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Your file / Votre référence
EA1011-001

Our file / Notre référence
10-HCAA-CA6-00026

November 29th, 2012

Mackenzie Valley Environmental Impact Review Board
#200 Scotia Centre
5102-50th Avenue
Yellowknife, NT
X1A 2N7

Via e-mail to:
pmercredi@reviewboard.ca

RE: Fisheries and Oceans Canada – Technical Submission for Avalon Rare Earth Metals proposed Thor Lake Mine Project

Fisheries and Oceans Canada (DFO) is pleased to provide the Mackenzie Valley Environmental Impact Review Board (MVEIRB) with our technical submission for Avalon Rare Earth Metals (Avalon) proposed Thor Lake Mine Project. DFO would like to note that the recent and upcoming changes to the *Fisheries Act*, have not affected DFO's review and conclusions as they relate to this project.

DFO's submission provides a summary of our involvement as well as our technical review of the information provided by Avalon throughout this environmental assessment. DFO is of the opinion that, based on the information provided by the Proponent, with the proper use of our standard operational statements and protocols, impacts to fish and fish habitat can be fully mitigated. DFO does not have recommendations to make to the Board on this project and would therefore respectfully request that our department not be required to attend or present at the hearings. If the Board, the public or any parties to this environmental assessment have questions related to our submission or conclusions, DFO would be pleased to respond in writing either prior to or immediately following the hearings.

If you have any questions, please do not hesitate to contact Sarah Olivier at (867) 669-4919, or email at Sarah.Olivier@dfo-mpo.gc.ca.

Sincerely,

Larry Dow
A/ Area Director – Western Arctic Area
Fisheries and Oceans Canada

cc Bev Ross, Fisheries and Oceans Canada
Rick Walbourne, Fisheries and Oceans Canada
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Fisheries and Oceans Pêches et Océans
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TECHNICAL REPORT

Avalon Rare Earth Metals Inc. Thor Lake Mine Project

Submitted to:
Mackenzie Valley Environmental Impact Review Board
November 29, 2012

MVEIRB Code: EA1011-01
DFO File No.: 10-HCAA-CA6-00026

Canada 

PLAIN LANGUAGE SUMMARY

The Department of Fisheries and Oceans (DFO) is responsible for developing and implementing policies and programs in support of Canada's scientific, ecological, social and economic interests in oceans and fresh waters. The following technical comments and recommendations are based upon our departmental mandate under the *Fisheries Act*, specifically related to the management of fish and fish habitat. DFO's primary focus in reviewing proposed developments in and around Canadian fisheries waters is to ensure that the works and undertakings are conducted in such a way that the proponent is in compliance with the applicable provisions of the *Fisheries Act*. DFO's technical review of Avalon Rare Earth Metals (Avalon) Thor Lake Project proposal is divided into five (5) main categories: the Tailings Management Facility, Access Roads, Water Withdrawals, Dock/Barging Structure, and Sediment and Erosion Control.

Based on Avalon's fisheries assessments, lake connectivity investigations and winter under ice dissolved oxygen data, DFO agrees that the lakes within the area of the Tailings Management Facility do not support fish or fish habitat and therefore would not require an authorization under Section 35 or be subject to Section 36 of the *Fisheries Act*.

Avalon has indicated that two watercourse crossings are needed in support of the access road from Great Slave Lake to the mine site between Fred and Cressy Lakes and Long and Thor Lakes. Both structures will consist of an arch culvert to avoid impacting the stream and potential fish habitat within. The use of arch culverts have been historically recommended by DFO as opposed to round culverts, as the latter requires in-water works often resulting in the destruction of fish habitat and requiring Authorization under the *Fisheries Act*. If installed correctly and sized adequately, an arch culvert can avoid any disturbance below the high water mark and eliminate any potential impacts to fish and fish habitat.

Large amounts of water withdrawn from ice covered waterbodies or watercourses can lead to oxygen depletion, loss of over-wintering habitat and/or reduction in littoral habitat. Thor Lake has been identified as the sole fish bearing water source for the Thor Lake project. Given the relatively small quantities of water required by the project and the use of an acceptable water intake screen, DFO concluded that the likelihood of impacts to fish and fish habitat as a result of water withdrawals in Thor Lake are negligible.

