



Energy Efficiency Consulting Services and Solutions

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4.10.17



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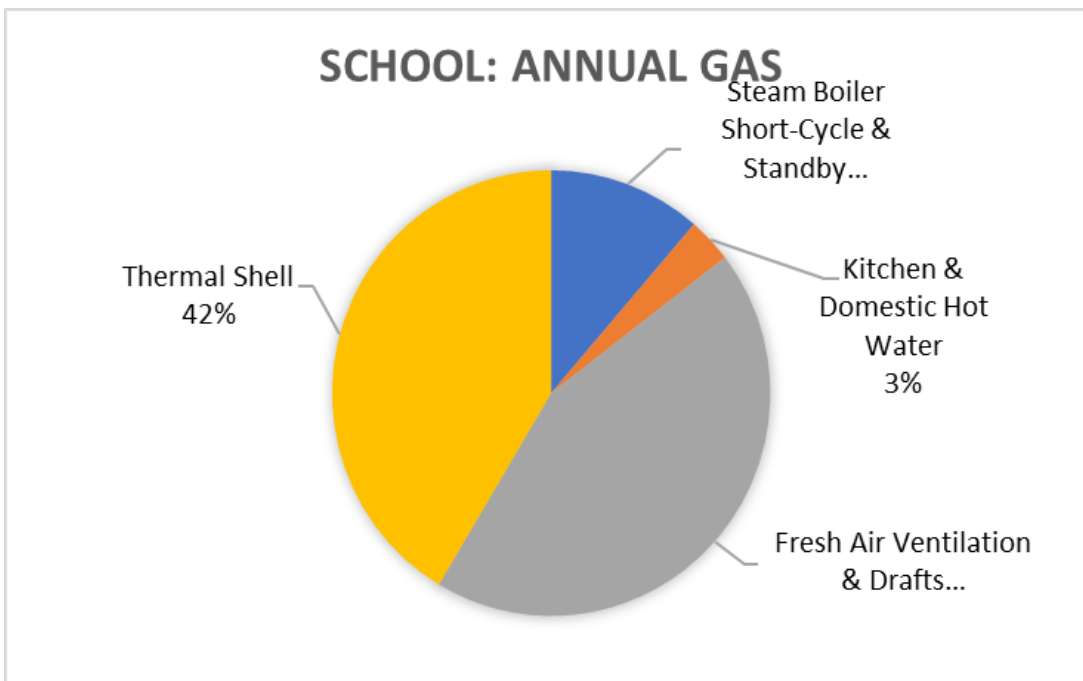
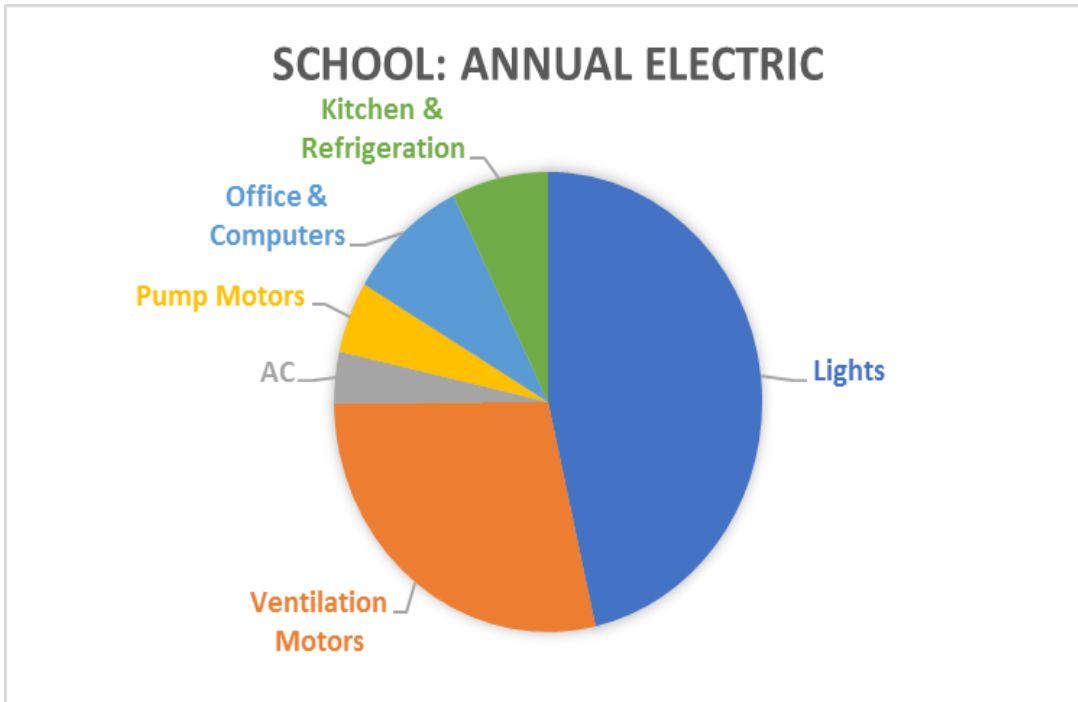
Education	1938 & 1958	86,000 sqft	boiler & rooftop, minimal/none AC, gas DHW
Education	1998	24,000 sqft	boiler & rooftop, central AC, gas DHW

	<u>Electric(2015-16 year)</u>	<u>Gas(Normalized)</u>
School	\$35,862	\$32,900
Pool	\$14,528	not available
	<u>Projected Annual Savings</u>	
School LED Lighting	\$7,750	
Pool LED Lighting	\$375	
Pool Pump Variable Speed Drive	\$2,250	
MN Sales Tax Exemption		\$3,400 (6/2015-2/2017)
Boiler System & Steam Trap Recommissioning		\$1900
Boiler1(1990-vintage) Replacement*		\$2,400
Equipment Replacement & Recommissioning	<i>Savings & Rebate Amounts to-be-determined**</i>	
• Air handler replacement with rooftop furnace/AC		
• Recommission unit ventilators, unit heaters, baseboard & exhaust ventilation		
• Installation of ductless heat pumps (AC)		

* Replacement steam boiler significantly reduced by "Equipment Replacement & Recommissioning"

** Energy savings calculations (prescriptive & custom rebates) will be based upon existing conditions discovered during recommissioning, ventilation and energy management upgrades.

