

Canada Games
Aquatic Centre



Centre Aquatique
Jeux du Canada



**CANADA GAMES AQUATIC CENTER
AND MARKET SQUARE DISTRICT
ENERGY SYSTEM
FEASIBILITY STUDY REPORT**
PROJECT #12-20-009

**PREPARED FOR
CITY OF SAINT JOHN**

JULY 2023



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CITY OF SAINT JOHN

CANADA GAMES AQUATIC CENTER AND MARKET SQUARE DISTRICT ENERGY SYSTEM

FEASIBILITY STUDY REPORT

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1 EXECUTIVE SUMMARY

MCW Maricor has prepared this report, which summarizes the energy performance, utility analysis and energy conservation opportunity associated with the thermal interconnect between the Canada Games Aquatic Centre and the Market Square located in Saint John, New Brunswick.

The thermal interconnect will have a direct and positive impact on energy sharing between the two facilities. Based on a study commissioned by the City it was determined the Market Square facility is “BTU surplus” (i.e. rejecting heat) for the majority of the spring/fall months and throughout the summer months. A thermal interconnect would allow the CGAC to use the waste heat from the Market Square energy centre to assist in heating the pool, domestic hot water preheating and in providing building heating. It has been estimated that **6,850 GJ** of thermal energy could be shared with the CGAC that is otherwise rejected through the Market Square cooling towers.

This proposed project will improve both facilities’ operation and energy performance. The following Table 1.1 demonstrates the energy production and financial results associated with the major energy reduction potential at the Canada Games Aquatic Centre.

Table 1.1 – Financial Results						
Description	Annual Savings ⁽¹⁾		Annual Energy & GHG Offset	Estimated Total Project Cost ⁽²⁾	Incentives ⁽³⁾	Simple Payback
CGAC Thermal Interconnect	(558,839) kWh	\$99,124	4,840 eGJ	\$1,848,227	\$739,291 (LCEF)	9.2 years
	(2,534) kW		172 teCO ₂		\$200,000	
	6,851 GJ Natural Gas				(NB Power)	

Notes:

1. Annual savings based on rates listed in Section 3 of this feasibility study. Additionally, \$70/teCO₂ has been carried in the savings calculation to reflect the true future potential of this low carbon project.
2. Total Project Cost includes soft costs. Applicable taxes not included.
3. Incentives are calculated at 40% of Estimated Construction Cost based on the Low Carbon Economy Fund. It should be noted that this program expires in March 2024. NB Power incentives are calculated at rebate of \$60/eGJ of energy saved at a cap of \$200,000 of remaining eligible claims for the CGAC. There is no expiry date on the NB Power program.



2 BUILDING AND SYSTEMS DESCRIPTION

General Facility Description	
Property Type	Aquatics Centre & Fitness Centre
Facility Location	50 Union Street Saint John, New Brunswick
Floor Area (ft²)	62,500 ft ²
Year Built	1984
Occupancy	Year-Round
Building Description	<p>The Canada Games Aquatic Centre provides programs and services for the Greater Saint John area with a focus on aquatic recreation/leisure/instructional services, wellness and fitness programming, rehabilitation services and sport development programs.</p> <p>The facility which is the largest aquatic centre in New Brunswick has a 50 meter competition pool and a 25 meter leisure pool complex complete with water slides and tots pool. The facility also features a weight room and fitness area.</p>
Lighting Systems	The facility has recently been retrofitted with modern LED lighting.
Heating System	There are two natural gas high efficiency condensing boilers that are being used as primary heating source within the facility. The existing condensing boilers supply heating to all air handling units, domestic hot water heaters, pool heaters, and hydronic baseboard heaters for perimeter heating, however most of the heating load is met with the ventilation system.
Ventilation System	The Aquatic Centre has various air handling systems, the majority of which are mixed air units serving dedicated zones throughout the facility. The pool air handling systems utilize heat pump dehumidification that operate to maintain acceptable humidity levels within the pool area.
Controls System	The aquatic centre is equipped with a Distech Direct Digital Control (DDC) system serviced by Trane. The DDC has control over space temperature set points and all mechanical equipment. Ventilation systems run based on time-of-day scheduling while heating and cooling systems run based on outdoor air temperature and indoor temperature set points. The DDC also controls the space conditions (temperature/humidity) for the pool areas.
Domestic Water	Domestic Hot Water is stored in two (2) 4,500 litres insulated vertical storage tanks. The DHW is heated through the boiler system via immersion bundles within each tank. Notably, this facility uses high volumes of domestic hot water due to shower use.
Special Considerations	Pool water heating and domestic hot water production means this facility is using the natural gas boiler system year-round. This attribute pairs well with the adjacent Market Square facility which is rejecting heat for the majority of the year.



3 UTILITY USE AND COST SUMMARY

3.1 ENERGY CONSUMPTION

MCW Maricor was provided with utility data from the client for the Canada Games Aquatic Centre and the Market Square facility. Furthermore, central plant thermal energy usage was provided for the Market Square facility, demonstrating a surplus of energy during the cooling season and shoulder seasons.

The data was compiled and entered into an energy accounting database in order to conduct a utility analysis. For a breakdown of the energy consumption, reference **Appendix A – Energy Usage Summary**. The analysis is based on the most representative year, selected from the data received. Energy usage was analyzed for the following periods:

- Electricity: January 2020 to December 2022
- Natural Gas: January 2020 to December 2022

The following figures illustrate the monthly profiles for the representative utility usages.

