Facilities Audit, Redevelopment Scenarios and Financial Analysis for Municipal Wellness Infrastructure Projects in the Town of Happy Valley–Goose Bay

SHEPPARD CASE
ARCHITECTS INC

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Submitted to:

the Town of Happy Valley-Goose Bay

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1.1 Introduction

1.1.1 RFP and Consultant Team

On Dec. 13, 2013, the Town of Happy Valley–Goose Bay advertised a Request for Proposals for consultant services related to municipal wellness infrastructure projects. Sheppard Case Architects Inc. responded to the request on Jan. 10, 2014, and was subsequently awarded the project on Jan. 24.

The consultant team that assisted Sheppard Case Architects to complete this report included Crosbie Engineering Ltd. (mechanical and electrical engineering), DMG Consulting Ltd. (structural and civil engineering), QSolve Inc. (cost estimating), Altus Group Ltd. (real estate valuation) and Costello Fitt Ltd. (financial analysis).

1.1.2 Scope of Work

The Request for Proposals document contained terms of reference which outlined the objectives and scope of the project. During the initial project meeting these objectives were clarified. As the project progressed, additional tasks were added. Consequently, some of the original objectives were reduced in importance in favour of focusing on other elements of the study.

The major tasks were as follows:

- Meet with stakeholder groups to determine the usage of existing facilities; what the existing wellness infrastructure's issues were in terms of access and suitability for various sports, fitness and other community activities; and what new recreational services or facilities are most important to the community.
- Complete a building condition assessment (audit) of the three main recreational facilities in the Happy Valley–Goose Bay area: the Broomfield Arena, Goose Bay Curling Club, and the Labrador Training Centre.
- The facilities audit was to consider architectural and engineering issues such as functionality of systems, life safety and building code compliance, accessibility for persons with disabilities and the cost of required repairs and renovations.
- Investigate the potential for reusing the Broomfield Arena for either a municipal depot or a fire hall, if the structure was no longer required for recreational use.
- Determine the real estate value of the former Canadian Air Force (CAF) Arena, the Goose Bay Curling Club, the Labrador Training Centre and the existing Fire Hall.
- Consider redevelopment options for the existing wellness infrastructure, ranging from simple repairs and maintenance to extensive renovations and additions to sale or demolition. Provide Class D estimates for each of the options.
- Consider basic program requirements for a new wellness centre to the degree required for an accurate Class D estimate of probable construction cost.
- Provide an estimate of all consulting fees and expenses as required to completely design, tender and administer the construction contracts for each of the projects described in the redevelopment scenarios.
- Consider the impacts of site location, schedule and phasing of construction on capital costs and yearly cash flows.
- Create a net present value (NPV) financial analysis to compare each redevelopment scenario. The NPV analysis will include both estimated capital and operating costs, recovery value of existing buildings, capital grants, potential revenue, inflation and financing costs.

1.2 Results

1.2.1 Stakeholder Input

From Feb. 12-13, 2014, members of the consultant team met with stakeholder groups to discuss wellness infrastructure in the community. Residents involved in organized sports and fitness activities such as running, walking, soccer, hockey, curling, broomball, gymnastics, swimming, aerobics and dancing, as well as other wellness activities such as cooking, food-sharing and hydrotherapy groups, attended the meetings.

The consultants also met with members of the Happy Valley–Goose Bay (HVGB) Town Council and recreation staff and staff members from the provincial departments of Tourism and Recreation and Municipal Affairs.

While representatives from the various groups often had questions or comments specific to the needs of their group, as expected, there were several issues common to all participants. These issues were:

- There is insufficient indoor multipurpose recreation space suitable for group activities or recreational sports. There is only one gymnasium in the town with unrestricted community access, which is in the Labrador Training Centre. Therefore all groups are competing for gymnasium time.
- The gymnasium in the Labrador Training Centre does not have air conditioning and is essentially unusable during the summer months. In fact, there is no gymnasium or large indoor recreation area in HVGB – including those in schools or church halls – with sufficient air conditioning to allow summer use.
- The swimming pool at the Labrador Training Centre is undersized for the number of people in the community. It cannot host competitions or even provide adequate practice facilities for those travelling elsewhere to compete.
- Ice time is in high demand at the Broomfield Arena, which can only maintain ice during the colder months due to building envelope and mechanical system deficiencies.
- Running and walking are popular activities in HVGB, but there is no indoor track where residents can continue this activity during the winter months. Running or walking on the community's roadways is not considered safe during the winter.
- The Labrador Training Centre and the Goose Bay Curling Club are located on the former Canadian Air Force section of the military base, now an industrial area at the extreme northwest edge of the town, away from the majority of HVGB's residential and commercial areas.

1.2.2 Existing Facility Audits

Building assessment audits were performed by the consultant team on the Broomfield Arena, Goose Bay Curling Club and the Labrador Training Centre during the Feb. 12-13 trip. The audits involved an analysis of existing drawings (when available) and a visual inspection of the buildings by architectural, mechanical, electrical, structural and civil consultants. A detailed account of the assessment comprises Part 2 of this report.

The following section highlights some of the major issues with the existing recreational infrastructure:

a. Broomfield Arena

- The building has seen many haphazard renovations over the years. Consequently, the exterior envelope is poorly insulated and poorly sealed against air and moisture penetration.
- The building is not compliant with the requirements of the National Building Code of Canada (NBCC) and the National Fire Protection Association (NFPA) 101 Life Safety Code in

terms of the total mezzanine area, occupancy classification, the amount of combustible construction, sprinklering requirements, exiting requirements and numerous other minor code infractions.

- The east wooden bleacher construction is structurally unsound and the seat, aisle and stair exiting arrangement is completely contrary to NBCC and NFPA requirements.
- Although past renovations have attempted to remedy this situation, the facility is not fully accessible for persons with disabilities.
- The mechanical and electrical systems are woefully inadequate and will require near-complete replacement within 10 years. The lack of proper heating, ventilation and humidity control is a particularly pressing issue and there are numerous plumbing leaks throughout the south mezzanine area.
- Excessive wear and degradation of the concrete slab surface has resulted in exposed refrigerant piping in some areas and increases the amount of energy required to keep the ice surface intact.
- The above mentioned envelope and mechanical issues result in excessive energy use. In a typical year, the Broomfield Arena consumes 2,500 megawatt hours of electricity with only seasonal operation of the ice plant. Historical data shows that a new facility this size should consume energy in the range of just 1,500 megawatt hours with year-round operation.
- The approximate cost to rectify (as much as possible) the major issues and deficiencies at the Broomfield Arena for continued operation for up to 20 years is **$6,450,000**.

b. The Goose Bay Curling Club

- The original building was not designed to resist snow or wind loading in HVGB. An analysis of existing drawings revealed that the roof structure failed and partially collapsed twice (in 1973 and 1980 respectively) and had to be repaired and the structure reinforced. Some truss members remain buckled.
- The exterior wall assemblies are in poor condition with badly damages cladding panels, suspected low insulation levels and damaged interior finishes. The apparent lack of structural wind bracing has resulted in damage to the exterior walls at every column location.
- There is no concrete floor slab below the ice area (it rests on a sand bed) and the lounge and washroom area floor is wood framed over an unventilated crawl space.
- There is suspected chrysotile asbestos-reinforced cement board wall and ceiling cladding in the mechanical room and suspected asbestos-reinforced vinyl floor tiles under the current floor finishes of the lounge and washroom area.
- The exiting situation and separation of the mechanical plant room is not in conformance with the NBCC, NFPA 101 or CSA-B52, the Mechanical Refrigeration Code.
- The facility is not accessible to persons with disabilities.
- The electrical and plumbing systems exhibit numerous deficiencies and will require near complete replacement. There is no mechanical ventilation.
- The ice plant is approximately 57 years old and in very poor condition. The ammonia expansion tanks are structurally deficient and were condemned by Service NL inspectors during the compilation of this report. Currently the facility cannot operate until the tanks are replaced.
- There is a pervasive, highly unpleasant odour throughout the facility of undetermined origin, possibly hydrocarbon based.
- The approximate cost to rectify (as much as possible) the major issues and deficiencies at the Goose Bay Curling Club for continued operation for up to 20 years is **$3,400,000**.

c. The Labrador Training Centre

- There are serious issues with humidity and air vapour transmission from the pool area into the unheated attic area. Despite numerous attempts to resolve this issue in the past, there is so much warm moist air escaping into the attic that during the February review there was 25 mm of ice covering the roof structure above the pool. When this ice melts, the water will saturate the aquatics area's upper ceiling.
- The suspended ceiling over the aquatics area has collapsed into the pool at least twice in recent years and it is only a matter of time until it collapses again.
- The building is not compliant with NBCC requirements in terms of the total mezzanine area as related to the occupancy classification, the amount of combustible construction, the lack of fire separations and several other code infractions.
- The mezzanine level between the aquatics and gymnasium areas incorporates a second, superimposed mezzanine level above. The complete mezzanine arrangement, including construction type and exiting features, is in violation of NBCC requirements. Superimposed mezzanines are strictly prohibited.
- The building is not accessible to persons with disabilities, though some accommodations have been made to allow partial access.
- The mechanical and electrical systems appear to be original to the building and are not adequate for a recreation facility of this type. The most pressing issue is the total lack of air conditioning which effectively renders the gymnasium unusable during the warmer months of the year. Other systems will require partial or total replacement in the near future.
- Chlorinated water from the pool is dumped directly into a wooded area near the building. This is typically not permitted by the provincial department of Environment and Conservation.
- The approximate cost to rectify (as much as possible) the major issues and deficiencies at the Labrador Training Centre for continued operation for up to 20 years is **$5,300,000**.

1.2.3 Real Estate Valuation

A real estate appraisal was commissioned to determine the recovery value of three existing recreational buildings and the current fire hall, with all associated land. The values provided by the appraisal were used in the Net Present Value analysis of the various redevelopment options when the option included disposing of one or more buildings. Refer to Appendix B for the detailed assessment reports.

The valuation estimates are as follows:

• The CAF Arena:	$400,000 – $500,000
• The Labrador Training Centre:	$520,000 – $610,000
• The Goose Bay Curling Club:	$240,200 – $265,200
• The Fire Hall:	$270,000 – $314,000

1.2.4 Cost Estimating

Estimates in this report are intended to provide *order of magnitude* costs and are accurate to ***Class D*** standards as per generally recognized industry practices.

The figures listed below are a combination of probable construction cost in HVGB at the time of this report, estimated architectural and engineering fees and typical project expenses and other soft costs. HST is not included.

The individual projects are described in detail in section 3.2 of this report and represent components or elements of the Net Present Value redevelopment scenarios.

a. Capital Cost of Recreation Projects

- The redevelopment of the former CAF arena into an indoor track and soccer facility: **$2,470,000**
- New aquatics and fitness facility (no ice sports): **$27,950,000**
- Extension to the Broomfield Arena for curling club: **$4,120,000**
- New complete wellness centre (aquatics, fitness, ice arena and curling): **$47,270,000**
- New complete wellness centre constructed in two phases (aquatics/fitness then arena/curling): **$50,640,000**

b. Capital Cost of Related Projects

- New fire hall building: **$2,890,000**
- Broomfield Arena conversion to municipal depot: **$6,550,000**
- Broomfield Arena conversion to fire hall: **$2,670,000**

1.2.5 Net Present Value Analysis

Net present value is a theoretical financial analysis tool that considers the time value of money when evaluating long-term revenues and expenditures. The analysis relies on the generally accepted principle that, everything else being equal, a cost obligation in the future is better than a cost obligation today, because if the money is not spent immediately, it can be invested and earn income before the obligation or payment is due. This phenomenon enhances the value of money today based on time, although its value would also be eroded by inflation.

Present value is a future amount of money that has been discounted to reflect its current value. The resultant net present value can be described as the difference amount between the sums of discounted capital costs and potential revenues over a specified time horizon, 30 years in this case.

Each redevelopment scenario – with its own capital costs, construction schedule and operating revenue/cost outcomes – generates different cash flow scenarios over the life of the project. The net present value analysis allows the life cycle costs of the different cash flow scenarios to be compared equally by leveling out the effects of different timing of expenses and revenues. The results are useful for comparing different scenarios, but it is important to remember that they do not represent actual costs. The cash flow tables included in Appendix A illustrate the estimated yearly cash flows for each scenario.

Eight redevelopment scenarios were created for the financial analysis exercise:

Scenario 1a: Maintain the status quo:
NPV – $21,945,300

Scenario 1b: Maintain the status quo, redevelop the CAF Arena:
NPV – $25,979,100

Scenario 2a: Build an aquatics and fitness facility, maintain the Broomfield Arena and Curling Club:
NPV – $38,175,600

Scenario 2b: Build an aquatics and fitness facility, maintain the Broomfield Arena with an extension for curling:
NPV – $38,140,800

Scenario 3a: Build a complete wellness centre on Town land:
NPV – $41,410,700

Scenario 3b: Build a complete wellness centre in the Goose Bay Town Centre development:
NPV – $45,479,000

Scenario 4a: Same as 3a, except with phased construction:
NPV – $48,022,200

Scenario 4b: Same as 3b, except with phased construction:
NPV – $50,577,400

1.3 Conclusions and Recommendations

1.3.1 Existing Recreation Facilities

Although stakeholder consultation was not the primary focus of this report, it was clear from the input received that the existing recreational infrastructure in Happy Valley-Goose Bay is insufficient to meet the demands of the community. Without exception, the individuals and groups consulted bemoaned the lack of available space for indoor activities and the substandard condition of the facilities that are currently available.

The three main recreational facilities available to the public are reaching the end of their useful life. A substantial injection of capital will be required just to maintain the current level of services. The Broomfield Arena, the busiest of the three, is approximately 40 years old and the Labrador Training Centre and Goose Bay Curling Club are surplus military buildings in excess of 55 years old.

The facility audits contained within this report indicate numerous issues with the existing infrastructure ranging from serious life safety deficiencies that should be immediately rectified, to failing mechanical and electrical systems, to ongoing maintenance issues typical of aging buildings. Energy usage is very high and even with all of the recommended renovations it is highly unlikely that these facilities will perform as well as a new building because some deficiencies will be impossible to remedy.

Another important consideration is that neither building is truly accessible to persons with disabilities. This segment of the population is essentially barred from participating in most indoor recreational activities that are available to other members of the community. This is not acceptable for publicly funded facilities.

The total capital cost investment required to repair and upgrade the existing facilities as indicated in this report is approximately $15,150,000. This capital investment will simply maintain the recreation space currently available.

Considering the high cost of the required repairs and renovations, the potential for continued high energy usage and the fact that this investment will not add any recreational space or services to the community, the findings of this report do not support further investment in the existing facilities.

1.3.2 Related Projects

The redevelopment scenarios consider options for the existing recreational facilities if a new wellness centre is constructed. The Labrador Training Centre, the Goose Bay Curling Club and the CAF Arena are located adjacent to one another in an industrial area. The real estate appraisal indicates that the combined value of these three properties is approximately $1,200,000 to $1,700,000. It is recommended these properties be sold and the profit used to offset the cost of a new wellness centre.

The Broomfield Arena will cost about $500,000 to demolish. However, since the 2005 extension has considerable inherent value, complete demolition is not recommended. At the request of the Town, a concept plan was developed to convert the Broomfield Arena into a municipal depot. The approximate cost for this conversion is $6,550,000. This redevelopment would create quite a large facility. Further work is required to determine if the Town truly needs such a large depot building.

The consultants were advised that a new fire hall will be required in the future and have estimated the construction cost at approximately $2,890,000. A redevelopment scheme for the Broomfield Arena, involving partial demolition of the original structure while keeping the 2005 extension intact, could create a fire hall to suit the needs of HVGB and provide leasable office space on the mezzanine level for approximately $2,670,000. When combined with the potential sale of the current fire hall property (valued between $270,000 – $314,000) and considering the total demolition cost of the arena, this redevelopment option for the Broomfield Arena potentially has a net cost of just $1,856,000, making it the preferred option.

1.3.3 Conclusions from the NPV Analysis

The net present value (NPV) results allow an equal comparison of the redevelopment scenarios even though the number is a theoretical value, not the total capital and operating cost. In general, if the NPV of one option is close to another, they are close in value and are considered to be a similar investment. If the NPV of one option is twice as high as another, the investment can be considered to be twice as much. Since all options in this analysis represent cost expenditures, the value closest to zero equates to the least amount of cost over the 30-year horizon of the analysis.

The NPV of Scenario 1a, maintain the status quo, is $21,945,300. This is the value of maintaining the current level of service. Essentially the NPV of doing nothing. Therefore this value is the baseline for comparing all other redevelopment scenarios.

Scenario 1b, which maintains the existing facilities and proposes redevelopment of the CAF Arena for added indoor recreational space, increases the base NPV by 18.4 per cent while providing only a marginal increase in the level of service to the community.

Scenarios 2a and 2b have essentially the same NPV, with a percentage increase over the base NPV of 74.0 and 73.8 per cent, respectively. Scenario 2b, which retains only the Broomfield Arena, has a lower NPV than 2a which keeps both the Broomfield Arena and the curling club, even though the capital cost is higher to rebuild the curling club (Scenario 2b). This is because of the higher operating and maintenance cost of the existing buildings relative to new buildings.

Both Scenario 3a and 3b involve the construction of a complete new wellness centre to replace all existing facilities. The only difference between the scenarios is the location of the building, either on Town-owned land (at no cost) or purchased land (estimated at $3,600,000). Scenarios 4a and 4b explore the costs associated with phasing the construction of the wellness centre over a number of years. This reduces yearly capital commitments, but results in a higher total cost over the life of the project, thus a higher NPV. Phasing increases the NPV by 16 per cent.

The NPV of Scenarios 2a, 2b and 3a differ by only 14.9 percentage points when compared to the baseline. Such a small difference in value favours the building of a complete new wellness centre over a partial renovation and reuse of existing facilities.

Building a complete new wellness centre represents the ideal solution to Happy Valley-Goose Bay's recreation needs in terms of providing services. Though it has a high capital cost when compared with maintaining the status quo, the results of the NPV analysis support Scenario 3a over the other seven options.

The capital investment of maintaining the existing buildings is $15,150,000 while the estimated cost of a new wellness centre is $47,270,000: a difference of $32,120,000 or a 212 per cent premium investment over the minimum requirement. However, the NPV of Scenario 3a (new wellness centre on Town land, one construction phase) is $41,410,700, which represents only an 88.7 per cent increase over the base NPV of Scenario 1a.

The fact that the NPV analysis indicates a much lower difference in value between Scenario 3a and the baseline, than the difference in capital cost alone, would indicate that investment in the new wellness centre has a higher return than the same investment to maintain the status quo.

2.1 The E. J. Broomfield Arena

2.1.1 Site

a. Location

The Broomfield Arena is located at the corner of Churchill Street and Hamilton River Road, adjacent to a ball field and the municipal depot. The entire area of the site dedicated to recreation use is approximately 4.4 hectares (11 acres), though the arena and associated parking only occupies 0.85 hectares (2.1 acres). The site is relatively flat, with a change in grade of only one metre across the entire area.

The site is accessible by vehicle from both Churchill and Broomfield streets, but the paved parking area is off Churchill. The main parking lot, on the west side of the building, can accommodate about 60 cars and there is a clearing on the east side of the building that could function as an overflow lot, though it is not currently designated as such. Designated barrier-free parking stalls are located immediately adjacent to the main entrance, at the northwest corner.

b. Site Services

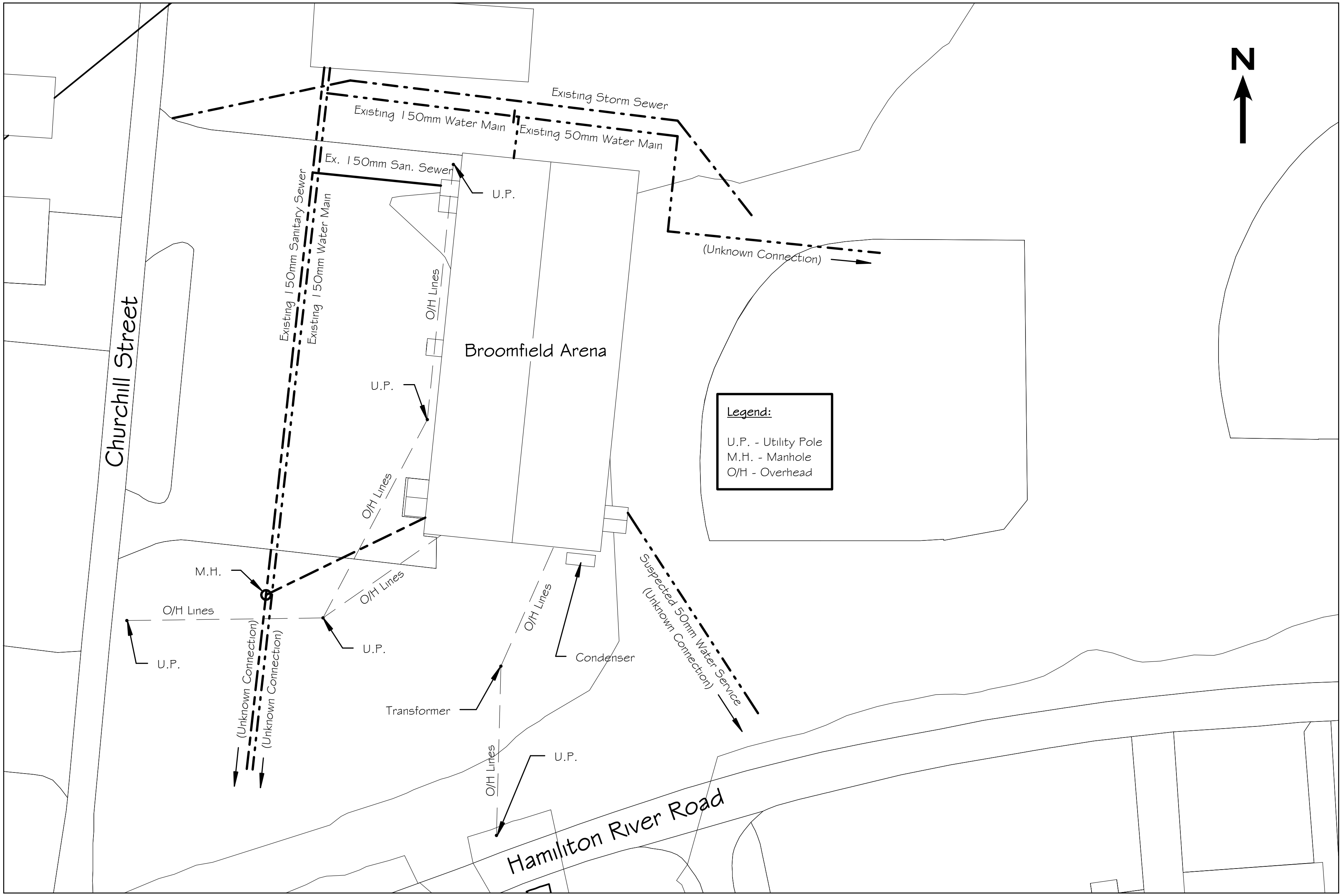
According to town officials there are catch basins located in the parking lot, at the time of the assessment these catch basin where not visible due to snow conditions. The parking lot grade appears to be lower than Churchill Street which would present a problem with surface runoff as a considerable amount of water may run towards the stadium entrances. This would be especially problematic in the Spring when the storm sewer may be frozen but snow and ice are melting on the surface.

The arena is serviced by two 50 mm waterlines, one entering the building in the 2005 north-end extension and the other entering through the ice-resurfacer garage. There are also two sanitary sewer lines. One exiting the new extension and one exiting the south end of the original building. Both are on the west side and both are 150 mm pipes. It is unclear as to where the sanitary sewer ties into the main line. Most likely it is under Hamilton River Road.


View toward the 2005 addition and new main entrance.


The original main entrance, now the *player's entrance*.


The southeast corner showing the ice-resurfacer lean-to.



Approximate locations of known site services at the Broomfield Arena site.

2.1.2 Structural

a. Design and Construction Overview

The E. J. Broomfield Arena consists of a large gable roofed, pre-engineered steel structure with minor wood frame additions and wood frame interior constructions. The main area of the arena, constructed during the 1970s, is a clear span with rigid frames (column and roof beam combinations) spaced 6,096 mm (20 feet) on centre. Structural steel purlins span between each frame to support the roof and horizontal steel girts span between frames to support the exterior walls. Within this volume there are wood-frame bleachers and a two-storey wood frame change room and office area at the south end. This mezzanine area has been constructed independent of the steel rigid frame structure.

There are also two wood frame extensions built on to the east and west sides for an ice-resurfacer garage and a player's entrance respectively. It is not clear when the extensions or interior wood frame constructions were built, but it is obvious that they do not all date from the time of the original construction.

In 2005 an additional two rigid frame structural bays of the same on-centre spacing as the original, were added to the north end of the building to create a lobby area, canteen, public washrooms and a mezzanine community room. This extension was a pre-engineered structure with some conventional steel columns and beams supporting the mezzanine level, which consists of a metal deck with concrete topping. The main floor throughout the building consists of a reinforced concrete slab.

In order to confirm that all the existing steel, concrete and wood members conform to Part 4 of the National Building Code of Canada 2010, a complete structural analysis would be required. An undertaking of that magnitude is considered beyond the scope of this report and is not standard industry practice for a building audit, unless the visual inspection were to reveal any obvious deficiencies.

There are no original drawings for the 1970s portion of the building, so it can only be assumed that the building was designed to resist wind and snow loads in conformance with the contemporary edition of the National Building Code of Canada (NBCC). The

1. Typical roof purlins.

2. Typical rigid frame arches.

3. Roof-level braced bay.

same can be said for the wood frame additions, however it does not appear as though the east bleacher would have satisfied the requirements of any NBCC since the 1970s. The steel erection drawings for the 2005 extension were available and the design appears to be in conformance with the 1995 edition of the NBCC.

b. Preliminary NBCC Evaluation

The requirements of building structures to resist various load cases has changed over the years as updated building codes and standards have evolved. The structural design criteria from the 1970 National Building Code of Canada was compared to the requirements of the 2010 version of the NBCC to determine if the changes would warrant a detailed analysis of the building's structural members or connections. Considering the limited access to some structural elements due to the non-destructive nature of this audit, this method of comparative Code analysis is an acceptable means to provide a clear understanding of the ability of the existing structure to resist loads.

Since the 1970 version of the NBCC, snow loads for the Goose Bay area have been increased by 18 per cent. This is not a significant change. If the original structure was in conformance with the 1970 Code, including all applicable safety factors, the building should be able to resist all reasonable snow load events.

The wind loads for the Goose Bay area have increased 20 per cent since the 1970 Code. This is also not a significant change and assuming the structure was designed to meet the original Code requirements, including safety factors, the building should be able to resist wind loads as necessary.

c. Field Investigation Notes

The structural inspection was visual and non-destructive in nature, which provided limited access, or in some cases no access, to the underlying structure. Only structural elements that were visible at the time of the audit have been inspected.

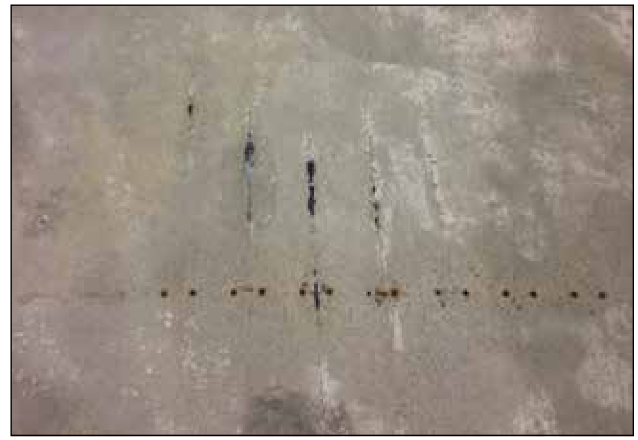
- A visual inspection of the main rigid frame and roof purlins yielded no signs of deterioration or possible failures. The purlins are braced at mid-span, which is typical for this type of construction (image 1). The purlins where checked for the 2010 snow load and yielded a new deflection limit of L/200. The existing rigid frames where not checked due to the complexity the design of the frames (image 2).

4. Possible removal of wall-level cross bracing.

5. Floor slab cracking at column locations.

- Typically pre-engineered buildings have braced bays in both the roof and the walls to properly transfer the wind loads to the foundations. The braced bays in the ceilings were visible at the time of inspection and appear to be in good condition (image 3). However, the braced bays in the walls are not visible. There is one location where it appears as though the brace was removed, possibly during a renovation (image 4).
- Pre-engineered buildings are designed to transfer a significant *kick-out* load to the base of the foundation and this load is usually resisted by steel cross ties either embedded in or buried below the concrete floor slab at every column location. At numerous places in the building cracks are apparent in the concrete floor at column locations (images 5 and 6). These cracks could potentially cause a problem by allowing moisture to reach the cross ties and hasten corrosion. On the surface of the slab under the ice there are signs of corrosion (image 7) which could indicate deterioration of embedded cross ties or it may simply be corroded anchors for the refrigerant piping too close to the surface. This issue should be investigated further.
- The exterior walls of the original pre-engineered building are constructed with steel girts supporting exterior metal siding. The girts span horizontally between rigid frames and are spaced at 2,900 mm (9.5 feet) on centre which is an excessively large spacing by today's standards. Typically these girts are spaced 1,200 mm (4 feet) on centre. It is possible that the gauge of the exterior metal siding may be contributing to the design of the wall structure. If the building were to be re-clad in the future, additional girts should be added to reduce the span of the siding panels.
- The wood joists supporting the second floor of the south mezzanine (image 8) are not acceptable based on the live loads as per the 2010 National Building Code of Canada. There is also evidence of water damage and rot in the structural members. Further evaluation of the complete wood framed floor system would be required to determine if there is any danger of failure.
- The wood frame bleaches on the east side of the stadium are severely under-designed for expected live loads and totally unacceptable as per the requirements of the National Building Code. Many framing members are undersized with 38 x 89 mm studs used as floor joists througout. The vast majority of the wood-to-wood connections and the wood-to-steel connections are unacceptable (images 9-11).

6. Floor slab cracking at column locations.



7. Corrosion of steel within the floor slab.

8. South mezzanine floor framing.

Much of the structure is balloon-framed with only nails supporting joists where they are attached to studs. This wood framed structure also exhibits signs of water damage and potential rot.

- According to facility staff, the support structure of the wood frame bleachers on the west side of the building was replaced in recent years as part of a mould remediation project (image 12). From a purely structural perspective, the bleachers appear to be framed in such a way as to meet the requirements of the National Building Code.
- The wood framed extensions that were constructed on the east side for the ice-resurfacer garage and the west side for the player's entrance would experience a considerable amount of snow loading and snow impact load due to their location under the main roof. As no drawings of these extensions are available, it is difficult to determine if the roof structures were designed to resist the abovementioned loads. Further evaluation would be required to determine the design of the wood trusses.

9. East bleacher wood framing.

12. West bleacher wood framing.

11. East bleacher wood framing.

10. East bleacher wood framing.

2.1.3 Architectural

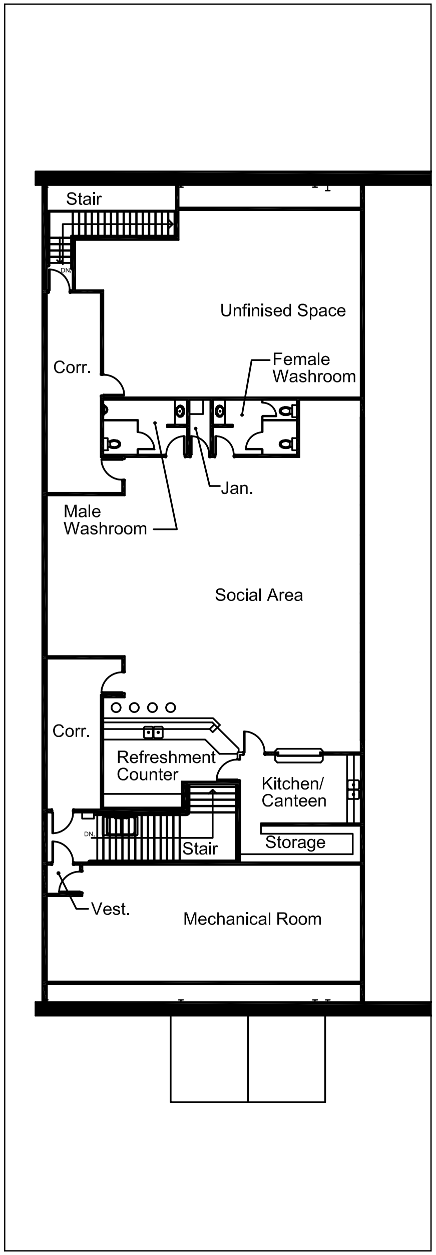
a. Building Envelope

(i) Exterior Walls and Related

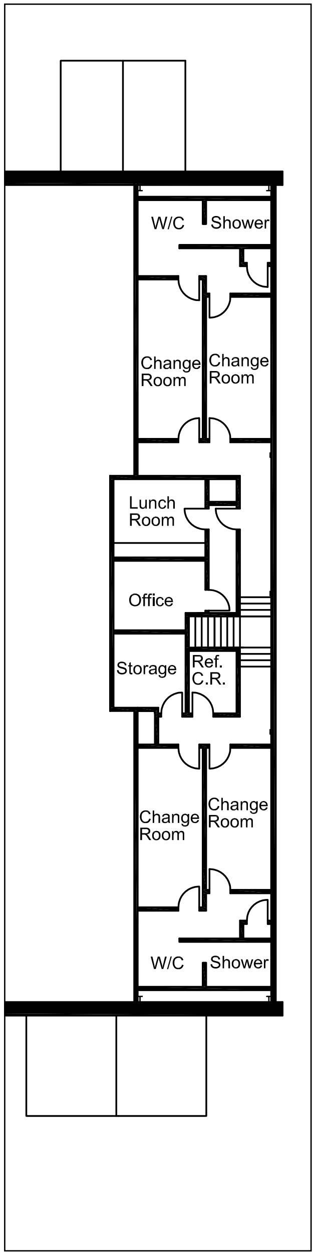
The exterior wall constructions explained below have been determined based on site observations and an analysis of available drawings. Due to the age of the facility and the numerous renovations to the building, the exterior wall construction at the complex varies. Without destructive testing, it is not possible to determine the condition of all exterior wall components. There were no drawings available from the original building construction but a previous report by Morrison Hershfield Ltd., commissioned in 2012, provided some insight into the exterior wall construction. Tender drawings were available from the 2005 extension.

