Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

REPORT

Yukon Government

Dawson City Integrated Energy and Facility Condition Assessment











January 2019

CANADA BEST MANAGED COMPANIES | Platinum member

CONFIDENTIALITY AND © COPYRIGHT

This document is for the sole use of the addressee and Associated Engineering (B.C.) Ltd. The document contains proprietary and confidential information that shall not be reproduced in any manner or disclosed to or discussed with any other parties without the express written permission of Associated Engineering (B.C.) Ltd. Information in this document is to be considered the intellectual property of Associated Engineering (B.C.) Ltd. in accordance with Canadian copyright law.

This report was prepared by Associated Engineering (B.C.) Ltd. for the account of Yukon Government. The material in it reflects Associated Engineering (B.C.) Ltd.'s best judgement, in the light of the information available to it, at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Associated Engineering (B.C.) Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Table of Contents

SECTION			PAGE NO.
Table of Contents			**i**
List of Tables			**iii**
List of Figures			**iv**
1	**Introduction**		**1**
	1.1	Context and Background	1
2	**Methodology**		**2**
	2.1	Information Gathering	2
	2.2	Analysis and Interpretation	4
	2.3	Reporting	5
3	**Facility Condition Assessment**		**6**
	3.1	City Hall / Fire Hall	6
	3.2	Public Works Building	8
	3.3	Dawson City Swimming Pool	10
	3.4	Waterfront Building	12
	3.5	AMFRC	14
4	**Facility Energy Assessment**		**16**
	4.1	Energy Source Breakdown	16
	4.2	Energy Use Intensity	17
	4.3	Facility Specific Analysis	20
5	**Assessment Summary**		**32**
	5.1	Condition Assessment Summary	32
	5.2	Energy Assessment Summary	33
	5.3	Facility Portfolio Summary	34
	5.4	Future Considerations and Recommendations	35
6	**Identified Improvement Projects**		**36**
	6.1	City Hall / Fire Hall	37
	6.2	Public Works Building	38
	6.3	Dawson City Swimming Pool	39
	6.4	Waterfront Building	40
	6.5	AMFRC	41

7 Key Assumptions and Uncertainties 42

Closure

Appendix A – Figures

Appendix B – Facility Condition Photos

Appendix C – Energy Assessment

Appendix D – Energy Assessment Photos

List of Tables

		PAGE NO.
Table 2-1	Facility Assessment Alignment	3
Table 2-2	Condition Grading Descriptions	4
Table 3-1	City Hall / Fire Hall General Information	6
Table 3-2	City Hall / Fire Hall – Facility Valuation and Condition Assessment	7
Table 3-3	Public Works Building General Information	8
Table 3-4	Public Works Building – Facility Valuation and Condition Assessment	9
Table 3-5	Dawson City Swimming Pool General Information	10
Table 3-6	Swimming Pool – Facility Valuation and Condition Assessment	11
Table 3-7	Waterfront Building General Information	12
Table 3-8	Waterfront Building – Facility Valuation and Condition Assessment	13
Table 3-9	AMFRC General Information	14
Table 3-10	AMFRC – Facility Valuation and Condition Assessment	15
Table 4-1	2017 Energy Use Intensity by Source	17
Table 4-2	Dawson and Reference Building Information	18
Table 4-3	Comparison of Dawson Building EUIs to Commercial Reference Building EUIs	19
Table 4-4	2015 and 2017 Energy Use Intensity	19
Table 4-5	Summary of City Hall / Fire Hall Top Energy Consumers	23
Table 4-6	Summary of Public Works Building Top Energy Consumers	25
Table 4-7	Summary of Dawson City Swimming Pool Top Energy Consumers	27
Table 4-8	Summary of Waterfront Building Top Energy Consumers	29
Table 4-9	Summary of AMFRC Top Energy Consumers	31
Table 5-1	Facility Condition Summary	33
Table 5-2	Facility Condition and Energy Summary	35

List of Figures

		PAGE NO.
Figure 4-1	2017 Annual Energy Use Breakdown	16
Figure 4-2	2017 City Hall / Fire Hall Heating Oil and Electricity Consumption Profile	22
Figure 4-3	City Hall / Fire Hall Electricity Consumption Distribution	23
Figure 4-4	2017 Public Works Building Heating Oil and Electricity Consumption Profile	24
Figure 4-5	Public Works Building Electrical Consumption Distribution	25
Figure 4-6	2017 Dawson City Swimming Pool Heating Oil and Electricity Consumption Profile	26
Figure 4-7	Dawson City Swimming Pool Electrical Consumption Distribution (kWh)	27
Figure 4-8	2017 Waterfront Building Heating Oil and Electricity Consumption Profile	28
Figure 4-9	Waterfront Building Electrical Consumption Distribution	29
Figure 4-10	2017 AMFRC Heating Oil and Electricity Consumption Profile	30
Figure 4-11	AMFRC Electrical Consumption Distribution	31
Figure 5-1	Condition Grade Summary by CRV	32
Figure 5-2	2017 Combined Facility Consumption, Cost, and Environmental Statistics	34
Figure 5-3	Energy, Condition, and Floor Area Comparison	34

1 Introduction

Associated Engineering (AE) was engaged by the Yukon Government to conduct a condition and energy assessment of five facilities in the City of Dawson (The City). This work was funded through the Northern Responsible Energy Approach for Community Heat and Electricity Program (REACHE), with the purpose of capturing opportunities for aligning energy related improvements with facility renewal investment needs.

The five Dawson City facilities included in the assessment are as follows:

1. City Hall / Fire Hall
2. Public Works Building
3. Dawson City Swimming Pool
4. Waterfront Building
5. Art and Margaret Fry Recreation Centre (AMFRC)

The facility locations and site plans are illustrated in Appendix A, Figure 1. This report documents the methodology, analysis, and key findings of the condition and energy assessments at each facility.

1.1 CONTEXT AND BACKGROUND

The City of Dawson is located on the confluence of the Yukon and Klondike rivers. The City has a population of nearly 2,000 people who work mainly in the tourism, mining and public service industries. The population swells each summer with the influx of tourists and visitors to the City.

The City is a community rich in First Nation culture and is best known for its authentic Klondike Gold Rush history. Many buildings and landscape features that supported the Gold Rush remain. The City is preparing an application for a UNESCO World Heritage Site designation because of its uniqueness and history. A unique challenge for the City is the preservation of its heritage and visual identity, which is partially achieved through a bylaw specifying building standards.

Like many other municipalities, the City faces a range of challenges in the management of its infrastructure assets to deliver effective and efficient public services, and the unique geography and history of Dawson City adds another layer of complexity to these challenges. The City is addressing these challenges through a range of initiatives intended to enhance its systems and practices related to the management of its assets.

Recent initiatives have included:

- An Asset Management Maturity Assessment and Improvement Roadmap: Conducted in the Spring of 2018, the maturity assessment compared current asset management practices against ISO55001:2014, an international standard for asset management. The assessment identified areas

of relative strength and areas for improvement. These findings were used to develop a "roadmap", which is a two-year prioritized program of recommended improvement activities.

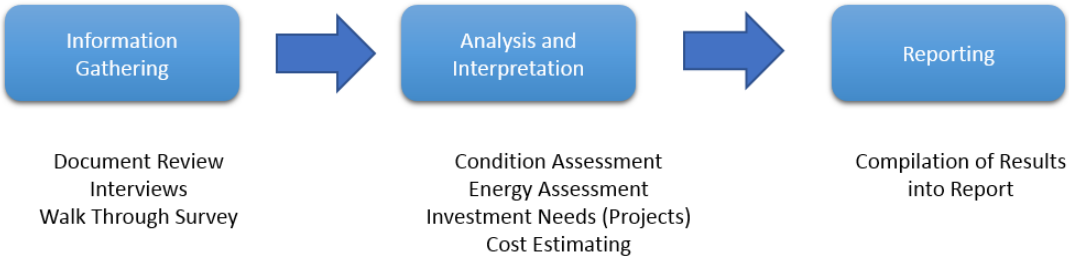
- Lucity Enterprise Asset Management (EAM) Software. The maturity assessment and roadmap were conducted in parallel with a data quality assessment and mapping exercise, as an initial step for the implementation of a new asset management system using the Lucity EAM software. Implementation of Lucity EAM is ongoing.

A key objective identified in the above work is to improve the information and understanding of existing building facilities. This project is therefore well aligned in helping to meet that goal.

2 Methodology

The purpose of the condition assessment and energy audit is to observe and report on the current physical condition and energy efficiency of each facility. This provides the basis to estimate and recommend facility improvement projects to the City, with consideration of energy improvement opportunities.

The workplan consisted of three steps as illustrated below.



2.1 INFORMATION GATHERING

2.1.1 Document Review and Interviews

The document review informed the walk-through survey by better understanding each facility. AE reviewed the following information prior to the walk-through survey:

- Pertinent building information,
- The City's asset inventory,
- Utility data,
- Performance information,
- Capital expenditures,
- Drawings, and
- Previous reports, assessments, or studies about the facilities.

AE interviewed City staff Trina Buhler (Project Manager) and Kim Biernaski (Building Maintenance Supervisor) to confirm the schedule, introduce staff, set expectations, and enable the capture of anecdotal and known condition and energy related issues.

2.1.2 Walk-Through Survey

The walk-through survey provided a visual observation of the property and information of the material systems and components. AE conducted the walk-through survey on October 29-31st, performed by the following AE personnel:

- Amy McClintock, M.A.Sc., P.Eng.
- Angelica Quiring, E.I.T.

City staff Trina and Kim attended all walk-through surveys and provided information about facility systems and repairs throughout the site visit.

During the walk-through, a condition and energy assessment form was completed for each building. A summary of the condition and energy assessment components, and corresponding alignment is shown in Table 2-1.

Table 2-1
Facility Assessment Alignment

Facility Systems	Condition Assessment Components	Energy Audit Components
Siteworks	Grounds Pathways Fences, Gates Exterior Lighting	Exterior Lighting
Exterior Shell	Exterior Walls, Cladding Windows, Frames Doors Roof, Gutters	Wall Insulation Windows Doors Roof Insulation
Services	Sinks, Taps, Other Plumbing Light Fittings, Electrical Outlets Building Mechanical Building Electrical Process Equipment	Domestic Hot Water Interior Lighting Heating, Ventilation, and Air Conditioning (HVAC) Other Specialty Systems (e.g. swimming pool heating or ice rink refrigeration)
Interior	Interior Walls, Ceiling, Woodwork, Tiling Floor, Coverings Windows, Screens Doors, Units, Cupboards, Worktops Appliances	
Structure	Foundations Steelwork, Beams, Girders Columns, Civil Works	

2.2 ANALYSIS AND INTERPRETATION

2.2.1 Condition Assessment

A condition assessment was completed for the five City facilities using the five-point rating scale described below. The analysis considered three asset levels:

1. Facility,
2. Facility systems, and
3. Facility system components.

During the walk-through survey, the system components were given a condition grade. Facility systems and overall facility grades were determined using a weighted score based on the component grades. The current replacement value (CRV) for each facility was provided by the City.

Table 2-2
Condition Grading Descriptions

Rating	Condition	Condition Grade Descriptors
1	Very Good	• Excellent physical or functional performance. No noted deficiencies. • Very reliable performance. No reactive maintenance incidents. • No reactive maintenance in the foreseeable future. • Low risk of failure in the foreseeable future. Greater than 80% of life expectancy remaining.
2	Good	• Good physical or functional performance. No noted deficiencies. • Reliable performance. Very low reactive maintenance frequency. • No reactive maintenance identified. • Low risk of failure in the foreseeable future. 50% to 80% of life expectancy remaining.
3	Fair	• Acceptable physical or functional performance. Minor deficiencies only. • Generally reliable performance. Low reactive maintenance frequency. • Minor reactive maintenance required. Relative low priority for repairs. • Relatively low risk of failure in the foreseeable future. 20% to 50% of life expectancy remaining.
4	Poor	• Some physical or functional deficiencies. • Unreliable performance. Repeated reactive maintenance incidents. • Reactive maintenance recommended with some degree of priority. Planned maintenance and/or running costs, increasing. • Reasonable risk of failure in the foreseeable future. 5% to 20% of life expectancy remaining.
5	Very Poor	• Significant physical or functional deficiencies. • Very unreliable performance. High reactive maintenance frequency. • Significant components urgently need replacing. Very high maintenance or running costs • High risk of imminent failure. Less that 5% of remaining life or the asset is life expired.

In conjunction with the determined renewal and maintenance projects and their associated costs, a facility condition index (FCI) has been determined and is included in Section 5.

2.2.2 Energy Assessment

Simultaneously, the utility data was analyzed to determine energy use patterns and high energy use areas in each facility.

The energy assessment has included:

- Energy Source Breakdown
- Energy Use Intensity Evaluation (energy consumption per square meter of floor area)
- Facility Specific Analysis
    - Energy System Review
    - Utility Profiles
    - Energy End Use Allocation

2.2.3 Determining Facility Improvement Projects

The information gathered during the preceding steps was analyzed to identify opportunities to improve energy efficiency in conjunction with facility renewal projects.

Renewal or maintenance needs (projects) have been identified for facility components with a condition rating of 3, 4 or 5 (fair to very poor).

Areas for energy improvement were determined for each facility, and in some cases high-level project scope and extent was defined. The energy improvement opportunities were aligned with the facility improvement projects from the condition assessment.

2.2.4 Cost Estimating

Cost estimates were applied to each condition improvement project and, where applicable, the energy improvement opportunities identified. Costs of implementation are high-level estimates based solely on the judgement of the project team. A high variance should be expected, as the estimates were developed to understand the magnitude of the costs for each project.

2.3 REPORTING

The findings from the information gathering and analysis phases are captured in this report as the recommended condition and energy improvement projects. The projects and costs were developed for subsequent incorporation into an implementation plan. Consideration of project prioritization and energy pay-back periods are not included in this report, as these will be incorporated into the implementation plan.

3 Facility Condition Assessment

This section contains a summary of the overall pertinent information for each facility. This was provided prior to the site visit and walk-through survey. A selection of condition site photos are included in Appendix B.

3.1 CITY HALL / FIRE HALL

The City Hall / Fire Hall building is a two-storey building constructed in 1988 and relocated to its current location in 2000. The relocation included a new concrete slab foundation, new superstructure framing, and other structural retrofits. The building mechanical systems were also updated in 2000 as part of the building retrofit.



Table 3-1 provides a summary of key facility information. Table 3-2 provides a summary of the estimated CRV allocation for facility systems and components and the results of the condition assessment.

Table 3-1
City Hall / Fire Hall General Information

Asset ID	STR00011
Address	1336 Front Street
Construction Date	1988
Conditioned Floor Area	1114.7 m^2
Number of Floors	2
Building Use	Main Floor: City Fire Department and Museum Second Floor: City Administration and Council Chambers
Hours of Operation	9:00 – 17:00 Monday to Friday, plus emergency year-round
Occupancy	Unknown
General Construction Type	Concrete footing, Wood and steel frame
Current Replacement Value	$4,326,000

Table 3-2
City Hall / Fire Hall – Facility Valuation and Condition Assessment

City Hall / Fire Hall	Facility CRV:		$ 4,326,000	Overall Condition Rating:	2.9
Facility System	**% of Facility CRV**	**% of System CRV**	**Estimated CRV**	**Description**	**Rating**
Siteworks	**15%**	**100%**	**$ 648,900**	**See below.**	**2.2**
Grounds		70%	$ 454,230	Slopes away from building on east side.	2
Pathways		10%	$ 64,890	Shrubs growing under garage door slabs. Some pitting on concrete slab.	3
Fences / Gates		13%	$ 84,357	Red fencing on north side of building – no deficiencies noted.	2
Outside Lighting		5%	$ 32,445	Broken light fixture on building 2591 (small building on north side). Other exterior light fixtures do not have deficiencies.	3
Other Considerations		2%	$ 12,978	Fuel tank is rusty. No spill containment seen on site. (See Appendix B, Photo 1.)	5
Exterior Shell	**19%**	**100%**	**$ 821,940**	**See below.**	**2.8**
Exterior Walls / Cladding		25%	$ 205,485	Metal cladding on 3 sides.	2
Windows / Frames		25%	$ 205,485	Paint on lower window frames is worn.	3
Doors		15%	$ 123,291	Door frames on east side of building split at base, pulling off of building, worn paint. Door damaged. Paint on red garage doors is worn. Trim needs re-painting. Main level door to Administration building hard to open.	3
Roof / Gutters		35%	$ 287,679	Soffit panel missing the length of building on east and west sides.	3
Interior	**16%**	**100%**	**$ 692,160**	**See below.**	**3.2**
Walls / Ceiling / woodwork / Tiling		40%	$ 276,864	Walls and ceiling in boiler room are unfinished. Worn paint near light switches in truck bay and around door frames. Crack in wall above person-door in truck bay. Water damage on ceiling in council chambers above counsellor's desk. (See Appendix B, Photo 2.) Crack in wall between top of door frame and ceiling in printing room. Other evidence of settling in hallway. (See Appendix B, Photo 3.)	4
Floor / Coverings		25%	$ 173,040	Concrete floor in boiler room has stains and floor covering chips. Large crack in floor in Museum. Concrete floor in truck bay in good condition. Cracks in upstairs bathroom linoleum floor. Anti-slip worn in main stairwell to second floor.	3
Windows / Screens		15%	$ 103,824	No deficiencies noted	2
Doors		15%	$ 103,824	Door to billiards room missing handle and paint is worn.	3
Units / Cupboards / Worktops		5%	$ 34,608	Noticeable cosmetic wearing on worktop surface in Fire Hall. No deficiencies noted on upstairs kitchenette.	2
Services	**30%**	**100%**	**$ 1,297,800**	**See below.**	**3.3**
Light Fittings / Electrical Outlets		10%	$ 129,780	No deficiencies noted.	2
Sinks / Taps / Other Plumbing		10%	$ 129,780	Wash bay sink fixtures are rusted.	3
Building Mechanical		40%	$ 519,120	Two oil-fired boilers for hydronic heating system. Boiler issues. To be replaced in 2020. Pipe leaks identified by stains in insulation. Rusty hydronic piping. (See Appendix B, Photo 4.) Ventilation in server room inadequate. Door left open to keep space ventilated. (See Appendix B, Photo 5.)	4
Building Electrical		20%	$ 259,560	No deficiencies noted.	2
Other Considerations		20%	$ 259,560	Elevator is non-operational. City has scheduled service. (See Appendix B, Photo 6.)	4
Structure	**20%**	**100%**	**$ 865,200**	**See below.**	**2.7**
Foundations		33%	$ 285,516	Concrete footing. Large crack in Museum floor.	3
Steelwork / Beams / Girders		34%	$ 294,168	Wood and steel frame. No deficiencies noted.	2
Civil Works / Columns		33%	$ 285,516	Evidence of settling from wall finishing cracks.	3

3.2 PUBLIC WORKS BUILDING



The Public Works Building is located at 1314 Front Street and was constructed in 1989. The two-storey building consists of an open three-bay garage and maintenance shop area on the main floor, with City office space on the second floor.

The building is constructed on concrete footings with a wood frame. Water infiltration occurs during Spring thaw due to roof and window deficiencies; however, no major renovations or upgrades have been done recently. The Public Works Building is essential to the City's operations.