In support of the Thor Lake mine, barging is required between the mine site at Thor Lake and the hydrometallurgical plant at Pine Point. Pile-driving will be required at the Pine Point location and the total resulting in-water footprint is stated to be 6.0 m². Based on mitigation measures provided and the minimal aquatic footprint, DFO concludes that this component of the proposal would not result in impacts to fish and fish habitat.

Promoting and implementing erosion and sediment control measures on development sites is considered to be a best management practice. Fish are highly susceptible to impacts caused by erosion and sedimentation which are easily preventable or mitigated using standard techniques. Provided Avalon develops and implements a Sediment and Erosion Plan as discussed, DFO concludes that there would no impacts to fish and fish habitat,

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1.0 INTRODUCTION

1.1 Background

Avalon Rare Earth Metals (Avalon) is proposing to develop an underground rare earth mine located approximately 5 km north of the Hearne Channel of Great Slave Lake and about 100 southeast of Yellowknife (Thor Lake Property). Additionally, a hydrometallurgical plant will be located at the former Pine Point mine site, approximately 85 km east of Hay River. The proposed development also includes:

- Camp Facilities
- Tailings Management Facility (TMF)
- Effluent and sewage treatment facilities
- Flotation Plant
- Access roads at Thor Lake and Pine Point including watercourse crossings
- Upgrade of airstrip
- Freshwater intake on Thor Lake
- Dock/barging facilities
- Decant pipe on the shore of Drizzle Lake

Fisheries and Oceans Canada (DFO) has completed its technical review of the proposed development, taking into consideration the information supplied by Avalon through their correspondence with DFO, their Developer's Assessment Report (DAR), responses to Information Requests and other pertinent documents submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB).

1.2 Mandate

DFO's guiding legislation includes the *Fisheries Act*, which confers responsibility to the Minister for the management of fisheries, habitat and aquaculture. The *Fisheries Act* provides DFO with its regulatory powers to conserve and protect fish and fish habitat. This is accomplished through the administration of the Fisheries Protection provisions and other sections of the *Fisheries Act* which are binding on all levels of government and the public. These include the following sections:

- the provision of sufficient water flows – **section 22**
- passage of fish around migration barriers – **sections 20 and 21**
- screening of water intakes – **section 30**
- prohibition against the destruction of fish by means other than fishing unless authorized by DFO – **section 32**
- the prohibition against the harmful alteration, disruption or destruction (HADD) of fish habitat unless authorized by DFO – **section 35**
- prohibition to deposit deleterious substances unless by regulation – **section 36**

Of note, Environment Canada (EC) is responsible for the administration and enforcement of the pollution prevention provisions of the *Fisheries Act* on behalf of DFO (section 34 and sections 36-42).

2.0 TECHNICAL COMMENTS – TAILINGS MANAGEMENT FACILITY

Avalon is proposing to construct a Tailings Management Facility within the footprint of Ring, Buck and Ball Lakes. DFO has reviewed the application to determine if these lakes are fish frequented and therefore subject to the *Metal Mining Effluent Regulations* (MMER), pursuant to Section 36 of the *Fisheries Act*, and administered by Environment Canada. The information used by DFO in this determination included, but is not limited to, fisheries assessment efforts and methods, seasonal variability in fish presence, connectivity with surrounding lakes, and winter water chemistry data.

2.1 Fisheries Status – Ring, Buck and Ball Lakes

2.1.1 Documents Reviewed

- Developer's Assessment Report (DAR), May 2011 :
 - o Section 2.5.2
 - o Section 2.8.3
 - o Section 2.8.4
 - o Section 4.7.3
 - o Section 6.6.3
- DAR Appendix A1 – Aquatic and Fisheries, January 2010
- Aquatic and Fisheries, May 2011 – Submitted in September 2011
- Melville et al. 1989. Thor Lake Area (NWT) – Environmental Baseline Survey
- Avalon Response to DFO IR_1

2.1.2 Proponent's Assessment and Conclusions

Avalon submitted their Developer's Assessment Report (DAR) to the Review Board in May 2011, a component of which was Appendix A1 – Aquatic and Fisheries dated January 2010. Additionally, Avalon submitted an updated report (dated January 2011) in September 2011 which included additional field data from 2010. This report included the fisheries assessments of Ring and Buck Lakes in 2009 and 2010 as well as nearby Ball Lake in 2010. Also, Stantec completed fisheries assessments of 5 lakes in 2011 which included Ring, Buck, and Ball Lakes and bathymetry was conducted in 2009 (Ring and Buck) and 2010 (Ball). Winter dissolved oxygen was taken in these lakes at various times during water quality sampling.

