ASHRAE LEVEL II ENERGY AUDIT

THE TOWNSHIP OF NORTH DUMFRIES

NORTH DUMFRIES COMMUNITY COMPLEX & COWAN PARK
2958 Greenfield Road, Ayr, Ontario

Project No.: 2018-0527-11

May 28, 2019

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Project No.: 2018-0527-11

May 28, 2019

Shelley Stedall
The Township of North Dumfries
2958 Greenfield Road
Ayr, ON N0B 1E0

Dear Shelley Stedall,

RE: North Dumfries Energy Audits

WalterFedy is pleased to submit the attached ASHRAE Level II Energy Audit to The Township of North Dumfries. This report encompasses the originally agreed to scope, and has identified the potential for energy consumption and cost saving measures at North Dumfries Community Complex & Cowan Park located at 2958 Greenfield Road in Ayr, Ontario.

Based on the information provided by the The Township of North Dumfries, the report was completed with the data supplied and collected, as well as engineering judgement and various analysis tools to arrive at the final recommendations.

All of which is respectfully submitted,

WALTERFEDY

Josh Gibbins, P.Eng.
Senior Energy Engineer
Energy Management Solutions

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519.576.2150 x480

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EXECUTIVE SUMMARY

This report presents the results of a ASHRAE Level II Energy Audit completed by WalterFedy for The Township of North Dumfries at North Dumfries Community Complex & Cowan Park located at 2958 Greenfield Road in Ayr, Ontario.

The purpose of this ASHRAE Level II Energy Audit is to review how energy is currently being consumed within the facility, gain an understanding of how the facility is being operated, and provide recommendations for how energy can be saved through energy conservation measures (ECMs).

This ASHRAE Level II Energy Audit was prepared in conjunction with a Building Condition Assessment (BCA) of North Dumfries Community Complex & Cowan Park. ECMs are based on replacement recommendations with energy savings potential in the BCA report as well as emerging and renewable energy technologies when applicable.

North Dumfries Community Complex & Cowan Park is a 3 storey arena facility built in 2011.

Table 1 summarizes the annual electricity, natural gas, and water consumption for North Dumfries Community Complex during the baseline year of 2017. The facility's energy use intensity was benchmarked against arena facilities in the Waterloo Region.

Table 1: Facility annual utility summary

Annual Electricity Consumption	[kWh]	1,503,529
Annual Electricity Cost	[$]	177,194
Facility Electricity EUI	[kWh/ft^2]	25.5
Median Electricity EUI	[kWh/ft^2]	15.4
Annual Natural Gas Consumption	[m^3]	105,860
Annual Natural Gas Cost	[$]	27,449
Facility Natural Gas EUI	[m^3/ft^2]	2.4
Median Natural Gas EUI	[m^3/ft^2]	1.3
Annual Water Consumption	[m^3]	21,277
Annual Water Cost	[$]	59,150

*Utility costs calculated using utility rates described in Table 5.

Table 2 summarizes the annual utility savings and simple paybacks for the recommended conservation measures evaluated in this report. Conservation measures were evaluated independently and do not reflect interactive effects.

Table 2: Recommended ECM summary table

ECM	**Electricity Savings** [kWh]	**Demand Savings** [kW]	**Nat. Gas Savings** [m^3]	**Cost Savings** [$]	**Capital Cost** [$]	**Utility Incentive** [$]	**Simple Payback** [years]
Optimize floating head pressure controls	60,500	0.0	0	7,130	2,000	0	0.3
Zamboni floodwater treatment	118,795	0.0	2,221	14,576	35,000	11,879	1.6
Interior LED lighting retrofit	164,218	33.0	0	24,258	68,600	13,196	2.3
Exterior LED lighting retrofit	15,702	0.0	0	1,851	12,800	1,825	5.9

Note: Cost savings calculated using utility rates from Table 5.

1 INTRODUCTION

1.1 Objectives

WalterFedy was hired by The Township of North Dumfries to complete an ASHRAE Level II Energy Audit at their North Dumfries Community Complex & Cowan Park facility at 2958 Greenfield Road in Ayr, Ontario. The purpose of this ASHRAE Level II Energy Audit is to review how energy and water is currently being consumed within the facility, gain an understanding of how the facility is being operated, and provide recommendations for how energy and water can be saved through conservation measures.

This report identifies and explains potential energy and water conservation measures and provides economic analyses in order to estimate utility savings, budget implementation costs, and simple payback periods. Energy savings are within an accuracy of +/-30% while implementation costs are within an accuracy of +/-50%.

The goal is to recognize ECMs with high savings and reasonable payback periods. An analysis of historical energy and water use provides insight into the consumption patterns of the facilities. The data and information pertaining to the property reflects conditions and operations at the time of the site survey on November 21, 2018.

1.2 Scope of work

The scope of work is as follows:

- Review and analyze the historical energy consumption of each building.
- Conduct an on-site survey of each building's energy consuming equipment and system areas.
- Review operating logs and interview site building operations personnel to obtain insight into operating issues and practices.
- Perform an opportunity assessment including but not limited to:
  - The estimated energy unit and cost savings identified for each Energy Conservation Measures (ECM);
  - The energy saving recommendations from current state for each new ECM identified, documenting proposed equipment or operational changes from current equipment;
  - An explanation of the methodology and calculations utilized to obtain the energy and cost saving estimates;
- and document such assessment.
- Determine the cost to implement the recommended measures, including equipment installation and significant changes to maintenance costs, and determine the simple payback period for each ECM using the estimated savings.
- Provide a ranking of ECM opportunities in order of payback period category (1 to 3 years, 3 to 5 years, and 6 to 10 years)
- Identify and include in the final Report all available grants or incentives per identified ECM available through the Independent Electricity System Operator (IESO), Local Utility or other Government programs and include identified grant.

1.3 Contact information

The contact information of the the Owner and Consultant (WalterFedy) can be found in Table 3.

Table 3: Contact Information

Client:	**Consultant:**
Shelley Stedall	Josh Gibbins, P.Eng.
Treasurer, Director of Corporate Services	Senior Energy Engineer
519.632.8800 x123	519.576.2150 x480
sstedall@northdumfries.ca	jgibbins@walterfedy.com
The Township of North Dumfries	WalterFedy
2958 Greenfield Road	675 Queen Street South, Suite 111
Ayr, ON N0B 1E0	Kitchener, ON N2M 1A1

2 HISTORICAL ENERGY USE ANALYSIS

2.1 General information

Electricity, natural gas, and water suppliers for North Dumfries Community Complex are summarized in Table 4.

Table 4: Facility utility information.

Facility Name:	North Dumfries Community Complex & Cowan Park
Location:	2958 Greenfield Road, Ayr, Ontario
Electrical LDC*:	Energy+
LDC Account No.:	00099150-00
Natural Gas Distributor:	Union Gas
NG Account No.:	190-3946 272-4753
Water Provider:	Region of Waterloo
Water Account No.:	210 11868 000

*Electrical Local Distribution Company

2.2 Utility rates

The utility rates shown in Table 5 are used throughout this report to evaluate the energy conservation measures identified in this ASHRAE Level II Energy Audit.

The electricity and natural gas rates are averages determined using the last 24 months of utility bills. The water rate is taken from the Region of Waterloo website and current as of November 1, 2018.

Table 5: Facility utility rates

Electricity Consumption	[$/kWh]	0.12
Electrical Demand	[$/kW]	12.4
Natural Gas Consumption	[$/m^3]	0.26
Water Consumption	[$/m^3]	2.78

2.3 Incentive summary

Electricity incentives

Electricity savings incentives have been calculated based on the IESO saveONenergy Retrofit Program as summarized in Table 6.

Table 6: Electricity savings incentives

Project Type	Demand Incentive	Consumption Incentive
Lighting	$400 / kW	$0.05 / kWh
Non-lighting	$800 / kW	$0.10 / kWh

1. The greater of the kW or kWh incentive will apply
2. Incentive capped at 50% of project cost

Natural gas incentives

Union Gas offers prescriptive and custom incentives for high efficiency natural gas consuming equipment. The incentives vary depending on the type of equipment. Information on all the incentives available can be found on the following webpage: *https://www.uniongas.com/business/save-money-and-energy/equipment-incentive-program*.

2.4 Data sources

The following data sources were used in this historical energy use analysis:

- 24 months of Energy+ monthly electricity bills.
- 24 months of Union Gas monthly natural gas bills.
- 24 months of Region of Waterloo bi-monthly water bills.
- Daily weather data for Kitchener/Waterloo.