Overview



Rooftop furnaces provide 20% of the annual heating requirement.

- Majority of rooftop furnaces are worn out and past design life (1991-vintage).

Boiler steam provides 60% and water/steam convertors provide the remaining 20% heating requirement.

- One boiler is 2016-vintage, the other boiler is 1990-vintage boiler.
- Maintaining steam pressure during mild weather creates wasteful overheating and boiler short-cycling.
- Steam boiler operational costs include clean-tune, chemical, steam traps, fatigue/failure, interrupt meter telemetry and associate dual-fuel oil storage/insurance....

Long term goal is to reduce heating load on the steam boiler distribution system with additional rooftop furnaces and reduce wasteful spring/fall steam boiler operation with air source heat pumps.

- The 2016-vintage boiler is 83+% thermal efficiency.

Braun Intertec air quality study documented several classrooms & offices “average level of carbon dioxide level measured during the primary occupancy hours for the school exceeded recommended guidelines of 1000 ppm”

- Primary causes of poor indoor air quality are malfunctioning unit ventilators, rooftop furnaces, air handlers and insufficient stale air exhaust.
- Note: Commons, Little Gym and Big Gym fresh air ventilation is excellent. The energy management system utilizes CO2 demand control ventilation to continually monitors/correct fresh air ventilation.

Predictive Technologies mechanical equipment assessment determined “although the age of the school of certain sections may be of concern, it is still felt that this equipment still has a useful life.”

- “all unit ventilators are operational and can add adequate outdoor air as needed to reduce CO2 levels. “all unit ventilators have updated controls and can modulate heating valves, fresh air and return air dampers. ***With this said, recommissioning is needed ...***”
- “50% unit heaters are controlled by the BAS, meaning they have the ability for night setback. Roughly the other 50% are electrically, pneumatically controlled and/or self-contained”
- “all rooftop units are operational with both the heating & cooling systems”
- “all exhaust fans need a maintenance schedule for lubrication and belt changes. Most EF’s were found operational, but some were found to have broken belts with the motor still operating and some were found not operating.”

The original ventilation design for the High School and Elementary school included barometric hoods to provide stale air relief/exhaust. The barometric relief hoods (whirlybirds) provide a hidden passageway for warm stale indoor air to escape the building. Unfortunately, barometric hoods are ONLY effective during cold weather and are NOT effective during mild weather. In addition, these hidden passageways created wasteful heat loss at night when the building is unoccupied.

- Restroom: Roof hood connected to a wall register located behind the toilets.
- Hallway: Roof hood connected to a ceiling or wall register located in upper level hallway.

IN=OUT. Effective fresh air ventilation must be balanced with exhaust fans. (To minimize cold air infiltration, modern ventilation design creates a slight positive building pressure.)

- High School barometric hoods (whirlybirds) should be replaced with exhaust fans.
- Additional exhaust fans can be installed in the Elementary School skylights.

The recommendations include the following

- a) Recommission/calibrate
 - steam boilers and steam distribution system
 - unit ventilators, unit heaters, radiant furnaces and air handlers
 - energy management, sensors actuators and thermostats
- b) Balance stale air exhaust with fresh air ventilation
- c) Steam trap recommissioning, eliminate abandoned and/or duplicative steam equipment and optimize steam boiler operation
- d) Replace rooftop and forced air furnace equipment before equipment failure
- e) Replace air handlers (steam) with rooftop (furnaces) to reduce steam heating & provide AC
- f) Install duct-less heat pumps to eliminate steam boiler operation spring/fall & provide AC
- g) Install electric heat as applicable to provide supplemental heat in spring/fall mild weather
- h) Boiler1 (1990-vintage) replacement and eliminate dual-fuel oil back-up

Recommendation Overview

School LED Lighting

Pool LED Lighting

Pool Pump Variable Speed Drive

Natural Gas Sales Tax Exemption

- **Rebates (Minnesota Energy Resources & Freeborn Mower) amount TBD**
- **Energy Savings calculations will be based upon existing conditions during recommissioning**

NOTE: Ductless Heat Pumps are applicable for High School and Elementary classroom unit ventilators

- Unit ventilator provides fresh air minimum 25% (lock-out economizer cooling)

Boiler....

- Diagnostic test steam/water convertors and replace as necessary
- Recommission steam traps
- Optimize steam pressure
- Eliminate abandoned equipment (pool and gym unit heaters) and cap/eliminate associated steam pipes
- Optimize mild weather (fall/spring) start-up and shut-down

Elementary Wing Unit Ventilators, Unit Heaters & Baseboard....

- Recommission unit ventilators, unit heaters and baseboard
- Furnace replacement
- Install exhaust fans to balance stale air exhaust with fresh air ventilation & fresh air cooling
- Optimize BAS energy management
- *Install ductless Heat Pump (fall/spring heat & spring/summer/fall AC)*

High School Unit Ventilators, Unit Heaters & Baseboard....