The proponent has stated that there is no connectivity between the waterbodies within the footprint of the Tailings Management Facility and the nearest fish-bearing water is Drizzle Lake. Section 2.5.2 of the DAR states that "Ring Lake.....is connected to Buck Lake via a marsh, which may have seasonal drainage channels into Buck Lake" and that "Buck Lake is bounded at its downstream end by bedrock outcrops and does not have a discernible channel."

The DAR concluded that if no fish were captured in two years of study, the lake is isolated from known fish bearing habitat, and the winter water quality data indicates that dissolved oxygen is below the acute minimum value for the protection of aquatic life, a lake was identified as non-fish bearing. Ring and Buck Lake, as well as Ball Lake, fit this criteria.

2.1.3 DFO's Conclusions and Recommendations

DFO has reviewed a variety of information provided by Avalon over the last several years to assist in determining the likelihood that these lakes are potentially fish frequented.

Fisheries Assessments

Gillnets (91.2 m x 2.4 m) with mesh ranging from 25-89mm were set in Ring and Buck Lakes in September 2009, 2010 and 2011, for overnight sets. Additionally, in 2009, 8 minnow traps were set in each lake and in 2010, dip netting and beach seining was employed. Ring Lake was beach seined again in 2011. No fish were captured during these field investigations. Additionally, Melville et al. (1989) conducted a baseline assessment of the area in September 1988 which included Ring Lake. While information in this report is somewhat limited it does indicate that one gill net composed of two mesh sizes was set for 48 hrs and captured no fish.

Ball Lake is located between Ring and Buck Lakes and was added to the sampling program in 2010 at the request of Fisheries and Oceans Canada (original review of project to Mackenzie Valley Land and Water Board in May 2010 prior to commencement of environment assessment). Gillnets (91.2m x 2.4m) with mesh ranging from 25-89mm were set overnight. This methodology was repeated in September 2011. No fish were captured during these field investigations.

Connectivity

While there may be no fish residing in a water body during a specific sampling period, it is also important to determine if connectivity exists to other waterbodies with known fisheries populations during periods of high flow, such as spring freshet. This may indicate the potential usage of the area during specific times of year by migrant fish species including spring spawners. While Ring, Ball and Buck Lakes are connected to each other as stated in the DAR “Buck Lake is bounded at its downstream end by bedrock outcrops and does not have a discernible channel.”

Winter/Under Ice Dissolved Oxygen

While there may be no connection between the lakes within the Tailings Management Facility and Drizzle Lake, there may still be a potential for this area to have over-wintering habitat for a resident fish population, despite the lack of fish captured during sampling. For a waterbody to sustain over-wintering fish habitat there must be a source of dissolved oxygen. The CCME Guidelines for Dissolved Oxygen in Freshwater for the Protection of Aquatic Life in coldwater is 9.5 mg/L for early life stages and 6.5 mg/L for other life stages (CCME, 1999). During the winter months, DO concentrations in winter systems are reduced by ice cover, which decreases re-aeration, influxes of oxygen-depleted groundwater and oxidation of organic material (Chambers, 1996). Under-ice dissolved oxygen was taken from this area and found to annually range from 0.55-1.13 mg/L at Buck Lake and 0.44-1.50 mg/L at Ring Lake. It is unlikely that these levels would sustain over-wintering fisheries populations.

Based on the information outlined above, DFO concurs with Avalon's assessment that Ring, Buck and Ball Lake are unlikely to support fish populations. We have no further information requirements or recommendations in this area.