The original structure is a typical pre-engineered building of primary steel rigid frames with horizontal girts and purlins design to withstand wind and snow loads and support the exterior wall and roof cladding. As it was constructed in the 1970s, the original building was likely fitted with minimal levels of insulation. In order to address this, the exterior walls have been furred out with wood stud construction, fibre glass and mineral wool batt insulation has been installed in the stud cavity and a polyethylene vapour barrier has been applied. Where subject to mechanical damage (typically behind the bleachers) a plywood finish has been installed to protect the assembly.

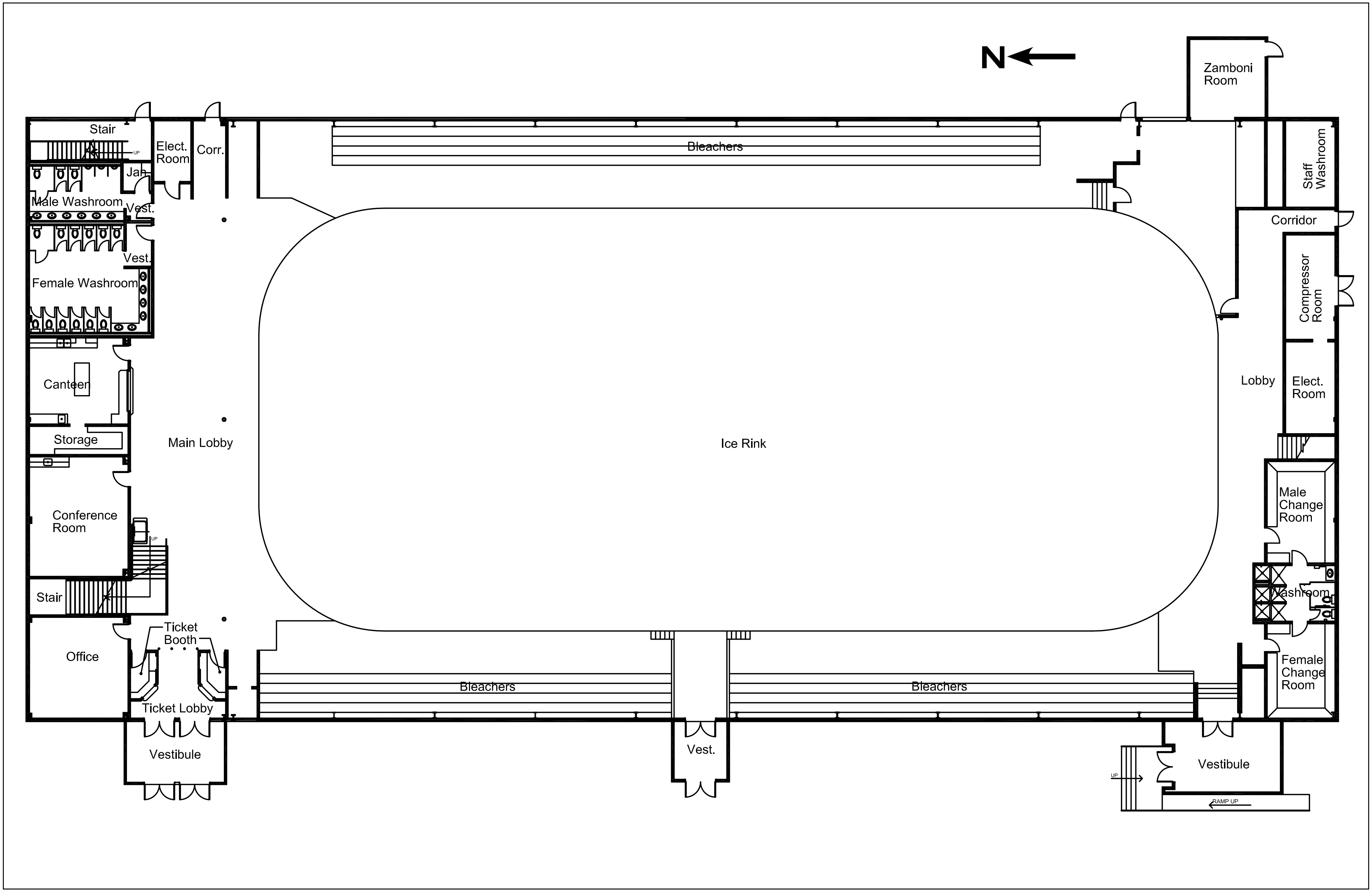
The amount of exposed vapour barrier on the exterior walls beneath the bleachers is a concern. Polyethylene film typically has a flame spread rating of less than 150, so exposed use is not strictly prohibited by the National Building Code, however it is not advisable and the situation should be discussed further with the authority having jurisdiction.



North mezzanine.



South mezzanine.



Main floor plan, Broomfield Arena.

SHEPPARD CASE ARCHITECTS INC

Throughout most of the building the continuity of insulation and vapour barrier is very poor and exposed areas of insulation have been left unfinished without any vapour barrier for extended periods of time. There are also wall areas in unfinished spaces (such as under the east bleachers) that have little to no insulation. The back of the cladding panels are visible in these areas. In addition, vapour barrier continuity has not been achieved across the primary steel arches or at the interface between the wall and roof assemblies.

The building extension constructed in 2005 is also a typical pre-engineered structure with an exterior metal siding profile designed to match that of the original building. The exterior wall is insulated with a typical pre-engineered building fibre glass blanket insulation complete with an integral air/vapour barrier. The insulation is held in place by compressing its full depth at the horizontal girts, which reduces its effective RSI (R) value to zero at these locations. Usually a rigid thermal spacer is used to counteract the thermal bridge at the metal girts, but this is typically ineffective.

On the main level of the extension, the interior side of the exterior walls is faced with 90 mm concrete block. On the upper mezzanine level, the wall is furred with 92 mm metal suds and finished with abuse resistant gypsum board, according to the drawings.

Though it is not an exterior wall, the partition separating the 2005 mezzanine and the open ice rink area is constructed as such with insulation and a vapour barrier. This wall separates two spaces with drastically different interior temperatures and it is important that it be properly sealed. However, there is currently no seal at all where this wall meets the underside of the roof deck.

(ii) Roof Assembly

The roof of the original Broomfield Arena is typical of this style of pre-engineered building with steel purlins located perpendicular to and on top of the primary rigid frames. A standing or overlapping seam metal roof spans across the purlins and batt insulation is held in place by compressing its full depth at the purlins. Similar to the wall construction, a rigid thermal spacer is typically used to counteract the thermal bridge occurring where the batt is compressed. The batt insulation features a factory


No vapour barrier or wall finish on exterior wall.


No continuity of insulation at bleachers, no vapour barrier.


Typical roof insulation with vapour barrier and mesh.

adhered air/vapour barrier which is exposed to the interior. A wire mesh retainer is employed to prevent the batt insulation from sagging and ultimately tearing away from contact with the underside of the metal roof.

Although it has not been confirmed, the consultants were advised that the metal roof of the original building was coated with a rubber membrane within the last couple of years. If that is indeed the case, the serviceable life of the roof should be at least another five to 10 years, depending on the exact product used and the quality of the installation.

The roof of the 2004/05 extension is similar to the original construction except that the insulation thickness is likely greater (it was specified as RSI 3.5 fibre glass on the provided drawings) and the thermal spacers may be somewhat more effective in short-circuiting the thermal bridge than those in the original building's roof.

(iii) Canopies and Vestibules

There are no large canopies at the Broomfield Arena, just a small projection over the emergency exit in the 2005 extension. There are however three entry and exit vestibules on the west side of the building. The northernmost vestibule was part of the 2005 expansion and is in very good condition. The two older vestibules are wood frame constructions and in poor condition. The player's entrance (which was the original main entrance) is completely missing eave fascia boards on one side and the batt insulation and attic space is exposed to the exterior. It appears as though the interior of the players entrance was recently refurbished and possibly insulated, but the emergency exit vestibule occurring midway on the west elevation has no insulation.

Redevelopment designs have been prepared to replace these vestibules. The project was tendered in the fall of 2013 but has not been awarded as of the date of this report. An entrance stair and accessible ramp are featured at the Player's Entry because the vestibule is approximately 700 mm above both exterior grade and interior finish floor. The redevelopment design has been executed in order to eliminate both the stair and the ramp, neither of which are fully compliant with respect to accessibility regulations.

(iv) Windows and Doors

There are no windows at the Broomfield area. The front entry screens installed as

Discontinuity of vapour barrier and insulation at structure.

No vapor barrier and poor insulation coverage at bleachers.

part of the north end extension feature double steel doors with half lite glazing, surrounded by sidelites and a glazed transom above. The screen is comprised of pressed steel framing elements with steel glazing stops. A centre mullion is provided on the exterior assembly which improves energy performance and provides greater resistance to forced entry. The assembly features heavy duty panic hardware, continuous hinges, closers, thresholds, weather-stripping and kickplates and should have fifteen years or more of serviceable life.

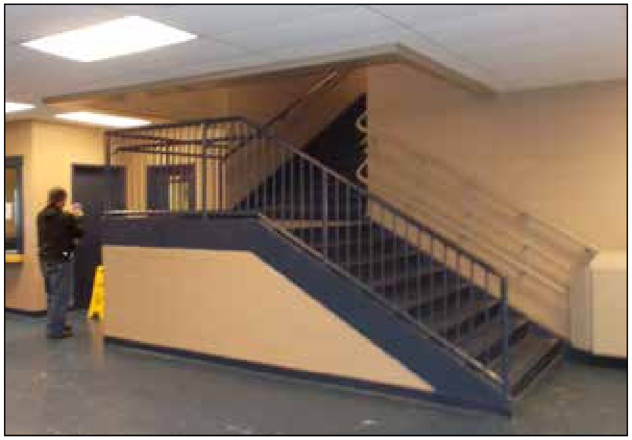
The remaining entry/exit doors, vestibule doors and service doors in the exterior wall assembly are also insulated steel doors. Generally equipped with panic sets and other heavy duty hardware, most exterior doors appear to be well maintained and meet National Building Code of Canada requirements for assembly occupancy. The double doors at the Players Entry also feature a removable centre mullion and half lite glazing.

Doors from the ice-resurfacer garage to the arena and to the exterior appear to be relatively new and are typical steel overhead doors with motor operators. The overhead door panels have injected foam insulation with steel skins. A third, older overhead door adjacent to the ice-resurfacer garage opens directly to the exterior from the main arena area. It is manually operated and appears to be in reasonable condition.

b. Vertical Circulation

Vertical circulation consists of wooden stairs in the original building and concrete-filled, steel-pan stairs in the 2005 north-end extension. The stair treads, risers, guards and handrails in the 2005 extension are in conformance with all applicable codes and regulations. The north end also features a folding platform lift so that the upper mezzanine is accessible to persons with disabilities.

The stairs to the southern mezzanine are covered with a black skate-resistant rubber with white high-density polyethylene (HDPE) nosing strips. This surface, while highly durable, can be very slippery when wet. Dimensionally (riser height and depth), these stairs do not conform to current National Building Code of Canada (NBCC) standards. The residential-quality wooden handrails are also non-conforming, in that they are discontinuous and do not extend for the required distances beyond risers.



North mezzanine stairs from main lobby, with handicap lift.

South mezzanine stairs c/w rubber treads and HDPE nosing.

Typical nonconforming stair and guard at east bleachers.

There are several sets of stairs forming an integral part of the wooden bleachers. These stairs vary in dimensions and finish: some have a ribbed rubber covering and nosings, while some are simply painted wood without nosings. Dimensionally, none of these stairs would meet the current requirements of the NBCC. Handrails and guards have been fabricated from dimensional lumber and also do not conform with NBCC or provincial accessibility requirements in terms of their height, the size of openings or their ability to resist lateral loads.

c. Interior Finishes and Millwork

(i) Wall and Partition Finishes

The walls and partitions of the 2005 northern extension are exclusively concrete block on the main level. This is a very robust construction with 50 years or more of serviceable life. The northern mezzanine level walls and partitions are constructed of steel stud framing with gypsum board cladding. Abuse resistant gypsum board is specified on the design drawings for the extension, but whether or not this was actually used (as opposed to regular gypsum board) has not been verified. The upper level consists of storage space, service space and a community room/viewing area so heavy use is not expected.

As a part of the extension and renovation work completed in 2005, most of the partition walls for the two main-level change rooms at the south end of the original structure were replaced with concrete block. These were the walls between the change rooms and the arena main open area and the change rooms and shared washroom area. The interior partition wall and knee walls at either side of the stairs of the original entrance vestibule (now the player's entrance) are also concrete block.

All other partitions throughout the original structure, including those supporting the bleachers and enclosing spaces beneath, are framed with wood studs. A surprising amount of this framing is completely exposed, without cladding, leading to concerns with respect to the degree of combustible construction and flame spread issues. Where partitions are finished, it appears to be with plywood or fibre board (hardboard). This is particularly true in the corridors and stairwells, where the flame spread rating on the walls is not permitted by the NBCC to exceed 75 and 25 respectively. Plywood has a flame spread rating of 110 and fibre board has a flame spread rating of 150, which both greatly exceed Code requirements.

South mezzanine partition with main arena open area.

Exposed vapour barrier and plywood wall finishes.

The washrooms associated with the players change rooms feature a ceramic tile dado and the showers are completely covered to the ceiling. The shower facilities that were developed as part of the 2005 extension scope in the original structure are finished with ceramic tile, and are generally in good condition.

(ii) Ceiling Finishes

Ceiling areas included within the scope of work for the 2005 extension and renovation are either suspended gypsum board or mineral acoustic tile in a t-bar grid. Vestibules and service spaces typically have gypsum board ceilings on the main level and service spaces on the mezzanine level are unfinished.

Throughout the 2005 extension, 3.5 RSI fibre glass batt insulation was specified to be placed above the ceilings as part of the ceiling assembly for both levels. This was presumably included in an effort to control the cost of heating the mezzanine area. However, the effectiveness of this is questionable given the apparent discontinuity of the installation and the air/vapour barrier between the colder arena open area and the heated mezzanine.

In the original building, the renovated change rooms and washrooms on the main level feature suspended t-bar ceilings but instead of mineral acoustic tile, the panels are a polycarbonate egg-crate type. This appears to be a decision to mitigate damage to the ceiling finish due to extensive leaking from the washrooms and showers on the mezzanine level above. Elsewhere in the original building, where rooms have ceilings they are typically gypsum board. The ceiling finish in the main arena area is simply the exposed inside surface of the insulation blankets with a wire mesh covering.

(iii) Floor Finishes

The floor finish on the main level of the 2005 extension is skate-resistant rubber throughout the lobby and public washrooms, with linoleum sheet flooring in the sports shop and kitchen area. The mezzanine area is a combination of sheet linoleum in the corridors, bar area and washrooms, carpet in the community room and exposed concrete in the service and storage spaces. With the exception of the carpeting, the floor finishes in the north end are highly durable and low maintenance.

South end change rooms, renovated in 2005.

Ceiling finish and water damage under south mezzanine.

Female public washroom in 2005 extension.

The bleacher floor finish is mainly just painted wood with some areas of a ribbed rubber sheet material. The painted wood likely requires a high degree of maintenance, probably yearly re-coating at a minimum.

The south end of the arena has a mixture of flooring ranging from exposed concrete to painted plywood (over the piping header trench) and skate-resistant rubber mats. The renovated change rooms have skate-resistant rubber flooring with areas of ceramic tile in the washrooms and showers. The south mezzanine area has an older type of skate-resistant rubber flooring in the corridors, change rooms and washrooms. The office areas have what appears to be linoleum sheet flooring and there are ceramic tiles in the shower areas.

Again, the painted wood is a very high maintenance finish while both the rubber and linoleum flooring is highly durable. The ceramic tile should also have a long service life if it is properly maintained.

Vinyl base is used throughout the facility in all spaces with finished flooring products.

(iv) Millwork and Equipment

The majority of the architectural millwork is contained in the 2005 extension on the north end of the facility. With the exception of the bar area in the community room, all of the millwork is constructed from plastic laminate on particle board with post-formed plastic laminate counter tops. This type of construction is of a fairly good quality and should prove to be reasonably durable and long-lasting. The community room bar is of a similar construction as the remainder of the millwork on the staff side with oak veneer plywood and solid oak trims on the public side.

The public washroom and change room counters are also post-formed laminate with drop-in style porcelain sinks. This type of counter is susceptible to water damage and swelling of the particle core at the sink cut-outs, which will eventually lead to delamination of the surface. Toilet partitions in the 2005 extension are a floor-mounted, over-head braced solid phenolic type. These are perhaps the most durable type of partitions available and are in excellent condition. The partitions in the south end of the building are solid phenolic in areas altered during the 2005 renovation and painted metal in those areas not altered, typically the mezzanine change room washrooms. The metal partitions are also in good condition.

Commercial kitchen equip. c/w fire suppression in canteen.

Typical millwork in the 2005 extension.

Millwork located elsewhere in the facility is limited to benches, shelves and gear compartments in the players changes rooms. These items are constructed of plywood and dimensional lumber with a painted finish.

There is a canteen in the 2005 addition with a substantial amount of millwork and a commercial-quality cooking area with deep fryers, a grill, soup cooker and a warming area, all installed under an NFPA compliant exhaust hood with an integral fire suppression system. This equipment is in excellent condition. The wall behind the cooking area is simply painted gypsum board, which presents maintenance issues, and should be protected with a stainless steel or fibre glass back-splash.

(v) Ice Rink Dasher Boards

In 2010 an entirely new aluminum-framed, high density polyethylene clad dasher board system with tempered glass shields was installed in the Broomfield Arena. This upgrade included all the boards, glass, player's benches, penalty boxes, time keeper's box and safety netting that is required for a fully functional recreational hockey rink. The system appears to have been supplied by Sport Systems Unlimited / Athletica, one of the leading manufacturers of NHL approved dasher board systems. This system should have a remaining serviceable life of 15 years or more.

d. Conformance with Accessibility Regulations

Most of the accessible features of the Broomfield Arena were installed during the 2005 expansion and renovation project. The new extension provided accessible entrance systems complete with power operated doors, barrier free service counters, accessible washrooms and a chair lift arrangement to permit access to the new second level mezzanine.

At the time of the site review, the power operators provided for the entry doors were not operational either because they were disengaged or malfunctioning. This should not be permitted in a public building like the arena.


Ice rink and dasher boards.


Male public washroom in 2005 extension.


New accessible main entrance system, 2005 extension.

(i) Parking and Passenger Loading Zones

According to the drawings for the 2005 renovation project, four accessible parking spaces have been provided adjacent to the main entrance, complete with identifying signage mounted to the building. The parking area appears to be reasonably level with no slope greater than 1:100 in all directions. Due to snow coverage at the time of the site visit, the surface markings at the parking spaces could not be verified.

(ii) Ramps

The player's entrance is located approximately 700 mm, or four steps, above grade and above the finished floor elevation of the arena. The entrance vestibule features a wooden wheelchair ramp on the exterior of the building that would allow patrons with disabilities to access the vestibule, but there is no permanent ramp installed inside the facility to allow access from the vestibule. This effectively eliminates any advantage gained by the exterior ramp. Since there is no barrier free path from the new extension on the north side to the change rooms on the south side, this entire area of the building is not accessible.

Drawings made available to the consultants seem to suggest that a temporary ramp may have been installed over the interior stairs to allow wheelchair entry in the past. The slope of such a ramp would be steep to the point of being dangerous and well beyond the 1:12 maximum slope permitted by the provincial regulations.

A reconfiguration design that was prepared by AMEC Americas Ltd. in 2013 calls for the demolition of the player's entrance vestibule and replacement with a vestibule located at the same elevation as the arena floor and the exterior grade. As of the writing of this report, it is not known if this project, which also incorporates changes for the central emergency exit and the ice-resurfacer garage, will proceed to construction.

(iii) Platform Lifts

In the 2005 extension a *Garaventa Artira* inclined platform lift has been installed on the stair accessing the upper level mezzanine. This stair is located in the lobby area, just beyond the main entrance. The width of the stair is such that it permits the full exit width required for egress with the platform in the in-use position. At the time of the site visit the platform lift did not appear to be operative. It could be that the power

Typical barrier-free toilet stall. Tissue dispenser is too high.

Nonconforming barrier-free shower in south change rooms.

was disabled. The platform lift is required by provincial regulations to be maintained in a operating state at all times while the facility is occupied.

(iv) Stairs and Guards

With the exception of those in the 2005 extension, the stairs throughout the arena are not compliant with either the provincial accessibility regulations or the National Building Code of Canada. Treads do not have contrasting nosings for visually impaired patrons, handrails are not continuous and they do not extend beyond risers. Also, the dimensions of the handrails are such that they are not considered *graspable* as per code requirements.

(v) Players Dressing Rooms

South End Original Mezzanine: From an accessibility perspective, nothing about the player's change rooms or washroom and shower facilities on the mezzanine at the south end of the arena is compliant with modern day regulations. The main areas of non-compliance relate to corridor, stair and door configurations and clearances, changes in elevation at thresholds and the type of door hardware used. Other specific non-compliant elements are discussed here under separate headings.

South End Main Level: As part of the 2005 extension and renovation project, a portion of the south end of the building was redeveloped with accessible washroom and shower facilities. As mentioned previously, the absence of an internal ramp makes this work superfluous, but the proposed 2013 project by AMEC Americas Ltd. attempts to redress this situation.

Surprisingly, there are aspects of the 2005 accessibility renovations which are non-compliant. The seat in the shower, for example, is on the wrong wall as the barrier free zone outside the shower is supposed to extend 300 mm beyond the back of the seat. This renders the entire plumbing and grab bar arrangement incorrect as well. It is important to note that the as-built arrangement is contrary to the design drawings which configure the shower correctly.

Accessible ticket counter in 2005 extension.

Typical nonconforming stairs and guards at bleachers.

Typical obstruction in bleacher aisle, nonconforming guard.

(vi) Washrooms

The washrooms in the 2005 northern extension are generally compliant with accessibility regulations, with the following exceptions:

- The toilet tissue dispensers are not compliant with regulations. They are required to be mounted below the grab bars in accessible stalls, whereas in this case they have been mounted above.
- Soap dispensers have been mounted 100 mm above the 1200 mm maximum height above the floor for wheelchair use.
- The door to the Male Washroom only offers 540 mm clearance beyond the latch side on the inward side of approach, whereas 600 mm is required for regulatory compliance.
- Also in the Male Washroom, the clear space from the face of the accessible toilet stall to the edge of the vanity is only 1165 mm, where it is required to be 1400 mm for regulatory compliance.
- Coat hooks are required to be provided in barrier-free toilet stalls for regulatory compliance, but none have been provided.

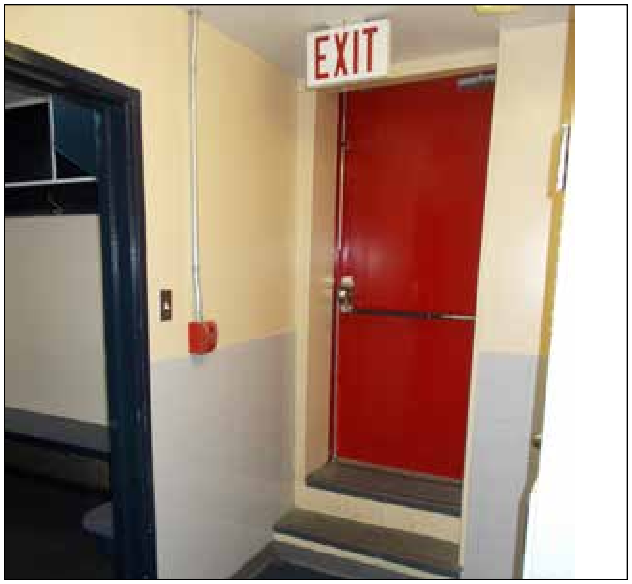
(vii) Service Counters

The service counter height at the ticket booths inside the front entrance are 860 mm above the finished floor, which is compliant with provincial regulations. The service counter height at the Canteen is 875 mm above the finished floor, which is 10 mm more than the maximum permitted height. This non-compliance is marginal and likely will not cause any difficulty to patrons using the facility.

(viii) Viewing Areas

As per the provincial regulations, designated seating spaces are required in assembly occupancies for wheelchair spectator viewing. These spaces are to be provided following a ratio in relation to the total amount of seating. For a building with the seating capacity of the Broomfield Arena, approximately seven spaces should be provided and distributed throughout the main viewing areas. However, no accessible seating areas are provided in this facility.

South mezzanine exit through change room and washroom.



South mezzanine exit door to exterior fire escape.

e. Fire and Life Safety Review

(i) Classification and General Compliance Issues

This building falls under the Group A or *Assembly* occupancy category of the National Building Code of Canada (NBCC), 2010 edition. Its Division is defined as *Arena Type* or Division 3.

The building has a building area or footprint of approximately 2,980 m^2 and is of combined combustible and non-combustible construction. The area of the original mezzanine is 222 m^2 and the floor assembly is combustible (wood framed). The area of the recent mezzanine is 512 m^2 and the floor assembly is non-combustible (steel deck with concrete topping). The building is not sprinklered.

It is difficult to strictly classify this building according to the NBCC. It is similar to a building classified under article 3.2.2.30 ***Group A, Division 3, up to 2 Storeys*** under which the minimum requirements include:

- Maximum building area limit of 3,000 m^2 if two stories in building height when facing three streets.
- All non-combustible construction.
- Floor assemblies and mezzanines constructed as fire separations with a fire resistance rating of one hour.
- Roof assemblies are required to have a fire resistance rating of 45 minutes.
- All assemblies requiring a fire resistance rating shall be supported with load bearing walls, columns and arches that exhibit a fire resistance rating equal to that of the assembly supported.

However, the amount of combustible construction occurring in this arena makes the above scenario unattainable and impracticable. In addition, the requirements for fire protection of assemblies could not be economically or practically achieved.

Alternatively, the building is also similar to a classification under article 3.2.2.32 ***Group A, Division 3, One Storey, Increased Area*** which allows for a combination of combustible and non-combustible construction. The minimum requirements include:

Improper hardware on change room door in egress path.

One of two exterior fire escapes from south mezzanine.

View of the (newer) west bleachers.

- Maximum building area limit of 3,000 m² when facing two streets.
- Mezzanines constructed from combustible construction are required to be fire separations with a fire resistance rating of 45 minutes.
- Roof assemblies are required to have a fire resistance rating of 45 minutes.
- All assemblies requiring a fire resistance rating shall be supported with load bearing walls columns and arches that exhibit a fire resistance rating equal to that of the assembly supported or shall be non-combustible.

This scenario is perhaps more plausible except that the original wood framed mezzanine construction would have to be fire rated using gypsum board applied continuously to the underside of the floor assembly. However, the problem with this classification is that the building cannot be considered a single storey unless the total mezzanine area is 10 per cent of the arena open floor area or less. This is roughly equal to the size of the original mezzanine and suggests that the 2005 extension was added contrary to the National Building Code, as it increased the total mezzanine area to a level well above that allowed in a building classified as one storey. Currently, the combined mezzanine area is approximately three times the area permitted. If the Broomfield Arena was classified as a two storey building as per the first comparison (3.2.2.30), all wood frame construction (i.e. the original mezzanine and the bleachers) would have to be completely demolished and reconstructed in non-combustible materials.

The installation of a complete sprinkler system throughout the Broomfield Arena would not resolve all of the abovementioned non-compliance issues, but it would certainly improve life safety within the building. Also, if an arena type building is intended for occasional use for trade shows or similar exhibition purposes, then it is required by the NBCC to be sprinklered.

(ii) Mezzanine Exiting

Exiting from the original southern mezzanine does not comply with the NBCC and is cause for concern. The mezzanine does have two exterior fire escapes in addition to the central stair into the arena. However, the access to these means of egress is actually through the change rooms and washroom at either side of the building. Exiting through adjacent rooms, like the change room and washroom, as opposed to exiting directly from the corridor, is in contravention of current day codes. The fact that the change room and the washroom doors may be dead-bolted is a serious life safety is-

Passageway under west bleachers, exposed wood framing.

Access to exit from west bleachers, exit door is to the left.

sue which should be rectified immediately. It may be argued that the doors would not be bolted when the rooms are in use, but this does not reduce the hazard as it cannot be properly controlled by staff or other occupants. In addition, the NBCC stipulates that a change in elevation in an assembly occupancy has to be addressed with a minimum of three risers to avoid a tripping hazard. The exit doors from the south mezzanine feature only two risers.

The 2005 extension has done nothing to make the Broomfield Arena code compliant. In fact, as was mentioned previously, it has exacerbated the situation by adding an extensive area of mezzanine that is not permitted in a single storey building.

The total width of exiting provided from the north mezzanine appears to be adequate for the occupant load and the emergency exit (northeast stair) from the new mezzanine is code compliant. However, the configuration of the main stair which empties into the open lobby is not compliant. The National Building Code only permits exiting through a lobby based on certain strict criteria, none of which have been met in this instance. The most important of these requirements is that the stair would have to be separated from the lobby by a fire rated partition.

(iii) Bleachers

There are a great many issues with the bleacher seating. All of the bleachers in the Broomfield Arena are wood frame construction. As has been previously discussed, under most occupancy scenarios, combustible construction would not be permitted in this building. In the very least, the combustible construction of the bleachers should be protected from adjacent spaces underneath with a fire rated partition or cladding system.

The only means of egress from the east bleacher is at the far ends of the entire structure. It appears as though there was once passages through the seating area to the area under the bleacher, where people would then have access to exits at floor level, but these openings have been boarded up. However even if they were opened, the underside of a combustible bleacher would not satisfy the construction requirements of an access to exit and there is insufficient headroom clearance. The existing situation whereby all of the spectators on the east bleacher (in excess of 300 people) are

View of the (older) east bleachers.

Typical obstruction of the cross aisle by the rigid frame.

Stairs/cross aisle and access to exit from east bleacher.

funneled into and through a number of 620 mm wide stair passages on their way to a single exit is extremely dangerous.

According to article 3.3.2.5 of the NBCC, the aisles should be a minimum of 750 mm in clear width if serving no more than 60 seats. A cross-aisle is required to be sized according to the width of the aisle (minimum 750 mm) plus 50 per cent of the aggregate total of the widths of all the aisles being served. Based on this requirement, the cross-aisle and stairs immediately behind the dasher boards would have to be approximately 1500 mm wide as opposed to 620 mm. In addition to the cross-aisle exiting, not a single component of the east bleacher exiting system is code compliant. For example, the NBCC requires that there be less than 60 seats served by a 750 mm aisle; that there be less than seven seats to pass before reaching an aisle; and that dead-end aisles not exceed six metres. None of these conditions are met.

The newer set of bleachers on the west side of the building are marginally better than those on the east, but they still exhibit many of the same code infractions. Particularly those dealing with dimensional requirements for aisles, cross aisles and stairs. At least the west bleacher provides access to a third, central means of egress in addition to the means of egress at either end.

Guards and handrails on both sets of bleachers are not of sufficient height, design or construction quality to meet any requirements of the current National Building Code. There are also numerous obstructions jutting into paths of travel from odd-angle stair treads to seats to the steel building structure. On the east bleacher, clearance to the rigid frames from the floor of the cross aisle is approximately 1,400 mm, well below average standing height. The minimum NBCC requirement is 2,100 mm.

(iv) Conclusions

The work required to bring this building into compliance would include major demolition and reconstruction of almost all of the existing components to eliminate all combustible construction, rectify exiting issues from both mezzanines and the bleachers, and the addition of a full sprinkler system.

From a fire and life safety perspective, the current conditions at the Broomfield Arena are so problematic that it is *practically* impossible to achieve full compliance with the current edition of the National Building Code or the Life Safety Code.

Barricaded former access to exit from the east bleacher.

Passage under east bleacher, exposed wood framing.