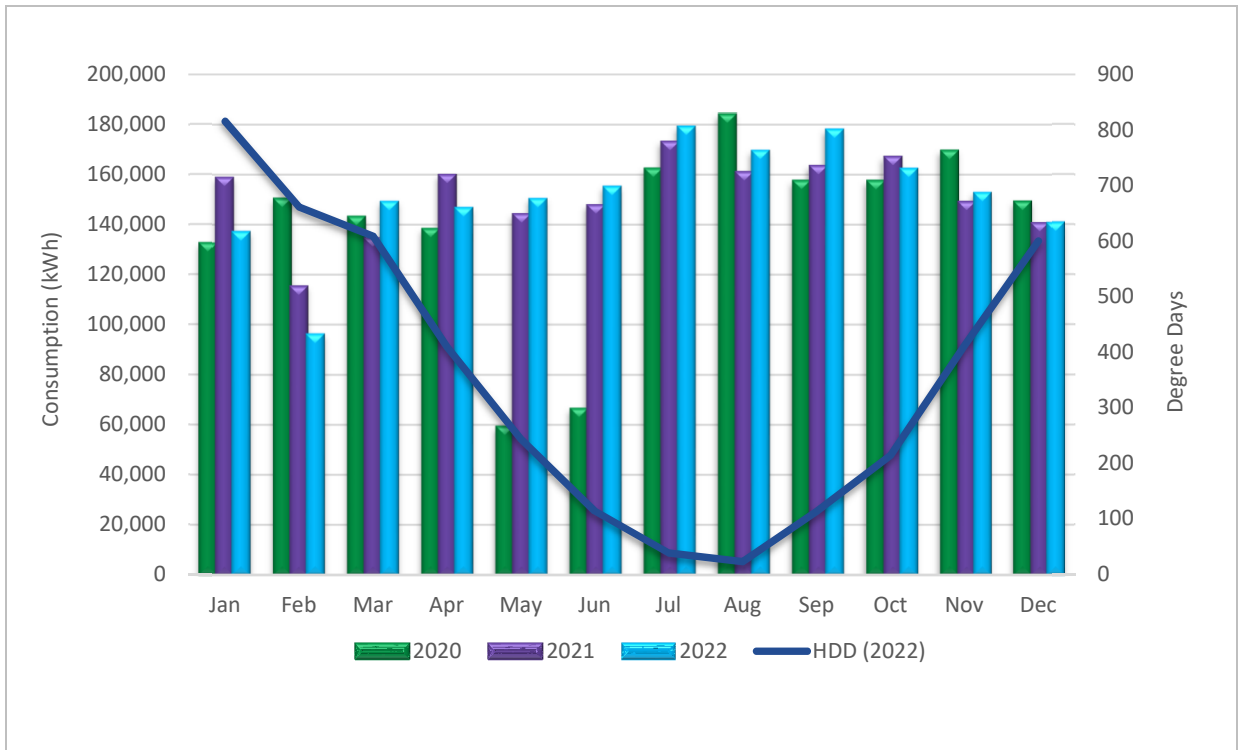


Figure 3.1.1: Electrical Consumption Profile

The above electrical consumption profile is relatively consistent year-round, which is to be expected for a facility primarily using natural gas for heating. The slight increase in electricity usage during the summer months can be attributed to cooling requirements.

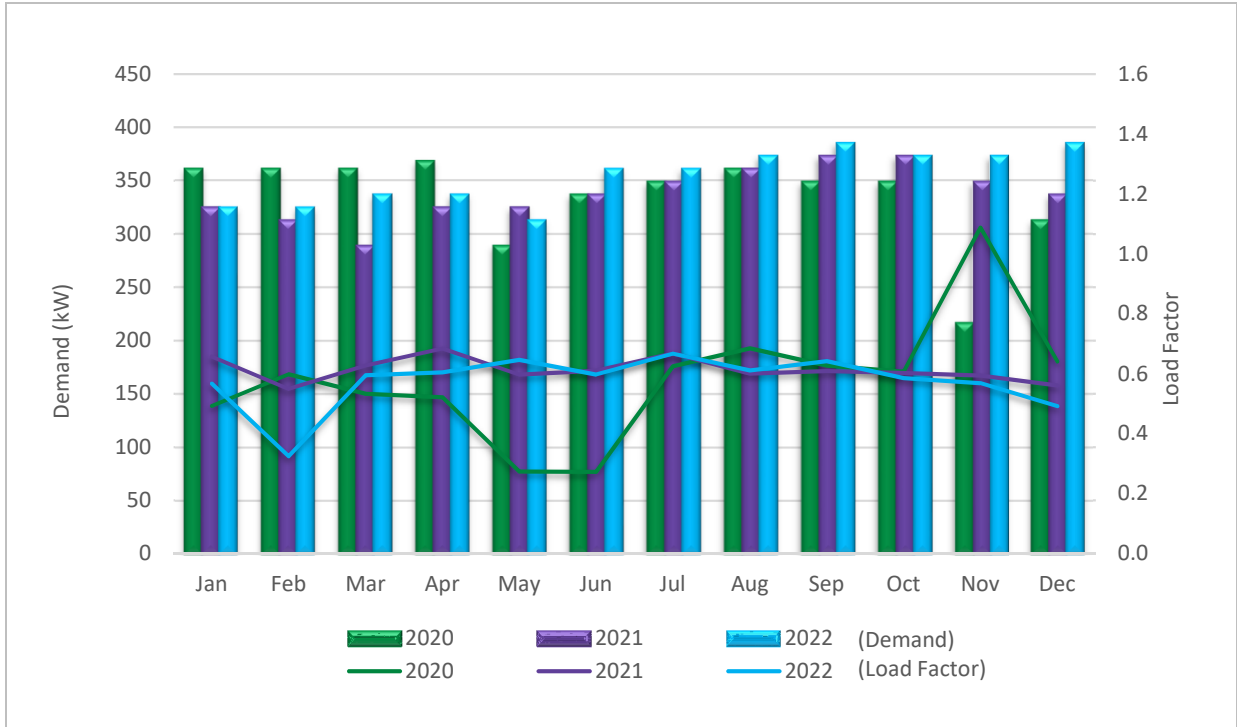


Figure 3.1.2: Electrical Demand Profile

The above electrical demand profile follows the same reasoning as the electrical consumption profile in figure 3.1.1.