3.0 TECHNICAL COMMENTS – ACCESS ROAD

3.1 Watercourse Crossings

3.1.1 Documents Reviewed

- DAR, May 2011:
 - o Section 4.7.5
 - o Section 4.8.5
 - o Section 11.2.9
 - o Section 11.3.7
- Avalon Response to Information Request DFO_7
- May 8th, 2012 Avalon Response to DFO Request for Clarification (dated April 28th, 2012)

3.1.2 Proponent’s Assessment and Conclusions

Avalon had originally indicated that the only crossing location was at the outlet of Cressy Lake and was identified as non-fish bearing and not providing a migratory corridor between Cressy and Fred Lakes. During the Information Requests, DFO requested additional information on all watercourse crossings and inquired specifically about the potential upgrade of a known crossing between Long and Thor Lakes. In Avalon’s response to Information Request DFO_7, Avalon provided details on the Fred Lake crossing, outlining that it will utilize an arch culvert to protect and maintain the existing fish habitat at this crossing site. As well, Avalon confirmed that the crossing between Thor and Long Lakes would require upgrading and informed DFO that a similar arrangement would be utilized at this site, namely the installation of an arch culvert.

3.1.3 DFO’s Conclusions and Recommendations

The use of arch culverts have been historically recommended by DFO as opposed to round culverts, as the latter requires in-water works often resulting in the destruction of fish habitat and requiring Authorization under the *Fisheries Act*. If installed correctly and sized adequately, an arch culvert can avoid any disturbance below the high water mark and eliminate any potential impacts to fish and fish habitat. In correspondence dated April 28th, 2012 upon reviewing Avalon’s response, DFO provided the following statement regarding watercourse crossing:

“ DFO requested additional information on all crossings. Avalon has provided a design for the Fred Lake crossing and noted that the Thor-Long crossing would also employ an arch culvert. DFO requests that final plans are made available prior to construction to ensure that works are completed outside the high water mark and that flows are maintained. No further information is required at this time.”

Avalon responded on May 8th, 2012, stating that “Avalon will be pleased to provide a copy of the final plans to DFO for review and comment prior to implementation”

4.0 TECHNICAL COMMENTS - WATER WITHDRAWAL – THOR LAKE

4.1 Water Quantity Effects

4.1.1 Documents Reviewed

- DAR, May 2011:
 - o List of Commitments (Commitments #112)
 - o Section 2.5
 - o Section 2.8
 - o Section 6.3
 - o Section 6.4
 - o Section 6.6
- DAR Appendix A1 – Aquatic and Fisheries, January 2010
- DAR Appendix C13- Thor Lake Project – (Updated) Feasibility Study Water/Solids Balance Analysis Results. Report NB11-00148
- Aquatic and Fisheries, May 2011 – Submitted in September 2011
- Avalon Response to Information Request DFO_5

4.1.2 Proponent’s Assessment and Conclusions

Thor Lake has been identified as the sole fish bearing water source to support the project. The hydrometallurgical plant at Pine Point will be supported with water from an existing open pit. Avalon anticipates that water usage for under-ice conditions will range from 51,000 m³/year during initial years to about 38,000 m³/year during later years of operation. As well, a sensitivity analysis was conducted assuming no reclaim from the TMF and no inflow into Thor Lake over a 4-month period. Under such conditions, the under-ice requirements from Thor Lake would be anticipated at 82,000 m³/year (Appendix C13).

In addition, bathymetric surveys conducted on Thor Lake indicate a maximum depth of 16m and an available under ice volume of 3.6 Mm³. As water is withdrawn all year round only, a portion of the total would be required during the winter. In response to Information Request DFO_05, Avalon stated that “*water withdrawal from Thor Lake will conform with the DFO Winter Water Withdrawal Protocol in the Northwest Territories (DFO 2010).*” This was also listed as a commitment in the DAR (DAR, List of Commitments #112).

