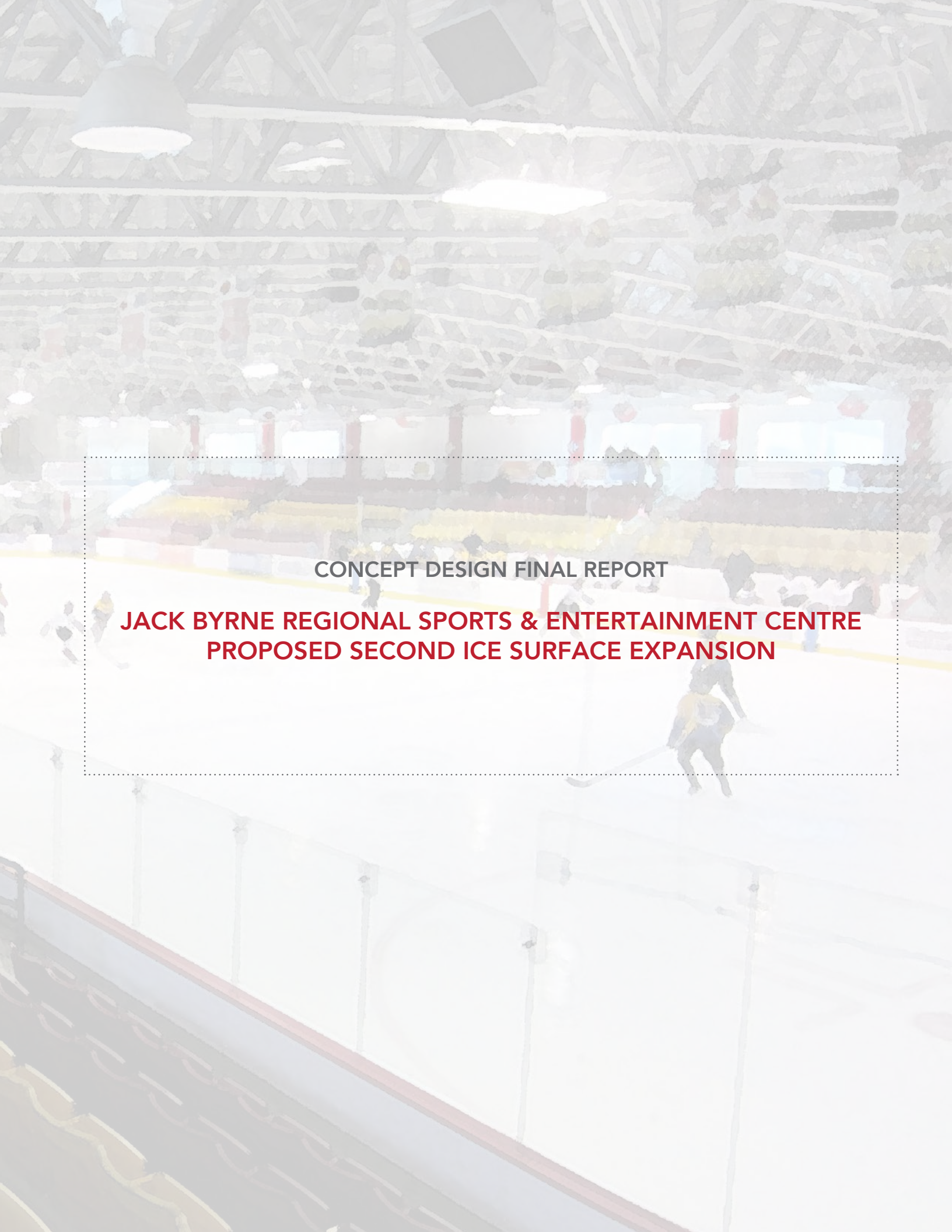

CONCEPT DESIGN FINAL REPORT

JACK BYRNE REGIONAL SPORTS & ENTERTAINMENT CENTRE
PROPOSED SECOND ICE SURFACE EXPANSION

Submitted to:

LORNE TUCKER,
MANAGER

Jack Byrne Regional
Sports & Entertainment Centre

7 Kennedy's Brook Drive

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CONCEPT DESIGN FINAL REPORT

JACK BYRNE REGIONAL SPORTS & ENTERTAINMENT CENTRE PROPOSED SECOND ICE SURFACE EXPANSION

Submitted by:

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February 28, 2018

CONTENTS

01. INTRODUCTION

01. Consultant Team

This conceptual design report has been compiled by:

i. LAT49 Architecture Inc. - architect

ii. Jewer Bailey Consultants Ltd. - structural, mechanical and electrical consultants

iii. CIMCO - refrigeration plant specialists

iv. QSolv Inc. - costing consultant

02. Report Contents and Purpose

The purpose of this report is to provide the board of directors of the Jack Byrne Regional Sports & Entertainment Centre with a detailed description of the proposed new expansion to the existing arena, so they can make an informed decision to proceed with detailed design. This report document is accompanied by schematic plans of the facility and the site (Appendix B).

A Class C estimate of probable construction costs is included with this report. The description of civil infrastructure, structural systems, architectural elements, and mechanical and electrical systems within this report represent the type of equipment, services and levels of finish included in the cost estimate.

02. SITE DESIGN AND LANDSCAPE

01. Site Description & Background

1. Location

The Jack Byrne Arena expansion project is located in the Town of Torbay, NL. The existing arena site was developed in 2006/2007 and included a single ice surface arena, parking lot, and the construction of Kennedy's Brook Drive.

The site works civil package also included for the design and construction of an on-site sewage treatment plant and water supply which included a deep well, water storage distribution system, fire pump, and domestic water pumps. The site also incorporated an 800 m^3 storm water detention pond which was developed through storm water management of the site and can be utilized as an emergency water supply for fire fighting.

The expansion of the existing arena site includes the construction of a new building to house a second ice surface, new parking area and a relocated entrance from Kennedy's Brook Drive. The civil works will include the parking lot layout, site grading, asphaltic concrete (pavement), curb, sidewalk and site landscaping.

2. Geotechnical Information

There was no geotechnical investigation or materials testing completed as part of this work.

A Geotechnical test pit investigation was carried out on January 3, 2007 by Jacques Whitford Limited, and a report was provided on January 12, 2007. A series of test

pits were completed to assess the site geology for the construction of the original building foundations.

The site geology generally consists of siltstone, sandstone and cobbles. Probable bedrock was identified in five of the seven boreholes.

This report is to be considered as a guide only. A new geotechnical evaluation of the site should be carried out in the area where the expansion is planned to verify if any special conditions exist.

3. Environmental Assessment

For the purpose of this report no environmental assessments were completed.

4. Land Acquisition

There will be land purchase required for this expansion project. Land for the new parking lot and access roads between the existing parking and future parking will need to be acquired. In addition, the extension of Kennedy's Brook Drive will be required to the project boundaries.

5. Site Considerations

The site plan has been developed with the following considerations:

i. The expansion layout must take into consideration the 22.66 m wide power easement which runs in the east/ west direction, through the parking lot behind the existing building.

ii. The existing entrance is requested to be reconfigured to accommodate traffic flow.

iii. Drainage will be to a series of catch basins located throughout the site with stormwater collection into the existing creek and emergency water supply detention pond.

iv. Finished elevations for the site works are selected

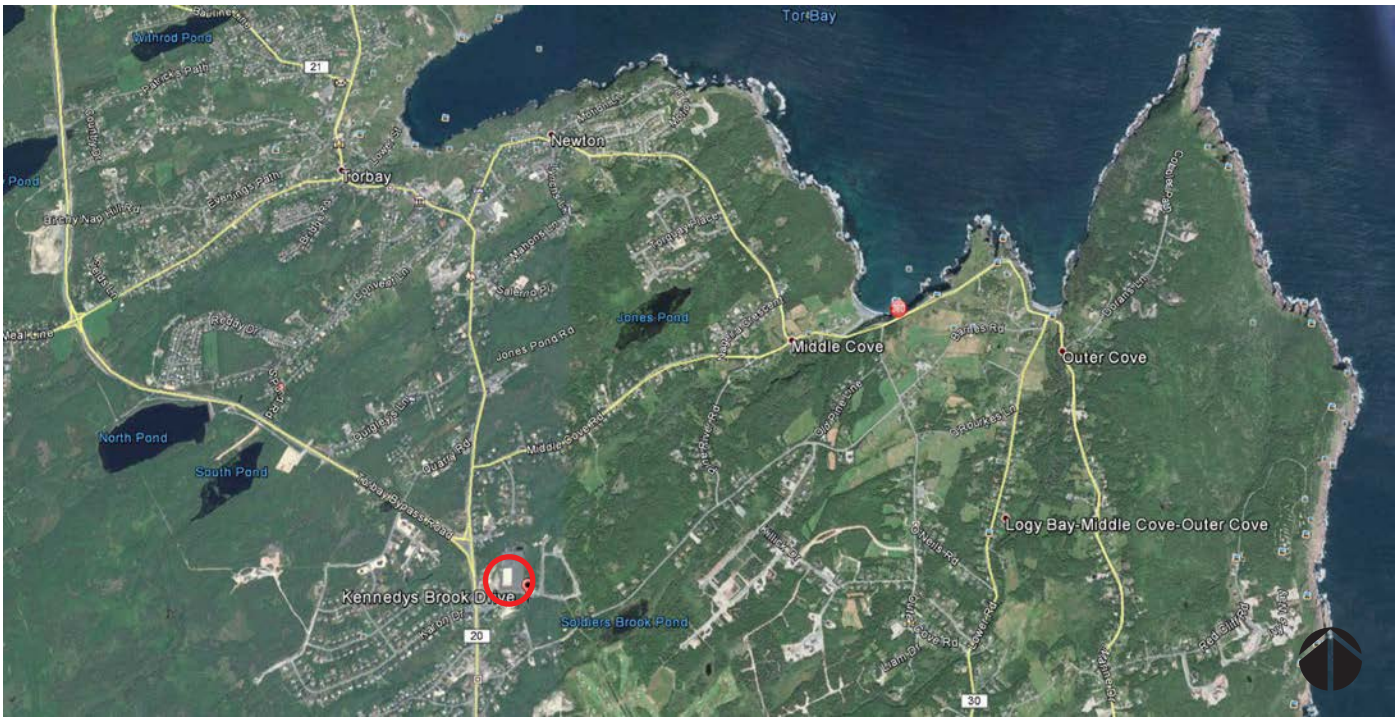

Image 01. Location of Jack Byrne Regional Sports & Entertainment Centre.

to minimize excavation and use existing grades wherever possible.

v. To minimize costs, new infrastructure is tied into the existing infrastructure as required.

02. Site Development

1. Site Grading

The existing arena and new expansion are at approximately 82.35 m above sea level. The site slopes from the south to north by 4.35 m. The new parking area on the east of the site will have access from Kennedy's Brook Drive. This area also slopes from south to north to 2.35 m. There is an area between the new expansion and the new parking lot which encompasses an existing ditch. This ditch will remain. There will be two access points between the new parking lot and the existing facility with two new culverts installed to span the ditch under the access roads.

2. Asphalt Concrete Pavement

Special recommendations for the pavement sub-structure should be made prior to the completion of design.

Generally, two 38 mm lifts of asphalt paving will be applied to all driving surfaces.

3. Granular Fill

The following combination of granulars is proposed:

i. 150 mm Class "A" Granular Base

ii. 300 mm Class "B" Granular Sub-Base

Fill under all roadways and parking areas will be compacted.

4. Concrete Curbs & Sidewalks

Along the building frontage 30 MPa concrete sidewalks with curbs will be provided. Low back curbs will be incorporated into the sidewalk at the accessibility ramps.

5. Pavement Marking

Painted lines, directional arrows and accessibility markings will be provided as necessary.

6. Traffic Design

The design flow of traffic will be two-way throughout the site, except for one-way sections at the main entrance drop-off area and the access roads past the new extension to the existing parking lot. Pedestrian traffic will be provided with cross walks and walkways.

Image 02. Existing site.

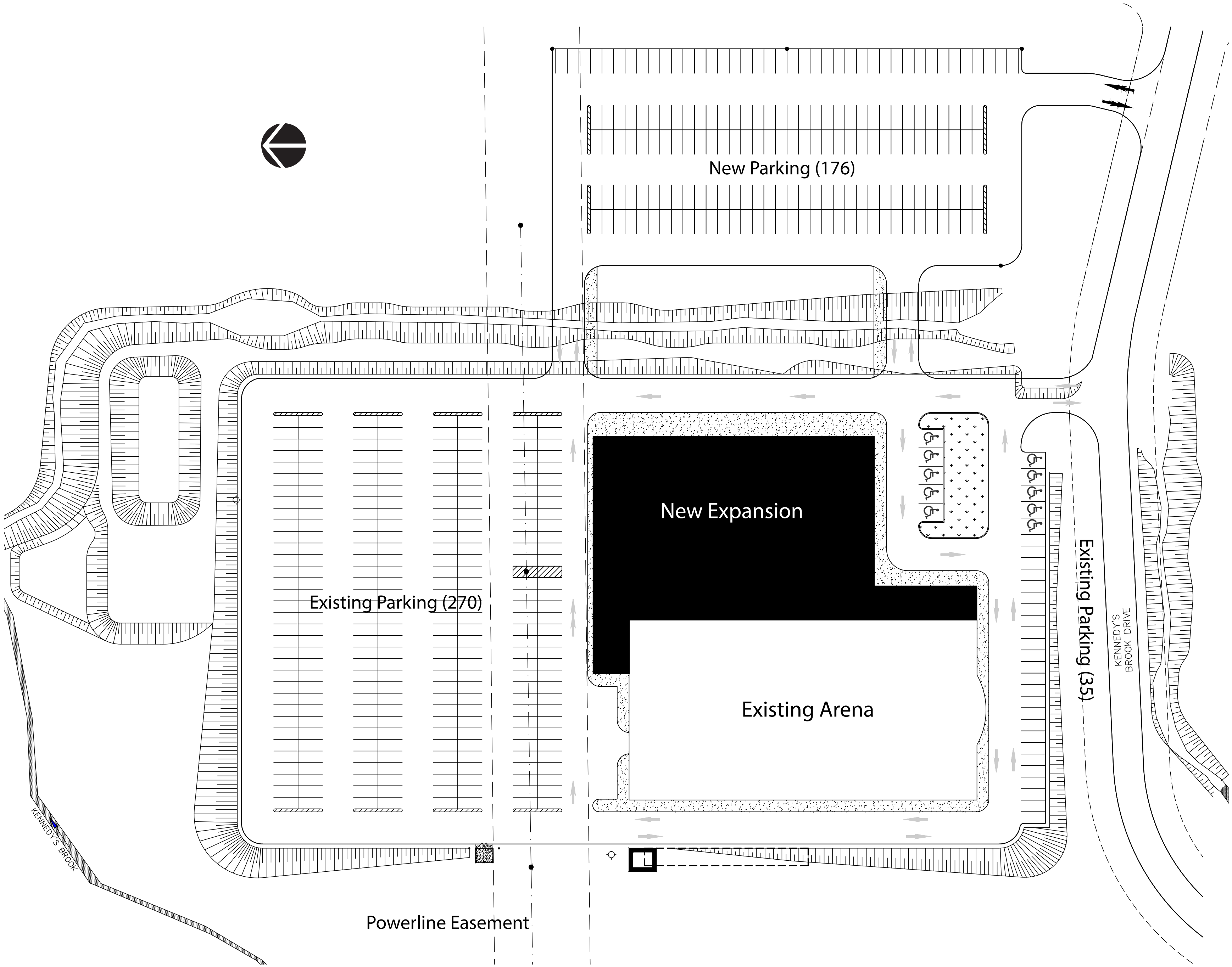

Image 03. Site plan.

7. Signage

Appropriate signage will be provided to indicate the flow of traffic, use of parking stalls, bus zones, drop-off areas, etc. This will be done in accordance with the guidelines of the "Sign Pattern Manual" as published by Transportation Association of Canada.

8. Landscaping

All areas not occupied by the building, concrete, asphalt, road granulars, or other facilities, will be landscaped using 150 mm of topsoil and nursery sod. Sodding is recommended over seeding due to the quality of the finished product and the immediate surface finish that it provides without requiring long growth periods.

9. Parking Lots & Roads

Four parking areas will be provided, for a total of 481 parking stalls including 19 accessible stalls for the entire complex, as per provincial regulations.

10. Walkways

Concrete walkways will be provided along the building frontage with an accessible ramp adjacent to the accessible parking stalls. Walkways will grant pedestrians safe access.

03. Site Servicing & Utilities

1. Trench Excavation

All piping systems should be constructed to the depth shown on the plans. Trenches will be excavated to the specified dimensions and grades given by the Engineer, and only as far in advance of the pipe laying as specified, to a maximum of 30 m.

The bedding material shall be compacted beneath and around the pipe to the undisturbed trench walls and have a compacted thickness of not less than 300 mm over the top of the pipe, unless otherwise indicated on the drawings.

2. Bedding & Backfilling

Bedding material for the sanitary and storm sewers and services will be aggregate material conforming to the required gradation. Bedding material for electrical conduit will be sand.

The remainder of the pipe trench will be backfilled with excavated material containing no stone larger than 150 mm. The material will be placed in layers not exceeding 300 mm in thickness and adequately compacted. Backfill material will be of a composition that provides insulation qualities.

3. Water

The existing water storage facility will provide the required water supply for domestic water and fire flow requirements. Fire flow requirements are to be coordinated with the mechanical systems inside the buildings and the existing pump house.

The water requirements for the new extension's system will connect to the existing water main inside the current building.

4. Hydrants

There is a dry barrel type hydrant located on the north side of the existing parking lot. There is also a connection to the emergency water reservoir to provide additional resources for fire fighters.

5. Wastewater

The existing building is serviced by a sanitary collection system flowing to an on site sewage treatment plant.

Image 06 shows the layout and connections from the existing arena and new extension to the sewage treatment area on the north side of the site. The existing connections are illustrated in red while the new connections are illustrated in blue.

New piping and manholes will be routed to the treatment plant area on the site.

Moving into the design development, a capacity analysis will be completed to determine if the existing plant has the capacity to handle and treat the sanitary flows from the entire facility or if a second plant will be required.

6. Storm Water

Storm water will be accommodated by new and existing catch basins which discharge to existing locations at Kennedy's Brook adjacent to the site. Two new culverts will be required crossing the brook to access the new parking area. These culverts will be 1500 mm x 3048 mm in size and are required at two locations.

A new headwall will be required at the north side of the new parking area.

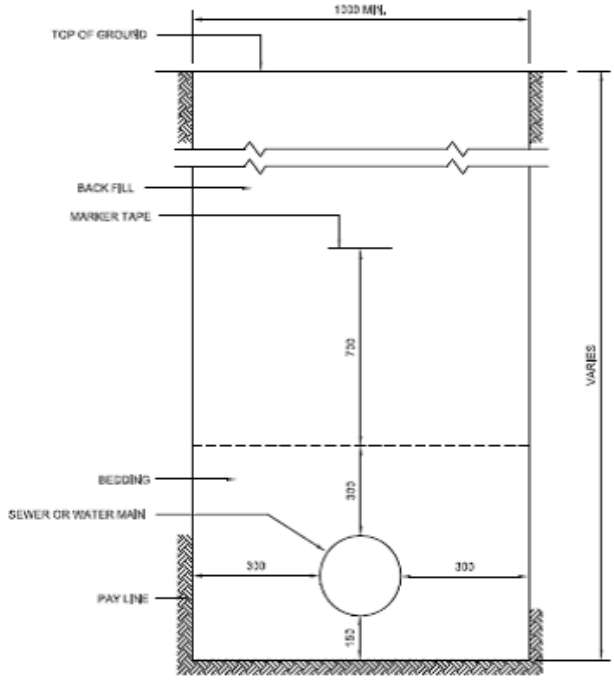

Image 04. Typical Trench Detail.

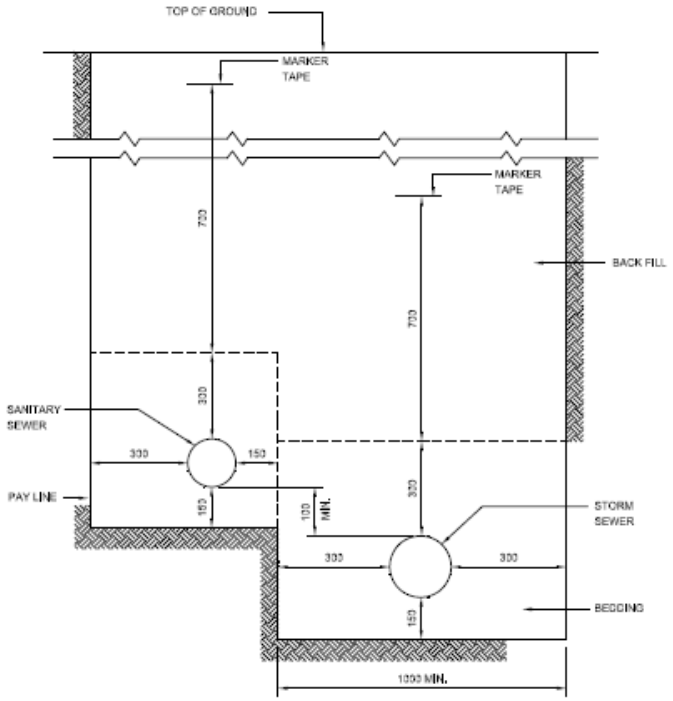

Image 05. Typical detail for two adjacent pipes.

The storm water will either run into the brook and be captured by the emergency water supply detention pond or continue to run downstream in the brook. **Image 06** shows the layout and connections of the storm water system. The existing connections are illustrated in green while the new connections are illustrated in cyan.

The new expansion will also incorporate an under-slab drainage pipe network to allow water under the slab to flow away from the site. The **Image 07** indicates how the existing and proposed under-slab drainage pipe network will be constructed.

7. Electrical Services

Three-phase power is available at the current site and will be extended to the new building location by Newfoundland Power.

There is a 22.66 m Newfoundland Power easement which runs east/west across the center of the site north of the proposed building expansion.

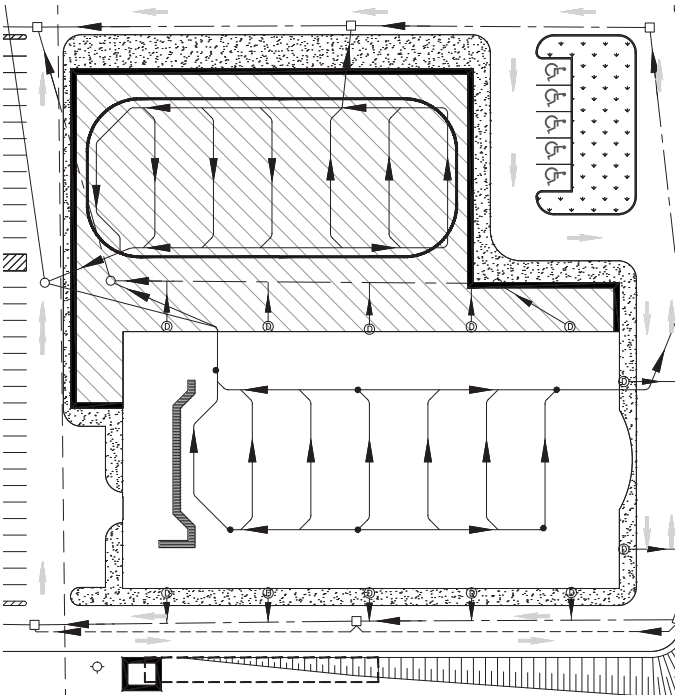

Image 07. Under-slab drainage network.

