Multi-Family Building
Energy Audit

Property Management, Inc.

Main St. Apartments
123-135 Main St.
Smalltown, PA 12345

April 8, 2010

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1 INTRODUCTION

On April 5, 2010, Bone Energy Services performed an on-site assessment of a 3-building apartment complex in Smalltown, PA in order to identify opportunities to improve the energy usage, comfort, health and environmental performance of the building. The basic attributes of this complex are:

Owner:	Property Management, Inc.
Property Manager:	Beverly Boss
Superintendent:	Sam Super
Size:	3 Buildings, 3 Stories
	47 units (123 Main St.)
	32 units (131 Main St.)
	23 units (135 Main St.)
Age:	1965 (45 years)
Configuration:	Common Entry, Walk-up
Structure:	Concrete slab foundation
	Masonry walls below grade
	Wood framed walls with brick cladding above grade
	Wood framed floors and ceilings
	Pitched wood-framed roofs (123 and 131 Main St.)
	Flat wood-framed roof (135 Main St.)
Occupancy:	Market rate
Utilities:	Central-Metered Natural Gas for heat, hot water, and cooking
	Individual electric for cooling, lights, appliances, and plug loads

During the site visit, we performed a thorough visual inspection and several specific tests that quantify energy efficiency attributes.

In addition, we performed a review of available fuel usage information.

This report is a summary of our findings and recommendations regarding changes that are expected to improve the performance of the building.

Evaluation Staff – Site Visit and Written Report

- Dave Bone – BPI Building Analyst & BPI Multifamily Building Analyst

2 MANAGER INTERVIEW

The property manager, Beverly Boss, and superintendent, Sam Super, were interviewed before and during the site visit. In general, the goal of the management team is to improve the comfort and energy efficiency of their portfolio in an effort to reduce operating costs and improve tenant retention. Several comfort/energy issues were noted:

- The buildings (particularly 123 and 131 Main St.) have experienced overheating on the top floors. The difference between the first floor and the third floor temperatures has been as much as 10-12 °F. Heat Timer controls systems (with outdoor reset, night setback, and indoor temperature feedback) and top floor zone controls (adjustable thermostatically actuated zone valves) have been installed on both of these buildings. This has improved the situation, but not completely eliminated the problem. Top floor tenants at 123 Main St. indicated that they still run their air conditioner in the winter months.
- The water bills are excessive at 131 Main St. They are often twice as high as those for 123 Main St., which is a larger building.
- The domestic hot water temperature fluctuates with demand at 123 Main St.

Recent and planned changes were noted:

- Two years ago, the attics at 123 and 131 Main St. were insulated with approximately 12" of blown cellulose.
- As noted above, the heating system controls were improved over the past 2-3 years.
- A new, indirect-fired water heating system was installed at 123 Lincoln about 1 year ago.
- Most of the windows in the building are double pane vinyl, but a number of the common areas windows are original single pane units with wood frames or early aluminum frame replacements. Management is replacing these as practical.

3 UTILITY BILL ASSESSMENT

Historical Energy and Water Usage

Utility usage data was provided for 12 months of consumption. This information was analyzed and compared to typical usage rates for similar buildings.

The building receives electricity through two types of accounts. One account serves the common areas of each building. There is a monthly service charge of $4.27, and consumption is billed at a decreasing tiered rate. The percent of consumption (kWh) billed at the higher rates is determined based on annual peak demand (kW). From month to month, the net rate per kwh fluctuates and is highest when consumption is lowest (summer) due to the impact of the annual demand level. It ranges from about $0.14 per kWh in the winter to about $0.18 per kWh in the summer.

Each apartment is billed separately for electricity. Bills were not provided for apartments.