4.1.3 DFO’s Conclusions and Recommendations

Excessive amounts of water withdrawn from ice covered waterbodies or watercourses can lead to oxygen depletion, loss of over-wintering habitat and/or reduction in littoral habitat. To address the issue of water withdrawal, and to provide standardized guidance to water users, including volume limits for certain water source types, the *DFO Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the NWT and Nunavut (June 2010)*(Appendix I) was developed in conjunction with industry and other regulators. The intent of the protocol is to provide a standardized tool to assist

industry in avoiding possible impacts to fish from winter water withdrawals while obtaining the water they require, as well as ensuring consistency among water users. The protocol recommends that in one ice-covered season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated. Based on the total volume of available under ice volume provided of 3.6 Mm³, the anticipated maximum annual under-ice withdrawal of 82,000 m³ represents approximately 2% of the available volume.

DFO concludes that given the relatively minor amount of water required by Avalon from Thor Lake, the likelihood of impacts to fish and fish habitat as a result of water withdrawal is negligible.

4.2 Water Intake Structure

4.2.1 Documents Reviewed

- DAR, May 2011:
 - o List of Commitments (#95)
- Avalon Response to Information Request DFO_5

4.2.2 Proponent's Assessment and Conclusions

As mentioned previously, a water intake will be required at Thor Lake in order to support the mine operation. In response to Information Request DFO_5, Avalon provided detailed information on the design of the water intake structure which states:

“The intake structure will be constructed as a pipeline that extends down the shoreline with a suspended pipeline (floating catwalk) out to the intake location (small barge). At the intake location (minimum of 10 m water depth) the intake pipe will extend vertically into the water column (above the lake bottom) to withdraw water. The general details for the barge and intake system are provided in Figure 3. As noted, the structure will be floating over the lake surface and will not be in contact with the lake bottom. As a result, no effects on fish or fish habitat are expected to occur.”

In this response, Avalon also stated that the water intake will be screened in conformance with the Department of Fisheries and Oceans Freshwater Intake End-Of-Pipe Fish Screen Guideline (DFO, 1995). This was also listed as a commitment in the Developer's Assessment Report (List of Commitments, #95)

4.2.3 DFO's Conclusions and Recommendations

As there are no in-water works associated with the construction of the water intake system, DFO concurs with Avalon's conclusions that no effects to fish and fish habitat are expected to occur however DFO does anticipate that these construction works would be included under the scope of any sediment and erosion plan as may be developed.

As well, with Avalon committing to using the *Freshwater Intake End-of-Pipe Fish Screen Guidelines*, DFO has no concerns related to the potential impacts of the water intake structure on fish in Thor Lake.

5.0 TECHNICAL COMMENTS – DOCK/BARGING STRUCTURES

5.1 Dock/Barging Structures – Great Slave Lake

5.1.1 Documents Reviewed

- DAR, May 2011:
 - o Section 4.7
 - o Section 4.8
 - o Section 6.11
- Avalon Response to Information Request DFO_8
- Avalon email to DFO dated May 8th, 2012
- Avalon – Summary of Changes to Project Description dated July 3rd, 2012

5.1.2 Proponent's Assessment and Conclusions

The project proposal requires dock facilities to support the barging of concentrate from the mine site at Thor Lake to the hydrometallurgical plant at Pine Point. The Developer's Assessment Report provided a brief description of these docking facilities that would be operational during open water season consisting mainly of barges moored to anchoring structures and ramping to offload to the shoreline (DAR, Section 4.7 and 4.8) The mooring dolphins would require the installation of piles that will occur between July 16 and September 16 to avoid impacts to fish. Avalon also states that pile-driving activities will adhere to the BC Marine and Pile Driving Contractors Association and Fisheries and Oceans Best Management Practices (2003). The avoidance of sensitive timing windows and implementation of best management practices are anticipated to result in no residual adverse effects to fish, or to the productive capacity of fish habitat (DAR, Section 6.11).

In response to Information Request DFO_8, Avalon provided additional information regarding the precise location, footprint and installation methods for dock facilities at both sites, including the extent of work to be done below the high water mark, which indicated among other things that in-water pile driving at the Thor Lake dock site was no longer required. In an email dated April 28th, 2012, DFO requested additional clarification regarding the size of twelve (12) mooring dolphins required at the Pine Point site and the total footprint resulting from their installation. In a response dated May 8th, 2012, and reaffirmed in the project changes summary document (July 2012), Avalon confirmed that the barge at the Thor Lake dock will now be moored to shore and secured by lines extended to four dead men anchors and that no pile driving would be required. Regarding the Pine Point dock, the total footprint of each dolphin would be 0.5 m², and the total footprint for the 12 dolphins would be 6.0 m². The size of the piles is guided by the Best Management Practices for Pile Driving and Related Operations, prepared by the BC Marine and Pile Driving Contractors Association (March 2003). According to that document, the installation of piles up to 45.7 cm would not result in shock waves in excess of 30 kPa, a level that results in minimal or no effects on fish or their habitat.