2.1.4 Mechanical

a. Methodology and References

The objective of this report is to provide information on the current condition of the mechanical systems at the Broomfield Arena and to review the systems with respect to code compliance, energy usage and maintenance issues. Recommendations for immediate and future improvements are also included.

This report describes the apparent condition of existing mechanical systems as observed during a site review. No investigation has been completed related to the presence of hazardous substances, contaminants or pollutants.

There were no drawings available from the original building construction, but Issued for Construction drawings were provided for the 2005 renovation and extension and a set of review drawings were provided for a 2010 replacement of the ice plant.

The following mechanical codes and standards were referenced during this study:

- ASHRAE 62.1-2007 Standard for Acceptable Indoor Air Quality
- ASHRAE 90.1-2007 Energy Standard for Buildings
- National Plumbing Code of Canada 2010
- National Building Code of Canada 2010
- CSA B52 Mechanical Refrigeration Code, 2010
- NFPA 10 Standard for Portable Fire Extinguishers

b. Heating, Ventilation and Air Conditioning Systems (HVAC)

(i) Heating and Cooling

The heating system at the Broomfield Arena is all electric, either base board or ceiling mounted units, and thus falls under the scope of the electrical discipline. There are no air conditioning systems in the building.

(ii) General Ventilation

It appears as though the original arena was constructed with limited ventilation capacity which is considered inadequate compared to modern standards. In addition, many components of the original ventilation systems have been removed or retrofitted during numerous repairs and upgrades since the 1970s. The remaining ventilation systems serving the arena facility are in very poor condition and have reached the end of their useful service life. Some of the existing equipment is no longer functional in any capacity. For example, a large louver in the south gable end does not have a functioning control system and appears to be fully opened at all times, even when the electrical system is heating the arena.

The 2005 extension has a heat-recovery ventilation unit that provides fresh air and exhaust rates meeting current minimum standards. However this system is not centrally controlled and is not being utilized to its full capacity.

It is recommended that if the arena is to be maintained for future use, a new dehumidification system be installed for the ice rink area to prevent the formation of fog and to reduce condensation on building components. This system would also ventilate the spectator area, which is not currently provided with any ventilation. In addition, new ventilation systems incorporating heat recovery should be installed for the change room and administration areas of the building located in the south mezzanine. There is currently no functional ventilation in this area whatsoever.

(iii) Exhaust Ventilation

Exhaust fans serving the original portions of the facility are in poor condition and do not appear to be fully functional. Even if the fans were operating as designed, there is insufficient capacity within the system to meet 2010 code requirements. The exhaust in the 2005 extension areas appears to be satisfactory.

The Mechanical Refrigeration Code, CSA-B52, requires that both a low-level continuous supply ventilation and a high-level exhaust system be installed in the machine room to prevent the possible build-up of ammonia gas. The refrigeration system was upgraded in 2010 and the ventilation system was made code-compliant at that time. There is also a detection system installed that will automatically activate the exhaust fan in the event of a refrigerant leak. A wall-mounted, battery-powered, locally-audible alarm is also provided. There is no visual alarm.

c. Domestic Plumbing Systems

The domestic plumbing system consists of sanitary drainage piping, domestic hot and cold water piping and associated plumbing fixtures. The original building water entry is located adjacent to the ice-resurfacer garage. There is also a separate water entry for the 2005 extension. Both are 50 mm lines. The domestic water is distributed throughout the building by copper lines of various sizes. Many of which appear to be exposed and uninsulated. Hot water for most plumbing fixtures and for ice-resurfacer use is generated by four separate electric hot water tanks of differing sizes, located in a room accessed from the ice-resurfacer area. It appears as though these tanks are approximately 10 years old and will likely require replacement in the near future. There is a single hot water tank in the 2005 extension serving local fixtures.

Sanitary drainage is conveyed from the building by two 150 mm lines. One serves the 2005 extension and exits the building under the main entrance and one serves the original sections of the building, exiting from the southeast corner.

All water closets in the building are floor-mounted vitreous china. Those in the 2005 extension and the south-end main floor change room (also renovated in 2005) are a commercial type with manual flush valves. Toilets in the south mezzanine and other non-renovated areas are a residential type with tanks. All lavatories are vanity mounted units with manually operated faucets. Shower fixtures are institutional grade with adjustable faucets. With the exception of a pre-fabricated residential-style shower in the referees change room, most of the fixtures are in fair to good condition, though residential-quality fixtures should be replaced with commercial grade where possible.

There is much evidence of active or former plumbing leaks throughout the south mezzanine area. It could be that the leaks are ongoing due to deterioration of older piping or the offending piping could have been replaced but the water damaged finished not repaired. In general, the plumbing distribution systems in the original building will require a major overhaul to remain serviceable into the future. The system in the 2005 extension is in very good condition.

d. Refrigeration System

The arena ice plant has an ammonia refrigeration system located in the mechanical room with a rated capacity of 75 tons. The system operates by feeding ammonia gas into two single-stage reciprocating compressors powered by 50 horsepower electric motors.

The ammonia gas is first sent at high pressure to an oil separator then on to the exterior evaporative condensing unit. Liquid ammonia flows back inside the building through the refrigerant float valve to the low pressure side of the system and to the surge drum. From here the ammonia enters a plate-and-frame chiller where it cools the brine solution as it boils to a gas. The ammonia gas is then drawn back into the compressor through the top of the surge drum, forming a continuous cycle.

The brine solution is pumped by a 20 horsepower centrifugal cast-iron pump through the chiller and then out through the piping underneath the ice rink. It returns to the suction header inside the mechanical room where there are connections to a brine strengthening tank and a heating unit. Cooling for the compressors and condenser are supplied by a closed-loop water system. Potable water from the building's domestic water system is circulated through the compressors, the evaporator and back to a 1,200 litre PVC storage tank by a two horsepower *Summit* centrifugal pump.

This system is controlled by a *Cimco* electronic control panel. The control system monitors the temperature of the brine solution in the piping header and starts the compressors in a lead-lag arrangement. The cooling water pump is interlocked with the compressors while the brine circulation pump runs continuously with a manual wall switch.

The mechanical room refrigeration system, the outside piping and the evaporative condenser were installed during the 2010 refit and remain in very good condition. However, the brine piping portion of the ice refrigeration system is original to the building and, by all accounts, is in very poor condition. If the building is to continue in its current capacity, the under-slab piping will require replacement.

e. Building Management and Control Systems

There are no distributed digital control (DDC) or energy management and control (EMCS) systems currently installed in the facility. Controls for the ventilation systems are localized and operated by wall mounted push-button or toggle style interface devices. Any upgrading of the HVAC systems in the future should include a DDC or EMCS system which would provide vastly improved environmental control accuracy and higher performance reliability. The integration of controlling devices would allow a single user interface for the entire facility and provide scheduling ability, historical trending, climatic data analysis and enhanced troubleshooting capabilities.

Hot water supply for the ice-resurfacing machine.

Domestic hot water heaters with uninsulated pipes.

Exterior condensing unit and mechanical room exhaust.

f. Fire Protection

The Broomfield Arena does not have a sprinkler system or any other built-in means to fight fires (standpipe, hose cabinets, etc.). As explained in the architectural section of this report, a sprinkler system is one of the most important components of a building's life safety design and it is required by the National Building Code for most arena occupancies. If this arena is intended for continued use a dry-pipe sprinkler system should be installed in accordance with the National Fire Protection Association's (NFPA) document 13.

The canteen constructed in the north end during the 2005 renovation has a stainless steel exhaust hood equipped with a wet-chemical fire suppression system that appears to be in good condition. This system would meet the provincial requirement for a NFPA approved system in a commercial kitchen.

There are some fire extinguishers located throughout the building, but there does not appear to be a sufficient quantity or the proper distribution to satisfy the requirements of NFPA 10, which is mandated by the National Building Code and provincial regulations.

g. Energy Usage

The current cost of electricity in Happy Valley–Goose Bay is approximately 20 per cent of the cost of electricity on the island portion of the province. It appears as though this low energy cost may have fostered an environment where facilities are operated with limited regard for energy conservation.

With annual energy usage at 2,500 megawatts and costs approaching $50,000 at just $0.02 per kilowatt hour, the Broomfield Arena consumes approximately twice as much energy as a new similarly-sized facility would. If the building as it is today were located on the island, electricity costs would be in excess of $250,000 per year, which would be completely unsustainable for a municipality the size of Happy Valley–Goose Bay.

Skid-mounted ice plant unit.

Skid-mounted ice plant unit.

2.1.5 Electrical

This report describes the apparent condition of existing electrical systems as observed during a site review.

a. Service and Distribution

(i) Main Electrical Service

Electrical power is supplied to the building from three utility transformers pole-mounted on a wooden H-structure owned by Newfoundland and Labrador Hydro. The service is run aerial to the main electrical room. The service is rated 1,200 amp, 347/600 volt, three phase, 4 wire.

The electrical service entrance is comprised of a two section service entrance board complete with a 1,200 amp, three pole main circuit breaker. The service entrance board was manufactured by *Square D* and installed in 2005. The board also contains an owner's meter which read 411 amps at the time of the site visit. The board feeds multiple older distribution panels, mechanical equipment and a 600 volt distribution board located in an electrical room in the newer section of the arena.

A peak load controller with contactors is also installed in the main electrical room to shed loads, such as domestic hot water, to minimize the peak demand. The electrical service has one utility meter, number P71160.

During the assessment, the following items were observed:

- The main service entrance board is in fair condition.
- The main electrical room is used as a storage room which is contrary to Code and limits working space in front of electrical equipment.
- The main electrical room contains two dry-type transformers and is not ventilated, which will cause overheating.
- The secondary electrical room in the 2005 extension also contains dry-type transformers. This room is not ventilated either, which will cause overheating.

(ii) 120/208 V Distribution

The secondary 120/208 volt distribution panels are located throughout the building. The original panel boards are approximately 40 years old whereas the newer ones are approximately 10 years old. The panel boards were manufactured by various companies with nameplates from A*malgamated Electric, Westinghouse, Cutler-Hammer, Federal Pioneer*, and *Square D*.

During the assessment, the following items were observed:

- At 40 years old, the original 120/208 volt distribution is in poor condition. The trip accuracy of the original breakers is questionable.
- General wiring types include RW90, Teck, AC90, NMD, R60, and TW wiring used as conductors.
- There are no spare circuit breakers in the original branch panel boards and replacement circuit breakers are no longer available.
- The original transformers are very dirty and noisy.
- There is no surge suppression equipment installed within the main distribution.
- Some of the panel board door locks and hardware are damaged, preventing the doors from closing.
- Several panels do not have a ground bus installed.
- Many panel boards are not identified and their directories are either missing or do not have current information.
- Exit and emergency lighting branch circuit breakers to not have lock-on devices.

- Some circuit breaker terminals are used for more than one wire connection.
- Panel boards have missing bushings, locknuts, fillers, and insulated throats.
- Several panels are improperly used as junction boxes with marrets covering spliced wires within a panel enclosure.
- Several panel boards are improperly used as a raceway.
- All power conductors should be color coded as per the Canadian Electrical Code requirements.
- The original panel board enclosures require cleaning (dust and debris).
- There are covers missing on junction boxes.
- One meter clearance in front of electrical equipment is not achievable in the domestic hot water tank room.

If the arena is intended for long-term use, most all of the secondary 120/208 volt distribution equipment original to the building would have to be replaced in order to rectify the issues noted above.

b. Grounding and Bonding System

The main grounding system does not appear to be properly designed. The main ground conductor is sized adequately and there appears to be a ground connection to the water main, but it could not be determined if it was connected to the distribution system. Also, no external ground bus could be located in the electrical room.

During the assessment, the following additional items were observed:

- Several branch circuit panel boards do not have a ground bus installed.
- Several duplex receptacles that were inspected are not bonded to ground.
- No information could be determined regarding the presence of exterior ground rods.

For continued use, bonding conductors should be installed to all electrical equipment throughout the building. In addition, a new external ground bus must be installed within all electrical rooms, the main service must be bonded to the water main and new external ground rods complete with new wiring should be installed.

Pole-mounted transformers on H-structure.

Main electrical room being used for storage.

c. Lighting Systems

(i) General Interior

There are two main types of interior lighting in the Broomfield Arena: high-bay metal halide over the ice surface and T12 fluorescent lighting in the remainder of the building. The high-bay metal halide lighting appears to be in fair condition. All lights are in working order with a good lighting distribution and few shadows are cast onto the ice surface. The fluorescent lighting is comprised of 305 x 1,220 mm surface mounted fixtures, 610 x 1,220 mm recessed fixtures or strip lighting fixtures (within the mechanical and other service rooms). The recessed and surface mounted fixtures generally have acrylic lenses. There is no consistency to the colour temperature of the lamps used within the facility.

The interior lighting systems remain serviceable, though if a major refit of electrical systems is considered, it would be advisable to replace the older T12 fixtures with new, energy efficient T8 fixtures. In the short term, care should be taken when replacing lamps so that the colour temperatures match.

During the assessment, the following additional items were observed:

- Many strip lighting fixtures in service rooms are missing wire guards and lens.
- The smaller electrical room in the older section of the building did not have a working light.
- There were damaged lens in many of the dressing room.
- The lighting level in many of the service rooms was very low and needs to be increased to meet Illuminating Engineering Society (IES) standards.

(ii) General Exterior

The exterior building lighting consists of metal halide wall packs located at intervals on the facade and near exits. Most of the exterior fixtures are in very poor condition. The light levels in the parking lot do not meet IES standards.

The exterior lighting fixtures are well beyond their serviceable life and should be replaced with energy efficient and long-lasting LED fixtures. Light standards should be installed in the parking lot to increase lighting levels for improved visitor safety.

(iii) Emergency Lighting

Emergency lighting is provided by individual 12 volt DC battery units with remote heads located throughout the building. Many of the individual units are equipped with two emergency heads. The branch circuits for emergency lighting do not have adequate lock-on devices and it is unlikely that the battery life will meet current standards.

The number and location of remote heads is inadequate and consequently the emergency lighting illumination levels throughout the building do not meet National Building Code requirements. Additionally, many of the units that were tested during this review were not working and most dressing rooms and washrooms do not have any fixtures whatsoever. Regular painted steel heads are installed in shower areas are badly corroded and require replacement with vapour-proof fixtures.

In general, the emergency lighting system requires a complete retrofit and a reevaluation of the quantity and distribution of fixtures to meet the current Code. New units are to have a minimum battery life of 90 minutes.

(iv) Exit Lighting

What exit lighting does exist throughout the facility is an older incandescent type. Exit lights are not located in all areas requiring such signage as per National Building Code regulations. A detailed review of exit lighting requirements should be undertaken and new signs added where necessary. Existing signage should be replaced with long-lasting LED fixtures.

Drying boot on a transformer.

d. Heating Systems

The main source of heat for the building is electric baseboard convectors with line-voltage room thermostats. There are also ceiling mounted unit heaters with fans. Many of the convectors and unit heaters appear to be in poor condition. There are ceiling-hung electrical radiant heaters over the spectator areas in the main arena open space. These heaters seam to be functioning properly, but are rusty with a generally poor appearance.

During the assessment, the following items were observed:

- The temperature control for many rooms was not working properly and excessive temperatures were experienced during the review.
- Many of the baseboard heaters exhibited mechanical damage and were filled with dust and debris.

For continued operation of the facility, at a minimum all heaters should be thoroughly cleaned and badly damaged units should be replaced. New low-voltage thermostats and solid-state heater relays should also be installed to provide more accurate control of heat levels.


Typical high-bay metal halide light fixture.

e. Wiring Devices

Generally, all receptacles are the U-ground type, rated 15 amp, 120 volt and light switches are rated 15 amp, 347 volt.

There appears to be an adequate number of receptacles installed in most rooms, though some areas were observed with extension cords in use. Most receptacles in the original section of the building are cracked and worn and should be replaced. Many receptacles do not have proper cover plates.

There are no ground-fault interrupter (GFI) circuit breakers installed and no GFI receptacles installed near sinks or other water sources, as is required by the Canadian Electrical Code. Many other receptacles that were inspected did not have the bonding conductor installed.

As with the receptacles, many of the toggle switches in the original building are worn, without cover plates and in need of replacement. Some switches do not have the bonding conductor installed and should be rewired with RW90 wire in conduit.

f. Wiring Method

There is a wide variety of wiring methods employed in the Broomfield Arena. There is RW90 in conduit, TECK, AC90, NMD, R60 in conduit and TW wiring used as conductors in conduit. Generally, the wiring in the 2005 extension is in good condition and the wiring in the original building is in poor condition, except those areas that were retrofitted either in 2005 or in 2010 when the refrigeration system was replaced.

During the assessment, the following items were observed:

- Some of the wiring is run in an untidy fashion and is not adequately secured or supported.
- The R60 rated conductors are comprised of a rubber based insulation which becomes brittle with age and flakes off the conductor.
- TW wiring currently in use is not rated as conductor cables.
- All power conductors are not color coded as per Canadian Electrical Code.
- Wiring method under the bleachers is run in an untidy fashion, conduits are not secured properly and there are open junction boxes, exposed wiring terminations, splices outside junction boxes, etc.
- Conduits for exterior receptacles are not supported properly.

It is imperative that R60 and TW rated conductors be replaced with RW90 rated conductors. The existing wiring has deteriorated and presents a high risk of shorting or arcing. In addition, all junction boxes require covers and all cable and conduit needs to be properly anchored or otherwise supported. Power conductors should also be colour coded.

Receptacle by sink in 2005 extension without GFI.

Uncovered junction box under bleachers.

Improperly supported wiring under bleachers.

g. Fire Alarm System

According to facility staff, the fire alarm system was either installed or there was a major upgrade in 2011. The system is an *Edwards EST Series* consisting of a main control panel installed near the entrance to the facility with explanatory graphics indicating that there are six zones. There are also visual strobe devices, audible horns and manual glass-rod pull stations installed. All components are connected from a fire alarm fused disconnect switch, painted red, in the electrical room.

In general, the layout and coverage of the fire alarm system is inadequate and not in conformance with current National Building Code of Canada requirements. Pull stations are required at all exits and there must also be heat detectors installed in all storage rooms and stairwells.

Given the apparent haphazard state, the fire alarm system should be serviced by a licenced technician to verify that all connected devices are functional. Additional fire alarm components should also be installed where necessary.

Improperly run and supported wiring in south mezzanine.

h. Communication Systems

(i) Voice and Data

The voice and data system in the building appears to be a combination of Cat 5e and Cat 6 cabling that is functioning as intended. No immediate remedial work is required.

(ii) Sound System

According to facility staff, the building's sound system was installed in 2012 and is in very good condition.

All of the head-end equipment (CD player, AM/FM tuner, cassette player and UPS) is located in a secure cabinet in an office on the south-end mezzanine. There are speakers suspended above the ice surface and ceiling-mounted in dressing rooms and other public areas.

Open device boxes and unsupported electrical devices.

2.2 The Goose Bay Curling Club

2.2.1 Site

a. Location

The Goose Bay Curling Club is located on Edmonton Street in the area of the former Royal Canadian Air Force Base. The site is approximately 1.0 hectare (2.5 acres) in area and the building is located with it's long axis parallel to the road, set back approximately 25 metres.

There is a gravel parking lot on the south side of the building that can accommodate approximately 40 vehicles. There are no designated barrier-free parking stalls.

There is a road or pathway around the back of the building that provides vehicle access to the mechanical room and a storage shed.

b. Site Services

There is no sign of any catch basins located in the parking lot and it appears as though storm water simply percolates through the gravel and sandy ground. Any surface water, during the course of a severe rain event, would likely run away from the building toward Edmonton Street or toward the vacant land on the north side. There is no ditching visible on the property.

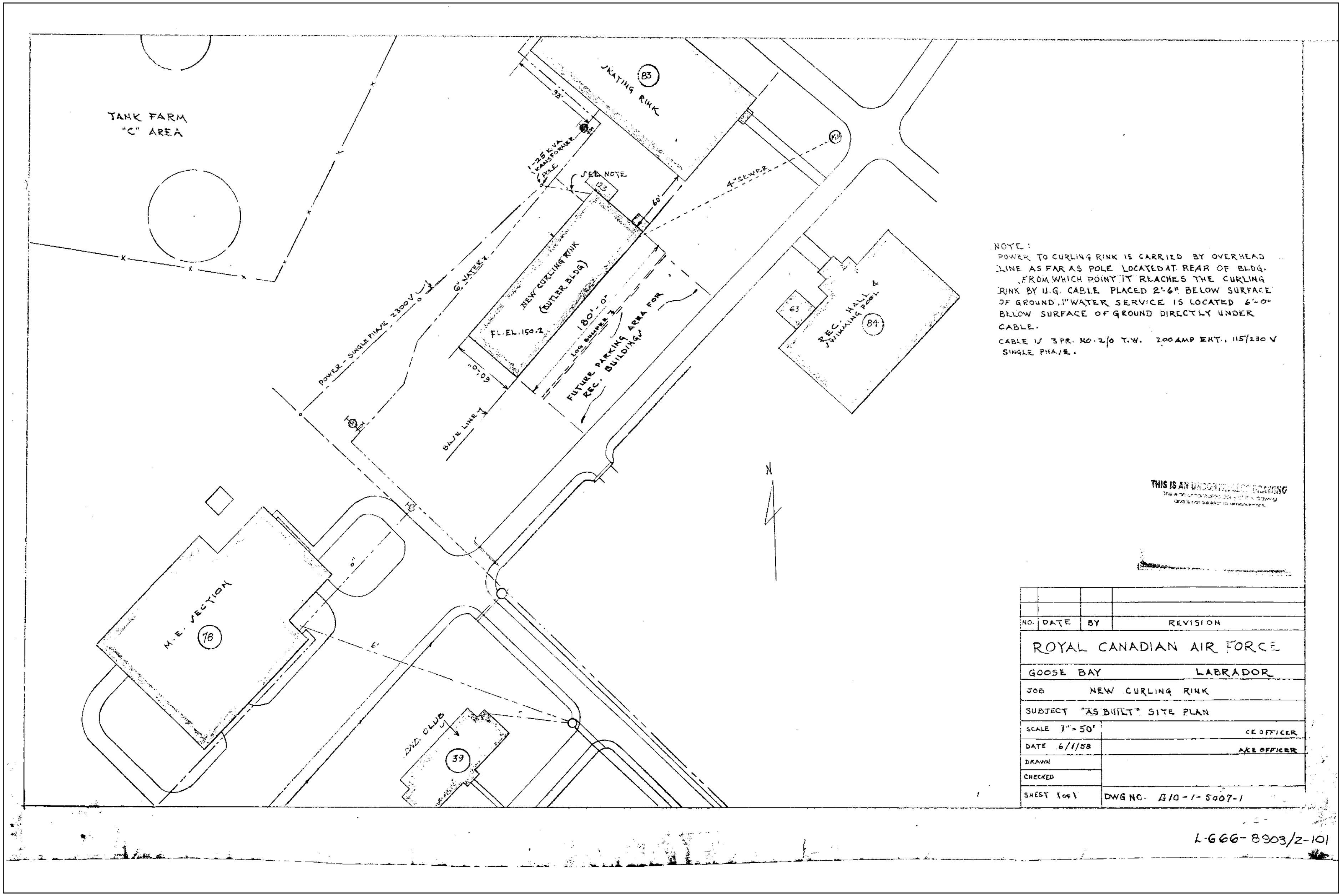
According to Royal Canadian Air Force drawings, the Curling Club is serviced by a 150 mm water main which travels along the north side of the building and a 25 mm service line enters the building at the northeast corner. A 100 mm sanitary sewer leaves the southeast corner of the building and heads toward a manhole at the intersection of Edmonton Street and Ottawa Avenue.

According to information supplied by the Town of Happy Valley - Goose Bay, there is also a sanitary line exiting the building midway along the north side and heading southwest toward Toronto Avenue. It could not be verified which of these sanitary lines is operational, but since the washrooms are all in the northeast end, it would seem as though that is the logical location for the pipe.

South elevation of Curling Club, CAF Arena in background.

Main entrance.

North elevation of Curling Club, CAF Arena in background.



RCAF Curling Club site plan, 1958.

2.2.2 Structural

a. Design and Construction Overview

The Goose Bay Curling Club is a 1950s-designed, pre-engineered steel structure on a perimeter concrete frost-wall foundation. The roof is supported by bowstring trusses which span a total of 18 metres across the building. The trusses bear on 205 mm W-section columns at either end and there are 150 mm steel pipe columns at mid span. It is unclear if the central pipe columns are original or if they were added at a later date. There have been several additions, both free-standing and lean-to, constructed over the years. All of these additions are wood framed with concrete foundations.

There is no concrete floor in the main building. The ice surface rests on a sand bed and the lounge area and associated spaces have a wood framed floor over an unfinished crawl space. The crawl space was inaccessible during the site investigation, so the condition of those members remains unknown. The mechanical room addition has a concrete floor, which is in poor condition.

b. Preliminary NBCC Evaluation

The exact construction date of the original building is unknown, but it does appear on a 1958 as-built site plan. Since no original design drawings are available, it can only be assumed that the building was designed to meet the minimum requirements for wind and snow loads in conformance with the contemporary edition of the National Building Code of Canada (NBCC). In order to confirm that all the existing structural members conform to Part 4 of the 2010 National Building Code of Canada, a complete structural analysis would be required. An undertaking of that magnitude is not standard industry practice for a building audit of this type. However, since individual members of the bowstring trusses exhibited signs of buckling, a detailed analysis of the truss's ability to resist live and dead loads as per the 2010 NBCC was completed.

Drawings were discovered for structural repair work in 1973 and 1980. The 1973 drawing details temporary wooden support structures to hold the roof purlins in place while the trusses are jacked-up and forged back into shape, which seems to suggest a partial collapse. Notes on that drawing also say that portions of the trusses will likely

1. Typical truss section with 1980 modifications.

2. Trusses with HSS tie-brace added in 1980.

3. Evidence of web-member buckling on a typical truss.

have to remain in a deflected state after the repairs. There is not enough information on the drawing to determine exactly where in the building the failure occurred. The 1980 drawings are more detailed and describe a reinforcement scheme for every bowstring truss as required to bring the 1950s design up to 1980 NBCC standards.

A visual inspection during this audit has determined that the 1980 repair strategy was indeed executed, albeit with some minor variations typical of actual constructed conditions versus design drawings. According to the drawings, the wooden floor of the lounge area was also reinforced at this time, but this has not been confirmed.

c. Field Investigation Notes

The structural inspection was visual and non-destructive in nature, which provided limited access, or in some cases no access, to the underlying structure. Only structural elements that were visible at the time of the review were inspected.

- Damage to several truss members was apparent after a visual inspection. Some compression members exhibit signs of buckling and other failures (images 3-5). This situation prompted a detailed analysis of the existing truss and its ability to resist expected snow loads.
- There is evidence of excessive movement or deflection at every exterior column location. Large vertical cracks in the wall finish indicate that movement in these locations has exceeded the finish's expansion and/or contraction limits (image 6). This could be the result of insufficient wind bracing or undersized columns or it could be the result of mechanical damage to the building. There does not appear to be any wind bracing located in the plane of the walls, though it may be covered.
- Damage to exterior siding panels (image 7) seems to indicate that snow may have been push up against the building at some time or that the weight of snow drifts against the walls may have transferred stresses into the columns.
- The connection between the perimeter columns and the trusses appear to be full moment connections (image 8) which could result in increased deflection in the column, especially if the column is under-designed.
- There was no access to the attic areas of the wood framed additions. It would be advisable to check the roof framing of these additions to ensure the trusses or rafters are sufficiently sized to resist expected snow loads.

4. Evidence of web-member buckling on a typical truss.

5. Web-member buckling on a typical truss near column.

d. Detailed Evaluation of Existing Trusses

(i) Methodology

Detailed drawings of the bowstring trusses were created for the 1980 repair project. These drawings identified which truss members were to be modified, what modifications were required and calculated loads for both the modified and unmodified truss members. These loads were tabulated and placed on the drawing for reference. A visual inspection during this building audit has determined, as best as possible, that all of the supplementary measures as detailed in the 1980 scheme appear to have been implemented.

Every truss is composed of 37 individual steel members that can be divided into 65 sections reacting to the various load cases. Since the truss is symmetrical, only half of these load cases needed to be analyzed – basically the portion of the truss from the exterior wall to the centre support. Using the load values and factors for Happy Valley – Goose Bay as required by Part 4 of the 2010 edition of the National Building Code of Canada, the live and dead loads were calculated for each individual member and thus an analysis was created for the complete bowstring truss. The resultant loads from the calculated analysis were entered into a table (opposite page) of a similar format to the one illustrated on the 1980 drawing. The 2010 loads were then compared to the 1980 loads and where there was an increase in loading, due to NBCC changes, the individual member in question was checked for adequacy.

(ii) Conclusions and Recommendations

Assuming that the modifications as per the 1980 repair strategy were implemented correctly (and it appears as though they were), the detailed analysis has concluded that the truss members are acceptable as per the requirements of the 2010 edition of the National Building Code of Canada.

It is impossible to be absolutely certain, but considering the notation on the 1973 drawing and the fact that further repairs were necessary in 1980, it is likely that the buckled truss members visible today predate the 1980 reinforcement. It was probably deemed unnecessary to remove and replace them at that time.

6. Typical wall finish cracking at columns.

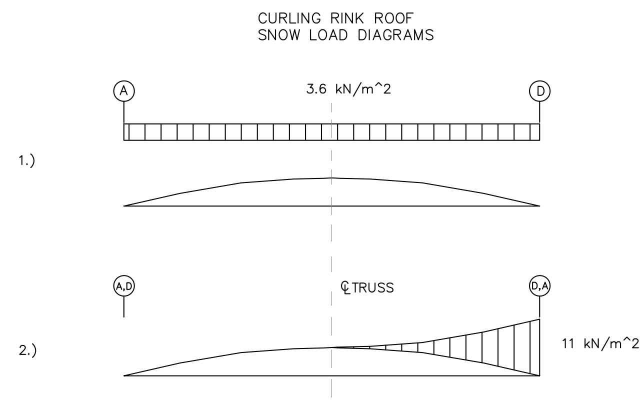
7. Damage to exterior cladding and wall support structure.

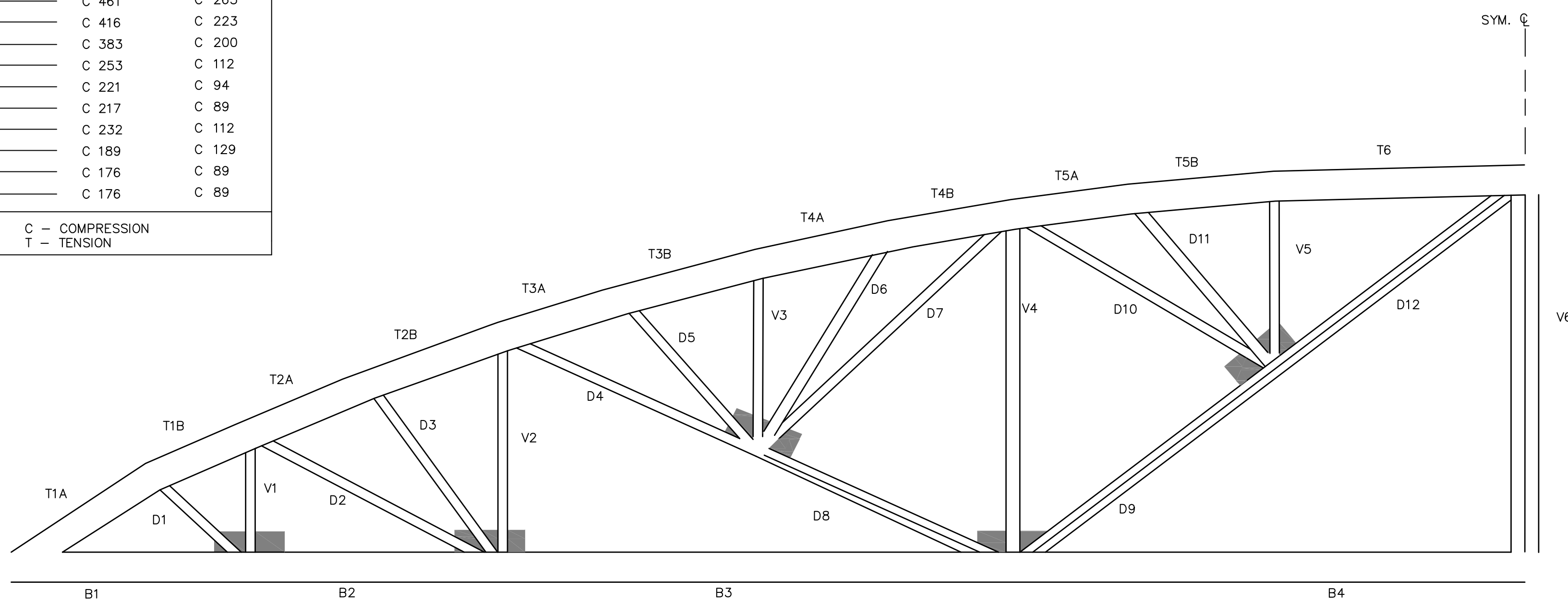
8. Typical 1980 moment connection at column and truss.

