-19 or greater – are used for floor insulation. Unfaced batts avoid moisture problems in the insulation because they don't have a vapor barrier to trap moisture coming either from the ground or indoors. These unfaced batts are often held in place with lath, stapled twine, or wire insulation supports. Most importantly perhaps, these batts should be installed so they touch the underside of the floor. Any gaps will allow convective loops or currents to carry away heat before the insulation can do its job.

The audit team believes the **originally installed insulation may be substantially displaced or poorly installed** in several locations in each of the subject buildings. For this reason, the audit team recommends a detailed inspection of the current condition of existing insulation, and the evaluation of replacement with properly installed insulation rated at R-30 or better. This would conform to current energy standards in Michigan, and increase the overall energy efficient performance of these facilities.

One method for consideration would be the application of a spray-foam urethane insulation, which could provide both the necessary insulation levels and an additional air infiltration barrier. This extra benefit is particularly relevant for this building, as the audit team observed significant leakage at the subject unit inspected.

An additional consideration would be to ensure that any and all ductwork located in the crawl space

remained sealed, insulated and protected. For more information please see 11.3 - ECM10.

Incentives

DTE Energy's Multifamily Program is not offering 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.

11.0 ECMs for End of Useful Life (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 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 Tankless On-Demand Hot Water Heater

Summary (per water heater)					
Premium Cost	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Reduction (Metric Tonnes)**
$600	$108	5.6	0	108	0.57

Recommendation Description

Usually, a water heater is replaced only when it fails. But if the existing water heater is at least twelve 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 HA 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 only)
- 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 on-demand tankless hot water heaters (Energy Factor of .82 or greater). This represents a 15% percent energy savings compared to a standard efficiency gas water heater.

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

- Minimum Energy Factor (EF) of 0.82 as of September 1st, 2010.
- Minimum Gallons per Minute of 2.5 gpm over a 7.7° rise
- Annual energy savings of 15% (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 may not offer incentives for replacing older hot water heaters with tankless on-demand units at this time.

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 twelve years. The existing hot water heaters were installed at different times. Four of the units have tanks that were installed in 1995 and two of the units have tanks that were installed in 2011. It is highly recommended that the four units from 1995 be replaced soon.

Rating Calculation

Fixture	Fixture's GPM Rating
Showerhead	1.5
Bathroom Faucet	0.5
Kitchen Faucet	1.0
Clothes Washer	2.5
Total GPM Demand	5.5

It is recommended to install an instantaneous hot water heater with at least a 5.5 gpm rating to fulfill the maximum demand. Typical uses require at most 120°F hot water, therefore the recommended rated temperature rise for these units should be 70°F.

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 of the entire facility.

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.


Inefficient Clothes Washer

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 old, cheapest functioning units available. These units are often very 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 approximately 10-20 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.

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
DTE Energy's Multifamily Program is not offering incentives for insulation 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.

12.2 FE2 - Duct Blaster Test and Duct Sealing

Recommendation Description

The HVAC ducting located in the subject unit observed (1020 Pennsylvania) displayed significant leakage. This duct leakage was detected when the blower door test was performed. Leakage was greatly exaggerated, and the project team believes 50% or more of the leakage resulting from the blower door test may be associated with unsealed, uninsulated or displaced ductwork.


Diagnostic testing equipment for ducts

Studies indicate that duct leakage typically wastes 10% to 30% of the heating energy purchased (Krigger and Dorsi, *Residential Energy, 5th Edition*). When ducts are located in an intermediate zone, as in this unheated crawl space, some of the heating energy contained in duct leakage is reclaimed by the home. The amount reclaimed depends on how well-connected the intermediate zone is to the conditioned zones versus how well-connected it is to the outdoors.

In this case, with direct ventilation openings around the perimeter, the ducts are fairly well-connected to the outdoors. This air exchange between ducts and outdoor air wastes energy in two ways. Heated air is lost or outdoor air enters and needs to be conditioned. Duct air leakage also pressurizes and depressurizes the home, providing a driving force for air leakage. Operation of the forced-air system increases home air leakage an average of two to five times.

It is recommended that unconnected duct joints are repaired and leaky duct joints are sealed and insulated to meet or exceed current energy codes. Duct mastic used with fabric webbing is the best material for sealing ducts.

A pre and post duct blaster test is recommended to quantify the impact of a potential improvement, and verify the quality of any work performed.

Incentives

DTE Energy's Multifamily Program is not offering incentives for duct sealing 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.

13.0 ECMs Evaluated but Not Recommended

The following ECMs were evaluated but are not recommended for implementation:

13.1 NREC1 - Ground Source Heat Pump

Summary					
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**GHG Emissions (Metric Tonnes)**
$69,486	$2,472	28.1	6,000	1,550	12.67

Description

According to the Great Lakes Adaption Assessment for Cities, the estimated number of days reaching temperatures at or above 90 degrees in Southeast Michigan will increase to 30-50 days per year due to global climate changes. With many of the Ann Arbor Housing residents being disabled or elderly, health issues often are exacerbated by the hot and humid weather. Consequently, AAHC plans on including air conditioning to all the tenant spaces.

At the present time, only a few of the tenant units at Hillside Manor have window air conditioners for space cooling. It was stated there are ten window air conditioners in the subject property. Three of the tenant units have one air conditioner, one of the tenants has three air conditioners, and the other tenant has four air conditioners within the tenant space. In cases where window air conditioners are present, the resident is responsible for those purchases and installation. Often, improper installation can cause damage to the windows and walls. Additionally, the appropriate size is not always selected; thus reducing the efficiency of the unit and increasing energy costs.

Most of the existing furnaces are approximately 2 years with an expected useful life of 15 years. Although the existing units are newer and have a 90% AFUE rating, units with higher efficiency ratings do exist on the market today.

With this in mind, AAHC has considered installing a ground source heat pump system for the overall heating and cooling needs. The property has sufficient acreage to drill wells and will benefit from energy cost savings for space heating in the tenant spaces. Ground source heat pumps (GSHP) are among the most energy efficient technologies for providing heating and air conditioning.

For heating, the efficiency of a heat pump is identified by the coefficient of performance (COP) rating. The COP is the ratio of the heating supplied over the electrical energy consumed. The higher the unit's COP rating, the more energy efficient it is. Typical COP values for air source heat pumps are within the range of 2 to 2.5 while the typical COP for a ground source heat pump is between 3 and 6.

For cooling, the efficiency is identified by the Energy Efficiency Ratio (EER) rating. The EER rating of a unit is the cooling output over the total electric energy input. Similar to the COP, the higher the unit's EER rating, the more energy efficient it is. Typical EER ratings for ground source heat pumps are

between 11 and 30. It is recommended that AAHC install a system with the highest EER rating that is feasible.

Energy savings for this ECM were based on a ground source heat pump system with a COP rating of 4.5 and an EER of 20.

Based on the estimated installation costs and calculated energy savings, payback for implementation is expected to be over 20 years. For this reason, a ground source heat pump system is not recommended.

It should be noted that our analysis does not account for maintenance savings, site security issues related to exterior equipment, renewable energy incentives that are not currently available to the Client and the durability of the entire system. Further evaluation of these items may increase the overall economic benefit of implementing this ECM.

Calculations

This ECM analyzes the cost savings associated with installing a ground source heat pump system over the existing standard efficiency furnaces and installing a central air-conditioning system in all of the units at Hillside Manor.

*The premium cost is the difference between the overall cost of the high efficiency item (ground source heat pump system) and overall cost to add the standard replacement item (central air conditioners).

Base cost of $2,800 for standard efficiency condensing unit/evaporator coil.
Overall installation and equipment cost of $86,286 for a ground source heat pump (20 EER; 4.5 COP) at site.

Incentives

DTE Energy's Multifamily Program is not offering incentives to install ground source heat pump systems at the present time.

Expected Useful Life Study

Furnaces typically have an expected useful life of 15 years. Standard efficiency condensing unit/evaporator coil system also has an expected useful life of 15 years. The interior units of a ground source heat pump system typically have an expected life of 20 years while the ground loop is anticipated to have an expected useful life beyond 100 years.

Manual J Calculation Results

To confirm appropriate sizing of the recommended cooling and 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. Detailed reports of the Manual J assumptions are included in the appendix of this report.

Most of the units at Hillside Manor can be grouped into similar types of construction; therefore values for heat loss and heat gain will be similar. Overall values for the heat loss within the software program are often increased by a factor of 15% to 25% to account for averages used in the winter design temperatures. The following table lists the calculated values for heat transfer in each unit:

Tenant Unit #	# of Bedrooms	Heat Gain (Btu/h)	Heat Loss w/ 25% Factor Increase (Btu/h)
1020	3	14,971	36,425
1022	3	16,899	34,485
1030	3	13,900	35,286
1032	3	16,674	34,486
1040	3	14,971	36,425
1042	3	16,899	34,485

These calculations have assumed previously recommended ECMs have already been implemented. It is recommended that all building envelope improvements be performed before installing a new heating and cooling system.

14.0 Feasibility Assessment of Green Energy Technologies

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

14.1 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 r high installation costs.

14.2 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.

14.3 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.

14.4 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.

14.5 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.

15.0 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.

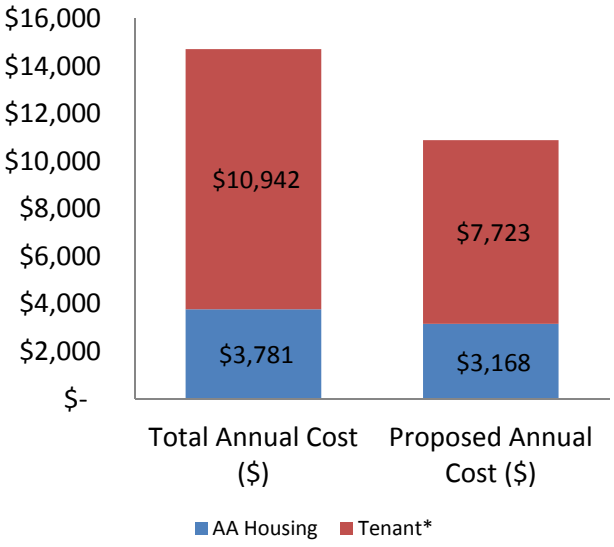
The combined annual EUI for the subject building is estimated at 88.1 kBtu per square foot per year. The annual energy cost index is an estimated $1.70 per square foot per year. Reduction of fuel (non-electrical) and electrical energy consumption through the implementation of recommended ECMs will potentially result in a reduced EUI of 58.83 kBtu per square foot per year, a potentially reduced annual cost index of $1.11 per square foot per year, and potential total annual energy cost savings of $3,832 per year.