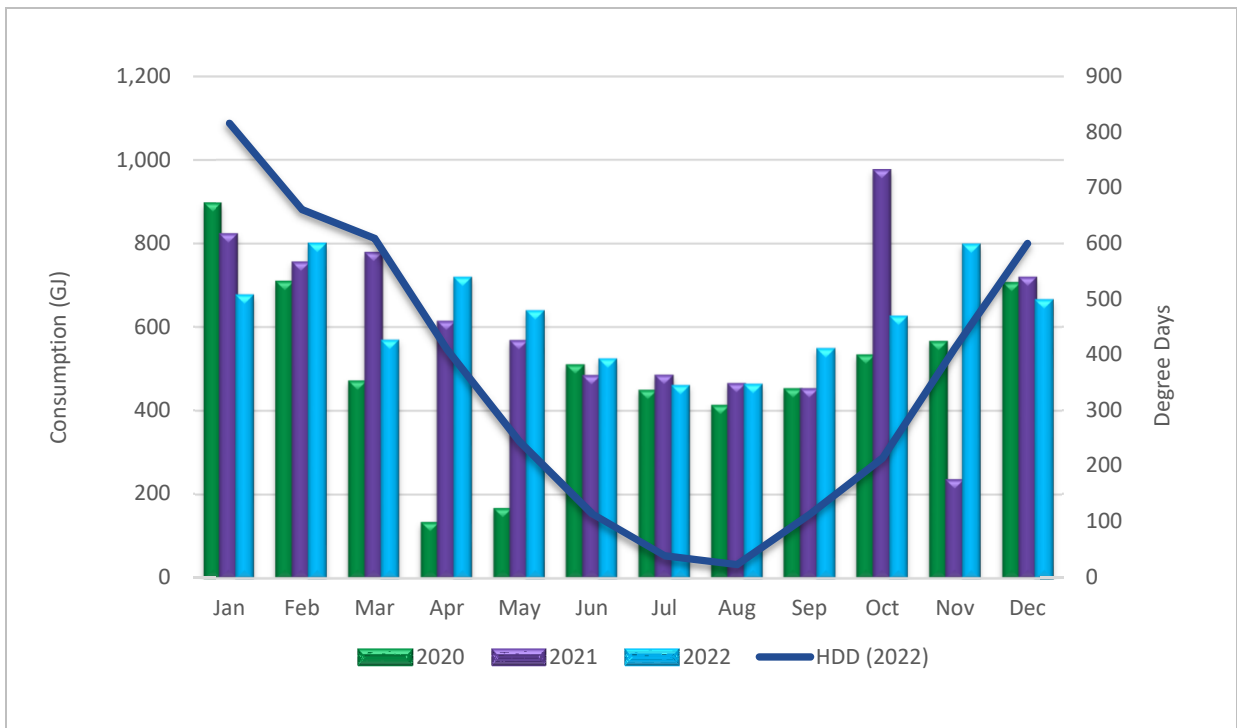


Figure 3.1.3: Natural Gas Consumption Profile



The above natural gas consumption profile generally follows the heating degree-days, which indicates the natural gas usage to be primarily weather-dependent. This is to be expected as the facility’s heating systems are natural gas fired. Notably, a baseline natural gas use is seen due to pool water heating and domestic hot water production.

3.2 RATES USED FOR CALCULATIONS

In order to evaluate the savings potential of the energy efficiency and conservation opportunity, the following energy rates were used. The information is based on the most recent rates published by Saint John Energy and Liberty Utilities.

Table 3.2.1 – Utility Rates (Not including HST) - CGAC				
Utility	Vendor	Rate	Marginal Rates	
Electricity	Saint John Energy	General Service 102	Energy Rate	
			First 100 kWh per kW	\$0.1144 / kWh
			Balance kWh	\$0.0809 / kWh
			Demand Charge	\$9.73 / kW
Natural Gas	Liberty	LGS	Delivery/Commodity (Weighted Average)	\$22.89 / GJ

3.3 ENERGY ACCOUNT SUMMARIES

The energy cost allocation of the facility was based on the utility data received and is summarized in **Table 3.3.1 - Energy Usage Summary**. The analysis is based on the most recent year of data.

Table 3.3.1: Energy Usage Summary				
Utility	Baseline	Amount	Unit	Utility Cost
Electrical Consumption	Jan/22-Dec/22	1,813,200	kWh	\$146,728
Electrical Demand	Jan/22-Dec/22	4,236	kW	\$41,216
Natural Gas	Jan/22-Dec/22	7,455	GJ	\$181,396
Total Utility Cost				\$369,340



3.4 GREENHOUSE GAS EMISSIONS ANALYSIS

Energy savings outlined in the report will result in Greenhouse Gas (GHG) reductions. The calculations of the GHG reductions for this project were based on the data provided by the City of Saint John through the Corporate Energy Plan as outlined in the following table 3.4.1.

Table 3.4.1: Greenhouse Gas Emissions per Fuel

Utility	Carbon Footprint per Unit			
Electricity	0.290	kg eCO ₂ / kWh	0.0002900	tonnes eCO ₂
Natural Gas	48.90	kg eCO ₂ / GJ	0.0489000	tonnes eCO ₂

The total GHG footprint calculated is demonstrated in the following table 3.4.2 for the baseline year of Jan/22 – Dec/22.

Table 3.4.2: Greenhouse Gas Emissions for Baseline Year – CGAC

Utility	Carbon Footprint per Unit			
Electricity	1,813,200	kWh	526	tonnes eCO ₂
Natural Gas	7,455	GJ	364	tonnes eCO ₂
Total			890	tonnes eCO₂

4 ENERGY EFFICIENCY AND CONSERVATION PROJECTION

The City proposes to construct a new buried distribution loop across St. Patrick Street to interconnect the Market Square energy centre directly with the Canada Games Aquatic Centre (CGAC) boiler plant and facilitate energy transfer through low temperature heating water. The below figure 4.1 demonstrates the proposed routing of the new piping.