TRUSS FORCE TABLE

MEMBER	MAXIMUM LOAD 2014 DRAWING	MAXIMUM LOAD 1980 DRAWING
B1	T 280	T 267
B2	T 240	T 236
B3	T 190	T 187
B4	C 298	C 125
V1	T 9	T 23
V2	T 52	T 36
V3	C 35	C 18
V4	C 103	C 54
V5	C 38	C 23
V6	C 403	C 236
D1	T 13	C 40
D2	C 41	C 36
D3	C 41	C 36
D4	C 128	C 89
D5	C 41	C 27
D6	C 35	C 45
D7	T 89	T 72
D8	C 208	C 143
D9	T 293	T 192
D10	T 64	T 76
D11	C 70	C 63
D12	T 312	T 223
T1A	C 505	C 303
T1B	C 461	C 263
T2A	C 416	C 223
T2B	C 383	C 200
T3A	C 253	C 112
T3B	C 221	C 94
T4A	C 217	C 89
T4B	C 232	C 112
T5A	C 189	C 129
T5B	C 176	C 89
T6	C 176	C 89

C – COMPRESSION
T – TENSION





Detailed analysis of existing truss design (after 1980 modifications).

2.2.3 Architectural

a. Building Envelope

(i) Exterior Walls and Related

The various wall assemblies explained below have been determined based on site observations and an analysis of construction drawings acquired from CFB Goose Bay (former owners of the building) for a number of renovations between the years 1958 and 1984. The exact age of the building is uncertain, but it does appear on a 1958 as-built site plan labeled as *New Curling Rink*. It is also noted on this drawing that the building was supplied by the Butler Manufacturing Company, an American manufacturer of pre-engineered metal buildings.

Due to the age of the facility and the numerous additions and renovations to the building, the exterior wall construction varies. Without destructive testing, it is not possible to determine the condition of all exterior wall components. Therefore, the internal components of exterior wall assemblies may not be exactly as described in this report as it is possible that the assemblies were either altered from what was illustrated on the available drawings or that those drawings were based on incorrect assumptions.

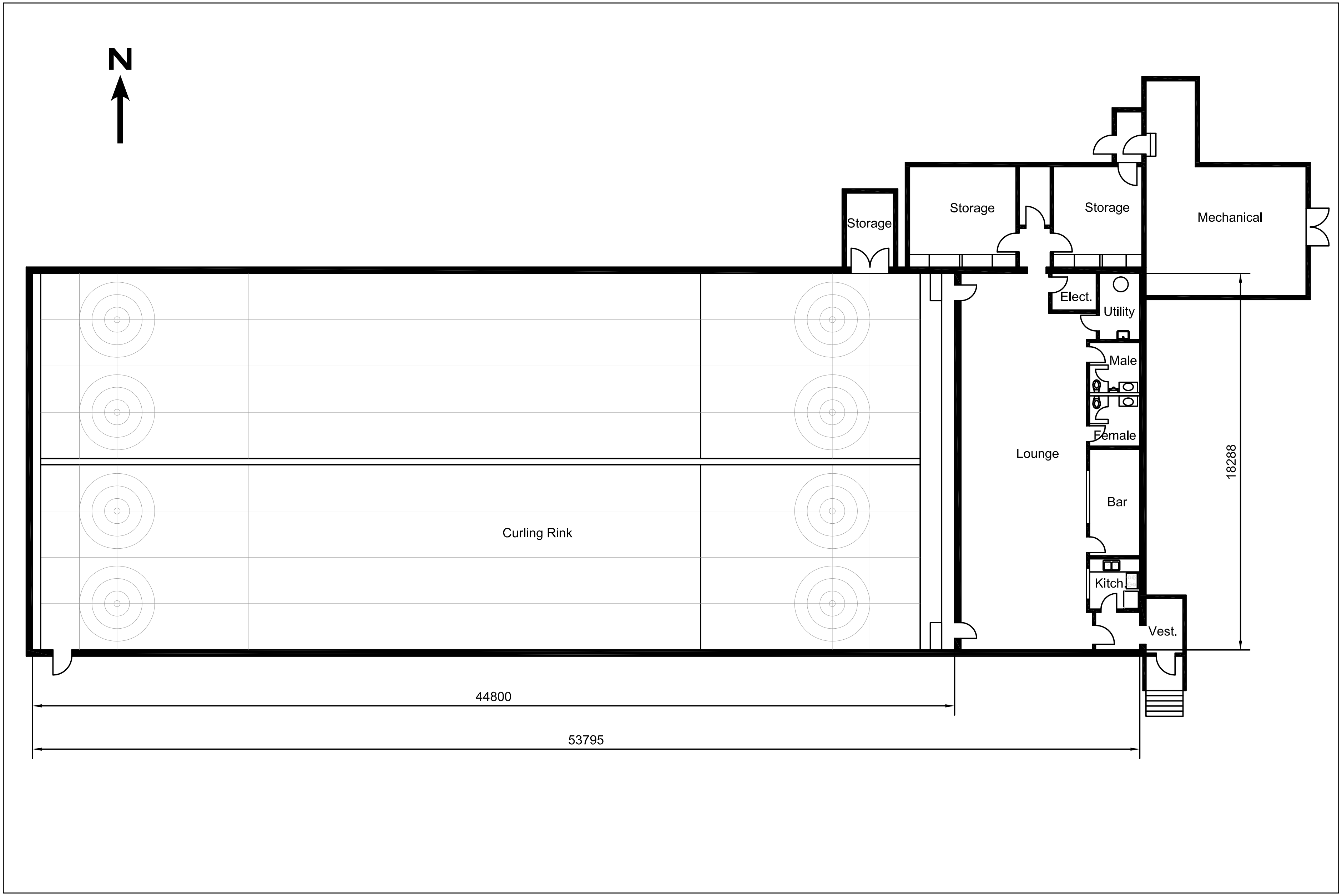
The exterior wall structure of the curling rink consists of light-gauge metal siding supported by 180 mm horizontal steel girts that are secured to 205 mm W-section columns. A wood framed wall of 38 x 89 mm studs, spaced at 406 mm on centre, is fixed to the girts, located to the immediate interior of the line formed by the column flanges. There may be plywood on the inside of the wood studs, but there does not appear to be any insulation in the original section of the wall.

Partial drawings from a 1965 renovation indicate that 50 x 50 mm furring was attached to the interior of the north and south walls of the ice rink area and the new cavity filled with 50 mm of batt insulation. A polyethylene vapour barrier and 9.5 mm gypsum board finish was also added. The drawings indicate *fire-proof* paint but this cannot be verified and it is doubtful that this was carried trough as a maintenance item. Also on the 1965 drawing, the west end wall is noted as remaining uninsulated to act as a *metal condensing wall*. Site investigations have determined that the interior

Rink area looking west.

Wall cladding and ceiling finish at southwest exit from rink.

West end wall. Note daylight visible through wall finish.

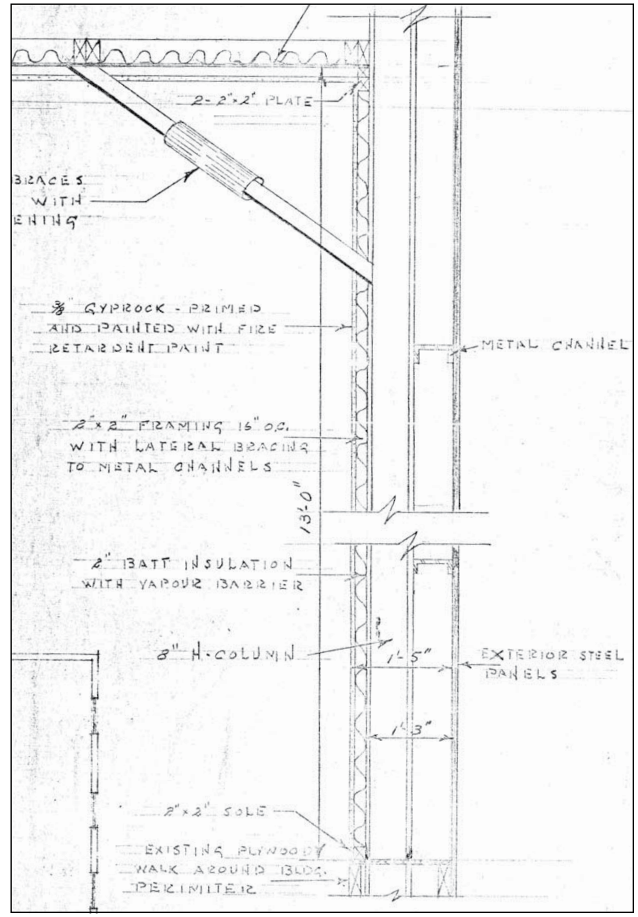


2014 As-built plan of the Curling Club, approximated from available drawings and site information.

of this wall has since been clad with plywood and though it is likely that the cavity was insulated, it could not be confirmed. A spray-applied mineral wool insulation has been applied to the back of the exterior siding panels at the upper portion of this wall.

The interior finish of the exterior walls exhibits vertical cracking at virtually every column location. This would seem to indicate structural movement either due to column deflection from roof loads or from wind gusts shaking the building.

The exterior steel siding panels are generally in very poor condition and well beyond their serviceable life. There is extensive evidence of buckling of the cladding on all sides, especially the south elevation near the main entrance. This has most likely been caused by pushing snow against the building or simply from the weight of accumulated snow bearing against the wall. It would seem as though there are an insufficient number of steel girts supporting the cladding. There have also been numerous patches made to the siding over the years.



Wall section from 1965 renovation drawings.

(ii) Roof Assembly

The roof is a barrel vault shape framed with light steel-angle bowstring trusses. The trusses support a standard steel deck and the exterior is finished with a corrugated metal roof. It is not known if any insulation exists within the cavity. Originally the building had insulation batts held in place, along the plane of the truss bottom chord, with suspended wood rafters and chicken wire. In 1965, 38 x 38 mm wood strapping and 9.5 mm gypsum board was added to cover this insulation. In 1989 the ceiling was removed exposing the trusses and metal deck. The deck was finished at that time with 38 mm of spray-on insulation and 12 mm of spray-on vapour barrier. The same finish was installed on the west gable end-wall. The spray insulation was likely an attempt to control an emissivity issue that would allow condensation on the steel to drip down onto the ice rink surface.


Spray-applied roof deck insulation and vapour barrier.

(iii) Free-Standing Additions and Lean-to Structures

Judging from the available drawings, it seems as though there was always a free-standing, wood-framed mechanical room just barely attached to the pre-engineered steel building's northeast corner. This building contained the ice plant that served both the curling club and the near-by CAF Arena. The mechanical room addition has a gable roof with asphalt shingles (in very poor condition) and possibly a vented attic space. Interior wall and ceiling surfaces of the mechanical room are entirely clad with what appears to be chrysotile asbestos cement board. There is a small lean-to shed attached to the mechanical room that was added between 1958 and 1962, which originally served as the entrance to the room. The door has since been boarded up.

According to the 1958 site plan, the main entrance was through a lean-to porch on the south edge of the east elevation. It appears the same on all available plans up to 1989. The current entrance porch appears to be somewhat larger and a canopy section was added to shelter the entrance door. Currently this addition is clad with asphalt shingles and horizontal vinyl siding. Six steps lead up to a small wooden deck outside of the entrance.

In 1984 a 3,000 mm x 2,400 mm lean-to ice maintenance shed was erected on the north side with a door to the interior rink area. This structure is framed with 38 x 89 mm wood studs and 38 x 140 mm wood rafters. The stud cavity is filled with batt insulation and the inside surfaces are finished with plywood. The roof is clad with asphalt shingles and the walls appear to have a wood-product composite siding material, such as *Color Loc*.

Since 1989 another wood framed, lean-to addition was built to house two locker rooms. This extension has its own lean-to porch that connects it to the original gable-roofed mechanical room. These additions have asphalt shingles and vinyl siding.

(iv) Windows and Doors

The original building had nine windows on each long side (north and south elevations) and two windows in the west end wall. These windows were approximately 1,625 mm wide x 1,270 mm high. In 1965 all but six of these widows were removed and replaced with galvanized sheet steel welded to the existing siding. In 1983, the two end-wall windows were removed and covered over and the remaining four were replaced with residential-style *Lockwood* casement windows. Since that time steel grilles have been added over the exterior to prevent forced entry.

It appears that the building only had two exterior doors when it was constructed: a single door at the main entrance; and a set of double doors at the opposite end of the

Wood window installed in 1983 with steel security grille.

Communicating door and steps from lounge to ice rink.

building in the ice rink area. The mechanical room addition had its own exterior entrance, but no connectivity with the curling club building. During renovations in 1983 another exterior door was added to the north side of the lounge area. Currently, the original exterior doors remain, except that the double door from the ice rink has been replaced with a single door and the 1983 exit door now leads to the lean-to locker room addition. The actual exit is located in the vestibule that connects the locker room extension with the mechanical room.

Exterior doors appear to be commercial grade steel doors, but interior doors are residential grade hollow-core wood doors with either a wood veneer or hardboard simulated panel finish. Residential hardware is typical on all doors except for exterior doors that feature panic hardware. The one exception is the door from the east locker room that leads thorough a vestibule to the mechanical room. This door is a 45 minute fire-rated, heavy-duty commercial steel door with commercial hardware. This door appears to be relatively new as it has not yet been painted. Unfortunately, it also appears to be installed backward, with the swing opposed to the direction of travel.

b. Interior Finishes and Millwork

(i) Partition Finishes

The partitions in the curling club are limited to the lounge area and various rooms that are immediately off the lounge including the kitchen, bar, washrooms, utility and storage rooms and locker rooms. These are almost certainly wood framed and are finished for the most part with gypsum board. In the washrooms, a resilient wall-cladding dado extends to a height of about 1200 mm above the finished floor. The rear vestibule is finished with *Masonite* residential wall board.

(ii) Ceiling Finishes

The main lounge is finished with a suspended acoustic tile ceiling in a T-bar grid. The tile is 610 x 1,220 mm format with a tegular edge, scored to give the impression of 300 mm sections. The washrooms, utility areas and the west locker room also have acoustic tile, but just the flat lay-in type. The east locker room has a gypsum board ceiling. All of these ceiling areas appear to have been installed recently and are in

Lounge area with bar (left) and canteen pass-throughs.

West locker room addition.

Typical washroom with vinyl flooring and wall dado.

good condition. There is no ceiling finish in the ice rink area and, as was mentioned previously, the mechanical room has a cement board ceiling which is suspected to contain chrysotile asbestos for reinforcement.

(iii) Floor Finishes

The floors throughout the lounge and the two locker rooms are carpeted. The lounge area has a commercial low-pile carpet while the locker rooms have a plush residential type. Both are showing signs of wear and are not suitable for this application.

The washrooms and canteen feature residential-quality vinyl sheet flooring. The (likely) original vinyl asbestos tiles are exposed in the utility room, leading to the possibility that a similar type of tile may be hidden beneath the current floor finishes elsewhere in the building.

The plant room has an exposed concrete floor that has been painted in the past but now is in very poor condition. The rear vestibule has no floor finish, the exposed plywood decking is unpainted.

(iv) Millwork and Equipment

There is very little millwork in this building. Both the bar and canteen operate as a pass-through service with laminate-covered wooden counters. The canteen cupboards are possibly original to the building and well beyond their serviceable life. The counter is a typical post-formed laminate top on particle board, applied to the original base cupboards, which have had their doors removed.

Vanities in the washroom are recently added off-the-shelf residential units with polymer tops and integral sinks. The toilet partitions are painted metal and are in reasonable condition. The kitchen equipment is residential quality and there were two glass-door beer coolers in the bar area.

The locker rooms feature banks of mismatched metal lockers of various sizes and colours. There is no benching, just an assortment of chairs. Both locker rooms also have door-less, built-in coat closets with metal rods and loose hangers.

Asbestos-containing floor tiles in janitor's room.

Canteen cupboards and residential equipment.

c. Conformance with Accessibility Regulations

The Goose Bay Curling Club has no provisions for handicap accessibility whatsoever. Since this building was constructed prior to 1981, when accessibility legislation was adopted by the province, and considering that it has not been substantially altered since that time, it is permitted to be nonconforming. It would, however, be desirable for a public facility such as this to accommodate persons with disabilities.

d. Fire and Life Safety Review

(i) Classification and General Compliance Issues

This building falls under the Group A or *Assembly* occupancy category of the National Building Code of Canada (NBCC), 2010 edition. Its Division is defined as *Arena Type* or Division 3. The building has a building area or footprint of approximately 1,180 m^2 and is of combined combustible and non-combustible construction. The building is a single-storey structure and is not sprinklered.

The building can be classified under 3.2.2.34 ***Group A, Division 3, One Storey***, which allows for combustible and non-combustible construction. There is a maximum building area limit of 1,250 m^2 if the building is facing two streets. Therefore, based on occupancy type and building area alone, the curling club is generally code compliant.

(ii) Exiting

Occupant loads for this facility are not large. The lounge has a maximum capacity of approximately 108 persons requiring 830 mm of exit width. This can be accomplished through a single door leading to the exterior, except that the NBCC requires an alternate means of egress.

The main entry doors, both the interior vestibule door and the exterior door, are fitted with door knobs. These doors do not comply with the requirements of exits from assembly occupancies as per NBCC article 3.3.2.7, which requires that all doors forming part of an exit have panic hardware.

View from lounge to exit door through east locker room.

New fire-rated door between locker room and vestibule.

The secondary means of egress from the lounge is through the east locker room then a vestibule which also leads to the mechanical room. There are numerous violations associated with this route:

- This egress route is not properly indicated with illuminated exit signs.
- The door from the lounge into the locker room swings in the direction of exit travel, but is not fitted with a panic hardware.
- The second door, from the locker room into the vestibule shared with the mechanical room, is fitted with a low-profile panic device but the door swing is in the wrong direction and therefore the panic set is mounted on the wrong side.
- The door from the mechanical room opens directly into the exit vestibule. Whereas the NBCC does not permit a *service room* to open directly into an exit.
- The actual exterior exit door is equipped with push-bar panic hardware but the door has been rendered inactive with a wood stud jammed behind the bar and against the frame. This situation should be rectified immediately.

(iii) Fire Separations

Both the National Building Code of Canada and the Mechanical Refrigeration Code, CSA-B52, requires that Class T machinery rooms (such as the ice-plant) be separated from the remainder of the building by a fire separation with a one-hour rating. It also requires that the mechanical room have at least one door that opens directly to the exterior and, where there is an interior door to the remainder of the building, that it open into a vestibule with self-closing, fire-rated doors.

It could not be determined if the wall between the mechanical room and the locker room is a one-hour rated assembly. It does appear that the new, unpainted steel door was added in an attempt to comply with the vestibule requirement of CSA-B52. The newly added door does have a 45 minute fire rating as required for a one-hour rated overall assembly.

The problem with this arrangement is that the vestibule satisfying the Mechanical Refrigeration Code cannot also serve as part of the required exit from the lounge area. As was mentioned above, the NBCC does not permit *service rooms* to open directly into an exit. There would have to be another fire-rated door inside the mechanical room for this vestibule to be compliant as an exit.

Exterior fire-exit door barred shut with wood plank.

Ice plant machinery in mechanical room.

2.2.4 Mechanical

a. Methodology and References

The objective of this report is to provide information on the current condition of the mechanical systems at the Goose Bay Curling Club and to review the systems with respect to code compliance, energy usage and maintenance issues. Recommendations for immediate and future improvements are also included.

This report describes the apparent condition of existing mechanical systems as observed during a site review. No detailed investigation has been completed related to the presence of hazardous substances, contaminants or pollutants.

There were no mechanical drawings available from the original building construction.

The following mechanical codes and standards were referenced during this study:

- ASHRAE 62.1-2007 Standard for Acceptable Indoor Air Quality
- ASHRAE 90.1-2007 Energy Standard for Buildings
- National Plumbing Code of Canada 2010
- National Building Code of Canada 2010
- CSA B52 Mechanical Refrigeration Code, 2010
- NFPA 10 Standard for Portable Fire Extinguishers

b. Heating, Ventilation and Air Conditioning Systems (HVAC)

(i) Heating and Cooling

The heating system at the curling club is all electric, either base board or ceiling mounted units, and thus falls under the scope of the electrical discipline. There are remnants of a hot-water or steam heating system, but it is completely disabled and most components have been removed. There are no air conditioning systems in the building.

(ii) General Ventilation

There is no ventilation in the facility. During the building audit, there was a pervasive highly unpleasant odour throughout the heated portions of the building. The source of this odour could not be determined but it may be from hydrocarbon contamination under the building, lubrication oil burning in the mechanical plant equipment or from a leak in the refrigeration system.

There is a single dehumidifier mounted on a ceiling-suspended platform at one end of the ice surface. It was difficult to determine if this unit was functioning correctly.

(iii) Exhaust Ventilation

There is limited exhaust from cabinet fans provided for the washrooms and the utility room. This system did not appear to be functioning and is in very poor condition.

The Mechanical Refrigeration Code, CSA-B52, requires that both a low-level continuous supply ventilation and a high-level exhaust system be installed in the machine room to prevent the possible build-up of ammonia gas. It appears as though some attempt was made to update the exhaust ventilation in the mechanical room, perhaps 10-15 years ago, but the system is very far from meeting the requirements of CSA-B52.

There does appear to be a detection system to activate the exhaust if an ammonia leak occurs, but its design is also noncompliant.

c. Domestic Plumbing Systems

The domestic plumbing system consists of sanitary drainage piping, domestic hot and cold water piping and associated plumbing fixtures. A 25 mm copper water entry is located in the mechanical room. The domestic water is distributed throughout the building by copper lines of various sizes, some of which are insulated. Hot water for plumbing fixtures in generated by a single residential-quality hot water heater, which appears to near the end of its useful service life. Lavatories are vanity mounted units with manually operated faucets.

Sanitary drainage is conveyed from the building by a 100 mm line which exits the building adjacent to the main entrance. All water closets in the building are floor-mounted vitreous china.

With the exception of washroom fixtures, most all components of the plumbing system are old and in poor condition. Leaks would be likely occurring for a system of this age, which has reached the end of its service life.

d. Refrigeration System

The ice plant appears to be original to the facility, though some components have been replaced and upgraded throughout the years. The ammonia refrigeration system is located in the mechanical room addition and has a rated capacity of 100 tons. The system operates by feeding ammonia gas into two single-stage reciprocating compressors powered by electric motors.

The ammonia gas is first sent at high pressure to an oil separator then on to the exterior evaporative condensing unit. Liquid ammonia flows back inside the building through the refrigerant float valve to the low pressure side of the system and to the surge drum. From here the ammonia enters a plate-and-frame chiller where it cools the brine solution as it boils to a gas. The ammonia gas is then drawn back into the compressor through the top of the surge drum, forming a continuous cycle.

The brine solution is pumped by centrifugal pump through the chiller and then out through the piping underneath the ice pad. It returns to the suction header inside the mechanical room where there are connections to a brine tank and a heating unit. Cooling for the compressors and condenser are supplied by a closed-loop water system.

Dehumidifier unit in rink area.

Ammonia tank with evidence of structural testing.

This system is controlled by an outdated *Cimco* control panel. The system monitors the temperature of brine in the piping header and starts the compressors in a lead-lag arrangement. The cooling water pump is interlocked with the compressors and the brine circulation pump runs continuously with a manual switch.

The mechanical room system was originally sized to provide the refrigeration for the curling ice pad and the nearby CAF Arena. It is thus oversized for the curling pad alone. This is resulting in high startup costs and demand charges that are not necessary and would be eliminated if the plant were sized for the curling rink alone.

The refrigeration plant, the brine piping system and the control system are all in very poor condition and cannot be expected to last much longer without causing major problems. In fact, in February of 2014 Service NL's Boiler and Pressure Vessel Division issued directives to the Goose Bay Curling Club to replace several pressure vessels in the plant due to corrosion and structural degradation.

e. Building Management and Control Systems

There are no distributed digital control (DDC) or energy management and control (EMCS) systems currently installed in the facility. Considering the generally substandard condition of all systems in the building, installation of a control system is not recommended unless there were to be a complete building retrofit and renewal.

f. Fire Protection

The Curling Club does not have a sprinkler system or any other built-in means to fight fires (standpipe, hose cabinets, etc.). As was discussed in the architectural section, a building of this configuration and occupancy does not require a sprinkler system. There are some fire extinguishers located in the building, but they are not distributed to ensure proper coverage as per NFPA 10.

In the canteen area there is only a residential re-circulating range hood above a typical residential-quality range/oven combination. The Fire Commissioner's office would likely require that a NFPA approved stainless steel exhaust hood with integral fire suppression be installed for continued operation of the canteen.

Severely corroded piping, likely associated with CAF Arena.

Hot water heater and associated piping.

Un-vented residential hood in canteen area.

2.2.5 Electrical

This report describes the apparent condition of existing electrical systems as observed during a site review.

a. Service and Distribution

(i) Main Electrical Service

Electrical power is supplied to the building by three separate overhead services. All three are owned by Newfoundland and Labrador Hydro. The services are rated 120/208 volt, three phase and 347/600 volt, three phase, 4 wire.

The main electrical room is being used for storage, which is contrary to Code and fire safety regulations. The main service entrance is rated 400 amps, 120/208 volt, 3 phase, 4 wire and is comprised of a single section service entrance board complete with a 400 amp, three pole main circuit breaker. The service entrance board is manufactured by *Federal Pioneer*, appears to be fairly new and is in good condition. The board feeds multiple older distribution panels and mechanical equipment located throughout the facility. The older distribution equipment is manufactured by *Square D*. The maximum peak demand of each of the utility meters is: number P71213 – 82.0 kilowatts; number P71025 – no demand; number P34524 – 43.2 kilowatts.

(ii) 120/208 V Distribution

The secondary 120/208 volt distribution panels are located throughout the building. The original panel boards are approximately 40 years old whereas the newer ones are approximately 10 years old. The panel boards were manufactured by various companies with nameplates from A*malgamated Electric, Westinghouse, Cutler-Hammer, Federal Pioneer*, and *Square D*.

During the assessment, the following items were observed:

- The 120/208 volt distribution is in poor condition. The trip accuracy of the original breakers is questionable.
- General wiring types include RW90, Teck, AC90, NMD, R60, and TW wiring used as conductors.

Transformers and service entrances.

Items stored in main electrical room.

- There are no spare circuit breakers in the original branch panel boards and replacement circuit breakers are no longer available.
- There is no surge suppression equipment installed within the main distribution.
- Some of the panel board door locks and hardware are damaged, preventing the doors from closing.
- Several panels do not have a ground bus installed.
- Many panel boards are not identified and their directories are either missing or do not have current information.
- Exit and emergency lighting branch circuit breakers to not have lock-on devices.
- All power conductors should be color coded as per the Canadian Electrical Code requirements.
- Original panel board enclosures require cleaning (dust and debris).
- There are covers missing on several junction boxes.

If a major renovation of the curling club is considered, most all of the secondary 120/208 volt distribution equipment original to the building would have to be replaced in order to rectify the issues noted above.

b. Grounding and Bonding System

The main ground conductor is sized adequately and there appears to be a ground connection to the water main, but it could not be determined if it was connected to the distribution system. Also, no external ground bus could be located in the electrical room.

During the assessment, the following additional items were observed:

- Several branch circuit panel boards do not have a ground bus installed.
- Several duplex receptacles that were inspected are not bonded to ground.
- No information could be determined regarding the presence of exterior ground rods.

For continued use, bonding conductors should be installed to all electrical equipment throughout the building and all devices should be properly grounded. In addition, a new external ground bus must be installed within all electrical rooms and new external ground rods complete with new wiring should be installed.

c. Lighting Systems

(i) General Interior

There are two main types of interior lighting in the facility: high-bay metal halide over the ice surface and T12 fluorescent lighting in the remainder of the building. The high-bay metal halide lighting appears to be in fair condition. All lights are in working order with a good lighting distribution and very little shadow cast onto the ice surface. The fluorescent lighting is comprised of 305 x 1,220 mm surface mounted fixtures, 610 x 1,220 mm recessed fixtures or strip lighting fixtures within the mechanical and other service rooms. There are also some incandescent pot-lights.

The interior lighting systems remain serviceable, though if a major refit of electrical systems is considered, it would be advisable to replace the incandescent pot lights and the older T12 fixtures with new, energy efficient compact fluorescent and T8 fixtures.

During the assessment, the following additional items were observed:

- Strip lighting in the mechanical rooms is missing wire guards.
- There were damaged lens the locker rooms.

- The lighting level in the mechanical room was very low and needs to be increased to meet Illuminating Engineering Society (IES) standards.

(ii) General Exterior

The exterior building lighting consists of metal halide wall packs distributed along the east elevation. Most of the exterior fixtures are in very poor condition. The light levels in the parking lot do not meet IES standards.

The exterior lighting fixtures are well beyond their serviceable life and should be replaced with energy efficient and long-lasting LED fixtures if the facility is intended for continued use.

(iii) Emergency Lighting

Emergency lighting is provided by individual 12 volt DC battery units with remote heads located throughout the building. Many of the individual units are equipped with two emergency heads. The branch circuits for emergency lighting do not have adequate lock-on devices and it is unlikely that battery life will meet current standards.

The number and location of remote heads is inadequate and consequently the emergency lighting illumination levels throughout the building do not meet National Building Code requirements. Additionally, many of the units that were tested during this review were not working.

In general, the emergency lighting system requires a complete retrofit and a reevaluation of the quantity and distribution of fixtures to meet the current Code. New units are to have a minimum battery life of 90 minutes.

(iv) Exit Lighting

What exit lighting does exist throughout the facility is an older incandescent type. Exit lights are not located in all areas requiring such signage as per National Building Code regulation. Very few exit doors have lights. Any new exit signage should be LED.

d. Heating Systems

The main source of heat for the building is electric baseboard convectors with line-voltage room thermostats. There are also ceiling mounted unit heaters with fans. The convectors and unit heaters appear to be in reasonable condition.

During the assessment, the following items were observed:

- The temperature control for most rooms was not working properly.
- Some of the baseboard heaters exhibited mechanical damage and were filled with dust and debris.

For continued operation of the facility all heaters should be thoroughly cleaned and damaged units replaced. New low-voltage thermostats and solid-state heater relays should also be installed to provide more accurate control of heat levels.

e. Wiring Devices

Generally, all receptacles are the U-ground type, rated 15 amp, 120 volt and light switches are rated 15 amp, 120 volt.

The number of receptacles installed in most rooms is inadequate. Many receptacles are cracked and worn and should be replaced. There are no ground-fault interrupter (GFI) circuit breakers installed and no GFI receptacles installed near sinks or other water sources, as is required by the Canadian Electrical Code. Many of the receptacles that were inspected did not have the bonding conductor installed.

As with the receptacles, many of the toggle switches in the original building are worn, without cover plates and in need of replacement. Some switches do not have the bonding conductor installed and should be rewired with RW90 wire in conduit.

f. Wiring Method

There is a variety of wiring methods employed in the building. There is RW90 in conduit, TECK, AC90, NMD, R60 in conduit and TW wiring used as conductors in conduit. Generally, the wiring is in poor condition.

During the assessment, the following items were observed:

- Some of the wiring is run in an untidy fashion and is not adequately secured or supported.
- The R60 rated conductors are comprised of a rubber based insulation which becomes brittle with age and flakes off the conductor.
- TW wiring is not rated as conductor cables.
- All power conductors are not color coded as per Canadian Electrical Code.
- The wiring in the mechanical room is haphazard with unsecured conduits, open junction boxes, exposed terminations and splices outside of junction boxes.

It is imperative that R60 and TW rated conductors be replaced with RW90 rated conductors. The existing wiring has deteriorated and presents a high risk of shorting or arcing. In addition, all junction boxes require covers and all cable and conduit needs to be properly anchored or otherwise supported. Power conductors should also be colour coded.

g. Fire Alarm System

There is no fire alarm system installed at the Goose Bay Curling Club.

Service entrance and distribution in mechanical room.

Open junction box with exposed conductors.

Typical metal halide high-bay light in ice rink area.

Happy Valley Goose Bay LABRADOR, CANADA

2.3 The Labrador Training Centre

2.3.1 Site

a. Location

The Labrador Training Centre is located on the corner of Edmonton Street and Ottawa Avenue in the area of the former Royal Canadian Air Force Base. The site is approximately 0.4 hectares (1 acre) in area and the building is located with it's long axis parallel to Edmonton Street, set back approximately 18 metres.

