NORTHLAND EARTH & WATER CONSULTING INC.

2014 Dam Safety Report
Fish Lake Hydro System
Whitehorse, Yukon

Prepared for

ATCO Electric Yukon

February 2015

Reference: 2014-02

NORTHLAND EARTH & WATER CONSULTING INC.

12 Aquamarine Place, Whitehorse, Yukon Y1A 6G8

February 26, 2015

ATCO Electric Yukon
100 – 1100 1st Avenue
Whitehorse, Yukon Y1A 3T4

Attention: Mr. Rob Williamson

Dear Rob,

Re: 2014 Dam Safety Report
Fish Lake Hydro, Whitehorse, Yukon

Please find attached the 2014 Dam Safety Report for Fish Lake Hydro that details Northland Earth & Water Consulting Inc.'s (Northland) observations and recommendations arising from site visits to the Fish Lake Hydro facilities completed in 2014 and in early 2015, as well as from reviewing documentation related to dam safety activities undertaken in 2014.

Northland thanks you for the opportunity to be of service; should you require any further assistance with this project or other water resources projects please do not hesitate to contact the undersigned at your convenience.

Yours truly,

Cord Hamilton, M.Eng., P.Eng.
Civil Engineering Consultant
Ph: (867) 332-6556
Email: chamilton@Northlandconsulting.ca

1. Introduction

As requested by ATCO Electric Yukon (ATCO), Mr. Cord Hamilton, P.Eng. of Northland Earth & Water Consulting Inc. (Northland) completed a series of site visits in 2014 and in early 2015 to observe water management structures associated with the Fish Lake Hydro system near Whitehorse, Yukon. Specifically, the following structures were observed on one or more occasions:

- Fish Lake Dyke;
- Ditch #3;
- Louise Lake Containment Dyke;
- Louise Lake Auxiliary Spillway;
- Louise Lake Control Structure;
- Ditch #1;
- Ditch #1 Spillway; and
- Pond #2 and its dam and discharge structures.

Northland's site visits were completed to observe the condition and performance of the water management structures in relation to dam safety requirements and in relation to the recommendations from previous annual inspections and the last formal Dam Safety Review which was completed in 2007.

In addition to these specific sources of additional information, Northland has also consulted with ATCO staff regarding various dam safety and related maintenance activities conducted in 2014.

Observations and recommendations from Northland's site visits and reviews of relevant information are presented in the following sections of this report.

2. Overview of 2014

Based on observations and review of dam safety activities, Northland can state that in 2014 significant progress has been made on the inventory of potential or actual dam safety deficiencies and non-conformances documented in the 2013 Dam Safety Report and that planning to address remaining or new issues is appropriate and correctly aligned with the significance of those issues.

Entering into 2014, the Fish Lake Hydro system had an inventory of 28 dam safety related recommendations carried forward from the 2013 Dam Safety Report. This included a few remaining recommendations from the 2007 Dam Safety Review and subsequence recommendations from the period of 2008 to 2013 inclusive.

During 2014, five of these existing recommendations have been discharged or superseded and three new recommendations have been identified. Of the resolved recommendations, the completion of upgrades to the Fish Lake Dyke has removed the single largest issue that remained from the 2007 Dam Safety Review.

Additional resolved recommendations primarily related to inclusion of protocols in the revised OMS Manual and the completion of as-built drawings for structures that have previously been upgraded or replaced.

In regards to the new recommendations, they related to two new issues: (1) addressing ice related damage to the Ditch #1 spillway that occurred in January 2015 and (2) addressing minor erosion issues on the backslope of the 2013 breach repair section of Ditch #3.

For reference, a consolidated list of the active recommendations arising from the 2014 observations, as well as from past reviews is presented in Table A1 in Appendix A. Past recommendations that have been addressed or superseded are presented in Table A2, also in Appendix A.

Specific comment on the condition, performance and any completed dam safety activities for individual components of the Fish Lake hydro system are presented in sections 3 to 10. New recommendations arising from the inspections and review of additional information are also detailed in sections 3 to 10.

Photographs of water retaining structures observed in 2014 are presented in Appendix B at the end of this report.

3. Fish Lake Dyke

3.1 Observations

The Fish Lake dyke was observed by Northland on numerous occasions in 2014 during the months of June through September when the final phase of planned upgrades to the dyke were completed.

The final upgrading activities completed in summer 2014 consisted of installing the replacement upstream armouring (riprap), replacing the discharge structure conduit with a new two conduit discharge structure, raising the dyke crest height, widening the crest, and installing an auxiliary overflow spillway section on the dyke access road.