5.1.3 DFO’s Conclusions and Recommendations

As outlined above, there have been some modifications to the dock structures throughout the environmental assessment resulting in no requirement for in-water works at the Thor Lake dock site and a minimal footprint at the Pine Point dock site of 6.0 m². As Avalon has mentioned, the installation of piles 18” in diameter and less (47.5cm) diameter would not result in shock waves in excess of 30 kpa. DFO concurs that this would result in minimal or no effects to fish (Godard et al. 2008)

Based on the information provided by Avalon, DFO concurs that impacts to fish and fish habitat can be adequately mitigated through the measures outlined. As well, DFO concludes that the minimal footprint associated with the mooring dolphins at the Pine Point dock does not result in the harmful alteration, disruption or destruction of fish habitat. However, DFO does anticipate that these construction works would be included under the scope of a sediment and erosion plan.

6.0 TECHNICAL COMMENTS – SEDIMENT AND EROSION CONTROL

6.1 Near water works

6.1.1 Documents Reviewed

- DAR, May 2011:
 - o List of Commitments (Commitments #96)
 - o List of Commitments (Commitments #121)
 - o Section 6.6
 - o Section 6.11
 - o List of Commitments (#96)
 - o List of Commitments (#121)
- Avalon Response to Information Request DFO_9
- Avalon email to DFO dated May 8th, 2012

6.1.2 Proponent’s Assessment and Conclusions

Throughout the DAR, Avalon stated that “*erosion and sediment control*” will implemented, and that “*riparian vegetation clearing and erosion control*” will be conducted according to the Land Development Guidelines for the Protection of Aquatic Habitat. This was reiterated in the List of Commitments (Commitment 96). In Information Request DFO-09, DFO stated that while some of the concepts presented in these guidelines may be applicable to Avalon’s proposed project, it should be noted that some measures may not be relevant or applicable in the northern context. DFO requested that a conceptual sediment and erosion control plan be provided. In the response to the Information Request on January 10th, 2012, Avalon provided this plan as requested which included site specific components, as well as sediment and erosion control measures and procedures. It is acknowledged by Avalon that this plan is of a preliminary nature as “*specific designs, methods and technologies will be dependant on a thorough reconnaissance of development areas to determine site specific characteristics and appropriate erosion control options.*” Additionally, Commitment 121 references “*implementation of erosion control measures if and as warranted.*”

6.1.3 DFO’s Conclusions and Recommendations

Promoting and implementing erosion and sediment control measures on development sites is considered to be a best management practice. Most impacts caused by erosion and sedimentation are easily preventable or mitigated using standard techniques. Fish are highly susceptible to effects of sedimentation and erosion, such as gill abrasion, potential asphyxiation of eggs, loss of interstitial spaces inhabited by juvenile fish and invertebrate food species, effects to visual predators caused by turbidity, etc (Robertson et al., 2006).

In an April 28th, 2012 email response to the conceptual sediment and erosion control plan provided by Avalon, DFO stated that *“once a final plan is implemented, all activities/structures should be included such as the decant pipe, emergency spillway, mooring structures, etc. Information was provided in Avalon's IR responses in this regard however it was not reflected in the conceptual plan.”* Avalon replied on May 8th, 2012, that they would be *“pleased to provide a copy of the final erosion and sediment control plan to DFO, which will include information on the decant pipe, emergency spillway, mooring structures, etc. prior to implementation.”*

7.0 REFERENCES

B.C. Marine and Pile Driving Contractors Association and Fisheries and Oceans Canada. 2003. Best Management Practices for Pile Driving and Related Operations. Unpublished Report. Victoria, BC.