There is a gravel parking lot on the north side of the building that can accommodate approximately 30 vehicles. There are no designated barrier-free parking stalls.

b. Site Services

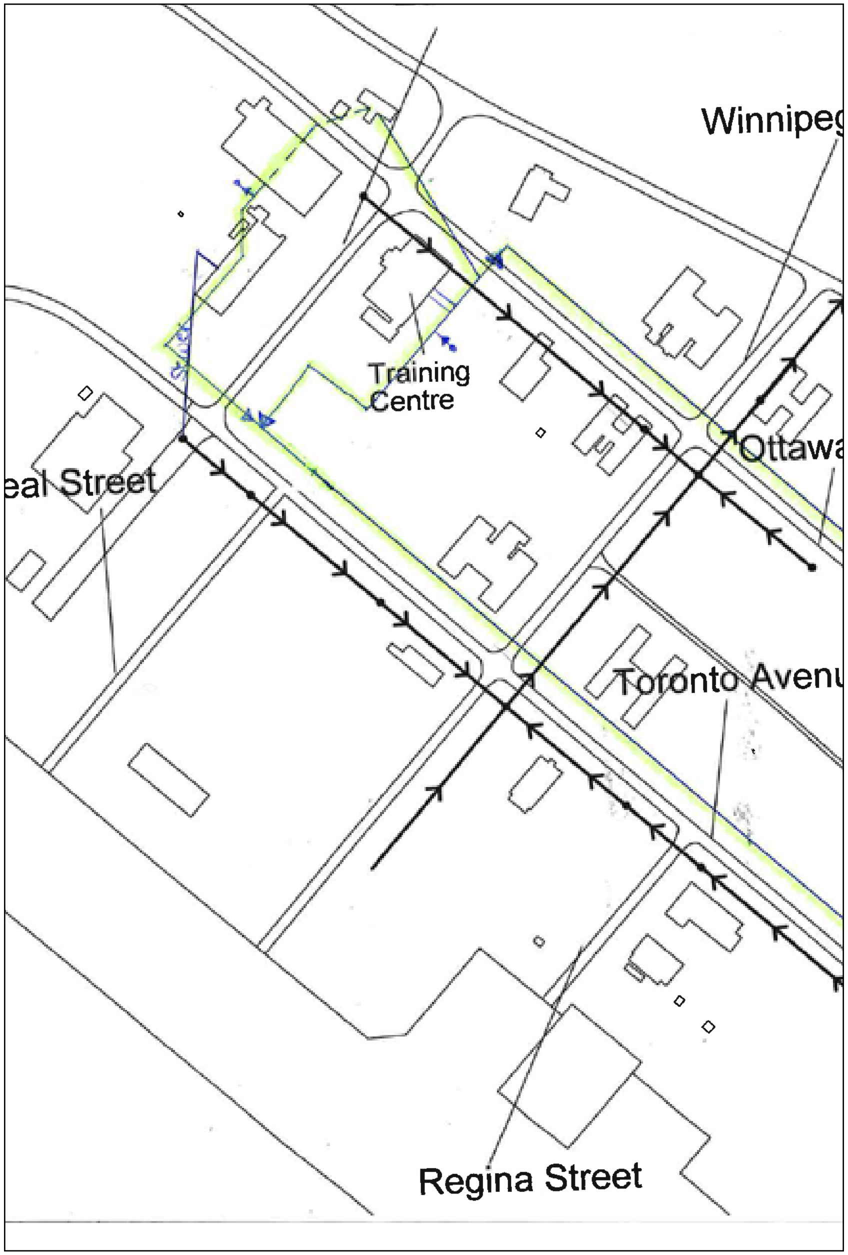
There does not appear to be any catch basins located in the parking lot. It is likely that storm water simply percolates through the gravel and into the ground. Any surface water, during the course of a severe rain event, would likely run away from the building, toward Edmonton Street. There is no ditching visible on the property.

According to information provided by the Town, there is a water main that travels along the north and east side of the building and it appears as though a 50 mm line enters the building in the pool mechanical room. The sanitary sewer is conveyed from the building through a 150 mm line that connects into the municipal services at the northeast corner of the building.

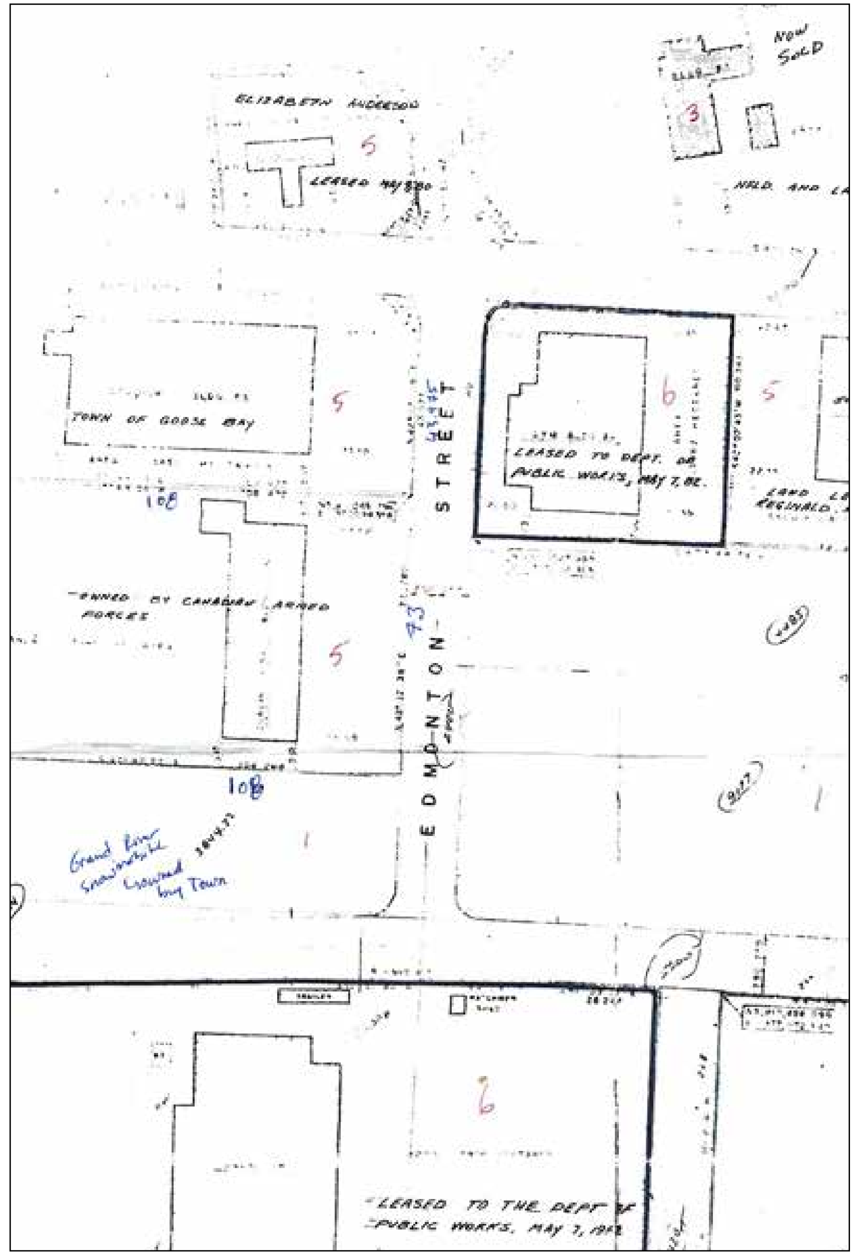
A secondary sanitary sewer line is dedicated to the swimming pool drainage. It leaves the northeast side of the building and travels across Ottawa Avenue then Hamilton River Road and drains into a forested area where the grade is considerably lower than the bottom of the pool. The dumping of large amounts of chlorinated water into a natural watercourse is generally prohibited by the provincial department of Environment and Conservation. It is unknown if special permission was granted for this facility.

View of the site from the southwest.

Parking lot on the west side, adjacent to the main entrance.



Site services plan from HVGB. Yellow line is water, black line/arrows are sanitary.



North side boundary plan circa mid-1980s. Training Centre is lot 6.

2.3.2 Structural

a. Design and Construction Overview

The Labrador Training Centre has an early type of pre-engineered structural steel frame comprised of non-conventional steel columns, a steel truss system and X-shaped wind bracing that spans multiple bays. The columns are constructed of parallel steel channels facing each other and connected by short horizontal and diagonal braces, basically creating small vertical trusses, much like a typical radio tower. The roof trusses span approximately 27.5 metres to every column and are a *Howe* style design with diagonals sloping toward the centre. They are fabricated from back-to-back angles and channels. Spanning perpendicular to each main roof truss are numerous shallow joists in the form of *Queen Post* trusses which support the roof cladding.

There is a second and third floor mezzanine between the pool and gymnasium areas that appears to be a combination of steel beams and wood floor framing. The level 2 HVAC room appears to have a wooden mill floor (solid joists on end) with concrete topping. The ground floor and the basement floor is a concrete slab on grade. There is a suspended concrete slab supporting the pool deck and the pool walls and floor are also reinforced concrete.

In order to confirm that all the existing steel, concrete and wood members conform to Part 4 of the National Building Code of Canada 2010, a complete structural analysis would be required. An undertaking of that magnitude is considered beyond the scope of this report and is not standard industry practice for a building audit, unless the visual inspection were to reveal any obvious deficiencies.

There are no original drawings for this building. It appears on a 1958 site plan of the area and was likely built during that decade. It can only be assumed that the building was designed to resist wind and snow loads in conformance with the contemporary edition of the National Building Code of Canada (NBCC).

b. Preliminary NBCC Evaluation

The requirements of building structures to resist various load cases has changed over the years as updated building codes and standards have evolved. The struc-

Typical perimeter columns.

Typical bracing detail.

tural design criteria from the 1953 National Building Code of Canada was compared to the requirements of the 2010 version of the NBCC to determine if the changes would warrant a detailed analysis of the building's structural members or connections. Considering the limited access to some structural elements due to the non-destructive nature of this audit, this method of comparative Code analysis is an acceptable means to provide a clear understanding of the ability of the existing structure to resist loads.

In the 1950s roof snow loads were calculated as being the same value as the weight of snow on the ground with no allowance for drifting at roof obstructions or intersections. The snow loading for Goose Bay as per the 1953 version of the NBCC was approximately 90 pounds per square foot or 4.3 kPa. The snow load from the 2010 NBCC is 4.32 kPa. This is not a significant change. If the original structure was in conformance with the 1953 Code, the building should be able to resist all reasonable snow load events.

There is no information readily available for design wind loads in Goose Bay during the 1950s. However, the building does appear to have a well-designed wind bracing system in the plane of the exterior walls.

c. Field Investigation Notes

The structural inspection was visual and non-destructive in nature, which provided limited access, or in some cases no access, to the underlying structure. Only structural elements that were visible at the time of the audit were inspected.

- There is no visible sign of deterioration or failure in any of the existing steel components that were accessible to view.
- The floor of the mezzanine HVAC room appeared to have a concrete topping installed on top of wood decking. The concrete topping is generally in poor condition and the floor system as a whole should be examined in more detail.
- In the stair down to the pool mechanical room there are some exposed steel beams that are supporting the floor above. A fair amount of moisture had condensed on the steel which will eventually cause corrosion, though the amount present at this time does not pose an immediate hazard.


Typical roof trusses and purlins.


HVAC room floor, concrete topping over wood mill floor.

Steel beams supporting part of the level 2 mezzanine floor.

2.3.3 Architectural

a. Building Envelope

(i) Exterior Walls and Related

The exterior wall constructions explained below have been determined based on site observations. There were no drawings available from the original building construction but some drawings from a 2003 re-cladding project were available. Due to the age of the facility and the obvious renovations to the building over time, it is not possible to determine the condition of all exterior wall components without destructive testing. Therefore, the internal components of exterior wall assemblies may not be exactly as described in this report.

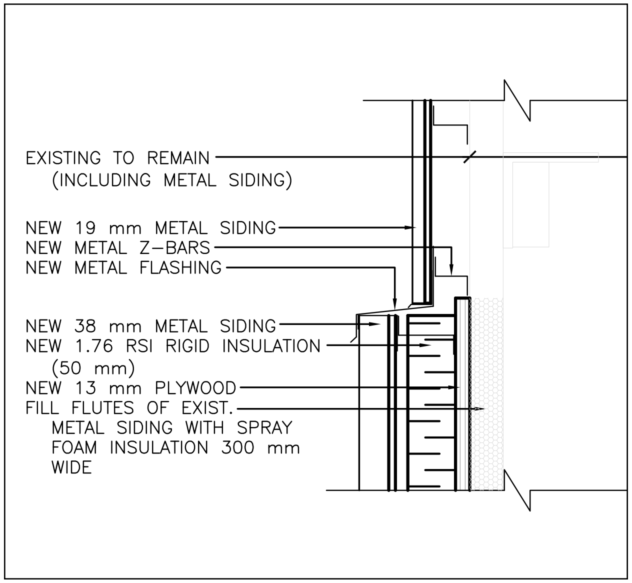
The building does not conform to a typical modern pre-engineered building, like the Broomfield Arena, but it has numerous attributes that are associated with that building form. A propriety design for the exterior columns, trusses and purlins is evident and their location on a regular grid allow for significant interior spans. It is reasonable to assume that the exterior wall structure is comprised of horizontal girts or purlins consistent with the angle braces that appear on the end-wall columns and the exposed girts that are visible in the attic on gable end walls. Also, the nearby CAF arena appears to have the exact same structural system as the Training Centre and horizontal girts are visible in the exterior walls of the arena.

Vertical metal siding would have been secured directly to these girts. Originally, blanket insulation, perhaps no more than 50 mm, complete with an integral vapour barrier and wire mesh covering would have been installed. This would be held in place by compressing it between the girts and the siding.

The building was re-sided in 2003. Issued for review drawings by Facilities Design Group Inc. for that project indicate that spray foam was applied to the exterior walls then a layer of 13 mm plywood, then 50 mm of rigid foam insulation between new horizontal Z-girts to support the new siding. This entire assembly was installed over the original metal siding. The insulation upgrade has not been confirmed for this report, but there has obviously been a new siding installation dating from about that time.

The interior side of exterior walls in the building are finished with a variety of materi-

View of the gymnasium exterior walls.



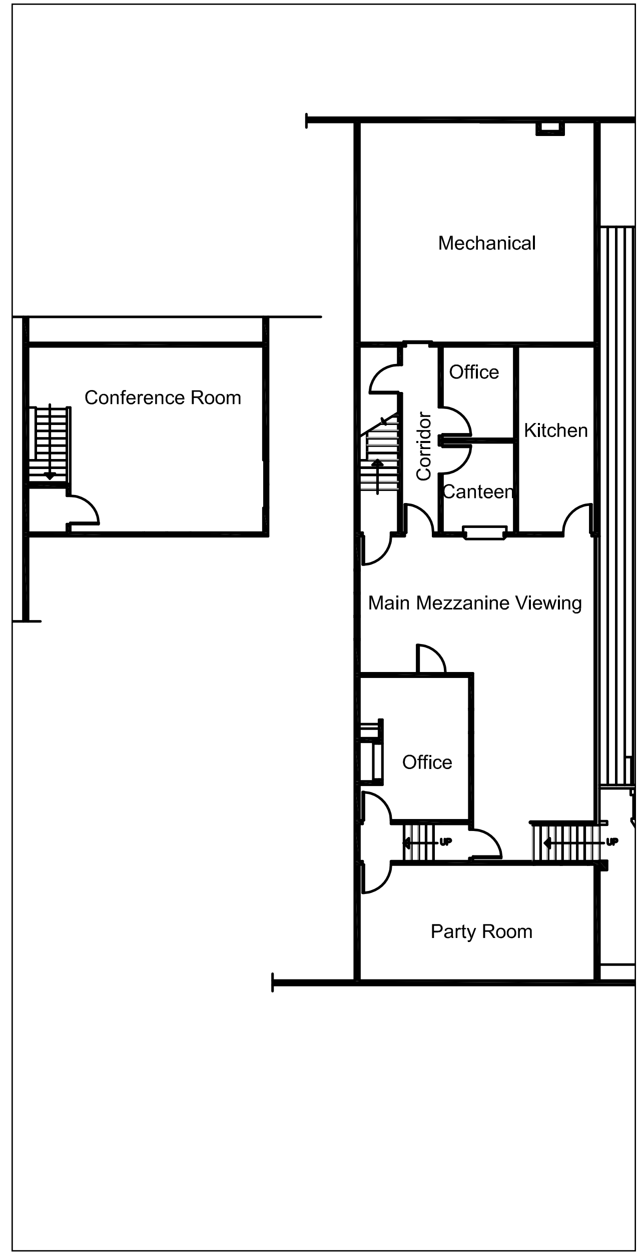
Detail from the 2003 re-siding tender drawings.

als. In the gymnasium, there is a robust surface, likely plywood or hardboard. Elsewhere gypsum board has been used and in mechanical areas there is limited use of cement board, which is suspected to have asbestos as a binder. In the pool area, the lower portion of the exterior walls are finished with ceramic tile. The walls are furred with wood studs and the tile substrate is likely to be plywood or paperless gypsum board. It is not known to what extent thermal upgrading was performed when the stud walls were erected. The upper portion of the exterior walls in the pool area have fabric drapery on pressure-treated wood frames covering what appears to be a combination of exposed air and air/vapour barrier materials.

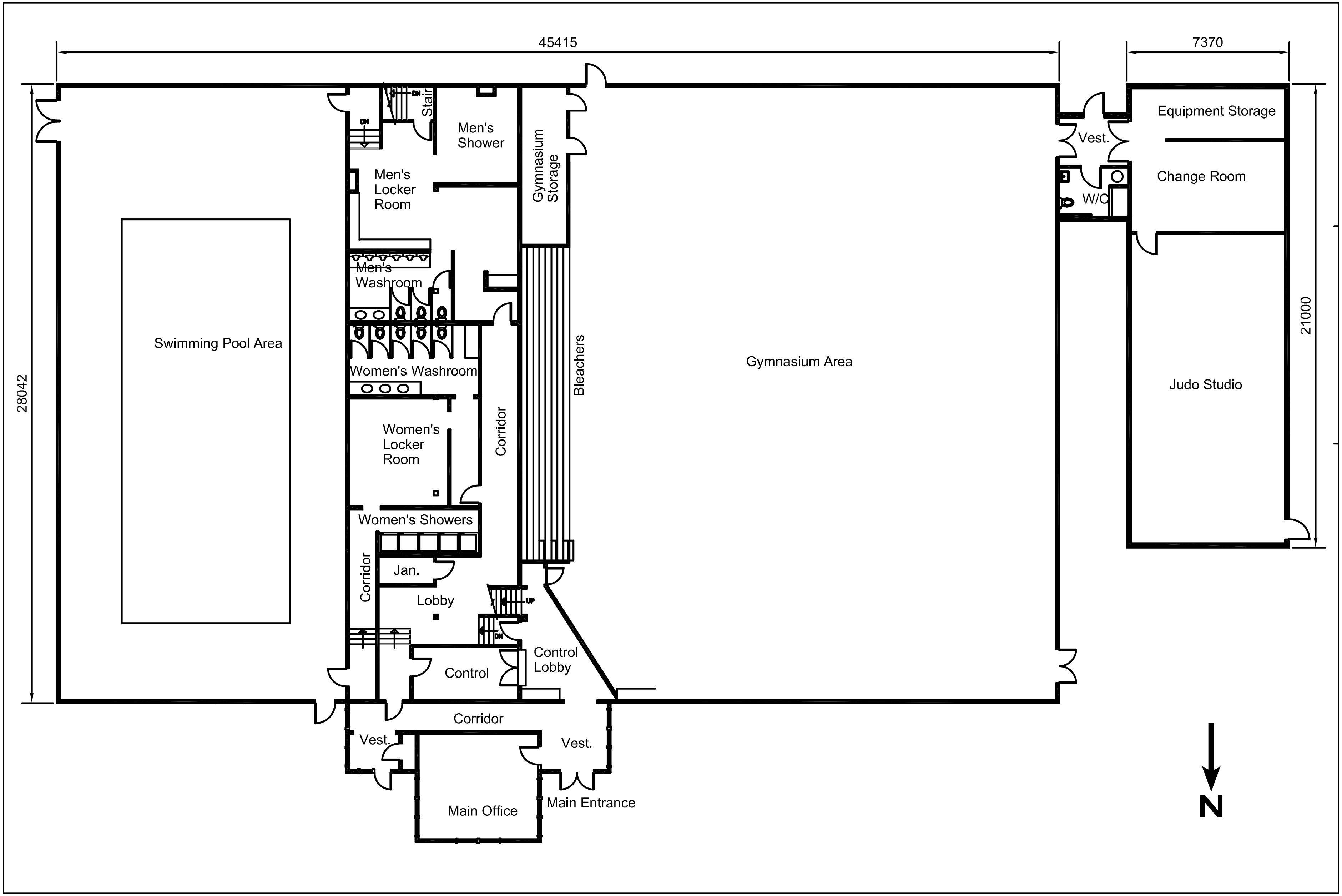
(ii) Roof Assembly

The roof structure for the main building is comprised of a dual pitch truss made up of light steel angles and top chords of back-to-back channels. The nodes have bolted gusset plates. These trusses span the shorter dimension of the rectangular building with lightweight open-web steel purlins supporting a galvanized steel deck. The exterior surface of the roof is a metal cladding product that appears to exhibit considerable degree of corrosion. Generally, the exterior roofing panels are secured to light-metal Z-bars, which are in turn secured to the galvanized metal deck. Insulation typically fills the cavity. Sometimes the exterior roofing panels are secured directly to the purlins. It is difficult to ascertain what exact method is employed at the Labrador Training Centre.

The interior space formed by this truss configuration is an uninsulated, ventilated attic with wood joists supporting the ceiling below. Over the majority of the ceiling area a double layer of fibre glass batt insulation has been installed, each layer 150-200 mm thick. Their also appears to be an original layer of vermiculite or cellulose loose-fill insulation of varying thickness under the fibre glass. The first layer of fibre glass is located between ceiling joists that span perpendicular to the trusses. The second layer has been laid above this. The general application is not consistent and has suffered from displacement where services required access over the years. In addition, an unacceptable amount of debris was noted distributed on top of and within the insulation. The ceiling finishes, typically gypsum board or plywood, have been attached to the wood ceiling joists. It is not known if furring/strapping was used and there does not appear to be a vapour barrier over the gym area.



First and second mezzanine level plans.



Main floor (gym and pool deck) and lower change room level plan.

SHEPPARD CASE ARCHITECTS INC

There are major problems with vapour penetration of the ceiling assembly over the pool area. In an attempt to remedy the issue of vapour penetration and consequent condensation within the attic space, a number of *band-aid* solutions have been applied. From the exterior, the excessive amount of ventilators (approximately 20 on the roof-top and 10 in the gable ends) is immediately noticeable. These were most likely added to increase air flow in the attic in an attempt to lower the humidity and reduce condensation. In the attic space a curtain of spun polyolefin air barrier (Tyvek) has been added to create an environmental separation between the pool side of the building and the remaining area. This curtain, unfortunately, also serves to limit cross ventilation and greatly lowers the effectiveness of the ventilators.

Above the suspended ceiling of the pool there appears to be self-adhered air/vapour barrier membrane affixed to a rigid substrate at the underside of the roof trusses. This is the most logical attempt at trying to prevent vapour penetration through to the attic. It was not possible to determine the continuity of the air/vapour barrier. In the attic space there is a layer of polyethylene vapour barrier installed over the cold side of the insulation. This strategy defies basic building science and will only cause moisture build-up within the insulation and may lead to corrosion of the lower chord of the steel roof truss. It is suspected that the polyethlene was added to the top of the insulation to catch condensate that is dripping down from the structure and roof deck above when the temperature in the attic is above freezing.

During the site review, most surfaces in the attic space over the pool area were coated in frost, up to 25 mm deep in some areas. There was also evidence of snow ingress through the gable-end goose-neck ventilators. Once outdoor temperatures rise above freezing, the frost will undoubtably melt and a considerable amount of water will fall onto the ceiling below.

(iii) Additions and Extensions

There are two additional one-storey structures, besides the main rectangular steel-framed building, that comprise the Labrador Training Centre. The entrance vestibule and main office is contained in a lean-to structure on the northwest side of the building, aligned with the interior mezzanine area. Judging from the 1958 RCAF site plan of the area, this structure is original to the building. There is another lean-to structure

Swimming pool area with suspended ceiling and drapery.

Attic space over gymnasium with Tyvek divider curtain.

Frost on pool side of divider curtain.

of unknown purpose illustrated on the 1958 plan. It is connected to the same side of the building, approximately midway along the gymnasium wall. This structure has since been demolished.

On the southwest side, connected to the main building by a short corridor, is a free-standing building housing the Judo club. This building appears to be a pre-fabricated, wood-framed portable structure commonly know as a double-wide trailer. Due to the snow conditions it was not possible to determine if this addition has a permanent foundation or if it is supported on blocks or jack-stands with skirting boards.

(iv) Windows and Doors

Exterior windows and doors are limited to the front entrance area and a window provided immediately above that provides natural light to the party room on the mezzanine. The strip windows specific to the front entry vestibule have one in three as operable awnings. These commercial aluminum windows are in good condition and they appear to have been installed as part of the re-cladding project of 2003. The window in the party room is a horizontal slider and may be of the residential vinyl variety. The interior wall surface below the party room window exhibits signs of water ingress either from the window itself or the connection between the wall and the window.

The entrance doors are similar to the windows in that they are a relatively recent installation. They are commercial grade aluminum doors and sidelites fitted with heavy-duty hardware. Emergency exit doors have also been outfitted with heavy-duty commercial hardware. These are typically insulated steel doors and are in good condition with the notable exception of the emergency exit doors from the pool area. These doors are subject to severe condensation and frosting up during the winter. This will obviously be an on-going maintenance problem and will ultimately lead to premature failure of the doors. In a cold climate like Labrador, there should be a heated vestibule between the pool enclosure and the exterior environment. Precautions should be taken to ensure that this condition or any attempt to remedy the issue, will not impede the use of the doors in the event of an emergency.

Generally, interior doors throughout the building are hollow-core, residential grade wood doors with wood frames and residential grade hardware. Some solid-core, commercial grade doors have been installed in high-traffic areas.

Ice build-up on the metal roof deck and structure over pool.

Pool area exterior door with frost and ice build-up.

b. Vertical Circulation

The vertical circulation in this building is particularly problematic. The gymnasium and swimming pool deck finished floor levels approximate exterior grade conditions, but the change rooms that service both these activity areas are located a lower elevation, approximately 720 mm below the main floor. This requires a stair of four risers leading down to the change room level from the entrance area and the gymnasium and a set of stairs in the male and female change rooms leading back up to the pool deck. These stairs are cast-in-place concrete, finished with terrazzo in the lobby areas and a trowelled epoxy-quartz flooring in the change rooms. The guards are noncompliant open pipe rails.

Access to the mezzanine from the gymnasium is via wood framed stairs with vinyl treads or by traversing the bleacher stepped aisle. The same construction is in place for the stairs from the mezzanine to the party room level and up to the third floor mezzanine conference room, except the treads in the last case are carpeted. The mezzanine stairs are reasonably acceptable, with the exception of the bleacher aisle, which is nowhere near meeting National Building Code dimensional requirements. Handrails, where provided, are a combination of steel pipe and residential quality wood and do not conform to NBCC requirements.

c. Interior Finishes and Millwork

(i) Wall and Partition Finishes

There are a variety of partition wall finishes throughout the building. The gymnasium area has a 2,440 mm high varnished plywood dado with painted hardboard (or possibly plywood) finish above. As indicated previously, the pool area has a ceramic tile dado with fabric draperies above. Most likely these draperies were added in an effort to reduce reverberation times, though the fabric would only be marginally effective. Group shower rooms and individual showers are also finished with ceramic tile, full height in this case. The remainder of the interior partitions appear to have a painted hardboard or gypsum board finish.

(ii) Ceiling Finishes

The gymnasium area has a painted plywood or hardboard ceiling. The lobby, corridors, change rooms, Judo room and mezzanine rooms have a painted gypsum board ceiling, except that there are a couple of rooms with acoustic tile in a T-bar grid.

The pool area has a large barrel-vaulted suspended ceiling that floats in the middle of the room. The underside of the attic floor assembly above is exposed at the perimeter. The vaulted ceiling is comprised of 610 x 1,220 mm *clean room*-style, vinyl-coated, compressed mineral -fibre tile held in place by a T-bar grid assembly. Site staff indicated that the ceiling was replaced approximately two years ago, but it is already evident that it is suffering from water damage from leaking above. The problems with this ceiling are related to the vapour transmission and condensation problems discussed in the Building Envelope section of this report.

At the time of the building evaluation it was noted that several of the tiles have absorbed enough moisture to cause them to sag below the T-bar support grid and are in danger of falling. These compressed mineral fibre tiles are quite heavy and rigid and could pose a serious threat to swimmers below.

(iii) Floor Finishes

The gymnasium appears to have a sprung hardwood floor, which is likely original to the building. It is in reasonable condition, but could certainly use a sanding and refinishing if the facility were intended for continued use. Given its age, the hardwood is probably of sufficient thickness to withstand the renewal procedure.

The Judo room has a specialized foam and rubber *Flexi-Conect sport* flooring, manufactured by *Dollamur,* which appears to be laid over a plywood subfloor on rigid Styrofoam insulation boards. This flooring is relatively new and in excellent condition.

The change room and pool deck area floor finish also appears to have been recently upgraded with a trowel-applied epoxy-quartz flooring with an integral base. This is also in very good condition. The shower rooms still have their (likely original) terrazzo finish, as does the raised urinal area in the mens change room. The main lower lobby and circulation area has also retained this finish.

Most areas of the mezzanines feature vinyl tile flooring with rubber base, though there are isolated areas of carpeting. The bleachers have pained wood deck boards and varnished wood seats.

(iv) Millwork and Equipment

There is very little millwork in the Labrador Training Centre. The base cupboards in the kitchen are residential quality, off-the-shelf units. Washroom vanities have been constructed on site of particle board and plywood with post-formed laminate tops.

The toilet partitions are overhead braced, floor-mounted, painted steel and appear to be in serviceable condition. The change room lockers are also painted steel and, though fairly old, appear to be in reasonable condition.

d. Conformance with Accessibility Regulations

Generally speaking, the Labrador Training Centre is not accessible to people with physical challenges. With all the change room facilities located approximately 720 mm lower than the gymnasium (on one side) and the swimming pool (on the opposite side) adapting the building to be fully accessible would be an extremely costly undertaking.

(i) Parking and Passenger Loading Zones

There are approximately 30 parking spaces available, but a designated barrier-free stall was not apparent. There is no accessibility signage and the parking surface is believed to be gravel, so stall markings would not be possible.

The main entrance is at grade and proper clearances are provided, so this entrance would be considered accessible. The surrounding area also appears to be relatively level, though snow covered at the time of the review.

(ii) Ramp or Lifts

There are no ramps or barrier-free platform lifts at this facility. Thus there is no way for a person in a wheelchair to access any area besides the entrance vestibule, gymnasium and the Judo anteroom. Though there are still barriers to easy wheelchair access in these areas.

(iii) Stairs and Guards

Due to the split-level design of this building, users must traverse a stair in order to move from one functional area to another.

Immediately after the entrance area, on the path toward the locker rooms, there is a set of stairs on either side of the control office, each with four risers. Dimensionally these stairs are reasonably close to compliance with the Code and they have distinct, slip-resistant nosings. The handrails do not meet NBCC or accessibility requirements due to their quantity, length (extension beyond the stair) or height. The stairs from the change room area back up to the pool deck are similarly non-compliant. Neither have the required visually-distinct nosings or proper handrails. In the men's change room toilet grab bars are used in lieu of actual wall-mounted handrails.

From the gymnasium there are two stairs that go up to the first mezzanine level. The stair from the control lobby is very steep with 190 mm risers and 230 mm treads (verses the 180 mm x 280 mm NBCC requirement) without compliant nosings. There is only one handrail where two are required and it does not have the proper extensions at either end. The stair forming part of the wooden bleacher is completely contrary to all Code requirements. The risers are not treated with a non-slip surface and they actually range in height from 160 mm to 380 mm, well beyond the NBCC maximum of 180 mm with a +/- 5 mm variance over the entire stair.

The guard at the edges of the mezzanine level is only 940 mm high, as opposed to the 1100m mm requirement and its ability to resist horizontal loads is questionable. The stairs to the upper mezzanine areas are lacking the required nosings and handrails. Dimensionally they are reasonably compliant.

(iv) Doors and Gates

Ironically, the one area of the building that has some accommodations for persons with disabilities is blocked by a completely non-compliant gate which would be almost impossible for a person in a wheelchair to negotiate unassisted. In order to enter the gymnasium one must pass through a plywood gate that is approximately 750 mm clear with only 800 mm of clear depth behind. The gate is opened by means of a hardware-store variety bolt latch on the gym side only which requires a person to reach over the gate to open it.

Only a couple of doors in this facility meet the accessibility requirements for clear width (800 mm) and unobstructed clear area on either side of the door (600 mm on the pull side, 300 on the push side for 1200 mm back from the door). One entrance door is suitable for barrier-free access with a power operator, though it is not marked as such. All other doors are too narrow to allow the passage of a wheelchair and do not provide the proper clearances or hardware for persons with disabilities. Even the door to the accessible washroom off the gymnasium does not even meet dimensional requirements nor does it have the correct hardware.

Moisture-soaked ceiling tile falling from ceiling over pool.

Shower in supposed barrier-free washroom.

Supposed barrier-free washroom.

(v) Washrooms

There are no fully accessible washrooms in the Labrador Training Centre. A washroom intended to be accessible, complete with a shower, has been added to the link between the gymnasium and the Judo room. However, this room is not strictly compliant with the provincial regulations. There are problems with the width and design of the door, clearances around fixtures and the style and location of grab bars.