- Recommission unit ventilators, unit heaters, baseboard/radiators
- Install exhaust fans to balance stale air exhaust with fresh air ventilation & fresh air cooling
- Update remaining pneumatic actuators/sensors to DDC
- WIFI programmable thermostats or BAS energy management
- *Install ductless Heat Pump (fall/spring heat & spring/summer/fall AC)*

District and High School Office(s) Rooftop & Baseboard

- Rooftop *furnace/AC* replacement
- Recommission unit heaters, baseboard
- Update remaining pneumatic actuators/sensors to DDC
- WIFI programmable thermostats or BAS energy management

106-Lab, 107-Lab, AG & Tech (Art) Classrooms Rooftop, Unit Ventilators & Unit Heaters

- Rooftop *furnace/AC* replacement
- Recommission unit ventilators, unit heaters, baseboard/radiators
- WIFI programmable thermostats or BAS energy management
- *Install ductless Heat Pump (fall/spring heat & spring/summer/fall AC)*

Ag-Welding & Tech Make-Up Air & Radiant Furnaces

- Recommission make-up air handlers and unit heaters
- Recommission radiant heaters
- WIFI programmable thermostats or BAS energy management
- *Note: AC is not applicable in a welding shop*

Band & Cardinal Air Handlers

- Replace air handler(s) with rooftop(s) *furnace/AC* (roof structural engineer = location)
Note: Existing air handlers and ductwork are insufficient for AC
- CO2 demand control fresh air ventilation
- Install ceiling fans (excessively high ceilings)
- Optimize BAS energy management

Kitchen Make Up Air Rooftop

- Make-up air rooftop *furnace/AC* replacement
- Recommission and interlock operation with kitchen exhaust hood
- WIFI programmable thermostats or BAS energy management

Commons Air Handlers, Unit Heaters & Baseboard

- Replace air handler with rooftop *furnace/AC* (roof structural engineer = location)
OR
Replace air handler in existing location with duct furnace (eliminate steam) and *central AC*
- CO2 demand control fresh air ventilation
- Recommission unit heaters, baseboard
- Update remaining pneumatic actuators/sensors to DDC
- WIFI programmable thermostats or BAS energy management

Small Gym Air Handlers, Unit Heaters & Baseboard

- Replace air handler with rooftop *furnace/AC* (roof structural engineer = location)
OR
Replace air handler in existing location with duct furnace and *central AC*
- CO2 demand control fresh air ventilation
- Recommission unit heaters, baseboard
- Update remaining pneumatic actuators/sensors to DDC
- WIFI programmable thermostats or BAS energy management

Locker Room Unit Heaters, Baseboard & Exhaust Fans

- Recommission exhaust fans
- Recommission unit heaters and baseboard
- Update and optimize BAS energy management

Big Gym Air Handlers

- Remove duplicative unit heater and steam pipe
- Replace air handlers with rooftop *furnace/AC* (remove penthouse)
- Optimize BAS energy management

Steam Boiler1 (1990-vintage) 4200 kBTU

- Replacement steam boiler, 1000 kBTU
- Eliminate oil back-up

Recommendations

1. School Lighting

FMCS Lighting Rebate @ \$1 per 400 lumens (projected rebate \$10,325)

Annual Savings **Electric** **Gas**
\$7,750

- a) Confirm T8 ballast LED compatibility.
 - Philips Lighting attachment brochure
- b) Install 12-watt T8 LED lamps OR
 Install 12-watt LED lamps and LED drivers.
- c) Replacement interior LED fixtures
- d) Replacement exterior LED fixtures

SCHOOL	Qty	Existing Watts	Proposed Watts	Annual Hours	KW Savings	KWH Savings	Savings Amount
12-watt Linear LED (F32T8 ballast)							
Hall, Stairs, Commons & Entrance	383	28	14.5	3000	5.1705	15,512	\$1,449
Class, Offices,...	1,604	28	14.5	1800	21.654	38,977	\$4,809
Locker & Restrooms	94	28	14.5	1800	1.269	2,284	\$282
Big & Little Gym	320	28	14.5	3000	4.32	12,960	\$1,211
Computer Lab & Elem Nurse (delamp)	62	28	7.5	1800	1.271	2,288	\$282
	2,463						
LED Exterior fixture							
LED Wallpack	9	210	72	4100	1.242	5,092	\$414
LED Wallpack	6	90	36	4100	0.324	1,328	\$108
LED Interior fixture							
<i>College Lounge & ITV (new fixture)</i>	30	58	20	1800	1.14	2,052	\$253
Annual Savings							\$7,751
Projected Investment							\$32,931
<i>Projected LED Lamp Investment (self-install)</i>						\$29,556	
<i>Projected New Fixtures Investment (self-install)</i>						\$3,375	
Projected FMCS Lamp Rebate & Fixture Rebate							\$10,077
Net Investment							\$22,854
Payback Years							2.9

KWH (2017)	\$0.0462	\$0.0531	\$0.049
KW (2017)	\$9.28	\$15.14	\$11.23

	<u>1-lamp</u>	<u>2-lamp</u>	<u>3-lamp</u>	<u>4-lamp</u>	<u>6-lamp</u>	Lamp Qty
Class, Offices,...	0	425	158	70		1,604
Locker & Restrooms	18	38				94
Hall, Stairs, Commons & Entrance	4	144	5	19		383
Big & Little Gym	2	10		22	35	320
Computer Lab & Elem Nurse (delamp)		62				62
						2,463
<i>College Lounge & ITV (new fixture)</i>		30				30

2. Pool Lighting

FMCS Lighting Rebate @ \$1 per 400 lumens (projected rebate \$376)

	Electric	Gas
Annual Savings	\$375	

Install 12-watt T8 LED lamps OR
Install 12-watt LED lamps and LED drivers.