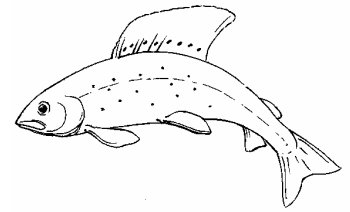
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Appendix I – DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut



DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the Northwest Territories and Nunavut

Rationale

In the Northwest Territories and Nunavut, winter activities such as access road construction, exploratory drilling and camp operations often require large amounts of water. Excessive amounts of water withdrawn from ice-covered waterbodies can impact fish through oxygen depletion, loss of over-wintering habitat and/or reductions in littoral habitat. The potential for such negative impacts to over-wintering fish and fish habitat has made winter water withdrawal a critical issue for Fisheries and Oceans Canada (DFO) in the Northwest Territories and Nunavut. To mitigate impacts to fish from water withdrawal from ice-covered waterbodies, and to provide standardized guidance to water users, including volume limits for certain water source types, DFO has developed this protocol in conjunction with industry and other regulators.

For the purposes of this protocol, a **waterbody** is defined as any water-filled basin that is potential fish habitat. A waterbody is defined by the ordinary high water mark of the basin, and excludes connecting watercourses.

This protocol will **not** apply to the following:

- Any waterbody that is exempted by DFO (e.g. Great Bear Lake, Great Slave Lake, Gordon Lake, and others as and when determined by DFO), and;
- Any waterbody from which less than 100m³ is to be withdrawn over the course of one ice-covered period.

In order to establish a winter water withdrawal limit for a given waterbody, the following criteria must be adhered to:

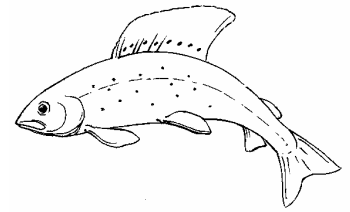
1. In one ice-covered season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated using the appropriate maximum expected ice thickness provided in Table 1.
2. In cases where there are multiple users withdrawing water from a single waterbody, the total combined withdrawal volume is not to exceed 10% of the available water volume calculated using the appropriate maximum expected ice thickness provided in Table 1. Therefore, consistent and coordinated water source identification is essential.
3. Only waterbodies with maximum depths that are $\geq 1.5\text{m}$ than their corresponding maximum expected ice thickness should be considered for water withdrawal (Table 1). Waterbodies with less than 1.5m of free water beneath the maximum ice are considered to be particularly vulnerable to the effects of water withdrawal.
4. Any waterbody with a maximum expected ice thickness that is greater than, or equal to, its maximum depth (as determined from a bathymetric survey) is exempt from the 10% maximum withdrawal limit (Table 1).

To further mitigate the impacts of water withdrawal, water is to be removed from deep areas of waterbodies (>2m below the ice surface) wherever feasible, to avoid the removal of oxygenated surface waters that are critical to over-wintering fish. The littoral zone should be avoided as a water withdrawal location. Water intakes should also be properly screened with fine mesh of 2.54 mm (1/10") and have moderate intake velocities to prevent the entrainment of fish. Please refer to the *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO, 1995) which is available upon request, or at the following internet address: www.dfo-mpo.gc.ca/Library/223669.pdf.

In order to determine the maximum water withdrawal volume from an ice-covered waterbody, and thereby conform to this protocol, the following information must be provided to DFO for review and concurrence prior to program commencement.

Water Source Identification

1. Proposed water sources, access routes, and crossing locations clearly identified on a map, with geographical coordinates (latitude/longitude and/or UTM) included.
2. Any watercourse connectivity (permanently flowing and/or seasonal) between the proposed water source and any other waterbody or watercourse.



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3. Aerial photos or satellite imagery of the water sources.
4. Estimated total water withdrawal requirement for work or activity and estimated total water withdrawal per water source (in m³).