Photographs #1 to #8 in Appendix B at the end of this memorandum show the completed summer 2014 upgrading activities at the dyke.

3.2 Recommendations

In respects to new recommendations, Northland has no new recommendations to add in relation to the Fish Lake Dyke and its discharge structure. While not a recommendation, ATCO is nonetheless advised to carefully monitor the performance of the upgraded structure over the next several years to ensure that the design is functioning as intended.

With respect to pre-existing recommendations, Northland notes that there were two pre-existing recommendations related to Fish Lake Dyke and its discharge structure. These recommendations are presented in Table 1.

Table 1: Pre-existing Fish Lake Dyke Recommendations

#	**Recommendation**
2008-04	Previously planned construction to add riprap, to increase width and height of the dyke and to add an emergency spillway should be updated and completed.
2008-06	Extend the staff gauge to the new dyke crest level, and check the staff gauge against a known stable bench mark for elevation.

On the basis of observations from 2014 Northland can confirm that recommendation 2008-04 has been addressed through completion of the final phase of upgrading activities at the Fish Lake Dyke. Recommendation 2008-06 (staff gauge installation on new intake structure) remains to be completed. It is understood that this item will be addressed in spring 2015.

4. Ditch #3

4.1 Observations

During 2014, Northland completed two site visits to Ditch #3, including visits in May and in September. The site visits were completed both for the general inspection of the canal and its control structure, as well as to:

(1) observe seasonal ice conditions near the upstream inlet of the channel; and

(2) observe the performance of the repaired breach location from the 2013 breach of the canal.

The physical condition of the canal and its containment dyke appeared unchanged from past observations with two exceptions. The first exception is the development of a minor erosion scar on the backslope of the dyke at the location of the former Franklin Lake spillway inlet. This scar is shown in Photograph #9.

The minor erosion scar was not observed in the 2013 but in 2013 the location was covered with aufeis (ice buildup from overflow crossing over from the Ditch #3 channel) and so the ground surface could not be observed. Moreover, Northland has no photographic evidence from past years that indicated the presence of this scar, although it may have been obscured by vegetation.

The second exception in regards to the condition of the channel was that a number of minor erosion gullies have developed on the backslope of the 2013 breach repair location. The gullies appeared to be the result of spring thaw runoff from the dyke crest concentrating at several points on the backslope of the repaired dyke section.

In respect to the issue of overflow ice at the inlet to the Ditch #3 channel, the May 2014 site visit was too late to observe the full buildup of ice at this location but there was still evidence to suggest that overflow ice had built up over the present dyke and allowed water (via seepage or overflow) to enter into the former spillway channel (Photographs #10 and #11). Thus, the issue of seasonal ice development and glaciation at this location will need to be further addressed in the detailed design of the Ditch #3 Diversion. The minor erosion issue observed at the inlet to the former Franklin Lake spillway is likely related to this ice issue and it will also be dealt with by the planned reconstruction of Franklin Lake channel in 2015.

During the May 2014 site visit it was observed that there was still a short section of the exterior slope of the containment dyke that has not been cleared of long term vegetation growth but it is understood this will be completed in 2015 as part of the Ditch #3 diversion works. In addition to the missing section of clearing, the dyke crest and slopes previously brushed are already re-growing and will need to be re-brushed.

The Ditch #3 "Drop-box" control structure was also observed and found to be in fair condition with no observable changes from its condition in 2013.

In fall 2014, it was observed that clearing activities for the proposed Franklin Lake channel were completed to allow for planned construction in summer 2015.

Photographs #9 to #15 in Appendix B at the end of this memorandum show the condition of Ditch #3 in 2014.

4.2 Recommendations

On the basis of observations and on the current planning of ATCO, Northland has one new recommendation in relation to Ditch #3.

The recommendation is that the backslope of the breach repair section should be lowered in slope to address erosion issues on the backslope and the crest of the dyke at this section should be graded to direct runoff away from running down the long backslope. This work should be completed in 2015 at avoid further gulley development on the backslope.

With respect to pre-existing recommendations, Northland notes that there were eight[1] pre-existing recommendations related to Ditch #3 and its control structure. These recommendations are presented in Table 2.

[1] Recommendation 2008-10 was omitted from the 2013 report on the basis that Northland was informed it was resolved which was found to be in correct.