Table 3-3
Public Works Building General Information

Asset ID	STR00012
Address	1314 Front Street
Construction Date	1989
Conditioned Floor Area	392.8 m^2
Number of Floors	2
Building Use	Main Floor: Vehicle and Equipment Garage Second Floor: City Administration and Lunch Room
Hours of Operation	8:00 – 17:00 Monday to Friday, year-round
Occupancy	Unknown
General Construction Type	Concrete footing, Wood and steel frame
Current Replacement Value	$791,700

Table 3-4
Public Works Building – Facility Valuation and Condition Assessment

Public Works Building	Facility CRV:		$ 791,700	Overall Condition Rating:	2.7
Facility System	**% of Facility CRV**	**% of System CRV**	**Estimated CRV**	**Description**	**Rating**
Siteworks	**15%**	**100%**	**$ 118,755**	**See below.**	**3.0**
Grounds		70%	$ 83,129	Grade slopes away from building on all sides. Site drainage good for the most part, but water collects under carpentry shop (separate building on site). Public Works equipment stored on east side of building. Brush maintenance required on east and south sides of building.	3
Pathways		20%	$ 23,751	Door apron slabs are chipped around edges. Wooden apron for staircase to the second floor offices is damaged	3
Fences / Gates		N/A		N/A	N/A
Outside Lighting		5%	$ 5,938	All exterior lighting operational is functional and has no noted deficiencies.	2
Other Considerations		5%	$ 5,938	Signage paint is chipping and looking weathered. Bollards by garage doors are rusted, paint faded. (See Appendix B, Photo 1.)	3
Exterior Shell	**19%**	**100%**	**$ 150,423**	**See below.**	**3.6**
Exterior Walls / Cladding		25%	$ 37,606	Metal cladding on 3 of 4 building faces. Cladding is discoloured on all sides. Former pipe penetration on east wall remains exposed. Wood siding on face of building is stained in areas and has chips.	3
Windows / Frames		25%	$ 37,606	Upstairs windows allow water infiltration in Spring. Paint peeling (water damage) on window frame in older office. (See Appendix B, Photo 2.)	4
Doors		15%	$ 22,563	Exterior doors allowed heat escape; dirt buildup on bottom of doors showing signs of wear. South truck Bay doors are dented in bottom right corner. (See Appendix B, Photo 3.)	3
Roof / Gutters		35%	$ 52,648	Roof: No vented soffits, no gable caps. In springtime, major icicles form on eves on both sides of the building causing water damage on the ceiling. Eavestroughs and gutters located above doors on west face only. Gutter for second floor door is bent and does not extend to ground. (See Appendix B, Photo 4.)	4
Interior	**16%**	**100%**	**$ 126,672**	**See below.**	**3.0**
Walls / Ceiling / woodwork / Tiling		40%	$ 50,669	Water damage on ceiling in older upstairs office, in hallway, and in common kitchen space. (See Appendix B, Photo 5.) Walls in new offices are not finished. Damage to wall beside kitchen sink and throughout the upstairs level.	4
Floor / Coverings (Up)		10%	$ 12,667	Upstairs: Carpet and linoleum.	2
Floor / Coverings (Down)		15%	$ 19,001	Garage: Concrete floor. Concrete coating in bathroom is eroded. (See Appendix B, Photo 6.)	3
Windows / Screens		15%	$ 19,001	Interior windows - no deficiencies noted	2
Doors		15%	$ 19,001	Interior doors upstairs no noted deficiencies.	2
Units / Cupboards / Worktops		5%	$ 6,334	Kitchenette upstairs Work bench in truck bay and wash sink noticeable cosmetic wearing on counter surface.	2
Services	**30%**	**100%**	**$ 237,510**	**See below.**	**2.5**
Light Fittings / Electrical Outlets		10%	$ 23,751	Missing light cover in stairwell.	2
Sinks / Taps / Other Plumbing		10%	$ 23,751	Upstairs kitchen sink, and sink in truck bay has no noted deficiencies. Downstairs bathroom sink drains slowly; shower has no noted deficiencies.	2
Building Mechanical		50%	$ 118,755	2 unit heaters for garage and one forced air furnace to heat upstairs offices. Furnace last inspected October 2014. Furnace is 29 years old and may be nearing end of life.	3
Building Electrical		30%	$ 71,253	No noted deficiencies.	2
Structure	**20%**	**100%**	**$ 158,340**	**See below.**	**2.0**
Foundations		33%	$ 52,252	No noted deficiencies.	2
Steelwork / Beams / Girders		34%	$ 53,836	No noted deficiencies.	2
Civil Works / Columns		33%	$ 52,252	No noted deficiencies.	2

3.3 DAWSON CITY SWIMMING POOL

The Dawson City Swimming Pool is located at 321 Fifth Avenue and was constructed in 2000. The building is constructed on concrete footings with a wood frame.



A solar panel system was used to pre-heat the pool water in past; however, this system has now been decommissioned. Earlier this year, the building mechanical systems were upgraded including new boilers. The Swimming Pool is only occupied in the summer and is winterized every year.

Table 3-5
Dawson City Swimming Pool General Information

Asset ID	STR00033
Address	321 Fifth Avenue
Construction Date	2000
Floor Area / Conditioned Floor Area	1787.1 m^2 / 1054.6 m^2
Number of Floors	1 + underground crawlspace
Building Use	Natatorium
Hours of Operation	7:00 – 22:00 7 days/week, May to September
Occupancy	92
General Construction Type	Concrete footing, Wood frame
Current Replacement Value	$4,998,900

Table 3-6
Swimming Pool – Facility Valuation and Condition Assessment

Dawson City Swimming Pool	Facility CRV:		$ 4,998,900	Overall Condition Rating:	2.5
Facility System	**% of Facility CRV**	**% of System CRV**	**Estimated CRV**	**Description**	**Rating**
Siteworks	**15%**	**100%**	**$ 749,835**	**See below.**	**2.1**
Grounds		70%	$ 524,885	Grade slopes away from building on all sides.	2
Pathways		20%	$ 149,967	Wrap-around decking.	2
Fences / Gates		5%	$ 37,492	Fence around fuel tank. No deficiencies noted.	2
Outside Lighting		5%	$ 37,492	One black light fixture on south side appears damaged and is missing lightbulb. (See Appendix B, Photo 1.) A light on east side non-operational.	3
Exterior Shell	**13%**	**100%**	**$ 649,857**	**See below.**	**2.6**
Exterior Walls / Cladding		25%	$ 162,464	Wood siding. Painted in 2018.	1
Windows / Frames		25%	$ 162,464	No deficiencies noted.	2
Doors		15%	$ 97,479	Noticeable gap between exterior exit doors on east side of building (near office); however, the building is not heated in the winter.	3
Roof / Gutters		35%	$ 227,450	Gutter paint is worn. Downspout on south-east corner has separated at joint. Downspouts are rusting. Eavestroph is too short; water goes behind and has rotted the window frames in the past. (See Appendix B, Photo 2.)	4
Interior	**12%**	**100%**	**$ 599,868**	**See below.**	**2.9**
Walls / Ceiling / woodwork / Tiling		40%	$ 239,947	Settlement crack visible on south wall in pool area and beneath water fountain near office. Paint is worn in office.	3
Floor / Coverings		25%	$ 149,967	Floor in Mechanical room worn. Pool deck is worn in multiple locations. Floor in both male and female change rooms/bathrooms are patched in multiple locations. (See Appendix B, Photo 3.) Floor in office has gaps between floor panels. Multiple repairs in pool liner. (See Appendix B, Photo 4.)	4
Windows / Screens		15%	$ 89,980	No deficiencies noted.	2
Doors		15%	$ 89,980	Paint is worn on door frame to office. Paint on interior doors is worn.	2
Units / Cupboards / Worktops		5%	$ 29,993	No deficiencies noted.	2
Services	**35%**	**100%**	**$ 1,749,615**	**See below.**	**2.8**
Light Fittings / Electrical Outlets		5%	$ 87,481	Light fixtures missing covers in women's bathroom. Drywall behind Light switch in office beneath Honeywell controller is not patched.	2
Sinks / Taps / Other Plumbing		5%	$ 87,481	Plumbing in crawlspace that is not insulated is corroded. Some pipe support hangers are corroded. (See Appendix B, Photo 5.) No noted deficiencies for upstairs plumbing (Building plumbing drained for winter).	3
Building Mechanical		35%	$ 612,365	New boilers/mechanical upgrade (2018). HVAC ductwork worn.	2.5
Building Electrical		20%	$ 349,923	Electrical conduit to bottom of Whirlpool pump panels is corroded. Electrical cabling including fittings to filter pumps is corroded. (See Appendix B, Photo 6.)	3
Process Equipment		35%	$ 612,365	Pentair Pool filters replaced in 2018. Floor bolts are rusted on hot tub pumps. Possible oil leak on concrete floor near hot tub pumps. Stainless steel pipe/UV reactor is corroded. Base footings on ladder down to crawlspace are corroded.	3
Structure	**25%**	**100%**	**$ 1,249,725**	**See below.**	**2.0**
Foundations		33%	$ 412,409	No noted deficiencies.	2
Steelwork / Beams / Girders		34%	$ 424,907	No noted deficiencies.	2
Civil Works / Columns		33%	$ 412,409	No noted deficiencies.	2

3.4 WATERFRONT BUILDING

The Waterfront Building is located at 1085 Front Street and was constructed in 1984. In 2015, the main floor of the building was renovated to amalgamate the three main level spaces into one larger Fitness Centre. It has become the most widely used recreation facility in Dawson City. The second floor is used for City administrative offices.



The two-storey building is constructed on pads and blocking with a wood frame. Another major upgrade occurred in 2017 with downsizing from four to two furnaces.

Table 3-7
Waterfront Building General Information

Asset ID	STR00034
Address	1085 Front Street
Construction Date	1984
Conditioned Floor Area	269.1 m^2
Number of Floors	2
Building Use	Main Floor: Fitness Centre Second Floor: City Administration
Hours of Operation	Main Floor: 5:00 – 22:00 7 days/week, year-round
Occupancy	Main Floor: 22 Second Floor: 8
General Construction Type	Pads and blocking, Wood frame
Current Replacement Value	$699,400

Table 3-8
Waterfront Building – Facility Valuation and Condition Assessment

Waterfront Building		Facility CRV:	$ 699,400	Overall Condition Rating:	2.4
Facility System	**% of Facility CRV**	**% of System CRV**	**Estimated CRV**	**Description**	**Rating**
Siteworks	**10%**	**100%**	**$ 69,940**	**See below.**	**2.0**
Grounds		70%	$ 48,958	Drainage sloped away from building to grated MH.	2
Pathways		20%	$ 13,988	New wooden ramp (2015) at NE entrance. Wooden boardwalk and steps at front .	2
Fences / Gates		N/A		N/A	N/A
Outside Lighting Back		2%	$ 1,399	Out of order at back of building (burnt out or electrical problems). (See Appendix B, Photo 1.)	3
Outside Lighting Front		5%	$ 3,497	Lighting at front sufficient.	1
Other Considerations		3%	$ 2,098	Fuel tanks slightly rusty. No spill containment seen on site. (See Appendix B, Photo 2.)	4
Exterior Shell	**20%**	**100%**	**$ 139,880**	**See below.**	**2.7**
Exterior Walls / Cladding		25%	$ 34,970	Wooden panels, patchwork, re-painted last year, minor paint peeling with 1-2 boards loose. Metal flashing at back corner dented.	2
Windows / Frames		20%	$ 27,976	Wooden trim painted, issues closing and opening. Windows upgraded in 2015. Windows throughout building difficult to open and close. Locks not user-friendly. (See Appendix B, Photos 3 and 4.)	3.5
Doors		15%	$ 20,982	No defects noticed.	2
Roof / Gutters		35%	$ 48,958	Metal, corrugated with snow breaks. Discoloration at stacks. Gutters at front. Missing gutters at back of building. Downspout by NE entrance has dents needs re-painting. Downspout at SE is in good shape. Roof flashing not observed. Fascia in good shape, no missing panels.	3
Other Considerations		5%	$ 6,994	Wooden garbage storage container, bike rack. No deficiencies noted.	2
Interior	**20%**	**100%**	**$ 139,880**	**See below.**	**2.8**
Walls / Ceiling / woodwork / Tiling		40%	$ 55,952	Major cracks in dry wall observed in stairwell to 2nd floor and office area. Evidence of crack progression being monitored. (See Appendix B, Photo 5.)	3
Floor / Coverings (Up)		15%	$ 20,982	Vinyl flooring on 2nd floor. No noted deficiencies.	2
Floor / Coverings (Down)		20%	$ 27,976	Floors re-done in 2015. Laminate floors on main level with no noted deficiencies. Liner deteriorating on floor in shower room. Shower drain issues (no floor drain in shower room) – water migrating out of shower room. (See Appendix B, Photo 6.)	4
Windows / Screens		N/A		See Exterior Windows.	N/A
Doors		15%	$ 20,982	Scuffing on bottom of doors, but open and close as intended. Minor cosmetic issue.	2
Units / Cupboards / Worktops		10%	$ 13,988	2nd floor kitchenette (sink and cupboards) no deficiencies noted.	2
Services	**30%**	**100%**	**$ 209,820**	**See below.**	**2.0**
Light Fittings / Electrical Outlets		10%	$ 20,982	2 light fixtures on main floor missing cover.	2
Sinks / Taps / Other Plumbing		10%	$ 20,982	No visible deficiencies for sinks and taps (no water pooling). Noticeable drainage issues in shower room.	2
Building Mechanical		50%	$ 104,910	2 forced air furnaces (1 per floor). No deficiencies noted.	2
Building Electrical		30%	$ 62,946	No deficiencies observed.	2
Structure	**20%**		**$ 139,880**	**See below.**	**2.3**
Foundations		33%	$ 46,160	No deficiencies noted.	2
Steelwork / Beams / Girders		34%	$ 47,559	No deficiencies noted.	2
Civil Works / Columns		33%	$ 46,160	Evidence of settling from wall finishing cracks. (See Appendix B, Photo 5.)	3

3.5 AMFRC

The AMFRC is located at 1026 and 1042 Fourth Avenue and was constructed in 2000. The two-storey building consists of a curling rink, curling lounge, arena, change rooms, administrative office, and commercial kitchen on the main floor. The second floor is largely vacant except for the mechanical rooms.



The building is constructed on permafrost with a pile foundation system and a steel frame. The building has experienced severe settling and The City is actively monitoring settling on an annual basis.

Recent building renovations include a 2015 electrical and mechanical renovation and a sprinkler system upgrade in 2016. An ice making system was also recently installed.

The City has indicated the possibility for construction of a new recreation centre in approximately five years; however, this has not been confirmed to-date. If construction goes ahead, this assessment will serve as a "lessons learned" for the future building.

Table 3-9
AMFRC General Information

Asset ID	STR00032
Address	1026 & 1042 Fourth Avenue
Construction Date	2000
Conditioned Floor Area	4682.7 m^2
Number of Floors	2
Building Use	Main Floor: Curling Rink, Arena, Administration, and Commercial Kitchen Second Floor: Mechanical Room and Vacant Area
Hours of Operation	Main Floor: 6:00 – 24:00 7 days/week, with ice from October to March
Occupancy	Arena and Administration: 600
General Construction Type	Piles, Steel frame
Current Replacement Value	$18,236,800

Table 3-10
AMFRC – Facility Valuation and Condition Assessment

Art and Margaret Fry Recreation Centre	Facility CRV:		$ 18,236,800	Overall Condition Rating:	2.9
Facility System	**% of Facility CRV**	**% of System CRV**	**Estimated CRV**	**Description**	**Rating**
Siteworks	**10%**	**100%**	**$ 1,823,680**	**See below.**	**2.2**
Grounds		70%	$ 1,276,576	Slopes away from building on east side.	2
Pathways		20%	$ 364,736	Paint peeling on green ramp/staircase to south entrance.	2
Fences / Gates		5%	$ 91,184	No permanent fence around Ref Plus free cooling unit mechanical equipment or exterior fuel tank. (See Appendix B, Photo 1.)	4
Outside Lighting		5%	$ 91,184	Some lights not on at time of inspection. Uncertain if lights were off or out of service.	3
Exterior Shell	**18%**	**100%**	**$ 3,282,624**	**See below.**	**3.0**
Exterior Walls / Cladding		25%	$ 820,656	Metal cladding dented near NW corner on north side of building. Metal cladding on south side of building is dented, perforated, and pulling away from building. Cladding appears discoloured on all faces. (See Appendix B, Photo 2.) Wood siding on front face of building has various scrapes.	4
Windows / Frames		25%	$ 820,656	No deficiencies noted.	2
Doors		15%	$ 492,394	Paint is worn, door hinge not securely attached on north side. Spray insulation is visible between door frame and top of exterior doors (added due to settling) on west side of building. Public east entrance door sticks possible due to settling.	3
Roof / Gutters		35%	$ 1,148,918	Issues with snow load on roof. Had to reduce allowable load of hoist on 2nd floor.	3
Interior	**17%**	**100%**	**$ 3,100,256**	**See below.**	**3.3**
Walls / Ceiling / woodwork / Tiling		40%	$ 1,240,102	Upstairs mezzanine (including hallway to the mezzanine) are unfinished. 50% of room is not insulated. (See Appendix B, Photo 3.) Settling crack above door frame to Parks and Rec Office, Zamboni Rm, Scuff marks on walls in hallway. Zamboni Room: Wall penetration from room to exterior is not patched. Hose connections in wall not patched. Paint is worn and peeling throughout room. (See Appendix B, Photo 4.) Significant holes in drywall. No baseboards installed. Significant gap between wall and ceiling filled with spray insulation. Drywall missing above Arena entrance doors. Spray foam insulation used to fill gaps between walls and settling foundation. Most visible in Arena area. (See Appendix B, Photo 5.) Ceiling panels drooping in curling rink area, one panel missing, and water damage on ceiling near stairwell. Cracks in wall in curling rink room. Wall patched and not finished above door in mechanical room.	4
Floor / Coverings		25%	$ 775,064	Change room floors are cut from skates and severely worn. Hallway floors are worn, especially between change rooms and arena. (See Appendix B, Photo 6.) Cracks in mechanical room floor. Boiler Mechanical Rm floor stained. Leaks on housekeeping pad near boiler pumps P-3.3.	4
Windows / Screens		15%	$ 465,038	No screens; No window deficiencies noted.	2
Doors		10%	$ 310,026	Automatic Zamboni room roll up door removed because building settlement prevented door from closing. City is procuring new roll up door. In general, paint is worn on interior doors, especially Mechanical Room doors.	2
Units / Cupboards / Worktops		5%	$ 155,013	No deficiencies noted.	2
Appliances		5%	$ 155,013	Kitchen in Curling rink area in good shape. No deficiencies noted.	2
Services	**35%**	**100%**	**$ 6,382,880**	**See below.**	**2.8**
Light Fittings / Electrical Outlets		10%	$ 638,288	Ceiling light fixture missing cover in Parks and Recreation Office. Ceiling light missing in shower room Ceiling light cover removed in Change Rm #3.	3
Sinks / Taps / Other Plumbing		10%	$ 638,288	Mold observed beneath sink in women's washroom at the Curling Rink.	3
Building Mechanical		40%	$ 2,553,152	Mech Room #2: Boilers installed 2013-2015 w/heat exchanger for Zamboni. Boilers are maintained by professional 1x a year. Pipework rusting in small Mechanical Room Fire suppression system is 1.5 years old and has a leak. Exterior fuel tank and associated piping rusting. Nameplate illegible. P-3.3 pump body and connections rusty.	3
Building Electrical		20%	$ 1,276,576	No deficiencies noted.	2
Other Considerations		20%	$ 1,276,576	Stairwell between rink area and curling area is unsteady. Step up to curling rink area is too steep. Stairwell to Mezzanine is a hazard for staff.	3
Structure	**20%**	**100%**	**$ 3,647,360**	**See below.**	**3.0**
Foundations		33%	$ 1,203,629		2
Steelwork / Beams / Girders		34%	$ 1,240,102	N/A	2
Civil Works / Columns		33%	$ 1,203,629	Severe building settlement observed. (See Appendix B, Photo 5.) City is actively monitoring building settlement with annual inspection program by geotechnical engineer.	5

4 Facility Energy Assessment

Energy assessments were conducted on the five City facilities to determine energy efficiency improvements. This consisted of a review of the facility information and utility data provided by the City. The following items were analyzed during the energy assessment:

- Energy Source Breakdown
- Energy Use Intensity
- Facility Specific Analysis
    - Energy System Review
    - Utility Profiles
    - Energy End-Use Allocation

4.1 ENERGY SOURCE BREAKDOWN

First, an understanding of the energy sources and breakdown was required. In general, the City uses two main sources to provide energy to its buildings and processes. Electricity produced by hydroelectric facilities is provided by Yukon Energy Corporation. Heating oil supplied by North 60 Petroleum provides heat to the buildings. Propane is used in the commercial kitchen at the AMFRC but has been assumed to be negligible in proportion to the other energy sources.