2.5 Facility utility use

Due to different billing periods among the utilities, monthly consumption was determined by calculating an average daily consumption over a billing period and summing the average daily consumption for each month of the year.

Electricity consumption

Table 7 summarizes the annual electricity consumption of North Dumfries Community Complex for the baseline year of 2017.

Table 7: Facility annual electricity consumption

Annual Electricity Consumption	[kWh]	1,503,529
Annual Electricity Consumption Costs	[$]	177,194

As seen in Figure 1, electricity consumption varies with time of year. There is a significant decrease in monthly electricity consumption in the months of June and July when the refrigeration plant is not operational.

Electrical demand

Figure 2 shows monthly peak demand for the previous two years. The monthly peak demand is significantly lower in the months of June and July when the refrigeration plant is not operational.

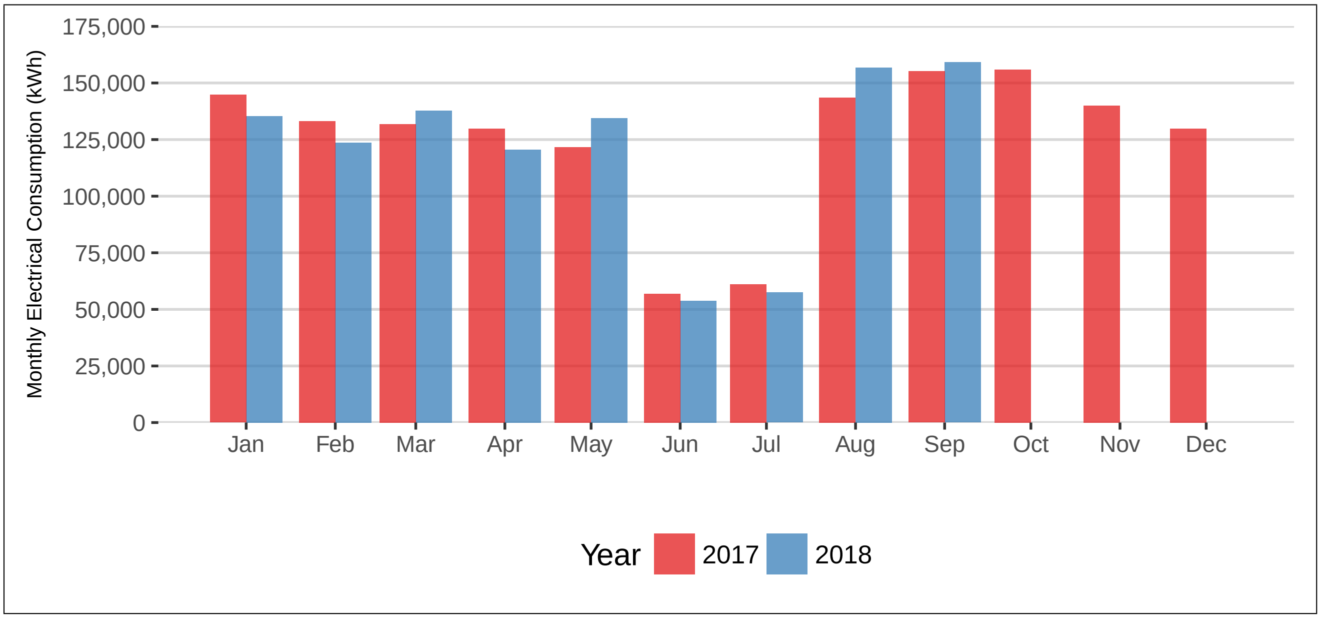


Figure 1: Monthly electricity consumption for the baseline period

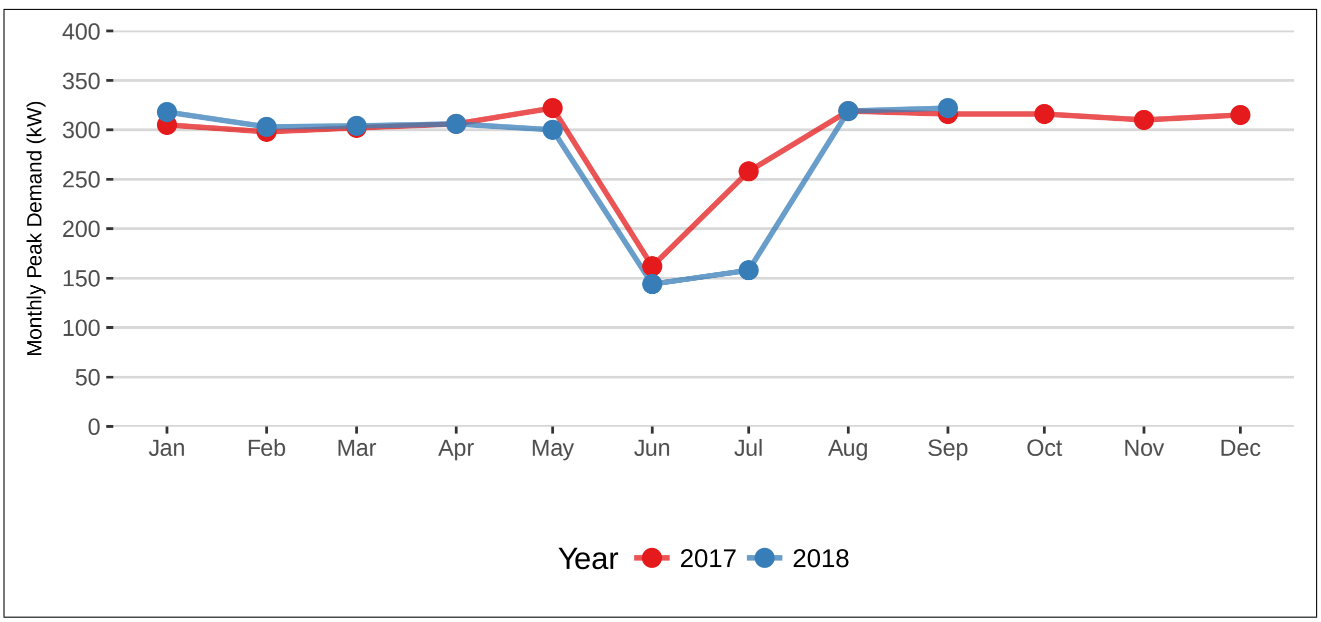


Figure 2: Monthly peak demand for the baseline period

Natural gas consumption

Table 8 summarizes the annual natural gas consumption of North Dumfries Community Complex for the baseline year of 2017.

Table 8: Facility annual natural gas consumption

Annual Natural Gas Consumption	[m^3]	105,860
Annual Natural Gas Consumption Costs	[$]	27,449

Natural gas is used for heating domestic hot water, radiant infloor heating, and for heating the ventilation air during the winter season. As seen in Figure 3, the summer natural gas consumption reflects the baseload natural gas consumption for domestic hot water while the ventilation air and infloor heating natural gas consumption increases as outdoor temperature decreases. There is a significant decrease in natural gas consumption in the months of June and July from 2017 to 2018.