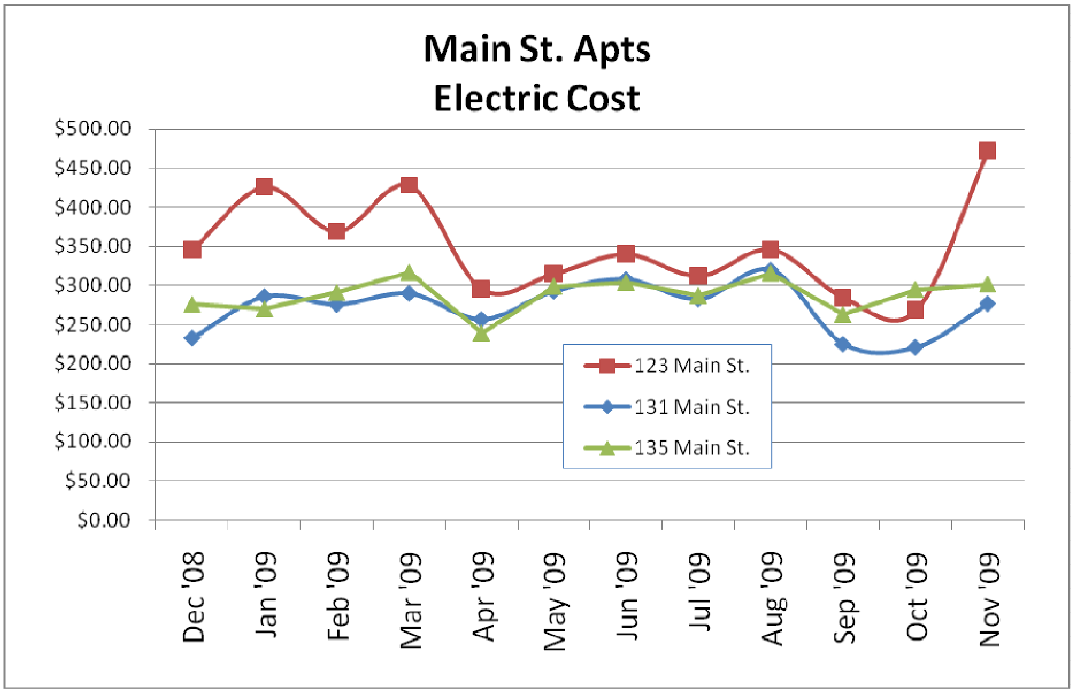
The building receives natural gas through house/common area meters. The gas commodity is purchased from an independent energy vendor for approximately $1.05 per therm. Delivery services are provided by the local utility. There is a monthly service charge of $10.12 per meter, and consumption is billed at approximately $0.30 per therm.

The building receives water and sewer service from the local government. There is no monthly service charge and the cost is currently $5.10 per 1000 gallons.

Electric Usage

Electric use data (actual utility bills) was provided for the common meters but not for individual apartments.

The overall total current annual electric cost is approximately $10,930, or $0.15 per square foot of total building area.



It is assumed that the apartment electric usage is much higher than that of the common areas because each apartment includes lighting and appliances. Most apartments also use window or sleeve air conditioning units.

The common area electric usage levels are moderate, and the patterns are typical for a facility heated with natural gas and with no central cooling. The lowest cost months occur during the spring, summer, and fall when no heating is in use. Consumption in these months can be considered to be the "baseload" that corresponds to year-round usage for lighting and laundry appliances. For the entire complex, baseload accounts for about 86% of total use. In the winter, the remaining 14% is consumed by the heating systems (primarily pumps).

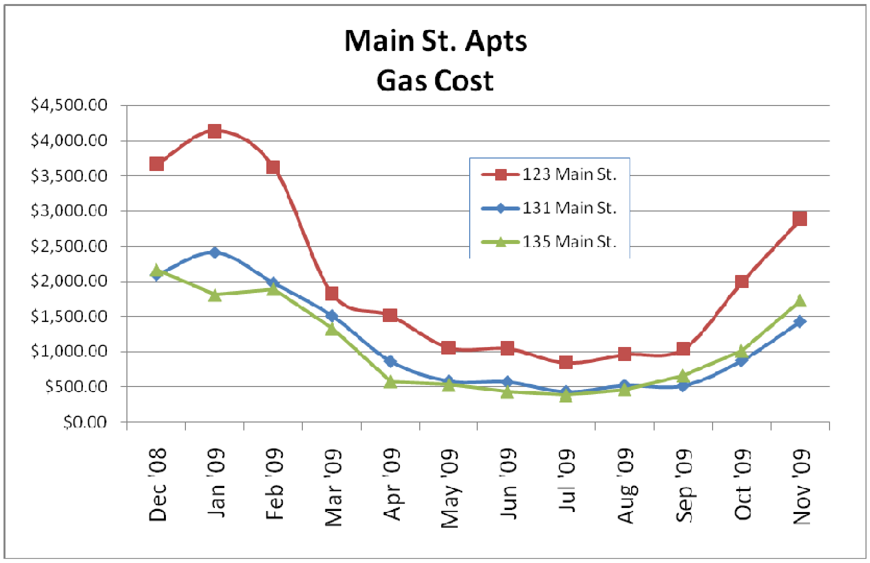
The cost in the three buildings is similar through the spring, summer, and fall. However, in the winter, the cost increases substantially for 123 Main St., while it remains flat in the other buildings. It was expected to rise in all three buildings, but did not. Overall, the cost per building is as follows:

	Annual Cost	***Percentage***
123 Main St.	$ 4200	38%
131 Main St.	$ 3270	30%
135 Main St.	$ 3459	32%

Natural Gas Usage

Natural gas use data (actual utility bills) was provided for each building.

