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June 27, 2022
File: 2022-5656

Kevin Okimi
Director of Parks and Open Space
Town of Halton Hills
1 Halton Hills Drive
Halton Hills, OT
L7G 5G2

Re: FAIRY LAKE OUTDOOR ICE PROGRAM FEASIBILITY REVIEW

Dear Mr. Okimi:

The Town of Halton Hills (Town) retained Associated Engineering (AE) to provide ice engineering services to review the feasibility of an outdoor ice program on Fairy Lake. The objective of this review is to determine general feasibility and considerations for an outdoor skating rink program at Fairy Lake, including the identification of a potential seasonal operating window for skating based on a climatic review. AE's scope of work to support this objective includes the following:

- Reviewing the lake suitability for outdoor recreational ice activities.
- Identifying a potential footprint for the outdoor ice rink on Fairy Lake.
- Providing general ice thickness recommendations for various types of equipment and activities for the construction and operations of an ice program on Fairy Lake.
- Providing recommendations and additional considerations to implementing an outdoor ice program on Fairy Lake.

1 METHODOLOGY

AE utilized the following methodology to complete this feasibility review:

- Conduct a desktop review of background documents provided by the Town, including:
  - 2008 bathymetric data.
  - Fairy Lake Water Quality Study (AECOM, dated December 2009).
  - Key Climate Indicators for Halton Hills (Klimaat Consulting & Innovation, dated July 2018).
  - 2022 Outdoor Ice Strategy Survey #1 (public consultation).
  - Storm outfall locations on Fairy Lake derived from open source data.
- Conduct a Project Kick off Meeting with Town staff to review project success, projected use of the ice surface, potential program footprint and location(s), site access, and local knowledge of previous seasons' ice conditions, including historical/anecdotal problematic areas for ice growth.
- Assess climatic data from November 2015 through to April 2022 to inform probabilistic season length for operation of an outdoor rink on a naturally freezing water body in the region.

- Determine ice thickness requirements for light-weight snow removal equipment and ice surfacing equipment.
- Consideration of key components for an effective ice safety management program.

2 PLANNING ASSUMPTIONS

AE made the following planning assumptions in the development of this review:

- The Town will self-perform construction and maintenance of the ice facilities.
- The facilities will include a combination of open skating areas and skating pathways on Fairy Lake.
- Skating areas will be separated from known storm outfall locations by a minimum of 20 m.
- Separation/deconflicting of lake areas used for recreational skating and ice fishing.
- Meteorological data obtained from the Guelph Turfgrass Institute Environment Canada weather station is a reasonable proxy for local weather conditions at Fairy Lake.
- The maximum weight of equipment used for construction and maintenance is limited to 1,200 kg. Typical equipment models and weights are provided in Section 6 of this memo, for the purpose of this feasibility review. Actual equipment weights will need to be confirmed by the Town.
- Water used for ice surface maintenance or construction will be drawn from Fairy Lake. No chlorinated water will be used on the ice surface.

3 PLANNING BASE CASE

The Town identified the boat launch area at Prospect Park as a desirable access point for lake activities due to the existing infrastructure such as parking and washroom facilities at this location. Figure 3-1 illustrates the potential ice program “base case” considered in this feasibility review. A sketch of the base case is also provided in Appendix B. The potential skating area identified in the base case reflects utilization of deeper areas of the lake, which are generally more favourable for consistent ice formation and ice growth, as well as separation of skating areas from known outfall locations. Anecdotal information regarding popular ice fishing areas was also considered. The extent of the actual footprint may need to be modified during implementation to suit actual site conditions.