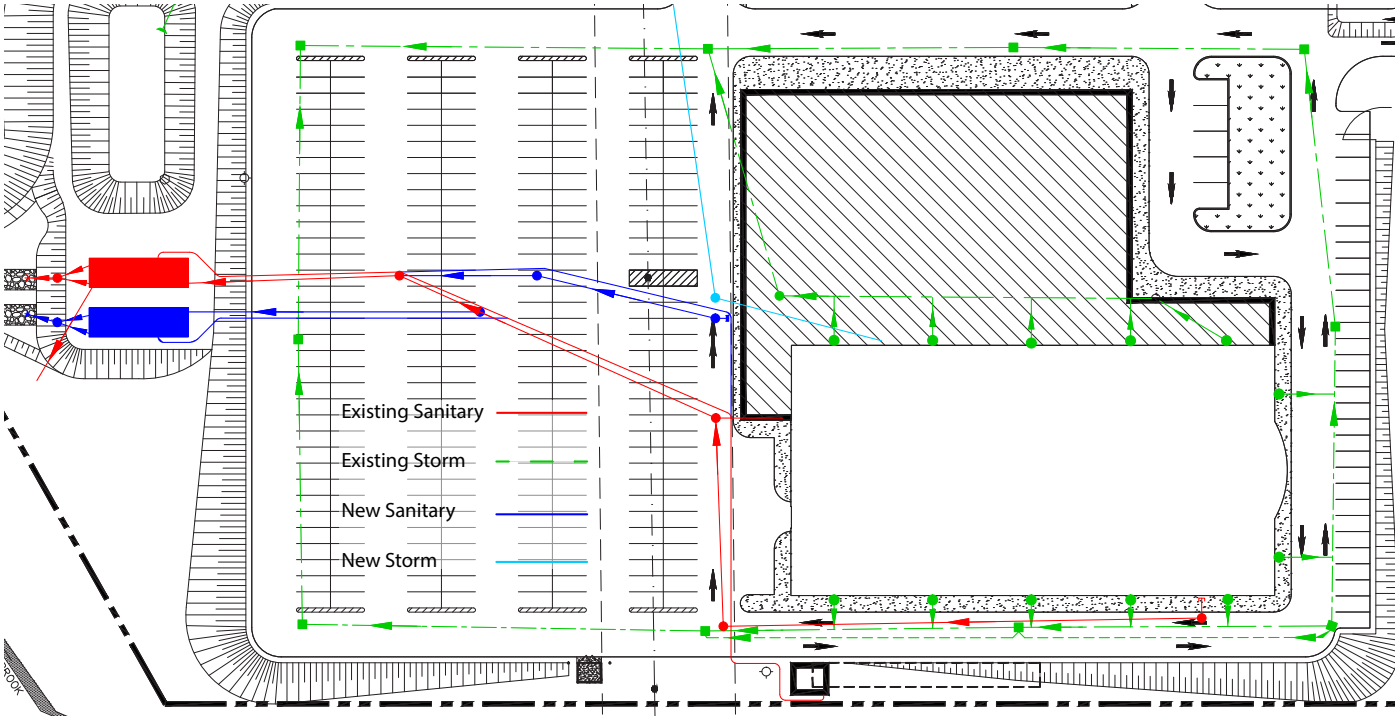

Image 06. Wastewater connections.

03. ARCHITECTURAL DESIGN

01. Existing Building Description

The Jack Byrne Regional Sports and Entertainment Centre is located at 7 Kennedy Drive, Torbay, NL. The existing arena has a total floor area of 4,777 m^2 (51,419 sf) with a building foot print of 3,499 m^2 (37,663 sf). The second level has an area of 1,278 m^2 (13,756 sf) and surrounds the open ice surface and spectator seating. The main level of the existing arena contains the ice surface, mechanical plant, ice resurfacer room, change rooms, public washrooms and administrative offices. The second level contains a community room, walking track, public washrooms, electrical room, sound booth, meeting room and canteen/kitchen service. The building measures approximately 81,700 mm (268 ft) long by 42,000 mm (138 ft) wide, with an overall approximate height of 11,502 mm (38 ft).

The existing building is a large, rectangular, two-storey gable-roof structure. The corners on the south end of the building are one storey, with the south-east corner serving as the main entrance.

The existing arena structure consists of concrete on the first level up to the mezzanine, including the mezzanine floor and spectator seating. On the second floor are a series of steel columns supporting large steel scissor trusses spanning the width of the open ice surface supporting the roof.

02. Tectonics

1. Massing

The new extension will be a combination of pre-engineered rigid frames and conventional structural steel supported by a reinforced concrete foundation. The total area of the new extension will be 4,084 m^2 (43,960 sf) bringing the total area of the facility to 8,861 m^2 (95,379 sf). The majority of the area of the new extension is on the main level, having a foot print of 3,211 m^2 (34,563 sf), with a mezzanine level of 873 m^2 (9,397 sf). The new building foot print will be 6,710 m^2 (72,225 sf) and measure approximately 92,420 mm (303 ft) long by 85,450 mm (280 ft) wide, with an overall approximate height of 11,502 mm (38 ft).

Image 08. Existing Jack Byrne Regional Sports & Entertainment Centre.

In terms of general massing, the combined new building is divided into three parts: the existing arena is a large, single-span rectangular structure, with a gable-style roof; the new extension will also be a large, single-span rectangular structure, with a gable-style roof and home to the new ice surface; and the connection between the new extension and the existing arena will be a long, two-storey rectangular structure, with a flat roof. For the purposes of this report, each mass will be referred to as: existing arena, new extension, and connecting bar. The connecting bar will house the lobby, ticket booth, pro-shop, new dressing rooms, first aid room, and ice resurfacer room on the first level; and new viewing area, meeting rooms, canteen and bar, and administrative offices on the second. As part of the formal strategy, the new extension has been pulled to the North of the existing arena to provide space for a new sun-filled formal entrance lobby and passenger drop-off.

At the South-West corner of the existing arena, the second level sees the addition of a multipurpose room to provide additional space for arena users and complete the formal appearance of the facility by filling in the corners and removing the red metal hipped roof.

2. Materials

As the expansion project is an addition to the existing Jack Byrne Regional Sports and Entertainment Centre, the materials will remain within the same palette. To create continuity with the existing building, the same combination of split-faced and smooth face architectural block will be used around the base perimeter of the connecting bar. The block will match the height of the existing arena creating a seamless connection. Additionally, the use of composite aluminum panels and matching green metal siding will help reinforce this bond. The bright red trim will continue along the entrance canopy, tying together

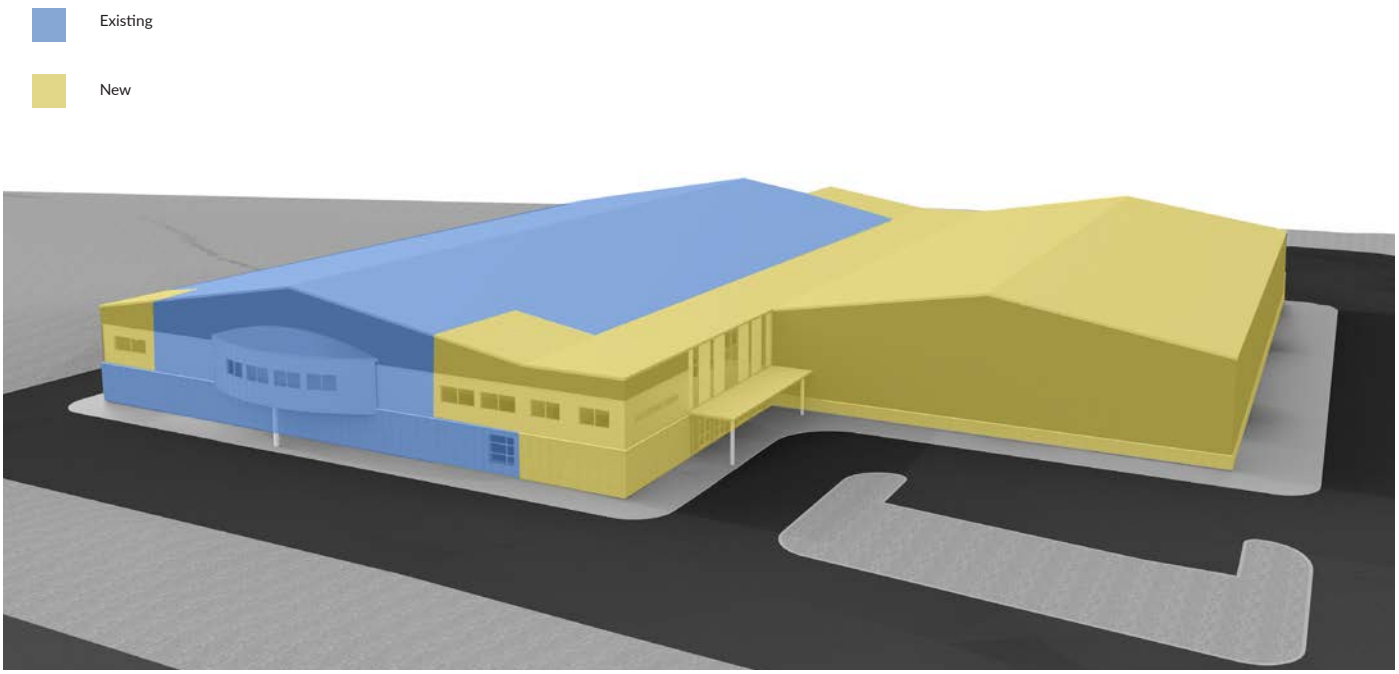

Image 09. Diagram of the existing Jack Byrne Regional Sports & Entertainment Centre with new extension and connecting bar.

the existing arena and the connecting bar.

The new extension will present itself with a simpler material palette, employing only the architectural block and green metal siding. This creates an easily identifiable monolithic form, helping to strengthen the arena's place within the region.

While these exterior cladding materials serve to unify the parts of the building into one cohesive facility, they have also been chosen for their durability and economy.

3. Fenestration

In accordance with client feedback the extension proposes, and in an effort to control costs, exterior glazing will be kept to a minimum. In fact, the entire new arena area is free from exterior windows. This eliminates any melting of the ice surface due to passive solar gain and reduces the glare from the southern sun on the ice surface. This in turn reduces the costs associated with running and maintaining a year-round ice surface.

All the new glazing is concentrated on the South-East corner of the connecting bar, providing daylight for the new main entrance lobby and new offices located on the second floor.

All window frames are proposed to be clear anodized aluminum with double-glazed, insulated sealed glazing units.

03. Program Elements

1. Entrance Lobby, Ticket Booth & Pro Shop

The new main entrance is located in the south-east corner of the connecting bar, between the existing arena and new extension. It replaces the existing entrance. There are four sets of double entrance doors with a flat exterior canopy

Image 10. Rendering of the existing Jack Byrne Regional Sports & Entertainment Centre with new extension and connecting bar.

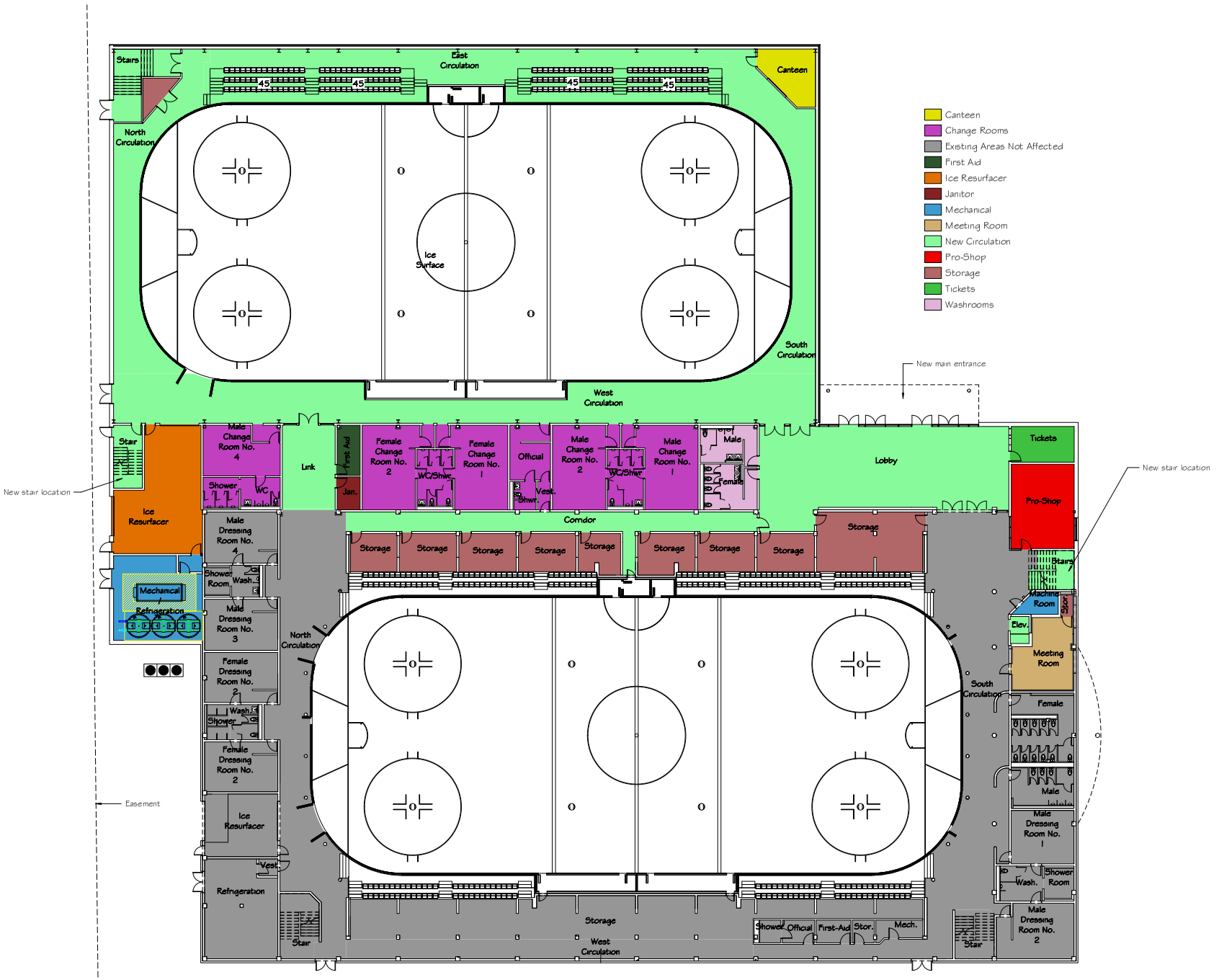

Image 11. Diagram of program elements on level 1.

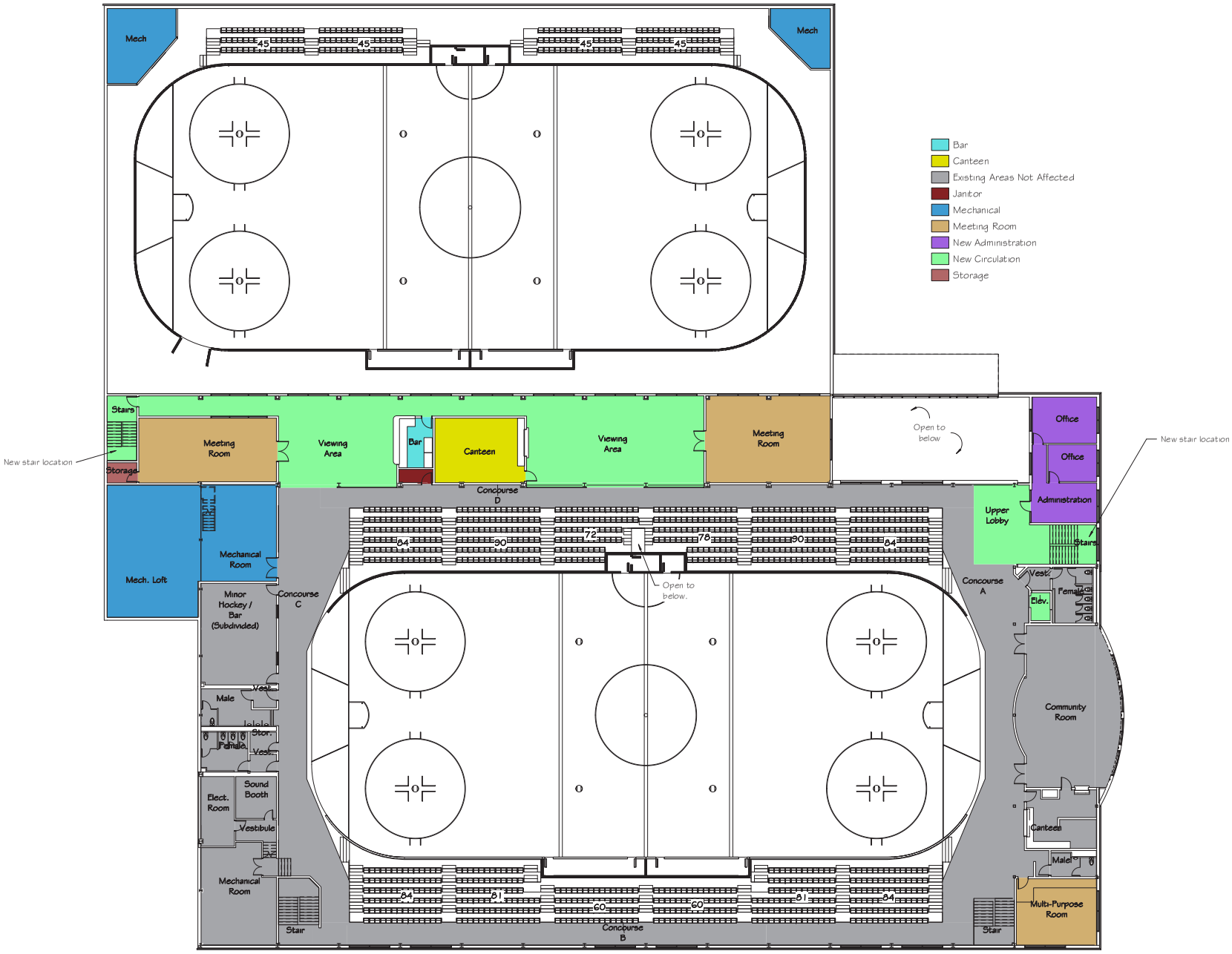

Image 12. Diagram of program elements on level 2.

to protect building users from rain or ice and snow falling from the roof. Immediately inside the entrance doors is a 183 m^2 (1,970 sf) double-height lobby with ample natural light provided by large East-facing windows. The lobby area serves as a weather vestibule between the arena open areas and the outdoors. It provides access to public washrooms and serves as the connection space between the existing arena and new extension.

An access corridor on the north-west side of the lobby allows for direct access to the change rooms located at the north end of the existing arena. This corridor also provides access to 212 m^2 (2,282 sf) of newly expanded, code-compliant, storage rooms under spectator seating, Partitions will be constructed from fire-rated concrete-blocks. This corridor also allows access to an improved entrance to the Time Keeper's box.

The lobby also houses the ticket booth, providing a point of sale for those attending events in both arenas.

The existing arena can be accessed through two sets of double doors on the south-west side of the lobby. Once past these doors, a new pro-shop provides 47 m^2 (506 sf) of retail space for sporting goods and equipment. The removal of the existing mezzanine staircase provides clear access to the spectator seating on the lower level. A new staircase adjacent to the Pro-Shop provides access to the upper concourse. The existing wheel chair lift will be replaced with an elevator to provide universal access to the upper concourse for people of all ages and abilities.

Image 13. Rendering of the new main entrance.

2. NHL Regulation Ice Surface, Change Rooms & First Aid

The new extension can be accessed through two sets of double doors at the north-east of the new lobby. This large open space contains the new NHL regulation size ice surface measuring 60,960 mm (200 ft) long by 25,908 mm (85 ft) wide, with seating for 180 spectators. The circulation space around the new rink also provides opportunities for spectators to stand, meet family and friends, and cheer on players at ice level.

A small satellite canteen in the south-east corner of the new extension provides convenient access to snacks during games and practices.

The new extension also provides access to five new dressing rooms located in the connecting bar, three male and two female. The four dressing rooms at the centre of the connecting bar are fully accessible and measure 8142 mm (27 ft) long by 5165 mm (17 ft) wide, with an approx. area of 40 m^2 (431 sf). Each pair of dressing rooms shares a wet area with showers, sinks and toilets.

The fifth dressing room measures 7444 mm (24 ft) long by 4922 mm (16 ft) wide, with an approx. area of 30 m^2 (323 sf) and is located in the north-west corner, adjacent to the ice resurfacer room. This dressing room has it's own wet area, including three dedicated showers.

In addition, the new official's change room can be accessed from both the existing arena and new extension, reducing the need for the officials to cross paths with

Image 14. Rendering of the new lobby.

players during games. The inclusion of a new first aid room provides dedicated support to the new ice surface while a new janitor's room promotes a clean and healthy facility.

The new extension is completely environmentally separated from the existing arena which means the 2,257 m^2 (24,294 sf) space can operate as a dedicated ice surface throughout the year and maintain a cooler indoor temperature than the original arena area.

3. Ice Re-surfacer, Refrigeration Plant & Mechanical Rooms

In the north-west corner of the new expansion is the new ice resurfacer room and new mechanical refrigeration plant. The new ice resurfacer room allows direct access to the new ice surface. The new expansion ice surface will have its own dedicated mechanical and refrigeration plant, allowing the new ice surface to be independent of the existing arena.

In the north- and southeast corners of the new extension are two elevated mechanical rooms. These provide dedicated space for new HVAC, electrical and mechanical equipment.

4. Meeting Rooms, Offices, Viewing Mezzanine, Canteen & Bar

The second level can be accessed by the new main stair and elevator in the existing arena adjacent to the pro-shop; by an exit stair in the north-west corner of the new expansion; or via the bleachers in the existing arena.

Image 15. Rendering of the new extension ice surface.

From the existing arena entrance, the new stair and elevator bring you to an upper lobby. Off the upper lobby are new offices, providing 66 m^2 (710 sf) of administrative space. These offices have a view to the outside as well as views into the main entrance lobby. At the south-west corner of the existing area is a new 44 m^2 (474 sf) multi-purpose room, providing additional space for meetings or similar small community gathers.

The new viewing area, canteen and bar are located between the existing arena and new expansion, on the second level of the connecting bar. The new 267 m^2 (2,874 sf) viewing area is open to the existing arena, providing a warm space to eat and drink while still being part of the action. Windows facing into the new extension allow full visibility of the new ice surface. The new canteen and bar will be 62 m^2 (667 sf) in total, replacing the existing 32 m^2 (344 sf) canteen. This will provide better service for large events programmed in the existing arena.

On the north and south ends of the new viewing area are two large meeting rooms totaling 163 m^2 (1,755 sf) with views into the new expansion. These meetings rooms provide much needed space for community gatherings, conferences, group meetings, birthdays, etc.

Off Concourse C on the north end of the existing arena is a new mechanical room with a mechanical loft. The loft space provides the clear height required by the ice resurfacer below and space for the addition of new HVAC equipment to serve the existing building.

Image 16. Rendering of the new viewing area and canteen/bar.

04. PRELIMINARY CODE REVIEW

01 Caveat

The preliminary safety code review has been undertaken to advance the project to the completion of concept design and into the design development phase. The consultant's research has been limited to the National Building Code of Canada and the Life Safety Code (NFPA 101). As of yet, there has been no formal consultation with the authorities having jurisdiction regarding the application of the aforementioned documents to the Jack Byrne Regional Sports & Entertainment Centre. These consultations are recommended to take place during the design development phase.

02 National Building Code of Canada 2015 Review

This review was completed using Part 3 of the National Building Code of Canada 2015: Fire Protection, Occupant Safety and Accessibility.

1. Section 3.1: General

3.1.2.1. Classification of Buildings

The building is classified as a Group A, Division 3 occupancy — assembly occupancies of the arena type.

3.1.2.3. Arena-Type Buildings

The classification above is valid if the facility is used occasionally for exhibition or trade-show purposes.

3.1.7.5. Rating of Supporting Construction

All columns supporting floors must have a fire resistance rating equal to the rating required of the floor. Service spaces are exempt from this requirement.