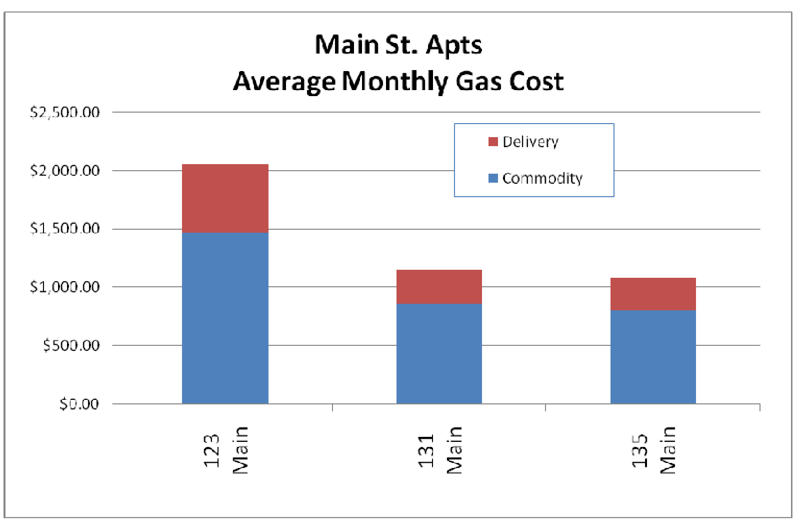
Total annual consumption is 34,943 ccf at a cost of $51,316. This translates to about $0.75 per square foot per year.



Consumption trends are typical for a building using natural gas for heating and domestic hot water. Heating usage begins in October, peaks in January, and ends in April. Water heating usage is fairly steady, with the lowest usage in the summer months. It increases in the colder months due to the need to heat colder incoming water from the street and the added heat loss from the pipes that are circulating through a building that is maintained at a lower temperature.

The steady consumption in the spring, summer, and fall months (approx. 1350 therms/mo) can be considered to be the "baseload" that corresponds to year-round usage for domestic water heating and cooking. This accounts for about 47% of total use. The remaining 53% is utilized for space heating. These are fairly typical proportions for family housing.

Natural gas is delivered by PSE&G, but the gas is purchased from Hess. The total cost is 63% gas (commodity) and 27% delivery.



Overall, the gas cost per building is as follows:

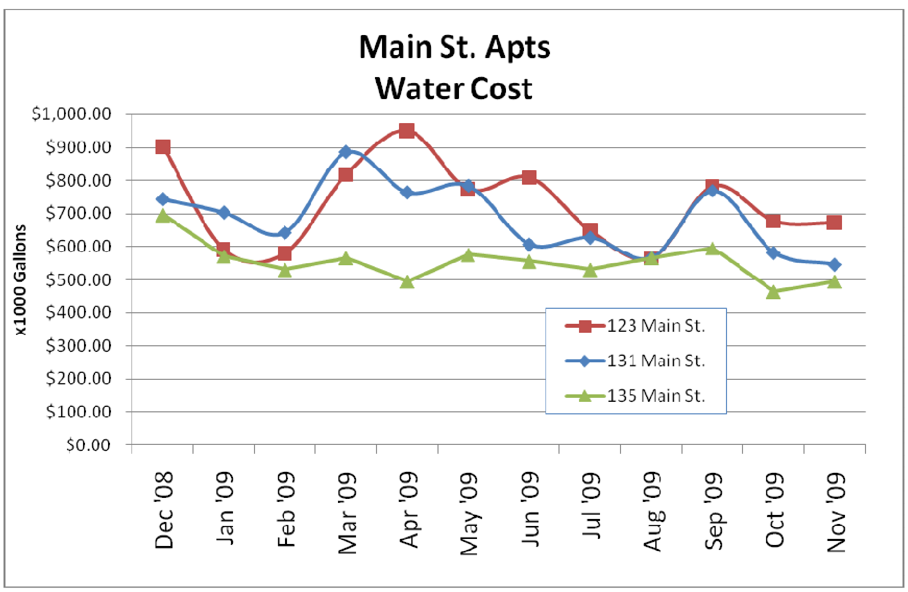
	Annual Cost	*Percentage*
123 Main St.	$ 24,597	48%
131 Main St.	$ 13,750	27%
135 Main St.	$ 12,969	25%

Water & Sewer Usage

Annual water use for the buildings totals about 4,680,000 gallons, at a cost of $23,633. This translates to an average use of 151 gallons per apartment per day. According to HUD data, this is about 56% more water use than a typical building of this size. Water usage fluctuates throughout the year with no apparent patterns. This may be due to leaks.