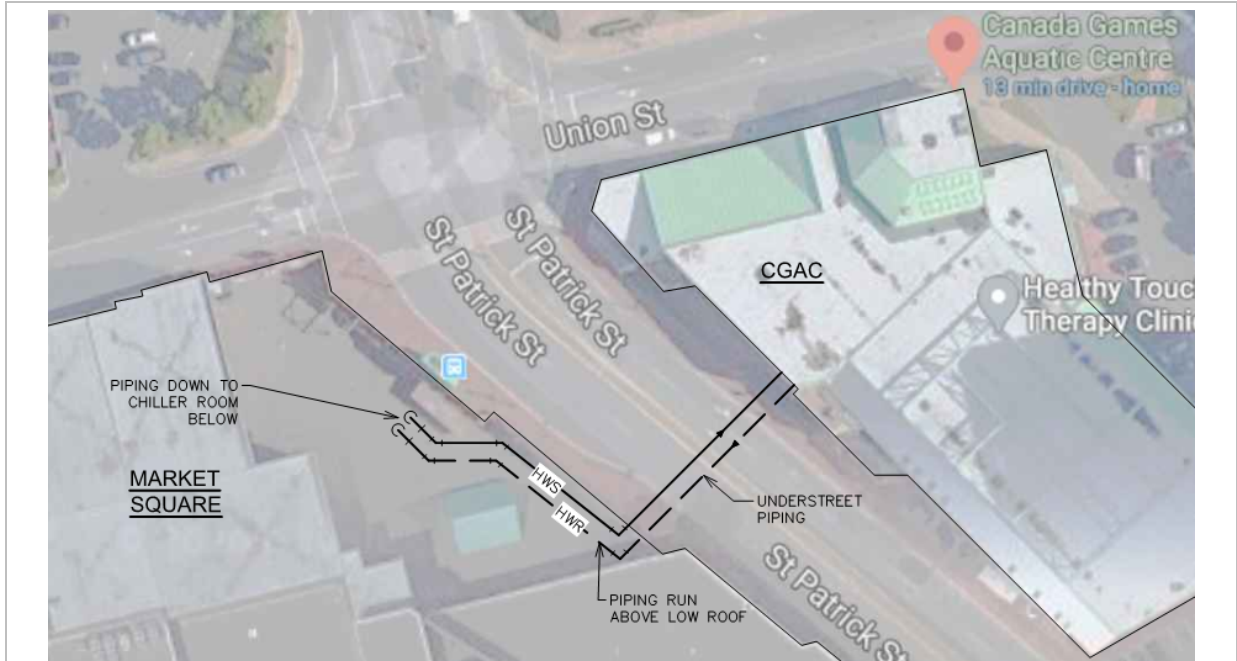


Figure 4.1: Proposed Underground Routing for Thermal Interconnect

A new pump set would be installed in the Market Square to facilitate the energy transfer through the new underground piping. The new piping would be interconnected with the existing low temperature heating loop serving the Market Square and draw energy from the loop when the loop has been deemed “BTU surplus”.

Navigating the route underneath the surface of St. Patrick Street required consultation with the City, Liberty Utilities and telecommunications. New underground piping required to interconnect the CGAC and the Market Square is feasible. Preliminary equipment has been selected and a flow schematic has been developed to define piping and equipment requirements within each facility. For further details on the proposed HVAC upgrades project, please reference **Appendix B – Preliminary Drawing Set**.

The Market Square facility was trended across multiple years to evaluate the available waste heat. The following Figure 4.1 demonstrates the daily waste heat available versus the outdoor air temperature. In total, the average usable waste heat from the Market Square facility exceeds 10,000 eGJ annually. The interconnect of these two facilities is mutually beneficial as the CGAC has a high base load heating requirement with pool water heating and high domestic hot water usage. The majority of waste heat will be utilized within the CGAC, offsetting the Market

Square’s need to operate its cooling tower system.

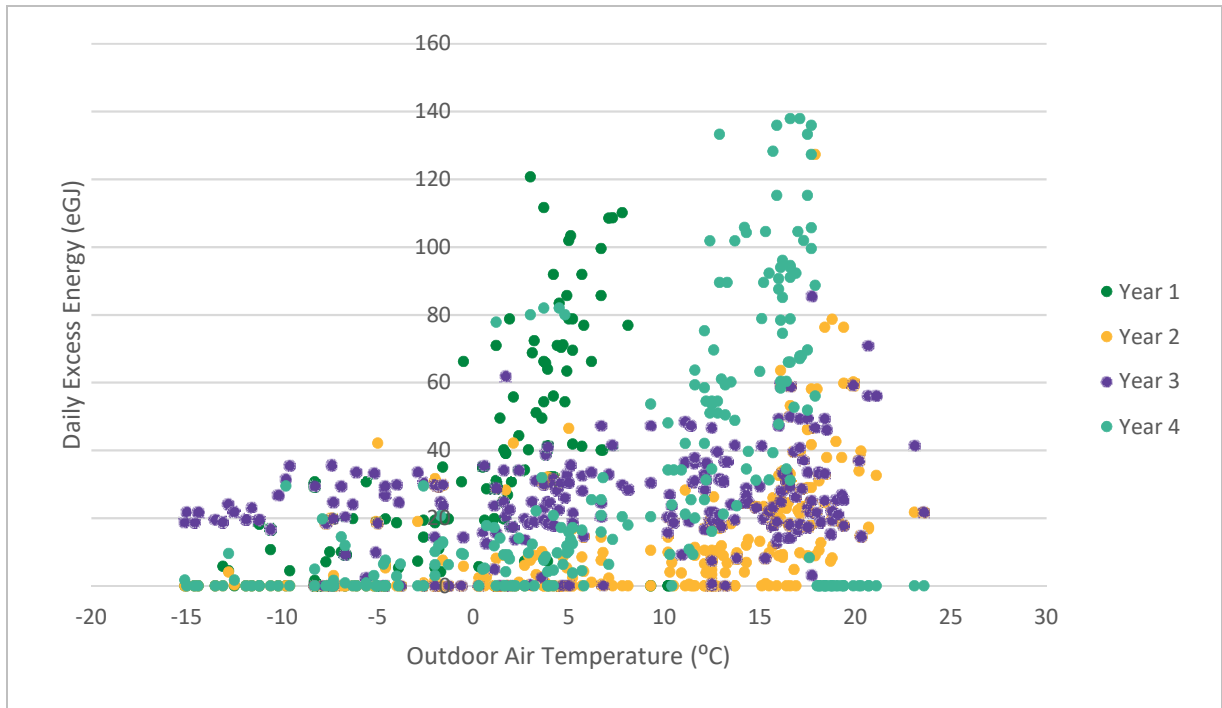


Figure 4.2: Daily Available Waste Heat versus Outdoor Air Temperature

Impact on Maintenance

The addition of new pump sets and water-water heat pump will increase the operations and maintenance requirements of City personnel.