The City provided monthly heating oil and electricity bills over a one-year period (2017) for each of the five facilities. The heating oil is supplied in litres, but a conversion of 10.72 kWh/litre[1] was used for comparison purposes. The energy use breakdown for each facility can be seen below in Figure 4-1.

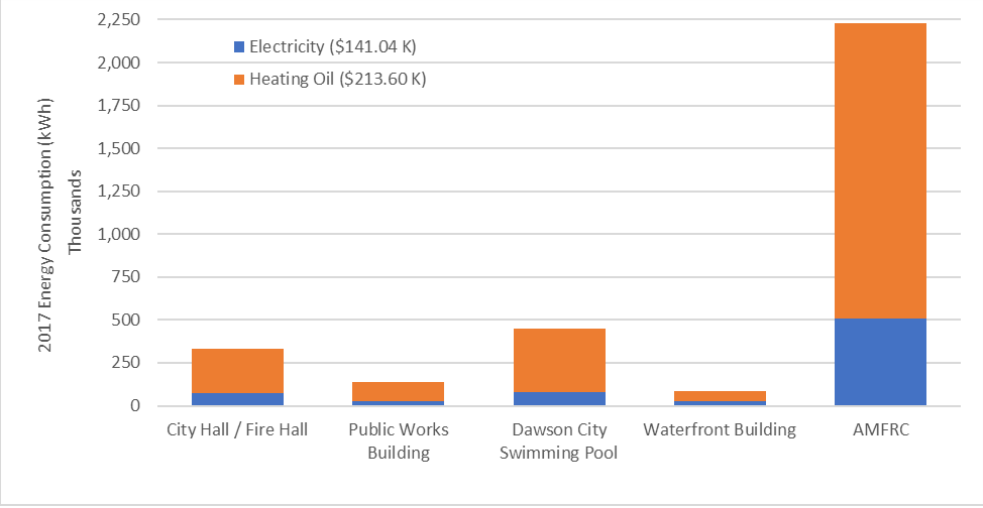


Figure 4-1
2017 Annual Energy Use Breakdown

[1] . The published calorific value of fuel oil is 0.03859 GJ/litre or 10.72 kWh/litre, as defined within the "Heat Recovery Analysis, Dawson City Pool Report" (Associated Engineering, 2017).

From Figure 4-1, we can see that heating oil is the significant source of energy used for the City Hall / Fire Hall, Public Works Building, and Dawson City Swimming Pool. From this, we can assume targeting increased electric efficiency will not be as effective as increased heating oil efficiency. The Waterfront Building shows a slightly more equal proportion of heating oil to electricity consumption, so targeting electric efficiencies may have a substantial impact on energy use reductions. The AMFRC consumes a high amount of electricity and heating oil, both of which could be opportunities for substantial energy use reductions.

Cost and greenhouse gas (GHG) emissions are important to consider when looking at energy sources. This is discussed further in Section 5.0.

4.2 ENERGY USE INTENSITY

Energy use intensities (EUIs) are the annual energy consumption divided by the conditioned floor area. This can be calculated using the amount, in kWh, or cost, in $CAD. Table 4-1 below compares the 2017 heating oil and electricity intensities.

Table 4-1
2017 Energy Use Intensity by Source

Building	2017 Heating Oil kWh/m^2/year	2017 Electricity kWh/m^2/year	2017 Total Energy kWh/m^2/year
City Hall / Fire Hall	235	65	300
Public Works Building	286	68	354
Dawson City Swimming Pool	354	75	429
Waterfront Building	217	108	325
AMFRC	367	108	475

From Table 4-1, it is observed that the AMFRC consumes the highest amount of heating oil per area, followed closely by the Dawson City Swimming Pool. The high heating oil intensity at the Dawson City Swimming Pool could be attributed to the additional heating load required for the pool water. The high electricity intensity at the AMFRC could be attributed to the additional cooling required for rink refrigeration; the high heating oil intensity, however, was not expected and was considered as an area for energy improvements. Additionally, the high electricity use at the Waterfront Building indicated another area for potential energy improvements.

The 2017 total EUIs for each building were converted to kBTUs per square foot and compared with existing commercial reference buildings constructed in or after 1980[2]. Dawson City was assumed to be located in the same climate zone[3] as Whitehorse, YT and Fairbanks, AK; climate zone 8 – Subarctic. A list of the Dawson facilities with the most applicable reference buildings is shown in Table 4-2.

Table 4-2
Dawson and Reference Building Information

Building	Floor Area (ft^2)	Number of Floors	Construction Date	EUI ($kBTU/ft^2$)
City Hall / Fire Hall	12,002	2	1988	88
Public Works Building	4,230	2	1989	103
Dawson City Swimming Pool	11,345	1	2000	125
Waterfront Building	2,895	2	1984	95
AMFRC	50,407	2	2000	139
Reference Buildings				
Medium Office	53,628	3	Post-1980	99
Small Office	5,500	1	Post-1980	110
Warehouse	52,045	1	Post-1980	151

From the information above, each Dawson building was compared against a single reference building to provide some level of understanding between the 2017 energy performance and the baseline data.

[2] The EUIs of commercial reference buildings are defined by the U.S. Department of Energy (DOE) Commercial Reference Buildings, Post-1980 Construction, Version 1.4_7.0 (DOE, 2012).
[3] The climate zones are defined within "ANSI/ASHRAE/IES Standard 90.1-2010 (SI Edition), Energy Standard for Buildings Except Low-Rise Residential Buildings, Table B-1 and Table B-2" (ASHRAE, 2010).

Table 4-3
Comparison of Dawson Building EUIs to Commercial Reference Building EUIs

Building	EUI (kBTU/ft^2)	Similar Reference Building	EUI (kBTU/ft^2)	% Difference
City Hall / Fire Hall	88	Small – Medium Office	110 – 99	-20% to -12%
Public Works Building	103	Small – Medium Office	110 – 99	-6% to +4%
Dawson City Swimming Pool	125	N/A	N/A	N/A
Waterfront Building	95	Small Office	110	-14%
AMFRC	139	Warehouse	151	-8%

From Table 4-3, it is apparent that the City Hall / Fire Hall, Waterfront Building, and AMFRC buildings are operating at a slightly lower energy intensity than the corresponding baseline reference buildings. The Public Works Building is within the range of the baseline energy intensity value. A similar reference building was not available for the Dawson City Swimming Pool.

In addition to the 2017 utility data, the City provided 2015 utility data in the form of an annual lump sum. The Table below compares the 2015 and 2017 EUIs by cost for the five facilities.

Table 4-4
2015 and 2017 Energy Use Intensity

Building	2015 $CAD/m^2/year	2017 $CAD/m^2/year
City Hall / Fire Hall	$33.65	$33.30
Public Works Building	$35.72	$38.65
Dawson City Swimming Pool	$58.46	$44.11
Waterfront Building	$55.76	$38.65
AMFRC	$37.86	$56.19

Table 4-4 provides an indication of the energy efficiency trend for each building and informs whether energy efficiency is improving, deteriorating, or remaining static. The Dawson City Swimming Pool and Waterfront Building energy efficiency has improved from 2015. In 2017, the Waterfront Building downsized from four to two furnaces, which likely explains the increased energy efficiency. Conversely, the energy efficiency has deteriorated since 2015 at the AMFRC and should be investigated further.

4.3 FACILITY SPECIFIC ANALYSIS

The next steps in the energy analysis provided a closer look at the energy use and efficiency for each facility, and consisted of the following steps:

1. Review of energy related systems and known defects,
2. Graph utility profiles, and
3. Determine energy-using equipment and end-use allocation.

A general understanding of the energy related systems for each facility was required to determine energy efficiency opportunities. The document review, interviews, and walk-through survey provided this. In general, each of the five facilities use heating oil for all space heating demands and electricity to heat the domestic hot water and for all other loads such as lighting, fans, and equipment controls.

Thermal imaging photos taken during the walk-through survey provided a basic understanding of building envelope efficiency for each facility. The thermal photos were reviewed to identify building envelope defects, such as: poor seals around doors and windows, air infiltration, thermal bridging, and potential missing/damaged insulation locations.

The 2017 utility profiles were then graphed to show month to month variations in energy use and provide an overview of the facility operation. For each facility, it was generally expected to see seasonal variations for heating oil, with high consumption during the winter months and almost no use in the summer months. The seasonal heating oil consumption was compared to the heating degree-days (HDD), which is an index of the monthly temperature relative to a base value. For this project, a base value of 18 degrees Celsius was used. Electricity consumption was expected to be static with slight seasonal variations if cooling equipment is utilized in the summer months. Unexpected patterns were noted as they often reflect opportunities to optimize equipment operation.

Lastly, the mechanical and electrical components with the highest energy consumption were estimated for each facility using drawings, manufacturer data, and nameplate photos from the walk-through survey. This determined the energy end-use allocation and narrowed down the target areas for energy use reductions. To check for accuracy, the calculated annual equipment consumption was totalled and compared to the total billed consumption for 2017, for each facility. The calculated energy consumption was within +/- 25% the billed energy consumption, except for the Public Works Building. The electricity consumption billed for the Public Works Building was 45% higher than the calculated electricity consumption.

The following sections contain the energy system review, utility profiles, top energy-using equipment, and the electricity end-use allocation for each facility. Refer to Appendix C and D for the complete energy end-use assessment and photos, respectively.

4.3.1 City Hall / Fire Hall

4.3.1.1 Energy System Review

Facility System	Description
HVAC	The building's space heating demands are satisfied by a hydronic heating system consisting of two oil-fired boilers. The boilers are fed from two fuel tanks located at the NE exterior side of the building. Heating fluid is circulated from the main mechanical room and delivered to multiple terminal devices including perimeter radiators and unit heaters. Wall-mounted thermostats are used to adjust the temperature. The building's space cooling and ventilation demands are satisfied by one roof-top condensing unit, one air handling unit, one make-up air unit, and multiple exhaust fans. A vehicle exhaust detector is installed in the Garage Bay to monitor carbon monoxide. The hydronic heating system serves the air handling unit and make-up air heating coils. Boiler upgrades have been planned for 2020.
Domestic Hot Water	An electric water heater supplies the domestic hot water to the various plumbing fixtures and appliances; these include approximately: seven sinks, one shower, and one washing machine.
Lighting	The interior lighting consists of linear fluorescent lighting. The exterior has a combination of LED and incandescent bulbs controlled with a photocell device. The building is equipped with an emergency lighting system.
Building Envelope	The building walls and roof contain "Batt" insulation of an unknown thickness. The exterior windows are single hung with double panes and wood framing. The exterior doors consist of a combination of swing and non-swing doors; the Museum has a swing garage door made of plywood with approximately 1.5 inches of Styrofoam insulation. The remaining garage doors open overhead.
Other Specialty Loads	Additional high-energy consumers include a data server room and an elevator. The elevator is heavily used during business hours and is an important service offered to the public.

The known energy related defects for the City Hall / Fire Hall include:

- Boiler issues including a broken recirculating pump (currently only able to run one boiler),
- Air handling unit door seal needs fixing,
- Water leakage from ceiling in council chambers, and
- Inadequate ventilation for the data server room.

4.3.1.2 Utility Profiles

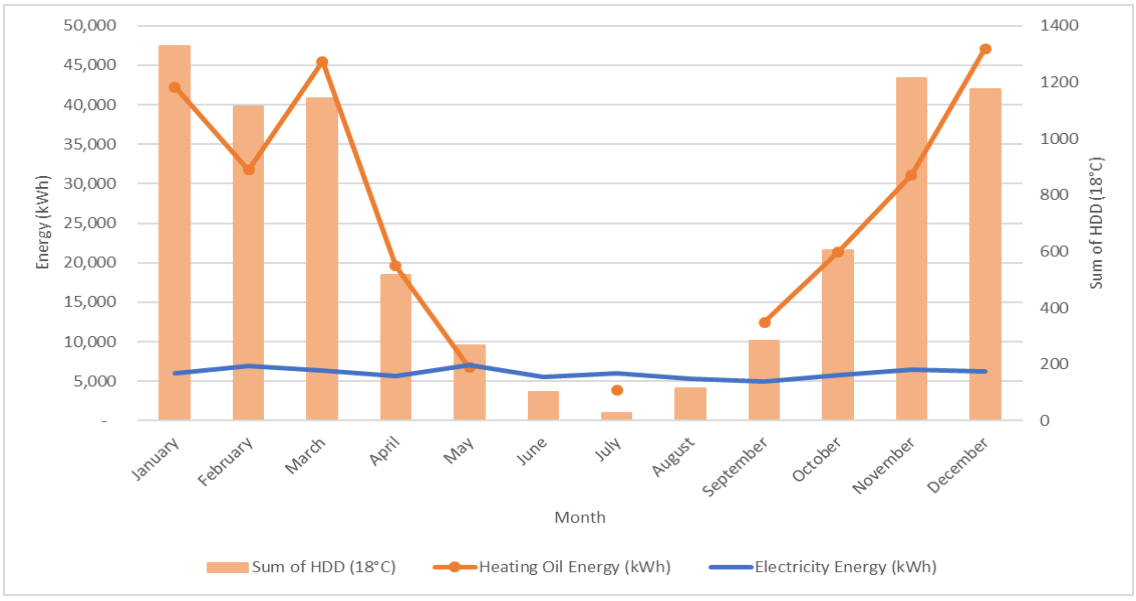


Figure 4-2
2017 City Hall / Fire Hall Heating Oil and Electricity Consumption Profile

From Figure 4-2, the following observations are noted:

- There is a reasonably close correlation between the heating oil consumption and the weather. The abrupt changes are expected due to the irregular nature of filling the fuel tanks.
- The heating oil consumption in June through August is small and indicates there was little, if any, heating demand in this period.
- In September, there was approximately 12,000 kWh of heating oil purchased; however, it was expected to be negligible at that time. This discrepancy is assumed to be attributed to the data, as energy delivery is tracked as opposed to the actual energy consumption.
- The electricity consumption is relatively static, fluctuating around 6,000 kWh each month.

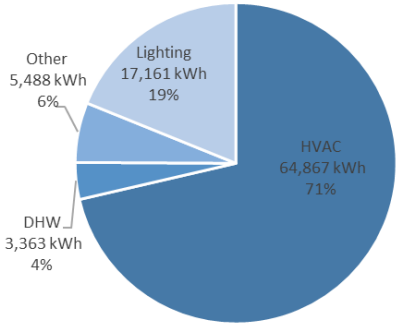
4.3.1.3 Energy End-Use Allocation

The modelled top energy consumers at the City Hall / Fire Hall are indicated in Table 4-5 and the approximate electricity end-use distribution for the City Hall / Fire Hall is depicted in Figure 4-3 below.

Table 4-5
Summary of City Hall / Fire Hall Top Energy Consumers

Equipment (Tag)	Approximate Energy Consumed 2017 (kWh)
Oil-Fired Boilers (B-1 and B-2)	267,190
Air Handling Unit (AHU-1-1)	52,300
Interior Lighting	15,190
Condensing Unit (CU-3-1)	5,850
Plug Loads (Data Server Room, Copier/Printer)	5,065

Figure 4-3
City Hall / Fire Hall Electricity Consumption Distribution



4.3.2 Public Works Building

4.3.2.1 Energy System Review

Facility System	Description
HVAC	The building's space heating demands are satisfied by an oil-fired forced air furnace and two oil-fired unit heaters. Wall-mounted thermostats are used to adjust the temperature. The furnace and unit heaters are fed from two fuel storage tanks with a pump located in the building mechanical room. The building's space cooling and ventilation demands are satisfied by one makeup air system and multiple exhaust fans in the Garage Bay. A vehicle exhaust detector is installed in the Garage Bay to monitor carbon monoxide.
Domestic Hot Water	An electric water heater supplies the domestic hot water to the various plumbing fixtures and appliances; these include approximately: three sinks, one shower, and one washing machine. A water softener is used to treat the water for the steamer which thaws the drainage system.
Lighting	The interior lighting consists of linear fluorescent lighting. The exterior has LED bulbs controlled with a photocell device. The building is equipped with an emergency lighting system.
Building Envelope	The building walls and roof are insulated with spray foam insulation with an approximate thickness of 1.5 inches. A new triple pane, casement-type exterior window was installed. The remaining four exterior windows are double pane, single hung. The exterior doors consist of single swing doors and double swing garage doors. The garage doors are opened and closed manually.
Other Specialty Loads	N/A

The known energy-related building defects include:

- Roof insulation issues:
  - Water leakage down inside wall cavity and into building through the windows,
  - Icicles form on eaves in Spring,

- Garage bay doors are swing type with air gaps, and
- Ceiling fans only move in one direction which is not conducive to seasonal temperature changes.

4.3.2.2 Utility Profiles

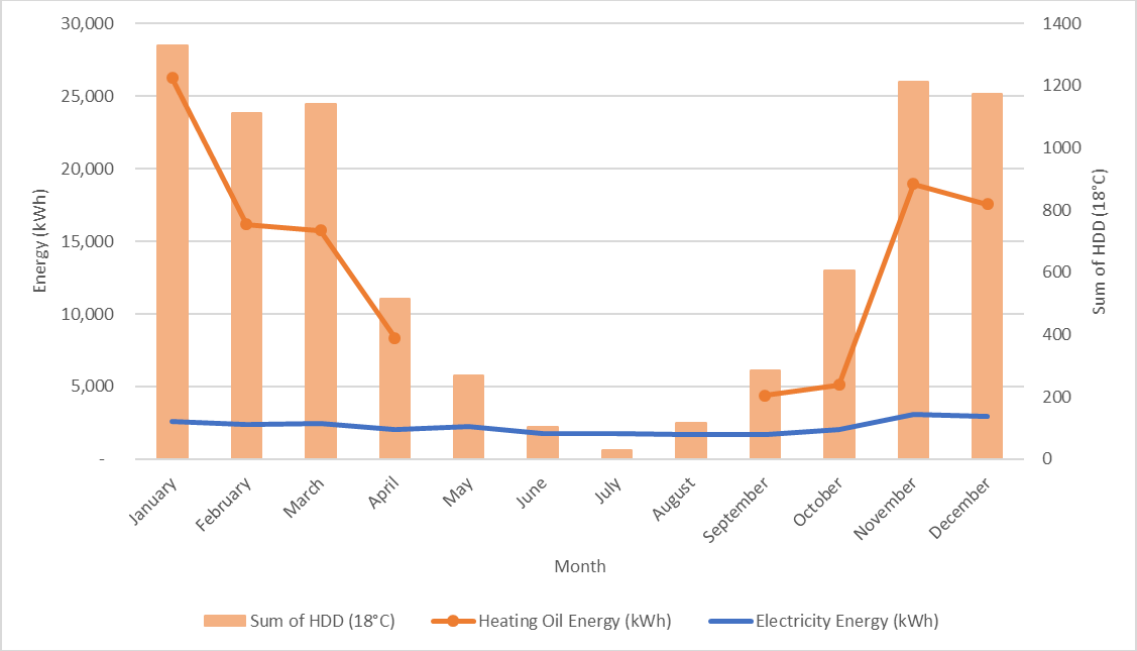


Figure 4-4
2017 Public Works Building Heating Oil and Electricity Consumption Profile

From Figure 4-4, the following observations are noted:

- There is a reasonably close correlation between the heating oil consumption and the weather. The abrupt changes are expected due to the irregular nature of filling the fuel tanks.
- The heating consumption drops off during May through August and indicates there was little, if any, heating demand in this period.
- The electricity consumption is relatively static, fluctuating around 2,250 kWh each month.

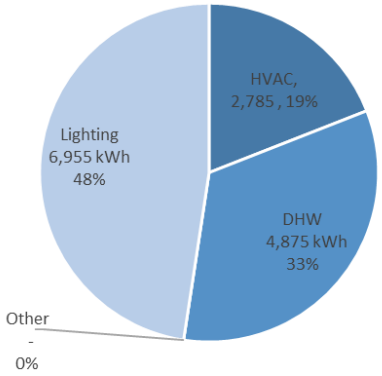
4.3.2.3 Energy End-Use Allocation

The modelled top energy consumers at the Public Works Building are indicated in Table 4-6 and the approximate electricity end-use distribution for the Public Works Building is depicted in Figure 4-5 below.