Results

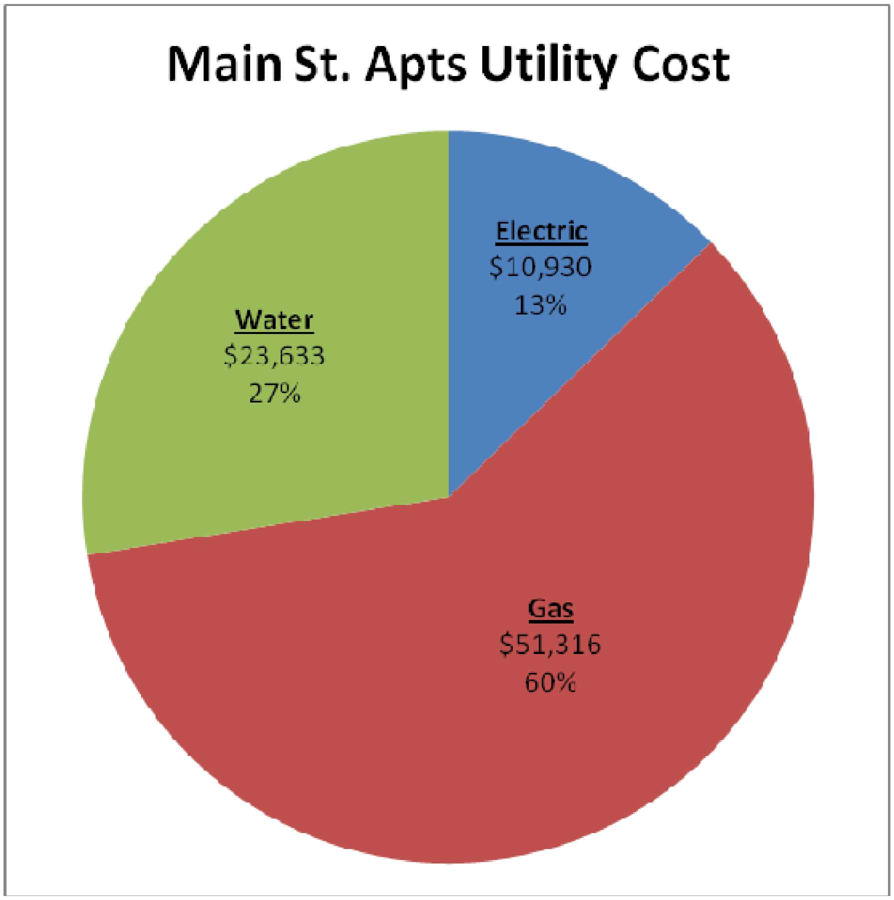
	Your Building	HUD Typical
Score Against Peers	22	50
Annual Water Use (gal/year)	4,677,000	3,001,399
Annual Water Use Intensity (gal/ft2-year)	67.8	43.5
Annual Water Cost Intensity ($/ft2-year)	0.34	0.22
Total Annual Water Cost ($/year)	23,633	15,166



Overall, the water cost per building is as follows. The cost per apartment is highest at 131 Main St.

	Annual Cost	*Percentage*	*Cost per Apt*
123 Main St.	$ 8,776	37%	$ 204
131 Main St.	$ 8,216	35%	$ 373
135 Main St.	$ 6,642	28%	$ 332

The overall utility costs for the common area services are demonstrated in the pie chart below.



Benchmarking

Building size, consumption, and weather data were used to compare the energy use of Main St. Apts. against others similar buildings using data compiled by two sources:

Note: For all benchmarking, apartment electric consumption was estimated at twice that of the common areas. This based on the experience of Bone Energy Services in auditing similar buildings.

New York State Energy Research and Development Authority (NYSERDA)
NYSERDA provides a benchmarking tool that compares building source energy use to a database of existing buildings. Source energy takes into account energy loss in the generation and distribution of electricity.

U.S. Department of Housing and Urban Development (HUD)
HUD provides a benchmarking tool similar to the NYSERDA version, but it is based on site energy use, rather than source energy.

	"Typical" Building	Main St. Apts	Difference
NYSERDA Database *Source Energy* (Millions of Btu/Year)	9,103	6,153	**32% Better**
HUD Database *Site Energy* (Millions of Btu/Year)	5,578	4,241	**23% Better**

Main St. Apartments Compared to Benchmarks

These tools provide an additional means of comparison by calculating what percentage of buildings use more and less energy than the evaluated building. Main St. Apartments is in the 76th **percentile**. This means that 24% of the buildings in the database use less energy than Main St. Apts (when adjusted to equalize size and climate factors), and 76% use more.