Impact on Indoor Environment

No impact.

Expected Service Life of Measure

- Piping, 25+ years
- Hydronic control valves, 25+ years
- Actuators, 10+ years
- Water-water heat pump, 15+ years
- Pumps, 15+ years

Assumptions & Calculations

For detailed calculations, reference *Appendix C – Estimated Savings Calculation Sheet*.

Impact on Greenhouse Gas Emissions

A significant reduction in natural gas use at the Canada Games Aquatic Centre will reduce greenhouse gas emissions. Furthermore, since the system will be using waste heat from the Market Square facility, the overall energy footprint of the Canada Games Aquatic Centre will be



reduced. Meaning the only additional electrical consumption will be for use of the water-water heat pump, which operates with a coefficient of performance.

Cost & Savings Summary

Annual Consumption Savings:	(558,839) kWh
Annual Demand Savings:	(2,534) kW
Annual Natural Gas Savings:	6,851 GJ
Annual GHG Emissions Savings:	172 teCO ₂
Annual Savings Reconciled at:	\$86,938
Annual Carbon Tax Avoidance:	\$12,156
Estimated Total Project Cost:	\$1,848,227
Estimated LCEF Incentives:	\$739,291
Estimated NB Power Incentives:	\$200,000
Simple Payback:	9.2 years

*Note: Estimated incentives funding calculated for the Low Carbon Economy Fund (LCEF) uses a 40% contribution towards the total project cost. This incentive funding is administered by the Federal Government through an agreement with the City and currently has an end date of March 2024.

For a high-level breakdown of the total project cost estimate, reference **Appendix D – Class “C” Opinion of Probable Cost**.



5 CONCLUSION

As part of their initiative to reduce energy consumption and the environmental footprint, the City of Saint John commissioned MCW Maricor to conduct a Feasibility Study of the Canada Games Aquatic Centre Thermal Interconnect with the Market Square. Having conducted a site review and analyzing the existing systems, energy efficiency and conservation estimates were developed which, if implemented, will provide both natural gas savings and financial savings in addition to reducing the City's environmental footprint. Available incentives from the Low Carbon Economy Fund have been estimated.

Like many building owners and managers, the City of Saint John must now include energy efficiency and conservation in the equation when making decisions on facility renewal and operation. The implementation of this project should be considered as a stepping-stone towards a continued focus on reducing energy consumption. This opportunity will allow the City to reap the financial and operational benefits of improved energy performance while demonstrating leadership in environmental responsibility.

APPENDIX A
**ENERGY USAGE
SUMMARY**

Project Name: Canada Games Aquatic Centre & Market Square - Thermal Interconnect

Building Name: Canada Games Aquatic Centre

Project Number: 12-20-009

62,872 sq.ft.