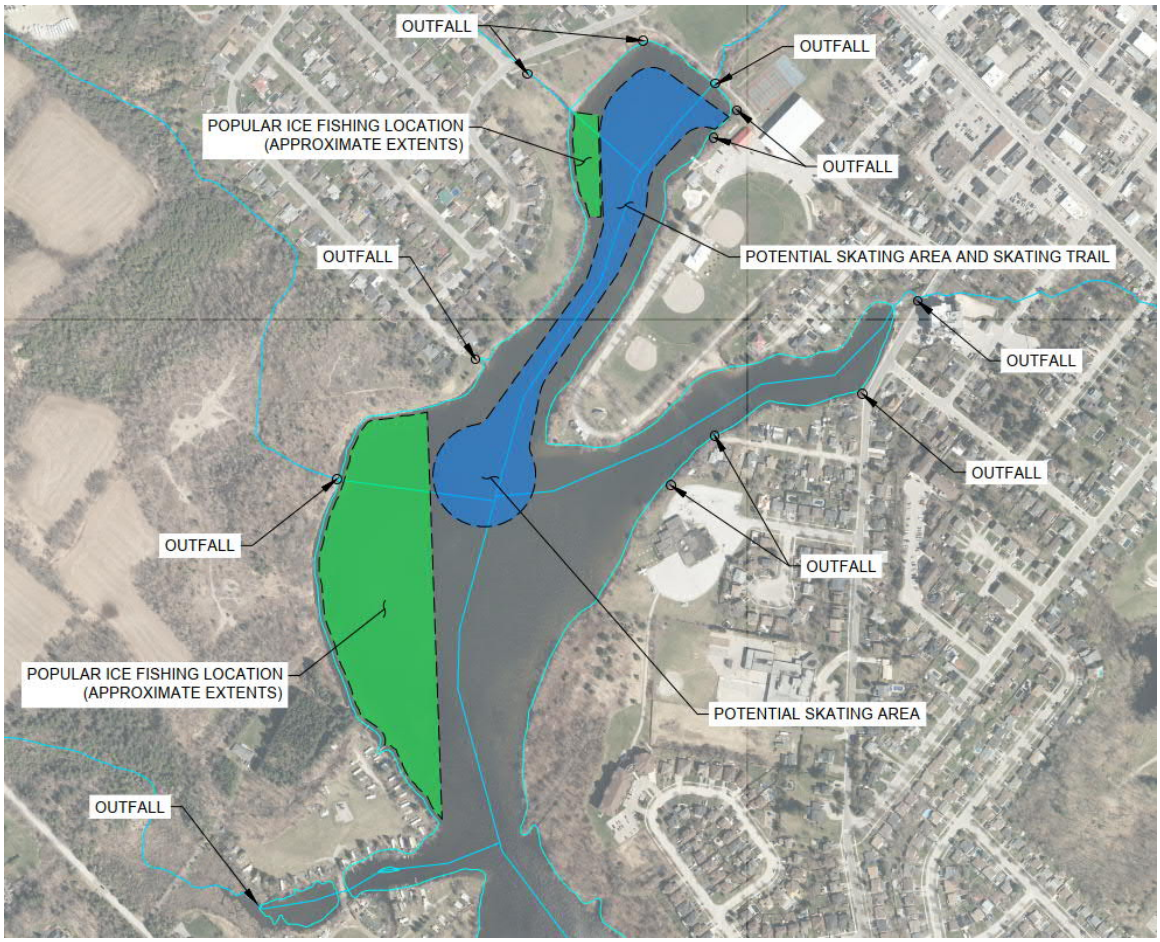

Figure 3-1
Potential Ice Program Layout (Base Case)

This base case is illustrative for the purpose of this feasibility review. It is expected to be reasonably achieved, however, determining construction, maintenance and operations costs is not included in AE's scope of work, and will influence the final size of the ice program.

Detailed ice thickness and ice condition data throughout the lake area from previous seasons are also currently not available. As more ice information is observed and collected in future years, and resource allocation and costs are better understood, considerations for changes to, or expansion of, the base case may be assessed and implemented.

4 CLIMATIC DATA REVIEW

4.1 FREEZING INDEX & ANTICIPATED OPERATING WINDOW

A commonly used approach to predict ice growth on a natural water body utilizes local Freezing Degree Days. The Freezing Index is a cumulative measure of Freezing Degree Days and is calculated as the sum of average daily degrees below freezing (0°C) over a specified period of time.

A review of contemporary meteorological data from the Guelph Turfgrass Institute Environment Canada weather station[1] was completed to assess the predictability of freeze-up of Fairy Lake to help determine a reasonable annual operating window to be used for planning the construction and operations of the skating area.

Using average daily climatic data from December to March (years 2015 to 2022), it is predicted that construction of the skating area could reliably begin in the second week of January (assuming use of light utility equipment as per Table 6-1 in Section 6 of this memo). If heavier equipment is used (refer to Table 6-1), recent historical data suggests construction could begin around the end of January.

Table 4-1 below illustrates the estimated cumulative Freezing Degree Days (FDD) required for 20 cm and 30 cm of good quality ice thickness through natural ice growth, as well as the average number of days starting from 1 December where this value was achieved since 2015[2].

