MEMO

SQUAMISH

TO: Council
FROM: Facilities Planning and Construction
DATE: February 17, 2026
RE: Summary – Ice Rink Closure Root Cause Analysis

Overview

The attached Root Cause Analysis, prepared by Summit Building Consultants (the Consultant), outlines the primary factors that led to the temporary closure of the Brennan Park ice arena in September 2025. This memo provides a high-level summary for Council's information.

The Root Cause Analysis was developed as a synthesis of multiple technical inputs, including direct site evaluations conducted by the Consultant and data provided by the professional engineering firms contracted for the project. The Root Cause Analysis reflects the combined expertise of the District's engineering partners, vendors and Facilities Staff.

Of note, professional engineering stamps are required for design specifications and building permits; they are not a standard requirement for an operational post-mortem report.

Key Points

- The event was caused by multiple compounding factors, not a single failure.
- Renovation work removed the south wall, allowing humid air from adjacent spaces, especially the natatorium (the indoor pool area), which was experiencing a mechanical failure and near-100% humidity, to migrate into the ice arena.
- Warm and humid outdoor conditions, frequent door openings, and normal resurfacing activities further increased moisture levels.
- The ice arena's current dehumidification system is undersized for the facility, limiting its ability to control humidity under these conditions.

Actions Taken

Temporary separation, supplemental dehumidification, and repairs allowed the ice arena to reopen safely on September 20, 2025.

The permanent south wall will be fully reinstated by spring 2026, restoring proper separation between the ice arena and adjacent recreation spaces.

Next Steps

Staff will review the Consultant's recommendations and bring forward proposed long-term upgrades in the upcoming 2027-2036 Financial Plan cycle. The permanent south wall reinstatement, which will restore proper separation between the ice arena and adjacent spaces, will improve humidity control during future operations. While the ice arena remains somewhat vulnerable until permanent upgrades are completed, enhanced monitoring and operational controls will continue to reduce risk in the interim.

MEMO

SQUAMISH

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Brennan Park Recreation Centre - Ice Arena Humidity Review

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INTRODUCTION

This report has been prepared by Summit Building Consultants Inc. (Summit) to review the performance of the existing dehumidification systems serving the ice arena at Brennan Park Recreation Centre in Squamish, British Columbia (BC), and to comment on contributing factors to recent humidity and condensation issues within the arena.

BUILDING DESCRIPTION

This section provides contextual information on the Brennan Park Recreation Centre, including building age, layout, and adjacency of major spaces, to support understanding of airflow pathways, moisture migration potential, and the conditions relevant to the observed arena humidity issues.

Brennan Park Recreation Centre is a multi-use municipal recreation facility located at 1009 Centennial Way in Squamish, BC. The complex includes an NHL-sized indoor ice arena and auditorium, a natatorium (indoor pool), gymnasium and fitness spaces, multipurpose rooms, and associated support areas such as change rooms, lobby, and administration areas.

The original arena and auditorium building was constructed in 1977, with the pool wing opened in 1992, based on District information provided at the time of the review and publicly available facility records.

The ice arena consists of a single NHL-sized sheet with rounded corners. The ice slab area is noted on the arena slab drawing as 14,200 ft². Surrounding the rink are spectator seating areas, circulation walkways, and team change rooms. The arena includes the playing surface, spectator bowl, and associated circulation spaces typical of a community ice arena.

For the purposes of this report, design occupancy assumptions have been informed by information available at the time of the review, and include the following indicative capacities:

- Spectator capacity: approximately 450 seated and 75 standing (525 total)
- On-ice population during typical events: approximately 30 players/coaches/officials

The ice arena shares a structural interface with the natatorium along its south side. The Zamboni room, lobby, and exterior access doors form additional connections between the arena and surrounding spaces. Detailed descriptions of the arena envelope, doorways, and air paths are provided in the following section.

EXISTING ARENA STRUCTURE AND MECHANICAL SYSTEMS

Doors, Openings, and Air Paths

The arena comprises a 14,200 ft² ice slab with surrounding spectator seating and circulation areas. Multiple interior and exterior doors connect the arena to the Zamboni room, lobby, change rooms, and exterior. The arena slab drawing indicates approximately twelve door

openings around the perimeter of the ice area, with typical clear widths of approximately 43", 72", and 91" including the Zamboni room door as its open to the exterior.

A dedicated Zamboni room is located adjacent to the ice surface, with large door openings between the arena and the resurfacer bay, and between the Zamboni room and the exterior. The arena is also connected to the building lobby and to the natatorium side of the complex via interior corridors and doorways. The overall configuration results in multiple potential air paths between the arena, the pool, and the exterior.

Detailed observations regarding door sealing, temporary construction separations, and observed air leakage paths are provided in the *Condition of Existing Components and Site Observations* sections of this report.

Mechanical Dehumidification Units

The arena is equipped with four dehumidifiers, installed as part of a mechanical upgrade completed in 2022. Three units (DH-1, DH-2, and DH-3) are located on a mezzanine platform in the northwest corner of the arena, while the fourth unit (DH-4) is located in the southeast corner.

Each unit is controlled by a local humidistat located in close proximity to the unit it serves and incorporates a rotating desiccant wheel with electric reactivation heaters. The units operate as standalone recirculating dehumidifiers with no dedicated supply ductwork distributing dry air across the broader arena volume; as a result, dehumidified air delivery is localized to the immediate vicinity of each unit.