Table 4-6
Summary of Public Works Building Top Energy Consumers

Equipment	Approximate Energy Consumed 2017 (kWh)
Furnace (F-1.1)	67,330
2 Unit Heaters (UH-1.1 and UH-1.2)	58,080
Interior Lighting	6,450
Domestic Hot Water Heater	4,880
Make Up Air Unit	720

Figure 4-5
Public Works Building Electrical Consumption Distribution



4.3.3 Dawson City Swimming Pool

4.3.3.1 Energy System Review

Facility System	Description
HVAC	The building's space heating demands are satisfied by a hydronic heating system consisting of two oil-fired boilers, installed as part of the 2018 mechanical upgrades. The boilers are fed from a fuel tank located at the NE exterior side of the building. Heating fluid is circulated from the main mechanical room and delivered to multiple terminal devices including radiant ceiling panels and unit heaters. Wall-mounted thermostats are used to adjust the temperature. The building's space cooling and ventilation demands are satisfied by one air handling unit, multiple exhaust fans, and a heat recovery ventilator with an electric duct heater. The air handling unit, with heating fluid supplied by the boilers, provides tempered outside air to the pool area.
Domestic Hot Water	Two electric water heaters supply the domestic hot water to the various plumbing fixtures and appliances; these include approximately: nine sinks, five showers, and one washing machine. The showers in the men's and women's change rooms were replaced in 2018 with push-buttons and flow restrictors.
Lighting	The interior lighting consists of ceiling-mounted H.I.D. lights in the pool area and linear fluorescent lighting for the remaining spaces. The exterior has incandescent bulbs controlled with a photocell device. The building is equipped with an emergency lighting system.

Facility System	Description
Building Envelope	The exterior walls are filled with “Batt” insulation of an unknown thickness. The roof is insulated with 100 mm rigid insulation with an RSI of 3.5. The windows are fixed, double pane, with vinyl framing. All exterior doors are double swing doors, metal, insulated, with a steel frame.
Other Specialty Loads	The pool heating system consists of two heat exchangers; one for the pool and one for the hot tub. The heating fluid is supplied by the boilers. Previously, a solar array (installed 2003) pre-heated the water; however, the system has since been decommissioned (2016). The water is treated with three high rate sand filters (two duty and one standby) and two UV units.

The known energy-related building defects included:

- Both boilers run at the same time and motors are starting to wear, and
- High heat levels in staff spaces causing staff to prop open door.

4.3.3.2 Utility Profiles

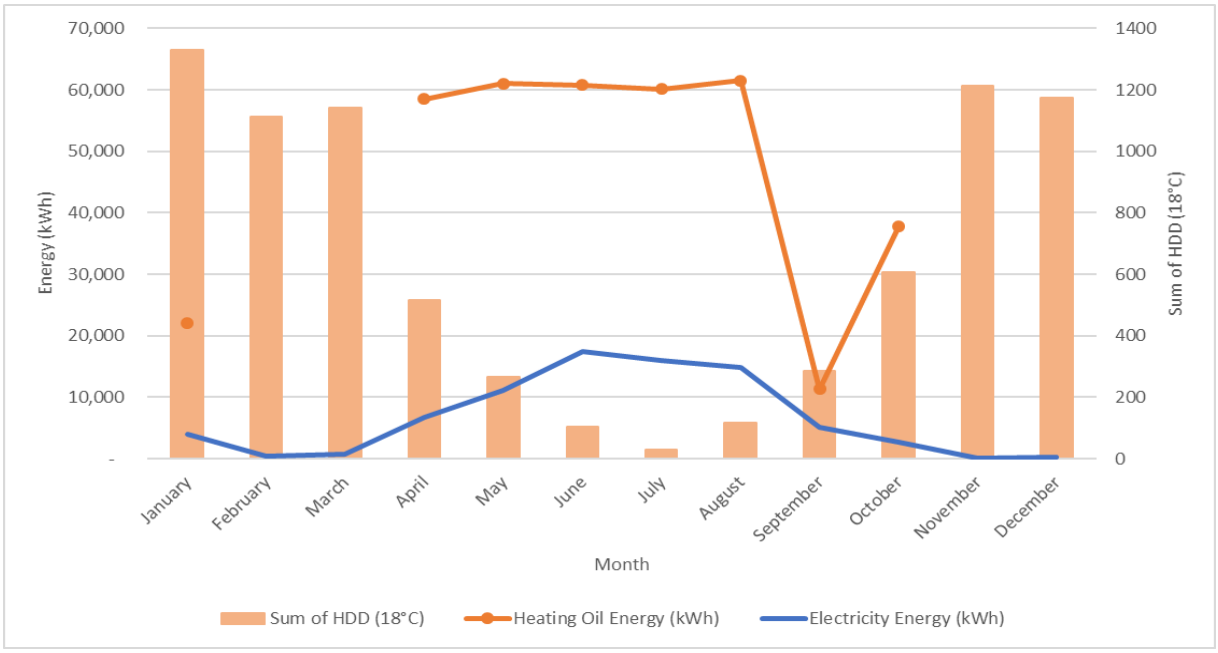


Figure 4-6
2017 Dawson City Swimming Pool Heating Oil and Electricity Consumption Profile

From Figure 4-6, the following observations are noted:

- There is no correlation between the heating oil consumption and the weather. This is expected as the Dawson City Swimming Pool heating demands are the opposite of typical buildings: high in summer for pool heating and little in winter as the building is closed and winterized.

- A large heating oil delivery occurred in October due to an ongoing issue with one of the new boilers that required trouble shooting in Octoer. The building normally winterized annually between October to April.
- The electricity consumption shows a similar trend as the heating oil, which is expected given the annual variation in occupancy rates.

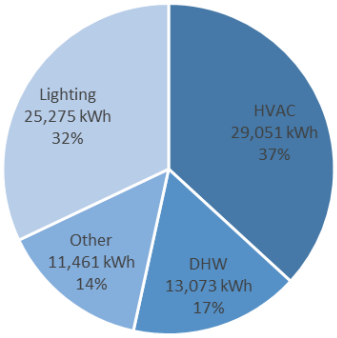
4.3.3.3 Energy End-Use Allocation

The modelled top energy consumers at the Swimming Pool are indicated in Table 4-7 and the approximate electricity end-use distribution for the Swimming Pool is depicted in Figure 4-7 below.

Table 4-7
Summary of Dawson City Swimming Pool Top Energy Consumers

Equipment	Approximate Energy Consumed 2017 (kWh)
Boiler 1 (B-1)	209,610
Boiler 2 (B-2)	209,610
Pool Lighting	18,240
Air Handling Unit (AHU-1)	13,600
Duct Heater	7,600

Figure 4-7
Dawson City Swimming Pool Electrical Consumption Distribution (kWh)



4.3.4 Waterfront Building

4.3.4.1 Energy System Review

Facility System	Description
HVAC	The building's space heating demands are satisfied by two oil-fired forced air furnaces installed in 2017; one each for the main floor and second floor. The equipment was downsized from four to two furnaces in 2017, following the main floor renovation to amalgamate the three separate spaces into one combined Fitness Centre. The furnaces are fed from two fuel tanks located at the NW exterior side of the building. A cabinet unit heater by the front door provides additional heat for the entrance and stairwell. There is currently no cooling or ventilation equipment in the building.
Domestic Hot Water	Two electric water heaters in the building crawlspace supply the domestic hot water to the various plumbing fixtures and appliances on the main floor; these include approximately four sinks and two showers. The sink on the second floor is serviced by its own dedicated electric hot water heater. The showers in the fitness centre do not have push-buttons or time restrictors.
Lighting	The interior lighting consists of a combination of linear fluorescent lighting and incandescent bulbs. LED and compact fluorescent bulbs light the building's front exterior. The incandescent bulbs at the back of the building are not currently in-service.

Facility System	Description
	The exterior lights are controlled with a photocell device. The building is equipped with an emergency lighting system.
Building Envelope	The exterior walls contain fibreglass insulation of an unknown thickness. The exterior windows are a combination of single hung and casement types, and a mixture of double and triple panes. All exterior doors are single swing doors.
Other Specialty Loads	Additional high-energy consumers include the cardio equipment, water fountain, and computers in the administration space upstairs.

The known energy-related building defects include:

- Shower issues causing high domestic hot water use:
  - Non-paying members entering through windows to use showers,
  - No controls on shower to limit water consumption,
- No ventilation system installed,
- Poor quality window installation, and
- Fitness Centre users leaving windows open in all seasons.

The 2015 main floor renovations were fast tracked with limited planning prior to construction; therefore, the potential for layout improvement should also be considered.

4.3.4.2 Utility Profiles

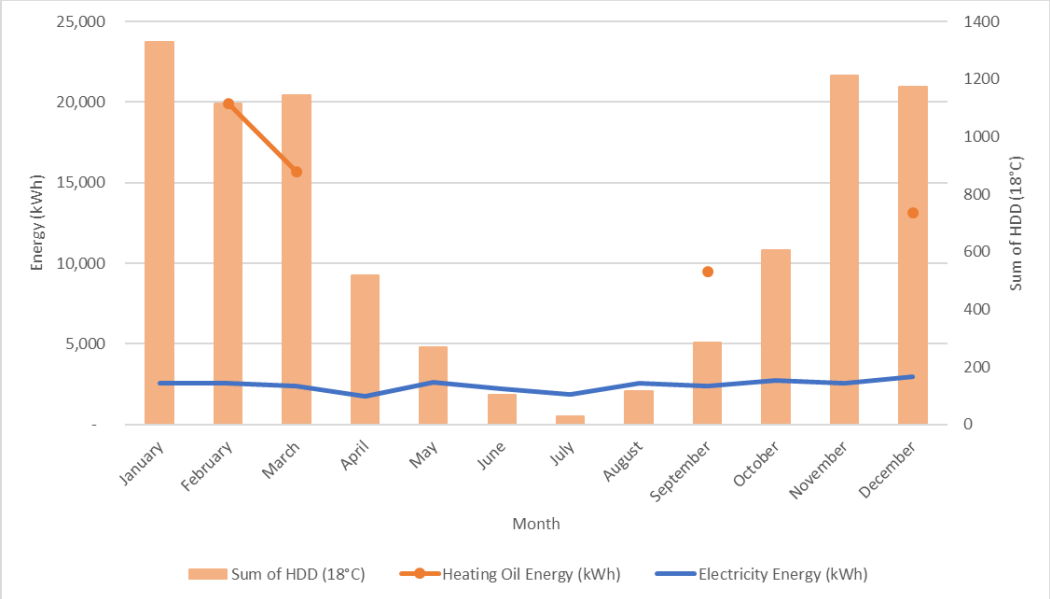


Figure 4-8
2017 Waterfront Building Heating Oil and Electricity Consumption Profile

From Figure 4-8, the following observations are noted:

- The correlation between the heating oil consumption and the weather was not determined due to the limited and irregular fuel tank fillings.
- The electricity consumption is relatively static, fluctuating around 2,500 kWh each month.

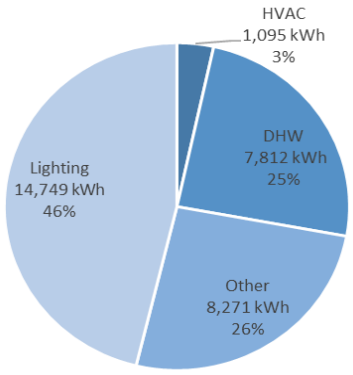
4.3.4.3 Energy End-Use Allocation

The modelled top energy consumers at the Waterfront Building are indicated in Table 4-8 and the approximate electricity end-use distribution for the Waterfront Building is depicted in Figure 4-9 below.

Table 4-8
Summary of Waterfront Building Top Energy Consumers

Equipment	Approximate Energy Consumed 2017 (kWh)
Main Floor Furnace	31,710
Second Floor Furnace	24,390
Interior Lighting	12,740
Plug Loads (Cardio Equipment, Computers)	8,270
Domestic Hot Water Heaters (x2)	7,420

Figure 4-9
Waterfront Building Electrical Consumption Distribution



4.3.5 AMFRC

4.3.5.1 Energy System Review

Facility System	Description
HVAC	The building's space heating demands are satisfied by a hydronic heating system consisting of two oil-fired boilers (2013). The boilers are fed from a fuel oil system, consisting of two fuel tanks and two fuel oil transfer pumps. Heating fluid is circulated from the main mechanical room and delivered to multiple terminal devices including perimeter radiators, radiant ceiling panels, and unit heaters. Wall-mounted thermostats are used to adjust the temperature. The building's space cooling and ventilation demands are satisfied by one condenser, five air handling units, and multiple exhaust fans. The hydronic heating system serves the air handling unit heating coils. A building automation system provides centralized controls for the building systems.
Domestic Hot Water	One electric water heater with a connected hot water storage tank supply the domestic hot water to the various plumbing fixtures and appliances in the arena and main building unit. domestic hot water demands are satisfied by. A second electric water heater supplies the domestic hot water to the various plumbing fixtures and appliances in the curling area. The plumbing fixtures and appliances throughout the building consist of approximately: 22 sinks, 13 showers, and a dishwasher.

Facility System	Description
Lighting	The existing lighting system consists of ceiling mounted H.I.D. lights in the arena and curling rink. The remaining interior spaces have a combination of linear fluorescent lighting and incandescent pot lights. Wall mounted lights with incandescent bulbs are installed on the building exterior. The exterior lights are controlled with a photocell device. The building is equipped with an emergency lighting system.
Building Envelope	The roof contains two layers of 100 mm semi-rigid insulation with an RSI of 3.0. The exterior walls contain two layers of 75 mm semi-rigid insulation. The exterior windows are fixed, double pane, with PVC frames. The exterior doors consist of multiple swing, metal doors with steel frames, and one swing, wooden door for zamboni/equipment access.
Other Specialty Loads	The ice rink refrigeration consists of a dry cooler, chiller, and brine pump for the arena and curling rink. A heat exchanger (using boiler heating fluid) provides hot water for the zamboni. Additional high-energy consumers include a fire suppression system with a nitrogen generator.

The known energy-related building defects include:

- Lighting remains on 24/7,
- The lighting in the area and curing rink is high-intensity discharge (H.I.D.) which isn't particularly efficient,
- Lack of climate controls between recreation and administrative spaces, and
- Inefficient boilers.

4.3.5.2 Utility Profiles

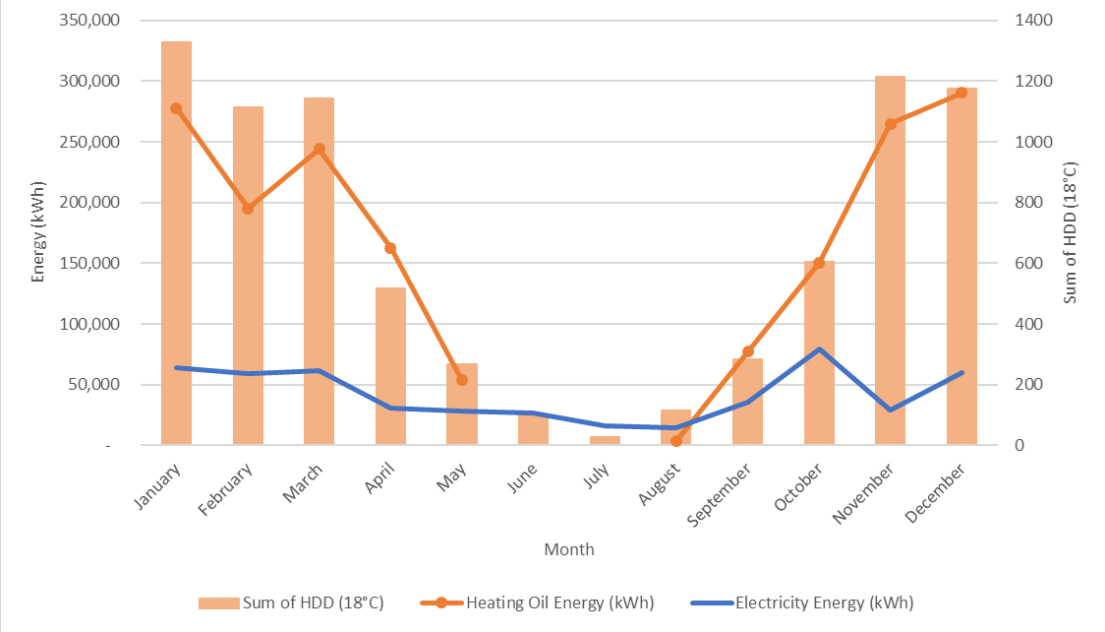


Figure 4-10
2017 AMFRC Heating Oil and Electricity Consumption Profile

From Figure 4-10, the following observations are noted:

- There is a reasonably close correlation between the heating oil consumption and the weather. The abrupt changes are expected due to the irregular nature of filling the fuel tanks.
- The heating oil consumption shows a higher amount of fluctuation than the previous buildings. The extreme peak in October is likely due to the additional cooling required for the rink refrigeration.

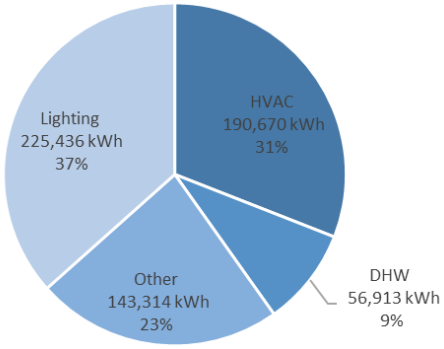
4.3.5.3 Energy End-Use Allocation

The modelled top energy consumers at the AMFRC are indicated in Table 4-9 and the approximate electricity end-use distribution for the AMFRC is depicted in Figure 4-11 below.

Table 4-9
Summary of AMFRC Top Energy Consumers

Equipment	Approximate Energy Consumed 2017 (kWh)
Boiler 1 (B-1.1)	783,210
Boiler 2 (B-1.2)	783,210
Interior Lighting	215,490
Refrigeration Chiller (PCU-1.1)	51,980
Air Handling Unit (AS-1)	61,100

Figure 4-11
AMFRC Electrical Consumption Distribution



5 Assessment Summary

5.1 CONDITION ASSESSMENT SUMMARY

A summary of the condition grading is shown in Figure 5-1 below.