Table 4-1
Estimated Cumulative FDD and Corresponding Average Start Date

Serial	Ice Thickness Required (cm)	Cumulative FDD	Average Number of Days from 1 December	Corresponding Average Start Date for Construction
1	20	95	39	8 January
2	30	214	60	29 January

AE assesses a cumulative total of 95 FDDs is required to form up to 20 cm of good quality ice thickness. A cumulative total of 214 FDDs is assessed as required to form up to 30 cm of good quality ice thickness. This planning window is based on historical averages and should be expected to change by a week or two on any given winter season, depending on seasonal variations.

[1] Weather data from 23-31 January 2017 was not available from the Guelph Turfgrass station. Data for this period was obtained from the Kitchener/Waterloo station.
[2] Natural ice growth thickness predicted using Stefan's Equation ($h=C(FDD)^{0.5}$).

4.2 ICE COVER DECOMMISSIONING

The decision to close an ice cover can be driven by various factors. AE assesses the primary factor is likely to be the onset of an extended warm weather event that degrades the ice cover and does not allow continued use for skating. Seasonal fluctuations are to be expected, and generally speaking, ice covers can withstand short periods of weather above freezing provided they are not too long in duration, and are followed by a period of sustained temperatures below freezing. Although somewhat arbitrary, based on experience, AE assesses the first day of a five day period with average daily temperatures above freezing as a reasonable planning date for the closure of a natural ice facility.

Table 4-2 shows the range of dates where five successive days of average daily temperature began in each of the past six years, as well as the average date over the seven-year period.

Table 4-2
Start of Five Day Warming Period

Year	First Day of Five-Day Warming Period
2016	8 March 2016
2017	22 February 2017
2018	23 March 2018
2019	10 March 2019
2020	22 February 2020
2021	9 March 2021
2022	14 March 2022
Average	3 March

Overall, the estimated closing date for ice skating over the past seven years ranged between 22 February and 23 March. The median closing date was 8 March and the average closing date is assessed as 3 March.

Figure 4-1 illustrates a summary of the cumulative FDDs for each of the past seven winter seasons. The shaded green box indicates the range of assessed “season start dates” and the shaded red box indicates the range of assessed “season end dates”.

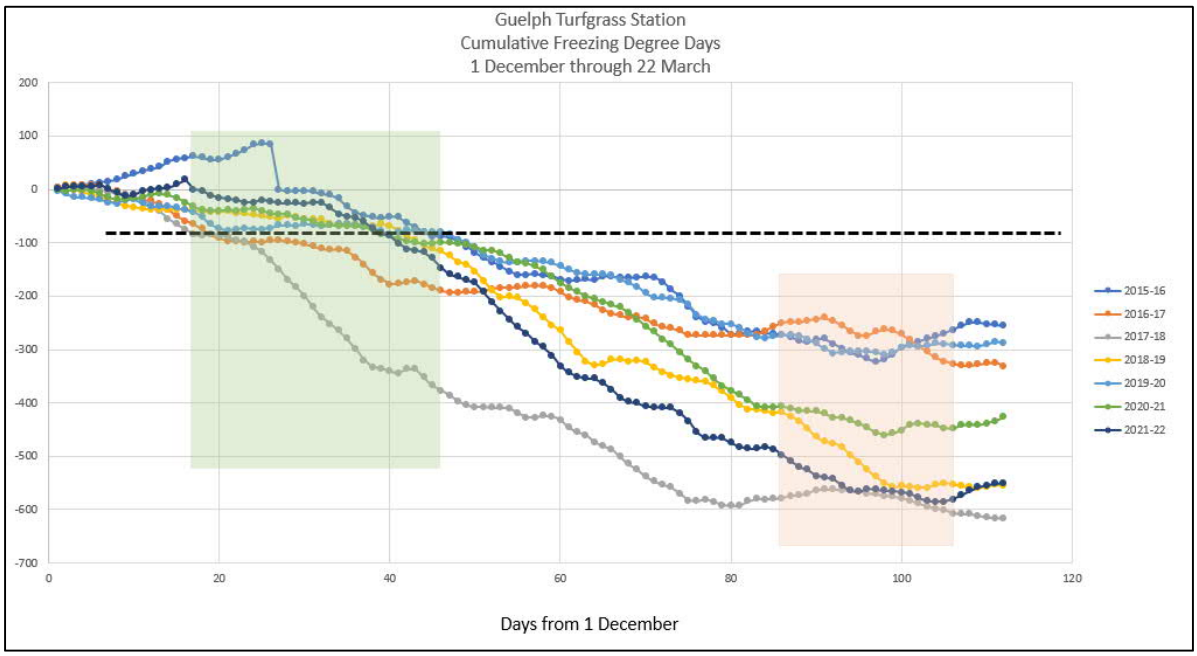

Figure 4-1
Summary of Cumulative Freezing Degree Days

The average number of assessed operating days over the past seven years is calculated in Table 4-3 using a 20 cm and 30 cm starting ice thickness.