Each dehumidifier includes:

- Process air inlet from the arena;
- Desiccant wheel (rotor) with electric reactivation heaters;
- Reactivation air path using outdoor air; and
- Process air discharge back to the arena.

The units are ducted to outdoor air on the reactivation side. Outdoor air is drawn across the reactivation heaters, through the desiccant wheel, and exhausted to ambient, transferring moisture from the process air stream to the reactivation air stream.

Based on site observations and manufacturers information, the dehumidifiers provide some outdoor air to the arena system as part of the desiccant process. However, they are not configured as a dedicated outdoor air units providing current code-calculated ventilation to the arena. Additional outdoor air reaches the arena via infiltration through doors and envelope openings and through air communication with adjacent spaces.

Spectator and Arena Air Heating

Space heating for the spectator seating and player bench areas is provided by four gas-fired unit heaters (Vantage or equivalent) mounted at high level above the bleachers.

- Rated outputs range from approximately 80,000 to 100,000 BTU/h

- All units are direct-vented to the exterior via dedicated vents.

Change Room and Referee/Officials Room Heating

The player change rooms are heated by ceiling-mounted electric unit heaters. Multiple electric unit heaters were observed in each change room during site visits. No nameplate data or rated capacities were visible or recorded at the time of inspection; therefore, exact kW or BTU/h outputs are unknown.

Natatorium Adjacent space and Dehumidification

Although not part of my review it is worth noting, the Brennan Park Recreation Centre contains multiple indoor spaces with differing environmental requirements including the ice arena and the natatorium. These spaces are served by independent mechanical systems and are designed to operate under different temperature and humidity conditions.

The natatorium is located immediately south of the ice arena and shares a common structural wall. Permanent openings, including doorways and circulation connections, exist along this interface as part of the original building layout.

The natatorium is served by a dedicated pool air-handling and dehumidification unit designed to maintain appropriate environmental conditions for indoor swimming pool operation. Due to the close physical adjacency of the two spaces, conditions within the natatorium and the integrity of separations between the spaces are relevant to understanding potential moisture migration pathways into the ice arena.

Observations related to natatorium operating conditions and their interaction with the arena are addressed in the Site Observations, Timeline of Events, and Technical Analysis sections of this report.

SITE OBSERVATIONS

The following observations are based on Summit's site review of the Brennan Park Recreation Centre ice arena. The observations are factual in nature and are intended to document conditions present at the time of the visit. No destructive testing was performed as part of this review.

Site Visit Information

Date of site visit: November 26, 2025
Time of site visit: 9:00 a.m.
Weather conditions at time of visit: Overcast, no precipitation
Summit representative(s): Paul Ellis
District / facility staff present: Warren Jagger

General Building Observations

Upon entering the Brennan Park Recreation Centre, visible condensation was observed on interior glazing within the lobby and circulation areas. The indoor environment in these areas felt noticeably damp and humid compared with typical arena conditions.

The ice arena was in active use at the time of the visit, with users on the ice surface. Occupancy levels were typical for regular programming, with no special events or unusually high spectator loads observed.

Adjacent recreation and circulation spaces exhibited signs of elevated humidity, including condensation on windows and a generally humid indoor feel. Based on a review of the building's automation system (BAS) and information available at the time of the review, the natatorium air-handling and dehumidification system was not maintaining normal humidity control at the time of Summit's site visit. Information received subsequent to the site visit indicates the natatorium unit experienced intermittent operating interruptions during project activities and also experienced an equipment-related interruption in operation. BAS readings reviewed during Summit's visit indicated relative humidity in the natatorium at or near saturation, representing a significant adjacent moisture source.

Ice Arena Interior Conditions

Within the ice arena, active condensation was observed on structural steel elements above the seating and circulation areas. Evidence of historic dripping was noted on steel members and adjacent surfaces, including staining consistent with repeated condensation events.

The arena air temperature at the time of the site visit was measured at 5-6°C using handheld instrumentation. Relative humidity readings taken within the arena using a handheld hygrometer were generally in the range of 78–85% RH.

Arena-mounted or system-connected humidity sensors were observed to be indicating relative humidity values approaching saturation, approximately 99% RH, at certain locations. The difference between handheld measurements and system readings may reflect sensor location, calibration, or localized microclimate conditions and warrants further review.

The ice temperature, based on an embedded slab temperature sensor, was observed to be approximately 17°F (−8.3°C). This measurement reflects the temperature within the ice slab rather than the exposed ice surface; however, both slab and surface temperatures are well below the observed arena air dew point under high-humidity conditions.

The ice temperature values referenced in this report are based on readings from an embedded slab temperature sensor associated with the brine refrigeration system and represent temperature within the ice slab rather than direct measurements of the exposed ice surface. No independent surface temperature measurements were taken during the site visit; however, both the embedded slab temperature and expected surface temperature remain well below the observed arena air dew point under high-humidity conditions and are therefore relevant to condensation and fogging risk.

Outdoor Conditions

Outdoor relative humidity measured near the building at the time of the visit was 70-80%, with temperatures of 7-8C.

Doors, Openings, and Air Paths

Multiple door openings were observed around the perimeter of the ice arena, estimated to be twelve in total, connecting the arena to exterior areas, the Zamboni room, and adjacent interior spaces. None of these doors include vestibules or airlocks.