3.1.8.1. Fire Separations and Closures

Any wall or partition intended to be a fire separation must be constructed as a continuos element and have a fire resistance rating that will stop the spread of smoke and fire, and will remain in place until the sprinkler system has actuated and controlled the fire.

3.1.10.1 Prevention of Firewall Collapse

Any connections or structural framing members connected to or supported on a firewall with a fire-resistance rating less than that required for the firewall will be designed so that the failure of the framing system will not affect the integrity of the firewall. A firewall is permitted to be supported on a structural frame of a building provided the frame has a fire resistance rating not less than that of the firewall.

3.1.10.2 Rating of Firewalls

The firewall will be of non-combustible construction and will have a resistance rating of not less than 2 hours.

3.1.17.1 Occupant Load Determination

The following occupant load factors from Table 7.3.1.2. Occupant Load Factor from the NFPA 101 have been used for this project:

i. 4.6 m^2/person for skating rink

ii. 1.4 m^2/person for assembly occupancies without fixed seating

iii. 9.3 m^2/person for office use and kitchens

iv. 46.5 m^2/person in storage rooms

v. seating capacity of the bleachers

The occupant loads for the new extension and connecting bar program areas of the facility are:

i. Ice Surface (for skating): 1,518 m^2 ÷ 4.6 m^2/person = 330 people

ii. Ice Surface (for assembly): 1,518 m^2 ÷ 1.4 m^2/person = 1,084 people

iii. Spectator Seating: 180 people

iv. Canteen: 48 m^2 ÷ 9.3 m^2/person = 5 people

v. Offices: 66 m^2 ÷ 9.3 m^2/person = 7 people

vi. Storage: 212 m^2 ÷ 46.5 m^2/person = 5 people

vii. Viewing Area: 267 m^2 ÷ 1.4 m^2/person = 191 people

Total occupant load for the new expansion is 718 (skating) or 1,472 (assembly).

2. Section 3.2: Building Fire Safety

3.2.1.1 Exceptions in Determining Building Height

Under this section, the viewing area and offices must be considered a storey in determining the building height. Therefore the new expansion and connecting bar is a 2-storey building.

3.2.1.6 Mezzanines

The connecting bar mezzanine level is considered a storey and the floor assembly will require the same fire resistance rating as other floor assemblies in the building.

3.2.2.10 Streets

The new expansion and connecting bar have a perimeter of 200 m (with a total building perimeter of 354 m). All building faces can be accessed from either the adjacent streets or the parking areas. In order for the building to be considered to face 3 streets, at least 75 per cent of the perimeter must be within 15 m of a street or access route.

3.2.2.17 Arena-Type Building Roof Assembly

If the roof is 6 m above the highest floor level then it will not be required to have a fire resistance rating (only applies if the building is not sprinklered).

3.2.2.31 Group A, Division 3, up to 2 Storeys, Sprinklered

The total building area (or footprint) of the complete building (existing arena plus new expansion and connecting bar) is 6,710 m^2. To comply with 3.2.2.31, the total building area (or footprint) of a 2-storey building must be no more than 6,000 m^2. Therefore, a firewall must be installed between the new extension and the connecting bar. This will, for fire safety purposes, treat the new expansion as a separate structure. The existing arena and connecting bar combined total building area will be 4,360 m^2 and the new total building area of the new expansion is 2,350 m^2. The new expansion must be of non-combustible construction and be fully sprinklered. The mezzanine and supporting structure for the connecting bar must also be of non-combustible construction and be fully sprinklered, and have a fire resistance rating of 1 hour minimum.

3.2.3.1 Limiting Distance and Areas of Unprotected Openings

Limiting distances for the new expansion and connecting bar will be calculated from the arena building faces to the centreline of surrounding public roads or to the edge of the property line.

3.2.5.4 Access Routes (under 3.2.5 Provisions for Firefighting)

A purpose-built access route is not required.

3.2.5.8 Standpipe System

A standpipe system is not required.

3.2.5.12 Automatic Sprinkler System

The sprinkler system must be designed and constructed in conformance with NFPA 13.

3.2.5.15 Fire Department Connections

There must be a hydrant no more than 45 m from the fire department sprinkler connection.

3. Section 3.3: Safety Within Floor Areas

3.3.1.5 Egress Doorways

Rooms with an occupant load more than 60 or an area more than 200 m^2 require at least 2 egress doorways located a distance from each other that is one third the maximum diagonal dimension of the room, measured as the shortest distance.

3.3.1.17 Capacity of Access to Exist

Capacity is based on room/area occupancy. NFPA 101 requires 7.6 mm/person for stairs and 5 mm/person for level components (including doors) and ramps.

3.3.1.21 Janitors' Rooms

Janitors' rooms and rooms for storing janitorial supplies are required to be unrated fire separations (i.e. smoke sealed).

3.3.2 Assembly Occupancy

Spectator seating within the new extension is in conformance with this subsection and NFPA 101 Life Safety Code. The seats are accessed by four separate stairs leading up from the new extension floor — one at either end and one at either side of the penalty boxes. There is a minimum 400 mm between the back of one fixed row and the upright position of the seat in the next fixed row of seats. There are no more than 7 seats between the any seat and the nearest aisle.

4. Section 3.4: Exits

3.4.2.1 Minimum Number of Exits

In a sprinklered building of Group A occupancy, the maximum size of a room or area permitted to have only one exit is 200 m^2, provided the occupant load is not more than 60 people.

3.4.2.2 Means of Egress from Mezzanines

The connecting bar mezzanine is attached and open to the existing arena. This area is required to have two separate means of egress. One must be an exit that conforms to the requirements of exits from a floor area (i.e. enclosed exit stair). The new emergency stair by the

ice resurfacer room will serve as the enclosed stair. The existing stairs within the existing arena will serve as the other means of egress for the mezzanine level.

3.4.2.4 Travel Distance

Travel distance can be measured from the access to means of egress in the room to the exit, where a room does not have direct access to an exit, provided that the corridor walls are unrated fire separations (since the building is sprinklered). This building is all under a single owner/occupancy so there are no public corridors as per the NBCC definition.

3.4.2.5 Location of Exist

Travel distance to at least one exit shall not exceed 45 m as per the NBCC, while NFPA 101, Section 7.6"Measurement of Travel Distance to Exist" allows for 76 m in a sprinklered building of assembly occupancy (see Table A.7.6). Other limits are 6.1 m for a common path of travel and for dead-end corridors.

3.4.3.2 Exit Width

NBCC requires 6.1 mm/person for corridors and passageways an 8 mm/person for stairs. NFPA 101 requires 5 mm/person for level components and ramps and 7.6 mm/person for stairs. The minimum width of exit components is 1100 mm for corridors and stairs, 800 mm for doorway openings.

3.4.4.1 Fire-Resistance Rating of Exit Separations

Exits must have a fire rating equal to the floor assembly rating.

5. Section 3.5: Vertical Transportation

The existing arena and connecting bar are required by provincial accessibility legislation to be equipped with an accessible lifting device. The elevator will be designed in conformance with ASME A 17.1/CSA B44 Safety Code for Elevators and Escalators, Section 5.

3.5.3.1 Fire Separation for Elevator Hoistways

The elevator hoistway is required to have a 1 hour fire resistance rating.

3.5.3.3 Firs Separation for Elevator Machine Rooms

The elevator machine room requires a 1 hour fire resistance rating, but does not require a rated separation from the hoistway it serves.

6. Section 3.6: Service Facilities

3.6.1.4 Storage Use Prohibition

Service spaces as defined under the Code cannot be utilized as storage areas.

3.6.2.1 Fire Separation Around Service Rooms

The refrigeration plant will be designed according to CSA B52-13 "Mechanical Refrigeration Code" and all services rooms will have a min 1-hour fire separation.

05. STRUCTURAL DESIGN

01. Structural Design Codes & Aids

1. Design Codes & Standards

The structural design for the new extension will conform to the 2015 National Building Code of Canada (NBCC 2015), Part 4, "Structural Design", and its referenced design standards, including:

i. CAN/CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete

ii. CAN/CSA A23.3, Design of Concrete Structures

iii. CAN/CSA S16, Design of Steel Structures

iv. CAN/CSA S136, Cold Formed Steel Structural Members

v. CAN/CSA S304.1, Design of Masonry Structures

vi. CAN/CSA A371, Masonry Construction for Buildings

2. Design Aids

The following list includes some of the design aids relevant to the structural design of the substructure and superstructure:

i. "Handbook of Steel Construction", Canadian Institute of Steel Construction

ii. "Concrete Design Handbook", Canadian Portland Cement Association

iii. "Reinforcing Steel: Manual of Standard Practice", Reinforcing Steel Institute of Ontario

iv. "Steel Deck Design Selection Tables", CANAM

v. "Steel Deck Diaphragm", CANAM

vi. "Steel Joist Selection Tables", CANAM

vii. Design Software, "STAAD/PRO", Bentley Systems Inc.

02. Structural Design & Analysis

The structural design will be performed in accordance with the limit states method. Design loadings include both gravity and lateral loads and the various combinations of these loadings as defined in the NBCC. In designing for the gravity and lateral loads, both strength and deflection criteria will be respected.

The analysis will be performed using several methods. Computer analysis (STAAD.Pro) will be carried out on the structure to refine the design to produce the most economical design within the design constraints. In addition, hand calculations will also be performed to provide a check against the computer results.

The design process will also be aided by the use of various in-house developed spreadsheets.

03. Design Loads & Combinations

All design loads are in accordance with the 2015 Edition of the National Building Code of Canada (NBCC 2015). Climatic information has been provided by the Meteorological Service of Canada for the nearest reference location; St. John's, NL.

1. Gravity Loads

The specified design gravity loads are as per section 4 of the NBCC, and the NBCC Structural Commentaries.

Snow Loads

$S = I_s [S_s (C_b C_w C_s C_a) + S_r]$ as indicated in 4.1.6.2(1)

Where the ground snow load S_s = 2.9 KPa and the rain component S_r = 0.7 KPa based on a 1:50 year return period. The importance factor for snow loads, I_s = 1.0. C_b (the basic snow load factor), C_w (the wind exposure factor), C_s (the slope factor), C_a (the accumulation factor) are indicated in Section 4.1.6.2 "Specified Snow Loads" in the NBCC.

The basic roof snow load = S = [2.9 (0.8 x 1.0 x 1.0 x 1.0) + 0.7] 1.0 = 3.02 KPa

The accumulation factor, C_a, will be adjusted accordingly to account for increases in snow loads due to roof obstructions such as mechanical equipment, parapets and increases due to differences in roof elevations. Appropriate C_a coefficients are outlined in Commentary G, Snow Loads in the NBCC Structural Commentaries.

Dead Loads

The specified design dead loads are calculated in accordance with subsection 4.1.4 of the NBCC. The dead loads include:

i. self weight of the structural members

ii. weight of all finishes

iii. weight of permanent equipment.

The roof dead load will vary for different portions of the structure depending on their composition.

Live Loads

The specified design live loads are in accordance with subsection 4.1.5 of the NBCC. Based on the facility occupancy a live load of 4.8 kPa will be used throughout.

2. Lateral Loads

Lateral loads are defined as wind loads and earthquake (seismic) loads.

Wind Loads

Wind loads are specified in 4.1.7 of NBCC and Structural Commentaries for external and internal pressure or suction.

$P = I_w \times q_{1/50} \times C_e \times (CgCp + Cg_iCp_i)$

The reference velocity pressures, q, is based on a 50 year return period and specified as 0.78 kPa.

These reference velocity pressures are modified by the relevant factors outlined in the code and commentaries to determine the design wind loading for the various building components.

Earthquake (Seismic) Loads

Earthquake loads are specified in 4.1.8 of NBCC and Structural Commentaries. The Structural acceleration ratios and Peak Ground Action (PGA) are as follows:

i. Sa(0.2) = 0.17

ii. Sa(0.5) = 0.12

iii. Sa(1.0) = 0.076

iv. Sa(2.0) = 0.025

Peak Ground Action (PGA) = 0.057

3. Load Combinations

In accordance with clause 4.1.3.2 of the NBCC, both gravity and lateral loads will be applied to produce the most critical load combinations for the structural design. Factored load combinations will be used for strength evaluation while specified loads will be used for serviceability requirements such as deflection.

4. Serviceability Limits

The deflection limits, or serviceability limit states, are defined in accordance with Sentences 4.1.3.4, 4.1.3.5 and 4.1.3.6 of the NBCC which states that deflection, vibration and fatigue are to be checked under the effect of specified loads in accordance with the appropriate design standard for the structural members.

The following deflection limits are used for the design of this building:

i. Members supporting construction susceptible to cracking: 1/360 of span

ii. Members supporting construction not susceptible to cracking: 1/300 of span

iii. Lateral deflection of the structure as a whole: 1/500 of height.

iv. Walls with metal cladding: 1/240 of height or length

v. Walls with brick veneer: 1/720 of height or length.

Vibration control will be in accordance with Commentary D "Deflection and Vibration Criteria for Serviceability and Fatigue Limit States" in the Structural Commentaries to the NBCC; and Annex E "Floor Vibrations", of CAN/CSA S16 "Design of Steel Structures".

04. Geotechnical Requirements

A new geotechnical test pit investigation will be required before design development begins to determine the bearing capacity in the area of the new footings and parking lot. A previous geotechnical investigation was carried out on January 3, 2007 by Jacques Whitford Limited. A series of test pits were completed to assess the site geology for the construction of the original building foundations. The site geology generally consists of siltstone, sandstone and cobbles. Based on the site assessment for the original building, the following recommendations were made concerning the foundation design and is expected to be similar for the future building expansion:

i. Spread footings founded on the undisturbed dense glacial till can be designed for an allowable bearing pressure of 300 KPa.

ii. Exterior footings should have a minimum soil cover of 1.2 m or equivalent for frost protection.

05. Structural Systems & Materials

The building structure will consist of two main components; substructure and superstructure. The substructure, or foundation, will be reinforced concrete. The superstructure will be a combination of structural pre-engineered steel and structural steel. These components can be further defined as described in the following sections.

1. Foundations

The building foundations will be designed based on the recommended allowable soil bearing capacity, as per the geotechnical investigation. A minimum of 1.2 m of soil cover to the underside of the footing will be used for frost protection on all exterior footings, unless they bear on bedrock.

The foundations will consist of reinforced concrete spread footings and piers at column locations and continuous strip footings and walls at the exterior perimeter.

The reinforced concrete spread footing sizes will vary with the applied loads and founding material. The exterior perimeter walls will be sized to carry the wall construction above and will tie into the existing perimeter wall foundations via dowels. Loadings from the new extension will be placed on the existing foundation wall which may require the existing footings to be built up to adequately support the new expansion. This will require doweling into the existing footing and pouring new footings along the existing wall footing to increase the bearing area.

2. Slab on Grade

The main floor of the facility will be a reinforced concrete slab on grade. Slab thickness will generally be 100 mm with local increases in thickness for concrete block walls. The slab will be reinforced with steel or synthetic fibres. Pits and trenches will be provided as required and reinforced with steel reinforcing bars.

Isolation joints will be used to separate the slab from any adjacent vertical surfaces to prevent restraint to shrinkage. The isolation joints will consist of 13 mm isolation board, sealed with joint sealant at the surface. Sawcut control joints will be suitably spaced in the slab to prevent cracking due to drying shrinkage of the concrete. The control joints will be 25 mm deep, 6 mm wide, and filled with joint sealant.

3. Rink Slab

The rink slab is constructed independently from the floor slab by installing an expansion joint around the edges, and pouring the rink slab as one continuous pour. The rink slab will be large enough to permit a regulation size ice rink and will be 150 mm thick with welded wire mesh and rebar reinforcing and cooling pipes embedded into the slab, similar to the existing building. Below the slab, heating pipes will be installed in a 300 mm thick bed of sand.

4. Superstructure

The building superstructure will comprise both traditional construction, including open web steel joists, steel beams and columns, and pre-engineered steel frames. The traditional construction will be contained in the connecting bar, spanning between the existing arena and the new extension tying them together at both the roof and floor levels. The roof extension will tie into the existing columns adding new snow and dead loads, so reinforcing of the existing columns may be required to pass the load through the structural system. The second level floor level will tie into the existing concrete wall, placing a greater load onto the existing concrete footings below, which may require extensions to the existing

foundations.

A structural evaluation exercise was used to determine the most economical construction method for the new ice surface area. This included: pre-engineered truss frames, similar to the existing building construction; traditional building construction methods; and pre-engineered rigid-steel frames. The chosen option was pre-engineered rigid-steel frames which will be more economical than the other options and are readily available. The rigid frames will have a similar configuration as the existing building and girts and purlins will frame out the roof deck and exterior walls. The roof structure functions to carry both gravity loads and wind loads normal to its plane. To resist lateral loads, the roof system will be designed to act as a horizontal diaphragm (with cross-bracing) to transfer the lateral loads to moment frames or braced frames. Bracing elements will be located to minimize interference with architectural features while providing sufficient structural capacity.

5. Materials

The materials used for the primary structural system will meet the following requirements:

Exterior Exposed and Rink Slab Concrete

i. Cement: Type GUb Portland cement with min. compressive strength at 28 days: 30 MPa.

ii. Minimum cement content: 340 kg/m^3 of concrete.

iii. Class of exposure: Type F-2.

iv. Nominal size of coarse aggregate: 20 mm.

v. Slump at time and point of discharge: 75-100 mm.

vi. Air content: 4 to 7 per cent (< 3 per cent for rink slab)

vii. Chemical admixtures: in accordance with ASTM C494.

Interior Concrete

i. Cement: Type GUb Portland cement with min. compressive strength at 28 days: 25 MPa.

ii. Minimum cement content: 340 kg/m^3 of concrete.

iii. Class of exposure: Type N.

iv. Nominal size of coarse aggregate: 20 mm.

v. Slump at time and point of discharge: 75-100 mm.

vi. Air content: less than 3 per cent.

vii. Chemical admixtures: in accordance with ASTM C494.

Concrete Reinforcement

Concrete reinforcement will meet the requirements of G30.18, Carbon Steel Bars for Concrete Reinforcement. All reinforcing will have minimum yield strength of 400 MPa. Slab on grade will be reinforced with steel or synthetic reinforcing fibres supplemented with reinforcing bars for special details.

Structural Steel

All structural steel will be designed, fabricated and erected in conformance to CSA Standard S16. Material strength will be 350 MPa in accordance with CSA Standard

Concrete Block

All concrete block will be designed in conformance with CSA S304.1.

06. MECHANICAL DESIGN

01. Design Approach

The scope of this project consists of the design of a new extension to the existing Jack Byrne Regional Sports and Entertainment Centre, including an NHL regulation size ice surface, dedicated refrigeration plant, heating and cooling equipment, ice resurfacer room and air handling equipment. Within the mechanical design, codes and standards will be applied, along with good engineering to meet the specific requirements. Where code requirements conflict, the more stringent has been made the standard. The reader can reference these codes and standards throughout the various sections of this report.

02. Refrigeration Plant

1. Option Development

Five options for the new refrigeration system for the new ice surface were considered. The options were developed and evaluated for initial capital cost, operating costs, as well as non-financial factors. The options were developed to address two major questions:

i. Should the existing plant be removed and a new, single, larger plant serve both the existing arena and the new expansion, or should the existing plant remain and a smaller capacity, dedicated, plant be provided to the new expansion only?

ii. Which refrigerant should be used for the new plant: ammonia (NH_3) or carbon dioxide (CO_2)?

Title	Option 1 Single Large Ammonia Plant for Both Ice Sheets	Option 2 Existing Plant Remains and New Ammonia Plant Added	Option 3 Single Large CO2 Plant for Both Ice Sheets	Option 4 Existing Plant Remains and New CO2 Plant Added	Option 5 Existing Plant Remains and New Basic Ammonia Plant Added
Existing Plant	Remove	Keep	Remove	Keep	Keep
New Plant Configuration	150 TR Plant to Serve both Ice Sheets	75 TR Plant to Serve new Ice Sheet only	150 TR Plant to Serve both Ice Sheets	75 TR Plant to Serve new Ice Sheet only	75 TR Plant to Serve new Ice Sheet only
Refrigerant	Ammonia	Ammonia	CO2	Ammonia / CO2	Ammonia
Existing Desuperheaters	Remove	Keep	Remove	Keep	Keep
Domestic Hot Water	Produce all domestic and ice flood hot water using new plant desuperheaters	Produce domestic and ice flood hot water for new arena only using new plant desuperheaters	Produce all domestic and ice flood hot water using new plant desuperheaters	Produce domestic and ice flood hot water for new arena only using new plant desuperheaters	Produce domestic and ice flood hot water for new arena only using new plant desuperheaters
Heat Recovery Loads	All loads for both buildings connected	All loads for both buildings connected but only heat recovery from one ice sheet	All loads for both buildings connected	All loads for both buildings connected but only heat recovery from one ice sheet	No Heat Recovery
Dehumidification	Utilize chilled water from ice battery to serve both ice sheets	Utilize chilled water from ice battery to serve both ice sheets	Utilize chilled water from ice battery to serve both ice sheets	Utilize chilled water from ice battery to serve both ice sheets	Utilize existing desiccant dehumidifiers and add new similar for new arena
Operator Requirements	Yes	Yes	No	No	Yes

Table 01. Options for new refrigeration plant.

With these questions in mind the five options were developed which consisted of four combinations of the two scenarios describe above and a base case for comparison (Option 5).

Table 01 describes the general parameters of each of the options and highlights the differences between them. As shown, the options included evaluation of the estimated capacity, availability of waste heat and ability for using the waste heat, domestic hot water preheating, ability to dehumidify and operator requirements.

2. Option Analysis

Each of the five options was computer simulated by CIMCO refrigeration and analysed for capital and operating costs. The capital costs are based on a database of historical costs for plants of similar type and capacity. The operating costs are based on computer simulations of operating energy. These simulations include estimates of building heating, cooling and dehumidification energy; offset energy costs for waste heat recovery; pumping energy; and refrigeration plant energy such as compressors and condenser fans. The estimated operator salary costs associated with each type of plant were also included.

To perform the simulations, it was required to make multiple calculation assumptions. This included assumptions for operating conditions, occupancy profiles, indoor conditions, etc. It is important to note that the assumptions that were applied are common to all options that were analysed. Therefore, the actual resulting dollar values are not as important as the relative difference

Option →	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
System type →	New Ammonia Ecochill for both rink	Keep existing + new Ammonia Ecochill	NEW CO2 plant for Both rinks	Keep existing + New CO2 plant	Keep Existing + New ammonia plant no HR
Primary refrigerant →	NECO150A	NECO80A	ECO2 150	ECO2 80	MAP System
Total Cimco supply	**2,108,000 $**	**1,720,000 $**	2,190,000 $	1,683,000 $	**875,000 $**
Hydronic loop in existing building	300,000 $	300,000 $	300,000 $	300,000 $	0 $
Total Mechanical supply	**300,000.00 $**	**300,000.00 $**	**300,000.00 $**	**300,000.00 $**	**0.00 $**
Total investment	**2,408,000 $**	**2,020,000 $**	**2,490,000 $**	**1,983,000 $**	**875,000 $**

Global costs

Option →	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Yearly energy consumption kWh eq.	1,571,305	1,966,713	1,486,502	2,065,592	3,037,560
Yearly energy cost	153,259 $	189,558 $	147,952 $	195,555 $	313,557 $
Initial investment	2,408,000 $	2,020,000 $	2,490,000 $	1,983,000 $	875,000 $
Operating costs for 20 years - AV	74,794 $	149,587 $	149,587 $	149,587 $	149,587 $
Maintenance costs for 20 years - AV	186,105 $	457,838 $	324,858 $	468,505 $	653,149 $
Major maintenance costs for 20 years - AV	65,420 $	130,839 $	83,745 $	146,374 $	271,298 $
Energy costs for 20 years - AV	2,776,388 $	3,434,119 $	2,680,490 $	3,542,753 $	5,680,290 $
Refrigerant costs for 20 years - AV	120 $	150 $	239 $	150 $	539 $
Yearly Cost (+) or Revenue (-) for 20 years - AV	0 $	0 $	0 $	0 $	0 $
Replacement costs (total for years 10 to 19) - AV	0 $	0 $	0 $	0 $	0 $
Actualized equipment residual value - AV	0 $	0 $	0 $	0 $	0 $
Actualized global cost for 20 years - VA	**5,510,826 $**	**6,192,534 $**	**5,728,919 $**	**6,290,369 $**	**7,629,862 $**
Annualized global cost	**514,222 $**	**568,912 $**	**459,684 $**	**504,743 $**	**684,259 $**
Percentage	75%	83%	67%	74%	100%
Difference with basic system	170,037 $	115,347 $	224,575 $	179,516 $	0 $

Table 02. Option analysis of new refrigeration plant options.

between each option. **Table 02** summarizes the results of the option analysis.