Another measurement of building energy use is called ***The Building Heating Index.*** This is a standard method used to compare a building's energy efficiency to other similar buildings. The Heating Index is a measurement of Btu's consumed per square foot per heating degree day. One of the largest databases that can be used for comparison was compiled using buildings in New York City and was published in the March/April 2003 issue of Home Energy Magazine. It indicates that consumption in a "typical" building heated with natural gas or oil is approximately 10. Main St. Apts. has a **Heating Index of 12.8.**

The results of the Benchmarking Tools and Building Heating Index are conflicting, with one indicating the complex is somewhat worse than average and the other indicating it is somewhat better. In general, it can be concluded that the complex is close to average. ***This does not mean that there are minimal opportunities for improvement***, though. There is a wide gap between a "typical" building and a peak performing building.

Based on the information found in the utility bills, the most significant savings opportunities exist in the heating/water heating systems and water conservation. However, each potential improvement measure must be carefully considered for its financial effectiveness.

Utility usage data was provided for one year of consumption. This information was analyzed and compared to typical usage rates for similar buildings.

4 AS-FOUND CONDITIONS AND RECOMMENDATIONS

Building Envelope

- The slab foundations are probably un-insulated, based on the age of the buildings. Adding insulation is impractical and would not be cost effective.
- Some insulation is likely to be installed within the wall framing, based on the age of the buildings. Modifying or supplementing this insulation is impractical and would not be cost effective.
- The attics at 123 and 131 Lincoln Ave are well insulated with cellulose. The attic under the flat roof at 135 Main St. has only a small amount (4-6”, R10-15) of fiberglass batts installed.

Recommendations:

1. ***Add 6-8” of blown cellulose insulation to the attic at 135 Main St. This can be done by cutting holes in the roof, adding insulation, and covering the holes with mushroom-cap attic ventilators.***
2. ***When insulating future attics that have eave vents, use solid windwash baffles (such as Berger Accuvents) instead of fiberglass batts at the top plates adjacent to the vents. This will improve the performance of the insulation around the perimeter of the attic.***

Windows and Doors

- Most of the windows in the buildings are replacement double-hung vinyl windows with 2-pane glass. Most do not have low-e coatings. Presence of inert-gas fills could not be determined.
- Some common area windows have single pane glass, with either wood or aluminum frames. This is particularly common in the stairwells, including the sidelights and transom windows around the exit doors.
- Exterior doors vary around the complex. Many are aging steel units with single pane glass. Weather stripping is either deteriorated or missing on most doors.
- New doors have recently been installed on the stairwells at 123 Main St. These are aluminum units with single pane tempered glass. The frames do not appear to include a thermal break.

Recommendations:

1. ***Replace existing single pane windows with double pane units as practical.***
2. ***When purchasing windows, choose units that are Energy Star labeled. This will ensure they have low-e coatings and inert-gas fills.***
3. ***When purchasing future exit door units, select models that include double-pane glass and thermally-broken frames that minimize heat conduction from inside to outside through the frame.***
4. ***Replace the temporary plywood covering the window opening in the 123 Main St. meter room with a high performance window.***

Air Leakage

One of the biggest losses of heated or cooled air in a building can be air leaking through, holes, chases, recessed lights, chimneys, cracks and other penetrations in the building shell. This occurs through three mechanisms:

- Wind Effect: Wind hitting the building creates positive pressure on the windward side and negative pressure on the leeward side, drawing air into and out of the building. Openings in the walls are most susceptible to this type of air leakage.
- Stack Effect: Hot air rising in the building results in positive pressure at the upper floors and negative pressure at the lower floors, drawing air into opening at the bottom of the building and out of openings at the top.
- Mechanical Effect: Exhaust fans and other devices can move large volumes of air into and out of a building.

Sealing leaks and utilizing ventilation fans properly can be one of the most effective ways of controlling energy costs. Air leakage was primarily evaluated using non-invasive visual inspection.

- A blower door was used to test a 1st floor efficiency apartment in 123 Main St. Infiltration was measured at 650 cfm at 50 pascals. This translates to approximately 0.50 air changes per hour under natural conditions. This is a reasonable level of air leakage for an apartment of this age.
- Numerous leakage points were noted in the exterior walls. These are noted in the recommendations below.
- Only minor leakage points were observed at the ceiling plane. Attic hatches seal well.
- The weather strip on most of the exterior doors is either deteriorated or missing.
- The new stairwell doors at 123 Main St. seal well, except at the base of the doors, where sweeps are missing and trim work had not been completed. A blower door was utilized to ensure that no other significant leakage is occurring around these units.
- All of the mechanical rooms are connected to both the exterior and the interior of the building. This allows outside air to pass directly into conditioned spaces.
- Air conditioner sleeves exist in many apartments. These have been abandoned for window unit in about half of the units.
- Stairwell doors are generally left open because they are the only means of access to upper floor apartments in this walk-up building. This may be increasing stack effect in the building.