The Zamboni room is connected to the exterior via a large overhead door. Based on information available at the time of the review, the original roller-door assembly was removed following failure and is awaiting replacement. At the time of Summit's site visit, the interim door condition provided limited resistance to air infiltration when opened, resulting in a direct air path between the exterior and the Zamboni room during resurfacing and service activities.

Large gaps and openings were observed in the temporary hoarding installed along the south side of the arena. These included unsealed penetrations and areas of incomplete enclosure that create direct air leakage paths between the arena, adjacent recreation spaces, and construction zones. During the site visit, at least one exterior door serving the construction or service areas was observed in a propped-open position, further confirming uncontrolled air pathways into the arena.

At the south-west portion of the arena, additional openings and access points to the construction zone were observed. Doors in this area were seen open at times during the review, confirming that air migration between spaces was occurring under normal operating conditions.

Mechanical Dehumidification System

The arena is served by four dehumidification units. The units are located in two opposite corners of the arena. There is no dedicated ductwork associated with the units to distribute dehumidified air evenly throughout the arena volume. As a result, moisture removal is localized near each unit, with reliance on general air mixing within the arena to distribute drier air to other areas.

The units were observed to be equipped with pleated air filters, which appeared visually clean at the time of the site visit. Information provided during the site visit indicated that air filters were recently replaced in October 2025.

Upon opening the unit access panels, a noticeable accumulation of dirt and debris was observed within the electric duct heater sections of the dehumidifiers. Cleaning of these heater sections is required to ensure proper heat transfer and reliable operation.

The fan belt assemblies were observed to have visible belt deflection in excess of manufacturers recommendations when checked by hand. Improper belt tension can reduce airflow and overall dehumidifier performance.

Based on information available at the time of the site visit, routine maintenance activities had been undertaken on the dehumidification units; however, no maintenance records or logbooks were available for review. Third-party servicing occurred following the arena closure in September 2025. The units were reported to operate continuously when ice is present in the arena and are controlled by local humidistats.

Operational Observations

Based on information available at the time of review, Zamboni resurfacing is typically performed approximately once per hour, with each resurfacing cycle lasting 15 minutes. No formal resurfacing logs were available for review as part of this site visit.

At the time of Summit's site visit on November 26, 2025, no temporary industrial dehumidification equipment was observed operating within the arena.

No carbon monoxide (CO) or carbon dioxide (CO_2) sensors were observed within the arena space. While this is not uncommon for older arena facilities, the absence of such sensors limits the ability to monitor indoor air quality during periods of active occupancy and Zamboni operation. The absence of CO and CO_2 monitoring is noted as an indoor air quality and operational monitoring consideration and was not identified as a contributing factor to the September 2025 humidity event.

Operational Observations - Ice Temperature Control

Review of the brine system logbook during the site visit identified variability in the embedded ice temperature sensor readings over the period reviewed. Recorded values generally ranged between approximately 14°F and 21°F over successive days in August.

The ice temperature values referenced in this report are based on readings from an embedded slab temperature sensor associated with the brine refrigeration system. These readings represent temperature within the ice slab at the sensor location and depth, rather than direct measurements of the exposed ice surface temperature.

No surface temperature measurements (e.g., infrared or contact surface readings) were taken during the site visit due to ice bookings. As a result, actual ice surface temperatures were not directly verified as part of this review. However, both embedded slab temperatures and expected surface temperatures remain well below the observed arena air dew point under high-humidity conditions and therefore remain relevant to condensation and fogging risk within the arena.

Based on review of available brine system log entries and information discussed during the site visit, the noted temperature fluctuations did not consistently align with periods of active ice installation ("ice making") or ice removal ("ice melt"). Several of the observed temperature swings occurred during periods of routine operation, outside of major build-up or removal activities.

The observed variability is not, by itself, indicative of a system fault. In typical arena operation, embedded ice temperature readings may fluctuate due to resurfacing cycles, refrigeration

staging, brine supply temperature control logic, sensor location and depth, or manual operational adjustments to setpoints.

While elevated ambient humidity and weather-driven loads can increase refrigeration run time and recovery demand, they do not typically cause frequent or abrupt changes in embedded slab temperature on their own. The observed variability is consistent with operational and control-related influences, such as refrigeration control response or manual setpoint adjustments, rather than with outdoor weather conditions alone.

Best practice for arena operation is to maintain stable ice temperature setpoints over time and address humidity-related issues primarily through air-side control measures (dehumidification, ventilation, and infiltration management), rather than through reactive adjustments to the brine system.

Further review of brine system controls, setpoint logic, and operating practices would be required to fully characterize the cause of the observed variability. This review would include confirmation of whether manual setpoint adjustments are being made during normal operation and why these adjustments are being made.

Building Automation System and Natatorium Conditions

A review of the building automation system (BAS) during the site visit indicated that the natatorium air-handling and dehumidification unit was not operating as intended at that time. BAS readings indicated relative humidity levels in the natatorium of 100%, representing a significant adjacent moisture source. This condition increases the potential for moisture migration into the arena through both permanent and temporary air leakage paths.

Summary of Observed Conditions

In summary, the site observations document the following conditions at the time of Summit's review:

- Elevated relative humidity within the arena and adjacent spaces.
- Active condensation and evidence of repeated condensation on structural elements and glazing.
- Ice slab temperatures well below the observed arena air dew point.
- Visible frost and ice accumulation on refrigeration and brine system components.
- Multiple uncontrolled air paths between the arena, exterior, and adjacent interior spaces.
- Temporary separation measures with visible gaps and penetrations allowing air migration.
- Localized dehumidification with limited air distribution across the full arena volume.
- Operational practices, including Zamboni flooding and frequent door operation, that contribute to moisture introduction and air exchange.
- Variability in ice temperature control practices observed through review of operational log entries.