A graph (**Table 03**) was prepared to visualize the net present value analysis. From the graph it is possible to see the effect of operating cost over the life of the refrigeration plant (20 years). The costs displayed on the left of the graph on year zero represent the initial capital costs. The slope of the line is indicative of the operating cost for the option (lower slope shows reduced operating costs). The final cost shown on the right side of the graph, at the end of the sloped line, shows the total cost of ownership (capital plus operating costs).

3. Recommended Refrigeration System

Based on the analysis, the recommended option is *Option 4: New Single CO_2 Plant – Existing Plant Remains*. This option comes with a reduced capital cost (second lowest) and lower overall total cost of ownership (second lowest). In addition to the financial analysis, other factors relating to constructability and continued operation of the facility were considered. The additional benefits associated with the recommended option are:

i. Existing header to remain. Allows continued operation of existing arena.

ii. Construction of new expansion can occur without disruption to existing arena. Allows for trade shows, minor hockey, etc.

iii. Benefits to waste heat recovery system to be connected to both arenas; ability to choose which loads use the waste heat; increased diversity maximizes heat recovery potential.

iv. Existing refrigeration plant has useful life

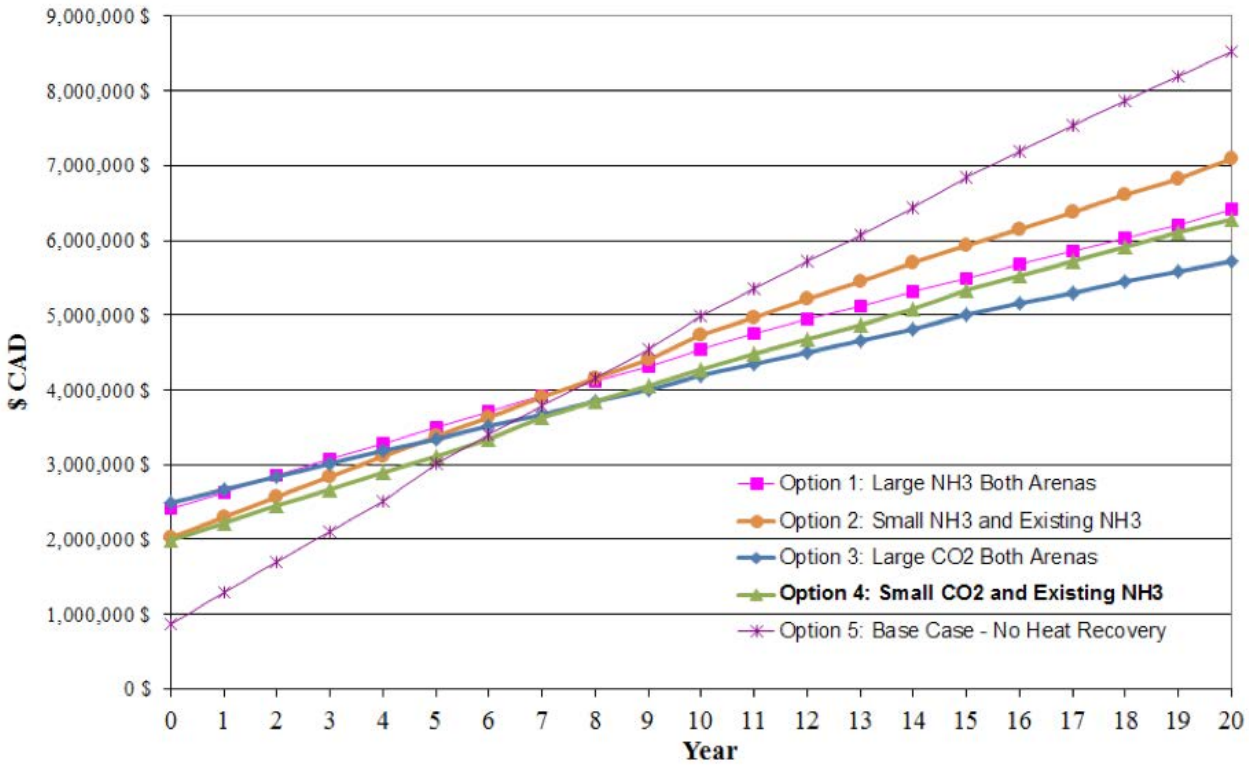

Table 03. Graph comparing lifetime costs of the different refrigeration plant options.

remaining (initially installed in 2009).

v. Large installation base of CO_2 refrigeration plants elsewhere in Canada.

vi. Operator requirements minimized through the use of CO_2 vs. NH_3 for the new plant.

4. Refrigeration System Description

The selected refrigeration system shall consist of a new CO2 based refrigeration plant dedicated to the second ice surface only. The existing refrigeration plant that currently serves the arena shall remain in service. The waste heat from the new refrigeration plant shall be distributed to the heating loads in both the new extension and the existing arena via a hydronic heating system. **Image 17** illustrates the basic configuration for the refrigeration system.

The new refrigeration plant will be an indirect CO_2 system complete with a CO_2 to glycol heat exchanger and pump that serves for ice sheet cooling. The ice sheet will be served by buried headers located under the concrete slab. The refrigeration plant will include indoor ice-battery thermal storage tanks and exterior pad-mounted CO_2 condensers. The new refrigeration plant will also include equipment connected for the waste heat recovery system necessary to serve the ice sheet including: a hot glycol thermal equalizer storage tank; indoor ice melt pit heating coil to serve the ice resurfacer; and an under-slab frost prevention heating system.

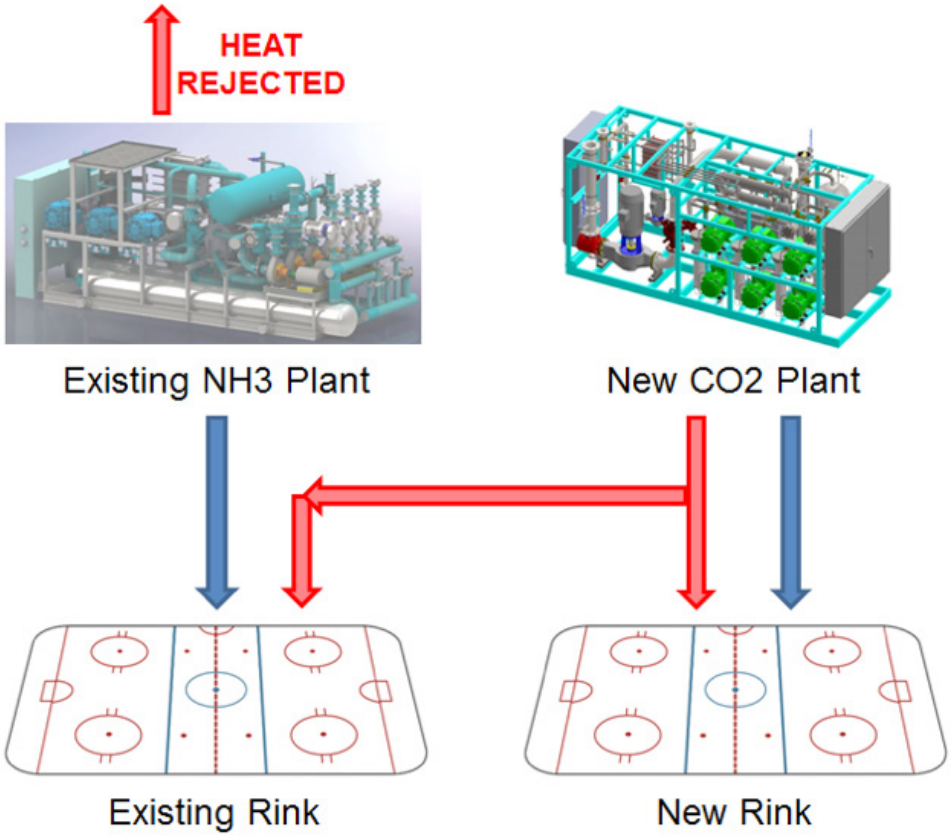

Image 17. Configuration of the refrigeration system

The refrigeration plant will be supplied with a dedicated control system which will monitor and control all functions of the refrigeration system. The building control system will be integrated with the refrigeration plant control system to coordinate the efficient use of waste heat when it is available.

Image 18 illustrates how the waste heat will be reused to help heat the existing arena and new expansion.

03. Heating, Ventilation & Air Conditioning

To ensure proper heating, cooling, and indoor air quality, and to ensure proper thermal comfort for spectator seating and rooms within the new extension, connecting bar and existing arena, the latest edition of the following codes and standards will apply:

i. The National Building Code of Canada (NBCC)

ii. The National Energy Code of Canada for Buildings (NECB)

iii. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality

iv. NFPA-96 - Ventilation Control and Fire Protection of Commercial Cooking Operations

1. Ambient Design Conditions

Ambient design conditions are exterior environmental conditions, such as temperature, humidity, winds and precipitation. The following outdoor ambient conditions

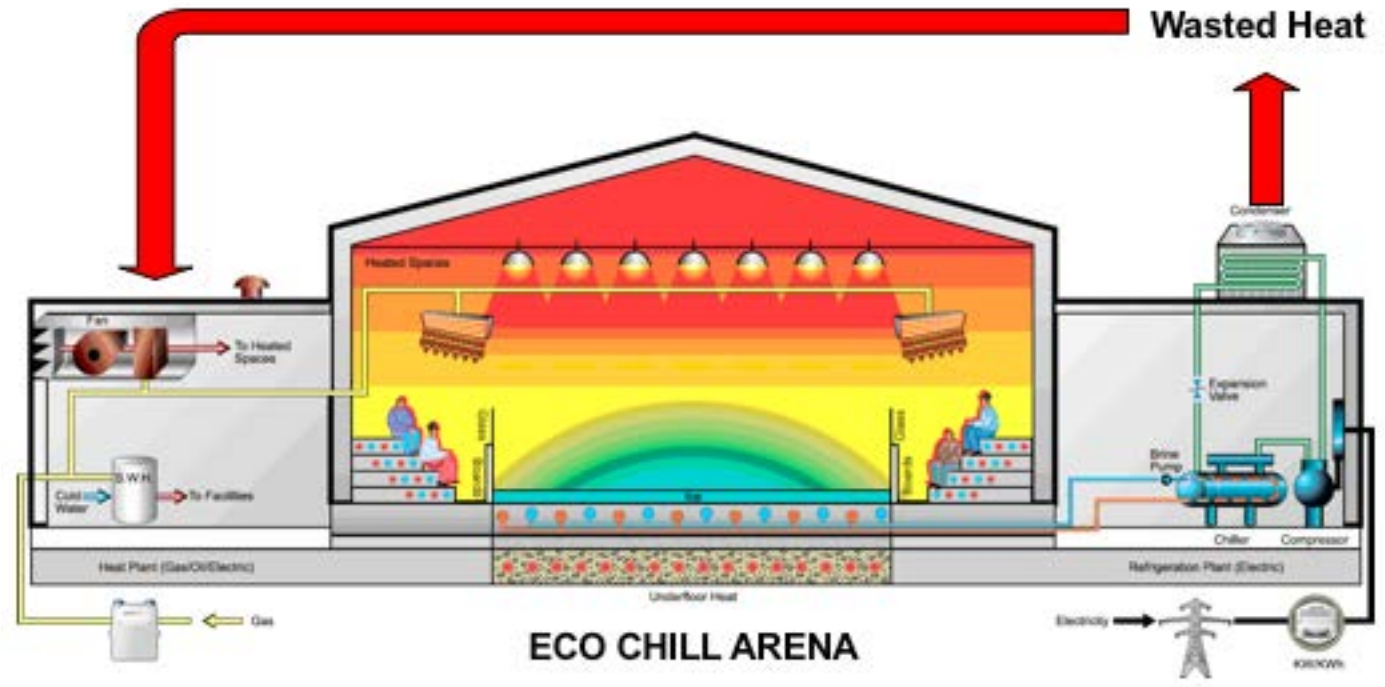

Image 18. Diagram of waste heat recovery.

were developed:

i. Heating Systems:

   a. Outdoor Dry Bulb Temperature: -16 °C (1 per cent Jan. Design Day from NBCC)

   b. Outdoor Relative Humidity: 80 per cent (Assumed)

   c. Infiltration Wind Velocity: 54.9 km/hr (Larger of 50 per cent of the 1 in 10 year wind velocity from Appendix C of NBCC or 50 km/hr)

ii. Cooling Systems:

   a. Outdoor Dry Bulb Temperature: 24 °C (2.5 per cent July Design Day from NBCC)

   b. Outdoor Dry Wet Temperature: 20 °C (2.5 per cent July Design Day from NBCC)

2. Indoor Design Conditions

The indoor design conditions were developed through the research of ice rinks air conditions, spectator thermal comfort and a consideration to prevent the transfer of moisture from adjacent spaces to the arena space. It has been determined that the optimal arena bowl indoor air condition is 12.8 °C dry bulb temperature with 40 per cent relative humidity. This indoor air condition results in a dew point of -0.4 °C. The ice surface temperature will vary from -5 °C to -7 °C depending on the sporting event.

It should be noted that the optimal indoor air condition will not totally eliminate heat transfer, however this condition is considered an obtainable indoor air condition to limit the degradation of the ice surface and provide manageable loads on the refrigeration plant.

In an attempt to improve the thermal comfort within the existing arena space the indoor dry bulb temperature can be increased above the 12.8 °C value. Since the adjacent spaces have openings between the spectator areas and the arena bowl it was decided to maintain the -0.4 °C dew point for all spaces within the building. This will enable the various system to operate at different temperature conditions without transferring moisture for one area to another. This should eliminate frost buildup on viewing room windows, for example.

The HVAC control system will measure temperature and relative humidity and calculate the resulting dew point temperature for each space. All air handling units will target a common space dew point temperature. The supply air temperature and dew point can be adjusted at each air handling unit to meet the desired space condition.

A summary of the resulting indoor air conditions are shown in **Table 04**.

3. Indoor Air Quality

The maintenance of indoor air quality is achieved via effective ventilation, air filtration and good engineering practices in the design of HVAC systems.

The minimum outdoor airflow requirements for each space shall be determined using Table 6.1 of ASHRAE 62, "Ventilation for Acceptable Indoor Air Quality". In recirculating air handling systems, the economizer minimum position will be controlled via demand control ventilation. CO_2 will be measured and used to adjust the economizer position to maximize energy efficiency and

maintain indoor air quality. In 100 per cent fresh air heat recovery air handling systems, the minimum outdoor airflow requirement and exhaust air make-up will be calculated for each space to ensure that the minimum is achieved.

Several other items that will be incorporated into the design to ensure optimal indoor air quality are:

i. Open duct ends to be sealed during construction; air Ducts to be mechanically cleaned prior to occupancy. Before and after video of duct cleaning will be required; ducts will be accessible for inspection and cleaning.

ii. Acoustically-lined ductwork will have an inside solid-type liner to protect against erosion of the insulation and entrainment of insulating fibres into the air stream; duct mounted silencers will be installed at sound source equipment where necessary as identified by acoustical analysis, limiting the use of acoustically lined ductwork to a minimum.

iii. Air handling units will be insulated double wall construction.

iv. Fresh air intakes will be separated from exhaust in accordance with the NBCC.

v. Air handling unit filtration will consist of 30-35 per cent pre-filters and 90-95 per cent final filters.

4. Heating System

The new extension will be heated throughout with waste heat from the new refrigeration plant via a hydronic heating system. Hot glycol from the new refrigeration plant will be used to heat a secondary hot glycol loop through a plate and frame heat exchanger. In addition, hot glycol will be routed to new duct mounted coils serving both air handling units and in-floor heating system within the existing arena.

The supply temperature from the refrigeration plant will be 35.0 °C and the return water temperature will be 29.4 °C. The heat exchanger will be selected with a 0.6 °C approach, therefore the supply water temperature from the secondary glycol loop will be 34.4 °C and the return fluid temperature will be 28.9 °C.

Hot glycol will be used as the heat source for the hydronic heating system with hydronic loads as follows:

Space	Heating				Cooling			
	Occ.		Unocc.		Occ.		Unocc.	
	DB	RH	DB	RH	DB	RH	DB	RH
Ice Surface / Bowl	18.3°C	28%	15.6°C	33%	20.0°C	25%	22.2°C	40%
Lounge Areas	22.2°C	22%	15.6°C	33%	-	-	-	-
Meeting Rooms	22.2°C	22%	15.6°C	33%	23.9°C	20%	29.4°C	14.3%
Corridors / Lobbies	22.2°C	22%	15.6°C	33%	-	-	-	-
Offices / Admin.	22.2°C	22%	15.6°C	33%	23.9°C	20%	29.4°C	14.3%
Dressing / W/R	22.2°C	22%	15.6°C	33%	-	-	-	-
Service / Storage	22.2°C	22%	15.6°C	33%	-	-	-	-
Vestibules	22.2°C	22%	15.6°C	33%	-	-	-	-

Table 04. Summary of resulting air conditions.

i. In-floor radiant heating for the new extension will be equipped with a supplemental, or back-up, electric boiler and will be decoupled from the remaining loops so that the electric boiler can be dedicated to the new in-floor heating without suppling the entire hydronic heating system.

ii. The in-floor radiant heating loops in the existing arena will remain connected to the existing electric boilers that serve these in-floor radiant heating systems.

iii. The main heat source for both arena bowls will be provided through the use of new air handling unit hydronic heating coils, in both the new air handling units and retrofit into the existing air handlers.

iv. Energy recovery units will be equipped with unit mounted hydronic heating coils to meet the air tempering requirements for the units. This includes the energy recovery units for the new ice area and retrofitting of the existing energy recovery units to accept new hydronic heating coils. The energy recovery units will function to provide ventilation only, therefore each space has an associated reheat load. The reheat load for each space will be added to the space load to produce a combined load that will be used to determine the total space heating requirement.

5. Cooling System

The air handling units serving the new expansion will be equipped with chilled glycol cooling coils to assist in dehumidification. The chilled glycol from the new refrigeration plant will be used to cool a secondary chilled glycol loop through a plate and frame heat exchanger.

The supply temperature from the refrigeration plant will be 5.6 °C and the return water temperature will be 11.1 °C. The heat exchanger will be selected with a 0.6 °C approach therefore the supply water temperature from the secondary glycol loop will be 6.1 °C and the return fluid temperature will be 11.7 °C.

This chilled glycol will be used as the cooling source for the hydronic cooling system with hydronic loads as follows:

i. The main air conditioning source for the new expansion arena bowl will be provided through the use of the air handling unit hydronic cooling coils.

ii. Energy recovery units for the new expansion will be equipped with unit mounted hydronic cooling coils to meet the dehumidification requirements for the units. The air handling units will function to provide ventilation only, therefore the spaces served by these units will not be air conditioned by the ERV's.

The spaces that require air conditioning, such as meeting rooms, offices and pro-shop, will be equipped with a dedicated variable refrigeration flow, multi-head, split, direct expansion heat pump system. This will allow the operation of air-conditioning to key locations during periods when the refrigeration plant is shutdown.

6. Dehumidification System

Located in the corners of the second ice surface area will be two dedicated desiccant dehumidifiers to assist the air handling units with dehumidification and re-circulation of air within the arena bowl. The supply and return for the dehumidifier will be ducted with grilles and diffuser via exposed duct within the arena. The ductwork will be minimal and arranged to promote circulation throughout the space. The intake and exhaust for the dehumidifiers will be connected to the exterior through wall louvers.

7. Ventilation System

Both arena bowls will be ventilated, heated and cooled by a total of four re-circulatory air handling units (two

existing and two new). The remainder of the extension, specifically the connecting bar, will be ventilated by four energy recovery units (two existing and two new). Unit assignments are described in **Table 05**.

Each air handling unit and energy recovery unit can be described as follows:

i. AHU-1/2: existing air handling units that serve the existing arena bowl. These units will be retrofitted to accept duct mounted hydronic heating coils that will be supplied with waste heat from the new refrigeration plant.

ii. AHU-3/4: used to serve the second ice surface arena bowl. Due to size constraints, two separate air handling units will be selected to serve the arena bowl, essentially operating as a single unit. These units will be constant-volume, re-circulating air handling units and capable of ventilating, heating, cooling and dehumidifying the arena bowl. Unit airflow will be sized at the required supply airflow rates to meet the larger of the ventilation, heating, cooling or dehumidification needs. They will be scheduled to operate continuously during normally occupied periods and on call for heating, cooling or de-humidification during normally unoccupied periods.

    The units will be equipped with economizers that will enable free-cooling and allow function for 100 per cent exhaust based on gas detection. They will contain independent supply and return fans to enable effective delivery of air during both re-circulation and free cooling. The minimum position of the economizers will be based upon demand control ventilation. The units will include hydronic heating coils and chilled water cooling coils, sized for the maximum heating, cooling and dehumidification loads. The units will also be equipped with electric heating coils to serve as the back-up heating source, since the hydronic heating system is dependent on the waste heat availability of the new refrigeration plant.

    The return air for these units will be taken from high and low locations to prevent destratification of the space. The supply air from the units will be directed onto the bleachers away from the ice surface to prevent air movement that may increase the convective heat transfer coefficient over the ice surface.

iii. ERV-1/2: existing air handling units that serve the existing arena support spaces. These units will be retrofitted to accept duct mounted hydronic heating coils that will be supplied with waste heat from the new refrigeration plant.

iv. ERV-3/4: new support spaces such as dressing rooms, washrooms, administration areas, offices, lobbies, lounges and meeting rooms located in the connecting bar, will be ventilated with two indoor, constant volume, energy recovery ventilators. Each unit will be equipped with an enthalpy wheel to allow recovery of both sensible and latent heat, and variable speed enthalpy wheels for defrost control and the prevention of over recovery. The units will be located in indoor mechanical rooms. The supply and exhaust

Unit Designation	Area Served	Unit Type
AHU-1/2	Existing Arena Bowl	Re-circulating Air Handling Unit Ventilation, Heating & Cooling
AHU-3/4	Extension Arena Bowl	Re-circulating Air Handling Unit Ventilation, Heating & Cooling
ERV-1/2	Existing Building	Heat Recovery Unit - Ventilation only
ERV-3/4	Existing Building	Heat Recovery Unit - Ventilation only

Table 05. Air handling unit and energy recovery unit designations.

airflow will be balanced to prevent pressurization problems and maximize recovery. Each unit will be equipped with unit mounted hydronic cooling and heating coils, sized to meet dehumidification and air tempering requirements for the worst-case defrost conditions. The cooling coil will be sized to meet the dehumidification requirements, and the heating coil will be sized to meet the air tempering requirements for the worst-case defrost condition of the unit. The units will also be equipped with electric heating coils to serve as a back-up heating source since the hydronic heating system is dependent on the waste heat availability of the new refrigeration system.

8. Exhaust System

The building will contain several exhaust fans to handle the various exhaust applications such as heat relief, gas detection and kitchen exhaust. The fans will be inline, centrifugal-style, with designations described in **Table 06**.