Bathymetric Survey Results

1. For all waterbodies: One longitudinal transect, connecting the two farthest shorelines, is to be conducted regardless of waterbody size. Note: a longitudinal transect may be straight or curved in order to accommodate the shape of a lake (see Figure 1).
2. For waterbodies equal to or less than 1 km in length: a minimum of one longitudinal transect and two perpendicular transects are to be conducted. Perpendicular transects should be evenly spaced on the longest longitudinal transect, dividing the lake into thirds (Figure 1).
3. For lakes greater than 1 km in length: a minimum of one longitudinal transect is to be conducted. Perpendicular transects (minimum of 2) should be evenly spaced on the longest longitudinal transect at maximum intervals of 500 m.
4. Additional transects should be run as required to include irregularities in waterbody shape such as fingers or bays (Figure 1).
5. All longitudinal and perpendicular transects are to be conducted using an accurate, continuous depth sounding methodology, such as open water echo sounding or ground penetrating radar (GPR), that provides a continuous depth recording from one shore to the farthest opposing shore (Figure 1). Any alternative technology should be reviewed by DFO prior to implementing for bathymetric surveys.

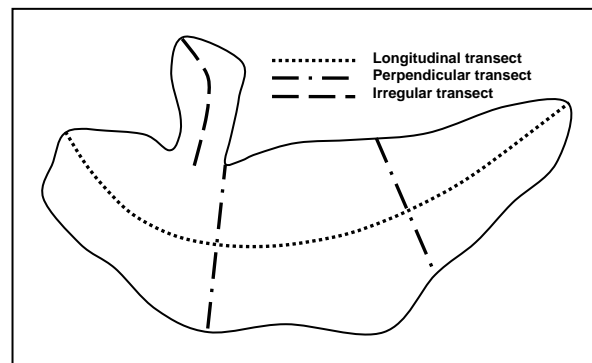
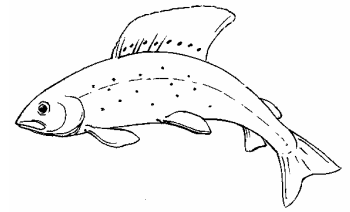


Figure 1. Minimum transect layout for a lake that is less than 1 km in length, with an irregularity.

Volume Calculations

1. Document the methods used to calculate surface area. If aerial photos or satellite imagery were used, provide the date (day/month/year) taken, as surface area may change depending on the time of year. If maps were used, provide the year that they were surveyed.
2. Detail the methods used to determine the total volume of free water, incorporating the relevant bathymetric information.
3. Calculate the available water volume under the ice using the appropriate maximum expected ice thickness, i.e. $Total\ Volume_{lake} - Ice\ Volume_{max\ thickness} = Available\ Water\ Volume$ (see Table 1 for maximum ice thickness).
4. For programs where ice-chipping is used, the total ice volume to be removed from the waterbody should be converted to total liquid volume and incorporated into the estimate of total water withdrawal requirement per water source.



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Table 1. Maximum expected ice thickness, and corresponding water depth requirements, for different regions in the Northwest Territories.

Area	Maximum Expected Ice Thickness (m)	Minimum Waterbody depth Required for 10% Water Withdrawal (m)
Above the Tree Line	2.0	≥3.5
Below the Tree Line - North of Fort Simpson	1.5	≥3.0
Deh Cho –South of Fort Simpson	1.0	≥2.5

A brief project summary report documenting and confirming total water volume used per water source and corresponding dates should be submitted to DFO within 60 days of project completion. Information should be provided in the following format (this information would also be useful as part of the project description):

Lake ID	number and/or name
Coordinates	latitude and longitude and/or UTM coordinates
Surface area	in ha
Total Lake Volume	in m ³
Under Ice Volume	in m ³ (based on max ice thickness for region)
Max expected ice thickness value used	in m
Calculated 10% Withdrawal volume	in m ³
Total required water volume extracted	in m ³
Aerial photographs of waterbody	PDF format
Bathymetric Map(s) of waterbody	PDF format

Any requests deviating from the above must be submitted to DFO and will be addressed on a site-specific basis.

Beaver and Muskrat

Many species of animals are highly sensitive to water fluctuations. In areas where beaver and muskrat may occur, the appropriate agencies or organizations should be consulted to determine if harmful effects will result from your activities, and whether these effects can be successfully mitigated through modifications to your plans including best management practices.

Please note that adherence to this protocol does not release the proponent of the responsibility for obtaining any permits, licenses or authorizations that may be required.

For more information contact DFO at (867) 669-4915.