These observations form the factual basis for the subsequent Timeline of Events and Technical Analysis sections of this report.

Photographic Record

Photographs taken during the site visit are included in the Photographic Appendix to this report. The photographs document representative examples of condensation, door conditions, temporary hoarding, mechanical equipment condition, and general arena conditions observed at the time of the review.

TIMELINE OF EVENTS – 2025 HUMIDITY ISSUE AND RINK CLOSURE

The following summary is intended to describe, in neutral terms, key events and conditions associated with the September 2025 arena closure and subsequent mitigation steps. Dates and descriptions are based on District of Squamish public information, Summit's site observations, and information available at the time of review, and should be confirmed where relied upon for future decision-making.

Early May–late August 2025 – Annual ice removal and ongoing renovation activities
The arena ice surface was removed for the annual summer shutdown period. During this period, renovation activities affecting areas adjacent to the ice arena proceeded as part of the broader Brennan Park upgrade program, including demolition of the south wall between the arena and adjoining recreation spaces. Temporary hoarding was installed; however, this work created a large interior opening between the arena, the construction zone, and the lobby/recreation areas, changing the building's established airflow patterns.

July 2025 – Ice installation and initial reports of elevated humidity
In late July 2025, the arena began re-establishing the ice surface for the upcoming season. Information available at the time of Summit's review indicates that elevated humidity conditions were observed during the ice installation period and early operation, compared with typical summer conditions in prior years. These observations are consistent with Summit's later site

observations, which identified condensation, elevated indoor relative humidity, and building automation system (BAS) readings approaching saturation at certain locations.

During this period, the existing dehumidification units were in operation and the natatorium we understand remained in service. However, ongoing renovation activities affecting areas adjacent to the arena, combined with seasonal summer weather conditions, were already contributing to increased latent moisture loads within the arena environment.

August 2025 – Warm, humid summer conditions
Historical weather data for Squamish show that August is typically one of the warmest months of the year, with average daily high temperatures in the high teens to low 20s °C and average relative humidity in the mid-70% range. In August 2025, there were several warmer-than-average days, with temperatures on certain days reaching the low 30s °C. These conditions increased the absolute humidity of outdoor air available to the building and contributed to higher indoor humidity when combined with renovation-related air paths and normal arena occupancy.

Late August to Labour Day weekend 2025 – Rapid increase in humidity
Over the latter part of August and into the Labour Day weekend, a more rapid increase in arena humidity was identified. During this period, the south wall separating the arena from adjoining recreation spaces had been removed as part of renovation work, and construction activities resulted in frequent operation of interior and exterior doors. These conditions created multiple air pathways between the arena, adjacent spaces, and the exterior, increasing the exchange of unconditioned air. Under these combined conditions, the existing dehumidification and ventilation strategy was increasingly challenged to maintain typical arena humidity levels.

Early September 2025 – Regional heat event and pool AHU cooling failure
In early September 2025, British Columbia experienced an early-autumn heat event, with several locations in the province recording unusually high temperatures for September. Around this time, the first stage of cooling on the Brennan Park pool air-handling/dehumidification unit reportedly failed. This resulted in very high humidity in the natatorium and adjacent construction spaces, with local measurements and BAS readings during our site visit indicating conditions near saturation (approaching 100% relative humidity). The temporary opening and leakage paths along the south side of the rink allowed this humid air to migrate into the arena volume.

September 2, 2025 – Temporary closure of the ice arena
On September 2, 2025, the District issued a public notice temporarily closing the Brennan Park ice arena as a safety precaution. The notice identified that removal of the wall separating the rink from the lobby and exterior as part of the renovation had allowed higher-than-anticipated heat and humidity to enter the arena, resulting in unsafe ice surface conditions. All programming and public use were cancelled until further notice.

Early September 2025 – Ongoing closure and investigation
Over the days following the closure, humidity levels continued to be monitored, contributing factors investigated, and options for additional temporary dehumidification and ventilation explored. These measures included the installation and refinement of temporary separation (hoarding) along the south side of the arena to reduce air migration from adjacent recreation

and construction areas, as well as exploration of additional temporary dehumidification and ventilation equipment.

Public updates during this period indicated that humidity levels had not improved sufficiently to allow safe operation and that the closure would extend at least until mid-September while specialized industrial dehumidification equipment was procured, installed, and connected.

September 12, 2025 – Temporary dehumidification and additional separation
By approximately September 12, 2025, temporary rental dehumidification equipment had been brought on site and connected to the arena to supplement the existing dehumidification units. The construction team also reinforced the temporary south wall and improved the separation between the rink and the adjacent renovation areas to reduce air migration. These measures were intended to lower the moisture load on the arena while longer-term solutions were evaluated.

September 2025 – Third Party service of dehumidification units
During September 2025, third-party service providers attended site to inspect and service the four dehumidifiers. Their service report identified a failed heater bank, blown fuses, and belt issues on one unit (DH4), along with performance checks on the other three units. Repairs were completed, including replacement of heaters and mechanical adjustments.

September 20, 2025 – Arena re-opens to users
The District announced that ice repairs were complete and the arena would re-open September 20, 2025, following installation and commissioning of temporary industrial dehumidification ductwork and repairs to the ice surface.