An additional result of implementing the recommended ECMs would be the reduction of greenhouse gas (GHG) emissions by 16.28 metric tonnes. 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 18. Impact Summary

% Energy Savings	33%
% Water Savings	16%
% Cost Savings	26%
Annual Cost Savings ($)	$3,832
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tonnes)	30%



16.0 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 evaluated the potential financial savings from changing to a different utility price structure due to limited details on provided rate structures.

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.

17.0 Signatures

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Recent annual electricity consumption, cost is summarized in the following tables:

Natural Gas

NATURAL GAS UBA
AAHC Site: **Hillside Manor**

Month	Start	End	Days	HDD	Consumption Therms	Actual (0) Estm. (1)	Delivery $	Gas $	Total $
Mar-12	13-Mar-12		29	529	254	0	$ -	$289	$289
Apr-12	15-Apr-12		32	513	234	0	$ -	$276	$276
May-12	15-May-12		31	171	161	0	$ -	$192	$192
Jun-12	14-Jun-12		29	90	127	0	$ -	$167	$167
Jul-12	13-Jul-12		30	23	149	0	$ -	$189	$189
Aug-12	14-Aug-12		32	80	147	0	$ -	$192	$192
Sep-12	12-Sep-12		28	223	192	0	$ -	$220	$220
Oct-12	9-Oct-12		28	478	338	0	$ -	$368	$368
Nov-12	11-Nov-12		32	836	444	0	$ -	$433	$433
Dec-12	14-Dec-12		34	946	678	0	$ -	$613	$613
Jan-13	13-Jan-13		30	1170	771	0	$ -	$669	$669
Feb-13	14-Feb-13		29	1098	659	0	$ -	$565	$565
				6,157	**4,154**				**$4,173**
									$1.005 $/Therm

Electricity

ELECTRICAL UBA
AAHC Site: **Hillside Manor**

Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Total Charges ($)
Mar-12	13-Mar-12		29	529	33	0	2638	$419
Apr-12	15-Apr-12		29	513	7	0	2803	$439
May-12	15-May-12		31	171	118	0	3567	$473
Jun-12	14-Jun-12		29	90	245	0	5037	$782
Jul-12	13-Jul-12		30	23	409	0	5188	$795
Aug-12	12-Aug-12		30	80	233	0	3951	$609
Sep-12	11-Sep-12		29	223	93	0	2926	$449
Oct-12	9-Oct-12		29	478	15	0	3307	$514
Nov-12	11-Nov-12		32	836	0	0	3622	$558
Dec-12	14-Dec-12		34	946	0	0	4068	$622
Jan-13	13-Jan-13		30	1170	0	0	3728	$565
Feb-13	14-Feb-13		29	1098	0	0	3545	$544
				6157	**1153**		**44,380**	**$6,769.17**
								$0.15253 Blended $/kWh

HUD Residential Energy Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up, and elevator buildings.

The HUD Residential Energy Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" to come back to this page.

***Directions:** Provide entries in ALL the grey spaces that apply for your Building Description and Annual Energy Consumption.*

Building Description

Preliminary: 9/17/07

Building Name: Hillside Manor (optional entry)

5-digit Zip Code: 48103 [Not Sure?]

Heating Degree Days: 6818

Mapping Location: *Ann Arbor, MI*

Cooling Degree Days: 840

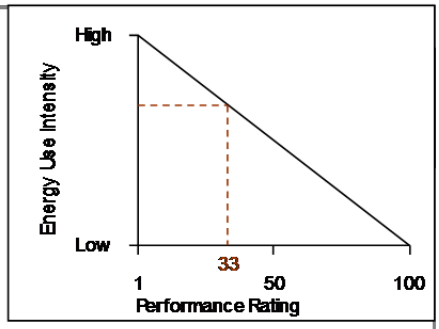
	Gross Floor Area (ft2)	Total Number of Units	Is This a Multifamily Building with Central Laundry? (Y/N)	Is this a Multi-Family Walkup Building? (Y/N)	Heated Floor Area (ft2)	Year Built
Building Description:	6,432	6	N	N	6,432	1996

Annual Consumption

	Electricity	Gas	#2 Fuel Oil	#4 Fuel Oil	District Steam	District Hot Water	Propane
Select Units:	kWh	Therms	Gal	Gal	kLbs	MMBtu	Gal
Energy	44,380	4,154					
Cost ($)	6,769	4,173					
Calculated unit cost:	$0.15 $/kWh	$1.00 $/therm	$/gallon	$/gallon	$/klbs	$/kBtu	$/gallon

Results

	Your Building	HUD Typical
Score Against Peers	**33**	50
Building Site Energy Use (kBtu/year)	566,825	473,064
Site Energy Use Intensity (kBtu/ft2-year)	88.1	73.5
Energy Cost Intensity ($/ft2-year)	1.70	1.42
Total Annual Energy Cost ($/year)	10,942	9,132



HUD Residential Water Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up and elevator buildings.

The HUD Residential Water Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" text to come back to this page.

Directions: Provide entries in the gray spaces below with your building description and annual water consumption.

Building Description

ORNL 8/22/2007

Building Name: Hillside Manor (optional entry)

5-digit Zip Code: 48103 Not Sure?

Mapping Location: *Ann Arbor, MI*

	Gross Floor Area of Building(s) (ft2)	Building(s) is Single-Family Detached or Semi-Detached? (Y/N)	Is Residents Water Use Paid Directly by the PHA? (Y/N)	Number of Units in Building(s)	Number of Units in Building(s) with In-Unit Laundry Hookups or Central Laundry Access?	How Many Buildings share this Water Meter?
Building Description:	6,432	N	Y	6	6	3

Annual Consumption

Building Annual Water Use: 440,572 (gallons/year)

Building Annual Water Use Cost: 3,632 ($/year)

Average Annual Water Cost: $0.8 ($/100 gallons)

Results

	Your Building	HUD Typical
Score Against Peers	**62**	**50**
Annual Water Use (gal/year)	**440,572**	**545,912**
Annual Water Use Intensity (gal/ft2-year)	**68.5**	**84.9**
Annual Water Cost Intensity ($/ft2-year)	**0.56**	**0.70**
Total Annual Water Cost ($/year)	**3,632**	**4,500**

Photo 1: Exterior view of the three duplexes

Photo 2: Exterior north end of one duplex

Photo 3: Storage area behind duplex

Photo 4: Exterior south end of duplex

Photo 5: Typical style window of each unit

Photo 6: Exterior view of window frame

Photo 7: Typical side door and exterior lighting

Photo 8: Soffit vents above second floor of building

Photo 9: Kitchen (refrigerator purchased by tenant)

Photo 10: Window air-conditioning unit

Photo 11: Interior window frame of typical window

Photo 12: Bathroom faucet with aerator

Photo 13: Standard efficiency showerhead

Photo 14: Bathroom exhaust fan (water damage)

Photo 15: Clothes washer in mechanical room

Photo 16: High Efficiency Furnace in mechanical rm.

Photo 17: DHW tank in mechanical room

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)
Tenant Spaces	94	1456	Incandescent	Incandescent - 60W	60	8212	CFL	16 watt CFL	16	2190	4.14	$ 282.00	6022	$918.36	0.3
						8212				**TOTALS**	**4.14**	**$ 282.00**	**6,022**	**$918.36**	**0.3**

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	Demand Reduction (kW)	Retrofit Cost ($)	Annual Energy Savings (kWh)	Annual Cost Savings ($)	SP (yrs)
Exterior Wallpacks*	15	4380	MH50	50 watt Metal Halide	66	4336	10W LED	10w LED Wall Pack	14	920	N/A	$2,625.00	3416	$522.71	5.0
						4336				**TOTALS**		**$2,625.00**	**3,416**	**$522.71**	**5.0**

* Only recommended if the photocells and lamps are intended to be replaced in the near future.

BARRON TRACE LITE

TLED101

MINI POLYCARBONATE LED WALL PACK

Model Number:

Accessories:

Type:

Job:

Approvals:

DESCRIPTION

The TLED101 series mini wallpack features a durable, vandal resistant, injection molded Bronze polycarbonate enclosure combined with a high performance LED light source that makes it a durable and efficient choice. Constructed of polycarbonate with a die cast aluminum base plate, the TLED101 is fully sealed and gasketed, is IP 65 rated and UL listed for Wet Locations. Available with a 10 watt LED light engine, the TLED101 provides an ideal light distribution and has a wide spectrum of applications including schools, office complexes, light commercial, apartments and recreational facilities.

SPECIFICATIONS

Construction:
Precision molded polycarbonate housing is mounted to a die cast aluminum base plate that provides superior heat dissipation while still maintaining an economical luminaire with durable performance. Fixture is completely sealed and gasketed with corrosion-resistant stainless steel captive fasteners. The LED light engine is protected by a high impact, UV stabilized polycarbonate prismatic refractor.

Optics:
TLED101 series mini wallpack delivers exceptional light quality, efficiency and light distribution. The 10 watt LED light engine powered by a constant current control driver provides a 50,000 hour rated life, 70% lumen maintenance, 4700K CCT and a CRI of ≥85. A low LED thermal junction (Tj) of 70°C (158°F) at a design ambient of 25°C (77°F) supports long life and low lumen depreciation.

Electrical:
LED light engines and drivers are securely mounted directly to the die cast aluminum base plate optimizing thermal management. LEDLITElogic heat sinking technology moves heat away from the LEDs maximizing system performance and delivering 50,000+ hour life with >70% lumen maintenance. The TLED101 series operates from 120-277V 50/60Hz with an auto-ranging voltage controlled circuit and simple two (2) wire input. The TLED101 is suitable for operation in -30°C (-22°F) to 40°C (104°F) ambient conditions. Optional transient surge protection and photocontrols are available.

Environmentally Friendly Design:
TLED101 luminaires consume very little energy and provide long life in comparison to traditional lamp technologies. Our manufacturing process utilizes no harmful chemicals such as mercury or lead and the LED light engines emit an extremely low UV and minimal heat. The compact design allows for the use of fewer materials and is recyclable, resulting in less overall waste.

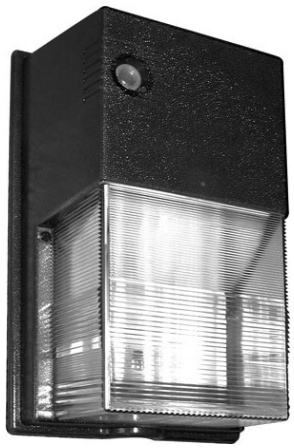
Installation:
The TLED101 series is ideal for mounting to any vertical surface and easily attaches to a 3" or 4" j-box. The TLED101 can also be surface mounted using the ½" conduit entry point at the bottom of the housing.