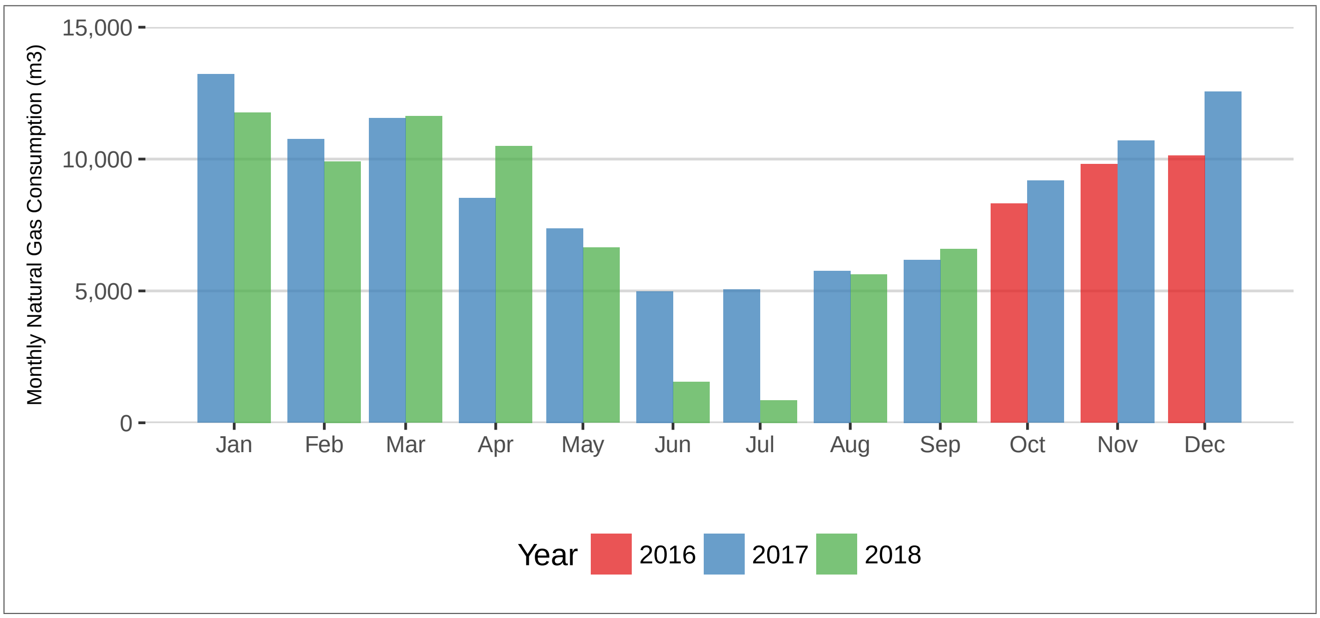


Figure 3: Monthly natural gas consumption for the baseline period

Natural gas regression analysis

As natural gas is used to heat outdoor ventilation air during the heating season, a linear regression analysis was completed comparing monthly natural gas consumption to heating degree days as seen in Figure 4.

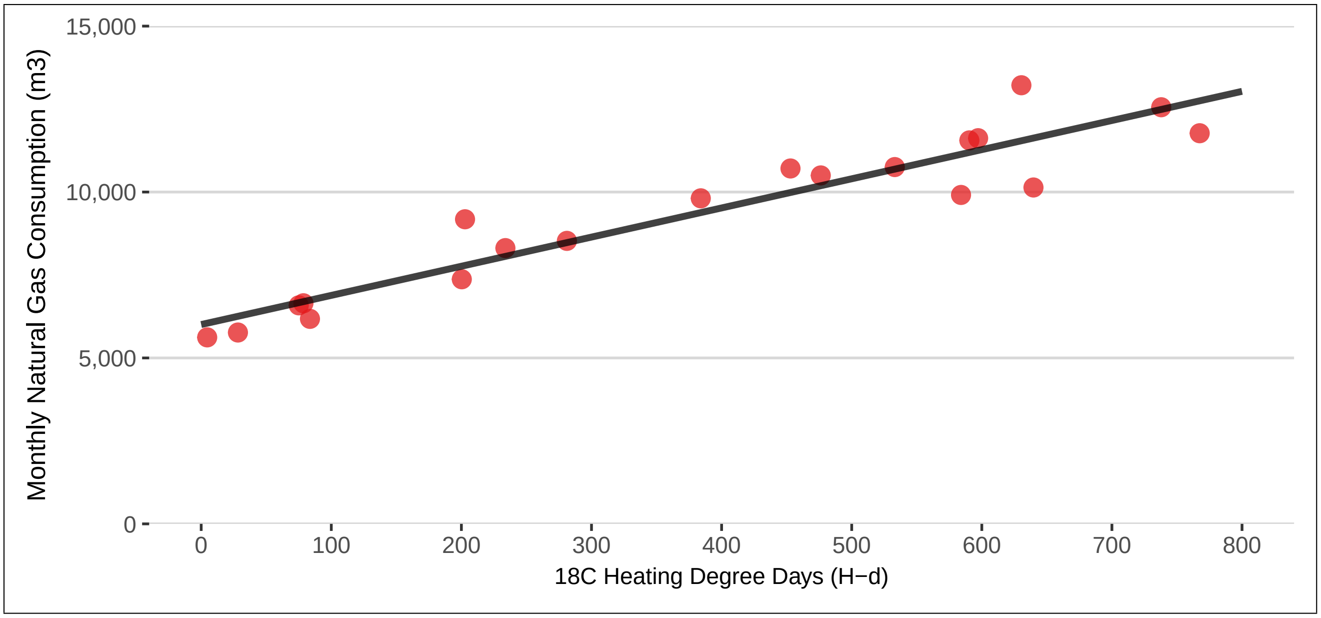


Figure 4: Linear regression of natural gas consumption vs. heating degree days

Linear regression resulted in the following model for natural gas consumption based on heating degree days (HDD):

$$\text{Natural gas consumption } [m^3] = 6{,}007 + 8.8 \times 18°C \text{ HDD } (r^2 = 0.89)$$

The r^2 value, also called the coefficient of determination, is a measure of how well the model predicts the actual consumption data. An r^2 value of 1 indicates that the linear regression model correctly predicts every data point. In this case, 89% of the variability in the natural gas consumption data can be explained by correlating consumption to heating degree days.

Water consumption

Table 9 summarizes the annual water consumption of North Dumfries Community Complex for the baseline year of 2017.

Table 9: Facility annual water consumption

Annual Water Consumption	[m^3]	21,277
Annual Water Consumption Costs	[$]	59,150

Figure 5 summarizes the monthly water consumption. Water consumption is slightly lower during the summer season. However, it is observed that there was an abnormally large increase in water consumption in September 2017 - October 2017.

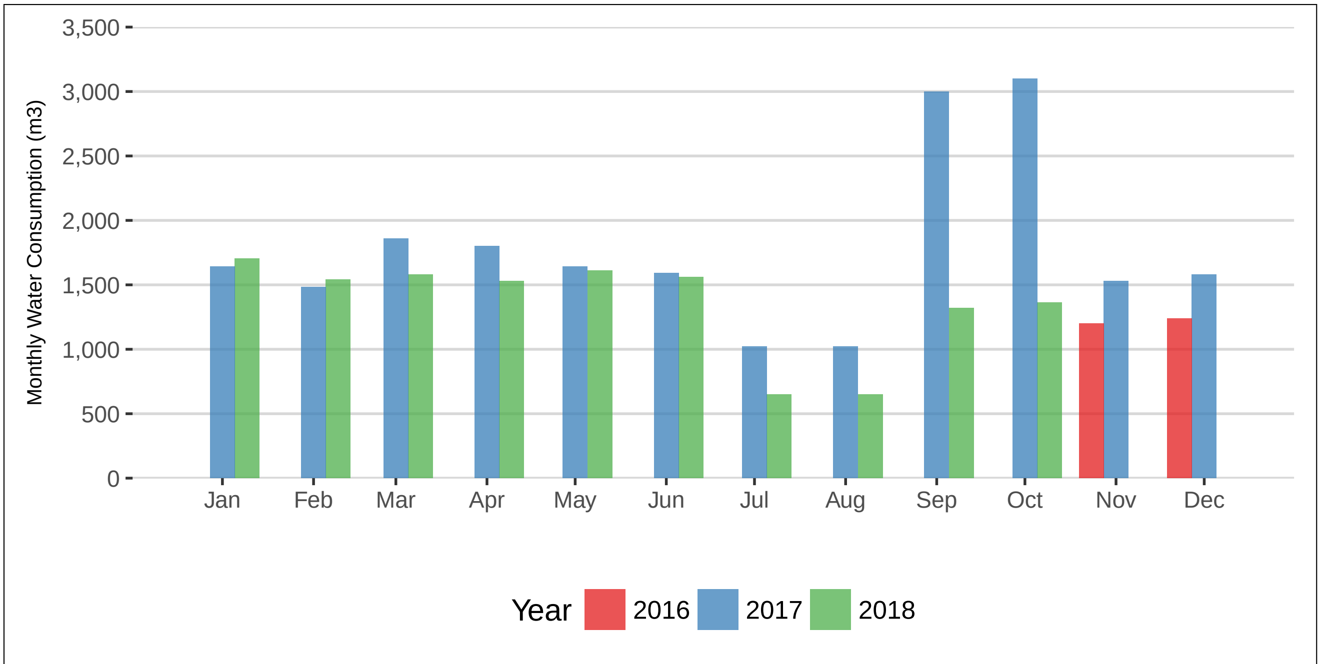


Figure 5: Monthly water consumption for the baseline period

2.6 Energy end uses

Table 10 summarizes the energy end uses for North Dumfries Community Complex.