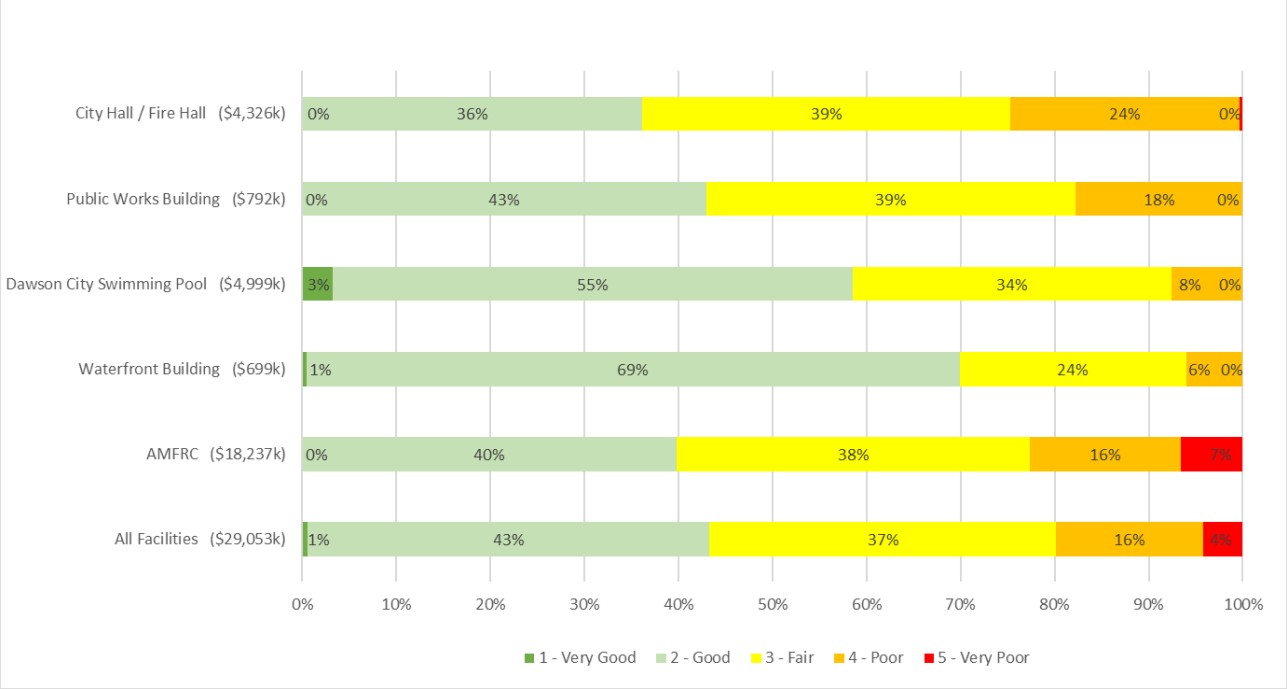


Figure 5-1
Condition Grade Summary by CRV

From Figure 5-1, the following observations are noted:

- Overall, the condition grading across all five facilities shows:
  - About 80% of the combined facility assets are rated as Fair or better.
  - 43% of the combined facility assets (CRV at $12.6 M) are rated as Good or Very Good, with no identified deficiencies and no immediate need for non-routine investment.
  - 37% of the combined assets (CRV at $10.7 M) are rated as Fair, with only relatively minor deficiencies identified.
  - 20% of the facility assets are rated as either Poor or Very Poor, requiring either urgent or imminent investment to address significant deficiencies.
- Only two facilities - City Hall / Fire Hall and the AMFRC - have assets rated as Very Poor, where urgent action and investment is required to remedy significant deficiencies. This grading applies to less than 1% (CRV at $13k) of the asset value at City Hall/Fire Hall but, 7% (CRV at $1.2 M), is reasonably significant at the AMFRC.

Improvement projects were determined for each facility component with a condition grade of Fair, Poor, or Very Poor. High-level cost estimates have been determined for the identified projects. This has enabled the calculation of a facility condition index (FCI).

The FCI was calculated using the following formula:

$$FCI = \frac{Cost\ of\ Recommended\ Projects}{Facility\ CRV}$$

The FCI in this assessment is based on all identified defects and investment needs rather than on current year required renewal costs to the building. The relative FCI for each facility is therefore considered more important than the absolute FCI number.

The overall condition rating and FCI for each facility is summarized below in Table 5-1.

Table 5-1
Facility Condition Summary

Facility	Overall Condition Rating	Facility Condition Index (%)
City Hall / Fire Hall	2.9	5.6
Public Works Building	2.7	22.0
Dawson City Swimming Pool	2.5	2.4
Waterfront Building	2.4	5.2
AMFRC	2.9	6.4

In general, the facilities were determined to be in relatively good condition, with each facility in the Good to Fair range. The City Hall / Fire Hall and AMFRC facilities were calculated as having the highest condition rating at 2.9. The Waterfront Building was determined to be in the best condition, at a condition rating of 2.4. The FCI indicates the Public Works Building has a significant amount of upcoming costs to remediate the deficiencies.

5.2 ENERGY ASSESSMENT SUMMARY

Heating oil and electricity are the two main energy sources consumed by the five facilities. The distribution of consumption, costs, and GHG emissions was considered when developing energy improvement projects. The distribution of costs and GHG emissions is shown graphically in Figure 5-2.

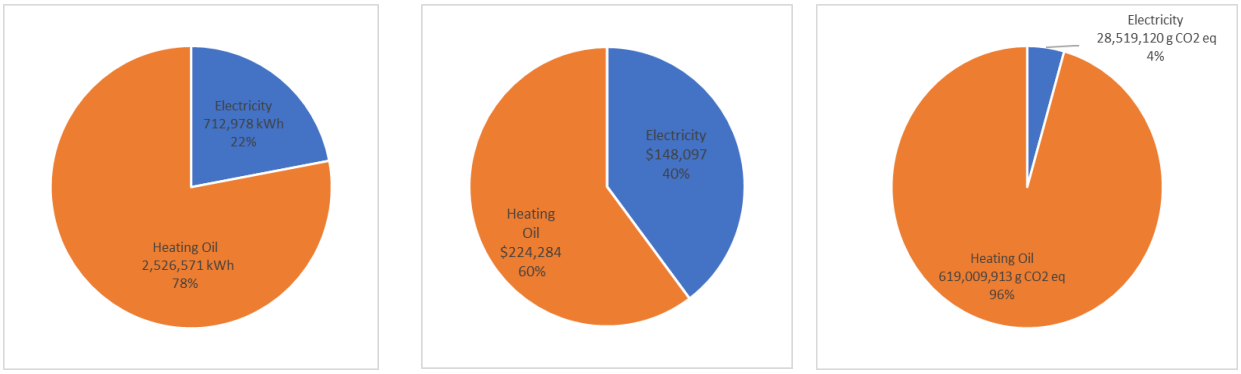


Figure 5-2
2017 Combined Facility Consumption, Cost, and Environmental Statistics

Heating oil made up 78% of the 2017 combined facility energy consumption and contributes a significant amount of GHG emissions, with an emission factor of 245 grams of CO_{2eq} per kWh. Electricity, on the other hand, made up 22% of the 2017 combined facility energy consumption but is relatively clean at approximately 40 grams of CO_{2eq} per kWh.

The cost of heating oil in 2017 was $0.88/litre or $0.08/kWh on average. In comparison, the electricity rate was $0.20/kWh on average; however, the electricity charges vary depending on the base cost, price blocks, and peak demands. The distribution of costs of all sources is shown in Figure 5-2.

5.3 FACILITY PORTFOLIO SUMMARY

A key objective of this project is to identify opportunities for improving energy efficiency or determining GHG reductions in conjunction with condition related investment (renewal and maintenance investment). Table 5-2 below provides a comparison of condition and energy information for each facility. Maintenance cost information would also support the analysis by highlighting if there is a correlation between condition and facility cost however this information is not available at this time.

Figure 5-3 provides a comparison of each facility including consideration of floor area. This graph provides a rough indication of where the largest opportunities exist for energy use improvement.

The most significant opportunities would appear to be related to the AMFRC, however this does not negate opportunities associated

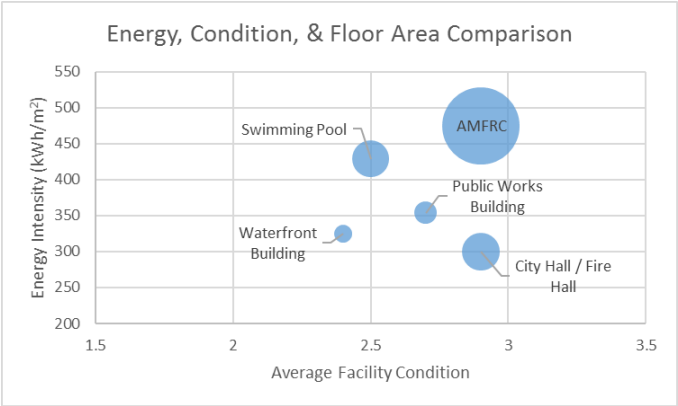


Figure 5-3
Energy, Condition, and Floor Area Comparison

with improving building envelope and ventilation systems to improve the overall building life expectancy and energy efficiency.

Facility	2018 Condition	Maintenance ($CAD/m^2)	2017 Energy (kWh/m2)	2017 Energy ($CAD/m^2)
City Hall / Fire Hall	2.9	Unknown	300	$33.30
Public Works Building	2.7	Unknown	354	$38.65
Dawson City Swimming Pool	2.5	Unknown	429	$44.11
Waterfront Building	2.4	Unknown	325	$38.65
AMFRC	2.9	Unknown	475	$56.19

Table 5-2
Facility Condition and Energy Summary

5.4 FUTURE CONSIDERATIONS AND RECOMMENDATIONS

Biomass / District Energy - In the future, biomass could provide an alternative energy source for Dawson City. A biomass district heating system was installed in 2012 to produce hydronic heat for a selection of City facilities; however, this system has not been implemented. In theory, the biomass system implementation should be relatively feasible as several City facilities have included future biomass design considerations.

Carbon Tax – There is considerable uncertainty over the direction and impacts of carbon taxation however, it is clear that the impact could be significant both directly and indirectly. Consideration should be given to the GHG emissions and carbon tax implications of different fuel sources in the future with efficiency efforts focussed on reduced consumption of oils. Consideration should also be given to the indirect impact of carbon taxes such as for building materials and equipment transported from provinces where carbon tax pricing is already impacting the cost of materials including transportation costs.

Lifecycle costs - Lifecycle costs including operational and maintenance considerations have not been included in the analysis so far. The condition and energy performance will have significant impacts on operational and maintenance costs beyond energy efficiency. Subsequent analysis to this report should include these considerations.

Communication and Liaison – It is clear that in order to achieve City goals and objectives, the City will need to communicate and liaise with a variety of stakeholders including customers, Yukon Government, and energy providers. The engagement will build more transparency and support for the goals set by the City including reduction of GHG emissions, energy efficiency and maintaining a good state of repair and performance of facilities.

6 Identified Improvement Projects

General recommendations include:

- When bills arrive, track information (amount and cost) in a spreadsheet to view trends over time and whether energy efficiency is improving, deteriorating, or remaining static.
- The utility rate structures should be broken down and analysed to determine if there are any cost savings associated with shifting energy use from peak demand periods to times when energy costs are lower.
- On an annual basis, evaluate the energy performance of facilities using EUIs. Changes in EUIs can be used to validate energy efficiency initiatives or upgrades, as well as determine if there are any issues to be resolved. Examples include:
    - kWh/m2/year
    - $CAD/m2/year
- When upgrading buildings or equipment, consider the ongoing energy costs and GHG emissions associated with these upgrades. Where appropriate, consider the more efficient equipment models, and consider how building upgrades will impact energy consumption.

The following sections provide a summary of the recommended improvement projects specific to each facility, with cost estimates where appropriate.

The identified projects have not been evaluated in terms of cost benefit or payback however, it is clear that a number can be delivered by maintenance staff, will cost very little and although the benefits are relatively small the payback on the activity is quick. This type of work includes for example door seal and sweep replacements or modification of control philosophy and changes in work practices.

Other types of projects require the installation of new equipment such as the lighting upgrades. While the installation of LED lighting can achieve a 40% reduction in costs compared to fluorescent lighting or over 70% compared to incandescent lighting the relative magnitude of lighting costs is low compared to the costs of installation and paybacks will be typically longer. This type of work can be considered as lighting units are replaced through lifecycle replacements or general building refurbishments.

Heating and ventilation control systems can often be relatively good in terms of payback and the benefits can be significant. Care should be taken to reviewing the balancing of heat distribution through the facility. The use of distributed sensors to support the balance of heat distribution can help to improve efficiency.

Some of the boilers and furnaces are recognized to be relatively new (e.g. Waterfront Building and Recreation Centre). However, the efficiency of these installations is relatively low (79 – 81%). Regular servicing will help reduce the drop-in efficiency of these furnaces over time. On eventual replacement consideration should be given to higher efficiency furnaces (95%) in conjunction with effective heat recover of exhaust air.

6.1 CITY HALL / FIRE HALL

Improvement Projects		Estimated Cost ($CAD)	ICC / SEB*
Condition Related Improvements			
C.1	Landscape maintenance (weedkilling) and minor concrete repairs	$3,000	
C.2	Repair exterior light fixture and/or bulb	$250	
C.3	Replace exterior fuel tank and provide containment to conform to the current standards	$15,000	
C.4	Re-paint exterior window frames as needed	$5,000	
C.5	Re-paint exterior doors and repair wood on frames as needed and replace door (main level door to City Hall admin area)	$40,000	SEB
C.6	Install soffit panel on underside of roof	$40,000?	
C.7	Repair interior wall finishing cracks and water damage, general interior refurbishment and painting. See also # E3 below.	$15,000	
C.8	General refurbishment of floors and coverings	$15,000	
C.9	Repair door to billiards room	$500	
C.10	Replace wash bay sink fixtures	$500	
C.11	Replace elevator	$50,000	
C.12	Monitor cracking and conduct structural investigation	$20,000	
C.13	Inspect vapour barrier and insulation above Council Chamber to confirm cause of water damage and repair as needed. If roof integrity is compromised, then repair may be more significant.	$2,000	SEB
Energy Related Opportunities			
E.1	Fix seal on air handling unit cabinet to improve efficiency of unit.	< $500	
E.2	Ensure exhaust fan in the data server room is operational and sized properly to match the intake air from the door grill. May require new exhaust fan.	$2,000	
E.3	Review heat balance through hydronic terminal units and update heating control systems to timer or motion-controlled system in line with building occupancy. Install new ventilation controls.	$15,000	
E.4	Upgrade lighting through installation of LED bulbs, motion sensors and/or timers. Also maintain good behavioural practices such as procedure for switching off lights at end of day. Potentially upgrade controls in conjunction with heating controls.	$20,000 - $30,000	
E.5	Review heating system opportunities prior to upgrading the boilers to maximise energy efficiency from currently available technologies.	$2,000 + boiler replacement	
E.6	Review and replace door seals as needed.	$3,000	ICC C.5

ICC – Energy project that can be completed *in conjunction with condition project.*

SEB – *Secondary energy benefit* associated with a condition project.

6.2 PUBLIC WORKS BUILDING

Improvement Projects	Estimated Cost ($CAD)	ICC / SEB*
Condition Related Improvements		
C.1 Site grading to improve drainage around carpentry shop, minor landscape maintenance	$20,000	
C.2 Replace wood slat on exterior staircase	$500	
C.3 Replace vehicle bollards and exterior signs	$30,000	
C.4 Repair exterior cladding and insulation at exposed pipe penetration	$7,500	SEB
C.5 Repair seals around windows, replace interior window wood framing where water damage visible. .	$15,000	SEB E.3
C.6 Repair superficial damage to exterior doors	$5,000	
C.7 Gutter improvements, investigate and repair leaking roof	$40,000	
C.8 Repair concrete floor coating in bathroom	$500	
C.9 Replace furnace and unit heaters (nearing end of life). This is the same as E.6.	$50,000	SEB E.6
Energy Related Opportunities		
E.1 Upgrade lighting through installation of LED bulbs (& associated wiring change), motion sensors and/or timers. Also maintain good behavioural practices such as procedure for switching off lights at end of day or when not in use or based on motion sensors. Potentially upgrade controls in conjunction with heating controls.	$20,000	
E.2 Inspect building envelope including vapour barrier and insulation in roof and NW exterior wall, repair as needed.	$20,000	ICC C.4
E.3 Re-seal exterior windows and weather-proof garage doors as needed.	$5,000	ICC C.5
E.4 Install ceiling fans with controls to adjust the direction in which the fan blades rotate, switch the direction every summer and winter.	Up to $2,000	
E.5 Construct an interior wall to section off the SW single door entrance, bathroom, and stairway from the garage bay area, to reduce the heating area required when the garage doors are opened.	$10,000	
E.6 Replace furnace and unit heaters (nearing end of life). This is the same as C.9. Consider radiant heat for large workshop / garage bay.	$50,000	ICC C.9

ICC – Energy project that can be completed *in conjunction with condition project.*

SEB – *Secondary energy benefit* associated with a condition project.

6.3 DAWSON CITY SWIMMING POOL

Improvement Projects	Estimated Cost ($CAD)	ICC / SEB*
Condition Related Improvements		
C.1 Replace damaged exterior light fitting and missing bulb.	$1,000	SEB E.1
C.2 Improvements to exterior door draft proofing.	$500	SEB E.2
C.3 General repairs and improvements to gutters and separated barge and gable jointing.	$5,000	
C.4 Repair crack on south wall in pool area to mitigate moisture ingress.	$1,000	
C.5 Replace floor covering in change room areas and other public access areas.	$100,000	
C.6 Install light covers in women's bathroom and patch and paint drywall.	$500	
C.7 Investigate and repair corroded pipework and fittings and improve of insulation where feasible in plant room.	$2,500	SEB
C.8 Investigate corrosion to bottom of whirlpool pump panels and electrical cabling and refresh fittings, potentially replace small pumps if required.	$2,500	SEB
C.9 Potential general M&E review, repairs and improvements around hot tub pumps, ladder to crawlspace, and stainless steel pipe / UV reactor, in conjunction with building electrical and plumbing works identified above (C.7 and C.8).	$5,000	ICC C.7 / C.8
Energy Related Opportunities		
E.1 Lighting upgrades: installation of high efficiency LED bulbs, motion sensors, timers and control philosophies such as lighting sweeps after hours.	$30,000	ICC C.1
E.2 Re-seal exterior windows and weather-proof doors as needed.	$1,000	ICC C.2
E.3 Commission new solar panel system to provide pre-heating for the pool.	$80,000 - 100,000	
E.4 Review heat and ventilation balancing in the office space area and modify as appropriate.	$5,000 - 10,000	

ICC – Energy project that can be completed *in conjunction with condition project.*

SEB – *Secondary energy benefit* associated with a condition project.

6.4 WATERFRONT BUILDING

Improvement Projects	Estimated Cost ($CAD)	ICC / SEB*
Condition Related Improvements		
C.1 Replace exterior light fittings along rear of facility	$1,500	SEB E.6
C.2 Provide spill containment for exterior fuel tanks to conform to the current standards	$1,500	
C.3 Investigate and repair/improve window mechanisms as needed (If window replacement is required, then increase expenditure)	$5,000	SEB E3 & E5
C.4 Install gutter along rear of building	$10,000	
C.5 Repair cracks in stairwell to 2nd floor and office area, complete as part of structure improvements if required	$5,000	
C.6 Replace shower unit with glass door and integrated room drainage	$10,000	ICC E2
C.7 Investigate settlement causing wall finishing cracks	$5,000	
Energy Related Opportunities		
E.1 Relocate water heaters from crawlspace to empty closets on main floor, un-condition the crawlspace area to reduce heating area required	$5,000	
E.2 Install timers or other flow limiting controls on showers to minimize domestic hot water use	$1,000	ICC C.6
E.3 Re-seal exterior windows and weather-proof doors as needed	$500	ICC C.3
E.4 Replace / Upgrade the forced air heating system furnaces for high efficiency alternatives (furnaces are 2017 models). Review duct system sizing for optimum heat distribution.	$30,000	
E.5 Review return air system for furnaces in conjunction with review of ventilation system requirements to mitigate requirements for manual window opening.	$10,000 - $20,000	ICC C.3
E.6 Lighting upgrades: installation of high efficiency LED bulbs, motion sensors, timers and control philosophies such as lighting sweeps after hours.	$10,000	ICC C.1

ICC – Energy project that can be completed *in conjunction with condition project.*

SEB – *Secondary energy benefit* associated with a condition project.

6.5 AMFRC

Improvements	Estimated Cost ($CAD)	ICC / SEB*
Condition Related Improvements		
C.1 Install permanent fencing around the major exterior equipment	$10,000	
C.2 Replace cladding panels in worst areas of damage	$30,000	
C.3 Repairs to walls, ceilings, woodwork and tiling as identified in the condition assessment	$100,000	
C.4 Replacement of floor tiles especially between arena and change rooms	$5,000	
C.5 Replace covers and lights in Parks and Recreation office, shower room, and change room #3	$1,000	SEB E.4
C.6 Cut out mold observed under sink in women's washroom at the curling rink and repair	$2,000	
C.7 Improve sealing mechanical equipment metalwork to prevent rusting	$2,000	
C.8 Replace stairs between rink and curling area	$10,000	
C.9 Underpin building associated with the current building settlement, or other structural upgrades	$1,000,000	
Energy Related Opportunities		
E.1 Relocate Parks and Recreation office and close any non-essential portions of the building during the summer months.	$2,000 - $5,000	
E.2 Replace the boilers with more efficient models. Boilers are 2013 models.	$40,000	
E.3 Review heat distribution through facility especially between recreational and administrative spaces.	$30,000	
E.4 Upgrade lighting through installation of LED bulbs, motion sensors and/or timers. Also maintain good behavioural practices such as procedure for switching off lights at end of day. Potentially upgrade controls in conjunction with heating controls.	$20,000 - $30,000	ICC C.5
E.5 Consider insulating the ground from conditioned areas and seal off crawl space from heating loss.	$50,000	ICC C.9
E.6 Re-seal exterior windows and weather-proof doors as needed	$5,000	
E.7 Insulate the mezzanine area where there is currently no insulation and increase insulation thickness and RSI value in roof to reduce overall heat loss.	$80,000 – $120,000	

ICC – Energy project that can be completed *in conjunction with condition project.*

SEB – *Secondary energy benefit* associated with a condition project.