POOL

		Existing Watts	Proposed Watts	Annual Hours	KW Savings	KWH Savings	Savings Amount
12-watt Linear LED (F32T8 ballast)	Qty						
Pool	94	28	14.5	1500	1.269	1,904	\$263
Annual Savings							\$263
Projected Investment							\$1,128
<i>Projected LED Lamp Investment (self-install)</i>						\$1,128	
<i>Projected New Fixtures Investment (self-install)</i>						\$0	
Projected FMCS Lamp Rebate & Fixture Rebate							\$376
Net Investment							\$752
Payback Years							2.9

KWH (2017)	\$0.0462	\$0.0531	\$0.049
KW (2017)	\$9.28	\$15.14	\$11.23

	<u>1-lamp</u>	<u>2-lamp</u>	<u>3-lamp</u>	<u>4-lamp</u>	<u>6-lamp</u>	Lamp Qty
Pool	6	24		10		94

3. Pool Pump VSD

FMCS Lighting Rebate @ \$30 per hp (projected rebate \$450)

	Electric	Gas
Annual Savings	\$2,250	

- a) Calibrate/replace flow meter
- b) Update pool pump with variable speed drive
 - Modulate pump speed with flow or pressure meter

Hp 15
Hours 8760

Load
Week1-52 80%

KW 9.9
KWH 87,133

	Load	VSD
Week1	60%	30%
Week2	65%	35%
Week3	70%	40%
Week4	75%	50%
Week5	80%	60%
Week6	80%	60%

KW 7.5
KWH 49,920

KW Save	2.5
KWH Save	37,213
Amount	\$2,245

Investment	\$2,500
Rebate	\$450
Net Investment	\$2,050
Payback	0.9

KWH	\$0.05195	\$0.05883	\$0.05424
KW (2017)	\$6.29	\$10.23	\$7.60

4. Sales Tax Exemption

- Up to three-year retroactive refund??

	Electric	Gas
Annual Savings	\$3,400 (6/15 – 2/17)	

MN Sales Tax Exemption

	Electric	Gas
Annual Savings		\$3,400 (July-2015 thru Feb-2017)

MN Sales taxes has been collected on the Minnesota Energy Resources gas account since the summer 2015

- *Unknown if the previous Alliant Energy was improperly collecting sales tax.*

As I understand, public schools are tax exempt

- Submit appropriate sales tax exemption forms with Minnesota Energy Resources to prevent further sales tax collection
- Submit appropriate forms with MN Dept of Revenue to claim a refund

* As I understand, you can claim up to 3-years

Usage (All Customers Selected)			Billed Amount (Current Customer Only)		
Gas	78,816.5	Therms	\$43,301.55	TAX	\$3,403.39

5. Boiler System & Steam Trap Recommissioning

- Minnesota Energy Resources Steam Trap Rebate (50% up to \$250 per steam trap)

	Electric	Gas
Annual Savings		\$1900

(4) *Steam/water convertors*

(70) *Steam Traps*

- *Steam trap failure wastes natural gas, chemical treatment and creates conditioners for premature equipment/pipe failure*

Qty (??) steam lines and abandoned equipment

- *Wasteful maintaining steam pressure in a pipe for equipment that is no longer required*

Steam pressure

- *Steam boiler systems in southern MN are designed for 5 psi steam*
- *Optimize boiler short cycling and reduce steam pipe heat loss*

- Diagnostic test steam/water convertors and replacement as necessary
- Implement steam trap diagnostics and recommissioning.
 - Identification, steam trap type, size....
 - Identify where steam trap is located on the pipe distribution system
 - Diagnostic test/repair
 - Determine schedule to test/repair steam traps – every year or every other year
- Eliminate duplicative and/or abandoned equipment
 - Large gym unit ventilator is no longer necessary. Heating load has significantly decreased since original design. (Roof insulation improvements and reduced sidewall exposure due to additions.
 - Pool (abandoned) unit heaters. These systems are no longer in use
 - Abandon other equipment location??
- Cap abandoned steam lines as they branch from the main header.
 - Utilize steam trap study determine location of steam branch lines that can be abandoned
- Optimize boiler steam pressure
 - On @ 5# & Off @ 7#
 - Burner modulation high fire @ 4# & low-fire @ 6#
 - Optimize/readjust the high & low to obtain the longest “ON-Cycle” low-fire

	<u>Therms</u>
Normalized Annual (steam boiler)	42,000
Abandon Equipment, Steam Trap & Boiler Recommission	5%-9%

Projected Annual Savings (Therms)	2,940
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Projected Annual Savings Amount	\$1,911
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6. Elementary Classroom Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

Annual Savings	Electric \$TBD	Gas \$TBD
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BAS Energy Management

Ten (10) Unit Ventilators

Four (4) Unit Heaters

Two (2) Baseboard

One (1) Forced Air Furnace

One (1) Bath Exhaust Fan

Unit ventilators, Unit heaters, Baseboard

- a) Clean housing, fan blades, dampers, actuators and coils
- b) Recommission fan motors, lubricate bearing
- c) Recommission/calibrate sensors and actuators
 - Mixed air
 - Discharge air
 - Face/bypass
 - Fresh air
 - Space sensor
- d) Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

Forced air furnace

- a) Replace Furnace (install central AC?)
- b) Repair/Install fresh air intake and actuated damper
- c) Optimize BAS energy management OR install stand-alone Honeywell JADE W722X Economizer
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

Restroom Exhaust Fan & Hallway Exhaust Fan(s)

- Fresh air = 11 @ 300 = 3300 CFM
- Exhaust air = 1 @ 1000 + 1 @ 2000 = 3000 CFM
- a) Replace restroom exhaust fan (located in closet) w/ power roof ventilator PRV, 1000 CFM
 - Backdraft damper
 - Inspect ductwork and repair as necessary = boy restroom, girl restroom & janitor closet
- b) Install one (1) power roof ventilator PRVs, 2000 CFM
 - Backdraft damper
 - Location above abandoned skylights. Ceiling register, ductwork and roof termination
- c) Control operation with existing energy management system
 - Occupied mode
 - Fan ON
 - Unoccupied mode
 - Fan OFF

Economizer Mode Hallway Exhaust Fan(s)