September–October 2025 – Pool shutdown and broader facility works
As part of the overall Brennan Park upgrade program, the pool was taken out of service for annual maintenance and renovation work in September and October 2025. Draining the pool and addressing issues with the natatorium air-handling/dehumidification system were among the measures taken to reduce humidity in the adjacent spaces and to prevent recurrence of extreme conditions.

November 2025 – CUPE Local 2269 labour dispute and re-commissioning of the rink
In mid-October 2025, a CUPE Local 2269 labour dispute (October 16–29, 2025) resulted in temporary suspension of arena programming and removal of the ice surface. The facility reopened on November 15, 2025. When the ice was reinstalled following resolution of the labour dispute and completion of temporary mitigation measures, condensation was still observed within the arena but at a reduced level compared with early September. Summit's subsequent site visit and measurements occurred after these mitigation steps and are described in the Site Observations section.

Late 2025 – Summit site review (post-event conditions)
During Summit's review, temporary sensors were reading up to ~99% RH in some locations, while handheld measurements within the arena were in the range of 78–85% RH. Active condensation was observed on steel structure above the bleachers and on glazing in the lobby/rec spaces, indicating that, although the extreme early-September conditions had passed,

moisture levels and condensation risk remained elevated under normal operation. (See Site Observations section.)

TECHNICAL ANALYSIS / THEORY

The humidity behaviour of the Brennan Park ice arena is governed by the balance between internal moisture generation, external moisture loads from outdoor air, moisture migration from adjacent indoor spaces (inter-zone loads), and the available latent removal capacity of the installed dehumidification systems.

For clarity, this section focuses on engineering principles and order-of-magnitude load comparison, rather than detailed psychrometric calculations. This approach is appropriate given the number of variables involved and the absence of complete commissioning, balancing, and long-term trend data.

The following discussion sets out:

- The accepted design basis for humidity control in ice arenas under ASHRAE and BC Building Code (BCBC) guidance;
- The key physical and operational parameters observed on site;
- A comparison between estimated moisture loads under typical and elevated conditions and the capacity of the existing dehumidification equipment; and
- A description of how the September 2025 failure event likely developed.

1. Design Basis – ASHRAE and Industry Guidance for Ice Arenas

Humidity control for indoor ice rinks is typically based on a combination of ventilation requirements and condensation control criteria established by ASHRAE and adopted by reference within the BC Building Code.

ASHRAE Standard 62.1 provides minimum outdoor air rates for spectator and play areas and establishes the baseline ventilation requirements for indoor air quality. The ASHRAE Applications Handbook and other industry guidance for ice arenas further recommend maintaining indoor conditions that limit fog formation and condensation on structural elements, glazing, and equipment.

Typical target conditions for community ice arenas include:

- Arena air temperatures generally in the range of approximately 10–15°C;
- Relative humidity generally in the range of approximately 40–50%; and
- Corresponding indoor air dew points typically maintained near 0–4°C (32–40°F).

Industry practice also recognizes that ice slab and ice surface temperatures are significantly colder than the surrounding air. Ice surface temperatures are commonly maintained in the range of approximately −4°C to −6°C, with embedded slab temperatures often colder depending on refrigeration control strategy. Maintaining indoor air dew points below the temperature of cold surfaces is therefore critical to limiting condensation risk.

These targets are consistent with maintaining acceptable ice quality while controlling condensation within the arena envelope.

2. Key On-Site Parameters – Brennan Park Arena

Summit's site observations and information available at the time of the review indicate the following key parameters relevant to arena humidity performance.

The ice slab area is approximately 14,200 ft² based on available arena slab drawings. Arena volume and design occupancy referenced in this report are based on estimates derived from available architectural and mechanical information provided by the District and prior consultants. These values are used for contextual and order-of-magnitude assessment only and require confirmation through detailed mechanical engineering review and verified geometry for any future system design.

The embedded ice slab temperature sensor was observed to be controlling ice temperatures at 17°F (−8.3°C). This measurement reflects slab temperature rather than true ice surface temperature; however, both slab and surface temperatures remain well below typical indoor air dew points during high-humidity conditions.

At the time of the site visit, the arena air temperature was 5-6°C. Handheld relative humidity measurements within the arena were generally in the range of 78–85% RH, while site sensors were observed to be indicating relative humidity values approaching saturation at certain locations.

Outdoor relative humidity measured near the building during the visit was 70-80%, with outdoor temperatures of 7-8C.

Multiple door openings connect the arena to the exterior, the Zamboni room, and adjacent interior spaces. These include a large overhead door serving the Zamboni room. At the time of the review, the original roller door at this location had been removed due to failure and was awaiting replacement, resulting in limited resistance to infiltration when opened.

Operational practices identified during the review include one Zamboni resurfacing cycle per hour, with each cycle lasting 15 minutes.

At an arena air temperature of 5-6°C and relative humidity of 78-85%, the indoor air dew point is approximately 2–3°C. This is at or near the upper limit of the dew-point range typically recommended for community ice arenas. Under these conditions, cold surfaces within the arena, including ice, steel structure, glazing, and refrigeration piping, are highly susceptible to condensation, consistent with the observed dripping and moisture accumulation.

3. Order-of-Magnitude Moisture Load Assessment

Arena humidity behaviour is influenced by a large number of interacting variables, including outdoor air ventilation, infiltration through doors and envelope leakage, air migration from adjacent spaces, occupant moisture generation, Zamboni resurfacing, and ice surface evaporation. Not all of these variables were directly measurable at the time of the site visit.