Table 4-3
Anticipated Operating Season Length

Starting Ice Thickness (cm)	Minimum Number of Operating Days	Average Number of Operating Days	Maximum Number of Operating Days
20	36	54	63
30	9	33	51

Planning for the use of light-weight utility vehicles for ice construction results in a significant increase to the number of Operating Days that can be expected in a given season.

5 TYPICAL PROJECT CYCLE

Projects on ice covers generally follow a cyclical and phased framework that includes: Planning, Construction, Operation, and Decommissioning. These phases are generally consecutive but may

overlap in certain instances. Figure 5-1 depicts a typical seasonal schedule of ice construction and operations for the Halton Hills region.

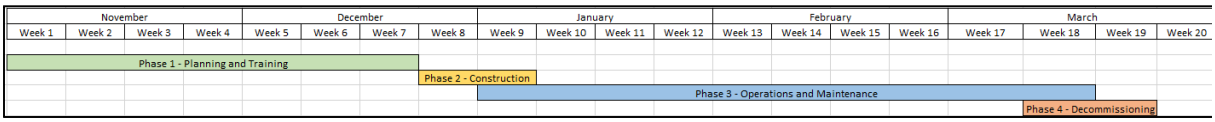

Figure 5-1
Typical Project Cycle

Below is a brief description of the phases identified for this feasibility review.

5.1 Phase 1 - Planning (November-December)

This phase begins when a decision is made to move forward with the construction and operations of a skating area. The main items that should be addressed in this phase include:

- Final decision on the size and layout of the skating area, including how the areas will be signed and marked to mitigate the risk of individuals operating in areas that have not been properly tested.
- Decision on the Rules of Use for the skating facility.
- Development of an Ice Management Program that is tailored to the facilities and Town staff. This Program would include (but is not limited to) ice integrity and thickness inspection methodology and frequency, ice hazards and control measures, safe work procedures, etc. Refer to Appendix A for a sample Ice Management Plan table of contents.
- Confirm required permits and licences are in place.
- Procurement of materials and equipment desired for the facilities (for example: nets, signage, fencing/barricades, specialty equipment, etc.).
- Training for Town staff on construction safety, ice inspection and maintenance requirements.
- Communication of intended use, rules, logistics and other project details to the public.

It is recommended a Risk Assessment be completed by Town staff which will inform final decisions on all of the items identified in the planning stage.

It is recommended the Town plan for a minimum of an eight-week timeframe for planning and recognize this timeframe could extend longer depending on the availability of Town staff and the level of public engagement envisaged. It is recommended the Planning Phase is finalized and necessary training completed by 15 December annually.

5.2 Phase 2 - Construction (December/January)

This phase begins when sufficient ice cover is present to begin construction efforts and is complete when the facility is opened to public. An aggregate of 95 Freezing Degree Days is expected to be required to provide sufficient natural ice growth to begin construction (additional details on Freezing Degree Days are provided in Section 4).

Signage is recommended to be placed during the construction phase to advise the public that the facilities are not yet safe for public use. Assuming light utility equipment is used for construction (See Section 6), a target minimum thickness of 20 cm of good quality ice is recommended prior to construction equipment being placed onto the ice cover.

5.3 Phase 3 – Operations and Maintenance (January – March)

This phase begins when the ice thickness and ice conditions are suitable for public access, including the installation of appropriate signs and markings to clearly identify areas safe for use.

Ice covers will experience cracking and other degradation with changing weather conditions and use. Inspection and maintenance programs are required to be completed regularly throughout the operating season to maintain a safe ice cover. The specific requirements for visual inspections, ice thickness monitoring and maintenance should be outlined in an Ice Management Plan that is developed during the Planning Phase.

Due to the impact of short-term fluctuations in ambient temperature on ice conditions throughout the winter, it may be necessary to temporarily close the skating facilities until ice conditions are suitable for safe use. The regular inspection program will identify these conditions and will cue necessary maintenance as required.

This phase will be completed when the Town decides to close the ice facilities for the season.