Table 10: Annual energy end uses

End Use	**Natural Gas Consumption** [m^3]	**Electricity Consumption** [kWh]	**Total Energy Consumption** [ekWh]	**Total Energy Percentage** [%]	**Energy Costs** [$]
Space Cooling	-	63,770	63,770	2.4	7,515
Refrigeration	-	764,980	764,980	29.2	90,154
Space Heating	40,860	-	431,347	16.5	10,595
HVAC	-	402,202	402,202	15.3	47,400
Water Heating	65,000	-	686,187	26.2	16,854
Lighting	-	236,488	236,488	9.0	27,871
Appliances/Plug loads	-	36,089	36,089	1.4	4,253
Totals	105,860	1,503,529	2,621,063	100	204,643

1. Refer to Table 5 for the utility rates used.
2. Natural gas converted to ekWh using factor of 11 ekWh/m^3
3. HVAC includes equipment such as ventilation fans, circulation pumps, etc..
4. Total end use energy consumption matches the total baseline year energy consumption.

Calculations

- Natural gas consumption was divided into space heating and domestic water heating.
- Domestic water heating natural gas consumption in summer months was estimated using average consumption in arena OFF months (June and July)
- Domestic water heating natural gas consumption in winter months was estimated using average consumption in summer arena ON months (August and September).

- Space heating natural gas consumption was calculated as the difference between the total annual natural gas consumption and domestic water heating natural gas consumption.
- Electricity consumption was divided into refrigeration, lighting, plug loads, space cooling, and HVAC.
- Refrigeration electricity consumption estimated based on difference in monthly electricity consumption in June and August.
- Interior lighting electricity consumption estimated based on typical operating hours throughout the operating season.
- Exterior lighting electricity consumption estimated based on 12 hour/day operation throughout the year.
- Soccer field lighting electricity consumption estimated based on approximately 28 hours of operation weekly from May - October.
- Plug loads estimated at 0.25 W/ft^2 operating continuously throughout the operating season.
- Space cooling electricity consumption estimated based on the average difference in monthly electricity consumption between summer arena ON months and winter arena ON months (January, February, March).
- HVAC electricity consumption estimated calculated as the difference between the total annual electricity consumption and the sum of the refrigeration, space cooling, lighting, and plug loads electricity consumption.

2.7 Energy use intensity (EUI)

The intent of this section is to compare annual energy consumption of the facility under investigation to arena facilities in the Waterloo Region. Data was obtained from the Ontario government which collects energy consumption and other building data from Broader Public Sector (BPS) organizations such as municipalities, school boards, universities, and hospitals. Annual consumption was normalized against the building's floor area to determine each facility's EUI.

As seen in Table 11, North Dumfries Community Complex is 66% above the median electricity EUI and is 85% above the median natural gas EUI for arena facilities in the Waterloo Region. The red bars in Figure 6 show the electricity and natural gas EUI of North Dumfries Community Complex in comparison to arena facilities in the Waterloo Region.

Table 11: Facility Electricity EUI comparison

Facility Electricity EUI	[kWh/ft^2]	25.5
Median Electricity EUI	[kWh/ft^2]	15.4
Facility Natural gas EUI	[m^3/ft^2]	2.4
Median Natural gas EUI	[m^3/ft^2]	1.3

Figure 7 compares the total annual electricity and natural gas consumption of all North Dumfries facilities.