There is one drinking fountain provided, but as it located on the inaccessible lower level and does not meet any requirements of the accessibility regulations.

(vi) Service Counters

The reception counter has no wheelchair accessible portion.

(vii) Viewing Areas

There is no viewing area provided for persons with disabilities. Regulations would require at least two spaces for a facility this size.

e. Fire and Life Safety Review

(i) Classification and General Compliance Issues

This building falls under the Group A or *Assembly* occupancy category of the National Building Code of Canada (NBCC), 2010 edition. The gymnasium and mezzanine area would be classified as Division 2 while the pool area would be classified as a Division 3 occupancy. Conservatively, the building has two major occupancies as neither can really be considered as ancillary, though research indicates that the Group A, Division 2 and 3 split of major occupancies is not uncommon for multi-purpose recreational facilities of this nature across Canada.

Under NBCC 3.1.3.1, these two major occupancies are required to be separated by a one-hour fire separation. There is no indication of a fire separation at the Labrador Training Centre between the pool area and the remainder of the building. Often when fitness or wellness facilities are operated by a single organization and the pool area does not have a large spectator capacity, such as in a typical YMCA facility, the build-

Non-accessible gate between gymnasium and entrance area.

High threshold at the entrance to the Judo room.

ings are usually designated solely as Group A, Division 2. Assumedly, in these cases the pool area is considered ancillary to the general recreational function of the facility.

The Labrador Training Centre has a building area or footprint of approximately 1,493 m^2, is of combined combustible and non-combustible construction and is not sprinklered. The building may be classified under article 3.2.2.25 ***Group A, Division 2, up to 2 Storeys*** under which the minimum requirements include:

- Maximum building area limit of 2,400 m^2 if one storey in building height (facing three streets) or 1,200 m^2 if two storeys in building height (facing 3 streets).
- Floor assemblies and mezzanines must be constructed as fire separations and, if of combustible construction, shall have a fire resistance rating of 45 minutes.
- Roof assemblies, if of combustible construction, shall have a fire resistance rating of 45 minutes.
- All assemblies requiring a fire resistance rating shall be supported with load bearing walls or columns that either have a fire resistance rating equal to that of the assembly supported or are of non-combustible construction.

In order to be compliant with the above criteria, the mezzanine would either have to be less than 40 per cent of the total room area and be completely open, or be less than 10 per cent of the total room area if it were partitioned off into rooms (which it is).

Given that the mezzanine is actually 25 per cent of the total room area, it would have to come under the 40 per cent rule. But since the mezzanine has been subdivided into separate rooms and it clearly exceeds the 10 per cent allowable area for partitioned mezzanines, it is not compliant with NBCC requirements.

If the mezzanine were to be considered a second storey, then the maximum building area limits under NBCC 3.2.2.25 (as noted above) are exceeded and the entire building is non-compliant.

Classifying the entire building under the A-3 category (swimming pools and arenas) may be acceptable to authorities having jurisdiction. As a single storey building under NBCC 3.2.2.34 ***Group A, Division 3, One Storey*** a building area of up to 1,500 m^2 is

View of the first mezzanine level.

Stairs leading to upper mezzanine and door to office area.

Stairs to party room and office on upper mezzanine level.

permissible, but this still does alleviate the problem of the subdivided mezzanine as previously discussed.

The only way to make the Labrador Training Centre compliant with the 2010 edition of the National Building Code would be to reconfigure the mezzanine so that no more than 10 per cent of its floor area is enclosed. In addition, the upper mezzanine conference room would not be acceptable under any circumstances as superimposed mezzanines are strictly prohibited by the NBCC. Even if the upper mezzanine level was accepted by the Authorities Having Jurisdiction, a second means of egress would have to be introduced. Fully sprinklering the building would not negate the mezzanine issues.

If the mezzanine were retained as is and the building was sprinklered, a classification of two storeys could be pursued under NBCC article 3.2.2.26 ***Group A, Division 2, up to 2 Storeys, Increased Area, Sprinklered***, however all combustible floor assemblies would have to be fire-rated for a minimum of 45 minutes. Since the roof structure is non-combustible it would not require a fire resistance rating. Practically speaking, the fire rating of floor assemblies would not be economically feasible, as it would require a near complete removal of all ceiling finishes in the lower level. This compliance strategy may be unrealistic.

(ii) Mezzanine Exiting

The mezzanine exiting is totally non-compliant. There is actually no true exit from either level of the mezzanine. The egress path from all areas of the mezzanine converge at a single open stair that leads into the gymnasium. This is not permitted to be the sole means of egress from a floor area.

(iii) Bleachers

There are many other NBCC infractions throughout the building, especially as it relates to stairs and guards, much of which has previously been discussed in this report. The bleachers are also completely non-compliant as there is only one aisle, the riser steps exceed the 200 mm NBCC maximum and the locations of each riser step in the aisle are not visually distinct from the cross-aisle approach. As well, none of the bleacher guards comply with NBCC requirements.

Sole access to exit from the all mezzanine areas.

Bleacher stepped aisle and seating area.

2.3.4 Mechanical

a. Methodology and References

The objective of this report is to provide information on the current condition of the mechanical systems at the Labrador Training Centre and to review the systems with respect to code compliance, energy usage and maintenance issues. Recommendations for immediate and future improvements are also included.

This report describes the apparent condition of existing mechanical systems as observed during a site review. No investigation has been completed related to the presence of hazardous substances, contaminants or pollutants. There were no mechanical drawings available from the original building construction or for the recent upgrading of the pool filtration and the dehumidification and air handling systems.

The following mechanical codes and standards were referenced during this study:

- ASHRAE 62.1-2007 Standard for Acceptable Indoor Air Quality
- ASHRAE 90.1-2007 Energy Standard for Buildings
- National Plumbing Code of Canada 2010
- National Building Code of Canada 2010
- CSA B52 Mechanical Refrigeration Code, 2010
- NFPA 10 Standard for Portable Fire Extinguishers

b. Heating, Ventilation and Air Conditioning Systems (HVAC)

(i) Heating and Cooling

The heating system at the Labrador Training Centre is all electric, either base board or ceiling mounted units, and thus falls under the scope of the electrical discipline. The only exception is the pool dehumidification and air handling unit, which provides some heating of the supply air. There is no air conditioning system in the building.

Dectron unit in the mezzanine mechanical room.

Residential-quality HRV in the Judo room extension.

Typical portable air conditioning unit in mezzanine offices.

(ii) General Ventilation

The pool area is served by a relatively new *Dectron* brand dehumidification and ventilation unit. The system consists of motorized air intake and return dampers, a supply fan, heating coil and exhaust fans. The system provides conditioned air to the pool enclosure. It is in very good condition and would meet modern standards for a swimming pool facility. However, the functionality of the *Dectron* unit is severely hampered by an extremely poor architectural envelope which allows moisture vapour to penetrate the pool enclosure and migrate into adjacent spaces. This problem is discussed in detail in the architectural section of this report.

There is very limited ventilation provided for the remainder of the facility. The gymnasium has no fresh air ventilation and no air conditioning, which is considered a serious deficiency for an athletic facility. It is suspected that the gymnasium is practically unusable during the summer months when outdoor temperatures are above 20 degrees Celsius and the relative humidity is high. The attached building housing the Judo room has a small residential heat recovery ventilator that is not able to adequately ventilate the space, especially if there was a large group of people in the room.

The mezzanine office and meeting areas have no ventilation besides portable air conditioning units that are actually vented into the gymnasium area. Ideally, a new air handling unit complete with fresh-air intake, heat-recovery exhaust and air conditioning is required to properly ventilate the gymnasium, Judo room and associated office and meeting spaces.

(iii) Exhaust Ventilation

The exhaust ventilation throughout the facility is totally inadequate and does not satisfy any contemporary codes or standards. The installation of new exhaust fans or heat-recovery ventilators is required for proper functionality.

c. Domestic Plumbing Systems

The domestic plumbing system consists of sanitary drainage piping, domestic hot and cold water piping and associated plumbing fixtures. The water entry is located in the pool mechanical room, the line is 50 mm copper. The domestic water is distributed throughout the building by copper lines of various sizes, some of which are insulated.

Vintage floor-mounted urinals with terrazzo surround.

Typical institutional-quality shower fixtures.

Crosslinked high density polyethylene (PEX) piping was also observed in some areas.

Hot water for plumbing fixtures in the mezzanine area is generated by a single residential-quality hot water heater. Another domestic water heater is located in the Judo addition to serve the accessible washroom located in the link between the main building and the Judo room. A large 99 kW cement-lined domestic water heater is located in the pool mechanical room and provides hot water for the pool area change rooms and showers. The manufacturer's label indicated that the tank was installed in 1983. After 31 years of continued use, the tank will likely require replacement in the near future.

Water closets throughout the building are residential-grade vitreous china floor-mounted, flush-tank type toilets. There are what appear to be original floor-mounted urinals in the male change room. Lavatories are vanity mounted units with manually operated faucets. Shower fixtures are institutional grade with manually operated push buttons. In general, the fixtures appear to be in reasonably good condition, though consideration should be given to updating them to commercial-quality water-efficient styles.

Sanitary drainage is conveyed from the building by a 150 mm line which exits the building in the area of the pool mechanical room. As most all of the plumbing system's components were installed when the building was constructed in the 1950s, they are likely near the end of their serviceable life.

d. Pool Systems

The swimming pool piping and filtration system appears to have been replaced within the past five years and is in very good condition. The pool water is cleaned by a closed-tank pressure sand filtration system. Each filter has a multi-port dial valve with control settings for normal, backwashing, and bypass modes of operation. The pool piping system is constructed of a combination of PVC and ABS pipes exposed underneath the pool deck suspended concrete slab. The pool filtration pump is of bronze construction, complete with an integral hair and lint strainer, with a rated flow of approximately 10-20 litres per second.

The swimming pool tank is fitted with two main drains of bronze construction at the

Cement-lined domestic water heater and tank.

View into pool tunnel with supply and return piping.

Pool chemistry systems.

deep end of the pool. Plastic skimmers with equalizer lines are distributed around the perimeter of the pool for surface skimming (recirculation filtering) and multiple inlet jets are provided around the perimeter for water supply. The existing pool main drains do not meet current standards for suction entrapment avoidance in swimming pools. It is recommended that the main drains be upgraded with anti-siphoning grilles to meet current requirements. There should also be an emergency pump shut-off system accessible by the lifeguard from the pool deck.

Pool heating is provided by an electric in-line heating system which is much older than most other components of the piping and filtration systems. It will likely require replacement in the near future.

The pool disinfection system consists of a chlorine chemical feed tank and dosing pump. The maintenance of water quality standards in accordance with Provincial Regulations appears to be carried out through manual testing and chemical addition by building maintenance staff. The existing pool disinfection and pH control systems should be replaced with an automated pool chemistry control system, which would simplify this maintenance procedure.

e. Building Management and Control Systems

There are no distributed digital control (DDC) or energy management and control (EMCS) systems currently installed in the facility. Considering the general lack of ventilation systems, installation of a control system is not recommended unless there were to be a complete building retrofit and renewal.

f. Fire Protection

The building does not have a sprinkler system or any other built-in means to fight fires (standpipe, hose cabinets, etc.). There are some fire extinguishers located in the building, but they are not distributed to ensure proper coverage as per NFPA 10.

In the mezzanine kitchen area there is a typical residential-quality range/oven combination but there is no ventilation provided whatsoever. If this were a new building, the Fire Commissioner's office would require that a NFPA approved stainless steel exhaust hood with integral fire suppression be installed in a kitchen or canteen area with an open range.

Pool filtration system and associated piping.

Un-vented range in mezzanine kitchen/canteen area.

2.3.5 Electrical

This report describes the apparent condition of existing electrical systems as observed during a site review.

a. Service and Distribution

(i) Main Electrical Service

Electrical power is supplied to the building from three utility transformers pole-mounted on a wooden H-structure owned by Newfoundland and Labrador Hydro. The service is run aerial to the main electrical room. The service is rated 800 amp, 347/600 volt, three phase, 4 wire.

The electrical service entrance is comprised of a two section service entrance board complete with an 800 amp, three pole main fused disconnect. The service entrance board was manufactured by *Federal Pioneer* and feeds multiple distribution panels and mechanical equipment located throughout the building.

An energy management system is installed in the main electrical room to shed loads to minimize the peak demand. The electrical service has one utility meter, number P44678.

During the assessment, the following items were observed:

- The main service entrance board is in poor condition.
- The main electrical service entrance and distribution equipment is located in the mezzanine level mechanical room, which contains the aquatics area's air handling equipment.
- The main electrical room contains two dry-type transformers and is not ventilated, which will cause overheating. The transformers were very dirty and noisy.

(ii) 120/208 V Distribution

The secondary 120/208 Volt distribution panels are located throughout the building. It is not possible to be certain, but all panel boards appear to be original to the building. The panel boards were manufactured by various companies with nameplates from A*malgamated Electric, Westinghouse, Cutler-Hammer, Federal Pioneer*, and *Square D*.

During the assessment, the following items were observed:

- The original 120/208 volt distribution is in poor condition. All of the devices and wiring of the distribution system appear to be original.
- General wiring types include RW90, Teck, AC90, NMD, R60, and TW wiring used as conductors.
- There are no spare circuit breakers in the original branch panel boards and replacement circuit breakers are no longer available.
- There is no surge suppression equipment is installed within the main distribution.
- Some of the panel board door locks and hardware are damaged, preventing the doors from closing.
- Several panels do not have a ground bus installed.
- Many panel boards are not identified and their directories are either missing or do not have current information.
- Exit and emergency lighting branch circuit breakers to not have lock-on devices.
- Some circuit breaker terminals are used for more than one wire connection.
- Panel boards have missing bushings, locknuts, fillers, and insulated throats.
- All power conductors should be color coded as per the Canadian Electrical Code requirements.

- Original panel board enclosures require cleaning.
- There are covers missing on junction boxes.

If the Labrador Training Centre is intended for long-term use, all of the primary 347/600 volt panel boards and feeders and the secondary 120/208 volt distribution sub-panel boards and wiring would have to be replaced in order to rectify the issues noted above. Some of the conduit could be re-used where appropriate.

b. Grounding and Bonding System

The main grounding system does not appear to be correctly designed. The main ground conductor is sized adequately, but it could not be determined if there was a connection between the water main and the distribution system. Also, no external ground bus could be located in the electrical room.

During the assessment, the following additional items were observed:

- The electrical room equipment is not grounded to an external ground bus.
- Several branch circuit panel boards do not have a ground bus installed.
- Several duplex receptacles that were inspected are not bonded to ground.
- No information could be determined regarding the presence of exterior ground rods.

For continued use, bonding conductors should be installed to all electrical equipment throughout the building. In addition, a new external ground bus must be installed within all electrical rooms; the main service must be bonded to the water main; and three new external ground rods complete with new wiring should be installed.

c. Lighting Systems

(i) General Interior

There are two main types of interior lighting in the facility: high-bay metal halide over the pool and T12 fluorescent lighting in the remainder of the building. The high-bay metal halide lighting appears to be in fair condition. All existing lights are in working order but the lighting distribution is not adequate for an aquatics facility.

The fluorescent lighting is comprised of 305 x 1,220 mm surface mounted fixtures, 610 x 1,220 mm recessed fixtures or strip lighting fixtures within the mechanical and other service rooms. The recessed and surface mounted fixtures are generally have acrylic lenses. There is no consistency to the colour temperature of the lamps used within the facility.

During the assessment, the following additional items were observed:

- There were a high number of lamps not functioning in the gymnasium area. They were probably simply burned-out.
- Many strip lighting fixtures in service rooms are missing wire guards and lens.
- Fixtures in the change room area were not vapour tight.

The interior lighting systems remain serviceable, but lighting levels in most areas is lower than what is typically required by the Illuminating Engineering Society standards. If a major refit of electrical systems is considered, it would be advisable to replace the older T12 fixtures with new, energy efficient T8 fixtures. In the short term care should be taken when replacing lamps so that the colour temperatures match throughout the building.

(ii) General Exterior

The exterior building lighting consists of metal halide wall packs distributed across the main elevation and located near exits. The exterior lights were likely installed during the 2003 re-cladding of the building, but several have broken lenses and do not appear to be functional. The light levels in the parking would not meet IES standards.

(iii) Emergency Lighting

Emergency lighting is provided by individual 12 volt DC battery units with remote heads located throughout the building. Many of the individual units are equipped with two emergency heads. The branch circuits for emergency lighting do not have adequate lock-on devices and it is unlikely that battery life will meet current standards.

The number and location of remote heads is inadequate and consequently the emergency lighting illumination levels throughout the building do not meet National Building Code requirements. Additionally, many of the units that were tested during this review were not working and the change rooms, washrooms and some corridors do not have any fixtures whatsoever.

In general, the emergency lighting system requires a complete retrofit and a reevaluation of the quantity and distribution of fixtures to meet the current Code. New units are to have a minimum battery life of 90 minutes.

(iv) Exit Lighting

What exit lighting does exist throughout the facility is an older incandescent type. Exit lights are not located in all areas requiring such signage as per National Building Code regulations. A detailed review of exit lighting requirements should be undertaken and new signs added where necessary. Existing signage should be replaced with long-lasting LED fixtures.

d. Heating Systems

The main source of heat for the building is by means of electric wall-mounted con-

Typical floor-mounted transformer.

Service entrance and main distribution panels.

Storage room lighting missing lenses and lamps.

vectors with individual room thermostats on line-voltage. The heaters are in varying states of repair.

During the assessment, the following items were observed:

- Many spaces such as washrooms and corridors did not have any heat source installed.
- Many of the baseboard heaters exhibited mechanical damage and were filled with dust and debris.

For continued operation of the facility all heaters should be thoroughly cleaned and badly damaged units should be replaced. New low-voltage thermostats and solid-state heater relays should also be installed to provide more accurate control of heat levels.

e. Wiring Devices

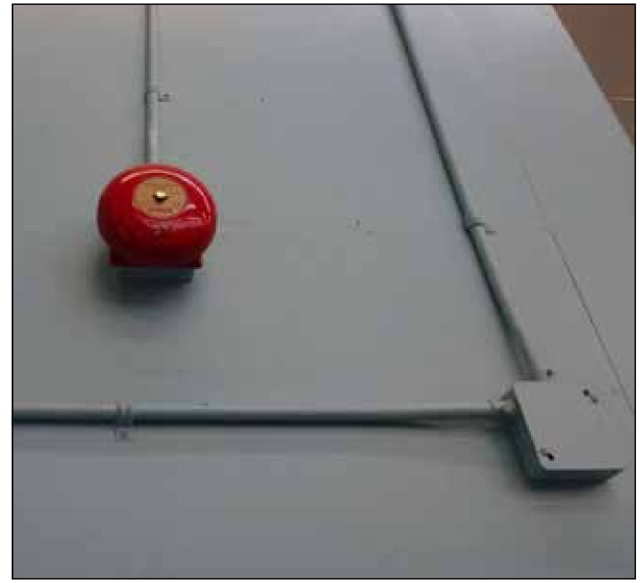
Generally, all receptacles are the U-ground type, rated 15 amp, 120 volt and light switches are rated 15 amp, 347 volt.

There appears to be an adequate number of receptacles installed in most rooms, although extension cords were in use in some areas. Some exterior receptacles had damaged cover plates. There are no ground-fault interrupter (GFI) circuit breakers installed and no GFI receptacles installed near sinks or other water sources, as is required by the Canadian Electrical Code. Many other receptacles that were inspected did not have the bonding conductor installed.

Many of the toggle switches in the building are cracked, worn, without cover plates and in need of replacement. Some switches do not have the bonding conductor installed and should be rewired with RW90 wire in conduit.

f. Wiring Method

There is a variety of wiring methods employed in the Labrador Training Centre. There is RW90 in conduit, TECK, AC90, NMD, R60 in conduit and TW wiring used as conductors in conduit. Generally, the wiring throughout the building is in fair to poor condition.



Fire alarm bell and typical surface-mounted conduits.

Typical heater and fire alarm panel with surface conduit.

During the assessment, the following items were observed:

- Some of the wiring is not adequately secured or supported.
- The R60 rated conductors are comprised of a rubber based insulation which becomes brittle with age and flakes off the conductor.
- TW wiring is not rated as conductor cables.
- Power conductors are not color coded as per Canadian Electrical Code.
- Conduits on the exterior of building for engine-block heater receptacles are not supported properly.

It is imperative that R60 and TW rated conductors be replaced with RW90 rated conductors. The existing wiring has deteriorated and presents a high risk of shorting or arcing. In addition, all junction boxes require covers and all cable and power conductors should also be colour coded.

g. Fire Alarm System

The Fire Alarm System was manufactured by *Cerberus Pyrotonics* and the main control panel with explanatory graphics is installed near the entrance to the facility. There are alarm bells and manual glass-rod pull stations installed in most areas throughout the building. All components are connected from a fire alarm fused disconnect switch painted red in the electrical room.

In general, the layout and coverage of the fire alarm system is inadequate and not in conformance with current National Building Code of Canada requirements.

Pull stations are required at all exits and there must be heat detectors installed in all storage rooms and stairwells. The alarm bells do not meet current standards and should be replaced with combined visual strobes and audible alarms. The main panel should be replaced with an addressable type.

h. Communication Systems

The voice and data system in the building appears to be a combination of Cat 5e and Cat 6 cabling that is functioning as intended. No immediate remedial work is required.

Typical incandescent exit sign and emergency light combination.

Lighting in the gym with mismatched colour temperatures and burned out units.

2.4 Recommended Renovations to Continue Operating Existing Facilities

2.4.1 Purpose

This section of the report is intended to outline and provide costs for recommended repairs and renovations that would be required to keep the existing facilities in operational condition and to maintain the current level of recreational programs. The work described below is not intended to improve the facilities beyond what is required to support current activities.

The work scope has been grouped into three categories: immediate repairs and upgrades; mid-term maintenance and repairs; and long-term maintenance and repairs.

The immediate repairs are those considered necessary to resolve (as much as possible) major environmental, structural and life-safety issues with each facility. This remedial work should be undertaken as soon as possible if either facility was intended for long term use. If a facility is only intended to operate for a short time until a replacement facility was completed, then the scope could be reduced only to repairs that are absolutely necessary.

The mid-term maintenance and repairs describes work that would be required in approximately five to 10 years if the facility was still in operation and the recommended immediate repairs had been completed initially. The long-term maintenance and repairs represents capital cost expenditures that could be expected in approximately 10 to 20 years, if the facility was in continued use and all earlier repairs, upgrades and maintenance items were completed as necessary.

2.4.2 Cost Estimating Accuracy

Estimates in this report are intended to provide *order of magnitude* construction costs only and are accurate to ***Class D*** standards (or +/-25 per cent) as per generally recognized industry practices.

All estimates have been based on a statement of requirements and an outline of potential solutions to the design problem. They are intended to provide an indication of the final project cost and are considered to be sufficient for the purpose of analysing the redevelopment options under consideration.

The figures listed below are an indication of the probable construction cost in Happy Valley – Goose Bay at the time of this report and are intended to represent fair market value of the scope of work assuming that such work is grouped into reasonably sized contract packages.

Unless noted otherwise, architectural and engineering design fees are not included, nor are value-added taxes. Refer to section 3.3 of this report for a discussion on consultant fees and expenses. All costs are expressed in first quarter 2014 Canadian dollars.

2.4.3 The Broomfield Arena

a. Immediate Repairs and Upgrades

The following renovations and/or upgrades are recommended to be completed within the next couple of years if the facility is intended for continued operation. Some of these items have previously been identified by the Town or by other consultants evaluating certain aspects of the facility.

- Construct new players entrance — $84,000.
- Repairs and expansion of the ice-resurfacer garage — $157,500.

- Demolish existing floor slab under ice surface, install new refrigerant piping and replace floor slab — $1,106,000.
- Demolish existing east bleachers and construct new NBCC compliant bleachers — $357,500.
- Complete NBCC required upgrades to west bleachers, clad bleacher structure with fire-rated gypsum board — $75,000.
- Resolve exiting problems associated with the south mezzanine level — $16,000.
- Install a fire rated gypsum board ceiling to protect the floor structure of the south mezzanine — $82,500.
- Upgrade finishes in the south mezzanine — $126,000.
- Spray fire proofing to the underside of the north mezzanine floor to make the 2005 extension NBCC compliant — $49,500.
- Repair the insulation and air/vapour barrier continuity at north mezzanine ceiling — $21,600.
- Repair the insulation and vapour barrier continuity in the exterior walls using existing material — $28,800.
- Replace the non-functioning HVAC system in the original building — $250,000.
- Install an energy management and digital control system for the HVAC systems — $100,000.
- Repair and replace (as necessary) plumbing systems in the south mezzanine — $175,000.
- Install a complete sprinkler system and additional fire extinguishers — $152,500.
- Upgrade the electrical distribution system and grounding — $42,500.
- Lighting upgrades, including emergency lighting — $15,000.
- Repairs to electric heating components — $5,000.
- Replacement and repair to wiring, conduit and electrical devices — $53,000.
- Work to complete fire alarm system — $12,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical upgrades — $69,500.

Estimated total cost for immediate repairs and upgrades: $2,978,900 x 10% contingency = $3,276,790.

b. Mid-Term Maintenance and Repairs

The following maintenance, repair and renovation items are expected to require completion within five to 10 years if the facility is intended for continued operation beyond that point in time.

- Replace all of the siding on the original building — $297,000.
- Install a new roof on the original building, repair the 2005 extension roof — $885,000.
- Maintenance and repairs to HVAC systems — $25,000.
- Maintenance and repairs to the ice plant — $50,000.
- Maintenance and repairs to the kitchen exhaust and fire suppression system — $25,000.
- Upgrading and replacement of certain components of the electrical distribution and grounding systems — $80,500.
- Additional lighting upgrades — $95,000.
- Maintenance and replacement of heating system components — $40,000.
- Repair and replacement of wring, conduit and devices — $42,000.
- Repairs to the fire alarm system — $3,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical upgrades — $109,500.

Estimated total cost for mid-term maintenance and repairs: $1,652,000 x 10% contingency = $1,817,200.

c. Long-Term Maintenance and Repairs

The following maintenance, repair and replacement items are expected to require completion sometime between 10 and 20 years in the future, if the facility is intended for continued operation for beyond 20 years.

- General updating, repair and replacement of interior finishes — $223,800.
- Replacement of the ice plant machinery — $250,000.
- Maintenance and repairs to electrical distribution equipment — $25,000.
- Maintenance and repairs to lighting equipment — $20,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical work — $75,000.

Estimated total cost for long-term maintenance and repairs: $593,800 x 10% contingency = $653,180.

2.4.4 The Goose Bay Curling Club

a. Immediate Repairs and Upgrades

The following renovations and/or upgrades are recommended to be completed within the next couple of years if the facility is intended for continued operation. Some of these items have previously been identified by the Town or by other consultants evaluating aspects of the facility.

- Asbestos abatement — $150,000.
- Complete replacement of ice plant and piping, complete with installation of a concrete slab under the ice — $1,200,000.
- Upgrading and replacement of interior finishes — $160,000.
- Replacement of entrance stairs and deck — $15,000.
- Renovations to resolve fire-exiting issues — $41,000.
- Installation of a basic HVAC system — $125,000.
- Digital control system for HVAC — $10,000.
- Replace complete plumbing system — $40,000.
- Install fire extinguishers — $1,500.
- Install canteen fire suppression — $30,000.
- Upgrade the electrical distribution and grounding — $17,500.
- Repair and replace some lighting components, including emergency lighting — $40,000.
- Repairs to electric heating devices — $5,000.
- Replacement and repair of wiring, conduit and electrical devices — $20,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical upgrades — $50,000.

Estimated total cost for immediate repairs and upgrades: $1,905,000 x 10% contingency = $2,095,500.

b. Mid-Term Maintenance and Repairs

The following maintenance, repair and renovation items are expected to require completion within five to 10 years if the facility is intended for continued operation beyond that point in time.

- Replacement of metal roofing and siding — $295,000.
- HVAC system maintenance — $25,000.
- Maintenance and repairs to plumbing system — $15,000.
- Maintenance to fire suppression and extinguishers — $2,500.
- Major upgrading of electrical distribution and grounding — $50,500.

- Replacement and repair of lighting systems, including emergency — $75,000.
- Replacement of heating system components — $30,000.
- Replacement of conduit and electrical devices — $45,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical upgrades — $15,000.

Estimated total cost for mid-term maintenance and repairs: $553,000 x 10% contingency = <u>$608,300.</u>

c. Long-Term Maintenance and Repairs

The following maintenance, repair and replacement items are expected to require completion sometime between 10 and 20 years in the future, if the facility is intended for continued operation beyond 20 years.

- Maintenance and repairs to the ice plant — $100,000.
- HVAC maintenance and repairs — $50,000.
- Upgrading of HVAC control system — $25,000.
- Repair and replace plumbing fixtures — $15,000.
- Maintenance to fire suppression system — $2,500.
- Selective replacement of distribution and grounding system — $15,000.
- Repair to wiring, conduit and electrical devices — $15,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical work — $25,000.

Estimated total cost for long-term maintenance and repairs: $247,500 x 10% contingency = <u>$272,250.</u>

2.4.5 The Labrador Training Centre

a. Immediate Repairs and Upgrades

The following renovations and/or upgrades are recommended to be completed within the next couple of years if the facility is intended for continued operation.

- Major renovations to pool enclosure ceiling and attic above to solve vapour transmission problem — $900,000.
- Main level accessible shower room addition — $306,000.
- Miscellaneous accessibility upgrades — $105,300.
- Installation of HVAC system with air conditioning — $250,000.
- Install an energy management and digital control system for the HVAC systems — $125,000.
- Repair and replace plumbing systems — $125,000.
- Install new electric in-line pool heaters — $25,000.
- Install a complete sprinkler system and portable fire extinguishers to NFPA standards — $155,000.
- Install a ventilation hood with fire suppression system in the canteen — $30,000.
- Upgrade the electrical distribution system and building grounding — $33,000.
- Repairs to lighting system, including emergency — $30,000.
- Repair electric heating components — $5,000.
- Replacement and repair to wiring, conduit and electrical devices — $25,000.
- Upgrades and repairs to fire alarm system — $30,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical upgrades — $100,000.

Estimated total cost for immediate repairs and upgrades: $2,244,300 x 10% contingency = <u>$2,468,730.</u>

b. Mid-Term Maintenance and Repairs

The following maintenance, repair and renovation items are expected to require completion within five to 10 years if the facility is intended for continued operation beyond that point in time.

- General updating and replacement of interior finishes — $140,000.
- Replace bleachers and mezzanine stairs — $120,000.
- Replace complete metal roof and penetration flashings — $320,000.
- Maintenance and repairs to the pool dehumidification system — $65,000.
- Maintenance and repairs to the pool filtration system — $75,000.
- Selective replacement of plumbing fixtures — $25,000.
- Replacement of electrical distribution and grounding equipment — $105,000.
- Lighting system upgrading and replacement of fixtures, including emergency — $95,000.
- Replace ageing electric heating devices — $50,000.
- Replacement and repair to wiring, conduit and electrical devices — $100,000.
- Maintenance and repair to fire alarm system — $5,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical work — $60,000.

Estimated total cost for mid-term maintenance and repairs: $1,160,000 x 10% contingency = $1,276,000.

c. Long-Term Maintenance and Repairs

The following maintenance, repair and replacement items are expected to require completion sometime between 10 and 20 years in the future, if the facility is intended for continued operation beyond 20 years.

- General updating and replacement of interior finishes — $210,000.
- Repair and replacement of exterior wall cladding — $180,000.
- Replacement of pool and pool deck area flooring — $95,000.
- Maintenance and repairs to the pool filtration system — $50,000.
- Selective replacement of plumbing fixtures — $50,000.
- Selective replacement of ageing electrical distribution and grounding systems — $62,000.
- Lighting system upgrading and replacement of fixtures, including emergency — $20,000.
- Selective replacement of electric heating devices — $10,000
- Repair and maintenance of wiring, conduit and electrical devices — $25,000.
- Miscellaneous architectural repairs to facilitate mechanical and electrical work — $40,000.

Estimated total cost for long-term maintenance and repairs: $782,000 x 10% contingency = $860,200.

Part 3. Redevelopment Scenarios

3.1 Net Present Value Scenario Descriptions

Scenario 1a: Maintain the status quo.

This scenario involves keeping the Broomfield Arena, the Labrador Training Centre and Goose Bay Curling Club operational for the foreseeable future. This option does not add any new recreation facilities or services. It simply maintains the current level of service, whether it is adequate or not.

All required repairs and up-grades to the existing facilities would be completed as necessary with major issues addressed first, with ageing equipment and building components replaced over time as required. The scope of this work is described in section 2.4 *Recommended renovations to continue operating existing facilities.*

The net present value (NPV) analysis considers the following project components and elements for this scenario:

- The capital cost of immediate, mid-term and long term repairs and/or upgrades required for each facility.
- The sale of the former CAF Arena building with profits used to offset the repair costs on recreation facilities.
- The capital cost to construct a new fire hall and the sale of the existing fire hall. (This is included in all options that retain the Broomfield Arena in order to equalize the comparison. Scenarios 3a/b and 4a/b allow the conversion of the existing arena building into a new fire hall).
- Current revenues and operating costs and how they may change in the future.