IESNA LM-79 and LM-80:
The TLED101 is evaluated in accordance with the parameters outlined and reported by LM-79 and LM-80 documents.

Listing:
UL Listed for wet locations.

Warranty:
The TLED101 LEDLITElogic series features a 5 year warranty.

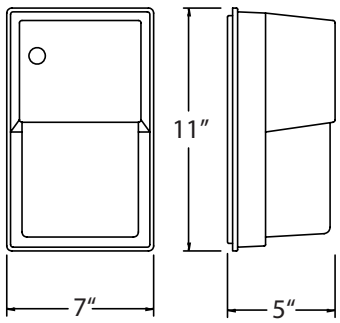
LEDLITElogic



Fixture Performance			
Watts	**Lumens**	**Lumens Per Watt (LPW)**	**Total Watts**
10	900	90	14

NOTE: Lumen maintenance and lfe (part of LM-80 data) are per published information from primary LED suppliers and is based on design operation at their specified thermal management and electrical design parameters.

DIMENSIONS



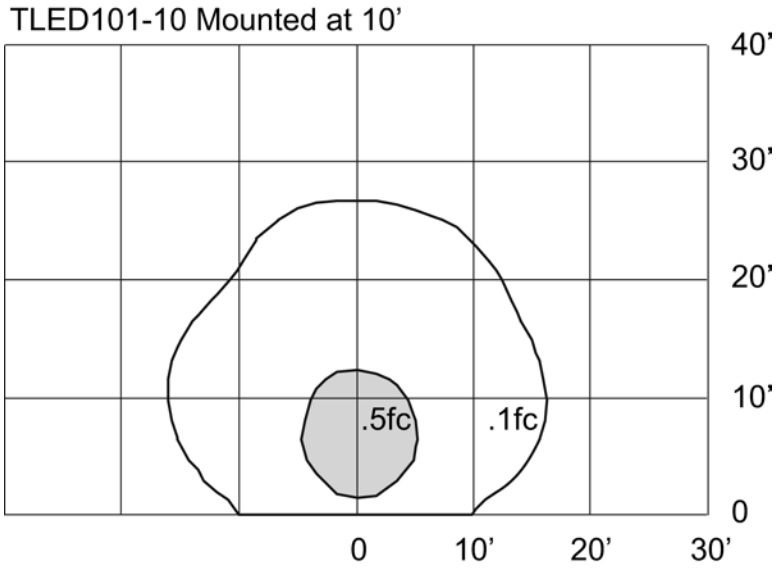
Approximate Weight: 4 lbs.

RoHS COMPLIANT

c UL us LISTED

SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

SAMPLE PHOTOMETRICS



ORDERING INFORMATION

TLED101	10	DT	TP	PC1
SERIES	TOTAL WATTS	VOLTS	OPTIONS (Factory Installed)	ACCESSORIES[1] (Field Installed)
TLED101	10 = 10 Watts	DT = 120/277V	TP = Transient Protection System	PC1 = 120V Photocontrol PC2 = 208-277V Photocontrol

[1] Order As Separate Line Item

BARRON lighting group

1911 West Parkside Lane • Phoenix, AZ 85027
888.533.3948 • 623.580.3948 • Fax: 623.580.8948
www.trace-lite.com • www.barronltg.com

Tenant Unit Programmable Thermostats (6)

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	6
Initial Cost for one programmable thermostat	$350
Initial Cost for one manual thermostat	$1
Unit Fuel Cost (Cooling) ($/kWh)	$0.153
Unit Fuel Cost (Heating) ($/Therm)	$0.90

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	74
Nighttime Set-Back Temperature (Average)	67
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.***

	6 Programmable Thermostat(s)	6 Manual Thermostat(s)	Savings
Annual Energy Costs			
Heating Energy Cost	$2,216	$2,458	$241
Heating Energy Consumption (MBTU)	*245*	*272*	*27*
Cooling Energy Cost	$0	$0	$0
Cooling Energy Consumption (MBTU)	*0.0*	*0.0*	*0*
Total	**$2,216**	**$2,458**	**$241**

TalkingThermostats.com

Comfort Solutions for persons who are blind or have low vision

VIP Series of residential *Talking Thermostats* that promotes independent living

All New VIP 3000 Universal Talking Thermostat

The ***NEW* VIP 3000** is a full featured universal multi-stage talking thermostat that can control most 24 Vac AC and Heating Systems including the newest multi-stage (up to 3H and 2C) gas, oil and electric furnaces, air conditioners and heat pump / dual fuel (hybrid) systems with 1 or 2 stage compressors and auxiliary heat. The VIP 3000 has enhanced speech functions and optional auto-changeover

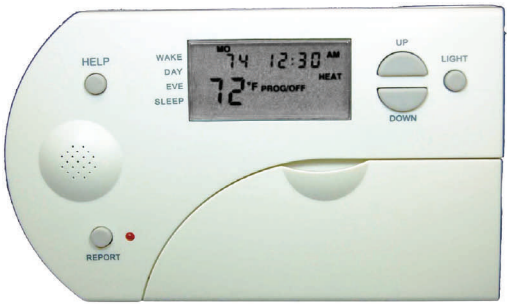
The Standard VIP 1007 and VIP 2007 Talking Thermostats

The VIP 1007

Controls single stage conventional 24 Vac gas, oil and electric furnaces and single stage electric air conditioning systems.

The VIP 2007

Controls single stage compressor heat pump systems with auxiliary heat. The VIP 2007 can also control one or two stage conventional 24 Vac gas, oil and electric furnaces and single stage electric air conditioners.



The VIP series is the first digital thermostat with audio playback of day, time, indoor temperature, temperature setting and programming instructions so blind and low vision users can precisely and easily manage their indoor comfort.

Yes, the VIP **"talks"** to you! When you press the day/time, weekend or weekday schedule buttons, you are **voice prompted** to enter the correct settings.

Press the REPORT button to hear

"day of the week, time, indoor temperature and the thermostat setting"

Press the UP or DOWN arrow buttons to

"raise or lower the temperature and hear the new temperature setting"

Press the HELP button to

"obtain a telephone number to call for questions regarding your thermostat"

Email: harry@talkingthermostats.com Tel: 1-800-838-8860 763-591-9557 Fax: 763-544-7166

VIP Series Talking Thermostat Features, Model Selection and Specifications

Features

- ***Very User Friendly -*** built in voice instructions guides the user in setting the day, time, temperature and weekly settings.
- ***Built in Loud Speaker*** - announces in a human voice, the current day, time, room temperature, set point and programming instructions when the appropriate button is pressed.
- ***Audio CD*** - with complete audio instructions to operate and program the VIP is included with each thermostat. Also included on the disk is a text file of the instructions.
- ***Push button Convenience*** - easy to use control panel, receive voice confirmation after each button press.
- ***Off Wall programming*** - program your VIP before mounting to the wall.
- ***Program Choice*** - programmable 5+2 setback schedule or non-programmable mode.
- ***Multiple programs*** - up to four time and temperature settings per weekday and separate weekend settings in the 5+2 programmable setback mode.
- ***Models for most applications*** - **VIP 1007** for conventional 1 stage heating / 1 stage cooling, **VIP 2007** for 1 stage compressor heat pump systems with auxiliary heat or conventional 2 stage heating / 1 stage cooling systems, **VIP 3000** can control all systems mentioned above in additional to most of the newest multi-stage (up to 3H and 2C) gas, oil and electric furnaces, air conditioners and heat pump / dual (Hybrid) fuel systems with 1 or 2 stage compressors and auxiliary heat. The VIP 3000 as enhanced speech functions and optional auto-changeover.
- ***Freeze protection*** - turns on heating system at 40 degrees if thermostat is off or is inoperative.
- ***Memory Backup*** - assures that all programmed data will be retained in the event of a power failure.
- ***Low Battery Alarm -*** announces when the battery is low.
- ***LCD Display*** - shows current time, temperature, set point temperature and system status for the sighted person. Everything that is displayed is also spoken.

Model Information

VIP 1000 Series (current model is the VIP 1007)

VIP 1007: The VIP 1007 controls single stage conventional 24 Vac gas, oil and electric furnaces and single stage electric air conditioning systems. The VIP 1007 replaces most 2, 3, 4 and 5 wire wire analog and digital thermostats including the very popular "round" model.

VIP 2000 Series (current model is the VIP 2007)

VIP 2007: The VIP 2007 controls single stage compressor heat pump systems with auxiliary heat. Please note, the VIP 2007 can only be used with heat pump systems that do not use an outdoor thermostat. The VIP 2007 can also control one or two stage conventional 24 Vac gas, oil and electric furnaces and single stage electric air conditioners.

VIP 3000 Series (current model is the VIP 3000)

VIP 3000: The VIP 3000 is a universal multi-stage talking thermostat that can control most 24 Vac Heating and Air Conditioning Systems including the newest multi-stage (up to 3H and 2C) gas, oil and electric furnaces, air conditioners and heat pump / dual fuel (Hybrid) systems with 1 or 2 stage compressors and auxiliary heat. Has enhanced speech functions (talking Fan and System buttons) and optional auto-changeover.

Specifications

Power Source.....4 AA batteries

Output Load Ratings.....1.5 amps max @ 24 Vac

Temperature Ratings

Operating.....40º F to 90º F (4º C to 32º C)

Setpoint Range.....50º F to 90º F (10º C to 32º C)

Accuracy .....± 2º F

Differential.. ..... 1 to 3º F

Humidity Rating.....5% to 90% RH, non-condensing

Wiring Connections.....Screw terminals

Case Material.....High Impact ABS Plastic

Flammability.....UL 94 V-0

Color.....White

Display

VIP 1007-VIP 2007…..…LCD 1.0 X 2.0"

VIP 3000……...LCD 1.4 X 2.3"

System Switch

VIP 1007-VIP 2007…..…3 position (Heat - off - Cool)

VIP 3000……...5 position (Off - Cool - Heat - Aux - Auto)

Fan Switch.....2 position (on - auto)

Freeze Protection.....40º F if thermostat is off or inoperative

Short Cycle Protection.....5 minute

Dimensions.....7.0"w X 4.0"h X 1.5"d

The EZRA Group LLC / Talking Thermostats.com

PO Box 27145 Golden Valley, MN 55427

E-mail: harry@talkingthermostats.com Tel: 1-800-838-8860 763-591-9557 Fax: 763-544-7166

YOUR ENERGY SAVINGS℠

YourEnergySavings.com
DTE Energy

DTE Energy
Multifamily Program

DTE Multifamily Program Application

Required Site Information

SITE NAME		FEDERAL TAX ID

SITE ADDRESS		

CITY	STATE	ZIP CODE

SITE REPRESENTATIVE NAME	SITE REPRESENTATIVE PHONE #
SITE REPRESENTATIVE EMAIL ADDRESS	SITE REPRESENTATIVE FAX #
SECONDARY REPRESENTATIVE NAME	SECONDARY REPRESENTATIVE PHONE #

Required Management Company/Owner Information

MANAGEMENT COMPANY NAME		FEDERAL TAX ID

MAILING ADDRESS		

CITY	STATE	ZIP CODE

MANAGEMENT COMPANY REPRESENTATIVE NAME	MANAGEMENT REPRESENTATIVE PHONE #
MANAGEMENT COMPANY EMAIL ADDRESS	MANAGEMENT COMPANY FAX #
SECONDARY REPRESENTATIVE NAME	SECONDARY REPRESENTATIVE PHONE #

Required Site Information

ELECTRICITY PROVIDER	ELECTRIC ACCOUNT NUMBER	GAS PROVIDER	GAS ACCOUNT NUMBER
YEAR BUILT	TOTAL # OF UNITS	TOTAL # OF BUILDINGS	TOTAL # OF VACANT UNITS

TOTAL NUMBER OF FLOORS	DOES BUILDING HAVE BASEMENTS?	MAX # OF BATHROOMS PER UNIT
MAX # OF SHOWERS PER UNIT	MAX # OF SINKS PER BATHROOM	AVERAGE SQUARE FOOTAGE OF UNITS

Optional Site Information

TOTAL # OF SHOWERS ON PROPERTY	TOTAL # OF SINKS ON PROPERTY	ARE WATER HEATERS IN UNITS?