Each exhaust fan can be described as follows:

i. Fan F-1: the new refrigeration plant will be equipped with an CO_2 detection system and an exhaust fan that can operate in response to high CO_2 detection levels, or remotely from outside the room prior to entering. The exhaust fan will discharge directly to the outside of the building through a wall louver located in the exterior wall. The make-up for this exhaust fan will be provided through an intake louver located in the exterior wall of the refrigeration plant, equipped with an insulated motorized damper and separated from the exhaust to prevent cross contamination.

ii. Fan F-2: ice resurfacing and storage area will be subject to motor vehicle traffic periodically. The space will be equipped with a two speed exhaust fan and passive intake ducted to the outdoors through wall louvers. Both stages of the exhaust fan will operate in response to a dedicated carbon monoxide (CO) and nitrogen dioxide (NO_2) detection system. The exhaust air will be drawn from both high and low within the space to remove contaminants that are lighter and/or heavier than air. In addition, the gas detection system will function to provide audible and visible alarms for the space in the event of a high level condition.

iii. Fans F-3/4: exhaust fans providing heat relief for the electrical and mechanical rooms. Due to the anticipated heat generation for these rooms, these spaces will be outfitted with inline exhaust fans and fresh air intake ducts to ensure proper exhaust operation, and to enable free cooling with outdoor air. The airflow rates for these fans are based on the maximum space temperatures of 40 °C.

The exhaust air will be taken high from within the space, while the make-up air will be delivered low, creating a cross breeze ensuring cool air flows across all the equipment before it is exhausted from the space.

The exhaust system operation will be intermittent and controlled from the space temperature sensors interfaced with the building automation system.

Fan Designation	Area Served	Unit Type
F-1	Refrigeration Plant Room Gas Detection Exhaust	Centrifugal Inline
F-2	Ice Resurfacer / Storage Gas Detection Exhaust	Centrifugal Inline
F-3	Electrical Room Heat Relief	Centrifugal Inline
F-4	Mechanical Room Heat Relief	Centrifugal Inline
F-5	Canteen Capture Jet Hood Exhaust Fan	Roof-mounted GEF

Table 06. Exhaust fan designations.

iv. Fan F-5: capture jet style, UV filter, dry hood over the kitchen cooking line. The exhaust for the hood will be ducted to a roof mounted GEF style exhaust fan, complete with listed exhaust damper. The capture jet hood will reduce necessary exhaust airflow, decreasing energy costs associated with treating make-up air. The UV filter will reduce maintenance associated with cleaning ductwork. The kitchen exhaust system will be in accordance with NFPA-96, Ventilation Control and Fire Protection of Commercial Cooking Operations.

9. Energy Conservation

Heating, ventilation and air conditioning systems will generally be designed in conformance with the National Energy Code of Canada for Buildings (NECB).

The second ice surface area will be served with dedicated re-circulating air handling units. The remainder of the building contains a high density of room exhaust requirements, i.e. washrooms, janitor's room, dressing rooms, shower rooms, lounge, canteen, etc. Energy recovery ventilators will be selected for these areas of the building as a means of energy conservation. These rooms will require make-up air to support the high total exhaust flow rates.

The duct distribution systems are reduced in size due to recirculating cooling airflow rates, therefore allowing ducting through the existing portions of the building. The energy recovery units will utilize total energy recovery (sensible and latent) enthalpy wheels. This type of unit was selected due to the high dehumidification requirements for the spaces and the ability of the enthalpy wheel to pre-treat the incoming airstream and reduce coil loads.

All air handling units within the new extension will be equipped with hydronic heating coils for fresh air heating, and all air handling units within the existing arena will be modified to receive duct mounted hydronic heating coils for fresh air heating. All of the heating coils will be connected to the waste heat recovered from the new refrigeration plant. All existing electric heating coils will remain in service as a supplemental or back-up source for heating the existing arena. The new air handling units will also have electric heating coils for the same purpose.

All spaces within the new extension and connecting bar will be equipped with temperature sensors that will be used to control the space heat via the building automation system. The building automation system will be capable of providing scheduled night setback during the heating season and set up during the cooling season. The operation of all major electrical loads including space heat will be controlled through the building automation system for the purposes of demand control. The shedding will be done by the building automation system through software.

04. Plumbing

The applicable codes governing plumbing systems are the latest edition of the following:

i. The National Plumbing Code of Canada (NPC).

ii. National Energy Code of Canada for Buildings (NECB).

1. Water Entrance

The existing arena is equipped with a water supply system consisting of a drilled well that supplies water to a 440 m^3

underground storage tank and a dedicated pump house external to the building. The pump house is located above the underground storage tank and is equipped with both domestic and fire water booster pumps. The pumps discharge into a common 200 mm DI Class 350 water supply pipe that is routed underground to the building. The supply pipe branches outside the building and supplies the building with a 200 mm DI Class 350 water supply for fire protection and a 100 mm DI Class 350 water supply for domestic water.

A review of the total building domestic water requirements (existing arena and new extension) was performed to determine if the existing domestic water supply would be sufficient to serve the building with the new extension:

i. Total Building Demand: 4834 gal (18,300 Liter)

ii. Peak Flowrate was estimated using three different approaches: assuming a three hour usage of the daily demand; using the Harmon Peaking Factor; and using the Hunter Curve from ASHRAE.

    The results for all three approaches are:

    a. 26.9 gpm (three hour usage of daily demand)

    b. 100.5 gpm (Harmon Peaking Factor)

    c. 202.5 gpm (Hunter Curve)

Currently the pump house contains two domestic water booster pumps. Each booster pump is rated for 150 gpm each for a total of 300 gpm which is sufficient to serve the complete building including the new areas.

The existing water entrance will be modified to include a new dedicated supply to serve the new extension. This new supply will be connected to the incoming 100 mm supply pipe and will be routed through the existing building to the mechanical room. This pipe will be used for domestic water and ice flooding for the new ice surface, as well as domestic water for the existing arena.

2. Domestic Distribution

The domestic water heating and ice flooding will be produced and stored in the new mechanical room and distributed throughout all areas of the building. The following are design considerations for the domestic distribution:

i. Plumbing piping will not be located in exterior walls unless no other alternative exists. When installed in exterior walls, plumbing piping will be installed on the warm side of the insulation; freeze-protected exterior wall hydrants will be provided around the building perimeter and will be equipped with vacuum breakers; drain valves will be provided at low points and will be equipped with vacuum breakers; access will be provided to all valves and faucets.

ii. Domestic water will serve to supply the ice flooding and ice re-surfacing water requirements. The water will be preheated to 29 °C using indirect hot water preheat tanks with heat recovered from the refrigeration plant. This preheated water will then be supplied to the domestic hot water system. The ice flooding and ice re-surfacing water for the new extension will be taken from teh preheat tanks then heated by commercial electric hot water tank(s), to a temperature of 60 °C.

iii. The existing arena domestic hot water system will remain as installed with the modification to be supplied with preheated water as describe above.

iv. Tempered water in the new extension will be provided to all lavatories and showers by a master thermostatic mixing valve located in mechanical room. The new tempered water assembly will be sized to serve the requirements of the new extension and will provide 43 °C water.

v. Piping will be installed according to NPC and sized according to ASHRAE Fundamentals; branches will be valved to NPC.

vi. All isolation valves will be ball type. No gate valves will be used.

vii. Recirculation will be implemented on all domestic hot water and tempered water branch lines over 30 m (100 ft) in length.

viii. All domestic hot, cold and tempered water piping will be insulated. All exposed insulated piping will be PVC jacketed.

ix. 82 °C domestic hot water for the satellite canteen in the new expansion will be supplied by an under counter electric booster heater located in the kitchen.

x. Vacuum breakers will be installed in the cold water supply to each domestic hot water tank.

xi. All hose bibbs will be equipped with integral vacuum breakers.

xii. A potable water thermal expansion tank will be provided on the domestic cold water piping to the domestic hot water tanks to absorb expanded water from the domestic hot water tanks.

Given the above requirements, the design criteria for domestic distribution are as follows:

i. Hot water supply piping: 60 °C

ii. Preheat water supply piping (DHWT): 29 °C

iii. Cold water piping: 4.4 °C

iv. Tempered hot water piping: 43 °C

v. Maximum operating pressure: 413.8 kPa

vi. Minimum operating pressure: 275.8 kPa

vii. Maximum pipe velocity: 1.5 m/s

viii. Maximum number of flush valves per branch: ASHRAE Fundamentals Handbook 2009

ix. Water hammer arrestors: Plumbing and Drainage Institute

x. Above ground piping up to NPS 3 will be copper Type L to ASTM B88. Above NPS 3, cement lined ductile iron to ANSI/AWWA C151/AZ1.51 and ANSI/AWWA C104/A21.4 will be used.

xi. Below ground copper piping for trap seal primer application will be Type K copper, soft annealed to ASTM B88 M continuous without joints.

xii. Above ground copper piping NPS 2 and above to be roll-grooved while piping below NPS 2 will be soldered with lead-free solder.

xiii. All joints in above ground cement lined ductile iron pipe will be AWWA mechanical joint or Class 150 flange, depending upon the situation.

3. Sanitary Drain & Waste Vent

All sanitary and waste water systems will be designed and installed in accordance with the NPC. Above ground general service piping copper to DWV ASTM B306 for NPS 3 and less, and cast iron to CSA B70 for NPS 4 and above. Below ground general service piping will be PVC DWV 15 up to NPS 6. An NPS 6 standpipe will be provided in the mechanical room for draining the sprinkler systems (i.e. dry alarm valves). This NPS 6 drain will be tied into the building storm drainage system because of the potential of surcharging the sanitary sewer system.

The following are considerations for the design of the sanitary and waste water system:

i. Drain lines will not be located in exterior walls unless no other alternative exists. When installed in exterior walls plumbing piping shall be installed on the warm side of the insulation.

ii. Trap seal primers will be used on all new drains and will be the electric actuated manifold type, except for primers for individual drains located

away from an electric primer location which will be the pressure drop actuated type; primers are being provided because of expected inactivity associated with most of the plumbing floor drains installed throughout the building.

iii. Vent piping will be insulated 3 m from roof penetration for condensation control and frost prevention.

iv. A low profile above floor grease interceptor will be used in the new extension canteen to service the three-compartment sink.

v. Plumbing roof vents will be fabricated from stainless spun aluminum with caps selected to properly fit the type and size of the pipe at each location; they will feature a telescoping cap design and an insulated vent stack cover.

vi. All underground sanitary piping for the new extension will be routed to a common location for connection into the sewage treatment system.

vii. All storage drainage piping from roof drains will be routed to a common location for connection into the site storage drainage system.

4. Plumbing Fixtures

Self-contained, refrigerated, water bottle filling stations will be located in corridor areas adjacent to the change rooms in compliance with applicable guidelines. Water closets will be of the elongated type with water saver (4.8 litres per flush) water closets specified. High efficiency (0.5 litres per flush) urinals will be used and hands free trim will be present in all lavatories, water closets, urinals and showers. All urinals and toilets will be wall mounted, and all lavatories will be in-counter mounted or wall mounted. Low flow aerators, 1.9 L/min, will be provided for all lavatories and all water closets to be supplied with open front seats. Water conserving shower heads will be installed to CAN/CSA B125-93 "Plumbing Fittings".

Accessible fixtures will be provided in accordance with CAN/CSA B651-M90 "Barrier Free Design". All showers will be field built with ceramic tile finish. All lavatories will be provided with accessible trim and offset waste, which will enable counter design to be continuous in appearance.

All sinks to be in counter mount, stainless steel with non-ledge back and deck mounted trim, unless otherwise noted. Janitors' mop sinks will be prefabricated and floor-level for ergonomic purposes.

Floor drains will be provided in areas as required by applicable codes and standards, including but not limited to: washrooms, janitor closets, shower anterooms and mechanical spaces where fluids are discharged or have the potential to be discharged.

05. Fire Protection & Suppression

1. Fire Protection Supply

As previously described, the existing arena is equipped with a water supply system consisting of a drilled well supplying water to an underground storage tank with a dedicated pump house external to the building. The pumps discharge into a common 200 mm DI Class 350 water supply pipe that is routed underground to the building. The supply pipe branches outside the building and supplies the building with a 200 mm DI Class 350 water supply for fire protection and a 100 mm DI Class 350 water supply for domestic water.

A review of the total building fire protection requirements (existing arena and new extension) was performed to

determine if the existing fire protection water supply would be sufficient to serve the new building with the new extension included. Total building demand is as follows:

i. Building Demand: 450 gpm

ii. Outside Hose Allowance: 250 gpm

iii. Estimated Fire Pump Flow: 750 gpm (Based on 700 gpm total)

Currently the pump house contains a single fire pump. The fire pump is rated for 1000 gpm which is sufficient to serve the building including the new building extension.

Similarly, a review of the storage tank capacity was performed to determine if the storage requirement was sufficient to serve the total building for fire protection:

i. Fire Pump: 60,000 gal (1000 gpm for 1 hour)

ii. Domestic: 18,000 gal (300 gpm for 1 hour)

iii. Total Storage Required: 78,000 gal

Currently the storage tank has a storage capacity of 440 m^3, or 116,000 gallons which is sufficient to serve the building, including the new extension. It should also be noted that an exterior open-air lagoon with a storage capacity of 800 m^3, or 211,000 gallons, is also available for firefighting.

2. Sprinkler System

The existing arena is sprinklered throughout. The sprinkler system design for the new extension will be in accordance with NFPA-13, "Standard for the Installation of Sprinkler Systems". The system will be hydraulically designed using the area/density method. All alarm valves used in the new extension will be wet type alarm valves with the exception of the dry alarm valves serving areas subject to freezing. The fire protection header within the existing arena will be modified to allow for the connection of a new dedicated supply pipe to extend the system into the new mechanical room. New alarm valves will be installed to serve the new building areas.

For the design of the sprinkler system, the following occupancy classifications will be used:

i. All dressing rooms, offices and assembly areas will have Light Hazard occupancy classification.

ii. Electrical rooms and storage rooms will have an Ordinary Hazard Group 1 occupancy classification.

iii. Mechanical rooms and the refrigeration plant room will have an Ordinary Hazard Group 2 occupancy classification.

Based on the above classifications, the following are the design considerations for the sprinkler system:

i. A total of two alarm valves will be provided in the new mechanical room to serve the new extension.

ii. Wet Alarm Valve – Support / Heated Areas; Dry Alarm Valve – Rink Area

iii. The dry alarm valve will be equipped with an air compressor to provide the supervisory air pressure for the system; the dry sprinkler system may be equipped with quick opening devices to meet the maximum time of water delivery for the most remote locations.

iv. For the light hazard areas:

   a. The wet sprinkler system design area density will be 4.07 litres per minute per square meter and the sprinkler design area will be 139 square meters.

   b. The dry sprinkler system design area density

will be 4.07 litres per minute per square meter and the sprinkler design area will be 181 square meters (139 square meters + 30 per cent for dry pipe system).

c. The water supply for sprinklers including the inside/outside hose allowance will be required for the duration of thirty minutes.

v. For the ordinary hazard group 2 areas the sprinkler system design area density will be 8.14 litres per minute per square meter and the sprinkler design area will be 139 square meters. The water supply for sprinklers including the inside/outside hose allowance will be required for the duration of ninety minutes.

vi. All elevator machine rooms, electrical rooms and data closets will have a dedicated isolation valve in a recessed cabinet, properly identified, to enable isolation of the group of sprinklers servicing these individual areas. Isolation valves will be mounted in walls directly outside the rooms they serve.

vii. An inside-outside hose allowance of 6.3 Litres per second (for light hazard areas) and 15.8 Litres per second (for ordinary hazard group 2 areas) will be added to the sprinkler water demand for the building to determine the actual water demand for firefighting purposes.

viii. The existing rotary water gong and siamese connection to enable the fire department to pump into the sprinkler system will remain.

ix. Sprinklers will be installed above and below ductwork in all mechanical rooms as required to comply with the requirements of NFPA-13; no combustible sprinkler piping will be installed on this project.

x. In finished and unfinished areas with ceilings ordinary temperature, quick response semi-recessed, chrome plated pendant sprinklers will be installed; in finished and unfinished areas without ceilings ordinary temperature, brass upright sprinklers will be installed.

xi. `Sprinklers in areas where they may be subject to possible damage will be covered with red wire guards.

xii. As per section 3.2.5.8 of NBCC the building is not required to have a standpipe system since the building is not more than 14 m in height and is sprinklered throughout.

4. Portable Extinguishers

Fire extinguishers will be located as per NFPA 10, "Portable Fire Extinguishers", and the National Fire Code of Canada.

The following are the design considerations for the types and placement of portable extinguishers:

i. Multi-purpose dry chemical type will be provided throughout the new extension in areas that are subject to freezing.

ii. Pressurized water based fire extinguishers will be provided throughout heated areas.

iii. Wet chemical type will be provided in the commercial kitchens adjacent to the ranges.

iv. Multi-purpose dry chemical type will be provided in the mechanical and plant rooms.

v. Fire extinguishers will be mounted in recessed or semi-recessed wall cabinets to deter potential vandalism.

vi. Carbon dioxide (CO_2) fire extinguishers will be installed in server rooms, electrical rooms, data closets and telephone rooms.

5. Wet Chemical Extinguishing System

The new extension canteen will be equipped with a wet chemical fire extinguishing system designed in accordance with NFPA-96, "Ventilation Control and Fire Protection of Commercial Cooking Operations". This system will be interlocked with the building fire alarm system to indicate an alarm should a fire be

detected under the commercial exhaust hood, and will include both plenum and appliance nozzles. They will be equipped with a micro-switch which will close upon activation of the detection system and energize a shunt trip, cutting the power supply to the commercial cooking appliances. Wet chemical fire suppression agent consisting of a solution of potassium carbonate (CK_2O_3) in water will be used. Heat detectors will be located over each appliance and in the exhaust duct connected to each hood. Mechanical actuation of the fire suppression system will be provided at the mechanical control box on top of the fire suppression agent cylinder and manual pull stations will be located within the kitchen. Chrome plated steel pipe for conveyance of extinguishing agent and the installation of heat detection cable will be provided.

06. Building Management & Controls

The new extension will utilize a direct digital control system (DDC) which incorporates a network of electronic devices designed to monitor and control various mechanical and electrical systems. It is intended to integrate the new system with the existing DDC system currently installed in the existing arena. The new expansion DDC system will communicate via BACnet, an industry standard network communications protocol for building automation and control systems.

Mechanical systems that will be monitored and controlled by the DDC system include: HVAC, hydronic heating/cooling, new ice plant refrigeration system, in-floor heating and plumbing systems. Major pieces of mechanical equipment, including air handling and energy recovery units, will be equipped with a dedicated DDC controller responsible for controlling economizers, heating/cooling coils, alarm monitoring, frost prevention, etc. Major plumbing equipment throughout the facility, such as domestic hot water and preheating domestic hot water systems will also be interfaced with the DDC. Air handling units will be monitored for carbon dioxide levels for the purpose of demand control ventilation. The DDC will be interfaced with the new expansion refrigeration plant for monitoring and controlling equipment. All building system loads will be controlled as part of the electrical demand control strategy.

07. ELECTRICAL DESIGN

This report outlines the technical design basis for the electrical systems required for the Jack Byrne Regional Sports and Entertainment expansion project and some areas of the existing arena undergoing renovation. The electrical systems will be designed to conform to the latest edition of the Canadian Electrical Code CSA C22.1 and the latest edition of:

i. National Building Code of Canada (NBCC)

ii. National Energy Code (NEC)

iii. National Fire Code (NFC)

iv. National Fire Protection Association (NFPA)

v. Provincial Fire Commissioner's Regulations

vi. Installation of Fire Alarm Systems CAN/ULC-S524

vii. Inspection and Testing of Fire Alarm Systems CAN/ULC-S536

viii. Verification of Fire Alarm Systems CAN/ULC-S537

ix. Computer Aided Design Drafting (Buildings) CAN/CSA-B78.5

x. IESNA - Illuminating Engineering Society of North America

xi. Building Facilities, Design Guidelines for Telecommunications CAN/CSA-T530

xii. BICSI Telecommunications Distribution Method Manual

xiii. The electrical design and installation will meet the requirements of the Handbook of Occupational Health and Safety; specifically, the Provincial Labour Codes and Buildings Accessibility Act and Regulations.

The design approach for the new extension will incorporate green building initiatives, such as the construction of a sustainable site through means of light pollution reduction, as well as indoor environmental quality through user controllability of lighting and heating in perimeter and non-perimeter spaces. There will be reduced impacts on energy usage through the implementation of a measurement and verification plan that will monitor building energy and verify that water and energy reductions are being achieved. The incorporation of these initiatives will affect the electrical design process for the systems as outlined below.

01. Electrical Service and Distribution

1. Service Entrance & Distribution Equipment

As a result of the new extension, the existing pad mounted transformer will need to be replaced with a larger transformer. The new transformer will be located in close proximity to the existing location and will be used to feed the new main electrical service switchboard, which will be located in the main electrical room of the new extension. To minimize downtime to the existing arena, the existing transformer and duct bank will remain in place until the new service is complete. The new service switchboard will be used to feed the existing main switchboard.

The new pad mount transformer will be powered from the same Newfoundland Power pole line that is presently feeding the existing pad mount. All wiring will be via underground duct banks. The high voltage wiring and pad mount transformer will be supplied and installed by Newfoundland Power. All underground conduit, secondary wiring, transformer pad and grounding will be supplied and installed by the contractor building the

facility.

Preliminary load calculations suggest that the new service will be 2000A, 347/600Volt, 3-phase, 4-wire. The new incoming main service entrance switchboard will be equipped with metering cabinets. To minimize modifications to the existing equipment and systems, the new 347/600V 3-phase, 4 wire service entrance switchboard will include a main circuit breaker and distribution board and will power the main switchboard in the existing arena. The main breaker will be electronic, with ground fault protection as required by the Canadian Electrical Code. A loss-of-phase protection and an adjustable long, short and instantaneous time trip settings, will be available on the breaker. The switchboard will be braced in excess of the available short circuit fault entering the building. The 600V panel-boards will be designed with an interrupting rating that will safely interrupt the maximum available fault at that location. The bus bracing level and interrupting ratings for all equipment will be calculated and selected during the design phase of the project.

High efficiency dry-type 600-120/208V step-down transformers will be supplied, providing power to panel boards used for servicing general purpose receptacle loads, smaller mechanical heating/plumbing/HVAC/ fire protection loads, communication systems, and the building automation control system. Low voltage panel boards will be complete with bolt-on circuit breakers rated to suit the interrupting current rating at those panels and will be located within main mechanical rooms and other common areas.

All electrical equipment will be CSA rated, sprinkler-proof and sized for the calculated demand load plus a minimum of 25 per cent spare capacity. Electric distribution high efficiency transformers will be specified in order to achieve significant energy savings and contribute to the overall green initiatives for the project.

2. Metering

The electrical distribution for the new expansion will be designed to allow for adequate measurement of all buildings systems that consume energy. The building energy monitoring will contribute to the project's green initiatives by helping to verify that expected energy reductions are being achieved as per design parameters. Continuous metering will be installed at the building entrance and also for end-uses such as lighting systems and controls, hydronic heating, refrigeration and HVAC systems. Where appropriate, similar load types will be grouped from a main point of distribution and metered for energy consumption information. The electrical single-line diagram will illustrate all metering points for the new extension. Meters will communicate over the RS485 industry standard Modbus protocol and be capable of data logging.

The service to the existing arena will be metered, however no individual loads will be measured.

3. Wiring Devices

Wiring devices for the new expansion will be specification grade in all areas. Cover plates for all interior flush mounted devices will be stainless steel and circuits for receptacle devices used on exterior walls, or areas

near sinks or other areas where water will be present, will be protected at the panel boards with ground fault interrupting breakers.

In addition to standard receptacles, power connections for any mechanical equipment, elevators, kitchen equipment, etc. requiring special configuration receptacles or direct connection will be provided.

4. Mounting Heights

Devices will be mounted at heights in accordance with the Provincial Accessibility Regulations as follows:

i. Receptacles:
   a. wall mounted general 450 mm
   b. above counter tops 150 mm
   c. in elect./mech. rooms 1050 mm
ii. Light Switches: 1200 mm
iii. Thermostats: 1200 mm
iv. Data/Telephone Outlets: 450 mm

02. Lighting Design

Lighting throughout the new extension will be designed in accordance with IESNA Standard on Illumination Systems, and ASHRAE 90.1. Lighting levels will be to IESNA Standards and are indicated in **Table 07**.