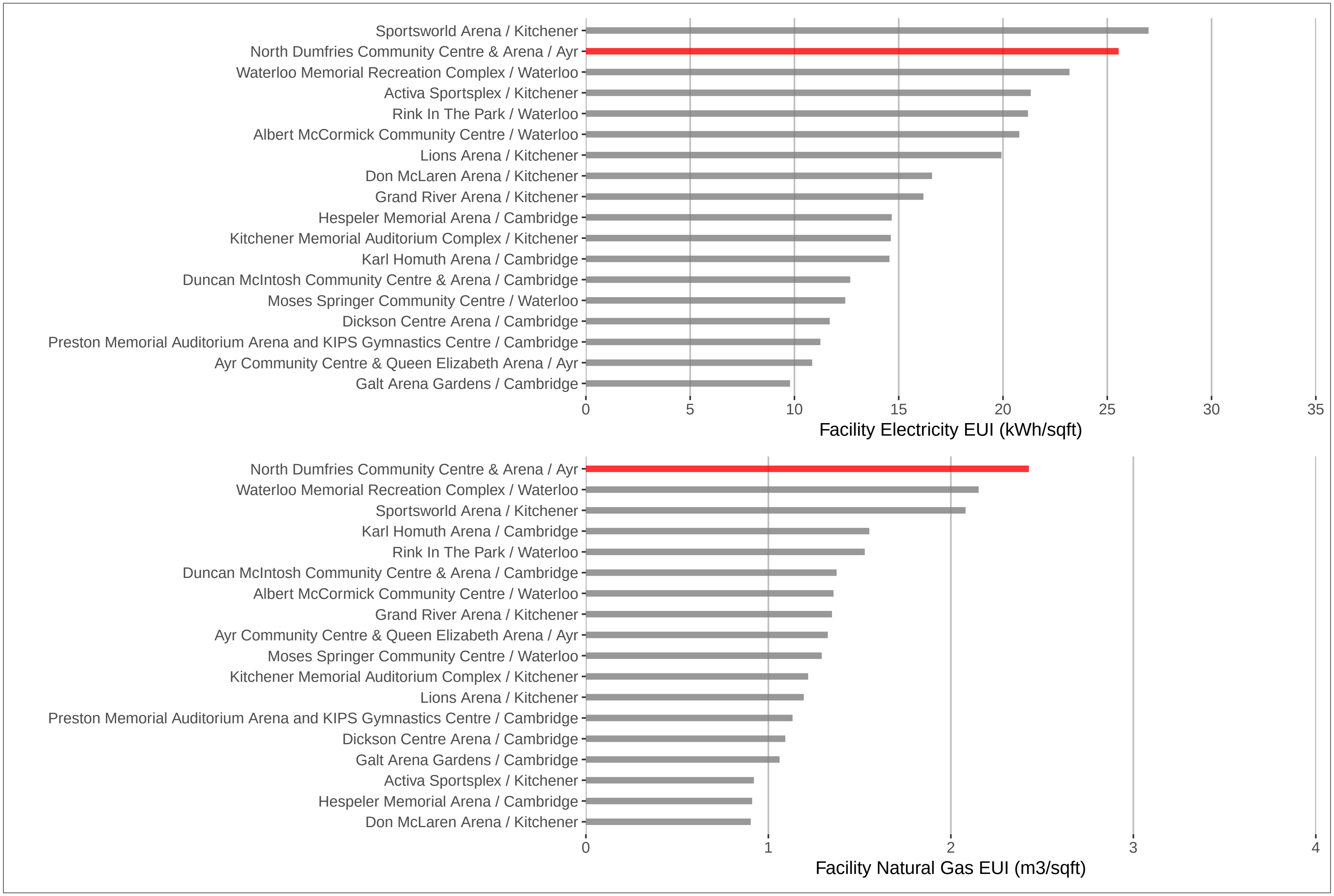


Figure 6: Electricity and natural gas energy use intensity by building

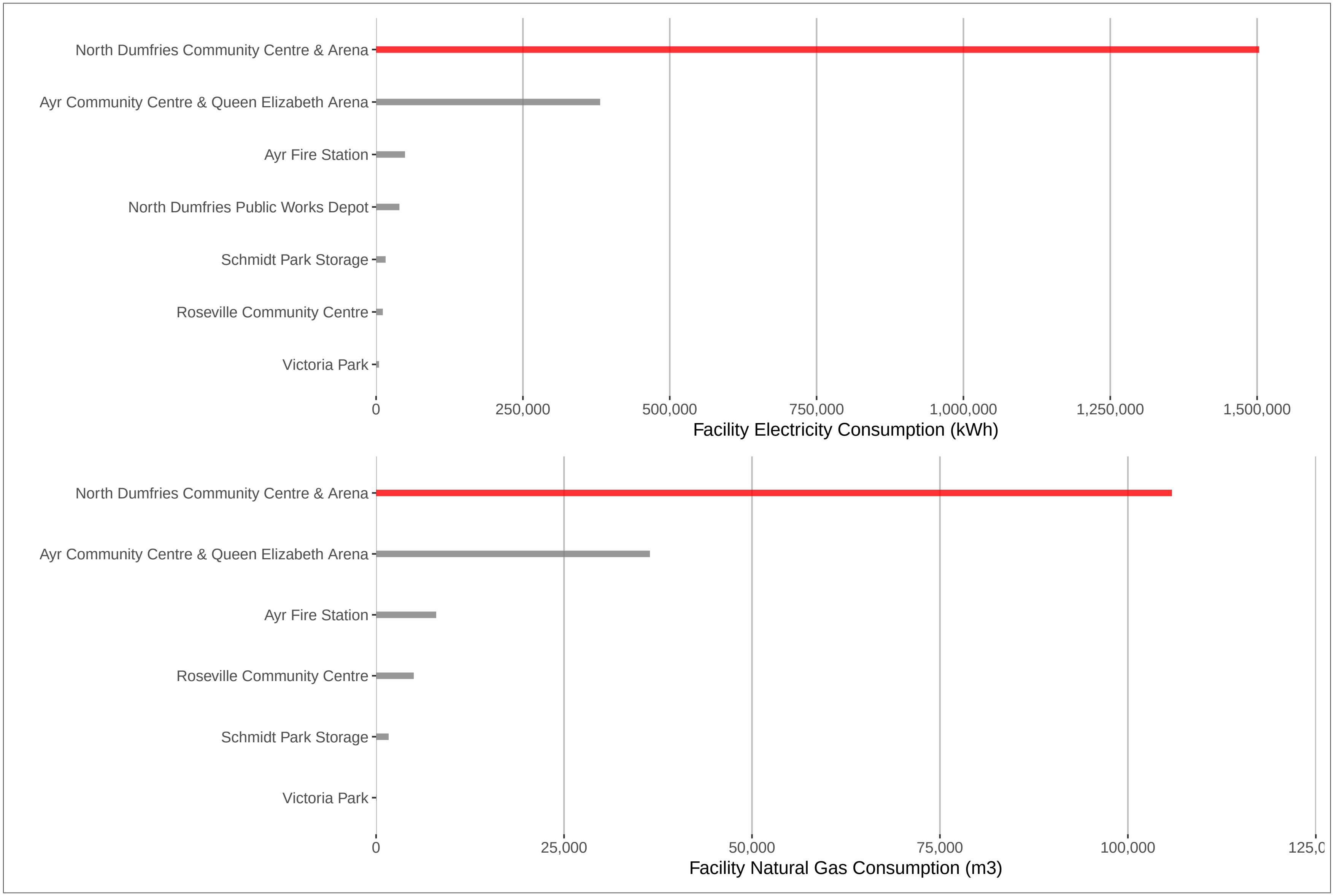


Figure 7: Annual electricity and natural gas energy use by building

3 EXISTING CONDITIONS

3.1 General facility information

North Dumfries Community Complex is a 2-storey arena facility constructed in 2011. It consists mainly of an ice rink, change rooms, concession areas, and spectator areas. Table 12 summarizes the general facility information for North Dumfries Community Complex.

Table 12: Facility background information

Facility name:	North Dumfries Community Complex & Cowan Park
Location:	2958 Greenfield Road, Ayr, Ontario
Number of floors:	3
Facility floor area:	73,733 ft^2
Year of construction:	2011
Building type:	Community Centre

Cowan Park consists of a mechanical room, washroom facilities, playground, spash pad, and a soccer field. Table 13 summarizes the general facility information for Cowan Park.

Table 13: Facility background information

Facility name:	Cowan Park
Location:	2958 Greenfield Road, Ayr, Ontario
Number of floors:	1
Facility floor area:	1,500 ft^2
Year of construction:	2011
Building type:	Park building and soccer field

3.2 Facility occupancy schedule

North Dumfries Community Complex & Cowan Park operates throughout the year, but the arena only operates from August - May. The weekly schedule varies depending on the season. Tables 14, 15 and 16 show the typical occupied hours throughout the year.

Table 14: Fall/winter weekly hours (September - April)

Monday - Friday	7:00 am - 11:00 pm
Saturday - Sunday	7:00 am - 11:00 pm

Table 15: Spring weekly hours (April - May)

Monday - Friday	7:00 am - 10:00 pm
Saturday	9:00 am - 10:00 pm
Sunday	Closed

Table 16: Summer weekly hours (June - August)

Monday - Friday	7:00 am - 5:00 pm
Saturday - Sunday	Closed

Cowan Park operates only in the summer months (May - October). Table 17 shows the typical occupied hours during the operating season.

Table 17: Cowan Park hours (May - October)

Monday - Friday	8:00 am - 11:00 pm
Saturday - Sunday	8:00 am - 11:00 pm

3.3 Building envelope

Table 18: NDCC building envelope details

Component	Installed	Description
Foundations	2011	arena slab comprised of concrete slab, steel rebar, rigid insulation, and plastic piping
Foundations	2011	4” poured reinforced concrete
Flat roofing structure	2011	corrugated metal roof decking
Masonry cladding	2011	full split face architectural concrete block veneer
Masonry cladding	2011	architectural brick accents
Metal clad exterior walls	2011	prefinished metal vertical cladding
Exterior windows	2011	double glazed and insulated, brushed aluminum framed units
Exterior doors	2011	hollow metal doors in metal frames
Exterior doors	2011	aluminum framed glazed doors
Exterior doors	2011	aluminum sliding glass doors
Overhead doors	2011	insulated overhead doors
Roof coverings	2011	standing seam steel roof
Membrane roofing	2011	mechanically fastened TPO membrane and rigid insulation
Skylights	2011	skylight to provide natural lighting to hallway on first floor
Roof hatches	2011	provides access to the flat roof level

Table 19: Cowan Park building envelope details

Component	Installed	Description
Foundations	2011	poured reinforced concrete
Masonry cladding	2011	full split face architectural concrete block veneer
Exterior doors	2011	hollow metal doors in metal frames
Exterior doors	2011	aluminum framed glazed doors
Exterior doors	2011	aluminum sliding glass doors
Overhead doors	2011	insulated overhead door
Roof coverings	2011	sloped roof with asphalt shingles with aluminum soffits

Exterior roof

NDCC: Above the ice rink and surrounding spaces is a pitched standing seam steel roof. The roofing system installed above the public areas consists of mechanically fastened TPO membrane and rigid insulation on top of steel decking. Skylights provide natural lighting to the hallway on the first floor.

Cowan Park: The roofing system installed is a sloped roof with asphalt shingles with aluminum soffits.

(a) NDCC exterior roof (b) NDCC skylights (c) Cowan Park exterior roof

Figure 8: Facility exterior roof

Exterior walls

NDCC: The block exterior walls consist of full split face architectural concrete block veneer as the cladding surrounding the public areas of the building. Prefinished metal vertical cladding is installed primarily along the upper portion of the elevations as well as surrounding the ice rink. The canopies above two entrances are supported by walls which are cladded by architectural brick accents.

Cowan Park: The exterior walls consist of full split face architectural concrete block veneer.

(a) NDCC exterior block wall (b) NDCC exterior wall with metal cladding (c) Cowan Park exterior wall

Figure 9: Building exterior walls

Exterior windows and doors

NDCC: Double glazed and insulated, brushed aluminum framed windows are installed throughout the building.

Three double and fifteen single hollow metal doors in hollow metal frames are positioned along the perimeter of the building. Five double and two single aluminum framed glazed doors in hollow metal frames and sidelites are positioned along the perimeter of the building and with two vestibule entrances. Two sets of automatic sliding glass doors with brushed aluminum frames, side glazing, transom and aluminum mullions are located within the vestibule and main entrance.

There are two insulated overhead doors within the building.

(a) Exterior door (b) Exterior door (c) Overhead door

Figure 10: NDCC exterior doors

Cowan Park: Hollow metal single doors in hollow metal frames are positioned along the perimeter of the building. There is one insulated overhead door within the building which provides access to the building's mechanical room.