DTE Energy Multifamily Program Lighting Specifications

LIGHTING SPECIFICATIONS

All lighting projects are expected to comply with the Illuminating Engineering Society of North America (IESNA) recommended lighting levels or the local code. All final applications must include manufacturers' specification sheets for lamps and ballasts. All incentives are for one-for-one replacements except as noted.

Compact Fluorescent Lamps, Screw-In (≤ 31 Watts)
Incentives are available for the replacement of incandescent lamps with CFLs that are ENERGY STAR® rated or that meet ENERGY STAR® criteria. The lamps must have a luminous efficacy of ≥ 50 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Lamps, Screw-In (> 31 Watts)
Incentives are available for the replacement of incandescent lamps with high wattage CFLs. The new lamp must have a luminous efficacy of ≥ 65 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Fixtures
Incentives are available for upgrades to interior hardwired compact fluorescent fixtures. Replacement fixtures must be new fixtures or modular hardwired retrofits with hardwired electronic ballasts. The compact fluorescent ballast must be programmed start or programmed rapid start with a power factor (PF) ≥ 0.90 and a total harmonic distortion (THD) ≤ 20%. Incentive is per fixture.

Compact Fluorescent Reflector Flood Lamps
Incentives are available to install CFL reflector flood lamps to replace incandescent reflector flood lamps. The CFL reflector flood lamps must have a luminous efficacy of ≥ 33 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFL's purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

42W 8-Lamp Compact Fluorescent High Bay Fixture
Incentives are available in high-bay applications (ceiling heights over 15 feet) for replacing any lighting fixtures greater than or equal to 350W with 42 Watt, 8 lamp compact fluorescent fixtures. Replacement fixtures must contain specular reflectors and electronic ballasts with a power factor (PF) ≥ 0.90. Incentive is per fixture.

ENERGY STAR® Qualified LED Recessed Down Light
Incentives are available to replace incandescent recessed lights with ENERGY STAR® qualified LED recessed down lights. Replacement lights must have a minimum efficacy of 35 lumens per watt. Incentive is per lamp. *Note: This incentive is not available for lamps purchased at retail stores participating in the DTE Energy lamp discount program. Incentive for lamps purchased from those retailers is included in the discounted price.*

Standard Linear Fluorescent Retrofit
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T8 or T5 lamps and electronic ballasts. The new fixture lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for a minimum of 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic discharge (THD) ≤ 20 % at full power output. For 2 and 3-foot lamps, ballasts must have THD ≤ 32 % at full light output. Incentive is per fixture.

High Output T8/T5 Lamp and Ballast replacing T12 Fluorescent Lamp
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T5HO or T8HO lamps and electronic ballasts. The replacement lamps must have a CRI ≥ 80. Incentive is per fixture.

Low Wattage 4-foot T8 Lamps (Lamps Only)
Incentives are available for replacing 32 Watt T8 lamps with reduced (low) wattage T8 lamps when an electronic ballast is already present. The lamps must be reduced wattage in accordance with the Consortium for Energy Efficiency© (CEE©) specifications (www.cee1.org) and as summarized in Table 2 below. Low wattage lamps must be either 25W or 28W and CEE© Listed. Qualified products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Incentive is per lamp.

High Performance 4-foot T8 Lamp and Ballast
Incentives are available for replacing existing T12 or T12HO lamps and magnetic ballasts or standard T8 lamps and electronic ballasts with high performance T8 lamps and electronic ballasts. Replacement fixtures must high performance in accordance with the Consortium for Energy Efficiency© (CEE©) high performance T8 specification, available at www.cee1.org, which and is summarized in Table 1 below. A list of qualified lamps and ballasts can be found at: http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must meet the specification in order to be eligible for an incentive. Incentive is per fixture.

LIGHTING SPECIFICATIONS

Table 1: High Performance T8 Specifications

High Performance T8 and T5 Characteristics				
Mean System Efficacy	≥ 90 Mean Lumens per Watt (MLPW) for Instant Start Ballasts			
	≥ 88 MLPW for Programmed Rapid Start Ballasts			
Performance Characteristics for Lamps				
Color Rendering Index (CRI)	≥ 80			
Minimum Initial Lamp Lumens	≥ 3100 Lumens *			
Lamp Life	≥ 24,000 Hours			
Lumen Maintenance or Minimum Mean Lumens	≥ 94% or ≥ 2900 Mean Lumens			
Performance Characteristics for Ballasts				
Ballast Efficacy Factor (BEF) BEF = (BFx100)/Ballast Input Watts	**Instant Start Ballast (BEF)**			
	Lamps	Low BF ≤ 0.85	Norm 0.85 < BF ≤ 1.0	High BF ≥ 1.01
	1	> 3.08	> 3.11	NA
	2	> 1.60	> 1.58	> 1.55
	3	≥ 1.04	≥ 1.05	≥ 1.04
	4	≥ 0.79	≥ 0.80	≥ 0.77
	Programmed Rapid Start Ballast (BEF)			
	1	≥ 2.84	≥ 2.84	NA
	2	≥ 1.48	≥ 1.47	≥ 1.51
	3	≥ 0.97	≥ 1.00	≥ 1.00
	4	≥ 0.76	≥ 0.75	≥ 0.75
Ballast Frequency	20 to 33 kHz or ≥ 40 kHz			
Power Factor	≥ 0.90			
Total Harmonic Distortion	≤ 20%			

* For lamp with color temperatures ≥ 4500k. 2950 minimum initial lamp lumens are allowed.

Low Wattage 4-foot T8 Lamp and Ballast

Incentives are available for replacing T12 systems with reduced (low) wattage lamp and electronic ballast systems. The lamps and ballasts must meet the Consortium for Energy Efficiency© (CEE©) specification (www.cee1.org) and summarized in Table 8-2 on the following page. Qualified lamp and ballast products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must qualify in order to receive an incentive for the system. Incentive is per fixture.

Table 2: Reduced (Low) Wattage 4-foot Lamps and Ballasts

Performance Characteristics for Lamps(1)		
Mean System Efficacy	≥ 90 MLPW	
Color Rendering Index (CRI)	≥ 80	
Minimum Initial Lamp Lumens	≥ 2585 Lumens for 28 W	
	≥ 2400 Lumens for 25 W	
Lamp Life(2)	≥ 18,000 hrs at three hours per start	
Lumen Maintenance –or- Minimum Mean Lumens(3)	≥ 94% -or- ≥ 2430 Lumens for 28 W ≥ 2256 Lumens for 25 W	
Performance Characteristics for 28 and 25 W Ballasts		
Ballast Frequency	20 to 33 Hz or ≥ 40 kHz	
Power Factor	≥ 0.90	
Total Harmonic Distortion	≤ 20%	
Performance Characteristics for Ballasts(4), 28 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.52
	2	≥ 1.76
	3	≥ 1.16
	4	≥ 0.88
Performance Characteristics for Ballasts(4), 25 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.95
	2	≥ 1.98
	3	≥ 1.32
	4	≥ 0.99

(1) Lamps ≥ 4500 K and/or 24,000 hours have a system efficacy specified ≥ 88 MLPW. Minimum initial and mean lumen levels are specified as follows: for 28 W lamps, limits are 2600/2340. For 25 W lamps, limits are 2300/2185.

(2)Life rating is based on an Instant Start Ballast tested in accordance with ANSI protocols. When used for Programmed Start Ballast, life may be increased depending upon the operating hours per start.

(3) Mean lumens measures at 7,200 hours

(4) Multi-Voltage Ballasts must meet or exceed the listed Ballast Efficiency Factor when operated on at least one of the intended operating voltages.

LIGHTING SPECIFICATIONS

High Output T5 and 4-foot T8 New Fixture Replacing HID
Incentives are available for replacements of HID fixtures with T8 or T5HO lamps and electronic ballasts. The T8 or T5HO lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤ 20% at full light output. This incentive is available for high-bay and low-bay fluorescent applications. Incentive is per fixture.

Pulse Start Metal Halide (retrofit only)
Incentives are available for replacing existing HID fixtures with pulse start metal halide fixtures in high-bay applications. Incentive is per fixture.

Exterior HID to LED/Induction Lighting Retrofit
Incentives are available for exterior applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate > 3,833 hours per year (> 10.5 hours per day). Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Eligible applications include canopy lighting and wall-packs. This incentive can be combined with incentives for exterior/garage bi-level control. Incentive is per fixture.

Garage HID to LED/Induction Lighting Retrofit
Incentives are available for garage and parking deck applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate 8760 hours per year or whenever the garage is open. Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Incentive is per fixture.

Exit Signs
Incentives are available for high-efficiency exit signs replacing or retrofitting an existing incandescent exit sign. Electroluminescent, T1, and LED exit signs are eligible. Non-electrified and remote exit signs are not eligible. All replacement exit signs must be UL or ETL listed, have a minimum lifetime of 10 years, and have an input wattage ≤ 5 Watts per face or be ENERGY STAR® listed. Incentive is per sign.

LED Traffic and Pedestrian Lights
Incentives are available for LED traffic lights on a per-signal basis (including arrows) that replace or retrofit an existing incandescent traffic signal. At minimum, red and green lamps must be retrofitted to qualify for the signal incentive. LED Signals must have a wattage of ≤17 watts per signal. Incentives are not available for spare lights. Lights must be hardwired, with the exception of pedestrian hand signals. Incentive is per signal.