- Economizer fresh air = 11 @ 600 = 6600 CFM
- Exhaust air = 3000 + economizer exhaust 2 @ 1500 = 6000 CFM
- d) Install two (2) power roof ventilator PRVs, 1500 CFM
 - Location above abandoned skylights
 - Fabricate ceiling register, ductwork and roof termination
- e) Control operation with existing energy management system
 - Economizer mode
 - Fan ON

Ductless Heat Pumps & Central AC in the classrooms

- a) Install ten (10) ductless AC
- b) Install one (1) central AC
- c) Optimize energy management
 - Unit ventilator provides fresh air minimum 25% (lock-out economizer cooling)
 - Utilize heat pump to eliminate steam boiler mild weather wasteful operation

7. High School Classroom Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

Annual Savings	Electric \$TBD	Gas \$TBD
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BAS Energy Management, Pneumatic and Thermostats

Eighteen (18) Unit Ventilators – note: (1) pneumatic? (6A Art Room)

- LL: Computer Lab, Media Center, 5A Ag, 6A Art Room
- 1st: 1-101, 1-102, 1-103, 1-104, 1-105, 1-107
- 2nd: 2-201, 2-202, 2-203, 2-204A, 2-204B, 2-205
- 3rd: 3-301, 3-302

Four (4) Unit Heaters – (4) pneumatic

Fifteen (15) Baseboard – note: (1) pneumatic? (girl restroom)

Two (2) Exhaust Fans

- Located on corners of 3rd level roof = identification unknown?

Seven (7) Barometric Relief Hoods

- 2x2 1st & 2nd Girl restrooms
- 2x2 1st & 2nd Boy restrooms
- 4x4 2nd hallway ceiling
- 2x2 2nd hallway wall
- (2) 1x1 ?? located next to 3rd level exhaust fans = identification unknown

Unit ventilators, Unit heaters, Baseboard

- a) Clean housing, fan blades, dampers, actuators and coils
- b) Recommission fan motors, lubricate bearing
- c) Recommission/calibrate sensors and actuators
 - Mixed air
 - Discharge air
 - Face/bypass
 - Fresh air
 - Space sensor
- d) Update pneumatic space sensors and actuators to DDC
- e) Install WIFI programmable thermostats or update BAS to energy management
- f) Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

3rd Exhaust Fans (2) & Barometric (2)

- a) Identify barometric location. Abandon and air seal.
- b) Identify exhaust location and confirm operation controlled by energy management system
 - Occupied mode
 - Fan ON
 - Unoccupied mode
 - Fan OFF

Restroom, Hallway & Media Exhaust Fans – Replace Barometric Relief

- Fresh air = $18 @ 300 = 5400$ CFM
- Exhaust air = $2 \text{ existing } @ 500 + 2 \text{ restroom } @ 1000 + 1 \text{ hallway } @ 1500 + 1 @ 500 = 5000$ CFM
- c) Restrooms: Replace (2) barometric relief hoods with (2) power roof ventilator PRV, 1000 CFM
 - Backdraft damper
 - Inspect/clean ductwork and repair as necessary
- d) 2nd Hallway: Replace (1) barometric relief hood with (1) power roof ventilator PRV, 1500 CFM
 - Backdraft damper
 - Inspect/clean ductwork and repair as necessary
- e) Media: Install (1) exhaust fan, 500 CFM
 - Location to be determined
 - Interlock with unit ventilator
- f) Control operation with existing energy management system
 - Occupied mode
 - Fan ON
 - Unoccupied mode
 - Fan OFF

Economizer Mode 2nd Hallway Exhaust Fan

- Economizer fresh air = $18 @ 600 = 10,800$ CFM
- Exhaust air = $5000 + \text{economizer exhaust } 1 @ 5000 = 10,000$ CFM
- g) 2nd Hallway: Replace (1) barometric relief hood Install with (1) power roof ventilator PRV, 5000 CFM
 - Backdraft damper
 - Inspect/clean ductwork and repair as necessary
- h) Control operation with existing energy management system
 - Economizer mode
 - Fan ON

Ductless Heat Pumps in the classrooms, offices & Media Center

- a) Install eighteen (18) ductless AC
- b) Optimize energy management
 - Unit ventilator provides fresh air minimum 25% (lock-out economizer cooling)
 - Utilize heat pump to eliminate steam boiler mild weather wasteful operation

8. District & High School Rooftop Replacement & Baseboard Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

	Electric	Gas
Annual Savings	\$TBD	\$TBD

Programmable Thermostats

(2) Rooftops provide heat/cool & fresh air ventilation

Baseboard provide office reheat

Rooftop & Baseboard

- Replace rooftop furnace/AC
 - Fresh air economized & CO2 demand control fresh air ventilation
- Recommission baseboard
- Update BAS energy management or install WIFI programmable thermostat(s) to control the rooftop and individual office baseboard
 - Occupied mode
 - Fan ON
 - CO2 demand control fresh air
 - Modulate fresh air economizer cool mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

9. 106/107 Labs, AC & Tech (art) Classrooms Rooftop Replacement, Unit Ventilators & Unit Heaters Recommissioning

- **Custom Rebates amounts TBD**
- **Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions**

	Electric	Gas
Annual Savings	\$TBD	\$TBD

Programmable Thermostats

(1) rooftops provide heat/cool & fresh air ventilation

(3) Unit Ventilators

Unit Heaters & Baseboard

Rooftop

- a) Replace rooftop furnace/AC
 - Fresh air economizer and CO2 demand control ventilation
- b) Update BAS energy management or install WIFI programmable thermostat(s)
 - Occupied mode
 - Fan ON
 - CO2 demand control fresh air
 - Modulate fresh air economizer cool mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED & Setback heat @ 60 degrees