5.4 Phase 4 - Decommissioning (March)

The decision to close the facilities for the season is conditions-dependent and is normally taken in the late Winter or early Spring, depending on the weather conditions experienced in the March timeframe. An outdoor ice facility that has been well-managed throughout the season is generally more resilient and capable of surviving short term warming events. Nonetheless, as the weather warms, the ice surface will become unsuitable for skating and a decision to close the facilities for the season will be required.

Given the intended use of the ice cover, ice rink decommissioning is expected to involve the removal of all equipment and signs on the ice cover and the placement of barricades and signs at established access points to advise the public that the ice conditions are no longer being monitored and that

further use of the ice cover for recreation is prohibited. A proactive approach for decommissioning the ice facility will be required for the safe retrieval any equipment on the ice (such as signage, portable light standards, fencing, etc.) by Town staff.

It is recommended that barricades and signs remain in place at the access points and around the lake until ice breakup has occurred. A communications plan to advise the public through social media and radio of the significant hazards associated with over ice activities following closure may also be beneficial.

The Decommissioning phase is also an ideal opportunity to collect and record “lessons learned” and adjustments that may be applicable to future seasons. These lessons should be recorded and incorporated into the Planning Phase for subsequent seasons.

6 GENERAL RECREATIONAL ICE THICKNESS REQUIREMENTS

The required ice thickness for safe construction and operations is an important factor driving the overall season length of a natural water body for recreational ice activity. It is generally more desirable to utilize light-weight utility vehicles to complete initial construction. These vehicles can operate safely on less ice thickness than heavier equipment. A key criterion for the start date for a given skating season is the timeframe required for ice growth to a thickness capable of supporting the construction equipment. Once construction equipment has safely cleared the skating area, most recreational activities can commence.

Table 6-1 illustrates typical ice thickness requirements that can be used for planning purposes for various light vehicles that can be used for snow clearance and ice maintenance:

Table 6-1
Typical Ice Thickness Requirements for Planning

Serial	Equipment Description	Maximum Weight (kg)	Minimum Ice Thickness Required for Construction Start
1	Kubota RTV 400 with Plow	1,200	19 cm
2	Kubota F2690 Tractor with L2163-60” Rotary Broom	1,150	19 cm
3	Light Pick up truck with plow	3,200	30 cm
4	Olympia Zamboni	3,900	35 cm

This is an illustrative list only and requires implementation of a comprehensive ice safety management program before adopting these ice thickness requirements. Corresponding ice thicknesses to actual equipment models to be used should also be confirmed prior to construction. However, this table provides a useful range of target ice thicknesses required for planning purposes.

7 RECOMMENDATIONS AND NEXT STEPS

Based on our review of the historical weather data and anticipated minimum ice thickness requirement, an operating season of 33 to 54 days is likely feasible on an average year. This feasible operating window is subject to actual weather and site conditions, and assuming a minimum requirement of 20 to 30 cm of ice.

Our recommended next steps to implement an outdoor ice program at Fairy Lake are summarized as follows:

- Determine permitting requirements and anticipated timelines. This may influence the start date and year for the outdoor ice program.
- Confirm project footprint, as well as associated equipment, resource and staffing requirements and costs.
- Complete a Risk Assessment to determine risks for the ice program and proposed mitigation methods.
- Prepare an Ice Safety Management Plan (refer to Appendix A for a sample table of contents).
- Develop a Communications Plan to communicate ice rink conditions and opening/closure, monitored ice locations, as well as “no go” areas.

CLOSURE

Thank you for the opportunity to complete a feasibility review for an outdoor ice program at Fairy Lake for the Town of Halton Hills. We trust that this technical memorandum meets the Town's needs to determine the general feasibility and recommended next steps for an outdoor skating rink program at Fairy Lake.

Please contact the undersigned should you have any questions.

Respectfully submitted,

Associated Engineering (Ont.) Ltd.

Yours truly,

Karine Poliquin, P.Eng.
Project Manager

Al Fitzgerald, P.Eng.
Ice Engineering Specialist

KP/AF/sn

Appendixes:

- A - Ice Management Program
- B – Potential Ice Program Layout Sketch

APPENDIX A – ICE MANAGEMENT PROGRAM (SAMPLE TABLE OF CONTENTS)