Scenario 1b: Maintain the status quo, redevelop CAF Arena.

This option is basically the same as Scenario 1a with the addition of the CAF Arena building redeveloped into an indoor soccer and walking/running track facility. The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of immediate, mid-term and long term repairs and/or upgrades required for each facility.
- The capital cost to redevelop the former CAF Arena building for indoor soccer and track.
- The capital cost to construct a new fire hall and the sale of the existing fire hall.
- Current revenues and operating costs and how they may change in the future.
- Projected revenues and operating costs for the new soccer and track facility.

Scenario 2a: Build an aquatics and fitness facility, maintain the Broomfield Arena and Curling Club.

This scenario involves building an approximately 5,000 m^2 (53,800 sf) stand-alone aquatics and fitness facility to replace the Labrador Training Centre on Town-owned property. The new building would include a 25 metre competition pool, a shallow-water leisure pool, a full-sized gymnasium, an indoor walking/running track, strength and conditioning area, fitness studios and associated change room, lobby, offices and other support spaces.

The Broomfield Arena and the Curling Club would be renovated and/or upgraded in the same manner as described in Scenario 1a. The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new aquatics and fitness facility.

- The capital cost of immediate, mid-term and long term repairs and/or upgrades required for the Broomfield Arena and the Curling Club.
- The sale of the former CAF Arena and the Labrador Training Centre building with profits used to offset the capital and repair costs associated with the other recreation facilities.
- The capital cost to construct a new fire hall and the sale of the existing fire hall.
- Current revenues and operating costs for the Broomfield Arena and the Curling Club and how they may change in the future.
- Projected revenues and operating costs for the new aquatics and fitness facility.

Scenario 2b: Build an aquatics and fitness facility, maintain the Broomfield Arena with a new extension for Curling.

This scenario involves building a new aquatics and fitness facility as described in Scenario 2a on Town-owned land adjacent to the Broomfield Arena. The Broomfield Arena would be renovated and upgraded with an extension constructed to provide a four sheet ice surface suitable for the Curling Club. Common spaces such as dressing rooms, washrooms and the canteen would be shared between the arena and the Curling Club.

The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new aquatics and fitness facility.
- The capital cost of immediate, mid-term and long term repairs and/or upgrades required for the Broomfield Arena.
- The capital cost to construct the Curling Club addition to the Broomfield Arena.
- The sale of the former CAF Arena, the Labrador Training Centre and the Curling Club buildings with profits used to offset the capital and repair costs on recreation facilities. These properties may be more valuable sold as a single parcel then sold individually.
- The capital cost to construct a new fire hall and the sale of the existing fire hall.
- Current revenues and operating costs for the Broomfield Arena and how they may change in the future, including the impact of the new Curling Club addition.
- Projected revenues and operating costs for the new aquatics and fitness facility and the new Curling Club facility.

Scenario 3a: Build a complete wellness centre on Town-owned land to replace all existing facilities.

This scenario involves constructing an approximately 10,014 m^2 (107,750 sf) wellness centre on Town-owned property, adjacent to the Broomfield Arena.

The new building would include a 25 metre competition pool, a shallow-water leisure pool, a full-sized gymnasium, an indoor walking/running track, strength and conditioning area, fitness studios, an NHL-sized ice rick with spectator seating, four sheet curling facility with spectator seating, and all associated change room, lobby, canteen, office and other support spaces.

This building would replace all existing recreation infrastructure and allow those properties to be sold and the Broomfield Arena to be converted into a new fire hall. This conversion would involve a partial demolition of the south end of the arena to reduce the size of the building. The existing fire hall would be sold and the profits applied to offset capital costs.

The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new complete wellness centre facility.
- The capital cost to convert the Broomfield Arena building into a new fire hall.
- The sale of the former CAF Arena, the Labrador Training Centre and the Curling Club buildings with profits used to offset the capital cost of the new wellness centre.
- The sale of the existing fire hall with profits used to offset the capital cost of the arena conversion.
- Projected revenues and operating costs for the new wellness centre.
- Projected operating costs for new fire hall / converted Broomfield Arena.

Scenario 3b: Build a complete wellness centre in the Town Centre Development to replace all existing facilities.

This scenario is the same as Scenario 3a except that the new wellness centre would be constructed on land within Goose Bay Capital Corporation's Town Centre Development. The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new complete wellness centre facility.
- Land acquisition costs for the Town Centre site.
- The impact of potential construction schedule constraints imposed by the developers related to the availability and/or accessibility of the site within the larger development area.
- The capital cost to convert the Broomfield Arena building into a new fire hall.
- The sale of the former CAF Arena, the Labrador Training Centre and the Curling Club buildings with profits used to offset the capital cost of the new wellness centre.
- The sale of the existing fire hall with profits used to offset the capital cost of the arena conversion.
- Projected revenues and operating costs for the new wellness centre.
- Projected operating costs for new fire hall / converted Broomfield Arena.

Scenario 4a: Phased construction of a complete wellness centre on Town-owned land to replace all existing facilities.

In this scenario the approximately 10,014 m^2 (107,750 sf) wellness centre as described in Scenario 3a would be constructed in two distinct phases.

Phase I would see the aquatics area, general fitness and shared common and support spaces constructed — approximately 5,675 m^2 (61,063). Phase II would be the arena and curling portions of the centre — approximately 4,340 m^2 (46,700 sf). This scenario also requires that some repairs and renovations be undertaken at the Broomfield Arena and the Curling Club to allow them to continue operating until Phase II was completed.

The new wellness centre would be constructed on Town-owned land adjacent to the Broomfield Arena. Once all phases of the new facility are complete, the Broomfield Arena would be converted into a new fire hall and the existing fire hall sold, along with the remaining recreation buildings.

The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new complete wellness centre facility in two phases. Phase I to begin in 2015 and Phase II to begin approximately four years later.
- The capital cost to repair and maintain the Broomfield Arena and Curling Club until Phase II is completed.
- The immediate sale of the former CAF Arena; the sale of the Labrador Training Centre once Phase I is complete; and the sale of the Curling Club once Phase II is complete. All profits will be used to offset the capital cost of the new wellness centre.
- The capital cost to convert the Broomfield Arena building into a new fire hall after the completion of Phase II.
- The sale of the existing fire hall with profits used to offset the capital cost of the arena conversion.
- Current revenues and operating costs for the Broomfield Arena and Curling Club continuing up to the end of Phase II construction.
- Projected revenues and operating costs for the new wellness centre assuming that the Phase I portion of the building can be operated during the construction of Phase II.
- Projected operating costs for new fire hall / converted Broomfield Arena.

Scenario 4b: Phased construction of a complete wellness centre in the Town Centre Development to replace all existing facilities.

This scenario is the same as Scenario 4a except that the new wellness centre would be constructed on land within Goose Bay Capital Corporation's Town Centre Development. The NPV analysis considers the following project components and elements for this scenario:

- The capital cost of constructing the new complete wellness centre facility in two phases. Phase I to begin in 2015 and Phase II to begin approximately four years later.
- Land acquisition costs for the Town Centre site.
- The impact of potential construction schedule constraints imposed by the developers related to the availability and/or accessibility of the site within the larger development area.
- The capital cost to repair and maintain the Broomfield Arena and Curling Club until Phase II is completed.
- The immediate sale of the former CAF Arena; the sale of the Labrador Training Centre once Phase I is complete; and the sale of the Curling Club once Phase II is complete. All profits will be used to offset the capital cost of the new wellness centre.
- The capital cost to convert the Broomfield Arena building into a new fire hall after the completion of Phase II.
- The sale of the existing fire hall with profits used to offset the capital cost of the arena conversion.
- Current revenues and operating costs for the Broomfield Arena and Curling Club continuing up to the end of Phase II construction.
- Projected revenues and operating costs for the new wellness centre assuming that the Phase I portion of the building can be operated during the construction of Phase II.
- Projected operating costs for new fire hall / converted Broomfield Arena.

3.2 Projects Included in NPV Analysis

3.2.1 Redeveloped CAF Arena

The Canadian Air Force (CAF) Arena was constructed in the early 1950's as a non-regulation sized ice hockey rink facility for the recreational use of military personnel stationed at CFB Goose Bay. The approximately 2,000 m^2 (21,500 sf) building is an early example of a pre-engineered structure and was constructed by the same manufacturer who supplied the Labrador Training Centre. The facility has not been used for over 20 years, except as unheated storage, and the interior has fallen into disrepair. The exterior of the building, however, is in excellent shape with no evidence of corrosion or major mechanical damage to the wall or roof cladding. The cladding panels are likely aluminum, rather than galvanized steel which is more common today. This assumption has not been confirmed through materials testing.

During consultations with community stakeholders the need for a year-round indoor soccer facility and indoor walking or running track was identified. Scenario 1b proposes that the CAF Arena be redeveloped into such a facility. If Scenarios 3 or 4 proceeded then there would be no need for this conversion, as a complete wellness centre would provide the necessary facilities.

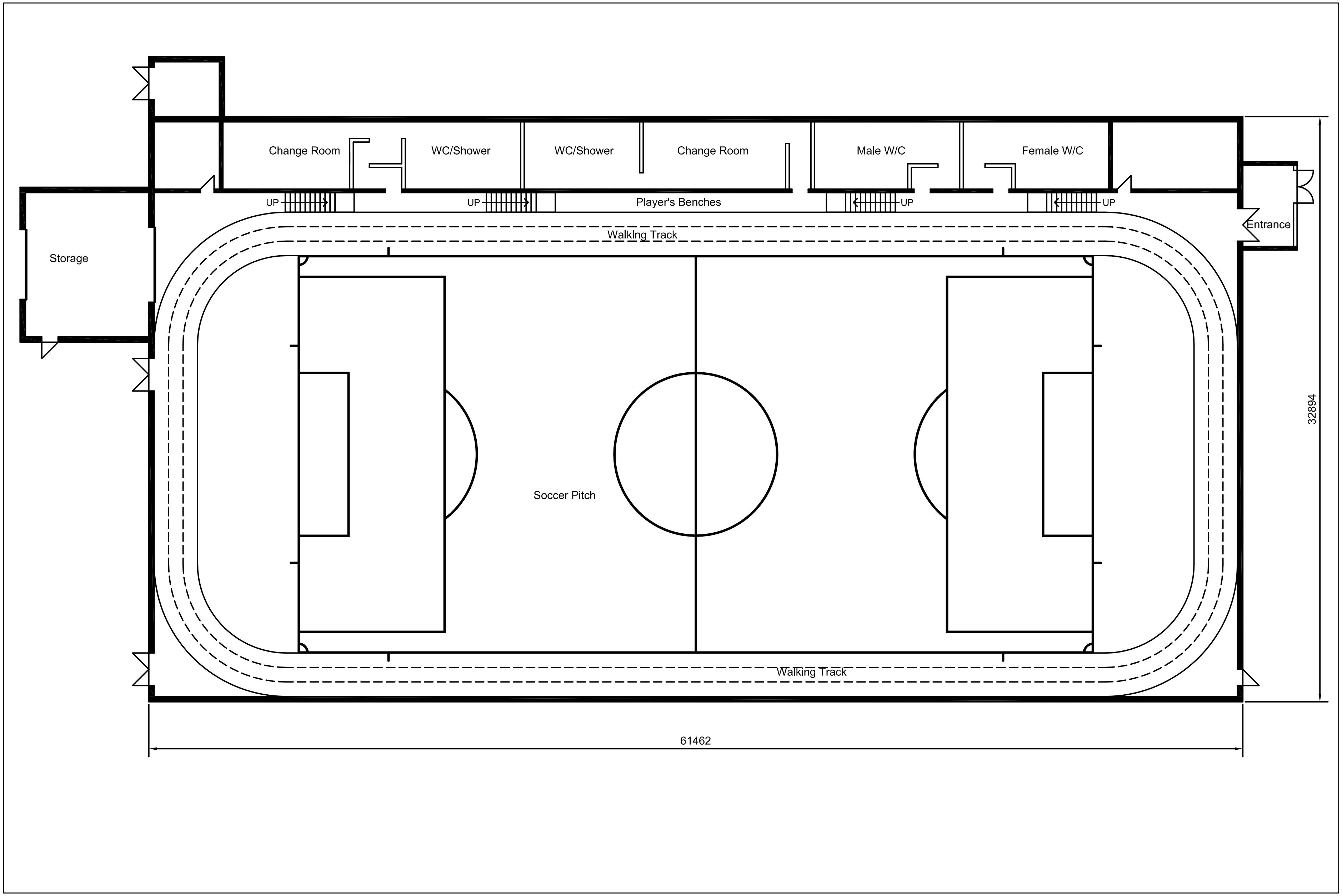
There is sufficient room to provide a 23 x 45 metre artificial turf field surrounded by a 2.4 x 155 metre long track. The existing bleachers are in excellent condition and only require minor renovations to make them compliant with National Building Code requirements. The area under the bleachers would be completely demolished and new change room and washroom facilities constructed. Renovations would also include an upgrading of the exterior wall insulation, installation of new metal liner panels, an upgraded entrance with new exterior doors and a complete new basic ventilation and electrical system to support the requirements of the new occupancy.

The total cost to convert the CAF Arena into a basic indoor soccer and track facility is estimated to be approximately **$2,071,000.** This figure represents the construction cost only, estimated to a *Class D* level. It includes all demolition, new construction and fixed equipment required for a functional facility. It does not include loose equipment, consulting fees or taxes. (Fees are discussed later in the report).

View of the CAF Arena building exterior.

Bleacher mezzanine level.

View into the main open area from the bleacher mezzanine.



CAF Arena: main floor plan of potential redevelopment into a soccer and track facility.

3.2.2 New Aquatics and Fitness Facility

Scenarios 2a and 2b propose that a new stand-alone aquatics and fitness facility be constructed and the existing ice sports facilities be maintained. Sheppard Case Architects have designed two facilities with a program similar to what would be required in Happy Valley–Goose Bay: The Ches Penney Family Y in St. John's and the Marystown Recreation Centre, on the Burin Peninsula. These facilities each included rectangular lap pools (competition-sized in Marystown), shallow water leisure pools, walking/running tracks, gymnasia, strength and condition areas, fitness studios and associated change rooms, lobby and office spaces. The Y also included a 60-space childcare centre.

The Ches Penney Family Y is a 6,040 m^2 (65,000 sf) building, constructed between 2009-2011 for a total cost of $15.8 million (plus HST). The public tender for the 3,250 m^2 (35,000 sf) Marystown Recreation Centre closed in December of 2013 for $12.9 million (plus HST) and construction began in April of 2014.

By applying an escalation factor to account for the time difference between each of these projects and a potential project in Goose Bay of two per cent per annum and a location factor to account for differences in construction costs between regions of 1.75 per cent (St. John's) and 1.5 per cent (Marystown) we are able to reasonably estimate the cost of building each of these facilities in Goose Bay in 2015: approximately $30.5 million for the Y and $19.7 million for the Marystown project.

Assuming that the Happy Valley–Goose Bay facility would have an area half-way between each facility, we can estimate that the cost would be approximately **$25,103,405.** This figure does not include loose equipment, consulting fees or taxes. Fees are discussed later in the report and they are included in the NPV analysis, as is an allowance for loose equipment.

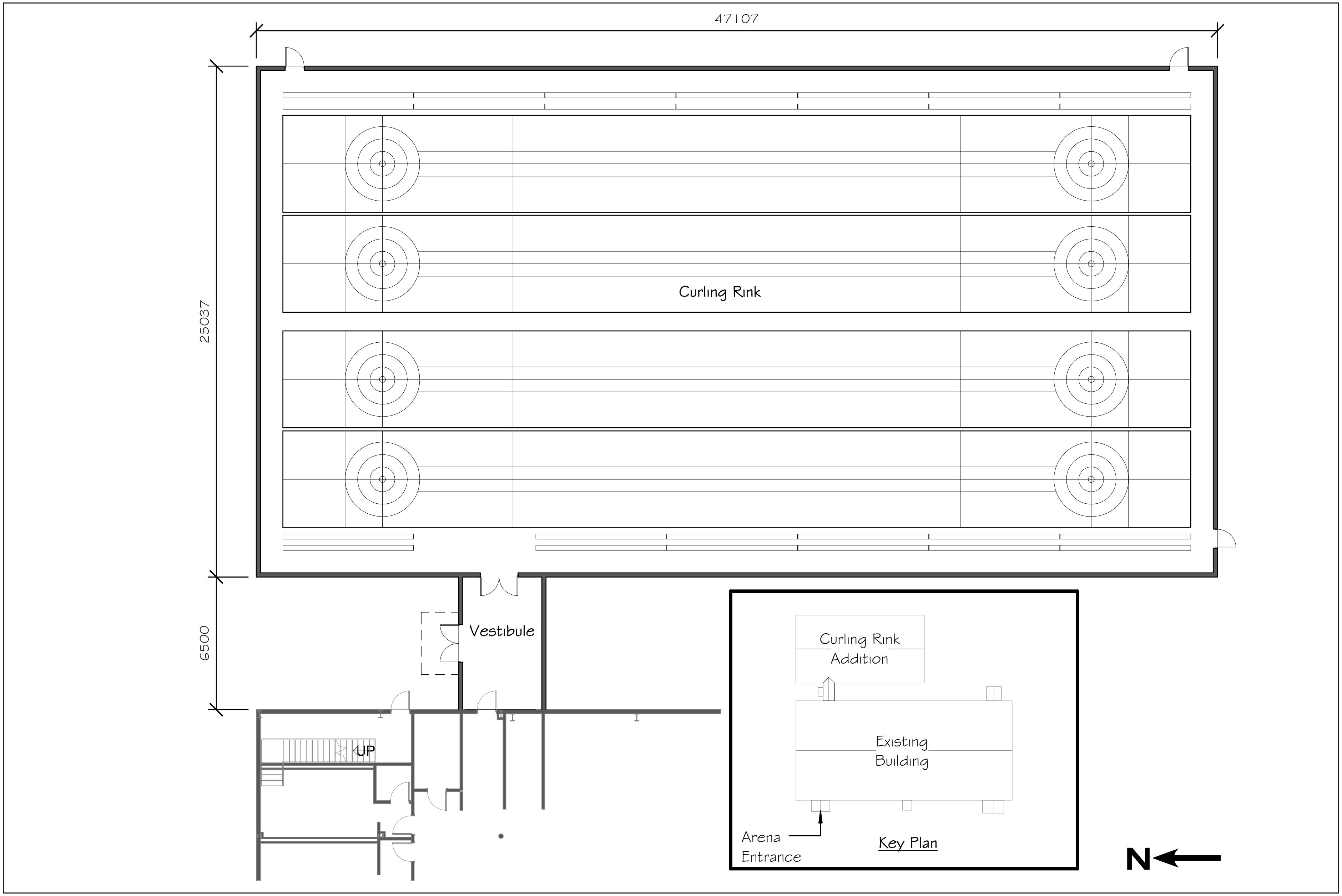
3.2.3 Curling Club Extension to Broomfield Arena

An extension to the Broomfield Arena is proposed in Scenario 2b to accommodate the Goose Bay Curling Club. This project would involve constructing an approximately 1,205 m^2 (12,970 sf) free-standing pre-engineered structure on the east side of the arena, connected to the existing main lobby by a 6.5 metre long link. Due to site constraints — specifically the proximity of the municipal depot — this location is really the only one available for an expansion large enough to contain the curling facility.

The addition would be a clear-span structure housing four curling sheets on a single ice surface with spectator seating on either side of the building, along the long axis. The existing Broomfield Arena ice plant would be expanded and augmented as required to provide refrigeration for the new ice surface. In order to control costs, no support spaces such as dressing rooms, public washrooms or a canteen would be provided in the new extension. Rather, the existing support facilities in the Broomfield Arena would be utilized by the Goose Bay Curling Club.

Using industry-standard *Class D* costing strategies to apply per-area figures (prorated for construction in the Happy Valley - Goose Bay area) to building elements such as substructure, structure, exterior envelope, doors, interior finishes, mechanical and electrical systems and site work we can reasonably assume that it will cost approximately **$3,680,000** to build the curling club extension and upgrade the existing Broomfield Arena ice plant as required.

This figure represents the construction cost only, estimated to a *Class D* level. It includes all demolition, new construction and fixed equipment required for a functional facility. It does not include loose equipment, consulting fees or taxes. Fees are discussed later in the report and they are included in the NPV analysis, along with an allowance for loose equipment.



Plan of a proposed extension to the Broomfield Arena to accommodate the Goose Bay Curling Club.

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3.2.4 New Complete Wellness Centre

Scenarios 3a and 3b propose building a new multipurpose wellness centre to replace all existing recreation facilities either on a Town-owned site or a site within *Goose Bay Capital Corporation's* Town Centre Development. Scenarios 4a and 4b involve the same building and site options, but with a phased approach to the construction whereby the aquatics, fitness and common spaces are constructed first with the ice arena and curling areas to follow.

The new facility would be approximately 10,014 m^2 (107,750 sf) on two levels, plus basement and penthouse mechanical rooms, and would include the following program areas or similar spaces to be determined after a detailed programming exercise:

- A large common lobby and entrance providing access to all functional areas of the building.
- A canteen with a seating area in the main lobby and a service counter in the hockey arena.
- A community kitchen and food preparation area.
- An indoor children's play area, adjacent to the lobby, with a jungle gym and other fitness-related play structures.
- A 25 metre, six-lane competition-ready pool.
- A beach-entry shallow water leisure pool with a water slide.
- A 674 m^2 (7,250 sf) full-sized multipurpose gymnasium.
- A 145 metre long indoor walking and/or running track.
- 600 m^2 (6,450 sf) of strength and conditioning space.
- 120 m^2 (1,300 sf) fitness studio (aerobics, yoga, etc.).
- An NHL-sized rink capable of maintaining ice year-round with spectator seating for approximately 2,250 people, including a heated observation area and mezzanine level viewing.
- A 1,224 m^2 (13,170 sf) multi-use area with spectator seating for approximately 300 people, which could accommodate four curling sheets, indoor soccer, trade shows/exhibitions.
- All associated change room (male, female and family), office, and other support spaces.
- Provision for leasable retail or office space can be included in the common areas, if desired.

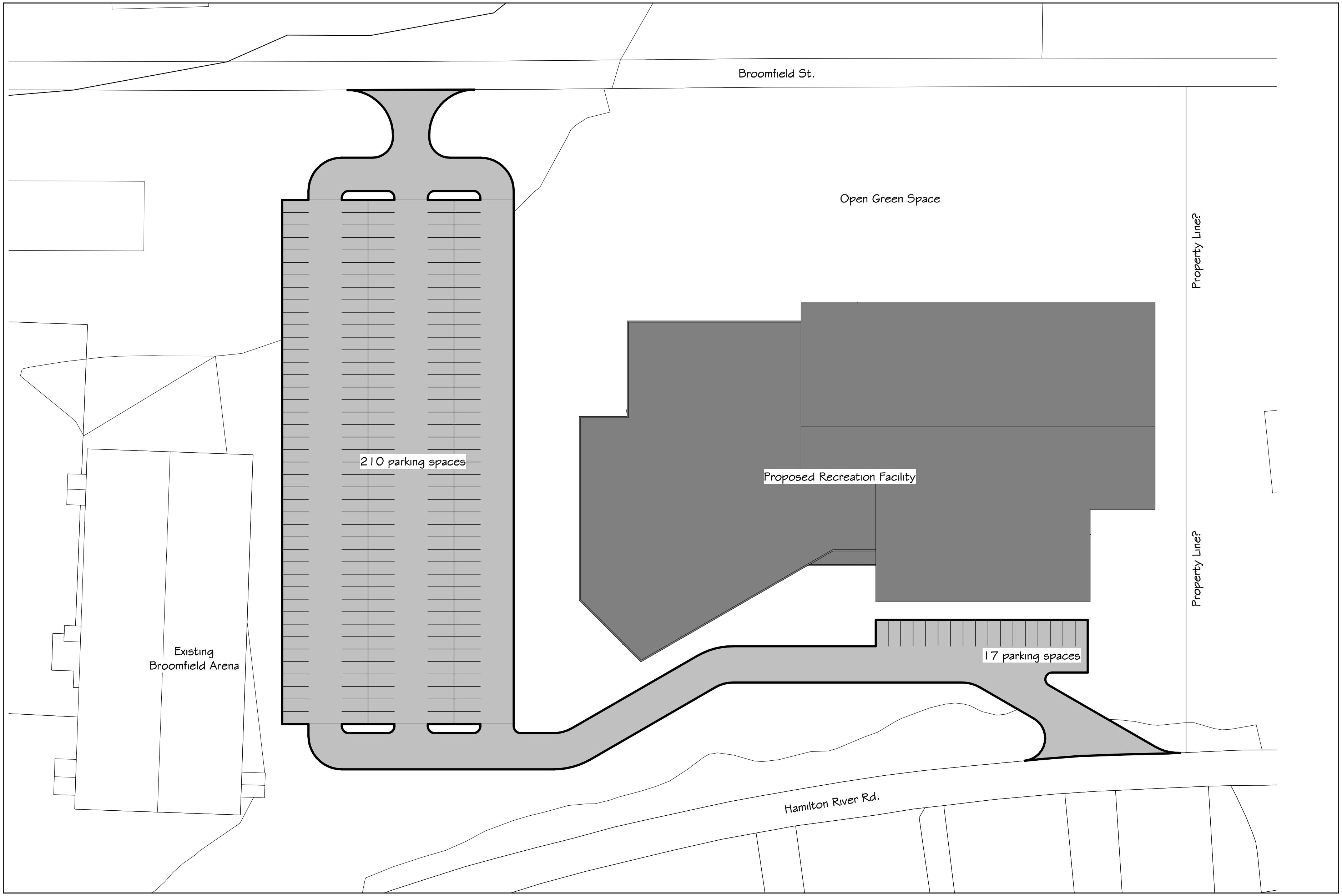
Estimating the cost of this facility involved an analysis of similar buildings built in Canada during the past 10 years with construction costs prorated to account for inflation, escalation and geographic location. The result of this exercise was a set of probable cost values per square metre (to a Class D level) for the various areas comprising the wellness centre:

• Aquatics:	1,409 m^2 @ \$4,500/m^2 — \$6,500/m^2
• Gym and Fitness:	2,008 m^2 @ \$2,750/m^2 — \$3,750/m^2
• Arena and Curling:	4,255 m^2 @ \$3,250/m^2 — \$4,750/m^2
• Common Areas:	1,458 m^2 @ \$3,500/m^2 — \$4,500/m^2
• Utility/M&E Rooms:	884 m^2 @ \$2,500/m^2 — \$3,000/m^2

These values provide the estimated costs for each area as follows:

• Aquatics:	\$6,340,500 — \$9,158,500
• Gym and Fitness:	\$5,522,000 — \$7,530,000
• Arena and Curling:	\$13,828,750 — \$20,211,250
• Common Areas:	\$5,103,000 — \$6,561,000
• Utility/M&E Rooms:	\$2,210,000 — \$2,652,000
Total building:	**\$33,004,250 — \$46,112,750**

For the net present value analysis, 75 per cent of the difference between the low and high range cost was added to the lowest value to give a *Class D* estimated cost of **\$42,835,625** for the wellness centre. This figure represents the construction cost only, including all fixed equipment and fixtures required for a functional facility. It does not include loose equipment, consulting fees or taxes. Fees are discussed later in the report and they are included in the NPV analysis, along with an allowance for loose equipment.



Proposed site plan of the new complete wellness centre located on Town-owned land east of the Broomfield Arena.

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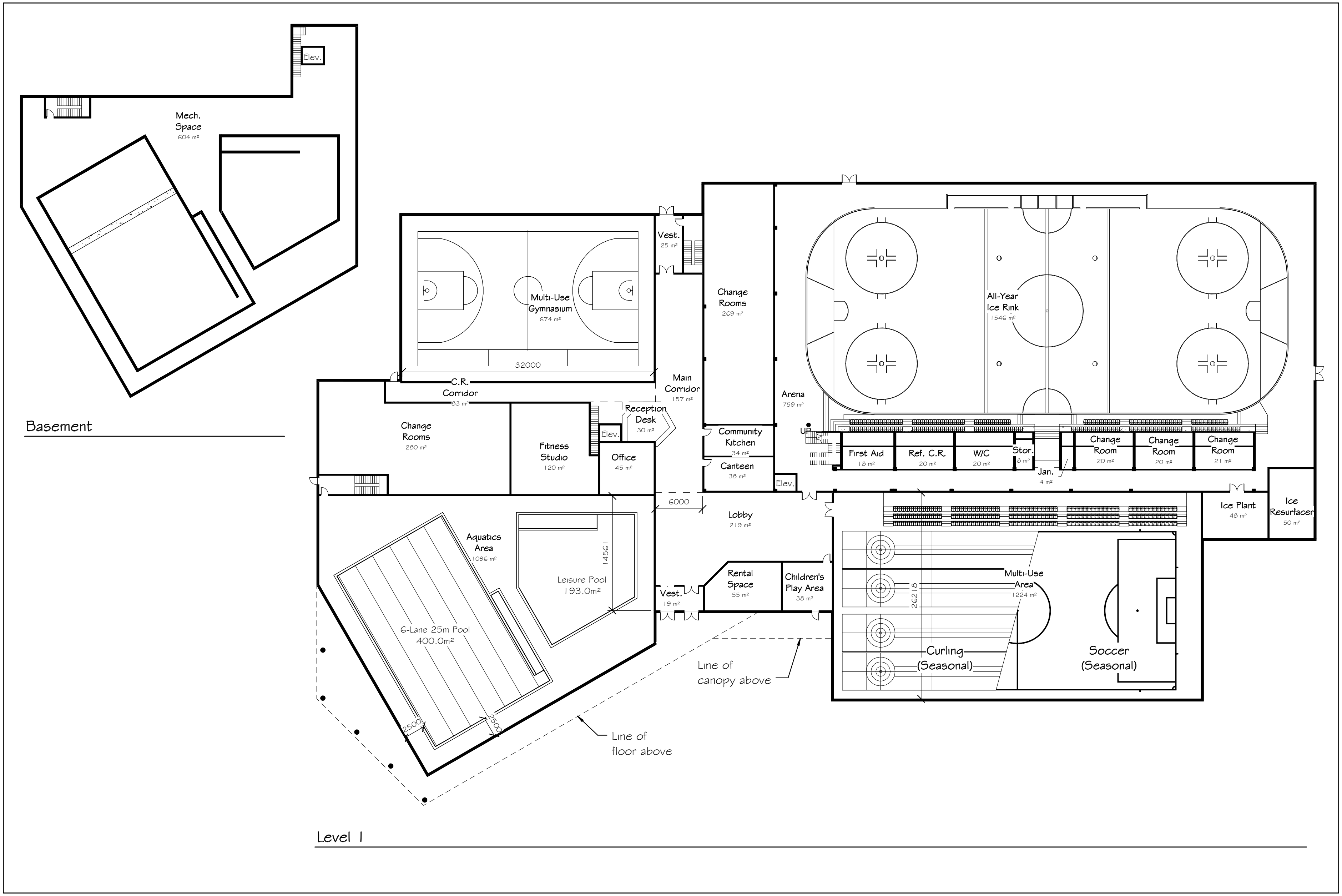
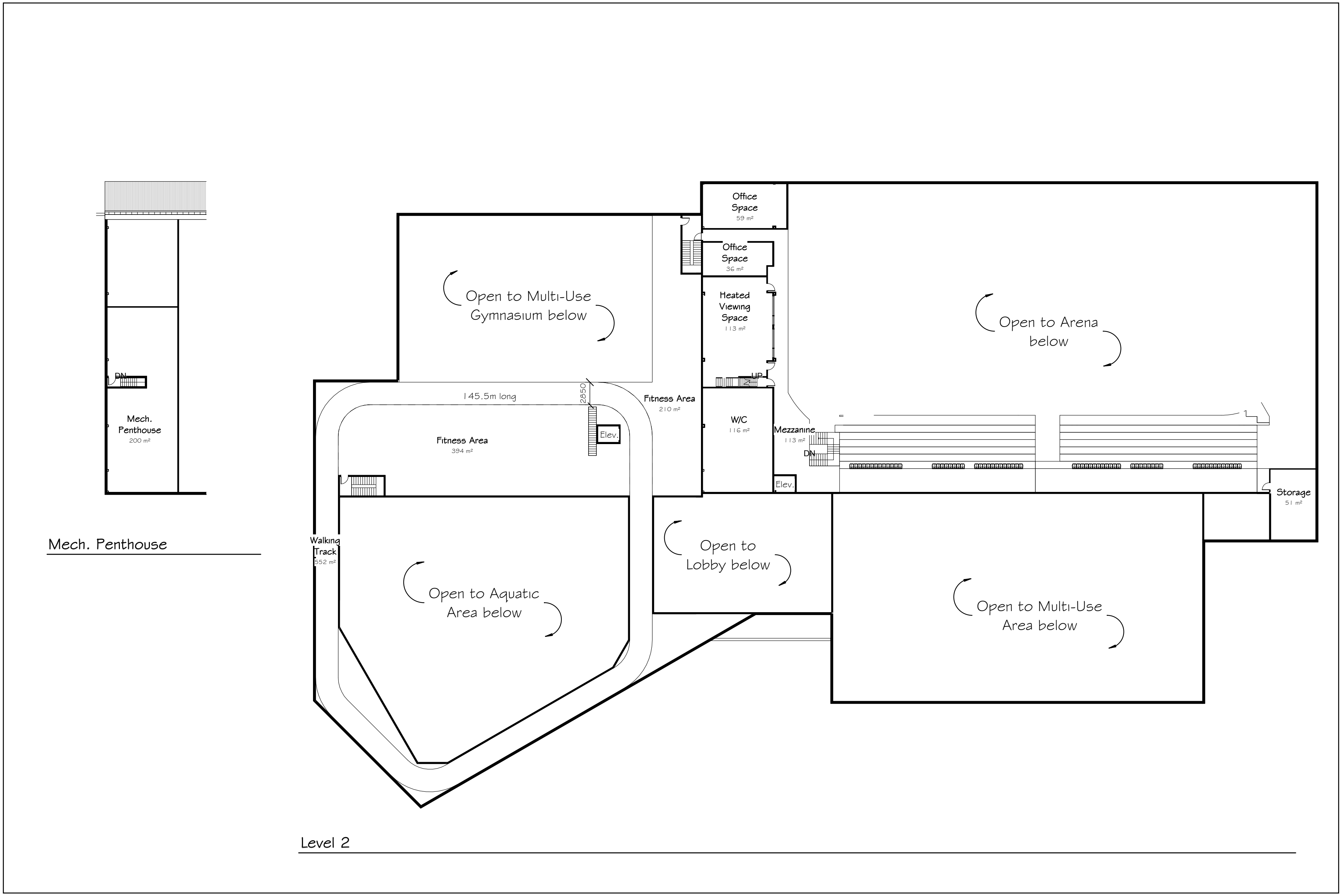


Main level and basement mechanical room plan of a proposed new complete wellness centre.