Unit ventilators, Unit heaters, Baseboard

- b) Clean housing, fan blades, dampers, actuators and coils
- c) Recommission fan motors, lubricate bearing
- d) Recommission/calibrate sensors and actuators
 - Mixed air
 - Discharge air
 - Face/bypass
 - Fresh air
 - Space sensor
- e) Update pneumatic space sensors and actuators to DDC
- f) Install WIFI programmable thermostats or update BAS to energy management
- g) Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED & Setback heat @ 60 degrees

Ductless Heat Pumps in the classrooms

- a) Install three (3) ductless heat pumps
- b) Optimize energy management
 - Unit ventilator provides fresh air minimum 25% (lock-out economizer cooling)
 - Utilize heat pump to eliminate steam boiler mild weather wasteful operation

10. Ag-Welding & Tech Make-Up Air & Radiant Furnaces Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

	Electric	Gas
Annual Savings	\$TBD	\$TBD

Thermostats

(4) radiant furnace

(2) Make Up Air

Radiant Furnaces

Recommission radiant furnaces

Install WIFI programmable thermostat(s)

Make-Up Air

- a) Clean housing, fan blades, dampers, actuators and coils
- b) Recommission fan motors, lubricate bearing
- c) Recommission/calibrate sensors and actuators
 - Mixed air
 - Discharge air
 - Face/bypass
 - Fresh air
 - Space sensor
- d) Update pneumatic space sensors and actuators to DDC
- e) Install WIFI programmable thermostats

AC is NOT applicable in Ag Department

11. Band & Cardinal Air Handler Replacement & Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

	Electric	Gas
Annual Savings	\$TBD	\$TBD

*BAS energy management
(2) air handlers*

Rooftop

- Replace two (2) air handlers with two (2) rooftop furnace/AC
 - Fresh air economizer and CO2 demand control ventilation
- Update BAS energy management
 - Occupied mode
 - Fan ON
 - CO2 demand control fresh air
 - Modulate fresh air economizer cool mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED & Setback heat @ 60 degrees
- Install ceiling fans*
 - *High ceiling height creates occupant discomfort*

12. Kitchen Make Up Air Replacement & Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

	Electric	Gas
Annual Savings	\$TBD	\$TBD

BAS Energy management

One (1) Rooftop make up air heat

Rooftop

- Replace rooftop furnace/AC
 - Fresh air economizer and interlock minimum fresh air with oven hood exhaust fan
- Update BAS energy management or install WIFI programmable thermostat
 - Occupied mode
 - Fan ON
 - Interlock rooftop fresh air damper with oven hood exhaust fan
 - Modulate fresh air economizer cool mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

13. Commons Air Handler Replacement, Baseboard & Unit Heater Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

Annual Savings	Electric \$TBD	Gas \$TBD
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BAS Energy Management

One (1) Air Handler

Baseboard and unit heaters

Air Handlers

- Replace air handler with rooftop furnace/AC
 - Fresh air economizer and CO2 demand control fresh air ventilation
 - Variable Speed Drive supply fan
 - Return/Exhaust fan
- Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Optimize supply fan VSD based upon heat/cool
 - Demand control fresh air minimum @ 0%
 - Modulate fresh air economizer cool mode
 - Heat @ 65 degrees and cool @ 72 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

Unit heaters, Baseboard

- Clean housing, fan blades, dampers, actuators and coils
- Recommission fan motors, lubricate bearing
- Recommission/calibrate sensors and actuators
 - Discharge air
 - Space sensor
- Update pneumatic space sensors and actuators to DDC
- Update BAS to energy management
- Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED & Setback heat @ 60 degrees

14. Little Gym Air Handler Replacement, Baseboard & Unit Heater Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

Annual Savings	Electric \$TBD	Gas \$TBD
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BAS Energy Management

One (1) Air Handler

Baseboard and unit heaters

Air Handlers

- a) Replace air handler with rooftop furnace/AC
 - Fresh air economizer and CO2 demand control fresh air ventilation
 - Variable Speed Drive supply fan
 - Return/Exhaust fan
- b) Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Optimize supply fan VSD based upon heat/cool
 - Demand control fresh air minimum @ 0%
 - Modulate fresh air economizer cool mode
 - Heat @ 65 degrees and cool @ 72 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

Unit heaters, Baseboard

- g) Clean housing, fan blades, dampers, actuators and coils
- h) Recommission fan motors, lubricate bearing
- i) Recommission/calibrate sensors and actuators
 - Discharge air
 - Space sensor
- j) Update pneumatic space sensors and actuators to DDC
- k) Update BAS to energy management
- l) Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Fresh air minimum @ 25% & modulate fresh air economizer cool mode
 - Interlock hallway exhaust fan with fresh air economizer mode
 - Heat @ 68-70 degrees and cool @ 72-74 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED & Setback heat @ 60 degrees

15. Locker Rooms Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

Annual Savings	Electric \$TBD	Gas \$TBD
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BAS Energy Management? or Pneumatic?

Two (2) Unit Heaters

Three (3) Baseboard

Three (3) Exhaust Fans

Exhaust Fans (3)

- Identify exhaust fans service location(s)
- Remove/clean exhaust fans
 - Confirm duct roof termination is properly installed
- Confirm operation controlled by energy management system
 - Fan Occupied mode
 - 15-minute ON & 45 minute OFF
 - Occupancy sensor modulates fan ON
 - Unoccupied mode
 - Fan OFF

Unit heaters, Baseboard

- Clean housing, fan blades, dampers, actuators and coils
- Recommission fan motors, lubricate bearing
- Recommission/calibrate sensors and actuators
 - Actuator
 - Space sensor
- Update BAS energy management
- Optimize energy management
 - Occupied mode
 - Fan ON
 - Heat @ 68-70 degrees
 - Unoccupied mode
 - Fan AUTO
 - Setback heat @ 60 degrees