7 Key Assumptions and Uncertainties

This project has been undertaken with the purpose of capturing opportunities for aligning energy related improvements with facility renewal investment needs – for the five identified facilities within the project scope. The level of detail adopted in the methodology developed and project execution have been has scaled to be commensurate with the timescale and budget available for project. As such, a number of assumptions have been applied, where the availability or quality of data is limited.

Some of the key assumptions and uncertainties are as follows:

- **Asset Values:** The value of the existing assets is based on CRV. The City provided AE with an overall CRV for each facility but there is currently no available breakdown for individual assets or for the various components or sub-systems that make up the overall facility (asset classes or categories). AE has therefore consulted with an in-house building systems specialist to provide an indicative breakdown of each facility into systems and sub-systems. These assumptions are used in the analysis undertaken in the report. It is recommended that further work should be undertaken in the future to provide a more detailed ("bottom-up") breakdown of asset values.

- **Energy Use Data**: The City provided AE with available data on energy use which comprised summary energy consumption information. This has provided a reasonable picture of energy consumption (electricity and oil) for each facility on a monthly basis over a calendar year. However, no daily energy use data is available and daily power demand profiles could not therefore be analyzed to consider potential recommendations on time-of-use corresponding to energy rate structures.

- **Energy Use Calculations:** Calculations of energy-use for individual items of equipment in each facility are based on limited data. Name plate power ratings were used where this was visible on equipment. AE then estimated power ratings – based on similar equipment - for equipment where no details were visible. No reliable data was available on equipment run times, therefore AE estimated these based on typical figures for the function performed by the equipment. The determined kWh usage for all equipment within each building was reviewed against the annual energy bills for the building. In general, there was reasonable correlation between the two, apart from the Public Work building where the electricity consumption billed was much higher than the calculated estimate. It is recommended that further validation of equipment energy usage be undertaken as a future exercise.

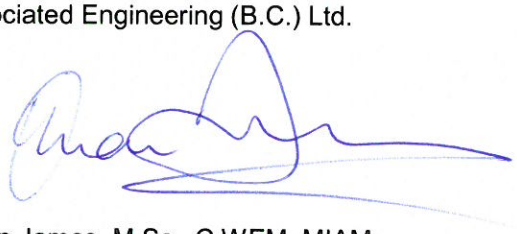
- **Cost Estimates**: The cost estimates used for condition recommendations are high-level "planning" estimates, prepared on fairly limited information. They are intended to provide indicative magnitude of costs for investment purposes at each facility. Further engineering-level investigation and analysis will be required or some of the recommendations and estimates will need to be firmed up and validated with the benefit of vendor or contractor quotations.

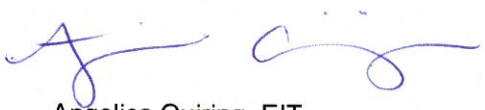
Closure

This report was prepared for the Yukon Government and the City of Dawson with the purpose of capturing opportunities for aligning energy related improvements with facility renewal investment needs identified for five City facilities.

The services provided by Associated Engineering (B.C.) Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering (B.C.) Ltd.





Owen James, M.Sc., C.WEM, MIAM
Project Manager

Angelica Quiring, EIT
Facility Assessor

QM STAMP

Appendix A – Figures



Associated Engineering

CANADA'S BEST MANAGED COMPANIES Platinum member

Dawson City Integrated Energy and Facility Condition Assessment

Figure 1: Facility Locations

Appendix B – Facility Condition Photos

1 CITY HALL / FIRE HALL CONDITION PHOTOS



Photo 1 – Rusty Fuel Tanks without Spill Containment



Photo 2 – Water Damage Visible on Ceiling



Photo 3 – Cracks in Wall Finishing



Photo 4 – Stains on Hydronic Piping Insulation



Photo 5 –Data Server Room Ventilation Inadequate



Photo 6 – Elevator Non-Operational

CANADA'S BEST MANAGED COMPANIES Platinum member

2 PUBLIC WORKS BUILDING CONDITION PHOTOS



Photo 1 – Garage Door Bollards are Rusted and Faded



Photo 2 – Water Damage on Interior Window Frame



Photo 3 – Garage Door Dented



Photo 4 – Gutter Bent and does not Extend to Ground.



Photo 5 – Water Damage Visible on Ceiling



Photo 6 – Concrete Floor Coating Eroded

CANADA'S BEST MANAGED COMPANIES Platinum member

3 DAWSON CITY SWIMMING POOL CONDITION PHOTOS



Photo 1 – Damaged Light Fixture with Missing Lightbulb



Photo 2 – Issues with Water Leakage behind Eavestroph

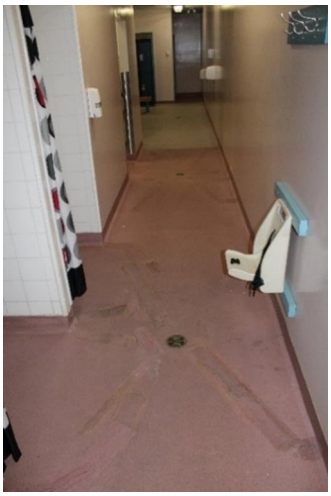


Photo 3 – Floor Coverings Patched



Photo 4 – Repairs Visible in Pool Liner



Photo 5 – Corroded Pipe Support Hangers



Photo 6 – Electrical Pump Cabling and Fittings Corroded

4 WATERFRONT BUILDING CONDITION PHOTOS



Photo 1 – Exterior Lighting Out of Order at Back



Photo 2 – Fuel Tanks without Spill Containment



Photo 3 – Windows Difficult to Adjust



Photo 4 – Windows Not Seated Properly in Frames



Photo 5 – Cracks in Wall Finishing

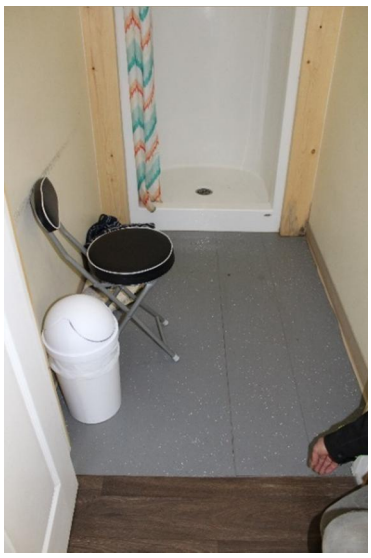


Photo 6 – Water Drainage Issues on Shower Room Floors

CANADA'S BEST MANAGED COMPANIES Platinum member

5 ART AND MARGARET FRY RECREATION CENTRE CONDITION PHOTOS



Photo 1 – No Permanent Fencing Around Exterior Equipment



Photo 2 – Dents in Exterior Cladding



Photo 3 – Mezzanine Unfinished Including Insulation



Photo 4 – Zamboni Room Paint Peeling and Hose Connections Unpatched



Photo 5 – Spray Foam Covering Gap Between Wall and Settling Foundation Worn



Photo 6 –Floors between Change Rooms and Arena

CANADA'S BEST MANAGED COMPANIES Platinum member

Appendix C – Energy Assessment

Associated Engineering

Facility Name: City Hall / Fire Hall
Assessment Date: 14-Dec-18

	Days	Count	Assumptions
	Winter	242	Jan-Apr, Sept-Dec
	Summer	123	May-Aug
	Occupied	252	Annual Working Days (Mon-Fri)
	Hours		
	Occupied	8	9:00 to 17:00

System	Building Location	Tag #	Year	Description	Make	Model	Serial Number	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017	Electric Energy Consumed 2017 (kWh)	Oil Energy Consumed 2017 (kWh)	Controls	Assumptions	Notes
HVAC	Mechanical Room	B-1	1999	Oil-Fired Boiler	Burnham	V904A-45	64179909	141.6	242	12	2904		267,190	Thermostat controls for unit and baseboard heaters	Winter: Assume runs at 80% power during work days for 6hrs, evenings and weekends at 50% power for 6hrs. Summer: Doesn't run.	Gross Output=483 MBH, Max Firing Rate=4.2 USGPH, Eff date unreadable, includes energy consumption for AHU and Makeup Air heating coils, terminal units (See Appendix D, Photo 1.)
	Mechanical Room	B-2	1999	Oil-Fired Boiler	Burnham	V904A-45	64132472	141.6	0	0	0		-	Thermostat controls for unit and baseboard heaters	Recir pump broken in 2017 - boiler not running	Gross Output=483 MBH, Max Firing Rate=4.2 USGPH, Eff 84.4% on 4/18/18 (See Appendix D, Photo 1.)
	Mechanical Room	P 2-1		Recirculating Pump	Grundfos	UPS 40-240 F		1.4	242	12	2904	3,920			Assume same run-time as boiler	Model from Williams Engineering Report, max power input 1350 W (See Appendix D, Photo 2.)
	Mechanical Room	P 2-2		Recirculating Pump	Grundfos	UPS 40-240 F		1.4	0	0	0	-			Recir pump broken in 2017 - boiler not running	Model from Williams Engineering Report, max power input 1350 W
	Mezzanine	AHU-1-1	2000	Air Handling Unit (Fans)	Eng Air	LM-8-C	S29933	6.0	365	24	8760	52,297		No time-of-day control settings, as per Williams Engineering Report	Assume runs 24hrs/day, year-round	Supply Capacity = 6844 CFM, Return Capacity = 5300 CFM, Supply Fan: 5hp, Return Fan: 3hp (See Appendix D, Photo 3.)
	Roof	CU-3-1		Condensing Unit (Fans & Compressor)	Lennox	LSA 180C-14	5699M04465	11.9	123	4	492	5,856		No time-of-day control settings, as per Williams Engineering Report, depends on temperature of supply air	Winter: Off. Summer: Runs 4hrs/day when outside temperature is highest	4 fans, 2 compressors, used PF of 0.8, and actual amps
	Ground Floor- Museum	FCU-1-1		Makeup Air Unit (Fan)	Eng Air			1.0	365	3	1095	1,095			Assume runs 3hrs/day, year-round	1 kW max - estimate fr. Sergey
	Ground Floor- Museum	UH 2-7, 2-8		Unit Heaters (Fan)				0.2	242	8	1936	387		Honeywell Thermostat	Assume runs 8hrs/d in winter. Off in summer.	100 W/each - estimate fr. Sergey
	Ground Floor - Equipment Room	UH 2-1, 2-2, 2-5, 2-6		Unit Heaters (Fan)				0.5	242	8	1936	968		Honeywell Thermostat	Assume runs 8hrs/d in winter. Off in summer.	125 W/each - estimate fr. Sergey
	Ground Floor - Equipment Room	EF 4-1, 4-2		Exhaust Fans				0.2	252	2	504	101			Fans only run when vehicles running in garage. Assume 1hr/morning, 1hr/afternoon every working day	HOA switch, in auto, with MS Starter, fans in Equipment Room, 100 W/each - estimate fr. Sergey
	Second Floor - Server Room	EF 3-5		Exhaust Fan				0.1	0	0	0	-			Assume broken (site photo)	100 W max - estimate fr. Sergey
	Ground Floor - Equipment Room	2-1 to 2-4		Ceiling Fans				0.1	252	8	2016	242			On constantly during working days. Off evenings and weekends.	20-30 W - estimate fr. Sergey
DHW	Mezzanine			Electric Automatic Storage Water Heater	GSW	6G50SDE1	S1312 F706620	6.0			560.5	3,363			Assume runs 2hrs/work day and .5 hr total/weekend days	184 L, 3000W/element
Other	Mezzanine		2000	Elevator		Prolift	C-43674	2.2	252	0.75	189	423			Assume runs 45min/working day	3 hp
	Second Floor			Data Server Room				2.6	252	6	1512	3,931			13 computers, 200W each, on for 6 hrs/working day, off evenings and weekends	(See Appendix D, Photo 4.)
	Second Floor			Printer/Copier								1,134			Assume copier consumption while printing is 2.4 kW, total printing time is 1 hr/working day, remaining time during work days in standby mode at .3 kW, and off weekends and evenings	
							Count	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017					
Lighting	Exterior			LED and incandescent bulbs			9	0.7	365	8	2920	1,971		Photo cell, HOA switch in Mezzanine	Gooseneck fixture at front-assume incandescent bulb 100W each, 3 LED lights at back 25W each, assume on for an avg 8hrs/day for the year	
	Mezzanine			Linear Fluorescent			12	0.4	260	1	260	100			2 per fixture, assume on for 1hr/work day for operator rounds	
	Ground Floor- Museum			Linear Fluorescent			24	0.8	152	8	1216	934		1 switch for all lights	Assumed type and 2 per fixture. 32W/tube. Covered so unable to confirm. Assume all lights on during May-Sept, 9am to 5pm	
	Ground Floor - Equipment Room			Linear Fluorescent			83	2.7	260	8	2080	5,637		4 switches (main garage)	2 per fixture in fire hall 32W/tube, 1 per fixture in mech room 50W/tube	(See Appendix D, Photo 5.)
	Entrance & Second Floor			Linear Fluorescent			128	4.1	260	8	2080	8,520			Assumed type and 2 per fixture. Covered so unable to confirm. Approximate count from site photos. Assume on for 8hrs/day each working day.	(See Appendix D, Photo 6.)

Total (kWh)	90,879	267,190
% Difference from Bills	25%	2%

CANADA'S BEST MANAGED COMPANIES Platinum member

Associated Engineering

Days	Count	Assumptions
Winter	242	Jan-Apr, Sept-Dec
Summer	123	May-Aug
Occupied	252	Annual Working Days (Mon-Fri)
Hours		
Occupied	9	8:00 to 17:00

Facility Name: Public Works Building
Assessment Date: 14-Dec-18

System	Building Location	Tag #	Year	Description	Make	Model	Serial Number	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017	Electric Energy Consumed 2017 (kWh)	Oil Energy Consumed 2017 (kWh)	Controls	Assumptions	Notes
HVAC	Mechanical Room	F 1-1		Oil Fired Forced Air Furnace	Olsen	HTL-100C	HTTL65132	29.8	242	12	2904	581	67,334	Thermostat controls, Set to 66°F on 2nd floor thermostat	Winter: Assume runs at 80% power during work days for 8hrs, evenings and weekends at 50% power for 6hrs. Summer: Doesn't run. Assume 200 W motor for fan.	Capacity: 101,000 BTUH, fuel oil de-aerator, Efficiency 88.5% (on Nov. 13, 2015), Checked 1/year Electrical component is for fan. (See Appendix D, Photo 1.)
	Garage Bay	UH 1-1, 1-2		2 Oil-Fired Unit Heaters	Reznor			60.0	242	4	968		58,080	Thermostat controls	Assume Model OH-95 with 100 W motor (est. from Sergey) Winter: Assume runs 2hr/morning/work day and 2hr/afternoon/work day. Evenings, Weekends off. Summer: Off. Assume 118,000 BTUH	In/for garage, fuel oil de-aerator, Don't run often, usually come on in cold weather when door opens (See Appendix D, Photo 2.)
	Garage Bay	UH 1-1, 1-2		2 Unit Heaters (Fans)				0.2	242	4	968	194			Same run time as above Assume Model OH-95 with 100 W motor (est. from Sergey)	(See Appendix D, Photo 2.)
	Mechanical Room			Fuel Pump	Emerson	SD55GYSCP-3083		0.1			3872	414			Assume runs combined time of furnace and unit heaters	HP: 1/7
	Garage Bay	EF 2-1, 2-2		Exhaust Fans				0.4	252	6	1512	665		Each have HOA switch in garage bay	Fans run when vehicles running in garage, otherwise very rarely. Assume 3hrs/morning, 3hr/afternoon every working day Assume 120 W/fan plus 200W motor for exhaust system (est. from Sergey)	
	Garage Bay			Make up Air Unit (Fan)				1.0	120	6	720	720			Assume 1 KW similar to Sergey's estimate for Fire Hall, Assume runs 6hrs/d during Spring and Fall (4 months).	High level opening with mechanically actuated dampner in exterior wall (See Appendix D, Photo 3.)
	Garage Bay			3 Residential Ceiling Fans				0.1	260	9	2340	211		Wall-mounted variable speed switches	Run constantly during 9hr work days. Off evenings and weekends. Assume 20-30 W/fan (est. fr. Sergey)	
DHW	Mechanical Room			Automatic Storage Water Heater	GSW	6G50SDE1	S1208 F703541	6.0			812.5	4,875			Assume runs 3hrs/work day and .5 hr total/weekend days	184 L, 3000W/element (See Appendix D, Photo 4.)
							Count	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017					
Lighting	Exterior			LED bulbs			7	0.2	365	8	2920	511		Photo cell, HOA switch in Mechanical Room	LED lights, 25W each	
	Main Floor			Linear Fluorescent			82	4.1	260	5	1170	4,797		2 switches for lights in Garage Bay - 0, 50, or 100% on/off	2 tubes/fixture, 50W/tube, 50% on 9hrs/work day	(See Appendix D, Photo 5.)
	Second Floor			Linear Fluorescent			22	0.7	260	9	2340	1,647		Lights on/off for main area, hallway, and each office	2 tubes/fixture, 32W/tube, on 9hrs/work day	(See Appendix D, Photo 6.)