The lighting densities indicated by ASHRAE 90.1 in **Table 07** are the maximum values permitted. It is intended to use less energy than these values where possible in an effort to reduce energy usage throughout the building. The total new extension will have a lighting power density of not more than 9.8 W/m².

1. Interior Lighting

Wherever possible, interior lighting in heated spaces will be fluorescent with T-8 lamps and high power factor energy efficient electronic instant start ballasts with less than 10 per cent total harmonic distortion. Lamps will be 32 watt, 3500 K in T-8 layout with initial ratings of 2950 Lumens. For areas such as offices, fixtures will be 2 ft x 4 ft recessed troffers complete with framed prismatic acrylic lens. Storage rooms, dressing rooms and public washrooms will utilize surface mount fluorescent light fixtures, with dressing room and washroom fixtures being vandal resistant. Refrigeration plant lighting fixtures will be coordinated with the supplier of refrigeration plant equipment for type and style to suit that location. Where required for video display terminal applications, such as the general offices, 2 ft x 4 ft deep cell parabolic fluorescent fixtures will be provided to prevent veiled lamp reflections and glare.

Lighting will be controlled by low voltage switches and lighting relays. Lighting relays will be grouped and placed in separate boxes adjacent to the lighting panel board.

All offices, storage rooms, dressing rooms and other unoccupied spaces will have lighting fixtures controlled by occupancy sensors. The sensors are designed so a passive infrared first detects a person entering the room, then the sensor engages a microphone detecting sounds indicating continued occupancy in the room.

Above the new expansion ice surface, LED light fixtures

will be installed and switched in sections to achieve two separate lighting levels. The lighting control for these lights will be hard-wired back to a low voltage controller.

Light switches for 347 volt lighting will be low voltage type, controlling lighting relays or line voltage where economical. Switches for direct control of other lighting will be 120 Volt, 15 Amp. Dimmer switches will be rated for the load being switched with allowances for gang mounted de-rating as required.

2. Exterior Lighting

New exterior parking area lighting will be pole mounted LED fixtures with drivers and will be connected into the existing exterior lighting control contactor. New exterior perimeter lighting will be provided by building-mounted LED fixtures at a height to match that of existing fixtures. Entrance lighting will be by LED fixtures recess mounted on soffits or surface mounted on walls over doors.

3. Emergency Exit Lighting

Emergency lighting will be installed in accordance with the latest editions of the National Building Code, National Fire Code of Canada and the NFPA Life Safety Code.

The central DC lighting system supplying power for

Area	Lighting Fixture Type	Light Level Lux		ASHRAE 90.1
		General	Task Light	
Offices	Recessed 2 x 4 acrylic lens	550		12.0
Ice Surface	LED	500-750		13.0
General	Fluorescent	300		13.75
Storage areas	Surface fluorescent with lens	300		6.8
Dressing Rooms	Vandal proof fluorescent	300		8.6
Washrooms	Vandal proof Surface with lens	300		10.6
Canteen	General	300	540	13.1
Perimeter lighting	LED	15 at ground level		1.5
Active entrance	LED	55 at ground level		2.7
Inactive entrance	LED	10 at ground level		2.7
Parking area	LED	10 at ground level		2.1
Corridor	Ceiling or wall mounted surface fluorescent	200		7.1

Table 07. Maximum light levels and energy consumption as dictated by ASHRAE 90.1.

emergency lighting in the existing arena will remain and continue to supply the presently connected loads. The new extension will have a central DC lighting system supplying power for emergency lighting, over the ice surface and throughout the building as required by the NBCC. The central DC lighting system will be installed in the new main electrical room and be comprised of battery racks, inverter and rectifier, which will be sized to accommodate all emergency lighting loads in the new expansion. Illumination will be adequate to permit an orderly, accident-free exit from anywhere in the building. General emergency lighting will be provided for corridors, windowless rooms, offices and for canteens and other large-group spaces.

The emergency central DC lighting system is designed to always be on to ensure continuous power for lighting when the normal power supply to the building is not available.

Exit lights will be complete with long life energy efficient LED lamps. Exit light signs will be the Running Man Pictogram to meet the National Building Code and the National Fire Regulations. Individual emergency lighting battery units will be CSA approved.

03. Alarm Systems

1. Fire Detection System

The fire alarm system for the new extension will be an extension of the existing fire alarm panel and system located in the existing arena. The system is fully addressable and expandable, which allows extension into the new building areas.

Manual pull stations will be placed at all exits. The building will be sprinklered and all sprinkler valves will be monitored by the fire alarm system. Heat and smoke detectors will be used in accordance with the NBCC (in areas such as ventilation ducts or areas not covered by the sprinkler system). Audible and visible alarm signals will be used throughout the building. The audible portion will consist of wall mounted horns. The visible signals will consist of strobe lights mounted on walls or ceilings adjacent to exit signs, and in internal areas to alert hearing impaired person. The existing fire alarm control panel is located in the main entrance vestibule and will be relocated to accommodate the new lobby in the connecting bar.

Fire Protection System

There is an existing fire water booster pump located in the pump house that is part of the fire water system. The existing pump is electrically driven and connected to the main electrical service switchboard in the pump house. There are no proposed changes to the existing pump house. For further details on the fire protection system, refer to the mechanical design sections of this report.

Fire Suppression System

A wet chemical fire suppression system will be installed in the new canteen and will include a micro-switch with normally open contacts. These contacts will close when an increase in temperature is detected above the stovetop. Consequently, an input signal will be transmitted to the fire alarm panel, which upon receipt will transmit an

output signal to energize a shut trip. The shut trip will de-energize electrical power to the commercial cooking appliances.

2. Security System

The security system for the new extension will consist of motion detectors and door contact devices wired to an existing central security panel currently located in the existing arena. All new devices will be supplied and installed by the electrical contractor. A remote keypad for accepting password inputs currently exists in the main entrance. No additional keypads will be installed for the new expansion, however, the existing one will be relocated to accommodate the new lobby in the connecting bar. The expandability of the existing security panel to accept the security system devices required for the expansion will be confirmed during detailed design. Should the existing system not be capable of accommodating this, a new security panel will be installed and existing wiring and location of remote keypad will be maintained to minimize cost impact.

New devices for the security system will be placed on all exterior doors and in other strategic areas, and wired as per manufacturer's instructions. The existing contract for the security system will be updated as required and can be maintained by the current security monitoring company.

04. Data & Communications

1. Telephone

All work under this system will be done in accordance with the requirements of the local telephone company. The existing building has a main incoming telephone service already in place which will remain as is.

The telephone system scope of work for the electrical contractor to service the new extension will include the supply and installation of zone conduits, BIX panels and cables to connect all telephones to the main telephone entrance service in the original building's main electrical room. It will also include the supply and installation of all required zone conduits and cables to link the main telephone entrance area with all data/telephone closets, as illustrated on the electrical floor plans. Conduits will be routed from outlets to accessible ceiling spaces. Outlet boxes will be supplied and installed by the electrical contractor. No. 6 AWG TW insulated cable will be used to connect the telephone ground bus to all new zone conduits installed in newly constructed areas.

2. Television

The existing television system will remain as is, with additional television outlets provided in the new expansion in locations as directed by the Owner during the design. Dedicated conduits and cabling will be installed from the main television backboard to each outlet location. Additional splitters will be supplied and installed to suit the exact quantity of new outlets added. All materials and installation are to be completed under the new construction contract.

3. Data

The existing networking data system will remain as is, with data outlets provided in the new extension in locations

to suit network and internet requirements; and to suit locations where wireless routers will be installed.

The data system scope of work for the electrical contractor to service the new extension will include EMT zone and distribution conduits and any required termination cabinets, wall drops and outlet boxes with horizontal wiring and terminations, backbone cabling and any required line and patch cords. All data wire, patch panels and hubs supplied and installed by the electrical contractor will be for a CAT 6 certified system.

Dedicated computer receptacles will be installed adjacent to each data outlet and both will be recessed wall mounted. Any communication closets will be arranged to accommodate CAT 6 distribution and rack arrangements. The entire data system is to be commissioned and certified by a qualified systems installer.

4. Public Address

The public address (PA) system for the existing arena is proposed to remain as is and will be expanded where possible to accommodate the new areas. Additional head-end equipment, mixers and amplifiers will be added as required to suit the expansion of the existing system. New PA system speakers will be mounted in corridors, lobbies and other areas accessed by the public. Maintenance rooms, such as the mechanical, electrical, water entry, refrigeration plant and ice resurfacer rooms, will have PA system horn speakers installed. Any new systems wiring as required by the system manufacturer will be in conduit.

The expandability of the existing public address system to accept the system devices required for the expansion will be confirmed during detailed design. Should the existing system not be capable of accommodating this, a new public address system will be installed as outlined above and all existing wiring and devices will be reused to minimize cost impact.

05 Energy Management

The electrical design will be coordinated with the mechanical design to provide all power for mechanical equipment. All control wiring for mechanical equipment will be supplied and installed by the controls contractor. Building control management system information, used to control and schedule load operation for energy conservation, will be integrated into the refrigeration plant control system.

Starters and disconnect switches for mechanical equipment will be provided by the electrical contractor. In general, all starters will be either variable speed drives or combination-type with circuit breakers, complete with normally open and closed auxiliary contacts, push buttons, pilot light and/or selector switches. Variable frequency drives and/or soft starts will be used for larger loads to provide low inrush motor starting currents and improved control of acceleration and deceleration, thus maximizing energy savings. This equipment will be supplied and installed by the electrical contractor.

08. COST ESTIMATE

QSolv Incorporated, a quantity survey and costing consultant firm, have been engaged to perform a Class C cost estimate for the Jack Byrne Regional Sports & Entertainment Complex new expansion. **Table 08** on the following page is a summary of the estimated cost as of July 2017.

A Class C estimate is based on a full description of the preferred option, construction/design experience, and market conditions. While this estimate is not as substantive as Class B or A, Class C estimates have between a -15% and +20% level of precision. They are intended to assist a client in making the correct investment decisions and obtaining preliminary project approval. The costing consultant reviewed the concept report and the initial Class C estimate (as presented to the client in April 2017). While there were some pluses and minuses, the overall net effect was minimal. Therefore, their recommendation is to leave the initial Class C estimate as is with no changes to the overall budget.

To accompany the costing breakdown are general notes from the costing consultants:

i. There are no costs associated with canteen (kitchen) equipment — only the partitions, flooring and ceilings, and we are assuming some rough-in of mechanical services.

ii. Due the heat recovery system proposed, the mechanical pricing provided by JBC is reasonable. The initial estimate, prior to receipt of JBC's estimates, did not include for heat recovery of the new expansion. JBC's design also has existing AHU's and ERV's for existing rink to be connected to waste heat with new heating coils.

iii. There are no costs included for replacing existing refrigeration equipment. The replacement of the existing plant if required/decided by the owner would be extra to the budget.

iv. Lighting in rinks and most areas will be LED lighting. JBC pricing for electrical appears to be reasonable.

v. Site work and site services costs were reviewed based on the report and no changes are necessary.

vi. There is no design contingency in the estimate.

vii. There is a 3 per cent Construction Contingency While typical, this may be low considering there is a fair amount of work to do in the existing facility.

viii. This budget takes into account the current competitive market conditions therefore it is adequate and should not be reduced at this early stage.

ELEMENTAL COST SUMMARY

PROJECT: JACK BRYNE CENTRE EXPANSION
LOCATION: TORBAY, NL
CLIENT: TOWN OF TORBAY
ARCHITECT: LAT 49 ARCHITECTURE

Class C Conceptual Estimate

DATE: JULY 14, 2017
CLASS: C CONCEPTUAL STAGE
FILE 13014
GFA: m2 4084

GROSS FLOOR AREA 4084 m2

ELEMENT	RATIO TO GFA	ELEMENTAL QUANTITY		ELEMENTAL UNIT RATE	ELEMENTAL AMOUNT	RATE PER GFA	TOTAL AMOUNT	%
A SHELL						778	$ 3,176,371	22.74
A1 SUBSTRUCTURE						99	$ 405,009	2.90
A11 Foundations	0.790	3225	m2	$ 125.58	$ 405,009	99		2.90
A12 Basement Excavation	0.000	0	m2	$ -	$ -	-		0.00
A2 STRUCTURE						385	$ 1,571,646	11.25
A21 Lowest Floor Construction	0.766	3129	m2	$ 116.16	$ 363,432	89		2.60
A22 Upper Floor Construction	0.217	887	m2	$ 576.02	$ 511,074	125		3.66
A23 Roof Construction	0.820	3351	m2	$ 208.06	$ 697,141	171		4.99
A3 EXTERIOR ENCLOSURE						294	$ 1,199,716	8.59
A31 Walls Below Grade	0.000	0	m2	$ -	$ -	-		0.00
A32 Walls Above Grade	0.461	1884	m2	$ 274.36	$ 516,806	127		3.70
A33 Windows and Entrances	0.012	48	m2	$ 1,360.38	$ 64,968	16		0.47
A34 Roof Coverings	0.663	2706	m2	$ 219.59	$ 594,143	145		4.25
A35 Projections	0.009	35	m2	$ 680.00	$ 23,800	6		0.17
B INTERIORS						320	$ 1,307,435	9.36
B1 PARTITIONS AND DOORS						118	$ 482,195	3.45
B11 Partitions	0.575	2348	m2	$ 159.48	$ 374,395	92		2.68
B12 Doors	0.053	215	m2	$ 501.40	$ 107,800	26		0.77
B2 INTERIOR FINISHES						94	$ 385,765	2.76
B21 Floor Finishes	0.983	4013	m2	$ 44.03	$ 176,711	43		1.27
B22 Ceiling Finishes	1.112	4543	m2	$ 37.68	$ 171,193	42		1.23
B23 Wall Finishes	1.150	4695	m2	$ 8.06	$ 37,861	9		0.27
B3 FITTINGS AND EQUIPMENT						108	$ 439,475	3.15
B31 Fittings and Fixtures	2.170	8861	m2	$ 40.57	$ 359,475	88		2.57
B32 Equipment	2.170	8861	m2	$ -	$ -	-		0.00
B33 Conveying Systems	2.170	8861	m2	$ 9.03	$ 80,000	20		0.57
SERVICES						1,459	$ 5,958,000	42.65
C1 MECHANICAL						1,067	$ 4,358,000	31.20
C11 Plumbing and Drainage	1.000	4084	m2	$ 195.89	$ 800,000	196		5.73
C12 Fire Protection	1.000	4084	m2	$ 55.09	$ 225,000	55		1.61
C13 Refrigeration Plant	1.000	4084	m2	$ 412.10	$ 1,683,000	412		12.05
C14 HVAC	1.000	4084	m2	$ 367.29	$ 1,500,000	367		10.74
C15 Controls	1.000	4084	m2	$ 36.73	$ 150,000	37		1.07
C2 ELECTRICAL						392	$ 1,600,000	11.45
C21 Services and Distribution	1.000	4084	m2	$ 61.21	$ 250,000	61		1.79
C22 Lighting, Devices and Heating	1.000	4084	m2	$ 293.83	$ 1,200,000	294		8.59
C23 Systems and Ancillaries	1.000	4084	m2	$ 36.73	$ 150,000	37		1.07
NET BUILDING SUBTOTAL - LESS SITE						2,557	$ 10,441,806	74.75
D SITE & ANCILLARY WORK						420	$ 1,715,053	12.28
D1 SITEWORK						383	$ 1,562,273	11.18
D11 Site Development	1.000	4084	m2	$ 272.35	$ 1,112,273	272		7.96
D12 Mechanical Site Services	1.000	4084	m2	$ 48.97	$ 200,000	49		1.43
D13 Electrical Site Services	1.000	4084	m2	$ 61.21	$ 250,000	61		1.79
D2 ANCILLARY WORK						37	$ 152,780	1.09
D21 Demolition	1.000	4084	m2	$ 32.70	$ 133,540	33		0.96
D22 Alterations	1.000	4084	m2	$ 4.71	$ 19,240	5		0.14
NET BUILDING SUBTOTAL - INCLUDING SITE						2,977	$ 12,156,858	87.03
Z GENERAL REQUIREMENTS AND ALLOWANCES						444	$ 1,811,712	12.97
Z1 GENERAL REQUIREMENTS AND FEES						360	$ 1,471,088	10.53
Z11 General Requirements and Overheads		11%			$ 1,087,133	266		7.78
Z12 Contractors Profit		4%			$ 383,956	94		2.75
NET BUILDING SUBTOTAL - EXCLUDING CONTINGENCIES						3,337	$ 13,627,947	97.56
Z2 ALLOWANCES						83	$ 340,623	2.44
Z21 Design Allowance		0%			$ -	-		0.00
Z22 Escalation Allowance		0%			$ -	-		0.00
Z23 Construction Allowance		3%			$ 340,623	83		2.44
TOTAL CONSTRUCTION COST (HST EXTRA)				$3,420 per m2			$ 13,968,600	100.00

Table 08. Summary of estimated costs.

APPENDIX A: COSTING REPORT

Jack Bryne Regional Sports & Entertainment Centre, New Expansion

Town of Torbay, NL

ELEMENTAL COST PLAN
CLASS C - CONCEPT DESIGN STAGE
JULY 14, 2017

QSolv

11 Randolph Street, Halifax, Nova Scotia, Canada, B2P 2A9

www.qsolv.ca

JBC JEWER BAILEY CONSULTANTS

LAT Architecture Inc.

Preamble

INTRODUCTION

The Class C conceptual estimate enclosed represents the construction costs for the proposed expansion to the existing Jack Bryne Arena complex located in the Town of Torbay, Newfoundland and Labrador, as designed by Lat49 Architecture for the Town of Torbay.

The project generally involves the construction of a new addition to house a new ice surface, new parking area, and a relocated entrance from Kennedy's Brook Drive. The civil works will also include the new parking lot layout, site grading, asphaltic concrete (pavement), curb and sidewalk, and site landscaping.

APPROACH

The construction costs for this report include all materials, labour, equipment, overheads, general conditions, plus markups and contractor's profit, for the building and siteworks as presented in the project documents. The **Total Tender Value is estimated at $13,562,000.00** plus value added taxes and the **Total Construction Value is estimated at $13,969,000.00** plus value added taxes.

Quantities were measured based on the Canadian Institute of Quantity Surveyors (CIQS) standards for Method of Measurement and presented in elemental format.

Pricing reflects competitive bids for every element of the work for a project of this type procured under an open market stipulated lump sum bid contract in Torbay, NL. Unit costs are developed and expressed as typical sub-contractor pricing and are inclusive of subcontractor's overheads and profits.

This estimate is an indication of the probable construction costs and is intended to represent fair market value of the construction costs. This estimate should not be considered a prediction of the lowest bid.

QSolv

Preamble

SPACE MEASUREMENT	The Gross Floor Area (GFA) of the expansion was measured at 4084 square metres (m2) based on the CIQS Method of Measurement standards.
COST BASE	All costs are expressed in third quarter 2017 (3Q2017) Canadian dollars. All costs are shown exclusive of the 15% Harmonized Sales Tax (HST). Please refer to the Summary Sheets where the HST is identified.
ESCALATION	An Escalation Allowance is excluded from this cost report. Once a project schedule is finalized, an escalation allowance will be applied to calculate construction costs for future years.
CONTINGENCIES	A Design Development Contingency Allowance is excluded from this report. A Construction Contingency Allowance of 3% is included in this report.
EXCLUSIONS	The following have been excluded from this cost report: Furniture, Fittings and Equipment (FF&E) unless otherwise noted Premium for single source materials or equipment Third party commissioning Interim financing Land acquisition costs Swing space or moving costs Risk allowance Design fees and disbursements Project management fees Operational costs Surveying and legal fees Fund raising fees

PROJECT COST SUMMARY

PROJECT: JACK BRYNE CENTRE EXPANSION
LOCATION: TORBAY, NL
CLIENT: TOWN OF TORBAY
ARCHITECT: LAT 49 ARCHITECTURE

Class C Conceptual Estimate

DATE: JULY 14, 2017
CLASS: C CONCEPTUAL STAGE
FILE 13014
GFA: m2 4084

GROSS FLOOR AREA 4084 m2

	DESCRIPTION	ELEMENTAL QUANTITY		ELEMENTAL UNIT RATE	ELEMENTAL AMOUNT	%	NOTES
1	BUILDING SHELL	4084	m2	$ 757.27	$ 3,092,691	19.25	
2	INTERIORS	4084	m2	$ 338.61	$ 1,382,900	8.61	
3	MECHANICAL	4084	m2	$ 1,067.09	$ 4,358,000	27.13	
4	ELECTRICAL	4084	m2	$ 391.77	$ 1,600,000	9.96	
5	SITEWORK	4084	m2	$ 394.68	$ 1,611,873	10.03	
6	ANCILLARY WORK	4084	m2	$ 37.36	$ 152,580	0.95	
7	GENERAL REQUIREMENTS & FEE	4084	m2	11%	$ 1,363,741	8.49	
8	DESIGN DEVELOPMENT CONTINGENCY	4084	m2	0%	$ -	0.00	
9	ESCALATION	4084	m2	0%	$ -	0.00	To be determined by others if required.
10	CASH ALLOWANCES	4084	m2	$ -	$ -	0.00	To be determined by others if required.
11	**TOTAL TENDER AMOUNT**	**4084**	**m2**	**$ 3,321.00**	**$ 13,562,000**	**84.42**	
12	CONSTRUCTION CONTINGENCY	4084	m2	3.0%	$ 406,854	2.53	
13	**TOTAL CONSTRUCTION AMOUNT**	**4084**	**m2**	**$ 3,420.00**	**$ 13,969,000**	**86.96**	
14	FURNITURE, FITTINGS AND EQUIPMENT (FF&E)	4084	m2	$ -	$ -	0.00	To be determined by others if required.
15	THIRD PARTY COMMISSIONING	4084	m2	$ -	$ -	0.00	To be determined by others if required.
16	LAND AQUISTITION COSTS	4084	m2	$ -	$ -	0.00	To be determined by others if required.
17	SWING SPACE COSTS	4084	m2	$ -	$ -	0.00	To be determined by others if required.
18	MOVING ALLOWANCE	4084	m2	$ -	$ -	0.00	To be determined by others if required.
19	PHASING ALLOWANCE	4084	m2	$ -	$ -	0.00	To be determined by others if required.
20	DESIGN FEES & DISBURSEMENTS	4084	m2	$ -	$ -	0.00	To be determined by others if required.
21	PROJECT MANAGEMENT FEES	4084	m2	$ -	$ -	0.00	To be determined by others if required.
22	PROJECT FINANCING	4084	m2	$ -	$ -	0.00	To be determined by others if required.
23	RISK ALLOWANCE	4084	m2	$ -	$ -	0.00	To be determined by others if required.
24	TRAFFIC STUDY	4084	m2	$ -	$ -	0.00	To be determined by others if required.
25	LEGAL AND SURVEY	4084	m2	$ -	$ -	0.00	To be determined by others if required.
26	TOTAL PROJECT AMOUNT (Less HST)	4084	m2	$ 3,420.00	$ 13,969,000	86.96	
27	HST	15%			$ 2,095,350	13.04	
28	TOTAL PROJECT AMOUNT (HST Included)	4084	m2	$ 3,933.00	$ 16,064,350	100.00	