61.8 Total EUI

Utility Usage - Jan 2020 to Dec 2022

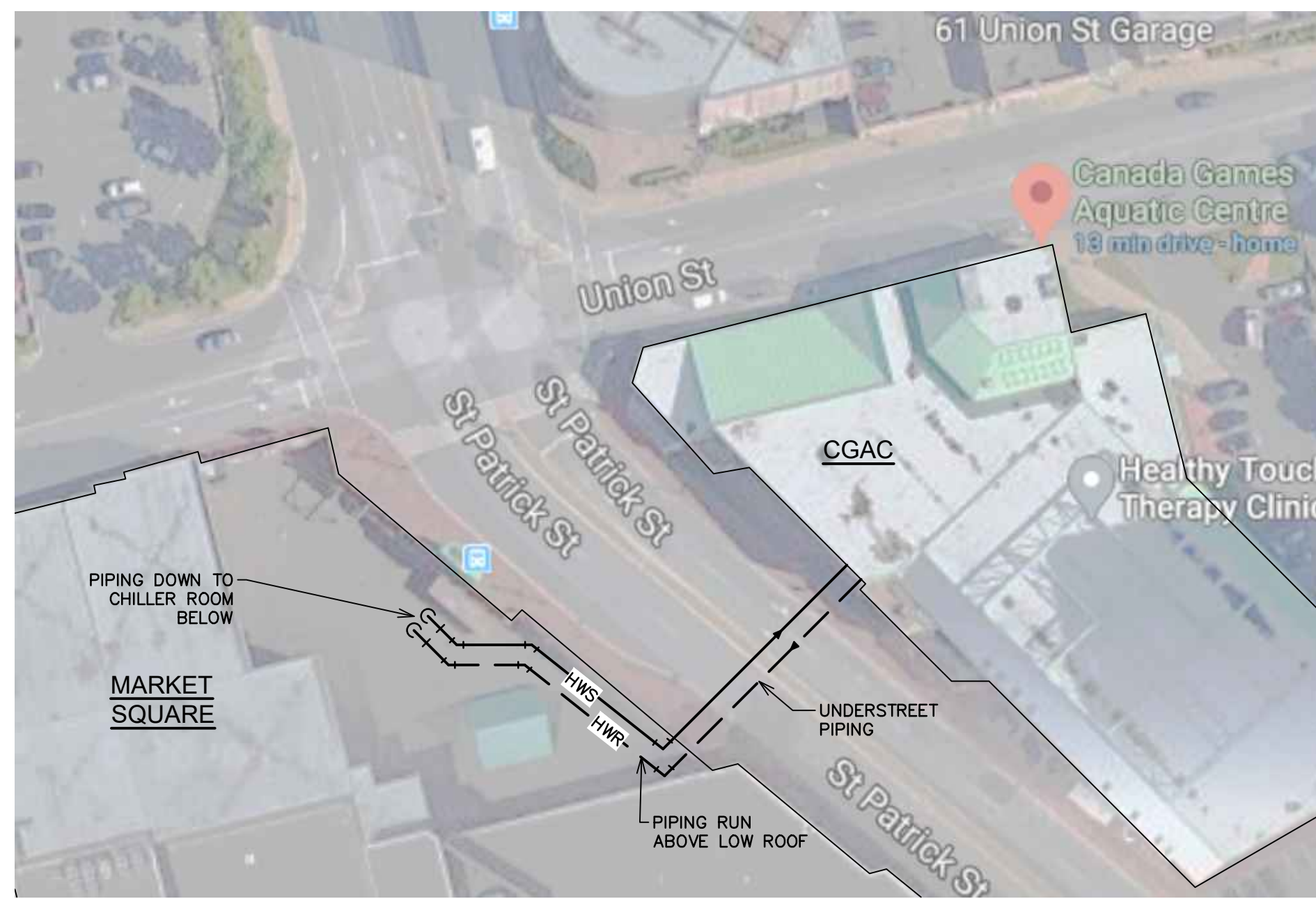
GS102 Elect. Rate Code

Date	Billing Days	Electrical Consumption (kWh)	Electrical Demand (kW)	Load Factor	Natural Gas (GJ)	HDD @ 18°C (Saint John, NB)
Jan-20	31	132,000	360.0	0.49	893	754
Feb-20	29	150,000	360.0	0.60	707	690
Mar-20	31	142,800	360.0	0.53	470	598
Apr-20	30	138,000	367.2	0.52	131	457
May-20	31	58,800	288.0	0.27	165	292
Jun-20	30	66,000	336.0	0.27	507	115
Jul-20	31	162,000	348.0	0.63	447	48
Aug-20	31	183,600	360.0	0.69	411	47
Sep-20	30	157,200	348.0	0.63	451	130
Oct-20	31	157,200	348.0	0.61	531	293
Nov-20	30	169,200	216.0	1.09	564	412
Dec-20	31	148,800	312.0	0.64	704	574
Jan-21	31	158,400	324.0	0.66	821	703
Feb-21	28	115,200	312.0	0.55	753	673
Mar-21	31	134,400	288.0	0.63	776	610
Apr-21	30	159,600	324.0	0.68	612	381
May-21	31	144,000	324.0	0.60	566	255
Jun-21	30	147,600	336.0	0.61	482	85
Jul-21	31	172,800	348.0	0.67	483	61
Aug-21	31	160,800	360.0	0.60	463	32
Sep-21	30	163,200	372.0	0.61	451	85
Oct-21	31	166,800	372.0	0.60	973	220
Nov-21	30	148,800	348.0	0.59	234	449
Dec-21	31	140,400	336.0	0.56	717	628
Jan-22	31	136,800	324.0	0.57	674	816
Feb-22	38	96,000	324.0	0.32	797	661
Mar-22	31	148,800	336.0	0.60	566	609
Apr-22	30	146,400	336.0	0.61	716	410
May-22	31	150,000	312.0	0.65	636	243
Jun-22	30	154,800	360.0	0.60	521	114
Jul-22	31	178,800	360.0	0.67	458	38
Aug-22	31	169,200	372.0	0.61	461	23
Sep-22	30	177,600	384.0	0.64	546	113
Oct-22	31	162,000	372.0	0.59	623	214
Nov-22	30	152,400	372.0	0.57	795	412
Dec-22	31	140,400	384.0	0.49	662	600

Baseline

Year 2022	1,813,200	4,236	7,455
Year 2021	1,812,000	4,044	7,330
Year 2020	1,665,600	4,003	5,979