Occupancy Sensors
Incentives are available for occupancy sensors for low occupancy interior areas, which automatically turn lights on when movement is detected. The minimum amount of time for the lights to stay on when no movement is sensed (delay set time) should be 10 minutes. The sensors can be passive infrared (PIR) or ultrasonic. All sensors should be hard-wired and control interior lighting fixtures. *To assist in rebate processing, provide the inventory of the controlled fixtures with the Final Application*. Incentive is per sensor.

Central Lighting Control
Incentives are available for automated central lighting control systems with override capabilities. This measure includes time clocks, package programmable relay panels, and complete building automation controls. Photo-sensors may also be incorporated into the central lighting control system. Incentive is per 10,000 square feet of controlled area.

Switching Controls for Multilevel Lighting
Incentives are available to install switching controls for multilevel lighting which may be used with daylight or occupancy sensors. If combined with daylight sensors, the controls must be commissioned in order to ensure proper sensor calibration and energy savings. This measure is applicable to spaces that require various lighting schemes such as classrooms, auditoriums, conference rooms and warehouses with skylights. Incentive is per 10,000 square feet of controlled area.

Daylight Sensor Controls
Incentives are available for new daylight sensor controls in spaces with reasonable amounts of sunlight exposure and areas where task lighting is not critical. The controls can be on/off, stepped, or continuous (dimming). The on/off controller should turn off artificial lighting when the interior illuminance meets the desired indoor lighting level. Daylight sensor controls are required to be commissioned in order to ensure proper sensor calibration and energy savings. Incentive is per 10,000 SF of controlled area.

Exterior Lighting, Bi-Level Control with Override
Incentives are available for retrofitting existing, exterior HID lighting with bi-level controls that reduce lighting levels by at least 50% when the space is unoccupied. The HID lighting must have an electronic ballast capable of reduced power levels, and be coupled with motion sensors to bring the light back to full lumen output for security reasons. Eligible controls include on-off controls, dimmers, and hi-lo ballast controls. This measure is applicable to exterior fixtures that are on during the night. Incentive is per fixture.

Light Tube
Incentives are available for new light tubes (tubular skylights) 10 inches to 21 inches in diameter. This measure is applicable to spaces that normally require electric lighting during peak hours (1 - 4 p.m. weekdays during the summer). The light tube must still allow an adequate amount of light during overcast conditions and must be coupled to daylight sensing controls. Incentive is per tube.

Delamping
Incentives are available for the permanent removal of existing fluorescent lamps. Permanent lamp removal is the net reduction in the quantity of lamps after a project is completed. Customers are responsible for determining whether reflectors are necessary in order to maintain adequate lighting levels. Lighting retrofits are expected to meet the Illuminating Engineering Society of North America (IESNA) recommended light levels. Unused lamps, lamp holders, and ballasts must be removed permanently from the fixture and disposed of in accordance with local regulations. This measure is applicable when retrofitting from T12 lamps to T8 lamps only. Removal of lamps from a T12 fixture that is not being retrofitted with T8 lamps is not eligible for this incentive, but may be eligible for other incentives. Incentive is per lamp removed.

HVAC (ELECTRIC) SPECIFICATIONS

Programmable Thermostat Setback/Setup (Air Conditioning)
Incentives are available for replacement programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® standards, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

General Clause for Heating Measures
Prescriptive incentives are available only for retrofit projects using natural gas as the primary fuel source. If a dual-fuel system is used, or if natural gas is the back-up or redundant fuel, the custom incentive application must be used. The incentives for boilers are only available for equipment used in space heating conditions, except for steam traps. Equipment for process load may be eligible for custom incentives.

Steam Trap Repair/Replacement
Incentives are available for the repair or replacement of steam traps that have failed open and that are leaking steam. Incentive is not available for traps that have failed closed or that are plugged. Replacement with an orifice trap is not eligible. Incentive is available once per 24 month period, per facility. Steam trap repair work must be recorded and the service report must be attached to the incentive application. Incentive is per repaired or replaced trap. The report must contain:

- Name of Survey/Repair Technician
- Survey/Repair Date
- System nominal steam pressure
- Annual hours of operation
- Number of steam traps serviced
- Per steam trap:
    - ID tag number, location and type of trap
    - If repair or replaced:
        - Orifice Size
        - Pre-and Post Conditions (e.g., Functioning/Not Functioning, Leaking/Not Leaking)

Pipe Wrap - Steam Boiler
Incentives are available for insulation applied to bare steam boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Pipe Wrap - Hot Water Boiler
Incentives are available for insulation applied to bare hot water boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Programmable Thermostat Setback/Setup (Gas Heat)
Incentives are available for new programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® criteria, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

Boiler Tune-up (Space Heating Boilers Only)
Incentives are available for tune-ups to natural gas fired, space heating boilers. Burners must be adjusted to improve combustion efficiency as needed. The incentive is available once in a 24 month period. Boiler size must be 110 MBH or greater. The service provider must perform before and after combustion analyses and attach the tune-up report to the Final Application. Incentive is per boiler. Tune-up report must contain the following information:

- Name of the technician performing tune-up
- Date of tune-up
- Boiler type (hot water, low pressure steam, high pressure steam)
- Boiler nameplate information (make, model, capacity)
- Annual hours of operation
- Pre-and Post combustion analysis results (an electronic flue gas analyzer must be used) including
    - o Combustion efficiency
    - o Stack temperature
    - o Flue gas levels of O2, CO2 and CO
- Statement that the following were performed:
    - o Check and adjust combustion air flow and air intake as needed
    - o Check burner and gas input
    - o Check draft control dampers
    - o Clean burners, nozzles, combustion chamber and heat exchanger surface (when weather or operating schedule permits
    - o Check combustion chamber seals
    - o Check for proper venting
    - o Complete visual inspection of system piping and installation
    - o Check safety controls

Boiler Water Reset Control
Incentives are available for boiler water reset controls added to existing boilers operating with a constant supply temperature. Incentives are for existing space heating boilers only. A replacement boiler with boiler reset controls is not eligible. The system must be set so that the minimum temperature is not more than 10°F above manufacturer's recommended minimum return temperature. For controls on multiple boilers to be eligible, control strategy must stage the lag boiler(s) only after the lead boiler fails to maintain the desired boiler water temperature. Incentive is per boiler.

AKTPEERLESS

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 1, October 2012).

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Building Analyst Professional No. 5023902
Building Performance Institute

Date: October 11, 2013

Part 2 Energy Audit Report and Excel RPCA Model were Received and Reviewed by Owner:

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Ann Arbor Housing Commission
727 Miller Ave
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Phone:734-794-6720
Fax: 734-994-0781

Date: 10-11-13

4.0 Part 3: Utility Consumption Baseline

AKTPEERLESS

Rental Assistance Demonstration (RAD): UTILITY CONSUMPTION BASELINE

1020-1042 Pennsylvania Avenue, Ann Arbor, Michigan 48103
HILLSIDE MANOR

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

ON BEHALF OF The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8359E-3-96

PIC # MI064

DATE September 9, 2013

AKTPEERLESS

Rental Assistance Demonstration (RAD): CONSUMPTION NARRATIVE REPORT

1020-1042 Pennsylvania Avenue, Ann Arbor, Michigan 48103
HILLSIDE MANOR

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

ON BEHALF OF The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PIC # MI064

PROJECT # 8359E-3-96

DATE September 9, 2013

Table of Contents

AKTPEERLESS

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 October 2012 (Version 1).

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 three (3) 2,094 square foot multi-family buildings. The subject buildings were constructed in 1996 and contain two (2) stories with a crawlspace. There are a total of six (6) three bedroom, one bathroom units at the site. The subject building is generally referred to as Hillside Manor.

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. No common meters exist at the site. Therefore, there are a total of six (6) electric meters, six (6) natural gas meters, and six (6) 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)
566,869 kBtu/yr	90.24 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)
595,429 kBtu/yr	94.78 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 October 2012 (Version 1).

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-14790, dated June 26, 2013 and revised July 31, 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 October 2012 (Version 1).

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 three (3) 2,094 square foot multi-family buildings. The subject buildings were constructed in 1996 and contain two (2) stories with a crawlspace. There are a total of six (6) three bedroom, one bathroom units at the site. The subject building is generally referred to as Hillside Manor.

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 1996. 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.

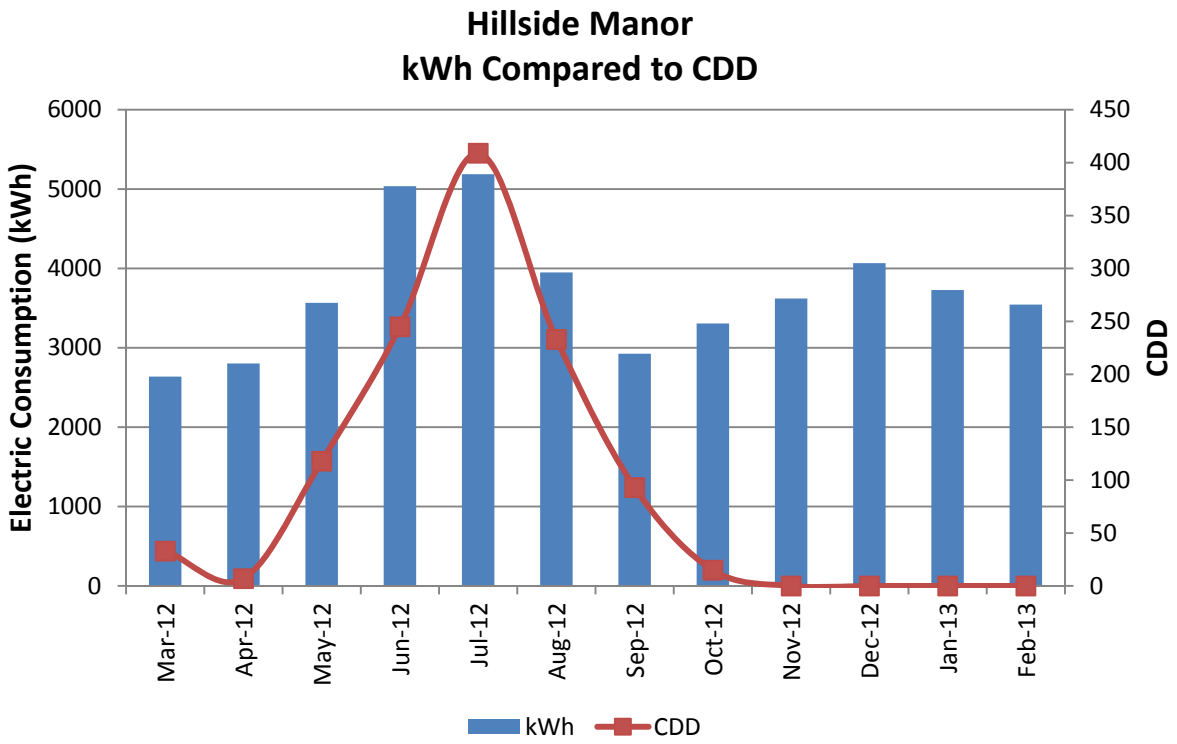

Figure 4.1 Electricity Consumption Graph

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 - Six (6) Non-Residential (Common) - None (0)
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	None
Responsible for Payment	Tenant
Rate	$0.153 / kWh
Site Consumption	44,380 kWh / year (151,469 kBtu / year)

Energy Use Intensity (EUI)	7.06 kWh / ft^2 (24.11 kBtu / ft^2)
Weather Normalized Site Consumption	42,749 kWh / year (145,901 kBtu / year)
Weather Normalized EUI	6.80 kWh / ft^2 (23.23 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, Hillside Manor, 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.