Recommendations:

1. ***Install new weather strip and door sweeps on all exterior doors where visual inspection indicates a poor seal.***
2. ***Install new sweeps and finish the floor trim work on the new stairwell doors at 123 Main St.***
3. ***Adjust the latching mechanisms on all exterior doors to ensure that the door seats against the weather strip when closed.***
4. ***Seal around the sleeve air conditioners with backer rod or a similar foam material.***
5. ***Encourage all residents to remove their window air conditioners during the heating season.***
6. ***Ensure that the exterior back draft dampers are functioning properly on all range hood outlets.***
7. ***Seal under all windows on the exterior where capping material is missing.***
8. ***Caulk around the laundry room windows at 123 Main St.***

9. ***Isolate the mechanical rooms from the conditioned spaces.***
    a. ***Cover louvers in the door between the mechanical room and laundry room in 123 Main St., and seal all penetrations through the adjacent wall.***
    b. ***Cover louvers in the door between the mechanical room and corridor in 131 Main St.***
    c. ***Seal all connections between the mechanical room and the laundry room in 135 Main St.***
    d. ***Consult an HVAC contractor or mechanical designer to ensure adequate combustion air is brought into each mechanical room from outside. This can be done by either resizing the existing louvers or adding a fan that is activated when any boiler fires.***
10. ***Install screens on all combustion air openings to prevent the entry of pests.***
11. ***Seal all penetrations (for pipe or conduit) through the top floor ceilings into the attic. This can be done with caulk, spray foam, or drywall joint compound.***

Heating Systems

- Each building has an atmospheric-vented boiler supplying hot water to baseboards in the corridors and in each apartment. The boilers all have rated steady-state efficiencies of approximately 80% and staged burner assemblies.
- The boiler input capacities are:
    - 1,255,000 btu/hr (123 Main St.)
    - 750,000 btu/hr (131 Main St. and 135 Main St.)
- Heat Timer HWRQ control systems have been installed in each building. These utilize outdoor temperature sensors and indoor (apartment) temperature data to determine the target temperature of the water in the heating loop. The set points at 123 Main St. seem reasonable:
    - No offset from the default starting temperature of 100 °F.
    - Reset ratio of 1.25 : 1.00 (1°F increase in loop temperature for every 1.25°F decrease in outdoor temperature.
    - System cutoff above 67°F.
    - Night-time setback of 5°F.
    - Room target of 72°F during the day and 67°F at night.

  These systems are continuously accessible via internet by the HVAC contractor (Tri-Tech Energy) to allow set point adjustments at any time.
- Pumps continuously run loop water through the building when the outdoor temperature is above the “system cutoff”.
- Additional, smaller pumps draw loop water into the boiler when the controller determines that the boiler must fire to maintain the loop temperature. This result in return water to the boilers at loop temperature that is sometimes 100-130F. This can result in flue gas condensation that can corrode heat exchangers and flue pipes.
- No pipes were found to be insulated in the mechanical room or elsewhere in the buildings.
- Combustion air is provided from both adjacent conditioned spaces and louvered openings to outdoors. See Section 4.3 for recommendations.
- The building was designed to operate without zone controls. However, due to significantly higher temperatures in the top floor apartments, thermostatic zone valves were added on the baseboards in the third floor apartments in 123 and 131 Main St.
- As noted in Section 2, temperatures remain uneven in 123 and 131 Main St. Variations are not as extreme in 135 Main.

Recommendations:

1. ***Consult with the site HVAC contractor or a mechanical designer to ensure that low boiler return water temperatures will not result in premature equipment failure due to flue gas condensation.***
2. ***Utilize apartment temperature data logging, thermal imaging, and zonal pressure analysis during cold weather to determine the cause of continuing overheating in top floor apartments. This is likely due to stack effect and rising hot air. Locating and correcting the causes of this air movement can result in significant energy savings.***
3. ***Insulate all boiler loop piping where practical. This is especially important in the mechanical rooms, which are directly vented to outside.***