16. Big Gym Air Handler Replacement & Recommissioning

- Custom Rebates amounts TBD
- Energy Savings calculations will be calculated during recommissioning... Energy savings depends upon existing versus final conditions

	Electric	Gas
Annual Savings	\$TBD	\$TBD

BAS Energy Management

Two (2) Air Handlers

One (1) Unit Heaters – Abandoned

Air Handlers

- Replace two (2) air handler with one (1) rooftop furnace/AC
 - Fresh air economizer and CO2 demand control fresh air ventilation
 - Variable Speed Drive supply fan
 - Return/Exhaust fan
- Optimize BAS energy management
 - Occupied mode
 - Fan ON
 - Optimize supply fan VSD based upon heat/cool
 - Demand control fresh air minimum @ 0%
 - Modulate fresh air economizer cool mode
 - Heat @ 65 degrees and cool @ 75 degrees (fresh air cooling)
 - Unoccupied mode
 - Fan AUTO
 - Fresh air CLOSED
 - Setback heat @ 60 degrees

17. Steam Boiler Replacement & Recommission

- Minnesota Energy Boiler Rebates (projected @ \$900)

	Electric	Gas
Annual Savings		\$2,400

- a) Replace Boiler1 (1990-vintage) with 1000 kBTU boiler, 83% steam boiler
 - Natural gas only – eliminate dual fuel
 - Air handler replacement with rooftop furnace/AC and installation of air source heat pumps will substantially reduce steam heating requirements and nullify dual-fuel
- b) Boiler2 (2016-vintage) back-up
- c) Update energy management system

	<u>Therms</u>		<u>Therms</u>
Existing Normalized Annual	42,000		
Projected Normalized Annual			20,000

	<u>Existing</u>	<u>High Efficiency</u>
Input kBTU @ low-fire	4200	1000
Standby Loss Nameplate	3.0%	1.0%
Boiler Efficiency	80%	83%
Short Cycle	5519	438
Heating	14481	13958
Annual Heating	20000	14396

Projected Annual Savings (Therms)	5,604
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Projected Annual Savings Amount	\$2,403
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Firm versus Dual Fuel -\$1,800

Notes

Two (2) steam boilers are clean-n-tuned annually. Dual-fuel burners, gas and oil.

- Boiler1, installed summer 2016.
 - Capable of conversion to hot water at a future date.
- Boiler2, 1990s-vintage.
 - Condition unknown. Diagnostics required to project life costs.

Heat delivery systems are approximately 45% steam, 35% steam/water convertors & 20% furnaces.

- Four (4) Steam/Water convertors
 - Condition unknown. Diagnostics and testing is required to life expectancy.
 - Recommissioning is required.
 - Service areas and heating equipment identified need to be confirmed.
 1. Domestic hot water w/ storage tank
 2. Elementary unit ventilators
 3. Commons & Little Gym baseboard and unit heaters
 4. Big Gym & Office baseboard and unit heaters
- Steam or water: Twenty-six (26) unit ventilators, twenty (20) unit heaters and baseboard/radiators.
 - Operational condition is fair.
 - Indoor air quality varies. Several areas exceed ASHRAE standards (CO2 <1000ppm)
 - Recommissioning is required.
 - Replacement unit ventilators will be capable of steam or hot water heat.
- Three (3) rooftop furnaces, four (4) radiant furnaces, one (1) forced air furnace and one (1) make-up air.
 - Operational condition is fair/poor.
 - Recommissioning is required
 - Rooftop service areas
 - District Office
 - High School Office
 - Biology
 - Radiant furnaces
 - Ag Welding Shop & CNA
 - Forced air furnace
 - (2) Elementary Classrooms (stand-alone building)
 - Make-up air furnaces
 - Kitchen (interlocked with kitchen oven exhaust hood?)
 - Ag Weld Shop & CNA

To be effective fresh air ventilation must be balanced with stale air exhaust fans. (Original High School design incorporated atmospheric relief hoods located on the roof (whirlybirds).

- Fifteen (15) exhaust fans are operational
 - Kitchen (2) – oven hood & dishwasher
 - High school 3rd level (2) – elevator location??
 - Labs (2) – East & West
 - Locker (3) – Boy & Girls
 - Elementary (1) – Restrooms
- One (1) return/exhaust
 - Large gym air handler return/relief fan (1)
- Seven (7) relief hoods located on old High School are NOT effective.
 - Girl Restrooms (1) 2x2 & Boy Restrooms (1) 2x2
 - Upper Level Hallway (1) 4x4 & (1) 2x2
 - Old Science Classroom (1) 2x2
 - High school 3rd level – (1) 1x1