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APPENDIX B – POTENTIAL ICE PROGRAM LAYOUT SKETCH

IF NOT 25 mm ADJUST SCALES
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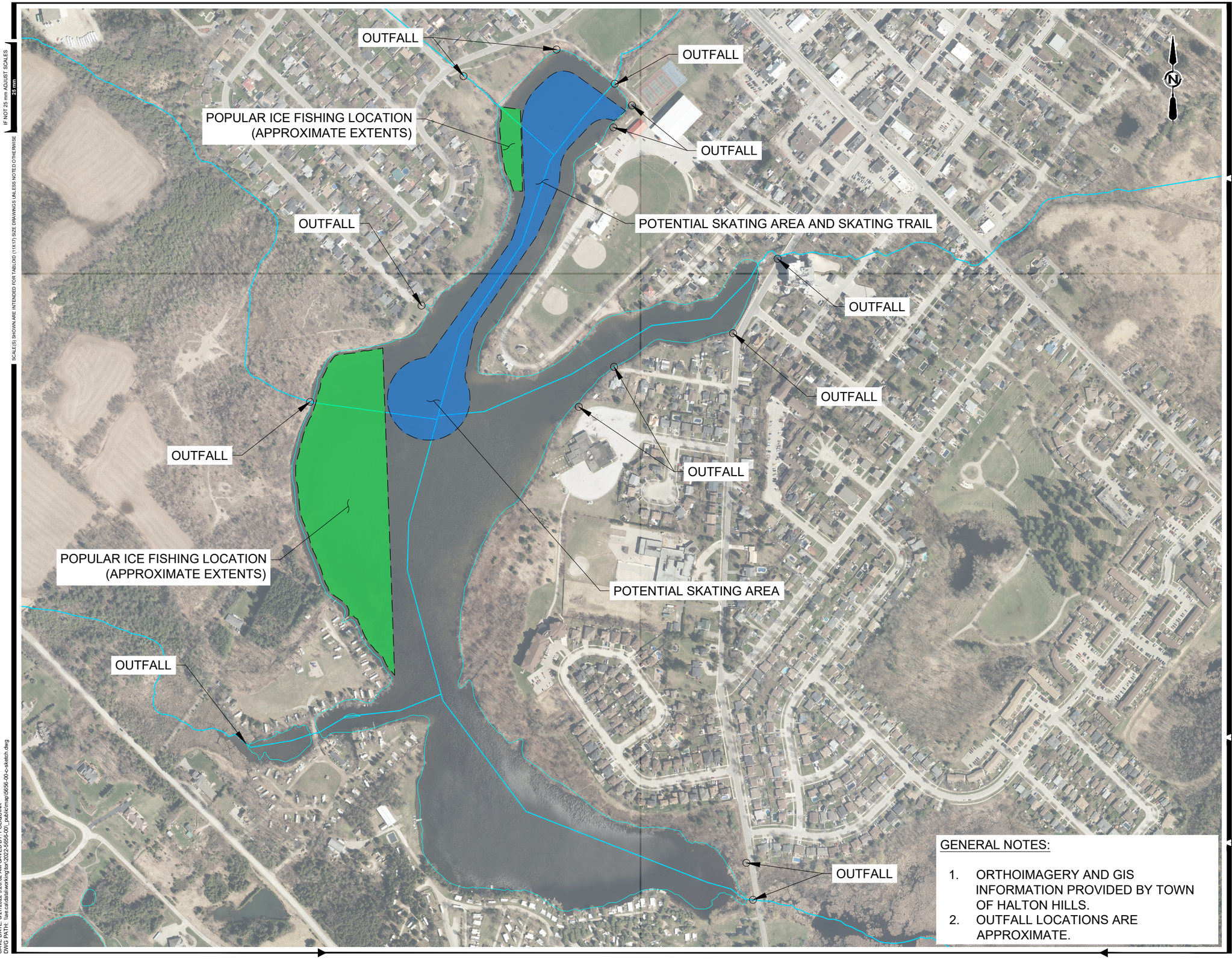
SCALE(S) SHOWN ARE INTENDED FOR TABLOID (11X17) SIZE DRAWINGS UNLESS NOTED OTHERWISE



GENERAL NOTES:

1. ORTHOIMAGERY AND GIS INFORMATION PROVIDED BY TOWN OF HALTON HILLS.
2. OUTFALL LOCATIONS ARE APPROXIMATE.

Associated Engineering

CANADA'S BEST MANAGED COMPANIES
Platinum member

FOR DISCUSSION ONLY

POTENTIAL ICE PROGRAM LAYOUT

TOWN OF HALTON HILLS

FAIRY LAKE OUTDOOR ICE PROGRAM
FOR DISCUSSION ONLY

AE PROJECT No.	20222515-00
SCALE	1:5000
APPROVED	-
DATE	20220627
REV	-
DESCRIPTION	FOR DISCUSSION ONLY

DWG No. -

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