<u>Domestic Hot Water (DHW) Systems</u>

- 123 Main St. has a DHW storage tank (119 gal) heated by a separate Laars Mighty Therm atmospheric-vented boiler.
    - The boiler is rated for 400,000 btu/hr and 80% steady state efficiency.
    - The aquastat on the boiler is set to 130°F and a pump continuously circulates water between the boiler and the storage tank. This results in continuous standby losses through the heat exchanger and a return water temperature that is consistently 130F or less.
    - No pump is present to re-circulate the water through the building to maintain water at a desired temperature close to the apartments.
- 131 Main St. has a 70 gallon State storage tank water heater.
    - The water heater has an integral flue damper to reduce standby losses. It was found disabled during the site visit and re-enabled by the superintendent.
    - The target temperature is set on an integral aquastat to 130°F.
    - A pump is installed to re-circulate the water through the building to maintain water at a desired temperature close to the apartments. It runs continuously.
- 135 Main St. has an 85 gallon A.O. Smith storage tank water heater.
    - The water heater has an integral flue damper to reduce standby losses. It was found to be operating properly during the site visit.
    - The target temperature was set on an integral aquastat to 150°F during the site visit. This was reduced to 135°F by the superintendent.
    - No pump is present to re-circulate the water through the building to maintain water at a desired temperature close to the apartments.
- No insulation was found to be installed on any DHW piping.
- As noted in Section 2, temperatures remain uneven in 123 and 131 Main St. Variations are not as extreme in 135 Main.

Recommendations:

1. ***Improve the controls on the DHW system in 123 Main St.***
    a. ***Only run the boiler recirculation pump when the boiler is firing. This will reduce standby losses. An auto-control mechanism is already installed on the boiler, but it is set to "Constant Pump" rather than "Auto Pump",***
    b. ***Install an aquastat on the tank (a port already exists and this is how it is designed to operate). Fire the boiler based on the tank temperature, and increases the setting on the boiler loop to allow it to reach a higher temperature (160-180°F). In addition, use a wide differential on the tank aquastat. All of these steps will reduce standby losses and short cycling. In addition, they will minimize flue gas condensation issues in the boiler.***

c. ***Alternatively, install a Heat Timer (or similar) DHW controller that allow a night setback on the system control temperature.***

2. ***If necessary to ensure adequate hot water to the buildings, increase the tank set points and install mixing valves to blend the hotter (150-160°F) water with cold water before delivering to the building. This will increase short term DHW capacity.***
3. ***Adjust system set points to deliver water to apartments at 120°F. This will protect against legionella bacteria growth while minimizing scalding risks.***
4. ***Disable the recirculation pump 131 Main St. It doesn't appear to be necessary in the other buildings and shouldn't be required in this one. If it is deemed necessary, install a temperature controller that shuts this pump off until the return water temperature drops below 110°F.***
5. ***Ensure that the integral flue dampers on the storage tank water heaters remain functional.***
6. ***Insulate all DHW piping where practical. This is especially important in the mechanical rooms, which are directly vented to outside.***

Cooling Systems

- Corridors and stairwells are not cooled.
- Apartments are cooled with window or sleeve-mounted air conditioners that are owned by the residents. These are aging and many are inefficient by modern standards. However, cooling is not a dominant energy expense in the Newark climate. Replacing these units is not practical or cost-effective.

Ventilation Systems

Ventilation plays a crucial role in the effective operation of building. Spot ventilation is necessary to remove moisture and contaminants at their source (usually kitchens and bathrooms). In addition, fresh air ventilation is required to exhaust residual contaminants and provide some outdoor air for the health of the occupants. However, ventilation has an energy penalty. Any outdoor air brought into a building must be heated or cooled from the outside temperature to the comfortable level maintained in the building. Therefore, ventilation must be carefully considered and implemented to balance these competing concerns.

- No ventilation systems were found to be installed at any of the Main St. Apartments buildings.

Recommendations:

1. ***When financially feasible, install exhaust fans to vent the bathroom (50+cfm) and kitchen (100+cfm) to outside.***
2. ***Install a continuous ventilation system to provide fresh air for occupants IF the building is sealed to below 0.35 air changes per hour of natural infiltration.***

Lights and Appliances

- Apartment lighting utilizes primarily compact fluorescent lamps (CFL's).
- Refrigerators in the visited apartments are fairly recent and use less than 700 kWh/yr of electricity.
- Corridors are lit at all times.
    - 123 Main St. uses CFL's in the lobby and in the 2nd and 3rd floor corridors. 4 ft. linear fluorescent lamps drawing about 60 watts per fixture are installed in a drop ceiling in the 1st floor corridor. Lighting levels are reasonable.
    - 131 Main St. and 135 Main St. use surface mounted 4-ft. linear fluorescent fixtures that draw about 70 watts per fixture. Lighting levels are higher than necessary for these spaces.
- All exit lights use LED lamps.
- Stairwells are lit at all times, using 2 ft., 2-lamp linear fluorescent fixtures that draw about 75 watts. Lighting levels are somewhat higher than necessary for these spaces.
- The laundry rooms in 131 Main St. and 135 Main St. are activated with occupancy sensors. A manual switch is used in 123 Main St.
- Exterior flood lights are controlled with a timer and use metal halide lamps. Most are 70W to 100W. The main entry lamp on 123 Main St. uses a 250W lamp.