QSolv

JACK BYRNE

ELEMENTAL COST SUMMARY

PROJECT: JACK BRYNE CENTRE EXPANSION
LOCATION: TORBAY, NL
CLIENT: TOWN OF TORBAY
ARCHITECT: LAT 49 ARCHITECTURE

Class C Conceptual Estimate

DATE: JULY 14, 2017
CLASS: C CONCEPTUAL STAGE
FILE 13014
GFA: m2 4084

GROSS FLOOR AREA 4084 m2

ELEMENT	RATIO TO GFA	ELEMENTAL QUANTITY		ELEMENTAL UNIT RATE	ELEMENTAL AMOUNT	RATE PER GFA	TOTAL AMOUNT	%
A SHELL						757	$ 3,092,691	22.14
A1 SUBSTRUCTURE						85	$ 346,412	2.48
A11 Foundations	0.790	3225	m2	$ 107.42	$ 346,412	85		0.02
A12 Basement Excavation	0.000	0	m2	$ -	$ -	-		0.00
A2 STRUCTURE						366	$ 1,496,303	10.71
A21 Lowest Floor Construction	0.766	3129	m2	$ 109.98	$ 344,108	84		0.02
A22 Upper Floor Construction	0.217	887	m2	$ 545.40	$ 483,909	118		0.03
A23 Roof Construction	0.820	3351	m2	$ 199.45	$ 668,286	164		0.05
A3 EXTERIOR ENCLOSURE						306	$ 1,249,977	8.95
A31 Walls Below Grade	0.000	0	m2	$ -	$ -	-		0.00
A32 Walls Above Grade	0.461	1884	m2	$ 303.27	$ 571,266	140		0.04
A33 Windows and Entrances	0.012	48	m2	$ 1,360.38	$ 64,968	16		0.00
A34 Roof Coverings	0.663	2706	m2	$ 219.59	$ 594,143	145		0.04
A35 Projections	0.009	35	m2	$ 560.00	$ 19,600	5		0.00
B INTERIORS						339	$ 1,382,900	9.90
B1 PARTITIONS AND DOORS						133	$ 541,289	3.88
B11 Partitions	0.575	2348	m2	$ 159.48	$ 374,395	92		2.68
B12 Doors	0.053	218	m2	$ 765.57	$ 166,894	41		1.19
B2 INTERIOR FINISHES						98	$ 399,285	2.86
B21 Floor Finishes	1.004	4102	m2	$ 43.41	$ 178,032	44		1.27
B22 Ceiling Finishes	1.134	4631	m2	$ 37.44	$ 173,393	42		1.24
B23 Wall Finishes	1.150	4695	m2	$ 10.19	$ 47,861	12		0.34
B3 FITTINGS AND EQUIPMENT						108	$ 442,326	3.17
B31 Fittings and Fixtures	2.170	8861	m2	$ 40.89	$ 362,326	89		2.59
B32 Equipment	2.170	8861	m2	$ -	$ -	-		0.00
B33 Conveying Systems	2.170	8861	m2	$ 9.03	$ 80,000	20		0.57
SERVICES						1,459	$ 5,958,000	42.65
C1 MECHANICAL						1,067	$ 4,358,000	31.20
C11 Plumbing and Drainage	1.000	4084	m2	$ 195.89	$ 800,000	196		5.73
C12 Fire Protection	1.000	4084	m2	$ 55.09	$ 225,000	55		1.61
C13 Refrigeration Plant	1.000	4084	m2	$ 412.10	$ 1,683,000	412		12.05
C14 HVAC	1.000	4084	m2	$ 367.29	$ 1,500,000	367		10.74
C15 Controls	1.000	4084	m2	$ 36.73	$ 150,000	37		1.07
C2 ELECTRICAL						392	$ 1,600,000	11.45
C21 Services and Distribution	1.000	4084	m2	$ 61.21	$ 250,000	61		1.79
C22 Lighting, Devices and Heating	1.000	4084	m2	$ 293.83	$ 1,200,000	294		8.59
C23 Systems and Ancillaries	1.000	4084	m2	$ 36.73	$ 150,000	37		1.07
NET BUILDING SUBTOTAL - LESS SITE						2,555	$ 10,433,591	74.69
D SITE & ANCILLARY WORK						432	$ 1,764,453	12.63
D1 SITEWORK						395	$ 1,611,873	11.54
D11 Site Development	1.000	4084	m2	$ 284.49	$ 1,161,873	284		8.32
D12 Mechanical Site Services	1.000	4084	m2	$ 48.97	$ 200,000	49		1.43
D13 Electrical Site Services	1.000	4084	m2	$ 61.21	$ 250,000	61		1.79
D2 ANCILLARY WORK						37	$ 152,580	1.09
D21 Demolition	1.000	4084	m2	$ -	$ 133,340	33		0.95
D22 Alterations	1.000	4084	m2	$ -	$ 19,240	5		0.14
NET BUILDING SUBTOTAL - INCLUDING SITE						2,987	$ 12,198,045	87.32
Z GENERAL REQUIREMENTS AND ALLOWANCES						434	$ 1,770,595	12.68
Z1 GENERAL REQUIREMENTS AND FEES						334	$ 1,363,741	9.76
Z11 General Requirements and Overheads		9%			$ 1,097,824	269		7.86
Z12 Contractors Profit		2%			$ 265,917	65		1.90
NET BUILDING SUBTOTAL - EXCLUDING CONTINGENCIES						3,321	$ 13,561,786	97.09
Z2 ALLOWANCES						100	$ 406,854	2.91
Z21 Design Allowance		0%			$ -	-		0.00
Z22 Escalation Allowance		0%			$ -	-		0.00
Z23 Construction Allowance		3%			$ 406,854	100		2.91
TOTAL CONSTRUCTION COST (HST EXTRA)				$3,420 per m2			$ 13,968,600	100.00

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LAT Architecture Inc.

Element	Quantities		Unit Rates	Sub-totals
A11 Standard Foundations				
1 Isolated Footings				
▪ Concrete	90	m3	$ 255.00	$ 22,950
▪ Formwork	180	m2	$ 130.00	$ 23,400
▪ Re-steel	8100	kg	$ 2.20	$ 17,820
▪ Dowel to existing	60	no	$ 50.00	$ 3,000
2 Strip Footings				
▪ Concrete	84	m3	$ 255.00	$ 21,381
▪ Formwork	213	m2	$ 130.00	$ 27,682
▪ Re-steel	6708	kg	$ 2.20	$ 14,757
▪ Dowel to existing	8	no	$ 50.00	$ 400
3 Pilasters/Piers				
▪ Concrete	21	m3	$ 255.00	$ 5,475
▪ Formwork	163	m2	$ 130.00	$ 21,216
▪ Re-steel	1718	kg	$ 2.20	$ 3,779
4 Foundation Walls				
▪ Concrete	170	m3	$ 255.00	$ 43,440
▪ Formwork	852	m2	$ 130.00	$ 110,729
▪ Re-steel	13628	kg	$ 2.20	$ 29,982
▪ Dowel to existing	8	no	$ 50.00	$ 400
A11 Standard Foundations Total	**3225**	**m2**	**$ 107.42**	**$ 346,412**
A12 Basement Excavation				
A12 Basement Excavation Total	**0**	**m2**	**$ -**	**$ -**
STRUCTURE				
A21 Lowest Floor Construction				
1 Rink Slab				
▪ Concrete c/w fibre reinforcing - 150mm thick	241	m3	$ 350.00	$ 84,493
▪ Screed, steel trowel, cure & seal	1543	m2	$ 15.00	$ 23,141
▪ Welded wire mesh reinforcing	1543	m2	$ 9.00	$ 13,884
▪ Reinforcing to slab edge	1837	kg	$ 2.20	$ 4,041
▪ 100mm extruded polystyrene insulation	1543	m2	$ 45.00	$ 69,422
▪ 10 mil poly vapour barrier	1543	m2	$ 3.00	$ 4,628
▪ Class A granular base (125mm thickness)	193	m3	$ 40.00	$ 7,714
2 Ice Surfacer Slab				
▪ Concrete c/w fibre reinforcing - 150mm thick	18	m3	$ 350.00	$ 6,466
▪ Screed, steel trowel, cure & seal	123	m2	$ 15.00	$ 1,847
▪ Welded wire mesh reinforcing	123	m2	$ 9.00	$ 1,108
▪ 100mm extruded polystyrene insulation	123	m2	$ 45.00	$ 5,542
▪ 10 mil poly vapour barrier	123	m2	$ 3.00	$ 369
▪ Class A granular base (125mm thickness)	15	m3	$ 40.00	$ 616
3 Circulation Slab				
▪ Concrete - 100mm thick	146	m3	$ 275.00	$ 40,229

Element	Quantities		Unit Rates	Sub-totals
▪ Screed, steel trowel, cure & seal	1463	m2	$ 15.00	$ 21,943
▪ Welded wire mesh reinforcing	1463	m2	$ 9.00	$ 13,166
▪ 100mm extruded polystyrene insulation	751	m2	$ 45.00	$ 33,795
▪ 10 mil poly vapour barrier	1463	m2	$ 3.00	$ 4,389
▪ Class A granular base (125mm thickness)	183	m3	$ 40.00	$ 7,314
A21 Lowest Floor Construction Subtotal	**3129**	**m2**	**$ 109.98**	**$ 344,108**
A22 Upper Floor Construction				
1 **New Addition - Second Level Framing**				
▪ Concrete to slab on deck	58	m3	$ 275.00	$ 15,966
▪ Welded wire mesh reinforcing	726	m2	$ 10.00	$ 7,257
▪ Screed, steel trowel, cure & seal	726	m2	$ 15.00	$ 10,886
▪ 38mm composite metal floor deck	726	m2	$ 35.00	$ 25,401
▪ Structural steel columns, beams, joists, miscellaneous framing	47172	kg	$ 4.50	$ 212,276
▪ Fireproofing to underside of deck	726	m2	$ 45.00	$ 32,658
2 **Existing Building - Second Level Framing**				
▪ Concrete to slab on deck	12	m3	$ 275.00	$ 3,322
▪ Welded wire mesh reinforcing	151	m2	$ 10.00	$ 1,510
▪ Screed, steel trowel, cure & seal	151	m2	$ 15.00	$ 2,265
▪ 38mm composite metal floor deck	151	m2	$ 35.00	$ 5,285
▪ Structural steel columns, beams, joists, miscellaneous framing	9800	kg	$ 4.50	$ 44,100
▪ Reinforce existing columns and beams	1	sum	$ 15,000.00	$ 15,000
▪ Fireproofing to underside of deck	151	m2	$ 45.00	$ 6,795
3 **Stairs 332**				
▪ Steel channel stringers with concrete infilled pans & railings	21	risers	$ 750.00	$ 15,750
4 **Stairs 350**				
▪ Steel channel stringers with concrete infilled pans & railings	21	risers	$ 600.00	$ 12,600
5 **Bleacher Structure**				
▪ 140mm concrete block walls	262	m2	$ 150.00	$ 39,342
▪ Concrete to slabs	11	m3	$ 500.00	$ 5,262
▪ Concrete to steps	12	no	$ 500.00	$ 6,000
▪ Metal deck and closures	132	m2	$ 55.00	$ 7,235
▪ Steel pipe railings and guardrails	60	m	$ 250.00	$ 15,000
A22 Upper Floor Construction	**887**	**m2**	**$ 545.40**	**$ 483,909**
A23 Roof Construction				
1 **Rink Building Structure**				
▪ Pre-engineered metal building framing including rigid frames, purlins, girt, framing for openings and bracing	2390	sf	$ 175.00	$ 418,201

Element	Quantities		Unit Rates	Sub-totals
2 Roof Structure Over Addition Connection space				
▪ 38mm galv metal roof deck	851	m2	$ 35.00	$ 29,785
▪ Structural steel columns, beams, joists and miscellaneous steel framing	42600	kg	$ 4.50	$ 191,700
3 Roof Structure Over Existing Low Roofs				
▪ 38mm galv metal roof deck	110	m2	$ 35.00	$ 3,850
▪ Structural steel columns, beams, joists and miscellaneous steel framing	5500	kg	$ 4.50	$ 24,750
A23 Roof Construction Total	**3351**	**m2**	**$ 199.45**	**$ 668,286**
EXTERIOR ENCLOSURE				
A31 Walls Below Grade				
▪ NIL				
A31 Walls Below Grade Total	**0**	**m2**	**$ -**	**$ -**
A32 Walls Above Grade				
1 Wall Type 1 - Split Face Block				
▪ Split face concrete block	614	m2	$ 185.00	$ 113,594
▪ Air/vapour membrane	614	m2	$ 24.00	$ 14,737
▪ 76mm insulation	614	m2	$ 35.00	$ 21,491
▪ 190mm concrete block	614	m2	$ 175.00	$ 107,454
2 Wall Type 2 - Metal Siding				
▪ 24mm vertical corrugated metal siding	1190	m2	$ 100.00	$ 118,969
▪ 76mm insulation	1190	m2	$ 35.00	$ 41,639
▪ Metal liner panel	1190	m2	$ 26.00	$ 30,932
▪ Aluminum composite panels	148	m2	$ 395.00	$ 58,460
3 Wall Type 5 - Curtainwall				
▪ Double glazed aluminum framed	80	m2	$ 800.00	$ 63,992
A32 Walls Above Grade Total	**1884**	**m2**	**$ 303.27**	**$ 571,266**
A33 Windows and Entrances				
1 Windows				
▪ Aluminum framed double glazed	24	m2	$ 750.00	$ 17,818
2 Entrance/Exit Doors				
▪ Aluminum framed, fully glazed double exit doors complete with hardware	4	no	$ 6,000.00	$ 24,000
▪ Power operators	1	no	$ 3,000.00	$ 3,000
▪ Double insulated steel doors with pressed steel frame and hardware	4	no	$ 2,500.00	$ 10,000
▪ Single exit insulated steel door with pressed steel frame complete with hardware	2	no	$ 1,500.00	$ 3,000
3 Overhead Doors				

Element	Quantities		Unit Rates	Sub-totals
▪ New sectional metal overhead door	10	m2	$ 650.00	$ 6,500
▪ 1hp electric door opener	1	no	$ 650.00	$ 650
A33 Windows and Entrances Total	**48**	**m2**	**$ 1,360.38**	**$ 64,968**
A34 Roof Coverings				
1 **Roof Type R1- Prefinished Metal**				
▪ 24ga corrugated metal roofing	2506	m2	$ 100.00	$ 250,569
▪ Purlins - included in Roof Structure A23	2506	m2	$ -	$ -
▪ Glass fiber reinforced polyisocyanurate insulation	2506	m2	$ 40.00	$ 100,228
▪ Liner panels	2506	m2	$ 26.00	$ 65,148
2 **Roof Type R2 - Modified Bituminous Roofing**				
▪ 2 ply modified bituminous membrane	757	m2	$ 45.00	$ 34,043
▪ 2 - 3mm asphalt cover boards	757	m2	$ 10.00	$ 7,565
▪ Tapered polyisocyanurate insulation	757	m2	$ 30.00	$ 22,695
▪ 152mm polyisocyanurate insulation	757	m2	$ 65.00	$ 49,173
▪ Vapour barrier - SBS modified bitumen peel and stick	757	m2	$ 24.00	$ 18,156
▪ 13mm GWB fastened to metal deck	757	m2	$ 10.00	$ 7,565
3 **Parapet Framing**				
▪ Allowance to flat roof area	200	m	$ 120.00	$ 24,000
4 **Roof Accessories**				
▪ Fall arrest anchors - allowance	1	sum	$ 7,500.00	$ 7,500
▪ Penetrations & flashings	1	sum	$ 7,500.00	$ 7,500
A34 Roof Coverings Total	**2706**	**m2**	**$ 219.59**	**$ 594,143**
A35 Projections				
1 **Entrance Canopy**				
▪ 38mm galv metal roof deck	35	m2	$ 35.00	$ 1,225
▪ Structural steel columns, beams, trusses, joists, miscellaneous framing	2100	kg	$ 5.00	$ 10,500
▪ 2 ply modified bituminous membrane	35	m2	$ 45.00	$ 1,575
▪ 2 - 3mm asphalt cover boards	35	m2	$ 10.00	$ 350
▪ Vapour barrier - SBS modified bitumen peel and stick	35	m2	$ 25.00	$ 875
▪ 13mm GWB fastened to metal deck	35	m2	$ 10.00	$ 350
▪ 22mm horizontal metal soffit	35	m2	$ 110.00	$ 3,850
▪ Flashings and trims	35	m2	$ 25.00	$ 875
A35 Projections Total	**35**	**m2**	**$ 560.00**	**$ 19,600**
PARTITIONS AND DOORS				
B11 Partitions				
1 **Type P1**				
▪ 190mm concrete block wall	1164	m2	$ 150.00	$ 174,528
▪ Masonry lateral support	294	m	$ 45.00	$ 13,213

Element		Quantities		Unit Rates		Sub-totals
2	**Type P2**					
▪	140mm concrete block	1110	m2	$ 150.00	$	166,438
▪	Masonry lateral support	303	m	$ 45.00	$	13,656
3	**Interior Partition Type P4.1**					
▪	16mm GWB - taped and sanded	75	m2	$ 30.00	$	2,237
▪	92mm steel studs at 405 c/c	75	m2	$ 28.00	$	2,088
▪	16mm GWB - taped and sanded	75	m2	$ 30.00	$	2,237
B11	**Partitions Total**	**2348**	**m2**	**$ 159.48**	**$**	**374,395**
B12	**Interior Doors and Screens**					
1	**Interior Doors & Frames**					
▪	Aluminum framed glazed doors c/w hardware	6	no	$ 3,000.00	$	18,000
▪	Hollow metal single door c/w PS frames and hardware	46	no	$ 1,500.00	$	69,000
▪	Hollow metal double door c/w PS frames and hardware	4	no	$ 2,200.00	$	8,800
2	**Interior Screens & Glazing**					
▪	Aluminum framed single glazed level 1	27	m2	$ 400.00	$	10,725
▪	Aluminum framed single glazed level 2	121	m2	$ 400.00	$	48,370
3	**Coiling Doors**					
▪	Aluminum coiling door	2	no	$ 4,000.00	$	8,000
▪	Door to Ice Resurfcer Room	1	no	$ 4,000.00	$	4,000
B12	**Interior Doors and Screens Total**	**218**	**m2**	**$ 765.57**	**$**	**166,894**
FINISHES						
B21	**Floor Finishes**					
1	**Exposed Concrete**					
▪	Concrete sealer	2634	m2	$ 15.00	$	39,511
2	**Rubber Flooring**					
▪	Rubber athletic flooring	698	m2	$ 110.00	$	76,754
▪	Plywood subfloor with bushings	698	m2	$ 25.00	$	17,444
▪	Rubber base	368	m	$ 5.00	$	1,839
3	**Linoleum Flooring**					
▪	Sheet Linoleum	440	m2	$ 45.00	$	19,811
▪	Rubber Base	299	m2	$ 5.00	$	1,495
4	**Resilient Tile**					
▪	Resilient tile	18	m2	$ 35.00	$	613
▪	Rubber base	35	m	$ 5.00	$	175
5	**Epoxy Flooring**					
▪	Epoxy flooring	312	m2	$ 35.00	$	10,918
▪	Epoxy base	185	m	$ 35.00	$	6,472

Element	Quantities		Unit Rates	Sub-totals
6 Entrance Flooring				
▪ Entrance flooring	0	m2	$ 75.00	$ -
7 Stair Finishes				
▪ PVC treads	48	no	$ 30.00	$ 1,440
▪ PVC Risers	52	no	$ 30.00	$ 1,560
▪ PVC landings	0	m2	$ 40.00	$ -
B21 Floor Finishes Total	**4102**	**m2**	**$ 43.41**	**$ 178,032**
B22 Ceiling Finishes				
1 Exposed Structure				
▪ Standard paint finish	2519	m2	$ 25.00	$ 62,972
2 Gypsum Board				
▪ 92mm framing suspended from structure	1565	m2	$ 25.00	$ 39,128
▪ 16mm GWB - taped, sanded, painted	1450	m2	$ 30.00	$ 43,504
3 Suspended T-Bar and Acoustical Ceiling Tile				
▪ T-bar & acoustical Tile	355	m2	$ 35.00	$ 12,434
4 Bulkheads				
▪ 92mm stud framing suspended from structure	192	m2	$ 40.00	$ 7,680
▪ 13mm gypsum board - taped, sanded, painted	192	m2	$ 25.00	$ 4,800
B22 Ceiling Finishes Total	**4631**	**m2**	**$ 37.44**	**$ 173,393**
B23 Wall Finishes				
1 Paint To Gypsum Board Walls and Partitions				
▪ Painting to gypsum board walls	4546	m2	$ 8.00	$ 36,370
2 Paint Concrete/Block Walls and Partitions				
▪ Sealer and paint	149	m2	$ 10.00	$ 1,491
3 Acoustical Wall Panels				
▪ Allowance	1	sum	$ 10,000.00	$ 10,000
B23 Wall Finishes Total	**4695**	**m2**	**$ 10.19**	**$ 47,861**
FITTINGS AND EQUIPMENT				
B31 Fittings and Fixtures				
1 Washroom Accessories				
▪ Grab bars	12	no	$ 150.00	$ 1,800
▪ Toilet tissue dispensers	10	no	$ 50.00	$ 500
▪ Hand dryers	6	no	$ 150.00	$ 900
▪ Soap dispensers	7	no	$ 50.00	$ 350
▪ Mirrors	7	no	$ 500.00	$ 3,500
▪ Feminine napkin disposal	7	no	$ 100.00	$ 700
▪ Waste receptacle	7	no	$ 25.00	$ 175
▪ Phenolic shower partitions	10	no	$ 2,000.00	$ 20,000