Happy Valley Goose Bay
LABRADOR, CANADA



Level 2 and mechanical penthouse plan of a proposed new complete wellness centre.

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3.2.5 Conversion of the Broomfield Arena

Scenarios 3a, 3b, 4a and 4b propose replacing the Broomfield Arena with a new facility. Once the new wellness centre is completed the existing building will be available either for redevelopment, for sale or it will require demolition. Due to its proximity to the existing municipal depot and possibly to the new wellness centre, the idea of selling the property for private development was not considered in the report.

a. Demolition

A comparative cost analysis and discussions with various contractors has determined that complete demolition of the building will cost approximately $500,000. As was discussed at length in Part 2 of this report, the northern end of the arena was only constructed in 2005 and has considerable residual value. For these reasons, complete demolition is not considered to be a recommended option.

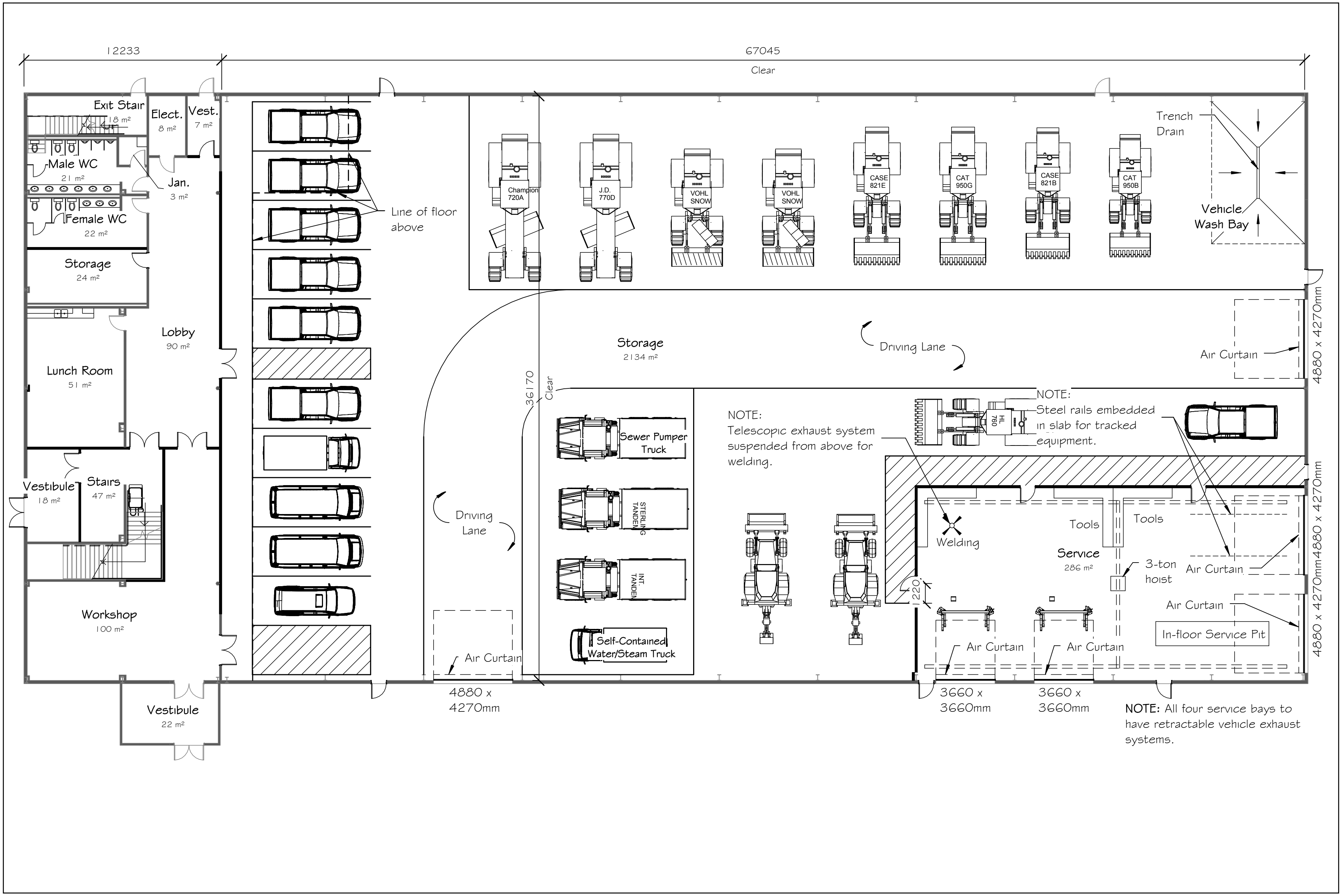
b. Conversion to a Municipal Depot

The consultants were asked to consider converting the Broomfield Arena into a depot to replace the adjacent municipal depot facility, which is not large enough to meet the needs of the Public Works department. Drawings were prepared in 2009 by the BAE Newplan Group to add a 367 m^2 (3,950 sf) extension to the existing building. The project was tendered but not awarded and the low bid was in the $900,000 range.

In consultation with Town officials a basic program was developed for the conversion which included four large-vehicle service bays with vehicle lifts and an over-head hoist, workshop, lunchroom, washrooms, office and storage space. The largest component of the program was to provide indoor storage for the Town's vehicles and equipment, including seven front-end loaders with plow or snow-blower attachments, two graders, two rubber-tire backhoes, three tandem dump trucks, two cube vans, nine light trucks and various small equipment and supplies.

A construction project to convert the Broomfield Arena into a municipal depot would involve the following scope of work:

- Demolish entire interior except the north mezzanine (2005 extension) down to exterior walls. Existing insulation recently added to the inside of exterior walls to be salvaged for reuse.
- Remove the original concrete floor slab and reinstall a new reinforced concrete slab, sloped for drainage.
- Furr existing exterior walls with new metal stud framing, reinstall batt insulation and add new metal liner panel.
- Complete repair and maintenance of the exterior cladding as recommended in Part 2 of this report.
- Add new service bay demising walls.
- Install a structurally-independent overhead crane/hoist and a maintenance pit in the service bay area.
- Add new overhead and man doors at perimeter complete with structural reinforcing of existing rigid frames/girts.
- Reconfigure existing (2005) northern extension area to new layout including an enclosed stair to resolve the non Code compliant mezzanine level exiting situation.
- Complete new general ventilation and heating system for the open garage area including air curtains over all garage doors.
- Install a compressed air system for the service bays.
- Install and oil separation systems for floor drainage.
- Complete replacement of the electrical service and distribution equipment.
- Supplemental lighting for service bays. Existing rink lighting may be reused for the general vehicle storage area.



Level 1 plan of the proposed conversion of the Broomfield Arena into a Municipal Depot.

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The probable cost of this construction project was generated through industry-standard *Class D* costing strategies, applying per-area figures prorated for construction in the Happy Valley–Goose Bay area to building elements as follows:

- Selective demolition — $559,000
- Supplementary foundation work and new reinforced concrete slab — $1,152,500
- Envelope repairs and replacement — $1,081,700
- Interior partitions, doors and finishes — $199,000
- Spray fireproofing as required — $49,500
- New overhead doors c/w structural requirements — $300,000.
- Gable roof and steel modifications at OH doors — $250,000
- Overhead crane/hoist c/w structure — $240,000
- Mechanical systems — $559,500
- Electrical systems — $746,000
- New fittings and equipment — $186,500
- Design contingency allowance — $532,420

The total estimated construction cost to convert the arena into a municipal depot is **$5,857,000.** This figure is more than five times the cost of the proposed extension to the existing depot. It is difficult to compare the costs of these two projects since the depot extension will create a building much smaller than the approximately 3,450 m^2 (37,122 sf) of space provided by the Broomfield conversion. If the BAE Newplan extension provides adequate space for the depot operations, it would not be feasible to proceed with converting the Broomfield Arena into a depot. For this reason, the conversion was not considered as an option in the NPV analysis.

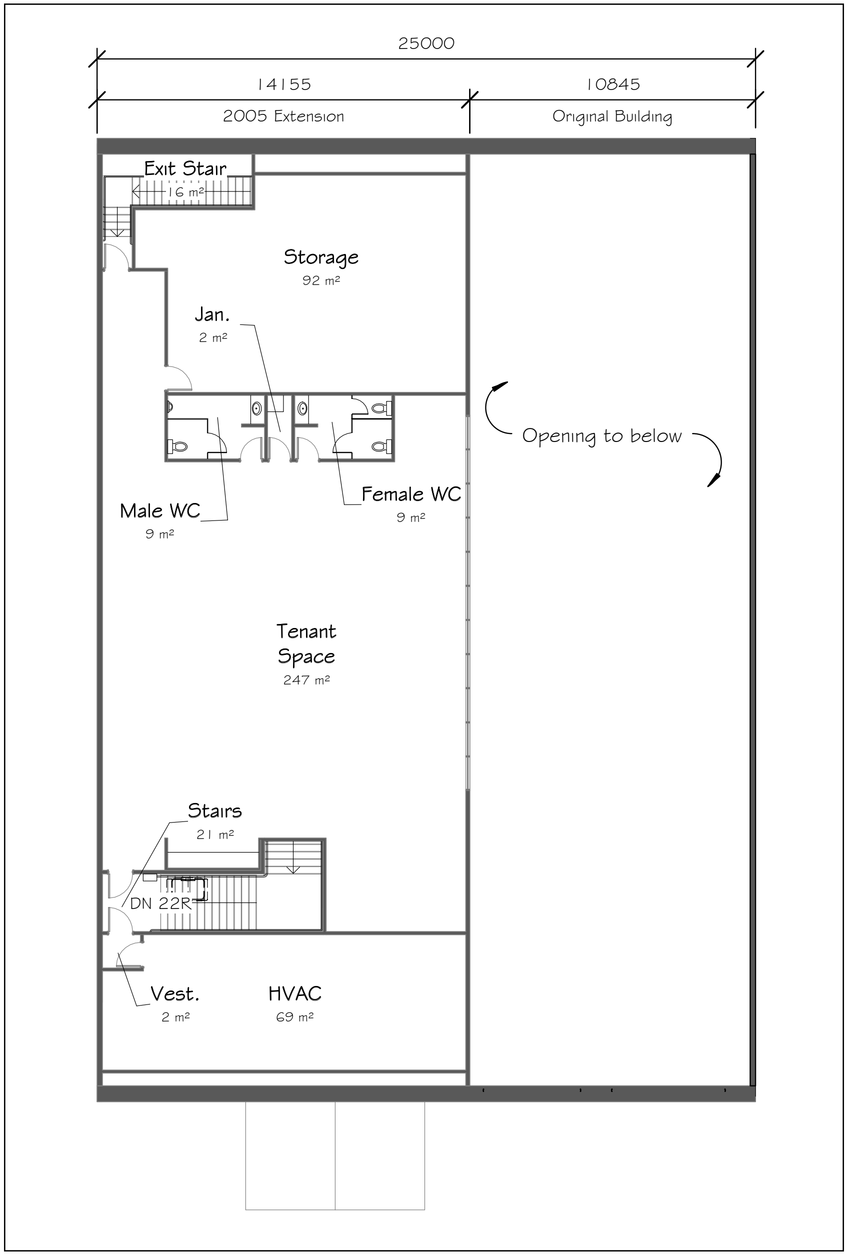
c. Conversion to a Fire Hall

The consultants were also asked to investigate the possibility of converting the existing municipal depot building into a fire hall if the Broomfield Arena were to become the new depot. Since the arena-to-depot conversion is not economically viable when compared to simply extending the existing depot building, the existing depot would not be available for redevelopment. However, converting the Broomfield Arena into a fire hall is an option worth considering.

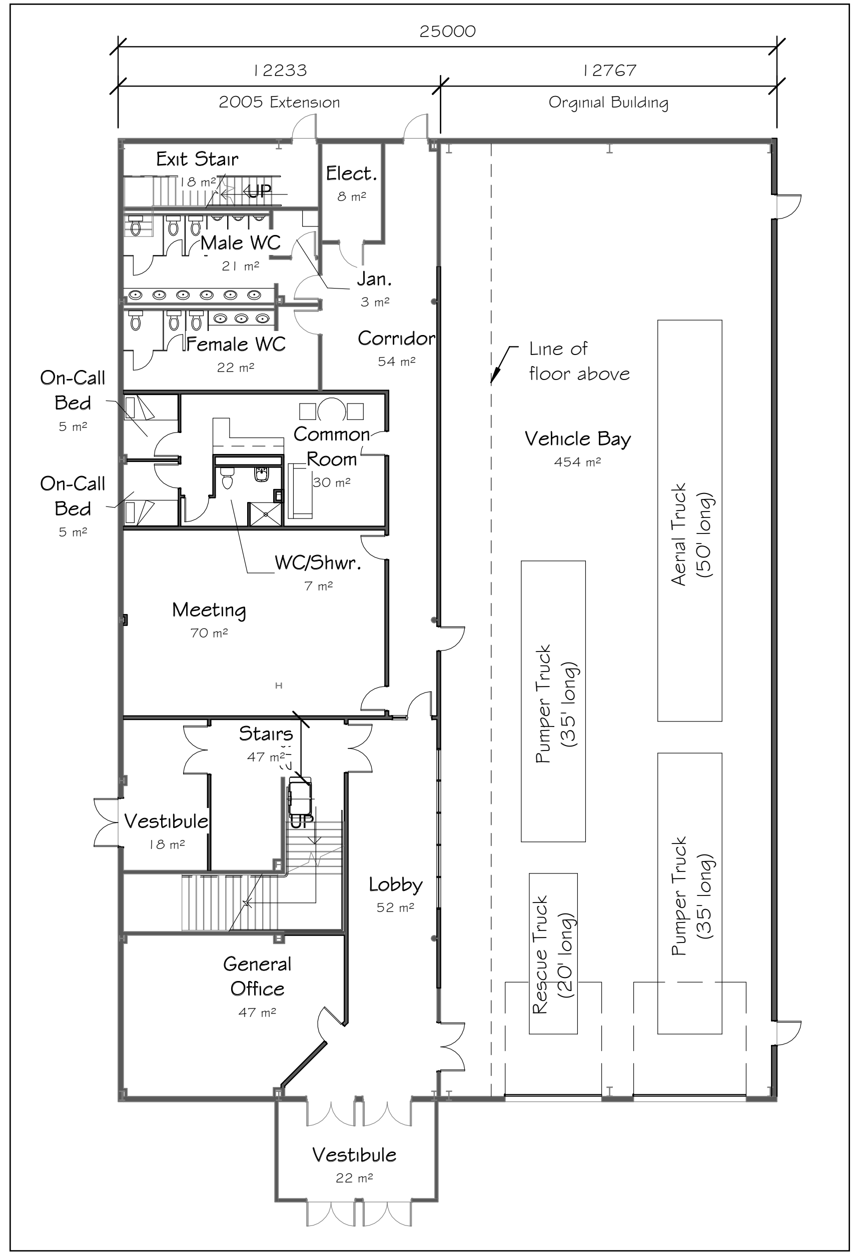
The current fire hall does not have the garage space to accommodate additional firefighting vehicles and if the Town were to ever purchase an aerial device, it cannot possibly fit in the existing fire hall due to insufficient overhead clearance. The design approach for converting the arena building into a fire hall first involves demolishing a large portion of the original building. The 2005 extension would remain in its entirety, but only two structural bays (approximately 12.7 metres) of the open arena area would be retained. This would become a two-bay garage, the full depth of the building. Which provides more than enough room for two pumpers, one aerial apparatus, one rescue vehicle and any smaller firefighting equipment as required.

The 2005 extension would be renovated to house ancillary spaces on level 1 including a general office area, a large meeting room, washrooms, sleeping quarters and a lounge for two personnel. The main stairs to the mezzanine level will be enclosed and provided with an exterior entrance separate from the fire hall. This will allow the second level to become leasable tenant space. The approximately 270 m^2 (2,895 sf) of space could potentially earn an annual income of $72,375 if leased at a rate of $25/sf.

The probable cost to convert the Broomfield Arena into a fire hall, including the partial demolition, has been estimated at $2,288,000. This figure represents the construction cost only, estimated to a *Class D* level. It does not include loose equipment, consulting fees or taxes. Fees are discussed later in the report and they are included in the NPV analysis.



Proposed conversion of the Broomfield Arena to a fire hall: Level 2.



Proposed conversion of the Broomfield Arena to a fire hall: Level 1.

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3.3 Consultant Fees and Expenses

As a basis to estimate consultant fees on projects we refer to the ***Guidelines and Recommended Minimum Fees for Architectural and Engineering Projects*** published jointly in 2003 by the Newfoundland and Labrador Association of Architects (NLAA) and the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL). This is the most recent version of the document, though an update is anticipated for release later in 2014.

3.3.1 Basic Fee as a Percentage of Construction Cost

In the Guidelines, building types are categorized by complexity and placed into one of seven groups. Assembly occupancies (as per the National Building Code) containing ice-arenas fall under Category 3, those containing pools are under Category 5 and those containing only fitness or gymnasium facilities are Category 4. The fire hall would also be considered a Category 4 building.

A corresponding table in the Guidelines list recommended percentages for the various project categories depending on the construction value of the project. Buildings of a higher complexity have a higher percentage fee than those of lesser complexity. The higher the construction value within a category, the lower the percentage. The HST on projected construction cost is not included in the percentage fee calculation. However, HST is charged on all consulting services.

3.3.2 Additional Consulting Fees

Besides the basic percentage fee recommended by the Guidelines and detailed above, there will be additional fees for consulting beyond the scope of basic services. These additional services would include commissioning, LEED consulting, energy modeling, landscape design, geotechnical engineering and surveying.

a. Commissioning

The Guidelines recommend a fee of 0.7 per cent of the construction cost for commissioning activities. For large, higher cost projects, this fee would provide sufficient funding for *enhanced commissioning* which would include a separate commissioning agent not otherwise associated with the project. On a smaller project it would only provide *fundamental commissioning* services undertaken by the design engineer.

b. LEED Consulting

If the project is targeting some level of LEED certification, the services of a LEED accredited professional (AP) will be required. For the purposes of the NPV analysis we assumed that all new-builds would target LEED. The fees for a LEED AP are not typically based on a percentage, rather they are tied to the scope of work with a minimum amount required regardless of the size of the project. The minimum fee would be adjusted as necessary to account for the complexity of larger projects.

c. Miscellaneous Fees and Expenses

Fees for landscape architects, geotechnical engineers, surveyors and other specialists are usually based on the scope of work or the construction value of their portion of the project.

Typical disbursements and expenses for projects will include: permit and registration fees for various government agencies to cover submittals for fire and life safety, accessibility, environmental health, etc.; LEED registration and certification fees payable to the Canada Green Building Council; energy modelling required for LEED certification; printing and courier costs; travel and accommodations; and additional site visits beyond once-monthly project meetings. Administrative fee mark-ups are often applied to disbursements in the range of five to 10 per cent.

3.3.3 Schedule of Fees and Expenses for NPV Analysis

Project	Construction Cost	Building Category	% Fee	Basic Fee	Cx Fee @ 0.7%	LEED Fee	Misc. Fees & Expenses	Total (HST not included)
Broomfield renos: short term	$3,276,790	3	8.48%	$277,872	$22,938	NA	$75,000	**$375,810**
Broomfield renos: mid-term	$1,817,200	3	9.27%	$168,454	$12,720	NA	$40,000	**$221,174**
Broomfield renos: long term	$653,180	3	10.57%	$69,041	$4,572	NA	$25,000	**$98,613**
Curling Club renos: short term	$2,095,500	3	8.85%	$185,452	$14,669	NA	$65,000	**$265,121**
Curling Club renos: mid-term	$608,300	3	10.57%	$64,297	$8,516	NA	$30,000	**$102,813**
Curling Club renos: long term	$272,250	3	10.57%	$28,777	$1,906	NA	$20,000	**$50,683**
Lab Training renos: short term	$2,468,730	5	10.55%	$260,451	$17,281	NA	$75,000	**$352,732**
Lab Training renos: mid-term	$1,276,000	5	11.32%	$144,443	$8,932	NA	$40,000	**$193,375**
Lab Training renos: long term	$860,200	5	12.59%	$108,299	$6,021	NA	$30,000	**$144,320**
CAF Arena to Indoor Soccer	$2,071,000	4	9.32%	$193,017	$14,497	$50,000	$40,000	**$297,514**
New Fire Hall Building	$2,467,000	4	9.32%	$229,924	$17,269	$50,000	$125,000	**$422,193**
New Pool and Fitness Facility	$25,103,405	5	8.54%	$2,143,831	$175,724	$100,000	$225,000	**$2,644,555**
Curling Club Extension to Arena	$3,680,000	3	8.48%	$312,064	$25,760	NA	$100,000	**$437,824**
New Complete Wellness Centre	$42,835,625	3/5	7.25%	$3,105,583	$299,849	$100,000	$325,000	**$3,830,432**
Arena Conversion to Fire Hall	$2,288,000	4	9.32%	$213,242	$16,016	$50,000	$100,000	**$379,258**
New Wellness Centre Phase I	$23,999,750	5	8.54%	$2,049,579	$167,998	$50,000	$225,000	**$2,492,577**
New Wellness Centre Phase II	$21,653,625	3	7.10%	$1,537,407	$151,575	$100,000	$225,000	**$2,013,982**

3.4 Financial (Net Present Value) Analysis

3.4.1 Introduction

The financial analysis examines a variety of capital and operating scenarios for upgrading or replacing the existing recreation facilities in Happy Valley–Goose Bay. It also involves the conversion, re-use or sale of former recreation facilities if they were no longer required for recreational use as per the parameters of the redevelopment scenarios.

The analysis uses a net present value (NPV) calculation to allow comparison of the financial implications of scenarios that have different capital costs, different operating costs and different timing of expenditures. The analysis depends on many assumptions which are briefly explained in this document. Careful attention should be given to the assumptions and their rationale, as different assumptions will produce different results.

There are eight redevelopment scenarios, each with its own list of sub-projects, schedules and operating costs. This large number of combinations and permutations may lead to some confusion between the similarities and differences of each scenario. Refer to section 3.1 of this report, *Net Present Value Scenario Descriptions,* for a detailed discussion of the scenario options. The capital costs and potential timing for each scenario are based on reasonably good information. However the operating costs, which tend to dominate the net present value analysis because of the long time frame of the projection, are significantly less reliable and should be treated with caution.

The results of the net present value analysis are summarized in Table 1. Essentially, the values increase in the same sequence as the numbering of the scenarios. Further tables and spreadsheets containing the detailed calculations are included in Appendix A.

3.4.2 Assumptions

a. Time Horizon

The costs have been projected over a 30 year time horizon as requested by the client group in the Request for Proposals document. This is a reasonable estimate of the useful life of the buildings before another major redevelopment program is contemplated due to aging basic systems and changing community needs. However, it is a very long time frame for projecting operating costs particularly when the starting point is uncertain.

b. Building Construction Costs

Construction cost estimates in this report are intended to provide *order of magnitude* costs only and are accurate to *Class D* standards or +/-25 per cent as per generally recognized industry practices. The construction costs include all site development and design and construction contingencies. Refer to Table 3 for a summary of project capital costs.

c. Equipment Costs

Allowances for equipment purchase were estimated based on the type and size of the proposed facilities as compared to similar facilities Sheppard Case Architects have been involved with in recent years. For the renovation-only projects, it is assumed that most of the equipment currently in use will remain serviceable. Table 3 summarizes the equipment costs for each project.

d. Consulting Fees

The rational behind the estimated consultant fees and expenses included in the net present value analysis is explained in detail in section 3.3 of this report, *Consultant Fees and Expenses*. These costs are also summarized in Table 3.

e. Schedule

The sequence and timing of construction is quite complex and the various project elements within each scenario are dependent on each other. Refer to Table 4 for details of how the construction sequence and timing under each scenario affect yearly cost flows.

f. Construction Cost and Net Operating Cost Inflation

Inflation is applied to construction costs in each year at a rate of six per cent per year starting in 2014 (Year 0). This is higher than the general rate of increase in the Consumer Price Index to reflect the historic price pressure on construction industries in Labrador.

Inflation is applied to net operating costs in each year at a rate of two per cent per year starting in 2014 (Year 0).

g. Recovery Value of Existing Buildings

Recovery values are based on appraisals prepared by Altus Group Ltd. (attached as Appendix B) and are adjusted for inflation to the anticipated time of sale. The value of the Labrador Training Centre is included, although it is not currently owned by the Town.

h. Capital Grants

Capital costs have been offset by capital grants from the federal and/or provincial governments totaling 70 per cent of the required capital funding. The recovery value of lands to be sold is not factored into the grant formula.

i. Capital Reserve Fund

There is insufficient information at this preliminary stage to calculate an appropriate life cycle cost based capital reserve fund. Instead, a reserve amount has been estimated at 1.5 per cent of the new capital investment, accumulating annually.

j. Operating Costs and Revenues

The consultants were provided with two background documents describing requirements for recreation facilities in Happy Valley–Goose Bay: one by Hatch Mott MacDonald from 2008; and one by Stantec from 2013. Neither of these reports present a rigorous business plan for proposed new facilities that would provide useful information on future program offerings, revenue potential, staffing profile for the new facilities or operating expenses.

Financial statements and utility bills were provided by the Town for the existing facilities and information was gleaned from a 2010 study of proposed facilities in Marystown, completed by Sheppard Case Architects and Costello Fitt. A business plan prepared in 2008 by dmA Planning and Management Services for a lifestyle centre in Bridgewater, Nova Scotia was also consulted.

The lack of reliable operating cost and revenue projections introduces a significance weakness in this net present value analysis. The best that can be done is to average per square meter operating costs from existing facilities and other sources and prorate them on the basis of the areas of the proposed new facilities. A further assumption has been made that program revenues from existing facilities will increase when new ones come on line as a result of increased enrollment and fees. Refer to Table 6 for detailed information on operating revenue and cost assumptions.

k. Financing Costs

The municipality’s 30 per cent share of the capital costs are financed over a 20 year period at five per cent per year. The principal portion is amortized in equal annual amounts starting in the year that it is drawn down and interest calculated on the declining balance.

3.4.3 Table 1: Financial Analysis Summary

	Scenario 1a	Scenario 1b	Scenario 2a	Scenario 2b	Scenario 3a	Scenario 3b	Scenario 4a	Scenario 4b
Construction costs	$15,795,150	$17,866,150	$36,293,625	$36,997,575	$45,123,625	$45,123,625	$53,313,665	$53,313,665
Consulting costs	$2,226,834	$2,524,348	$4,180,962	$4,200,169	$4,209,690	$4,209,690	$5,526,748	$5,526,748
Furniture equipment	$0	$100,000	$200,000	$200,000	$600,000	$600,000	$475,000	$475,000
Grants	-$12,615,389	-$14,343,349	-$28,472,211	-$28,978,421	-$34,953,321	-$34,953,321	-$41,520,789	-$41,520,789
Net HST	$0	$0	$0	$0	$0	$0	$0	$0
Subtotal	**$5,406,595**	**$6,147,149**	**$12,202,376**	**$12,419,323**	**$14,979,995**	**$14,979,995**	**$17,794,624**	**$17,794,624**
Sale of land/buildings	-$697,480	-$237,538	-$1,191,638	-$1,466,118	-$1,466,118	-$1,466,118	-$1,466,118	-$1,466,118
Purchase of land	$0	$0	$0	$0	$0	$3,593,625	$0	$3,593,625
Total Capital cost before inflation	**$4,709,115**	**$5,909,611**	**$11,010,738**	**$10,953,205**	**$13,513,877**	**$17,107,502**	**$16,328,506**	**$19,922,131**
Total Capital after inflation	**$6,795,894**	**$8,117,589**	**$13,284,296**	**$12,646,785**	**$15,352,969**	**$20,338,847**	**$19,907,685**	**$25,099,877**
NPV of Capital Costs	**$4,995,549**	**$6,278,210**	**$12,144,228**	**$11,829,181**	**$14,720,244**	**$18,971,934**	**$17,928,322**	**$21,518,658**
NPV of Operating Costs	**$16,949,754**	**$19,700,862**	**$26,031,418**	**$26,311,595**	**$26,690,421**	**$26,507,088**	**$30,093,895**	**$29,058,718**
Total NPV	**$21,945,302**	**$25,979,071**	**$38,175,645**	**$38,140,777**	**$41,410,665**	**$45,479,022**	**$48,022,217**	**$50,577,376**

Redevelopment Scenarios as per Section 3.1:

1a: Maintain the status quo.

1b: Maintain status quo, redeveloped CAF arena.

2a: Build an aquatics and fitness facility, maintain Broomfield Arena and Curling Club.

2b: Build an aquatics and fitness facility, maintain Broomfield Arena with a new extension for Curling.

3a: Build a complete wellness centre on Town-owned land to replace all existing facilities.

3b: Build a complete wellness centre in the Town Centre Development to replace all existing facilities.

4a: Phased construction of a complete wellness centre on Town-owned land to replace all existing facilities.

4b: Phased construction of a complete wellness centre in the Town Centre Development to replace all existing facilities.

3.4.4 Table 3: Capital Cost Summary

*refer to Appendix A for Table 2

Project		Construction Costs	Consulting Fees and Expenses	F&E Costs	Total
Broomfield Arena Renovations	Years 1 & 2	$3,276,790	$375,810	$0	$3,652,600
	Years 7 & 8	$1,817,200	$221,174	$0	$2,038,374
	Year 20	$653,180	$98,613	$0	$751,793
	Total	**$5,747,170**	**$695,597**	**$0**	**$6,442,767**
Curling Club Renovations	Years 1 & 2	$2,095,500	$265,121	$0	$2,360,621
	Years 7 & 8	$608,300	$102,813	$0	$711,113
	Year 20	$272,250	$50,683	$0	$322,933
	Total	**$2,976,050**	**$418,617**	**$0**	**$3,394,667**
Labrador Training Centre Renovations	Years 1 & 2	$2,468,730	$352,732	$0	$2,821,462
	Years 7 & 8	$1,276,000	$193,375	$0	$1,469,375
	Year 20	$860,200	$144,320	$0	$1,004,520
	Total	**$4,604,930**	**$690,427**	**$0**	**$5,295,357**
CAF Arena Conversion to Soccer and Track		$2,071,000	$297,514	$100,000	**$2,468,514**
New Fire Hall		$2,467,000	$422,193	$0	**$2,889,193**
New Pool and Fitness Facility		$25,103,405	$2,644,555	$200,000	**$27,947,960**
Curling Club Extension to Broomfield Arena		$3,680,000	$437,824	$0	**$4,117,824**
New Wellness Centre		$42,835,625	$3,830,432	$600,000	**$47,266,057**
Broomfield Conversion to Fire Hall		$2,288,000	$379,258	$0	**$2,667,258**
New Wellness Phase 1 (Aquatics and Fitness)		$23,999,750	$2,492,577	$200,000	**$26,692,327**
New Wellness Phase 2 (Arena and Curling)		$21,653,625	$2,013,982	$275,000	**$23,942,607**

Land Sales	Selling Price	Less selling costs	Net recovery
Curling Club	$292,000	-$17,520	**$274,480**
Existing Fire Hall	$252,700	-$15,162	**$237,538**
Labrador Training Centre	$565,000	-$33,900	**$531,100**
CAF Arena	$450,000	-$27,000	**$423,000**

Land Purchase	Purchase Price
Town Centre Site	**$3,593,625**