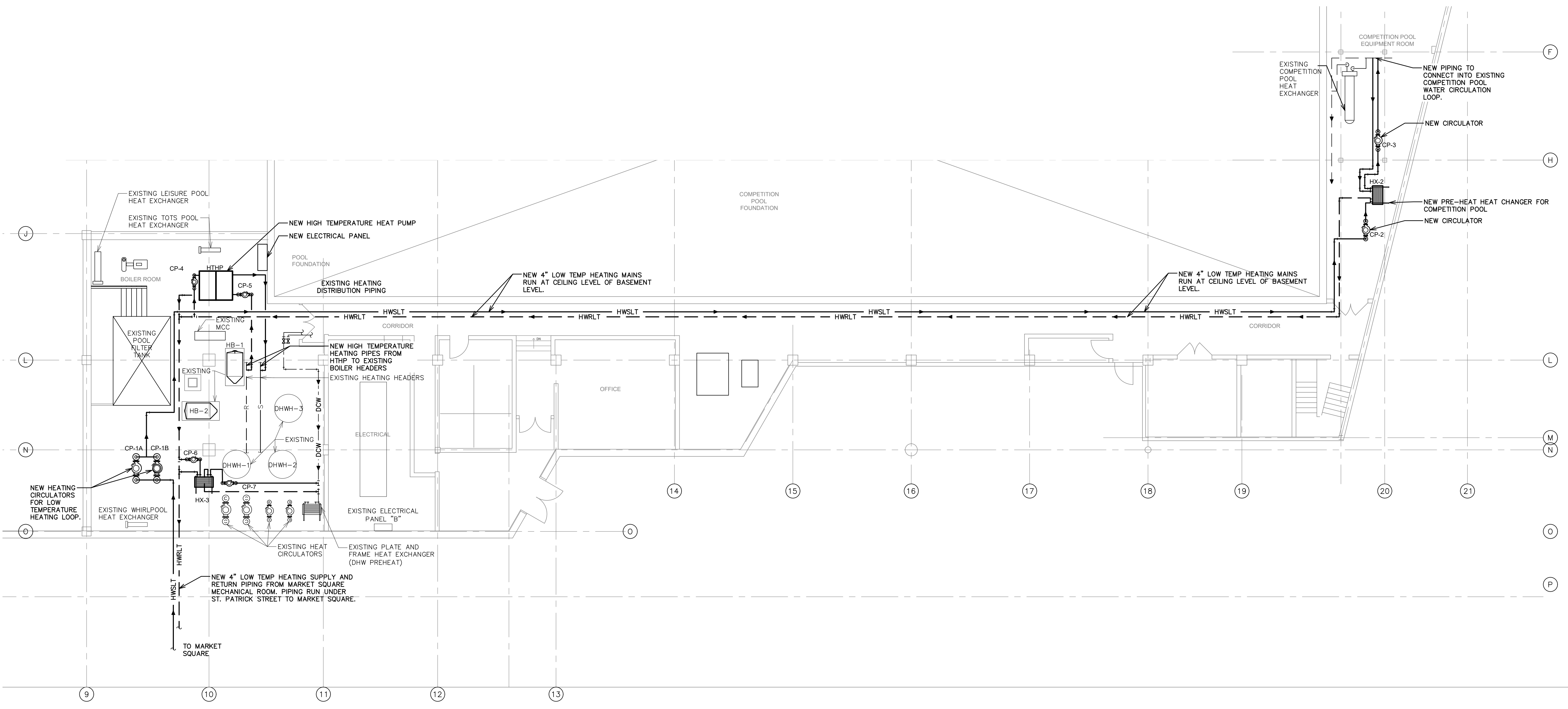
APPENDIX B
**PRELIMINARY
DRAWING SET**



1

M-1 SITE PLAN

N.T.S.



STAMP:
PRELIMINARY ONLY
 NOT TO BE USED FOR CONSTRUCTION

NO.	REVISIONS	DATE	INIT.

PROJECT TITLE:
CANADA GAMES AQUATIC CENTER THERMAL INTERCONNECT TO MARKET SQUARE

DRAWING TITLE:
BASEMENT HEATING NEW WORK & SITE PLAN

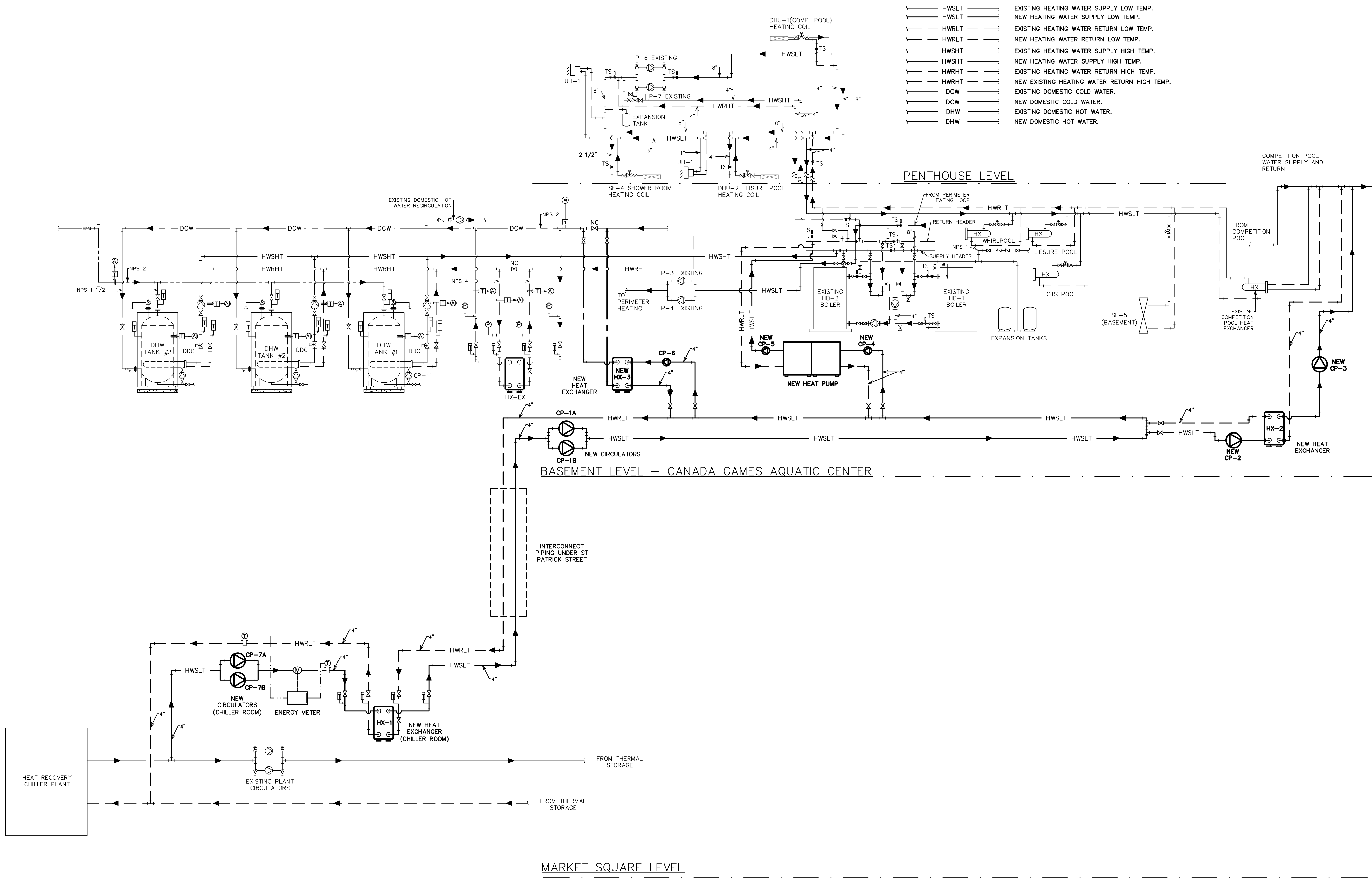
SCALE: AS NOTED	DATE: APRIL 2020
DRAWN BY: K.M.	DRAWING NO: M-1
CHECKED BY: S.R.E.	

N.T.S.