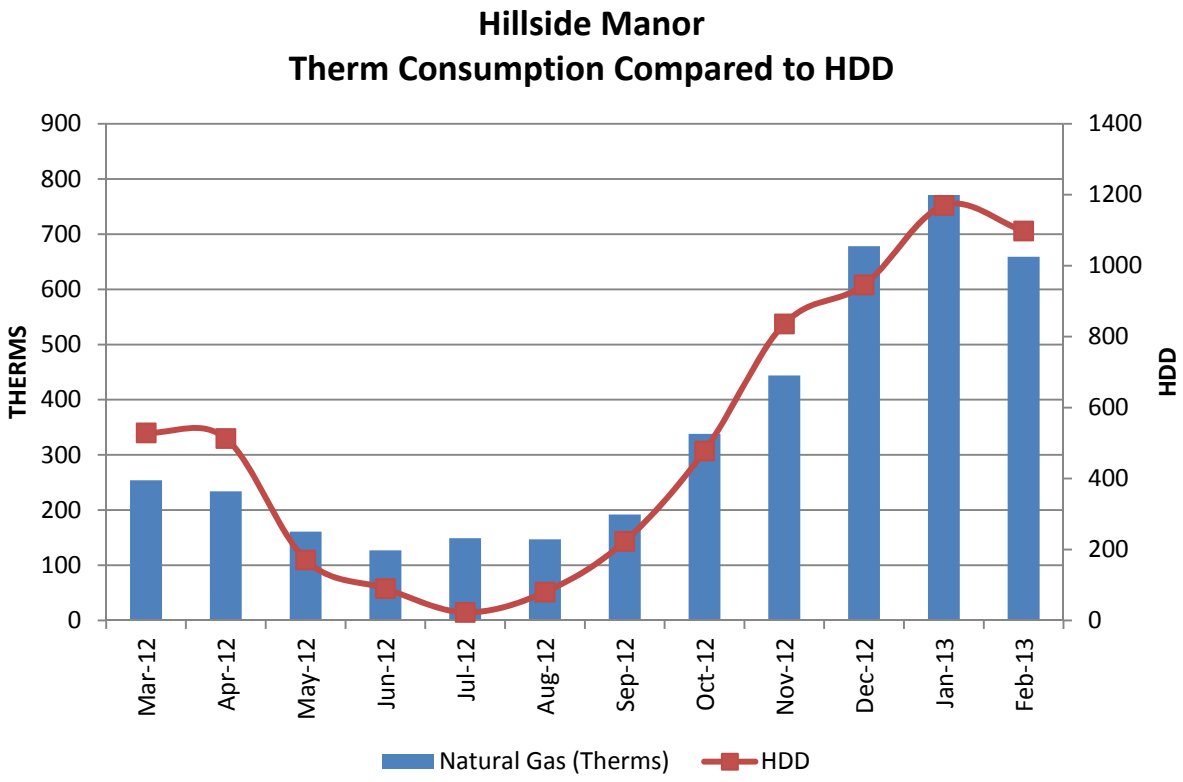

Figure 4.2 Natural Gas Consumption Graph

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 – Six (6) Non-Residential (Common) – None (0)
Use for Residential	Gas-fired furnaces for space heating, ranges for cooking, dryers for laundry.
Use for Non-Residential	None
Responsible for Payment	Tenant
Rate	$1.005 / therm
Site Consumption	4,154 therms / year (415,400 kBtu / year)
Energy Use Intensity (EUI)	66.13 kBtu / ft^2

Weather Normalized Site Consumption	4,495 therms / year (449,528 kBtu / year)
Weather Normalized EUI	71.56 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, Hillside Manor, 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

Report submitted by:

Henry McElvery
Technical Director of Energy Services
AKT Peerless Environmental Services
Illinois Region
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Fax: 248.615.1334
Building Analyst Professional No. 5023902
Building Performance Institute

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 1, October 2012).

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Building Performance Institute

Date: October 11, 2013

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

Jennifer Hall, Executive Director
Ann Arbor Housing Commission
727 Miller Ave
Ann Arbor, MI 48103
Phone:734-794-6720
Fax: 734-994-0781

Date: 10-11-13

5.0 Part 4: Integrated Pest Management Inspection

Rental Assistance Demonstration Program (RAD)
Integrated Pest Management Inspection Report

8/07/2013

Project Name: Ann Arbor Housing HillsideManor
FHA Number:
Section 8 Expiration Date:

Dear Ann Arbor Housing:

At the meeting held on July 26th of 2013, we provided the 6 units with Integrated Pest Management (IPM) materials and information to assist in gathering data for the property's IPM review. Below is a report of our glue trap findings, comments, and infestation status (high, moderate, low, none). (Lengthen the table as needed to reflect all units, whether glue traps were returned to IPM inspector or not. Include results from common areas monitored such as laundry, interior trash handling, and storage areas.)

Unit	Visually Inspected	# Traps Collected	Kitchen Trap Count	Bathroom Trap Count	Maintenance Issues	Housekeeping Issues	Other Comments	Status (H, M, L, N)
1020	Y	1	n/a	0		Kitchen cabinets are completely jam packed.	1 Fruit fly in bathroom trap. Red flour beetles and Indian meal moths in kitchen. Bedroom trap missing	N
1022	N	2	n/a	0			1 earwig in bathroom	N

							trap, 1 Indian meal moth in the bedroom trap.	
1030	N	2	0	0			1 silver fish in bathroom, 1 pavement ant in bedroom trap	N
1032	Y	0	n/a	n/a			No pest activity observed.	N
1040	N	1	0	n/a			Bedroom trap is missing.	N
1042	N	3	0	0				N

After analyzing the findings of the glue traps, we conducted a visual inspection of **2 units (see attached photos)** and have concluded that the glue trap findings do reflect the current state of infestation in the units and property.

The Green Retrofit Physical Condition Assessment scope of work, at Part 3.2.D.ii requires a ". . . detailed narrative describing the property's pest infestation, if any, and a corrective course of action for each infestation, and if needed, specific actions for serious infestations within individual units." **(IPM Inspector – add comments below)**

> We also provided monitoring devices for all bedrooms on 7/26/2013, and removed them on 08/22/2013. We felt it prudent to monitor these areas for bed bugs as they are of increasing concern. We did not capture any bed bugs in the monitoring devices we installed, nor did we observe any signs of bed bugs during our inspections.
>
> During our inspection of the six units at Hillside Manor, we found no signs of roaches. Furthermore, our detailed inspections of 2 units also failed to reveal any pests of significance. There were pantry pests observed in two of the six units. We recommend that the tenants go through their cabinets and do a thorough cleaning and evaluation of the contents to locate the source. 50% of the units reported occasional invaders. To minimize the amount of activity of these occasional invaders, we recommend: sealing exterior entry points (gaps, holes, etc), removing the clutter from around the foundation which holds moisture against the side of the building. Some pipes and lines going into the building have gaps around them. These openings provide access to pests and should be sealed.

In addition to the inspection of the units, we inspected the interior and exterior areas of the property for evidence of infestations in the trash disposal areas, laundry facilities, storage areas and any other common area where water and/or

food storage is present. Additionally, we inspected all areas where the envelope has been penetrated and all points of ingress/egress for any entry points for pests. Below are our findings for these areas, with a status (high, moderate, low, none) noted, and comments for corrective measures, both immediate and long-term. (Lengthen the table as needed to reflect all areas inspected)

Area	Comments	Status
Exterior	There are several areas on the exterior of the buildings where entry points need to be sealed. There are a few downspouts that need to be fixed so that the water flows away from the building. The trees/bushes should be trimmed away from the buildings so that they are not touching or overhanging. Railroad ties have been used in the landscaping. This and other areas where there is wood to soil contact are at risk for termite issues. We recommend these be removed and replaced with a non-wood alternative.	M

Based on the above findings, interviews with the property managers, maintenance staff, and tenants, and the review of all documentation made available to us regarding past Pest Control effort we conclude the following course of action is required: (The RPCA Scope of Work requires, at Part 3.2.D.iv, "[the report details]… an immediate course of action, which identifies and estimates the cost of the measures required to address the pest infestations for each identified group (see prior paragraph) and an continuing course of action for using IPM principles at the property"). **(IPM Inspector - add detailed comments below for the units and the common areas including the recommendations from Exhibit 2)**

We discussed current practices with the administrator. At this time a pest control professional with a staff person inspects/treats units on an as needed basis. All units are subject to annual inspections during which pest activity is also looked for. We recommend the following: 1) Adding exterior multicatch rodent traps on the exterior, particularly near entry doors, 2) Installing insect monitors in all units and schedule regular inspections by the pest control professional instead of relying on the observations of the staff and tenants, we estimate the cost of a monthly service to be around $8 per unit with a minimum service charge of $32. and 3) Most pest policies are currently verbal. We recommend developing specific policies for pests of concern and getting these policies down in writing.