Block-load estimates prepared during the September 2025 event indicate that, under BCBC design summer conditions for Squamish, the arena moisture load would be on the order of approximately 90–100 kg/hr of moisture removal.

When outdoor air temperature and humidity are elevated, consistent with early September 2025 weather conditions, application of the same block-load methodology indicates moisture loads on the order of approximately 160–170 kg/hr. This increase primarily reflects higher outdoor air moisture content under design ventilation assumptions and represents an increase of approximately 60–70% relative to design conditions.

Summit's review indicates that several additional contributors present during the September 2025 event are not fully captured by simplified block-load assumptions and would further increase the effective moisture load acting on the arena. These contributors include:

- Frequent opening of the large Zamboni door and other exterior doors without vestibules;
- Removal of the original roller door at the Zamboni room;
- Temporary removal of the south wall between the arena and adjoining recreation spaces, with incomplete temporary hoarding;
- Migration of near-saturated air from the adjacent natatorium during a period of pool air-handling system failure; and
- Ongoing Zamboni resurfacing introducing additional latent load from resurfacing water, despite the use of a cold-water 'Real Ice' vortex flooding system. While the floodwater temperature is lower than traditional systems, resurfacing still represents a periodic moisture input to the arena environment.

While these effects are difficult to quantify precisely without detailed field measurement, they would reasonably increase the effective moisture load acting on the arena beyond calculated block-load values during periods of active operation.

4. Installed Dehumidification Capacity

The arena is served by four dehumidification units. Based on manufacturer published performance data, each unit is capable of removing approximately 21–23 lb/hr of moisture at typical rink return air conditions (approximately 50–55°F entering air temperature and 60–70% relative humidity).

The combined nominal latent capacity of the four units is therefore approximately 38–42 kg/hr under typical operating conditions.

This capacity represents less than one-quarter of the moisture removal required under conservative block-load estimates for elevated humidity conditions and significantly less than the effective load experienced during the September 2025 event.

In addition, the physical arrangement of the units located in isolated corners of the arena without dedicated distribution ductwork further limits their effectiveness in controlling humidity uniformly across the full arena volume.

5. Likely Behaviour During the September 2025 Event

During the September 2025 closure event, several compounding factors occurred simultaneously.

The natatorium air-handling and dehumidification system experienced reduced performance, resulting in near-saturated air conditions in the pool and adjacent circulation spaces. At the same time, the south wall separating the arena from the adjoining recreation spaces had been removed as part of renovation work. While additional temporary separation was implemented following the arena shutdown, visible gaps and access points remained, allowing humid air from adjacent spaces to migrate into the arena.

Outdoor weather conditions during early September were warmer and more humid than typical for the season, increasing the absolute moisture content of outdoor air entering the building through infiltration and door operation.

Zamboni resurfacing and routine programming continued until conditions became unsafe, introducing additional latent load and repeated periods of air exchange through door operation.

Under these conditions, the effective dew point of air entering the arena would have been significantly higher than the 0–4°C range typically targeted for ice arenas. Given the embedded ice slab temperatures measured near −8.3°C and the presence of structural and enclosure surfaces operating below the elevated air dew point, condensation, dripping, and fogging was unavoidable.

Given an effective moisture load substantially exceeding 160–170 kg/hr, and an installed dehumidification capacity of approximately 38–42 kg/hr, the existing system could not meaningfully reduce humidity during the event. The resulting conditions support the observed ice deterioration and the decision to temporarily close the arena for safety reasons.

6. Summary of Humidity Assessment

In summary:

- Conservative block-load estimates indicate moisture loads on the order of approximately 95–100 kg/hr under BCBC design summer conditions and approximately 160–170 kg/hr under elevated humidity conditions similar to those experienced in early September 2025.
- Additional site-specific factors present during the September event would reasonably increase the moisture load beyond simplified block-load estimates.

- The four existing dehumidifiers provide a combined nominal latent capacity of approximately 38–42 kg/hr, substantially below even conservative estimates of required moisture removal.
- While improvements to separation, infiltration control, and adjacent system performance are necessary, the existing dehumidification system is materially undersized relative to the arena's size, climate, and operational requirements.

A long-term solution will require a comprehensive humidity and ventilation strategy, supported by detailed engineering analysis, to reliably maintain acceptable arena conditions under both typical and elevated weather scenarios.

CONCLUSIONS AND RECOMMENDED STRATEGY

For clarity, the September 2025 arena humidity event is best understood as the result of both short-term contributing factors and longer-standing underlying vulnerabilities. The contributing factors explain why the event occurred when it did, while the underlying vulnerabilities explain why the arena was unable to tolerate those conditions without experiencing unsafe operating impacts.