2

M-1 BASEMENT - PLUMBING NEW WORK

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- HWSLT — EXISTING HEATING WATER SUPPLY LOW TEMP.
- HWSLT — NEW HEATING WATER SUPPLY LOW TEMP.
- HWRLT — EXISTING HEATING WATER RETURN LOW TEMP.
- HWRLT — NEW HEATING WATER RETURN LOW TEMP.
- HWSHT — EXISTING HEATING WATER SUPPLY HIGH TEMP.
- HWSHT — NEW HEATING WATER SUPPLY HIGH TEMP.
- HWRHT — EXISTING HEATING WATER RETURN HIGH TEMP.
- HWRHT — NEW HEATING WATER RETURN HIGH TEMP.
- DCW — EXISTING DOMESTIC COLD WATER.
- DCW — NEW DOMESTIC COLD WATER.
- DHW — EXISTING DOMESTIC HOT WATER.
- DHW — NEW DOMESTIC HOT WATER.

STAMP:

PRELIMINARY ONLY
 NOT TO BE USED FOR CONSTRUCTION

NO: REVISIONS DATE INIT.
 PROJECT TITLE:
CANADA GAMES AQUATIC CENTER THERMAL INTERCONNECT TO MARKET SQUARE

DRAWING TITLE:
PIPING FLOW SCHEMATIC

SCALE: AS NOTED DATE: APRIL 2020
 DRAWN BY: K.M. DRAWING NO: **M-2**
 CHECKED BY: S.R.E. N.T.S.

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APPENDIX C
**SAVINGS
CALCULATION
SHEET**

Market Square & Canada Games Aquatic Centre Thermal Interconnect

Energy Savings Calculations

MCW Job No: 12-20-009

Utility Data	2018 Annual	8288 GJ	
	2019 Annual	8246 GJ	
	2020 Annual	5979 GJ	COVID
	2021 Annual	7330 GJ	
	2022 Annual	7455 GJ	
2022 weighted Rate	NG \$	22.89 GJ	
	Elec \$	0.0809 kWh	
	Elec \$	9.73 kW (True demand cost)	

Potential Savings Retrofit	Existing GJ	Direct HR Opportunity		Natural Gas Offset to HTHP GJ		Electrical Input kWh at COP	Remaining Natural Gas GJ	Energy Savings	
		GJ	%	GJ	%			GJ	Electricity kWh
Space Heating	1,005	-	0%	804	80%	77,258	201	804	77,258
Ventilation Requirements	2,684	-	0%	2,282	85%	219,341	403	2,282	219,341
Pool Water Heating	2,093	1,569	75%	523	25%	50,288	-	2,093	50,288
Domestic Hot Water Heating	1,673	837	50%	837	50%	80,436	-	1,673	80,436
	7,455	2,406		4,445		427,323	604	6,851	427,323

Pumping:	hp	kW	VFD	Avg Load	Hrs	kWh
Market Square (CP-8A/8B)	7.5	5.6	Y	50%	8,760	24,506
CGAC:						
Primary: CP-1A/1B	5	3.7	Y	50%	8,760	16,337
HX-2: CP-2	3	2.2	N	75%	8,760	14,704
Pool Pre-heat: CP-3	3	2.2	N	75%	8,760	14,704
Heat Pump: CP-4	3	2.2	N	75%	8,760	14,704
Heat Pump: CP-5	5	3.7	N	75%	8,760	24,506
HX-3: CP-6	3	2.2	N	75%	8,760	14,704
DHW Preheat: CP-7	1.5	1.1	N	75%	8,760	7,352
		23.1 /mth				131,516

Additional Usage	
Pumping	See Table - 278 kW
HTHP	188 kW/mth - 2,256 kW
Pumping	See Table - 131,516 kWh

Total Savings		
GJ NG	6,851	\$ 156,829
kWh	- 558,839	-\$ 45,210
kW	- 2,534	-\$ 24,651
Carbon Tax (\$70/teCO2)		\$ 12,156
Total		\$ 99,124

Total Project		City Net	
Capital	\$ 1,848,227	\$ 1,108,936	City Capital 60%
		-\$ 200,000	Incentive @ \$60/eGJ
SPB	18.6	9.17	SPB

Carbon Reduction Potential		
eCO2	174	tons
	10,643	\$/ton

APPENDIX D
CLASS "C"
**OPINION OF
PROBABLE COST**

Canada Games Aquatic Centre Thermal Interconnect with Market Square Complex

MCW Job No. 12-23-012

Opinion of Probable Cost, Class "C"

05-Jul-23

Equipment	<u>Unit Cost</u>	<u>Contingency</u>		<u>Total</u>
High Temperature Heat Pump	\$245,000	5%	\$	257,250
Heat Exchangers (HX-1,2,3)	\$130,000	5%	\$	136,500
Pumps CP-1 through CP-8	\$200,000	5%	\$	210,000
Equipment general installation	\$172,500	15%	\$	198,375
Piping				
Street Crossing (Civil Work)	\$150,000	15%	\$	172,500
Street crossing thermal piping	\$52,500	15%	\$	60,375
Primary pipe loop from Market Square to CGAC Pump Room	\$108,000	15%	\$	124,200
Branch piping to heat exchangers	\$58,500	15%	\$	67,275
Branch piping to high temperature heat pump	\$24,000	15%	\$	27,600
Tie-in at Market Square	\$107,000	15%	\$	123,050
800 USGal - 40% propylene glycol	\$15,750	15%	\$	18,113
Controls				
Equipment tie-ins	\$18,600	15%	\$	21,390
Various Sensors	\$19,500	15%	\$	22,425
Programming	\$22,945	15%	\$	26,387
Electrical				
Wiring, tie-ins, accessories - CGAC	\$54,600	15%	\$	62,790
Wiring, tie-ins, accessories - Market Square	\$10,400	15%	\$	11,960
Total Construction Cost			\$	1,540,189
OH&P, Permits etc (5%)			\$	77,009
Soft Cost (15%)			\$	231,028

ESTIMATED PROJECT COST \$ 1,848,227 + HST

Notes:

Hazardous materials abatement, if required, not included
 Costing does not include taxes



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