Total (kWh)	14,615	125,414
% Difference from Bills	45%	11%

CANADA'S BEST MANAGED COMPANIES Platinum member

Facility Name: Dawson City Swimming Pool
Assessment Date: 14-Dec-18

Days	Count	Assumptions
Winter	242	Jan-Apr, Sept-Dec
Summer	123	May-Aug
Occupied	153	May-Sept
Hours		
Occupied	15	7:00 to 22:00

System	Building Location	Tag #	Year	Description	Make	Model	Serial Number	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017	Electric Energy Consumed 2017 (kWh)	Oil Energy Consumed 2017 (kWh)	Controls	Assumptions	Notes
HVAC	Mech Room	B-1	2017	Oil-Fired Heating Boiler 1	Well McLain	BL-880-WF		274.6	153	7	1071	589	209,610	Tekmar 204	Open days: Normal operation runs 5hrs at 75% during pool hours, alternates with other boiler, and runs 2 hours at 50% during night. Off in Winter.	Efficiency 85.7% (Oct. 12, 2016), Input=274 kW fr AE Mech Upgrades Schedule,(Input light oil=1050 MBH), Electric = 0.55 kW fr AE Mech Upgrades Schedule, (motor hp=3/4) (See Appendix D, Photo 1.)
	Mech Room	B-2	2017	Oil-Fired Heating Boiler 2	Well McLain	BL-880-WF	801607830	274.6	153	7	1071	589	209,610	Tekmar 204	Open days: Normal operation runs 5hrs at 75% during pool hours, alternates with other boiler, and runs 2 hours at 50% during night. Off in Winter.	Efficiency 85.6% (Oct. 12, 2016), Input=274 kW fr AE Mech Upgrades Schedule, (Input light oil=1050 MBH), Electric = 0.55 kW fr AE Mech Upgrades Schedule, (motor hp=3/4) (See Appendix D, Photo 1.)
	Mech Room	P-1	2017	Boiler 1 Circulator Pump	Taco	2400-70		0.4	153	7	1071	399		Relay Module, Tekmar 204	Run time same as Boiler 1	Motor =0.5 hp
	Mech Room	P-3	2017	Boiler 2 Circulator Pump	Taco	2400-70		0.4	153	7	1071	399		Relay Module, Tekmar 204	Run time same as Boiler 2	Motor =0.5 hp
	Mech Room	P-5	2017	Secondary Loop Circulator Pump	Taco	KV 3006		0.8	152	8	1216	912		Relay Module	Alternates with P-6, assume each runs 8hrs/d	Motor=1 hp
	Mech Room	P-6	2017	Secondary Loop Circulator Pump	Taco	KV 3006		0.8	152	8	1216	912		Relay Module	Alternates with P-5, assume each runs 8hrs/d	Motor=1 hp
	Attic	HRV-1		Heat Recovery Ventilator				2.2	152	5	760	1,702		LRD	Assume runs 5hrs/d. Off in winter.	2*1.5 hp (motor schedule) for vent
	Attic	DH-1	2017	Electric Duct Mounted Heater	Thermolec	MD33-9483-C2CACNT0P6B1A5M6SC		10.0	152	5	760	7,600		SCR Modulating	Assume runs 5hrs/d. Off in winter.	Duct sensor and remote temp controller
	Mech Room	AHU-1		AHU (Fan)	Silent Aire			3.7	152	24	3648	13,607		CMS	Runs 24x7 (Heat Recovery Analysis Report)	5 hp supply fan motor, 2" insulated cabinet panels, rated at 2800 L/s (See Appendix D, Photo 2.)
	Mech Room	SF-2		Space Cooling S/A Fan				0.2	152	5	760	141		MMP/R/HOA	Assume runs 5hrs/d when outside temperature high. Off in winter.	1/4 hp motor
	Pool Area	EF-1		Exhaust Fan (East)				0.4	152	10	1520	567		MMP/R/HOA	Assume runs 10hrs/d	Fixed speed, air flow matches AHU to maintain neutral pressure in area, rated at 1400 L/s, 1/2 hp
	Pool Area	EF-2		Exhaust Fan (West)				0.4	152	10	1520	567		MMP/R/HOA	Assume runs 10hrs/d	Fixed speed, air flow matches AHU to maintain neutral pressure in area, rated at 1400 L/s, 1/2 hp
	Crawlspace	EF-3		Exhaust Fan for Crawlspace				0.2	152	8	1216	226		MMP/R/HOA	Assume runs 8hrs/d	1/4 hp motor
	Mech Room	EF-4	2017	Inline Exhaust Fan	Fantech	FG 4XL		0.3			2142	536		On/Off Switch	Runs when boilers are running	Motor=1/3 W (assumed error, used hp)
	Main Floor	CUH-1		Cabinet Unit Heater				0.5	152	4	608	304			Assume 500 W fan, on 4 hrs/d to provide extra heat for entrance. Off in winter.	Location on dwg M-3
DHW	Crawlspace	P-2		Domestic Hot Water Circulator Pump				0.1			722	77			Assume motor = 1/7 hp, run time is sum of both water heaters run time	Re-located in 2017 Upgrades, Recirculates hot water from system
	Crawlspace	HWT-1	2017	Domestic Hot Water Heater (Electric)	Bradford White	E32-120R-3		18.0			361	6,498			Runs 0.5 hrs every 2hrs during opening hours, alternates with other heater, 0.5 hr total each evening/night when closed	AE Mech Upgrades Schedule, 450 L
	Crawlspace	HWT-2	2017	Domestic Hot Water Heater (Electric)	Bradford White	E32-120R-3		18.0			361	6,498			Runs 0.5 hrs every 2hrs during opening hours, alternates with other heater, 0.5 hr total each evening/night when closed	AE Mech Upgrades Schedule, 450 L
Other	Crawlspace	MP-P1		Main Pool Pump 1 Circulation				1.5	152	7	1064	1,596		CMS	Running constantly when pool is open, alternates with MP-P2. Off for evening/night.	2 hp (See Appendix D, Photo 3.)
	Crawlspace	MP-P2		Main Pool Pump 2 Circulation				1.5	152	7	1064	1,596		CMS	Running constantly when pool is open, alternates with MP-P1. Off for evening/night.	2 hp (See Appendix D, Photo 3.)
	Crawlspace	MP-P3		Main Pool Pump 3 Circulation				1.5	0	1	0	-		CMS	Assume stand-by for 3rd filter	2 hp (See Appendix D, Photo 3.)
	Crawlspace	WP-P1		Whirl Pool Pump 1				0.8	152	15	2280	1,710		CMS	Running constantly when pool is open	1 hp (See Appendix D, Photo 4.)
	Crawlspace	WP-P2		Whirl Pool Pump 2				1.5	152	3.75	570	855		CMS	Assume for hot tub jets, runs 25% of opening hours	2 hp (See Appendix D, Photo 4.)
	Crawlspace			2 UV Reactors	Hanovia UV			5.0	152	7.5	1140	5,700			Assume units alternate, 1 running constantly when pool is open, power (kW) assumed at 2.5 kW/unit, off in evenings.	(See Appendix D, Photo 5.)
	Crawlspace	P-4	2017	Sump Pump	Little Giant	6-CIA		0.3	15	1	15	4		Diaphragm Pressure Switch	Ran 15 days for 1 hour	Motor=1/3 hp (Mech Upgrades Schedule)
							Count	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017					
Lighting	Exterior			Wall mount H.I.D. (Incandescent bulbs)			6	0.6	365	10	3650	2,190		Photo cell	7 days/week year-round, Off between 6 am to 8 pm, incandescent bulbs 100W each	
	Main Floor - Pool			Ceiling mount H.I.D.			20	8.0	152	15	2280	18,240			On May-Sept during pool hours	(See Appendix D, Photo 6.)
	Main Floor			Linear Fluorescent			66	2.1	152	15	2280	4,815			On May-Sept during pool hours	31 surface mounted fixtures, 2 recessed fixtures
	Crawlspace			Linear Fluorescent			6	0.2	152	1	152	29			On May-Sept for 1 hrs/day	

Total (kWh)	78,860	419,220
% Difference from Bills	0%	12%

CANADA'S BEST MANAGED COMPANIES Platinum member

Facility Name: Waterfront Building
Assessment Date: 14-Dec-18

Days	Count	Assumptions
Winter	242	Jan-Apr, Sept-Dec
Summer	123	May-Aug
Occupied	365	Year-Round
Hours		
Occupied	17	5:00 to 22:00

System	Building Location	Tag #	Year	Description	Make	Model	Serial Number	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017	Electric Energy Consumed 2017 (kWh)	Oil Energy Consumed 2017 (kWh)	Controls	Assumptions	Notes
HVAC	Main Floor			Oil Fired Warm Air Furnace	Olsen	WML80C2	3717B011662	25.2	242	8	1936		31,712	Honeywell wall thermostat, set to 18°C	Winter: Assume runs at 70% power during work days for 6hrs, evenings and weekends at 50% power for 2hrs. Summer: Off.	Output range: 59,000 to 86,000 BTU/hr, EFF:79.7% (Jan.1/12) (See Appendix D, Photo 1.)
	Second Floor			Oil Fired Warm Air Furnace	Olsen	WML80C2	3717B011661	25.2	242	8	1936		24,394	Emerson wall thermostat, set to 22°C	Winter: Assume runs at 50% power during work days for 6hrs, evenings and weekends at 50% power for 2hrs. Summer: Off.	Output range: 59,000 to 86,000 BTU/hr, EFF:79.7% (Jan.2/12) (See Appendix D, Photo 2.)
	Main Floor - Front Entrance			Cabinet Unit Heater (Fan)	Ouellet			0.5	365	6	2190	1,095		Built-in thermostat with control knob	Assume motor is 120 V, 500 W for 40 cfm fan, on 6hrs/d	Main floor entrance by janitor room and staff washroom
DHW	Second Floor			Electric Water Heater	GSW Space Saver	SS06SEB015	1410J004407	1.5	260	1	260	390			On 0.5 hr every 4 hrs/working day	Max Watts Element: 1500, 22.7 L capacity, for upstairs sink
	Crawlspace			2 Electric Water Heaters								7,422			2*184 L capacity, calculated kWh assuming 100 gallons usage/d from website: https://www.energy.gov/eere/femp/energy-cost-calculator-electric-and-gas-water-heaters-0	For main floor showers/sinks
Other	Main Floor			Water Fountain				0.05	365	2	730	37			Assume motor power from Rec Centre drinking fountains, on for 2 hours/d for fitness centre users	
	Main Floor			Cardio Equipment				4.5	365	4	1460	6,570			2 treadmills, with 3hp continuous motor, runs 4 hrs/day	(See Appendix D, Photo 3.)
	Second Floor			Computers				0.8	260	8	2080	1,664			4 computers, 200W each, on for 8hrs/working day	(See Appendix D, Photo 4.)
							Count	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017					
Lighting	Exterior-Back			Incandescent bulbs			3	0.3	365	10	3650	1,095		Photocell	On 10hrs/day Assume incandescent bulbs 100 W each	
	Exterior-Front/Side			LED and compact fluorescent bulbs			7	0.3	365	10	3650	913		Photocell	On 10hrs/day 3 LEDs 30W each, 4 compact fluorescent bulbs (front) 40W each	
	Main Floor			Linear Fluorescent & incandescent bulbs			45	1.8	365	17	6205	11,045			On during fitness centre hours (17hrs/day, 7days/wk) single bulbs in fitness washroom and shower room 100W each	E9R Sylvania Octron/Eco, 3500K, F032/835/ECO - 32W/tube (See Appendix D, Photo 5.)
	Main Floor			Incandescent bulbs			5	0.5	365	2	730	365			Assume on 2hrs/d for cleaning staff	Hallways, janitor room, staff washroom
	Second Floor/Stairwell			Linear Fluorescent			20	0.6	260	8	2080	1,331			Assume all on during working day	(See Appendix D, Photo 6.)
											Total (kWh)	31,926	56,105			
											% Difference from Bills	9%	4%			

Associated Engineering

	Days	Count	Assumptions
	Winter	242	Jan-Apr, Sept-Dec
	Summer	123	May-Aug
	Open	365	Year-round
	Ice	182	Jan-Mar, Oct-Dec
	Hours		
	Open	18	6:00 to 24:00

Facility Name: Art and Margaret Fry Recreation Centre
Assessment Date: 14-Dec-18

System	Building Location	Tag #	Year	Description	Make	Model	Serial Number	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017	Electric Energy Consumed 2017 (kWh)	Oil Energy Consumed 2017 (kWh)	Controls	Assumptions	Notes
HVAC	Mech Room 2	B-1.1		Boiler 1	Well McLain	BL-888	8811307421	559.0	242	8	1936	1,936	783,209	MMP	Winter: runs at 80% power for 6 hours/d while building open, alternates with other boiler, runs at 50% power for 2 hours/d at night. Off in Summer.	558 kW Capacity (M-16R), 1hp motor (E12) (See Appendix D, Photo 1.)
	Mech Room 2	B-1.2		Boiler 2	Well McLain	BL-888	881307422	559.0	242	8	1936	1,936	783,209	MMP	Winter: runs at 80% power for 6 hours/d while building open, alternates with other boiler, runs at 50% power for 2 hours/d at night. Off in Summer.	558 kW Capacity (M-16R), 1hp motor (E12) (See Appendix D, Photo 2.)
	Mech Room 2	P-3.1		Pump 1 Boiler Circulation				0.8	242	8	1936	1,452		MMP/HOA	Same run time as boiler	Motor=1 hp, (E12 schedule)
	Mech Room 2	P-3.2		Pump 2 Boiler Circulation				0.8	242	8	1936	1,452		MMP/HOA	Same run time as boiler	Motor=1 hp, (E12 schedule)
	Mech Room 2	P-3.3		Pump 3 Secondary Hot Water Circulation	Taco	V3008		3.7	242	8	1936	7,221		VFD	Same run time as boiler	Motor HP=5 (nameplate photo)
	Mech Room 2	P-3.4		Pump 4 Secondary Hot Water Circulation	Taco	V3008		3.7	242	8	1936	7,221		VFD	Same run time as boiler	Motor HP=5 (nameplate photo)
		P-2.1		Fuel Oil Transfer Pump 1				0.2	242	1	242	45		MMP/HOA	Runs 1hr/d during winter when boilers are on. Alternates with P-2.2. Transfers oil from outdoor to indoor tank.	Motor=0.25 hp (E12 schedule)
		P-2.2		Fuel Oil Transfer Pump 2				0.2	242	1	242	45		MMP/HOA	Runs 1hr/d during winter when boilers are on. Alternates with P-2.1. Transfers oil from outdoor to indoor tank.	Motor=0.25 hp (E12 schedule)
	AHU Room	AS-1, F-1.1		Air Handling Unit 1 (Supply Fan)	McQuay	CAH030FHAC	FBOU010400846	18.6	365	9	3285	61,101		VFD	Runs 9hrs/d during opening hours, 2hrs/d during night. Year-round.	Motor=25hp (E12 schedule) Main Building Unit (See Appendix D, Photo 3.)
	Main Building Unit	EF-1.1 to 1.11		Exhaust Fans				2.1	365	20	7300	15,374		MMP/R or HOA	Same run time as AHU 1	0.25, 0.33, 1 hp (E12 schedule)
		P-3.6		HWS Circulation Pump (AHU 1)				0.6	273	11	3003	1,682		MMP/HOA	Winter: runs 9 hrs/d while open, runs 2hrs/d at night. Summer: off.	0.75 hp (E12)
	Zamboni Room	AS-2, F-2.1		Air Handling Unit 2 (Supply Fan)				0.4			7564	2,821		MMP/HOA	Assume runs constantly in winter, otherwise zamboni room gets too cold. (info from site visit). In summer: assume runs 11hrs/d.	Zamboni Room, 0.5 hp (E12 schedule)
	Zamboni Room	EF-2.1, 2.2		Exhaust Fans (1 for tailpipe)				0.6			7564	4,228		MMP/HOA	Same run time as AHU 2	0.25 and 0.5 hp (E12)
	Mech Room 1	AS-3, F-3.1		Air Handling Unit 3 (Supply Fan)	McQuay	CAH035FHOC	FBOU010400850	11.2	365	10	3650	40,844		CMS	Runs 9hrs/d during opening hours, 1hrs/d during night.	Motor=15 hp (E12 schedule), Arena Unit
	Mech Room 1	EF-3.1 to 3.3		Exhaust Fans (AHU 3)				2.2	365	10	3650	8,176		MMP/HOA	Same run time as AHU 3	Motor=1 hp each, (E12 schedule)
	Mech Room 1	P-3.7		HWS Circulation Pump (AHU 3)				0.6	273	10	2730	1,529		MMP/HOA	Winter: runs 9 hrs/d while open, runs 1hrs/d at night. Summer: off.	0.75 hp (E12)
	Curling Lounge	AS-4, F-4.1		Air Handling Unit 4 (Supply Fan)				5.6	365	6	2190	12,264		CMS	Assume runs 6hrs/d on average throughout year.	7.5 hp (E12) Curling Lounge
	Curling Lounge	AS-4, F-4.2		Air Handling Unit 4 (Return Fan)				2.2	365	6	2190	4,906		CMS	Same run time as AHU 4 supply fan	3 hp (E12)
		EF-4.1 to 4.3		Exhaust Fans (AHU 4)				1.3	365	6	2190	2,847		MMP/ HOA or R	Same run time as AHU 4 fans	0.25+1.5 hp (E12)
		P-3.8		HWS Circ Pump (AHU 4)				0.4	242	5	1210	451		MMP/HOA	Assume runs 5hrs/d in winter. Summer off.	0.5hp (E12)
	Refrigeration Plant	AS-5, F5.1		Air Handling Unit 5				1.2	365	6	2190	2,519		CMS	Assume runs 6hrs/d on average throughout year.	Curling Rink, 1.5 hp
		EF-5.1, 5.2		Exhaust Fans (AHU 5)				0.8	365	6	2190	1,643		MMP/HOA	Same run time as AHU 5	0.5 hp each (E12)
		P-3.9		HWS Circ Pump (AHU 5)				0.1	242	5	1210	154		MMP/HOA	Assume runs 5hrs/d in winter. Summer off.	0.17 hp (E12)
	Throughout	CUH 1.1 to 1.8, UH-1.1 to 1.16, UH-2.1 to 2.9		Space Heating Terminal Units (Fans) (CUH & UH)				4.5	242	8	1936	8,685		MMP	Winter: Assume runs 8 hrs/d. Summer: Off.	From dwg E12 motor schedule
	Mech Room 2	P-3.5		Glycol Fill Pump				0.3	242	1	242	61		MMP	Rarely fill glycol system. Assume runs 1hr/winter to top up.	0.33 hp (E12 schedule)
	Crawlspace	P-1.3 to 1.6		Sump Pumps				1.0	123	0.5	62	61		MMP	Assume run 0.5 hours/ day in summer.	0.33 hp each (E12 schedule)
	Crawlspace	EF-1.12		Crawlspace Exhaust Fan				0.2	365	0.3	97	18		MMP/HOA	Assume runs 8hrs/month per year.	0.25 hp (E12)
DHW	Mech Room 2	DHWH-1.3		Domestic Hot Water Heater 3 (Electric)	Bradford White	MII80543SCF132-866	MG36518855	57.0				51,984			Winter: Assumes runs 3hrs/d on average. Summer: runs 2 hrs /d on average.	3 kW motor (E12), 9 kW for each of 6 elements (nameplate photo) (See Appendix D, Photo 4.)
		P-1.2		DHW Pump				0.1				19		MMP	Winter: Assumes runs 0.5 hr/d on average. Summer: 0.25 hr/d on average.	0.17 hp (E12)
	Curling Area	DHWH		Domestic Hot Water Heater (Electrict)	GSW	6G80SDE1	S1147 F700278	9.0				4,910			Winter: Assumes runs 2 hrs/d. Summer: Runs 0.5 hrs/d.	2 elements, 4500 W each
Other	Refrigeration Plant	PCU-1.1		Chiller	Trane Series R	RTWD 180G 2F02 A1A	U16H06004	105.0	182	5	910	95,550				(See Appendix D, Photo 5.)
	Refrigeration Plant			Pumps 1-4				6.0	182	0.5	91	546			Assume similar pump power to swimming pool pumps	From site photos. Not sure of pump purpose.
	Refrigeration Plant			Pumps 5-6				1.6	182	0.5	91	146			Assume similar pump power to hot tub pumps	From site photos. Not sure of pump purpose.
		COMP1		Compressor				3.7	182	4	728	2,715		MMP		5 hp motor (E12)
	Exterior			Dry Cooler	Ref Plus	FVD-244D-8-SP	D2016070706	0.9	182	4	728	677				Motor 1.25 hp
	Refrigeration Plant	P4.1		Cooling Brine Pump				30.0	182	8	1456	43,680		Direct Connection		40 hp
	Mech Room 2			Nitrogen Generator	Potter											
							Count	Power (kW)	Days On 2017	Hours On/Day 2017	Total Hours On 2017					Surface mount
Lighting	Exterior			LED and Incandescent Bulbs			10	2.7	365	10	3650	9,946		Photocell	1 LED light at side door 25W, Black gooseneck fixture-assume incandescent 100W each, 1800 W for photocell device	Surface mount
	Curling Crawlspace			Linear Fluorescent			16	0.5	365	1	365	187				Count from dwg E3
	Arena Crawlspace			Linear Fluorescent			40	1.3	365	1	365	467			2 tubes/fixture, 32W/tube	Count from dwg E3
	Ground Floor-Arena			Ceiling mount H.I.D.			36	27.0	365	5	1825	49,275		3 switches for Arena lighting		Surface mount, pendant mount, and recessed, count from dwg E3
	Ground Floor-Curling Rink			Ceiling mount H.I.D.			12	9.0	365	5	1825	16,425		All lights on 1 switch (curling rink)		Recessed fixture, count from dwg E3
	Ground Floor-Curling Lounge			Linear Fluorescent			54	1.7	365	24	8760	15,137		All lights on 1 switch (curling lounge)	2 tubes/fixture, 32W/tube	Surface mount and recessed
	Ground Floor-Curling Lounge			Incandescent Bulbs			32	4.8	365	24	8760	42,048				Recessed fixture
	Ground Floor-Admin/Change Rooms			Linear Fluorescent			164	5.3	365	24	8760	46,603				(See Appendix D, Photo 6.)
	Ground Floor-Admin/Change Rooms			Incandescent Bulbs			25	3.8	365	24	8760	32,850				
	Second Floor-Mezzanine			Incandescent Bulbs			8	1.2	365	24	8760	10,512				
	Second Floor-Mech Area			Linear Fluorescent			34	1.1	365	5	1825	1,986			2 tubes/fixture, 32W/tube	