Recommendations:

1. ***Replace the 4 ft. corridor light fixtures in 131 Main St. and 135 Main St. with 2 ft. lamps (T8 with electronic ballasts). These will provide more reasonable light levels and consume 50% less electricity. Rotating these fixtures perpendicular to the corridor is likely to improve light distribution.***
2. ***Replace the stairwell light fixtures with similar T8, electronic ballast models. These will provide similar light levels and consume 50% less electricity.***
3. ***Install an occupancy sensor in the laundry room at 123 Main St. Alternatively, install vacancy sensors in all laundry rooms. These require occupants to activate the lights manually, then they turn off automatically if no motion is detected after a set time period.***
4. ***Replace all metal halide exterior flood lamps with high pressure sodium "conversion" lamps that are designed to function with metal halide ballasts. 35W HPS lamps should provide similar output to the current 70-100W MH lamps. A 100W HPS can be used to replace the 250W MH flood lamp.***

Laundry

- Laundry equipment is owned by the building management.
- Energy Star labled clothes washers are installed (or are awaiting installation) in all buildings. This is likely to decrease laundry costs (primarily water and natural gas for water heating and drying) by 30-50%.

<u>**Water Fixtures**</u>

- Visited apartments included 2.5 gpm shower heads, 2.2 gpm faucet aerators, and 1.6 gpf toilets. These are all at or below the maximum levels mandated by the federal government.
- At tenant changeovers, 1.6 gpm Delta show heads are installed.
- No clear cause of the excess consumption at 131 Main St. was observed.

Recommendations:

1. ***Replace all lavatory faucet aerators with 1.5 gpm versions. This will reduce water use as well as water heating energy.***
2. ***Evaluate the Niagara Conservation Earth Massage N2917CH, a 1.75 gpm shower heat which provides a variable spray pattern and reliable performance at a reasonable cost. Bone Energy Services has found consistent resident satisfaction with this model.***

<u>**Health and Safety**</u>

- Carbon monoxide detectors are installed in each apartment.
- No measurable ambient carbon monoxide was detected at any locations in the complex.
- Condensing water was noted to be dripping from cold water pipes in one mechanical room.
- Energy Star labled clothes washers are installed (or are awaiting installation) in all buildings. This is likely to decrease laundry costs (primarily water and natural gas for water heating and drying) by 30-50%.

Recommendations:

1. ***Insulate cold water pipes in the mechanical room to prevent water from condensing out of the humid outdoor (combustion) air on the cold pipe surfaces.***

<u>**Maintenance Issues**</u>

- The flat roof on 135 Main Ave. is showing significant deterioration.

Recommendations:

1. ***Cover the roof surface with a reflective elastomeric acrylic coating (available from Henry, Acrymax, and others). This will extend the life of the existing membrane and reduce future deterioration by providing lower surface temperatures. In highly deteriorated areas, embed a fiber mesh in the coating for improved strength and protection.***
2. ***This coating will reduce the cooling load and improve comfort in the summer. However, it will also reduce heat gain when it is desired in the winter. The net result will be little if any energy savings, but improved maintainability.***

5 DISCLAIMER

The energy conservation opportunities contained in this report have been reviewed for technical accuracy. Savings estimates reflect experience with similar and/or past projects and results provided by industry-standard software. However, because energy savings ultimately depend on the lifestyle of the residents, the weather, and many other factors that cannot be controlled, Bone Energy Services does not guarantee the savings estimated in this report. Bone Energy services shall not, in any event or circumstance, be held liable should the actual energy savings vary from estimated savings.

The recommended modifications to building components and operation are intended as a starting point for the implementation of changes. Significant modifications to a building or its components should be reviewed and certified by a licensed architect or engineer. Compliance with all applicable national, state, and local codes and best practices is essential to realizing expected savings. Applicable codes supersede any recommendations in this report. Bone Energy Services may suggest certain contractors or products that will help attain the necessary energy savings. These entities and/or products are chosen based on experience and/or expertise, Bone Energy Services neither provides compensation, nor is it provided compensation, for any recommended products or services.