Sincerely,
Christina L. Driksna License # C006070435
Service Supervisor, Griffin Pest Solutions
Member of QualityPro Green

Rental Assistance Demonstration Program (RAD)
Effective Integrated Pest Management for Affordable Housing

Essential Elements of Effective IPM (per HUD May 27, 2007 Guidance)	**Status at Development** (checkmark all that are present)	**Comment on Existing Strategies and Deficiencies; Make Recommendations**
1. Communicate Policies Communicate ownership/ management's IPM policies and procedures to: • All building occupants • Administrative staff • Maintenance personnel • Contractors.	☒ Written pest control policy in place. ☒ Policy communicated to: ☒ Staff. ☒ Resident services. ☒ Maintenance staff. ☐ Renovation/rehabilitation staff/contractors. ☒ Pest control services. ☒ Policy communicated to residents.	The resident handbook is currently under revision at Hillside Manor Apartments. It addresses what the tenants can expect from the housing commission, including treatment 2x a year. It also states tenant responsibilities. Residents are given 24 hours notice for any pest inspection or treatment. In the leasing contract, residents are notified there is a pest management company the apartment complex utilizes.
2. Identify Problem Pests Identify pests and environmental conditions that limit the spread of pests. ***CONTINUED FROM COLUMN ON THE FAR RIGHT: In the lease it is written that the tenant must contact the manager with any pest or housekeeping issues. Units are inspected annually. Maintenance and pest control notifies the office of any sanitation/clutter issues as well as any maintenance issues that are conducive to pest infestation when servicing units on an individual basis.	☒ Policy described strategy to address pests: ☒ Rats. ☒ Mice. ☒ Cockroaches. ☒ Bedbugs. ☐ Other pests: _____ _____ ☒ Policy described strategy to address environmental conditions: ☒ Water damage and effective cleanup. ☒ Housekeeping and maintenance within the apartment units.	Verbal policy for the listed insects. Never had a problem with rats. If there is a problem with rats or mice, they will notify pest control and seal any areas the rodents are entering the apartment. Cockroach and bed bug issues are high priority and pest control is notified as soon as possible. All other reported pest issues are lower priority. Maintenance has ant bait stations that they hand out to tenants reporting ant issues. *Continued on the far left column.*

Rental Assistance Demonstration Program (RAD)
Effective Integrated Pest Management for Affordable Housing

Essential Elements of Effective IPM (per HUD May 27, 2007 Guidance)	**Status at Development** (checkmark all that are present)	**Comment on Existing Strategies and Deficiencies; Make Recommendations**
3. Monitor and Track Establish an ongoing monitoring and record keeping system for: • Regular sampling and assessment of pests • Surveillance techniques • Remedial actions taken • Assessment of program effectiveness.	☒ Pest control complaints: ☒ Maintained accurate, up-to-date, and accessible tracking reports maintained. ☒ Recorded in electronic format. ☒ Analyzed regularly for timeliness, recurrent problems and other trends. ☒ Action taken based on analysis of complaints. ☒ Ongoing and regular monitoring of trash handling areas and common areas: ☒ Visual monitoring. ☐ Glue trap monitoring. ☐ Ongoing and regular inspection of exterior areas. ☐ Results of visual monitoring and glue trap monitoring recorded and tracked. ☒ Annual inspection of each resident for housekeeping and maintenance concerns. ☐ Annual summary of results of complaint and monitoring analysis.	Records are given from the pest management company and are available online through the customer portal. All work orders are input into the computer and are usually taken care of within 5 days by the pest management company if for high priority pests but no longer than 30 days - Trash areas are inspected once a week and cleaned if necessary Exterior inspections are completed on an as needed basis by maintenance staff. Results of monitoring are recorded by pest management company and made available online. Annual inspections are completed by a combination of managment, maintenance staff and outside contractors. All issues found are written up and everything is fixed asap
4. Set Thresholds for Action Determine, with involvement of residents: • Pest population levels – by species – that will be tolerated • Thresholds at which pest populations warrant action.	☒ Zero tolerance set for priority pests: rats, mice, cockroaches, and bedbugs. ☒ Residents and staff aware of zero tolerance policy. ☒ Tolerances set for other pests such as ants and spiders.	Staff is aware of verbal zero tolerance policy. Other low priority pests are addressed as needed. Office hands out bait stations for ants when issues are reported

Rental Assistance Demonstration Program (RAD)
Effective Integrated Pest Management for Affordable Housing

Essential Elements of Effective IPM (per HUD May 27, 2007 Guidance)	**Status at Development** (checkmark all that are present)	**Comment on Existing Strategies and Deficiencies; Make Recommendations**
5. Improve Non-Pesticide Methods Improve: • Mechanical pest management methods • Sanitation • Waste management • Natural control agents.	☒ Regular and ongoing cleaning of [*Frequency]* ☐ Interior trash handling areas [n/a] ☒ Exterior trash handling areas [1 x week] ☐ Laundry rooms [n/a] ☐ Storage areas [n/a] ☐ Regular removal of interior trash [n/a] ☒ Confirm dumpsters ☒ Are of adequate size ☒ Are in good repair ☒ Have tightly fitting lids ☐ Are located at least 25 feet from building ☐ Show no signs of overflow problems.	Interior trash is taken out by tenants from their own apartments and placed in their trash bins that they must take to the road on trash day. Once a week on Thursday, maintenance checks for any oversized items that need to be picked up and disposed of.
6. Prevent Pest Entry and Movement • Monitor and maintain structures and grounds including ○ Sealing cracks ○ Eliminating moisture intrusion and accumulation • Add physical barriers to pest entry and movement.	☐ Exterior holes greater than ¼" sealed. ☐ Cracks in walls, foundation and floor sealed. ☒ Sewer traps filled with water. ☒ Screens in place on opened windows and doors in warm weather. ☒ Door sweeps in good working condition. ☐ Materials damaged by water quickly repaired or replaced. ☐ Cause of water damage corrected.	Exterior holes that are 1/4 inch or larger need to be sealed. There are some door sweeps that need to be lowered or replaced. Cracks in the foundation should be sealed to prevent pest entry. Some screens are damaged and need to be replaced.
Essential Elements of Effective IPM (per HUD May 27, 2007 Guidance)	**Status at Development** (checkmark all that are present)	**Comment on Existing Strategies and Deficiencies; Make Recommendations**
7. Educate Residents and Update Leases • Develop an outreach/educational program • Ensure that leases reflect residents'	☒ Resident leases set specific requirements for: ☒ Housekeeping, sanitation, and trash storage. ☒ Reporting of pests, leaks, and mold.	Educational materials on bed bugs from the state are occasionally handed out along with a request that they report any

responsibilities for: ○ Proper housekeeping ○ Reporting presence of pests, leaks, and mold.	☒ Educational materials on pest control and pesticide use provided to residents. ☒ New residents expressly told that they are responsible for proper housekeeping and reporting presence of pests, leaks, and mold. ☐ Units inspected within one month after moving in. ☒ Residents regularly reminded of responsibilities. ☐ Resident told to notify resident services before using any pesticides spray or fogger.	issues to management immediately. Units are not inspected within one month of moving in unless a problem is reported. Resident responsibilities are posted and available in the resident handbook. Residents are not specifically prohibited from using pesticides nor required to notify resident services before their use. Residents are told to report any issues so that the pest management company can address them. However the handbook does recommend tenants use boric acid in their cupboards to control pests.
8. Enforce Lease Enforce lease provisions regarding resident responsibilities such as: • Housekeeping • Sanitation • Trash removal and storage.	☒ Pest control services and maintenance alerting resident services to housekeeping, sanitation and trash problems on an identified, established schedule. ☒ Resident services addressing residents with housekeeping problems through education. ☒ Residents with ongoing or unresolved housekeeping, sanitation or trash problems addressed through enforcement of lease.	Management tries to get assistance for tenants who have ongoing or unresolved housekeeping, sanitation or trash problems through resident services if the resident is unable to do it themselves. Failure to dispose of garbage, waste and rubbish in a safe and sanitary manner (16i) and failure to allow inspection or extermination services (16q) are listed as grounds for lease termination.
Essential Elements of Effective IPM (per HUD May 27, 2007 Guidance)	**Status at Development** (checkmark all that are present)	**Comment on Existing Strategies and Deficiencies; Make Recommendations**
9. Use Pesticides Only When Necessary Use pesticides only when necessary, with preference for products that, while producing the	☐ Snap traps used for mice. ☒ Rodenticides only used in tamper-resistant plastic boxes.	There is no specific treatment of units at

desired level of effectiveness, pose the least harm to human health and the environment, and, as appropriate, notifying PHA management before application.	☒ No sprays or foggers used by staff, contractors, or residents without written, advance approval of property manager. ☐ Boric acid and baits used at unit turnover.	turnover unless a problem is found. If a unit has an issue that is discovered at the time of turnover, the pest management company is notified and the unit is scheduled for treatment.
10. Post Signs Provide and post 'Pesticide Use Notification' signs or other warnings.	☒ Program in place to notify residents and staff of pesticide use. ☒ Signs used to notify residents and staff in advance of pesticide application (if for other than bait stations). ☒ Residents notified after units treated. ☒ Residents notified after common areas treated.	All staff are notified of pesticide use 24 hours in advance. All residents receive notices 24 hours prior to a pesticide application or inspection. Cloudy house stickers are provided by the pest management company after common areas are treated.
11. Summary	☒ How many of the ten Essential Elements of Effective IPM listed in this chart are: - Fully addressed? 4 - Partially addressed? 6 - Missing entirely? 0	There are a few policies that need to be written about the pest management service at Hillside Manor Apartments and information pamphlets made available to tenants.