Total (kWh)	616,333	1,566,418
% Difference from Bills	22%	9%

CANADA'S BEST MANAGED COMPANIES Platinum member

Appendix D – Energy Assessment Photos

1 CITY HALL / FIRE HALL ENERGY PHOTOS

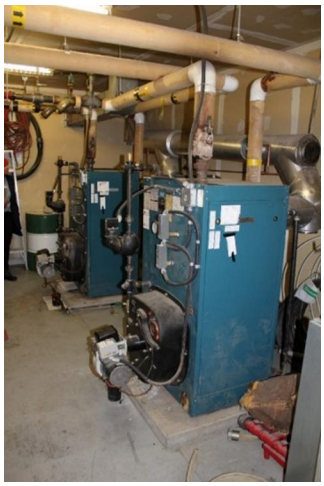


Photo 1 – Oil Fired Boilers (B-1 and B-2)



Photo 2 – Boiler Recirculating Pump



Photo 3 – Air Handling Unit (AHU-1-1)

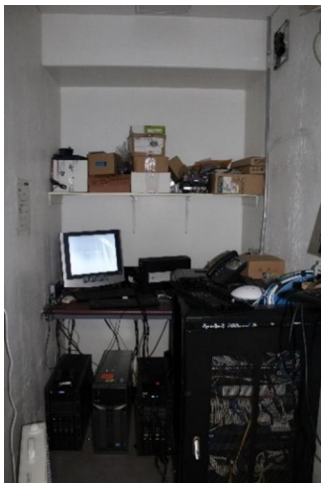


Photo 4 – Plug Loads (Data Server Room)

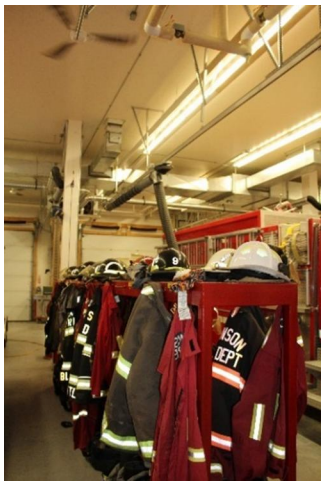


Photo 5 – Interior Lighting (Main Floor)

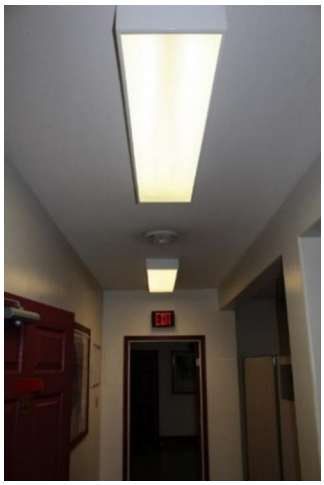


Photo 6 – Interior Lighting (Second Floor)

CANADA'S BEST MANAGED COMPANIES Platinum member



Photo 7 – NW Swing Garage Door



Comments: Door insulation coverage and poor seals at top and base of door visible.



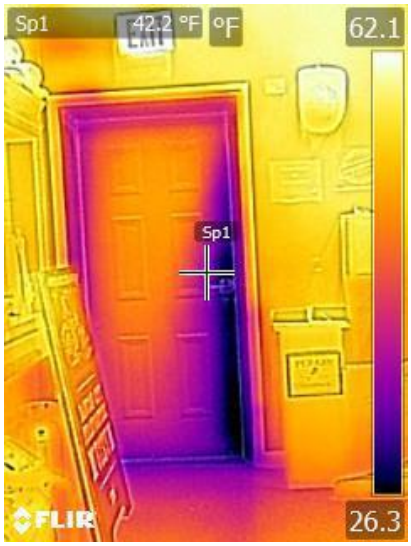
Photo 8 – NW Swing Garage Door



Comments: Door insulation coverage and poor seal at base of door visible.



Photo 9 – NW Entrance to Museum



Comments: Poor door seals and air infiltration visible.

CANADA'S BEST MANAGED COMPANIES Platinum member

2 PUBLIC WORKS BUILDING ENERGY PHOTOS



Photo 1 – Oil Fired Forced Air Furnace (F 1-1)



Photo 2 – Oil Fired Unit Heaters (UH 1-1 and 1-2)



Photo 3 – Make Up Air Unit



Photo 4 – Domestic Hot Water Heater



Photo 5 – Interior Lighting (Main Floor)

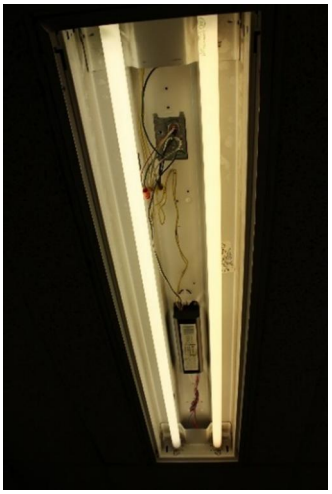
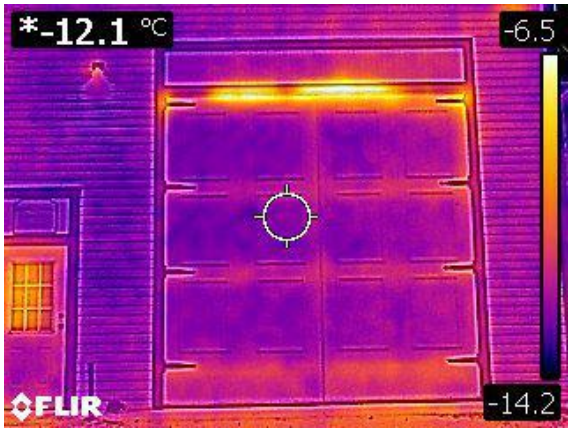


Photo 6 – Interior Lighting (Second Floor)

CANADA'S BEST MANAGED COMPANIES Platinum member



Photo 7 – SW Swing Garage Door



Comments: Poor seal visible at top of door.

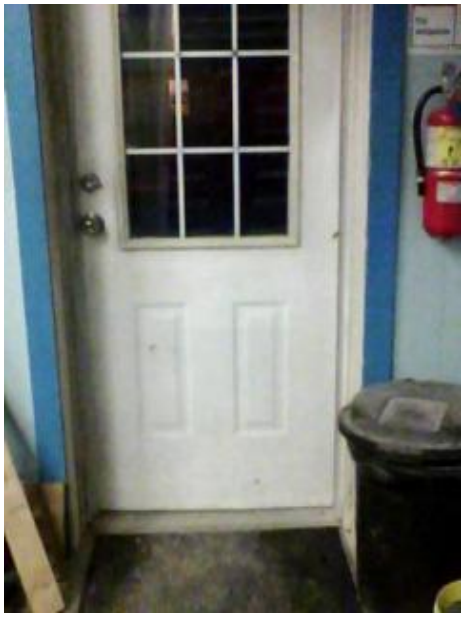


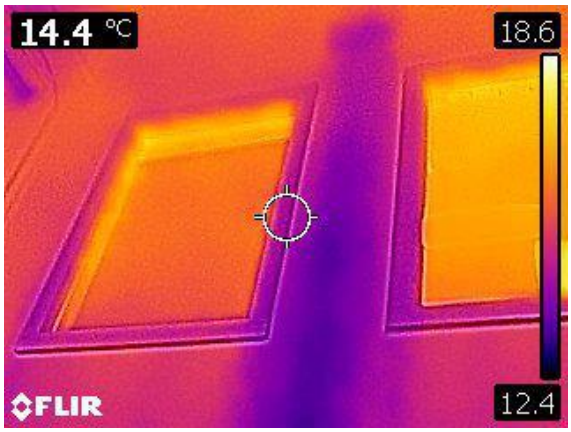
Photo 8 – SW Entrance Single Door



Comments: Poor door seal and air infiltration visible at base of door.



Photo 9 – Interior Wall with Windows



Comments: Sharp contrast visible between wall temperatures.

CANADA'S BEST MANAGED COMPANIES Platinum member

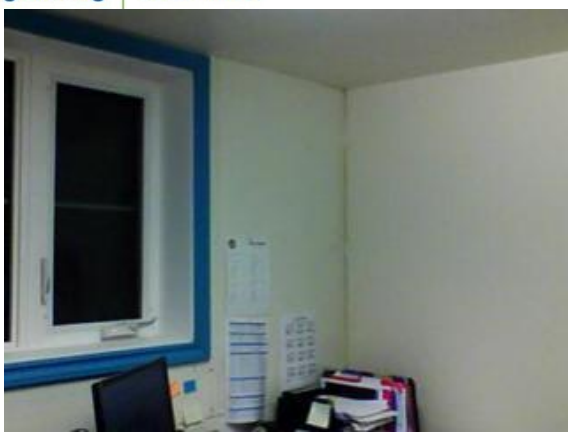
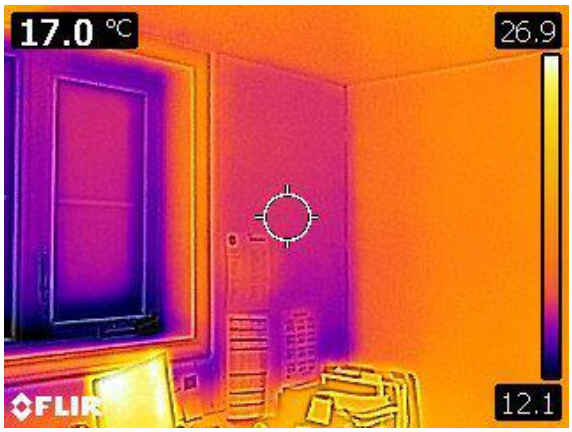


Photo 10 – NW Facing Wall



Comments: Sharp contrast visible between wall temperatures. Air infiltration visible at window.

DAWSON CITY SWIMMING POOL ENERGY PHOTOS



Photo 1 – Oil Fired Boilers (B-1 and B-2)



Photo 2 – Air Handling Unit (AHU-1)



Photo 3 – Main Pool Circulation Pumps (MP-P1, MP-P2, and MP-P3)



Photo 4 – Whirl Pool Pumps (WP-P1 and WP-P2)



Photo 5 – UV Reactor

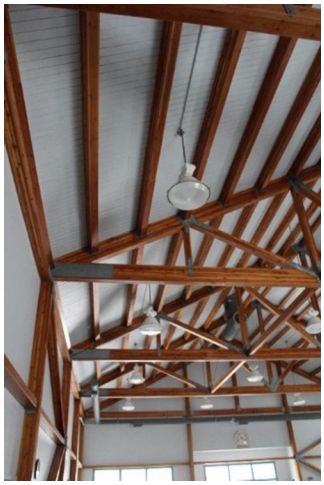
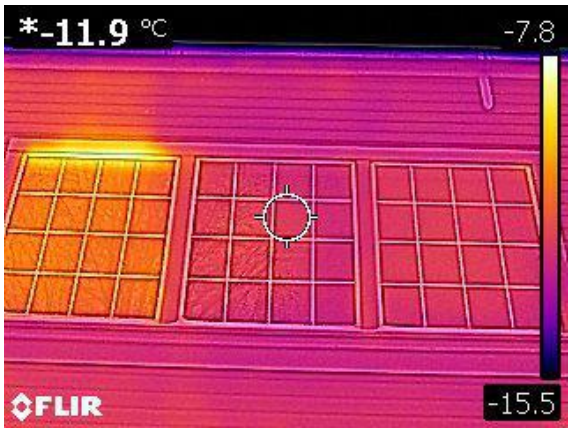


Photo 6 – Interior Lighting (Pool Area)

CANADA'S BEST MANAGED COMPANIES Platinum member



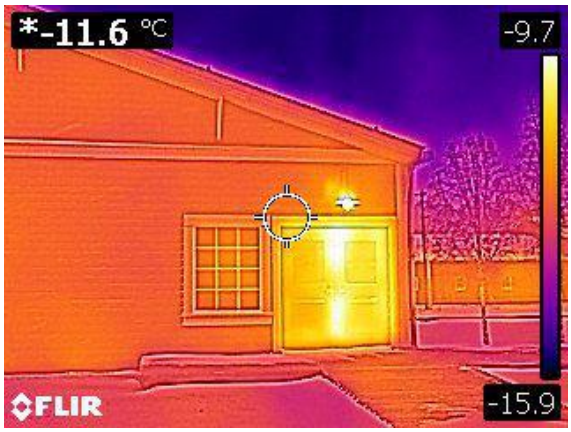
Photo 7 – SW Facing Windows



Comments: Poor Window Seal Visible.



Photo 8 – Double Doors at Public Entrance



Comments: Poor Door Seal Visible.

CANADA'S BEST MANAGED COMPANIES Platinum member

4 WATERFRONT BUILDING ENERGY PHOTOS



Photo 1 – Oil Fired Forced Air Furnace (Main Floor)



Photo 2 – Oil Fired Forced Air Furnace (Second Floor)

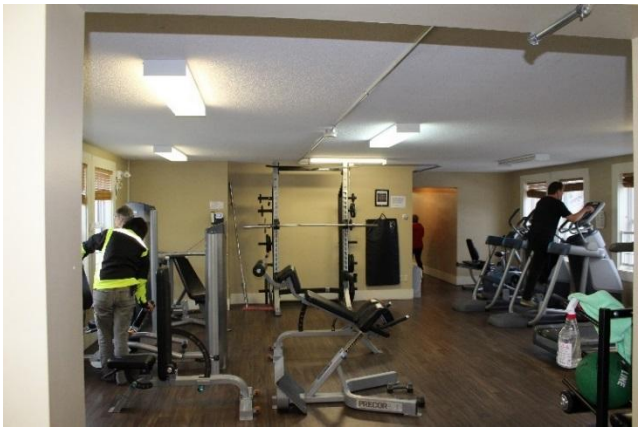


Photo 3 – Plug Loads (Main Floor Cardio Equipment)



Photo 4 – Plug Loads (Second Floor Computers)



Photo 5 – Interior Lighting (Main Floor)



Photo 6 – Interior Lighting (Second Floor)

CANADA'S BEST MANAGED COMPANIES Platinum member



Photo 7 – Main Entrance to Fitness Facility



Comments: Poor door seal and air infiltration visible.



Photo 8 – SE Facing Wall (Main Floor)



Comments: Poor door seal and air infiltration visible at windows and door. Thermal bridging apparent at wall and ceiling joints.

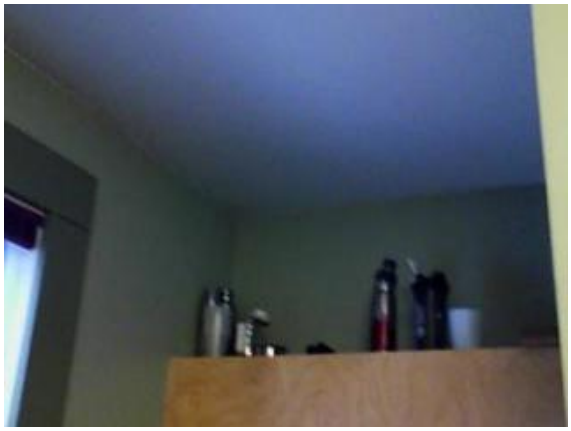
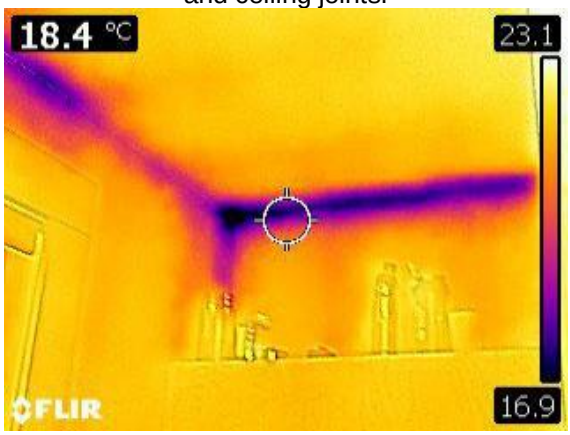


Photo 9 – NE Facing Wall (Second Floor)



Comments: Thermal bridging apparent at wall and ceiling joints.

5 ART AND MARGARET FRY RECREATION CENTRE ENERGY PHOTOS



Photo 1 – Oil Fired Boiler (B-1.1)



Photo 2 – Oil Fired Boiler (B-1.2)



Photo 3 – Air Handling Unit 1 (AS-1)



Photo 4 – Domestic Hot Water Heater (DHWH-1.3)



Photo 5 – Refrigeration Chiller (PCU-1.1)

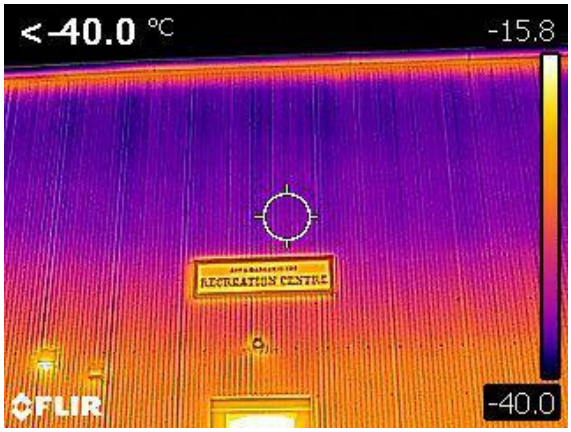


Photo 6 – Interior Lighting (Administrative Office)

CANADA'S BEST MANAGED COMPANIES Platinum member



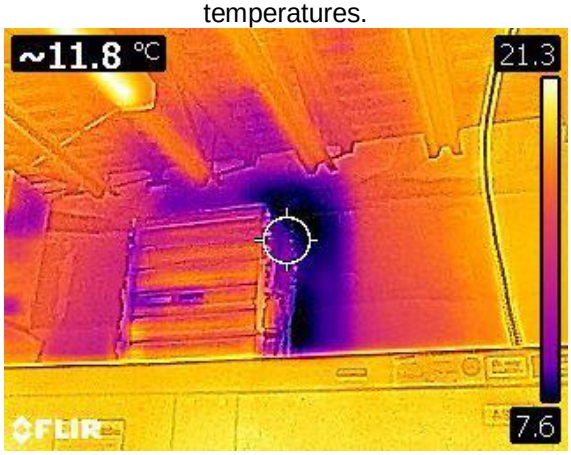
Photo 7 – NW Facing Wall



Comments: Sharp contrast visible between wall temperatures.



Photo 8 – Air Handling Unit Room



Comments: Poor seals visible around AHU exterior wall opening.



Photo 9 – Exterior Entrance to Zamboni Room

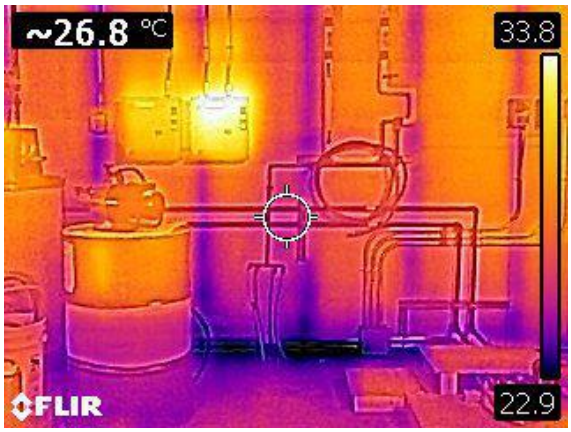


Comments: Poor door seals and air infiltration visible at base of door.

CANADA'S BEST MANAGED COMPANIES Platinum member



Photo 10 – Mechanical Room 1



Comments: Poor electrical connection or potential issue with electrical equipment overheating.