Based on the information reviewed, site observations, manufacturer data, operational records, and weather context, the September 2025 arena humidity event and subsequent shutdown were not the result of a single failure or isolated deficiency. Rather, the event was caused by the convergence of multiple compounding factors, including:

- The temporary removal of the south wall between the arena and adjoining recreation spaces during renovation, significantly altered the established air separation and allowed humid air from adjacent areas to migrate into the arena.
- Failure and reduced performance of the natatorium air-handling/dehumidification system during a period of warm and humid weather, resulting in near-saturated air conditions in spaces directly connected to the arena through construction openings and leakage paths.
- Above-average outdoor temperature and humidity conditions in early September, increasing the absolute moisture content of both outdoor air and air infiltrating the building envelope.
- Operational factors including frequent door opening at the Zamboni room, removal of the original roller door, and routine resurfacing activities, all of which increased short-term infiltration and latent load on the space.
- A dehumidification system capacity that is materially lower than what is often designed for would typically target to control humidity in an arena of this size and configuration under ASHRAE-style design expectations, particularly when subject to abnormal infiltration and inter-zone moisture migration.
- While the existing dehumidifiers were observed to be operational and capable of moisture removal under normal conditions, their combined latent capacity was insufficient to offset the elevated moisture loads present during the September event.
- Under these conditions, condensation, dripping, fogging, and unsafe ice conditions were unavoidable.

Corrective actions taken following the shutdown, including installation of temporary separation and supplemental dehumidification, reduced but did not eliminate the underlying risk, confirming that a long-term solution is required.

Collectively, these contributing factors acted upon an arena system with vulnerabilities, including uncontrolled air pathways, localized and non-distributed dehumidification, and the absence of verified commissioning or testing and balancing data confirming system performance under adverse conditions.

PROPOSED ACTION PLAN

In Summit's opinion, addressing the Brennan Park arena humidity challenges requires a layered, long-term strategy, rather than reliance on short-term mitigation alone. The conditions observed in September 2025 resulted from the interaction of multiple systems and operational factors, and future mitigation should focus on reducing risk across all contributing pathways. Key elements of this strategy include the following.

Restoration and stabilization of the natatorium air-handling and dehumidification system to ensure that adjacent spaces are reliably controlled and effectively isolated from the arena under all operating conditions. Consistent humidity control in the pool and recreation areas is critical to reducing inter-zone moisture migration into the rink.

- Improved permanent separation and sealing between the arena, Zamboni room, and adjoining spaces, including reinstatement of a properly sealed Zamboni door and reduction of uncontrolled air leakage paths. These measures are intended to limit infiltration and short-term moisture spikes associated with door operation and construction interfaces.
- Development of a comprehensive arena humidity and ventilation strategy that reflects current operating expectations, climatic conditions in Squamish, and applicable ASHRAE guidance. This strategy should include evaluation of additional or replacement dehumidification capacity and/or a dedicated outdoor-air humidity-control system. A detailed engineering design is required to refine the required capacity so that any future system is appropriately sized for the space and operating conditions, avoiding both under-performance and unnecessary oversizing.
- This design should account for remaining uncertainties such as infiltration rates, door operation, actual outdoor air delivery, and operational practices.
- As part of any future arena mechanical review or system upgrade, consideration should be given to the addition of CO and/or CO_2 monitoring within the arena. Such monitoring would support improved indoor air quality oversight during periods of occupancy and resurfacing operations, particularly given the age of the facility and current reliance on operational practices.
- Implementation of structured operational practices, including a stable ice temperature control philosophy, formalized maintenance procedures, and improved documentation of plant operation and servicing. Clear operating setpoints, routine inspection protocols, and record-keeping will help reduce variability, support system performance, and improve long-term reliability.

Taken together, these actions provide a balanced approach that addresses immediate risks, improves resilience to future weather events, and supports informed decision-making for future capital planning, without relying on single-point solutions.

This report has been prepared for the District of Squamish for the purposes described herein. Questions regarding interpretation of the findings may be directed to the undersigned.

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LIMITATIONS

This report has been prepared based on information available to Summit at the time of review and is subject to the following limitations.

The humidity load estimates and capacity comparisons presented in this report are intended to provide order-of-magnitude context rather than precise design values. Arena humidity behaviour is influenced by a large number of interacting variables, including but not limited to outdoor weather conditions, infiltration through doors and envelope leakage, air migration from adjacent spaces, operational practices, and control system behaviour. Not all of these variables were measurable or quantifiable at the time of the site visit.

Detailed psychrometric calculations have been simplified for reporting purposes. While estimates are grounded in accepted engineering practice and ASHRAE guidance, they necessarily rely on assumptions where direct measurement data were unavailable. These assumptions include, but are not limited to, infiltration rates, effective outdoor air delivery, moisture contribution from Zamboni resurfacing, and distribution effectiveness of the existing dehumidification systems.

No formal testing, adjusting, and balancing (TAB) reports or commissioning documentation were available for review for the arena dehumidification systems, ventilation systems, or associated controls. As a result, actual airflow rates, latent performance, control sequencing, and system interactions could not be independently verified.

Summit did not perform destructive investigation, tracer-gas testing, blower-door testing, or long-term trend logging of temperature and humidity. Observations of condensation, humidity, and operational behaviour are based on conditions at the time of the site visit and review of available operational records.

Weather and climate data referenced in this report are drawn from publicly available historical datasets and are provided for contextual understanding of regional conditions. Microclimatic effects, short-duration weather spikes, and localized conditions at the facility may differ from airport or regional reference stations.

This report is not a code compliance audit and should not be interpreted as a definitive determination of compliance with the BC Building Code or other regulatory requirements. References to codes and standards are provided for context only.
Future refinement of calculations and recommendations would require additional data collection, detailed field measurements, and formal system testing.

Manufacturer-published dehumidification capacities are nominal and dependent on specific operating conditions, including entering air temperature and humidity, airflow rates, desiccant wheel speed, heater staging, and filter condition. Actual in-service performance may vary from published values and cannot be confirmed without detailed field measurement and functional testing.