PEST INSPECTION PHOTOGRAPHIC RECORD

Project No.: XXXXX.09R-XXX.257 **Project Name: Hillside Manor**

Photo #1:	Street elevation

Photo #2:	Living room, Unit 1020 Typical 3 bedroom

Photo #3:	Kitchen, Unit 1020 Typical 3 bedroom

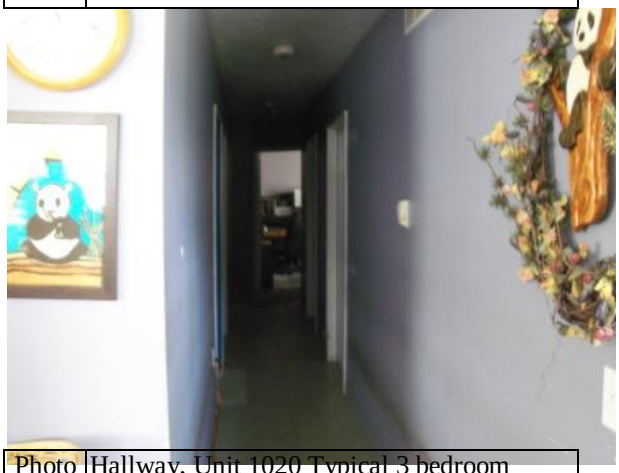

Photo #4:	Hallway, Unit 1020 Typical 3 bedroom

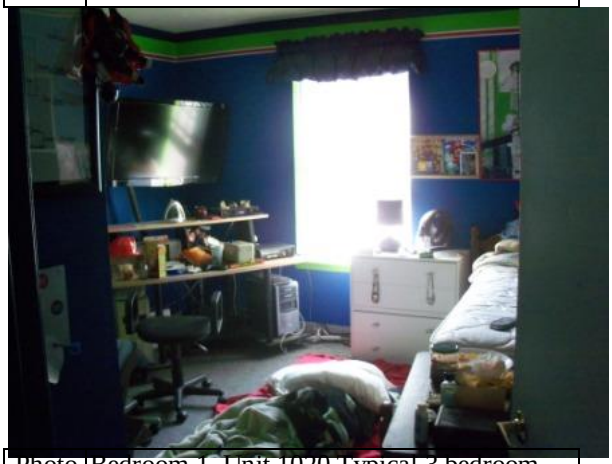

Photo #5:	Bedroom 1, Unit 1020 Typical 3 bedroom

Photo #6:	Laundry room, Unit 1020 Typical 3 bedroom

PEST INSPECTION PHOTOGRAPHIC RECORD

Project No.: XXXXX.09R-XXX.257 **Project Name: Hillside Manor**

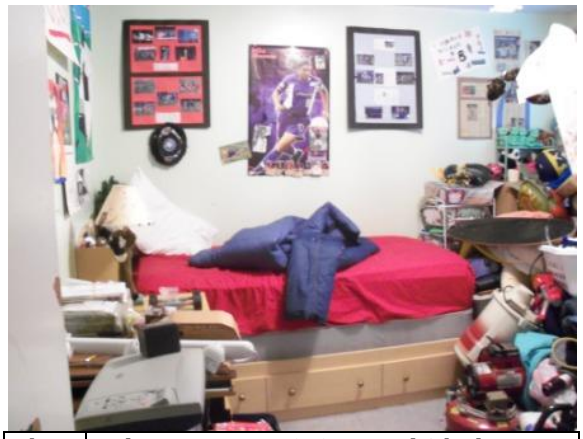

Photo #7:	Bedroom 2, Unit 1020 Typical 3 bedroom

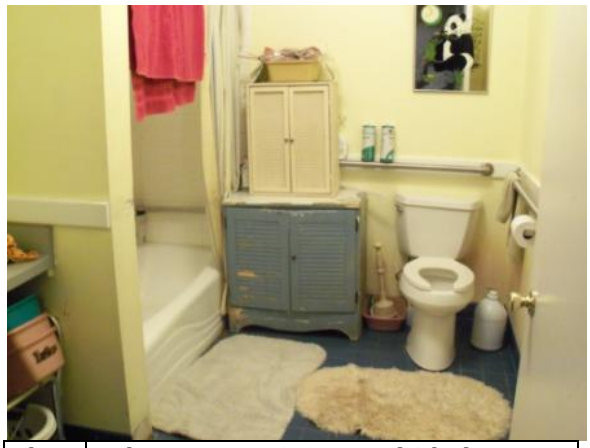

Photo #8:	Bathroom, Unit 1020 Typical 3 bedroom

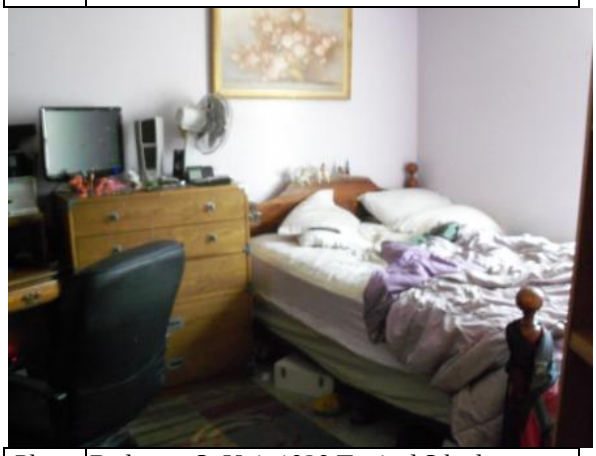

Photo #9:	Bedroom 3, Unit 1020 Typical 3 bedroom

Photo #10:	Living Room, Unit 1032 Typical 3 Bedroom

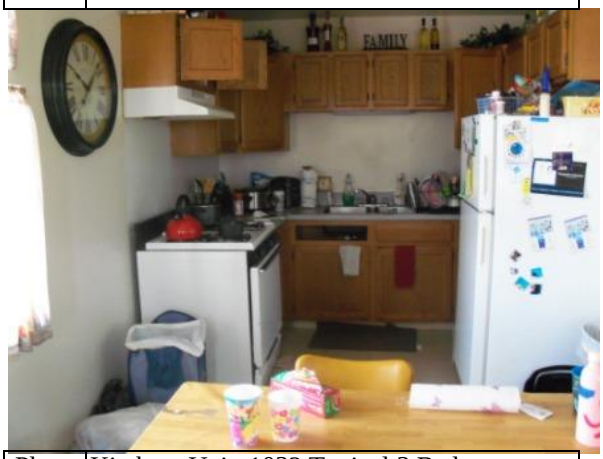

Photo #11:	Kitchen, Unit 1032 Typical 3 Bedroom

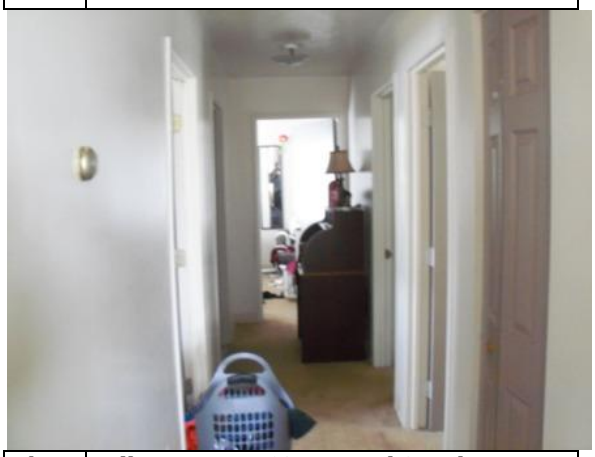

Photo #12:	Hallway, Unit 1032 Typical 3 Bedroom

PEST INSPECTION PHOTOGRAPHIC RECORD

Project No.: XXXXX.09R-XXX.257 **Project Name: Hillside Manor**

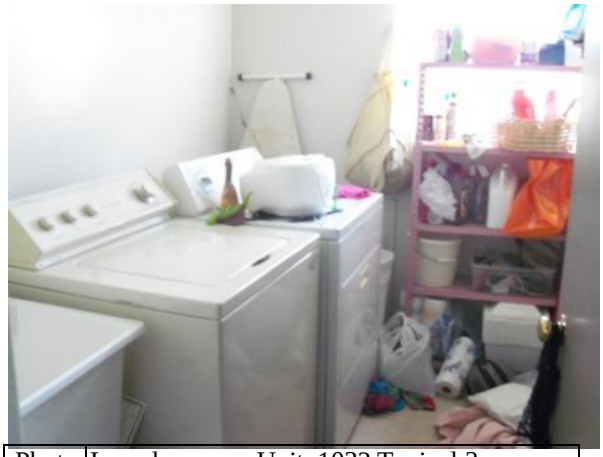

Photo #13:	Laundry room, Unit 1032 Typical 3 Bedroom

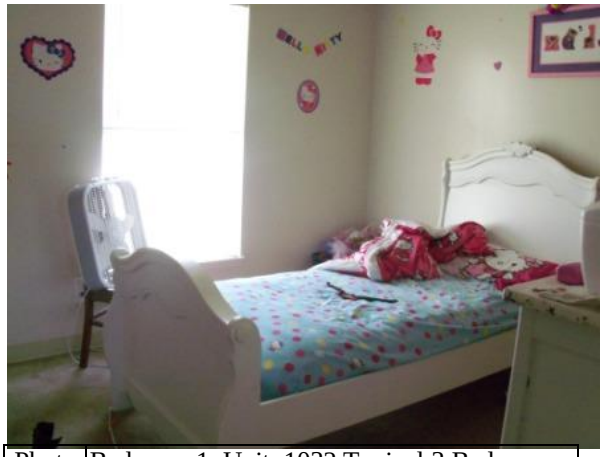

Photo #14:	Bedroom 1, Unit 1032 Typical 3 Bedroom

Photo #15:	Bedroom 2, Unit 1032 Typical 3 Bedroom

Photo #16:	Bathroom, Unit 1032 Typical 3 Bedroom

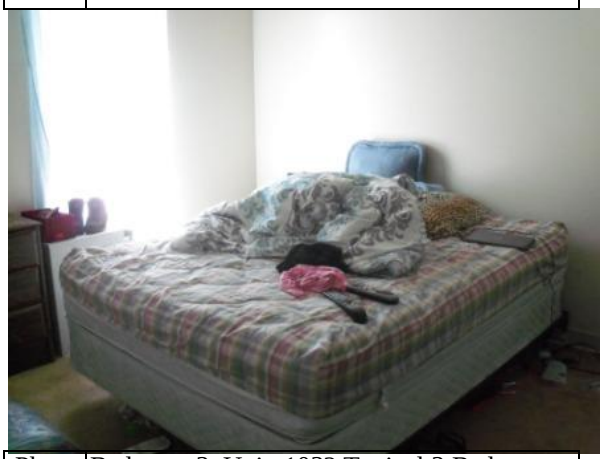

Photo #17:	Bedroom 3, Unit 1032 Typical 3 Bedroom

Photo #18:	Damaged window screens

PEST INSPECTION PHOTOGRAPHIC RECORD

Project No.: XXXXX.09R-XXX.257 **Project Name: Hillside Manor**

Photo #19:	Damaged window screens (there is tape over holes currently)

Photo #190:	Missing downspout

Photo #21:	Holes in siding, potential entry point

Photo #22:	Gap around door, potential entry point

Photo #23:	Damaged dryer vent, Potential entry point

Photo #24:	Downspout not sloping away from building. Water will pool at foundation.

PEST INSPECTION PHOTOGRAPHIC RECORD

Project No.: XXXXX.09R-XXX.257 **Project Name: Hillside Manor**

Photo #25:	Offset downspout, water will pool at foundation.

Photo #26:	Weep holes should have screen in them to prevent pest entry.

Photo #27:	

Photo #28:	

Photo #29:	

Photo #30:	

AKTPEERLESS

5.1 Acknowledgements of Part 4: Integrated Pest Management Inspection (IPMI)

The IPMI, Exhibit 4 – IPMI Report and Exhibit 5 – Effective IPM for Affordable Housing were completed by Christina L. Driksna of Griffin Pest Solutions. Griffin Pest Solutions certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 4.1 (Version 1, October 2012).

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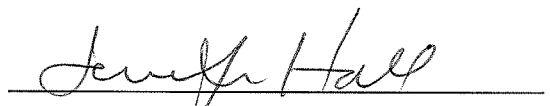
Date: October 11, 2013

Part 4 IPMI Exhibit 4 and Exhibit 5 were Received and Reviewed by Owner:



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Date: 10-11-13