(a) Exterior door (b) Overhead door

Figure 11: Cowan Park exterior doors

3.4 Mechanical systems

Table 20: Existing mechanical equipment

Description	Manufacturer	Model	Qty	Location	Installed	Size
DHW storage tanks	A.O Smith	TJV 120A	3	Boiler room	2011	
DHW circulation pumps	Armstrong		5	Boiler room	2011	1/6 HP to 1/2 HP
Sanitary sewage pump			1	Mechanical room	2011	
DHW heater	A.O Smith	BTH 300A 100	2	Water room	2011	130 GAL
DHW heater	A.O Smith	BTH 199 000	1	Boiler room	2011	100 GAL
Water softener			2	Water room	2011	
Boiler	Viessmann	Vitodens 200 - W	3	Boiler room	2011	350 MBH
In-floor heating pump	Bell & Gosset		2	Boiler room	2011	5 HP
In-floor heating pump	Armstrong		1	Boiler room	2011	3/4 HP
In-floor heating pumps	Various		20	Throughout	2011	1/25 HP to 3/4 HP
Exhaust fan			1	Ice resurfacing room	2011	1/3 HP
Exhaust fan			2	Various	2011	1/8 HP
Exhaust fan			1	Refrigeration room	2011	1/3 HP
Exhaust fan			2	Ice rink	2011	3/4 HP
Exhaust fan	Penn Barry	FX18BHFT	1	Rooftop	2011	1 1/2 HP
Exhaust fan			14	Various	2011	
Exhaust fan			1	Main electrical room	2011	1/20 HP
Hood fan	Captive Aire		1	Concession	2011	2000 CFM
Unit heater	Miniveil		1	Vestibule	2011	
Split condensing unit			1	Walking track	2011	
Split condensing unit	Goldstar	GS180CE	1	Rooftop	2011	18 MBH
Make-up AHU	ICE		1	Rooftop	2011	
Air furnace (gas)	Carrier	48PGEC06-D-10-A6	2	Rooftop	2011	113 MBH
Air furnace (gas)	Carrier	48PGEC14-D-10-BH	3	Rooftop	2011	226 MBH
Air furnace (gas)	Carrier	48PGEC08-D-10-A6	1	Rooftop	2011	180 MBH
Air furnace (gas)	Carrier	48PGFC05-D-10-A6	1	Rooftop	2011	113 MBH
Air furnace (gas)	Carrier	48PGEC12-D-10–F	3	Rooftop	2011	226 MBH
Air furnace (gas)	Carrier	48PGEC06-D-10-A6	4	Rooftop	2011	113 MBH
Air furnace (gas)	Carrier	48PGEC07-D-10-A6	1	Rooftop	2011	113 MBH
ERV	Venmar		1	Rooftop	2011	
ERV	Venmar	ERV1500e	5	Rooftop	2011	
ERV	Venmar	ERV2000e	1	Rooftop	2011	
ERV	Venmar	ERV500e	1	Rooftop	2011	
Humidifier	Cimco-Toromont	CDH-142	1	Rooftop	2011	417 MBH

Space heating system

NDCC: Space heating throughout the facility is provided by a combination of radiant infloor heating and packaged rooftop units. Some of the packaged rooftop units are equipped with energy recovery ventilators (ERVs). The radiant infloor heating system is partially served by heat recovered from the refrigeration plant, but also provided by the boiler plant. There is also a dehumidifier which helps control temperature and humidity in the arena.

Cowan Park: There is one electric unit heater, wall mounted within the mechanical room that is original to the year of construction.

(a) Condensing boiler (b) Infloor radiant heating manifold (c) Dehumidifier

Figure 12: Space heating systems

Space cooling system

NDCC: Space cooling throughout the facility is provided by packaged rooftop units.

(a) Packaged rooftop unit

Figure 13: Space cooling system

Domestic hot water system

NDCC: Domestic hot water (DHW) is provided by several natural gas domestic hot water heaters. DHW tanks are used to maintain the temperature of the DHW.

Cowan Park: DHW is provided by an electric domestic hot water heater.

(a) NDCC DHW heater (b) NDCC DHW tank (c) Cowan Park DHW heater

Figure 14: Domestic hot water system

3.5 Building automation system

The HVAC, refrigeration and exterior lighting are controlled by the building automation system.

3.6 Lighting

Table 21: Existing lighting fixtures

Fixture Type	Quantity	Total Demand [W]
CFL	91	2,627
FLUOR	512	44,931
HAL	22	5,620
MH	63	16,500

Exterior lighting

NDCC: Exterior lighting consists of fixtures and bollards placed near the entrances. The parking lot has a number of pole fixtures.

Cowan Park: Exterior lighting consists of wallpacks placed on the exterior elevations. The soccer field has a number of spotlights.

(a) NDCC exterior lighting fixtures (b) NDCC exterior bollard (c) NDCC parking lot pole fixture

Figure 15: Exterior lighting

Interior lighting

NDCC: Interior lighting consists mostly of fluorescent and halogen fixtures. The arena has fluorescent hi-bay fixtures. The majority of the interior lighting is controlled by occupancy sensors.

Cowan Park: Interior lighting consists fluorescent fixtures throughout.

(a) NDCC fluorescent fixtures (b) NDCC arena fixtures (c) Typical fluorescent fixtures

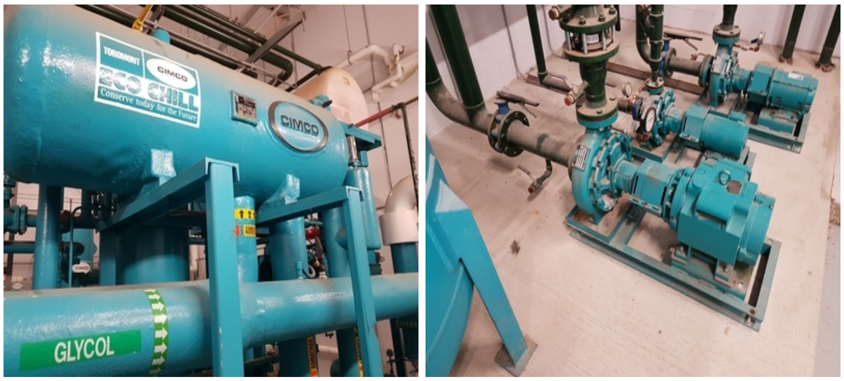
Figure 16: Interior lighting

3.7 Refrigeration

NDCC: The refrigeration plant serves one NHL sized ice pad from August - May. The refrigeration plant consists two screw compressors, brine pump, cooling tower, and several heat recovery heat exchangers. Heat from the refrigeration plant is used to pre-heat flood water and DHW, and serve the radiant infloor heating system.

Table 22: Existing arena equipment

Description	Manufacturer	Model	Qty	Location	Installed	Size
Chiller	CIMCO	N/A	1	Refrigeration Room	2011	N/A
Compressor	CIMCO	N/A	2	Refrigeration Room	2011	N/A
Chilled water pump	WEG	N/A	2	Refrigeration Room	2011	15 HP
Chilled water pump	WEG	N/A	2	Refrigeration Room	2011	2 HP
Cooling tower	CIMCO	N/A	1	Refrigeration Room	2011	N/A
Balancing tank	N/A	N/A	1	Refrigeration Room	2011	N/A
Heat exchanger	CIMCO	N/A	2	Refrigeration Room	2011	N/A



(a) Eco chill package (b) Glycol pumps
Figure 17: Arena cooling system

3.8 Plumbing fixtures

NDCC: The public washrooms and staff washrooms throughout are equipped with floor mounted toilets, lavatories, urinals and shower stalls. They are manufactured by American Standard. The men's washroom typically has two toilets, three urinals and two wall mounted lavatories. The women's washroom typically has four toilets and two wall mounted lavatories.

There are a total of six dressing rooms, one junior team dressing room and one referee dressing room. Each dressing room has one toilet, one lavatory and one shower with three heads, the referee room has one toilet, one lavatory and one shower with two heads and the junior team dressing room has one toilet, one lavatory and two showers with two heads.

Throughout the building are various kitchens and kitchennetes servicing the staff and public. The plumbing fixtures installed in these spaces are a mixture of stainless steel single and double baisin sinks and faucets.

There is one mop sink in each of the janitor rooms on the first floor.

Table 23: NDCC existing plumbing fixtures

Description	Manufacturer	Qty	Location	Installed
Toilets	American Standard	N/A	Washrooms	2011
Toilets	American Standard	N/A	Dressing rooms	2011
Urinals	American Standard	N/A	Washrooms	2011
Faucets	American Standard	N/A	Washrooms	2011
Faucets	American Standard	N/A	Dressing rooms	2011
Faucets	N/A	9	Kitchens	2011
Faucets	N/A	2	Janitor rooms	2011

Cowan Park: The men's and ladies public washrooms are equipped with floor mounted toilets and lavatories. They are manufactured by American Standard and Crane Plumbing. The men's washroom has two toilets, two urinals and two wall mounted lavatories. The women's washroom has three toilets and two wall mounted lavatories.

Table 24: Cowan Park existing plumbing fixtures

Description	Manufacturer	Qty	Location	Installed
Toilets	American Standard	5	Washrooms	2011
Urinals	American Standard	2	Washrooms	2011
Faucets	American Standard	4	Washrooms	2011

(a) Washroom faucet (b) Toilet (c) Urinals

Figure 18: Typical plumbing fixtures

4 ENERGY CONSERVATION MEASURES

4.1 Building envelope upgrades

Building envelope upgrades typically include the following components:

- Roof: Increasing insulation to reduce heat losses through the roof.
- Exterior walls: Increase insulation to reduce heat losses through the exterior walls.
- Windows: Replacing old windows with new high efficiency windows to reduce heat losses through the windows.