Descriptions of operational practices are based on information available at the time of review and are not intended to represent a comprehensive assessment of day-to-day facility operations or staffing practices.

APPENDIX A – REFERENCES

A1. District of Squamish – Arena Closure Notices and Updates

1. *Notice of Temporary Ice Rink (Arena) Closure – Brennan Park Recreation Centre*, District of Squamish news release, September 2, 2025. Describes initial closure due to unsafe ice conditions from high humidity, reference to removed separation wall and plan to drain pool for annual maintenance starting September 3, 2025.
   Link: https://squamish.ca/government-and-administration/district-information/news/notice-of-temporary-ice-rink-arena-closure/
2. *Ice Arena Closure Update*, District of Squamish news release, September 3, 2025. Provides update on continued closure for September 4, use of commercial dehumidifiers, partial pool draining, and potential reopening as early as September 5.
   Link: https://squamish.ca/government-and-administration/district-information/news/ice-arena-closure-update/
3. *Ice Arena Update – September 4*, District of Squamish news release, September 4, 2025. Extends closure through at least September 12, notes strained existing dehumidification equipment and renovation impacts, and describes efforts to procure industrial dehumidifiers.
   Link: https://squamish.ca/government-and-administration/district-information/news/ice-arena-update-september-4/
4. *Ice Area Opening September 20*, District of Squamish news release, September 19, 2025. Confirms reopening of the arena on September 20 following installation of hard ducting for temporary dehumidification and ice repairs.
   Link: https://squamish.ca/government-and-administration/district-information/news/ice-area-opening-september-20/
5. *Temporary Arena Closure FAQ*, District of Squamish, 2025. Provides detailed explanation of contributing factors (wall removal, mechanical upgrades, unusual ambient humidity ratios 25–35% above design, etc.) and timeline of events (early August humidity identification, Labour Day spike).
   Link: https://squamish.ca/rec/temporary-arena-closure-faq/

A2. Media Coverage

6. *Humidity forces temporary shutdown of Brennan Park arena, The Squamish Chief, September 2, 2025. News article summarizing the closure, unsafe ice conditions, and the role of heat and humidity.*
   Link: (Squamish Chief website – article ID as per search result)
7. *Brennan Park ice arena closed due to humidity, The Squamish Reporter, September 2, 2025. Article describing the closure, humidity issues, and efforts to source industrial dehumidifiers and adjust renovation schedule.*
   Link: https://www.squamishreporter.com/2025/09/02/brennan-park-ice-arena-closed-due-to-humidity/
8. *"We Can't Keep Doing This": Ice Rink Closure Sparks Outcry, The Squamish Reporter, September 8, 2025. Follow-up article discussing ongoing closure impacts, expected closure through at least September 12, and community response.*
   Link: https://www.squamishreporter.com/2025/09/08/we-cant-keep-doing-this-ice-rink-closure-sparks-outcry/
9. *Squamish council hears heartfelt plea for more ice access, The Squamish Chief, October 11, 2025. Describes reopening of the arena on September 20 and broader discussion of arena capacity and reliability.*
   Link: (Squamish Chief website – article ID as per search result)

A3. Weather and Climate Data (Context)

The following references were reviewed to establish regional weather conditions during the August–September 2025 period and to provide context for the humidity event. Environment and Climate Change Canada (ECCC) is the primary authoritative source for Canadian climate data.

Environment and Climate Change Canada (Primary Source)

1. **Historical Climate Data – Squamish Area (Nearest ECCC Stations)**

   Environment and Climate Change Canada – Climate Data Online.
   Provides daily and hourly temperature, humidity, and dew point data from official monitoring stations.
   Link: https://climate.weather.gc.ca/
   (Search by station location; Squamish data are typically referenced via nearby long-term stations such as Vancouver Harbour, Whistler, or Britannia Beach depending on availability.)

2. **Canadian Climate Normals (1991–2020)**

   Environment and Climate Change Canada – Climate Normals.
   Provides long-term averages for temperature, humidity, and precipitation used for design context.
   Link: https://climate.weather.gc.ca/climate_normals/

3. **Daily Data Report – British Columbia (August–September 2025)**

   Environment and Climate Change Canada – Daily Data Reports.
   Used to confirm periods of elevated temperature and humidity during late summer and early fall 2025.
   Link: https://climate.weather.gc.ca/historical_data/search_historic_data_e.html

APPENDIX B – PHOTOGRAPHS

Condensation on Natatorium entrance doors due to failed AHU.

Condensation on the ice arena glass

Observed temperature and humidity within the Ice arena space

Gaps in the Zamboni room exterior door

Examples of gaps at all exterior doors

Holes in Natatorium temporary wall

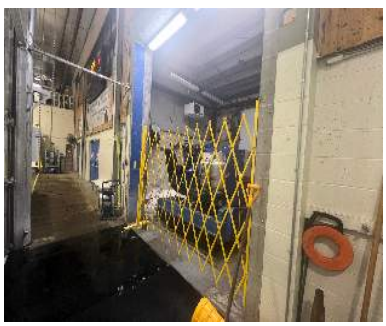
Large deflection on Dehumidifier DH-1 fan belt which needs to be adjusted.

Insects and debris covering the dehumidifier electric duct heaters

Considerable condensation on the steel structure

Various water drips on walkways and seating areas within the arena

Considerable ice build-up on Brine system components



Missing Zamboni room door