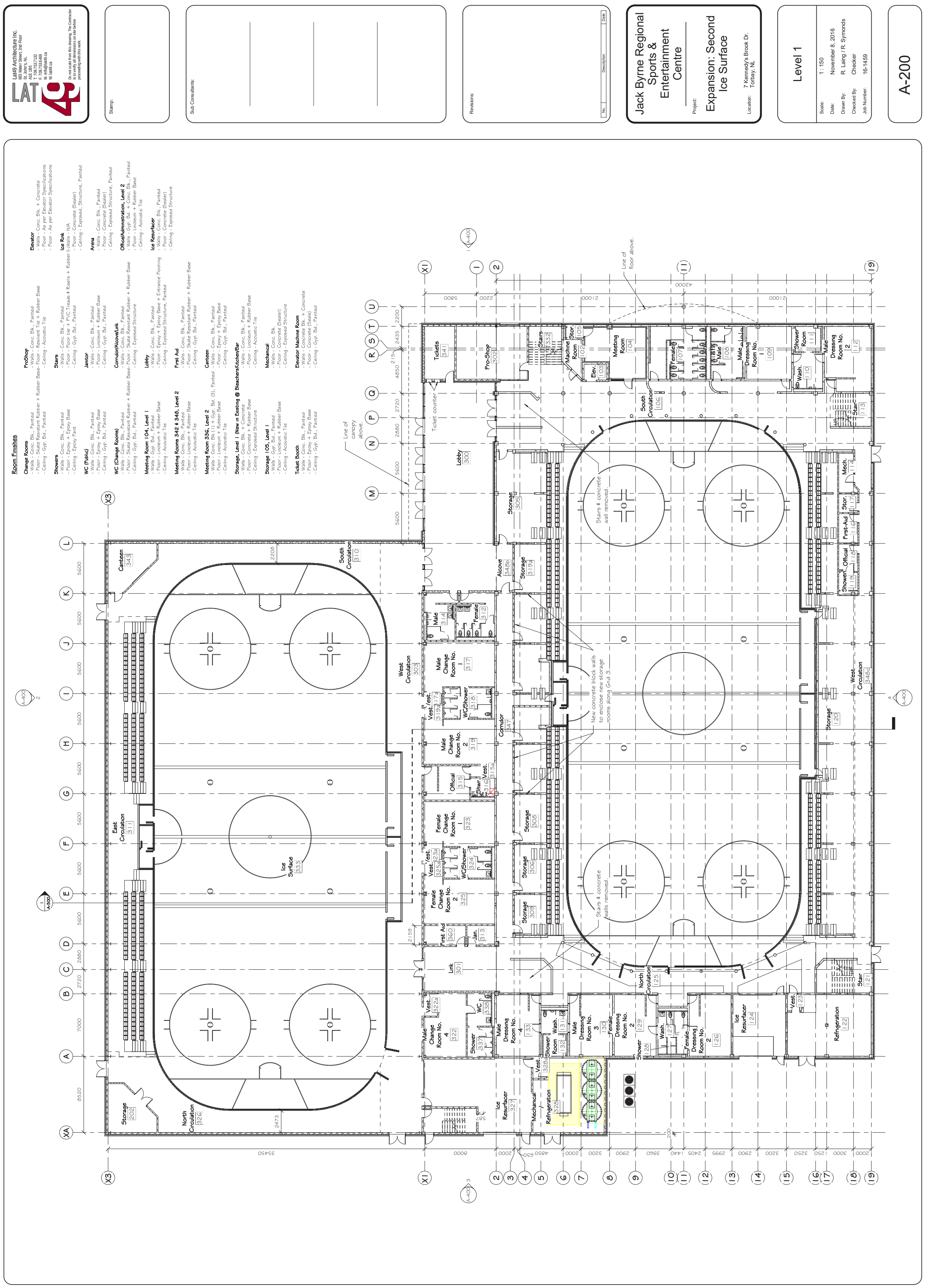
Element	Quantities		Unit Rates	Sub-totals
▪ Shower fold down seat	10	no	$ 300.00	$ 3,000
▪ Robe hooks	40	no	$ 30.00	$ 1,200
▪ Phenolic toilet partitions - handicapped	6	no	$ 2,400.00	$ 14,400
▪ Phenolic toilet partitions - standard	4	no	$ 1,800.00	$ 7,200
▪ Phenolic urinal partitions	4	no	$ 600.00	$ 2,400
▪ Baby Changing Station	1	no	$ 1,500.00	$ 1,500
2 Millwork/Casework				
▪ Ticket Booth tops	2	m	$ 500.00	$ 1,000
▪ Counter at Canteen	5	m	$ 500.00	$ 2,500
▪ Bar counter	8	m	$ 1,500.00	$ 12,000
▪ Washroom vanities integral solid surface	4	m	$ 500.00	$ 2,000
▪ Change room benches	129	m	$ 300.00	$ 38,700
▪ Change room shelves	129	m	$ 300.00	$ 38,700
▪ Robe hooks	125	no	$ 30.00	$ 3,750
3 Miscellaneous Specialties-Rink				
▪ Bleacher seating	180	no	$ 125.00	$ 22,500
▪ Indoor soccer goals	2	no	$ 4,000.00	$ 8,000
▪ New scoreboard	1	no	$ 8,000.00	$ 8,000
▪ Hockey nets	2	no	$ 4,000.00	$ 8,000
▪ Boards systems include penalty and team bench areas	214	m	$ 450.00	$ 96,300
▪ Plexiglass	186	m	$ 200.00	$ 37,200
4 Miscellaneous Specialties				
▪ Interior signage allowance	1	sum	$ 7,500.00	$ 7,500
▪ Window coverings allowance	24	m2	$ 120.00	$ 2,851
5 Miscellaneous Metals				
▪ Railing at Level 2 stair opening	13	m	$ 900.00	$ 11,700
▪ Elevator sump pit frame & cover	2	no	$ 1,000.00	$ 2,000
▪ Elevator pit ladder	2	no	$ 1,000.00	$ 2,000
B31 Fittings and Fixtures Total	**8861**	**m2**	**$ 40.89**	**$ 362,326**
B32 Equipment				
1 Kitchen Equipment				
▪ Canteen kitchen equipment	0	sum	$ -	$ -
B32 Equipment Total	**8861**	**m2**	**$ -**	**$ -**
B33 Conveying Equipment				
1 Passenger Elevators				
▪ Electric traction - 2 stop, 3000 lb capacity	1	LS	$ 80,000.00	$ 80,000
B33 Conveying Equipment Total	**8861**	**m2**	**$ 9.03**	**$ 80,000**
Mechanical				
C11 Plumbing and Drainage				
1 Plumbing & Drainage Allowance				

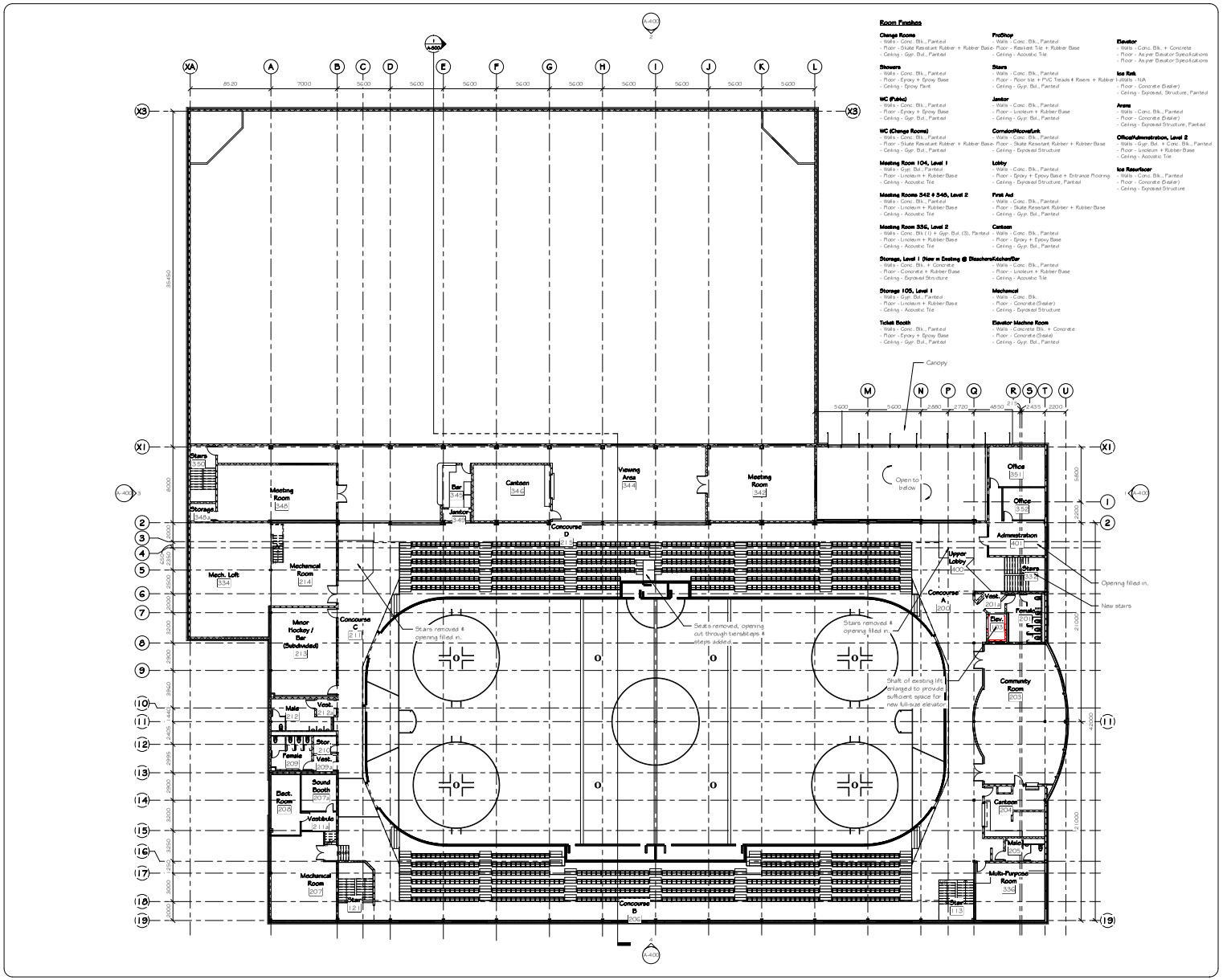
Element	Quantities		Unit Rates	Sub-totals
▪ Cost estimate developed by JBC	4084	m2	$ 195.89	$ 800,000
C11 Plumbing and Drainage Total	**4084**	**m2**	**$ 195.89**	**$ 800,000**
C12 Fire Protection				
1 Sprinkler System - Standard Wet System				
▪ Sprinkler system cost estimate developed by JBC	4084	m2	$ 55.09	$ 225,000
C12 Fire Protection Total	**4084**	**m2**	**$ 55.09**	**$ 225,000**
C13 Heating, Ventilation, Air Conditioning				
1 HVAC Equipment				
▪ Refrigeration plant cost estimate developed by JBC	4084	m2	$ 412.10	$ 1,683,000
▪ HVAC cost estimate developed by JBC	4084	m2	$ 367.29	$ 1,500,000
C13 Heating, Ventilation, Air Conditioning Total	**4084**	**m2**	**$ 779.38**	**$ 3,183,000**
C14 Controls				
1 Building Control				
▪ Cost estimate developed by JBC	4084	m2	$ 36.73	$ 150,000
C14 Controls Total	**4084**	**m2**	**$ 36.73**	**$ 150,000**
Electrical				
C21 Services and Distribution				
1 Distribution - Normal Power				
▪ Cost estimate developed by JBC	4084	m2	$ 61.21	$ 250,000
C21 Services and Distribution Total	**4084**	**m2**	**$ 61.21**	**$ 250,000**
C22 Lighting, Devices and Heating				
1 Lighting, Devices, Heating Allowance				
▪ Cost estimate developed by JBC	4084	m2	$ 293.83	$ 1,200,000
C22 Lighting and Heating Total	**4084**	**m2**	**$ 293.83**	**$ 1,200,000**
C23 Systems and Ancillaries				
1 Systems and Ancillaries Allowance				
▪ Cost estimate developed by JBC	4084	m2	$ 36.73	$ 150,000
C23 Systems and Ancillaries Total	**4084**	**m2**	**$ 36.73**	**$ 150,000**
Site Works				
D11 Site Development				
1 Site Work				
▪ Cut site	1250	m3	$ 10.00	$ 12,500
▪ Trench footings	293	m3	$ 13.00	$ 3,811
▪ Backfill footings	200	m3	$ 32.50	$ 6,500

Element		Quantities		Unit Rates	Sub-totals
▪ Sand subbase to SOG		611	m3	$ 40.00	$ 24,451
▪ Granular subbase to SOG		611	m3	$ 38.00	$ 23,228
▪ Trench underslab plumbing		159	m3	$ 26.00	$ 4,145
▪ Backfill underslab plumbing		159	m3	$ 38.00	$ 6,058
▪ Remove existing asphalt and dispose		2981	m2	$ 10.00	$ 29,811
▪ Grade site		2256	m2	$ 10.00	$ 22,557
▪ Foundation drainage		330	m	$ 90.00	$ 29,700
▪ E/O mass rock allowance		600	m3	$ 65.00	$ 39,000
▪ E/O trench rock allowance		300	m3	$ 150.00	$ 45,000
▪ Demolition and removals		1	sum	$ 10,000.00	$ 10,000
2 Hard Surfaces					
▪ Granular subbase to asphalt		2200	m3	$ 32.00	$ 70,400
▪ 100mm thick asphalt		900	tonne	$ 250.00	$ 225,000
▪ Concrete curb		345	m	$ 140.00	$ 48,300
▪ Line painting		1	ls	$ 10,000.00	$ 10,000
▪ Granular subbase to sidewalk		680	m3	$ 32.00	$ 21,773
▪ Concrete sidewalk		4536	m2	$ 110.00	$ 498,960
3 Soft Landscaping Surfaces					
▪ Topsoil and hydroseed		3200	m2	$ 6.00	$ 19,200
▪ Topsoil & sod		540	m2	$ 12.00	$ 6,480
4 Miscellaneous Site Fixtures/Equipment					
▪ Bike Racks, benches, waste receptacles		1	LS	$ 5,000.00	$ 5,000
D11 Site Development Total		**4084**	**m2**	**$ 284.49**	**$ 1,161,873**
D12 Mechanical Site Services					
1 Mechanical Site Services Allowance					
▪ Cost estimate developed by JBC		1	m	$ 200,000.00	$ 200,000
D12 Mechanical Site Services Total		**4084**	**m2**	**$ 48.97**	**$ 200,000**
D13 Electrical Site Services					
1 Service Entrance					
▪ Cost estimate developed by JBC		1	LS	$ 250,000.00	$ 250,000
D13 Electrical Site Services Total		**4084**	**m2**	**$ 61.21**	**$ 250,000**
Demolition/Ancillary Work					
D21 Demolition					
1 Selective Demolition in Existing Rink					
▪ Remove siding to columns		22	no	$ 1,000.00	$ 22,000
▪ Remove siding for egress for existing to addition		90	m2	$ 50.00	$ 4,480
▪ Remove brick for egress for existing to addition		90	m2	$ 100.00	$ 8,960
▪ Remove roof panels to accommodate new roof		270	m2	$ 50.00	$ 13,500
▪ Remove stairs		2	ea	$ 1,500.00	$ 3,000
▪ Remove stairwell walls		416	m2	$ 100.00	$ 41,600

Element	Quantities		Unit Rates	Sub-totals
▪ Remove existing lift	1	sum	$ 15,000.00	$ 15,000
▪ Removals as req'd to accommodate new elevator	1	sum	$ 10,000.00	$ 10,000
▪ Removals of exiting seating as req'd	1	sum	$ 4,800.00	$ 4,800
▪ Miscellaneous removals	1	sum	$ 10,000.00	$ 10,000
D21 Demolition Total	**4084**	**m2**	**$ 32.65**	**$ 133,340**
D22 Alterations				
1 Changes to Existing Building				
▪ Patch and paint existing partitions and walls	134	m2	$ 50.00	$ 6,720
▪ Flooring repairs	50	m2	$ 50.00	$ 2,520
▪ Miscellaneous alterations	1	LS	$ 10,000.00	$ 10,000
D22 Alterations	**4084**	**m2**	**$ 4.71**	**$ 19,240**
General Requirements and Fees				
Z11 General Requirements and Overheads				
▪ Contractor's Overheads			9.00%	$ 1,097,824
Z11 General Requirements and Overheads Total	**4084**	**m2**	**$ 268.81**	**$ 1,097,824**
Z12 Contractor's Profit				
▪ Contractor's Profit			2.00%	$ 265,917
Z12 Contractor's Profit Total	**4084**	**m2**	**$ 65.11**	**$ 265,917**
Allowances				
Z21 Design Allowance				
▪ Design Development Contingency			0.00%	$ -
Z21 Design Allowance Total	**4084**	**m2**	**$ -**	**$ -**
Z22 Escalation				
▪ Escalation			$ -	$ -
Z22 Escalation Total	**8861**	**m2**	**$ -**	**$ -**
Z23 Construction Contingency				
▪ Construction Contingency			3.00%	$ 406,854
Z23 Construction Contingency	**4084**	**m2**	**$ 99.62**	**$ 406,854**

APPENDIX B: SCHEMATIC PLANS


Jack Byrne Regional Sports & Entertainment Centre
Expansion: Second Ice Surface
7 Kennedy's Brook Dr.
Torbay, NL
Level 1
Scale: 1:150
Date: November 8, 2016
Drawn By: R. Laing / R. Symonds
Checked By: Checker
Job Number: 16-1459
A-200
3/31/2017 3:52:49 PM



3/31/2017 3:54:41 PM

LAT49 Architecture Inc.
803 Water Street, 2nd Floor
St. John's, NL
A1E 1B1
T. 709.753.7322
T. 709.753.6460
M. info@lat49.ca
W. lat49.ca

Do not scale from this drawing. The Contractor is to verify all dimensions on site before proceeding with the work.

Stamp:

Sub Consultants:

Revisions:

No.	Description	Date

Jack Byrne Regional Sports & Entertainment Centre

Project:

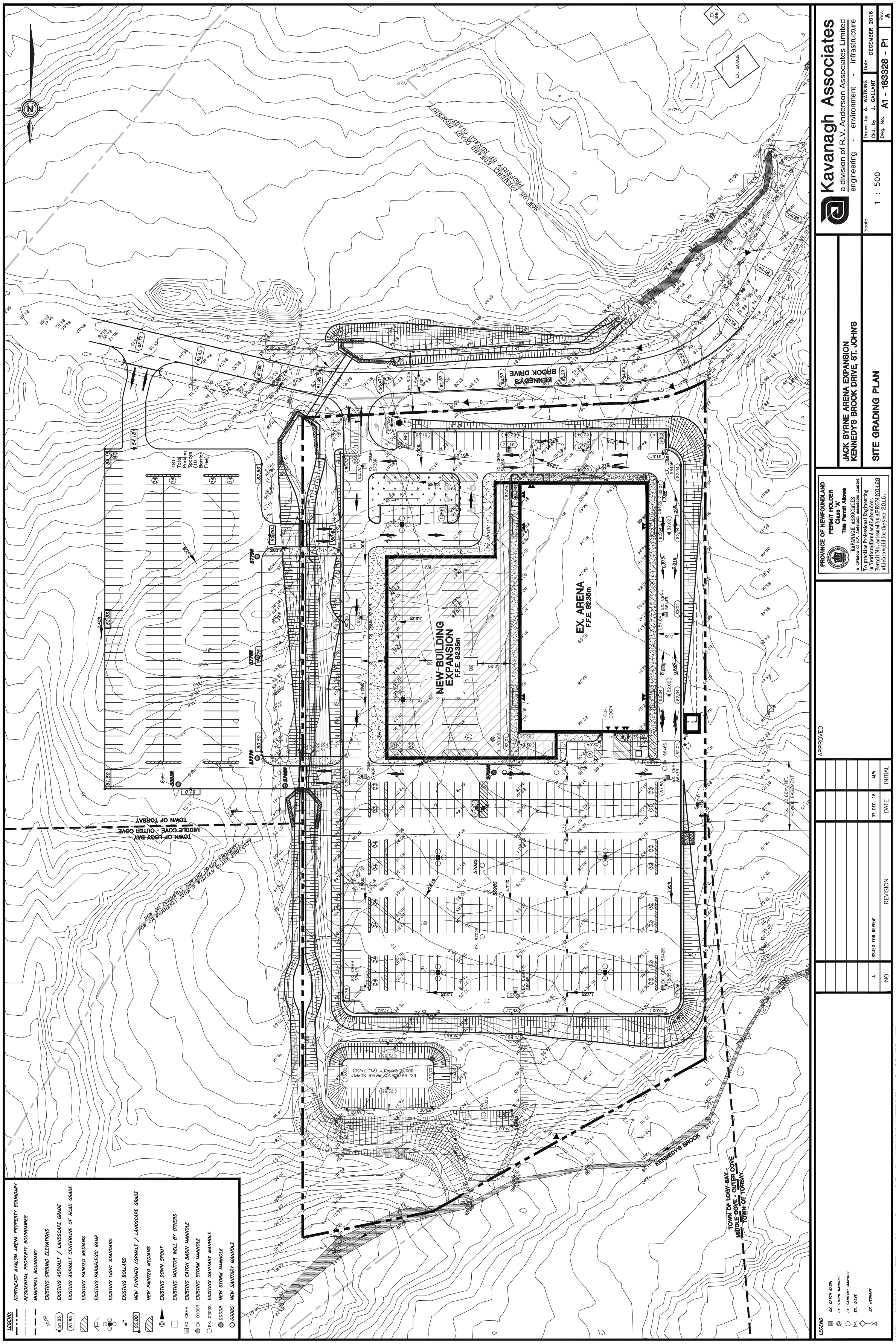
Expansion: Second Ice Surface

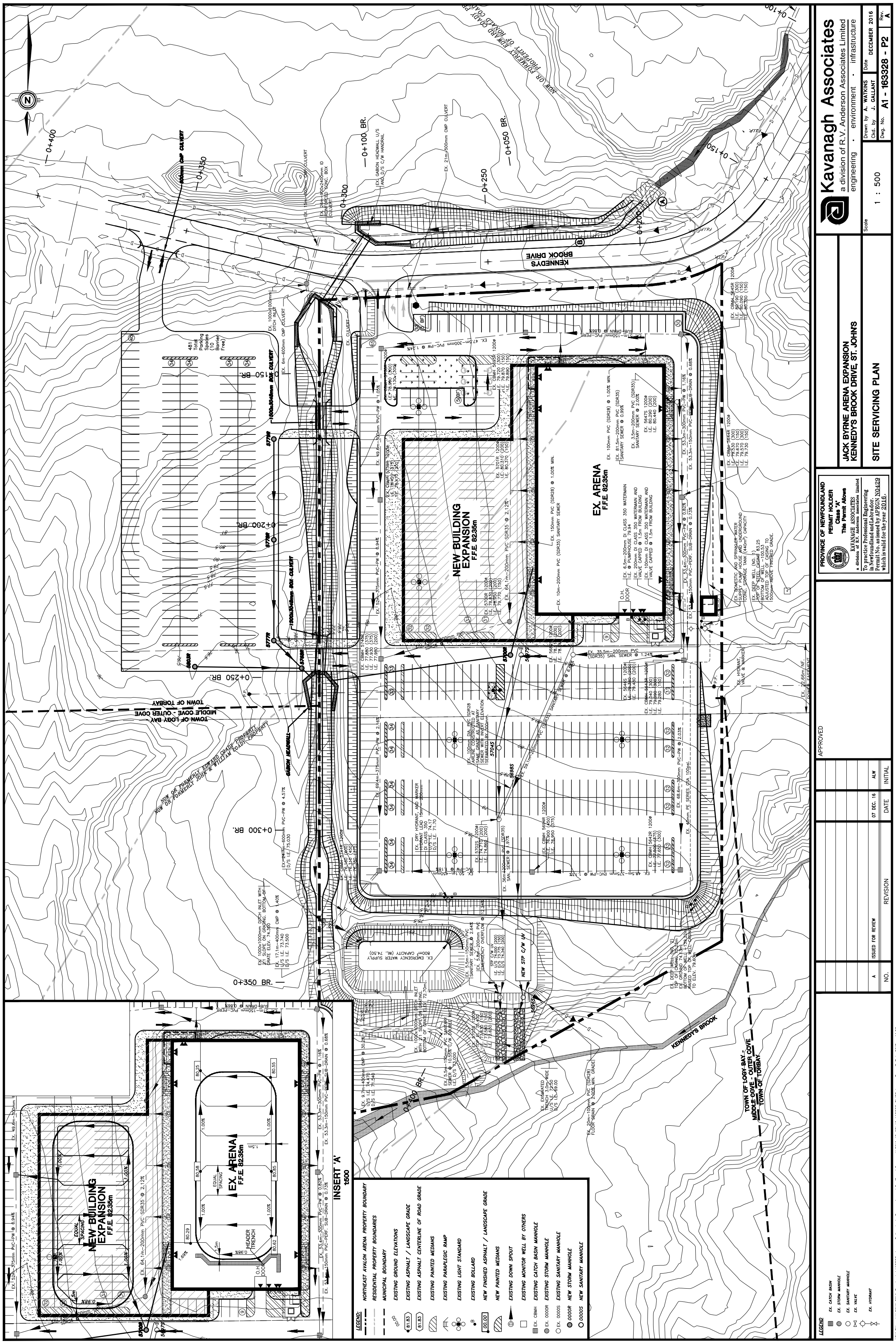
Location: 7 Kennedy's Brook Dr. Torbay, NL

Level 2

Scale:	1 : 150
Date:	November 8, 2016
Drawn By:	R. Laing / R. Symonds
Checked By:	Checker
Job Number:	16-1459

A-201


Kavanagh Associates
a division of R.V. Anderson Associates Limited
engineering · environment · infrastructure
JACK BYRNE ARENA EXPANSION
KENNEDY'S BROOK DRIVE, ST. JOHN'S
SITE GRADING PLAN
1 : 500
A1 - 163328 - P1
DECEMBER 2016
NEW BUILDING EXPANSION
EX. ARENA
KENNEDY'S BROOK DRIVE
KENNEDY'S BROOK
LEGEND


Kavanagh Associates
a division of R.V. Anderson Associates Limited
engineering · environment · infrastructure
JACK BYRNE ARENA EXPANSION
KENNEDY'S BROOK DRIVE, ST. JOHN'S
SITE SERVICING PLAN
Scale 1 : 500
Date DECEMBER 2016
Dwg. No. A1 - 163328 - P2
Rev. A
EX. ARENA
NEW BUILDING EXPANSION
KENNEDY'S BROOK DRIVE
INSERT 'A'