Building envelope upgrades are not recommended to be considered until the envelope components are due for replacement due to the high cost of implementation, and low opportunity for utility savings. A qualitative analysis of the building envelope upgrades are presented in Table 25.

Table 25: Building envelope upgrades

Category	Description
Building component	Building envelope (roof, exterior walls, windows)
Recommended change	Increase insulation in roof and exterior walls, and replace windows
Impact on occupant comfort	Improved thermal comfort due to reduced heat loss, and increased air tightness
Estimated cost	High (> $100,000)
Estimated level of annual savings	Low (> 100 year payback)
Priority	Low (Envelope is relatively new, and low opportunity for utility cost savings)

4.2 Interior LED lighting retrofit

LED lighting technology continues to rapidly advance, resulting in increased energy efficiency, improved product reliability, increased selection, and reduced costs. Applications where lighting retrofits are typically the most feasible include facilities with dated light fixtures (prior to T8 fluorescent lamps), contain high light fixture densities (resulting in a high W/ft^2 ratio), and have extended daily use (24/7 operation). Replacing existing fixtures with LED fixtures can decrease overall lighting costs significantly, while providing improved lighting levels for occupants.

This report analyzes an interior LED fixture replacement with no fixture reduction. LED fixture replacement has the following benefits:

- Allows for the highest level of flexibility for enhanced lighting controls, whether it is tied to occupancy and daylight sensors, zonal controls, wireless, addressable sensors, or network solutions to be integrated on each luminaire.
- Maximized performance when the fixture body is designed with the proper heat dissipation for LED light sources.
- Optimized visual comfort with lenses designed to reduce LED glare and improve the light distribution.

Assumptions

- The existing light fixtures were retrofitted on a one-for-one basis.
- LED fixture replacement costs on a per fixture basis were held constant. No economies of scale were assumed.
- Costs include both fixture and installation costs.
- No maintenance cost savings were taken into account.
- Cowan Park interior fixtures not taken into account due to low annual operating hours.

Calculations

- The existing lighting electrical demand [kW] was determined by summing the electrical demand for all lights in the building.
- The existing lighting electrical demand [kW] was multiplied by the annual operating hours to determine the annual electricity consumption [kWh] for the existing lighting.
- A review of each existing light fixture type was completed to determine a suitable LED fixture replacement (per unit basis).
- An approximate cost and electrical power [W] for each LED fixture replacement was determined.
- The annual electricity consumption and monthly demand for the LED retrofit scenario was calculated and compared to the existing conditions.

Table 26 provides a summary of the LED lighting retrofit analysis results.

Table 26: Interior LED lighting retrofit

ECM	**Electricity Savings** [kWh]	**Demand Savings** [kW]	**Nat. Gas Savings** [m^3]	**Cost Savings** [$]	**Capital Cost** [$]	**Utility Incentive** [$]	**Simple Payback** [years]
Interior LED lighting retrofit	164,218	33.0	0	24,258	68,600	13,196	2.3

Note: Cost savings calculated using utility rates from Table 5.

4.3 Exterior LED lighting retrofit

An exterior LED lighting retrofit has the following benefits in addition to those described previously:

- Improved lighting levels areas surrounding the building for increased occupant safety.

- Increased fixture lifespan resulting in lower maintenance costs.

This report analyzes an exterior LED fixture replacement with no fixture reduction.

Assumptions

- The existing light fixtures were retrofitted on a one-for-one basis.
- LED fixture replacement costs on a per fixture basis were held constant. No economies of scale were assumed.
- Costs include both fixture and installation costs.
- No maintenance cost savings were taken into account.
- Parking lot lights were excluded as they have already been retrofitted with LED.
- Soccer field lights were included.

Calculations

- The existing lighting electrical demand [kW] was determined by summing the electrical demand for all lights in the building.
- The existing lighting electrical demand [kW] was multiplied by the annual operating hours to determine the annual electricity consumption [kWh] for the existing lighting.
- A review of each existing light fixture type was completed to determine a suitable LED fixture replacement (per unit basis).
- An approximate cost and electrical power [W] for each LED fixture replacement was determined.
- The annual electricity consumption and monthly demand for the LED retrofit scenario was calculated and compared to the existing conditions.

Table 27 provides a summary of the LED lighting retrofit analysis results.

Table 27: Exterior LED lighting retrofit

ECM	**Electricity Savings** [kWh]	**Demand Savings** [kW]	**Nat. Gas Savings** [m^3]	**Cost Savings** [$]	**Capital Cost** [$]	**Utility Incentive** [$]	**Simple Payback** [years]
Exterior LED lighting retrofit	15,702	0.0	0	1,851	12,800	1,825	5.9

Note: Cost savings calculated using utility rates from Table 5.

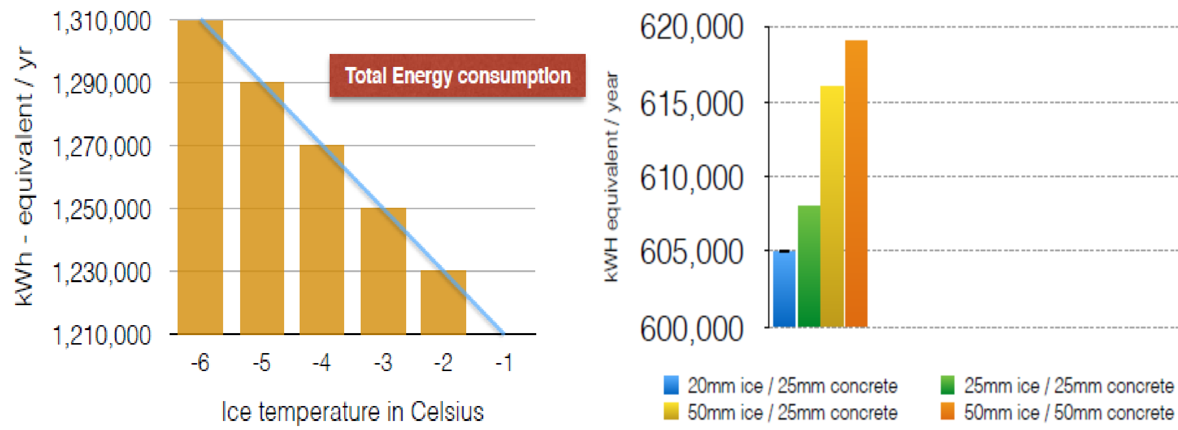
4.4 Zamboni floodwater treatment

REALice is a water treatment device for ice arenas to remove micro-air bubbles from water that is used when laying and resurfacing the ice. This high precision de-aeration makes it possible to flood the ice with unheated water to create hard and resilient ice and lower utility costs.

The financial saving mechanisms for the REALice system are as follows:

1. Reduction in thermal energy required to heat up the resurfacing water.
2. Reduction in electricity for the operation of the refrigeration plant as 1) low-temperature resurfacing water is applied to the ice surface, 2) the ice rink slab temperature is raised (approximately 1.5°C) to allow resurfacing water to freeze an an appropriate rate, and 3) ability to reduce ice thickness (approximately 6 - 13 mm) without adversely affecting ice quality.

The typical electricity consumption savings realized from increasing ice rink slab temperature and decreasing ice thickness are shown in Figure 19.



(a) Electricity consumption vs ice rink slab temperature (b) Electricity consumption vs ice thickness

Figure 19: Effects of increasing ice rink slab temperature and decreasing ice thickness

Assumptions

- The North Dumfries Community Complex is assumed to be comparable to other similar arena facilities.
- Ice is resurfaced approximately eight times per day.
- Zambonis use approximately 100 gal per resurfacing.
- Existing delta T on resurfacing water is approximately 110°F.

Calculations

- Electricity and natural gas consumption savings are estimated based on the performance of the REALice system at comparable facilities.

Table 28 provides a summary of the Zamboni floodwater treatment analysis results.

Table 28: Zamboni floodwater treatment

ECM	**Electricity Savings** [kWh]	**Demand Savings** [kW]	**Nat. Gas Savings** [m^3]	**Cost Savings** [$]	**Capital Cost** [$]	**Utility Incentive** [$]	**Simple Payback** [years]
Zamboni floodwater treatment	118,795	0.0	2,221	14,576	35,000	11,879	1.6

Note: Cost savings calculated using utility rates from Table 5.