Natural Gas

Rooftop, Radiant, Furnaces & Kitchen Appliances = Firm Service

Steam Boilers = Interruptible Service w/ Fuel Oil Back-up

Pool = data not available at this time

SCHOOL

Period End Date	Firm		Degree Day	Interrupt		Degree Day	Tax Amount
	Therms	Amount		Therms	Amount		
09/20/2015				0	\$5	11	\$0
10/19/2015				0	\$5	281	\$0
11/13/2015				803	\$457	448	\$31
12/15/2015	3,583	\$1,722	1,609				\$399
12/15/2015				6,707	\$3,683	970	\$399
01/18/2016	4,037	\$2,322	1,613				\$160
01/18/2016				9,200	\$5,284	1,613	\$363
02/18/2016	2,273	\$1,335	1,432				\$92
02/18/2016				8,329	\$4,877	1,432	\$335
03/21/2016	1,563	\$885	925				\$61
03/21/2016				5,893	\$3,320	925	\$228
04/20/2016	1,210	\$652	660				\$45
04/20/2016				4,414	\$2,366	660	\$163
05/19/2016	904	\$516	372				\$36
06/20/2016	419	\$231	81				\$16
05/19/2016				437	\$253	372	\$17
06/20/2016				0	\$6	81	\$0
07/20/2016	300	\$175	124				\$12
08/19/2016	304	\$183	229				\$13
08/01/2016				0	\$22	232	\$1
Aug-Feb	9,893	\$5,378	4,654	25,039	\$14,310	4,755	\$1,780
Annual	14,592	\$8,021	7,045	35,782	\$20,276	7,025	\$2,372
09/20/2016	390	\$236	37				\$16
10/19/2016	521	\$326	205				\$22
10/01/2016				11	\$35	117	\$2
11/17/2016	1,224	\$760	502				\$52
11/01/2016				647	\$309	400	\$21
12/19/2016	2,730	\$1,714	1,326				\$118
12/01/2016				3,439	\$1,538	676	\$106
01/01/2017				8,227	\$3,865	1,433	\$266
01/18/2017	3,042	\$2,017	1,419				\$139
02/01/2017				8,214	\$4,186	1,419	\$288
Aug-Feb	7,906	\$5,053	3,489	20,536	\$9,934	4,045	\$1,030

	Firm			Interrupt	
	Therms	Amount		Therms	Amount
Normalized	18,000	\$10,735		42,207	\$22,170

Electric

SCHOOL = Large Power

360

Service Charge	@	250.00*	/mo.
Energy Charge			
Usage from 6/1 - 9/30	@	\$0.05231	/kWh
Usage from 10/1 - 5/31	@	\$0.04620	/kWh
Demand Charge			
Usage from 6/1 - 9/30	@	\$15.14	/kW
Usage from 10/1 - 5/31	@	\$9.28	/kW

Le Roy School

	KWH	Amount	KW	Amount	Total
Jul-17					
Jun-17					
May-17					
Apr-17					
Mar-17	39,360	\$2,035	116.9	\$1,085	\$3,120
Feb-17	36,240	\$1,896	118.8	\$1,102	\$2,998
Jan-17	31,920	\$1,881	121.9	\$1,131	\$3,012
Dec-16	37,680	\$2,155	124.1	\$1,151	\$3,306
Nov-16	33,600	\$1,950	119.0	\$1,105	\$3,055
Oct-16	32,400	\$1,890	128.4	\$1,192	\$3,082
Sep-16	32,160	\$2,075	126.0	\$1,908	\$3,983
Aug-16	29,040	\$1,885	94.3	\$1,428	\$3,313
Aug-					
Mar	272,400	\$15,767	949.4	\$10,102	\$25,869
Annual					
Jul-16	25,440	\$1,707	94.6	\$1,432	\$3,139
Jun-16	29,280	\$1,923	113.5	\$1,719	\$3,642
May-16	37,200	\$2,143	115.2	\$1,069	\$3,212
Apr-16	24,720	\$1,516	108.0	\$1,002	\$2,518
Mar-16	37,200	\$2,143	115.2	\$1,069	\$3,212
Feb-16	30,960	\$1,829	112.8	\$1,047	\$2,876
Jan-16	32,400	\$1,902	105.6	\$980	\$2,882
Dec-15	34,080	\$1,911	108.0	\$1,002	\$2,913
Nov-15	29,520	\$1,692	103.2	\$958	\$2,650
Oct-15	29,520	\$1,691	110.4	\$1,025	\$2,716
Sep-15	33,360	\$2,080	120.0	\$1,817	\$3,897
Aug-15	20,880	\$1,467	69.6	\$738	\$2,205
	247,920	\$14,716	844.8	\$8,635	\$23,351
Annual	364,560	\$22,006	1276.1	\$13,856	\$35,862

POOL = General Demand Metered**290**

Service Charge	@	32.00*	/mo.
Energy Charge			
Usage from 6/1 - 9/30	@	\$0.05883	/kWh
Usage from 10/1 - 5/31	@	\$0.05195	/kWh
Demand Charge			
Usage from 6/1 - 9/30	@	\$10.23000	/kW
Usage from 10/1 - 5/31	@	\$6.39000	/kW

LeRoy Pool**Billing**

Period	KWH	Amount	KW	Amount	Total
Jul-17					
Jun-17					
May-17					
Apr-17					
Mar-17	21,113	\$1,196	46.638	\$298	\$1,494
Feb-17	15,964	\$911	29.8	\$190	\$1,101
Jan-17	14,536	\$921	32.878	\$210	\$1,131
Dec-16	14,264	\$895	24.454	\$156	\$1,051
Nov-16	12,684	\$802	27.608	\$176	\$978
Oct-16	11,891	\$753	23.5	\$150	\$903
Sep-16	11,780	\$849	38.588	\$395	\$1,244
Aug-16	13,856	\$974	28.461	\$291	\$1,265
Aug-Mar	116,088	\$7,300	251.927	\$1,867	\$9,167
Annual					
Jul-16	12,050	\$870	35.593	\$364	\$1,234
Jun-16	15,023	\$1,073	40.939	\$419	\$1,492
May-16	15,700	\$987	30.46	\$195	\$1,182
Apr-16	13,132	\$835	30.87	\$197	\$1,032
Mar-16	18,422	\$1,152	32.22	\$206	\$1,358
Feb-16	16,702	\$1,050	34.48	\$220	\$1,270
Jan-16	18,618	\$1,166	35.43	\$226	\$1,392
Dec-15	16,746	\$1,013	33.76	\$216	\$1,229
Nov-15	15,155	\$922	33.99	\$217	\$1,139
Oct-15	12,967	\$795	30.28	\$193	\$988
Sep-15	13,852	\$955	29.66	\$303	\$1,258
Aug-15	10,828	\$742	29.66	\$212	\$954
Aug-Mar	123,290	\$7,793	259.48	\$1,795	\$9,588
Annual	179,195	\$11,558	397.342	\$2,970	\$14,528