4.5 Optimize floating head pressure controls

Refrigeration systems are designed to move heat from the ice pad to the building exterior. Typically, the operation of the system requires that the ammonia vapour condense at 95F in the evaporative condensing unit. This fixed setpoint has been established such that the system can function in the hottest days of the summer and traditionally was operated in this manner throughout the entire year. However, for the majority of the year (when it is cooler outside) the temperature setpoint where the ammonia vapour condenses can be lowered increasing the efficiency of the refrigeration plant. The condensation temperature of the ammonia is controlled by the discharge (head) pressure of the compressors.

CIMCO, has developed a refrigeration system controller (Seasonal Plus Controller) that "floats" the head pressure of the compressors based on outside air conditions. The head pressure setpoint is dynamically changed by the controller in response to the outdoor wet bulb temperature to allow condensing at the lowest temperature possible. In using floating head pressure control, the condenser fan is constantly operating at a variable speed rather than cycling on and off. The process of floating head pressure improves the efficiency of the compressors, saving electricity.

In addition, the Seasonal Plus Controller includes a infra-red (IR) camera mounted over the ice rink to more accurately monitor the ice surface temperature, the current refrigeration system controller monitors the slab temperature to determine when additional cooling is required. Monitoring of the ice surface temperature (compared to slab temperature) allows for a faster response from the refrigeration plant.

A case study of an arena refrigeration plant in both fixed and floating head pressure control mode (50F wet bulb) was highlighted in an ASHRAE journal. This article provided a comparison of compressor COP in both modes clearly showing the benefit of a floating head pressure strategy.

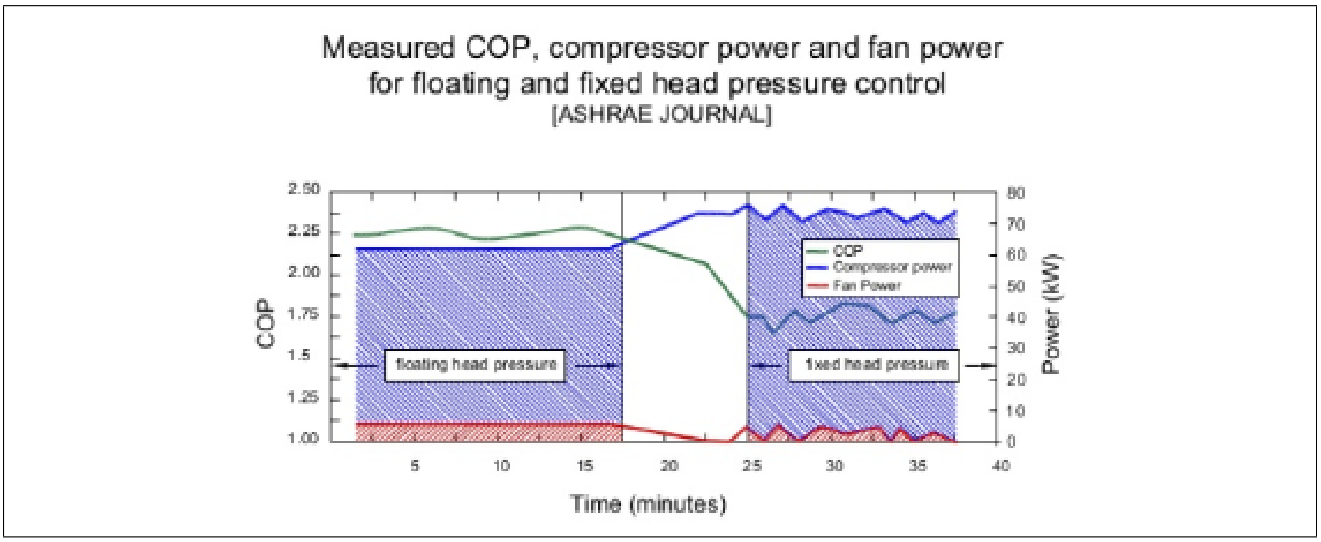


Figure 20: Measured compressor performance for both floating and fixed control mode (ASHRAE Journal - Feb 1999)

Through conversations with CIMCO, it was discovered that the facility has already implemented floating head pressure controls. However, the controls have not been optimized and are not operating as they should be. Therefore, optimizing the controls represents a low cost opportunity to reduce annual utility costs.

Assumptions

- The North Dumfries Community Complex is assumed to be comparable to other similar arena facilities.
- Capital costs represent only the cost associated with a site visit from a CIMCO technicial to optimize the floating head pressure controls.

Calculations

- CIMCO has completed numerous business cases for municipalities on the potential savings from the installation of the Seasonal Plus Controller at community arena's. This includes completing the saveONenergy incentive application on behalf of owners.
- Electricity consumption savings are based on the performance of the Seasonal Plus Controller at comparable facilities and the specifics of the North Dumfries Community Complex.

Table 29 provides a summary of the refrigeration system waste heat recovery analysis results.

Table 29: Floating head pressure controls

ECM	Electricity Savings [kWh]	Demand Savings [kW]	Nat. Gas Savings [m^3]	Cost Savings [$]	Capital Cost [$]	Utility Incentive [$]	Simple Payback [years]
Optimize floating head pressure controls	60,500	0.0	0	7,130	2,000	0	0.3

Note: Cost savings calculated using utility rates from Table 5.

4.6 Install rooftop solar PV system

A solar PV analysis was conducted for North Dumfries Community Complex using the HelioScope online modeling tool. A detailed report of the analysis and results can be found in the Appendices. This section provides a summary of the report's analysis and recommendations.

Assumptions

- The roof can structurally support the solar panels.
- Solar panels were placed with setbacks from roof edge and accounting for existing rooftop structures and shading.
- Solar panels were arranged in a configuration to maximize power production.

Calculations

- Demand savings estimated at 20% of total system size.
- Electricity will be credited under a net metering scenario at the utility price of $0.118/kWh.

Table 30 provides a summary of the solar PV analysis results.

Table 30: Install solar PV system

ECM	Electricity Savings [kWh]	Demand Savings [kW]	Nat. Gas Savings [m^3]	Cost Savings [$]	Capital Cost [$]	Utility Incentive [$]	Simple Payback [years]
Install solar PV system	327,635	59.1	0	39,344	886,100	0	22.5

Note: Cost savings calculated using utility rates from Table 5.

4.7 Replace plumbing fixtures

The existing plumbing fixtures are described in Section 3.8. The existing plumbing fixtures are low flow fixtures and therefore do not present a large opportunity to reduce water and natural gas consumption through reduced domestic hot water consumption.

5 RECOMMENDATIONS

Table 31 summarizes the annual energy savings and simple paybacks for the conservation measures evaluated in this report. Conservation have been sorted based on their payback period.

Table 31: Conservation measures summary table

ECM	Electricity Savings [kWh]	Demand Savings [kW]	Nat. Gas Savings [m^3]	Cost Savings [$]	Capital Cost [$]	Utility Incentive [$]	Simple Payback [years]
Optimize floating head pressure controls	60,500	0.0	0	7,130	2,000	0	0.3
Zamboni floodwater treatment	118,795	0.0	2,221	14,576	35,000	11,879	1.6
Interior LED lighting retrofit	164,218	33.0	0	24,258	68,600	13,196	2.3
Exterior LED lighting retrofit	15,702	0.0	0	1,851	12,800	1,825	5.9
Install solar PV system	327,635	59.1	0	39,344	886,100	0	22.5

Note: Cost savings calculated using utility rates from Table 5.

Table 32 summarizes the conservation measures recommended for implementation or further investigation. These were selected as they had a payback period of less than 10 years.

Table 32: Recommended conservation measures summary table

ECM	Electricity Savings [kWh]	Demand Savings [kW]	Nat. Gas Savings [m^3]	Cost Savings [$]	Capital Cost [$]	Utility Incentive [$]	Simple Payback [years]
Optimize floating head pressure controls	60,500	0.0	0	7,130	2,000	0	0.3
Zamboni floodwater treatment	118,795	0.0	2,221	14,576	35,000	11,879	1.6
Interior LED lighting retrofit	164,218	33.0	0	24,258	68,600	13,196	2.3
Exterior LED lighting retrofit	15,702	0.0	0	1,851	12,800	1,825	5.9

Note: Cost savings calculated using utility rates from Table 5.

Table 33 summarizes all ECMs which were analyzed qualitatively.

Table 33: Qualitative ECM summary table

ECM	Estimated Cost	Estimated Annual Savings	Priority
Building envelope upgrades	High	Low	Low

APPENDICES