Table 2: Pre-existing Ditch #3 Recommendations

#	**Recommendation**
2008-10	Cut all existing trees and shrubs on crest and upstream/downstream faces of the embankment.
2013-01	Update the design parameters in the OMS manual for the temporary Ditch #3 spillway into the diversion channel to Franklin Lake to require a weir length of at least 25 m and an invert of 1030.10 m for passage of the peak IDF flow through Ditch #3 for the current operating conditions.
2013-02	In association with proposed upgrades to the Fish Lake Dyke proceed with installation of a lateral overflow spillway into the Ditch #3 Diversion to Franklin Lake. The lateral overflow spillway should have a discharge capacity of at least 10.6 m3/s at a Ditch #3 canal level of 1030.45 m.
2013-03	Annually monitor the potential erosion at the left hand side of the chute wall of the Ditch #3 Drop Box at its exit into the flip bucket.
2014-01	Develop and implement a specific protocol for the removal of winter stoplogs from the Ditch #3 drop box and incorporate this protocol in the May 2014 revision of the OMS Manual.
2014-02	Complete the proposed freeboard improvements of the remaining low area along the Ditch #3 dyke in association with the Franklin Lake diversion construction in 2015. If the diversion is delayed the freeboard improvements should be completed separately by 2015.
2014-03	Further investigate the development of overflow ice at the proposed inlet to the Franklin Lake diversion channel and to the extent possible account for overflow ice development in the design and operation of the new control structure into the Franklin Lake diversion channel.
2014-04	If overflow ice is found to be an issue that interferes with the use of the Franklin Lake diversion to manage early season freshet flows then proceed with the installation of the parallel spillway beside the Ditch #3 drop box.

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) In regards to recommendation 2008-10, roughly 200 m of the downslope side of the Ditch #3 dyke remained to be cleared as of September 2014 but it is understood it will be cleared in summer 2015. In the 2013 report this recommendation was removed as it was incorrectly understood to have been completed in December 2013.

(2) In regards to recommendation 2013-01, the revised parameters have not been included in the latest revision of the OMS Manual; however, ATCO staff is aware of the requirement and the provision itself will be obsolete once the planned construction of the new discharge structure is completed in summer 2015. If the planned reconstruction occurs in 2015 this recommendation will not be required.

(3) In regards to recommendation 2013-02, the Franklin Lake diversion channel and control structure are still on schedule for construction in summer 2015.

(4) In regards to recommendation 2013-03, the 2014 OMS Manual update includes requirements to annually observe this issue; therefore, it can be removed from the list of recommendations as it is now an annual protocol.

(5) In regards recommendation 2014-01, a protocol for removal of stoplogs from the Ditch #3 Drop-box has been included in the OMS Manual update.

(6) In regards to recommendation 2014-02, the remaining free board improvements are still planned to be completed in association with the 2015 construction of the Franklin Lake diversion channel.

(7) In regards to recommendation 2014-03, observations in 2014 confirmed that the icing issue requires consideration in the detailed design of the Franklin Lake diversion channel control structure and it is understood that this will be addressed to the extent possible in the design.

(8) In regards to recommendation 2014-04, it will require several years of observation of the new Franklin Diversion structure to ascertain whether the parallel spillway at the Ditch #3 Drop box is required.

Therefore, Northland confirms that previous recommendations 2013-03 and 2014-01 have resolved and that excluding 2014-04, the remaining recommendations are scheduled to be resolved as part of the planned construction activities in summer 2015.

5. Louise Lake Containment Dyke

5.1 Observations

The Louise Lake containment dyke was observed in September 2014. The condition was consistent with past observations from 2007 to 2013. As in past site visits, other than minor revelling of surficial materials on the steep downstream slope, and small incised gullies created by beavers dragging trees up the downstream slope there no evidence of slope distress or movement on the downstream side of the dyke.

The animal burrows on the upstream slope of the dyke near its north end observed in 2011 were still present but no further collapse of the burrows was observed.

Seepage through the dyke and into a well-defined seepage pond at the toe of the dyke was observed consistent with past inspections. Vegetation regrowth on the dyke backslope has reinitiated and will likely require removal within two years.

Photographs of the dyke are presented as Photographs #16 and #17 in Appendix B.

5.2 Recommendations

On the basis of observations and on the current planning of ATCO, Northland has no new recommendations in regards to the Louise Lake Containment dyke.

With respect to pre-existing recommendations, Northland notes that there were three pre-existing recommendations related to the Louise Lake Containment Dyke. These three recommendations are presented in Table 3.

Table 3: Pre-existing Louise Lake Containment Dyke Recommendations

#	**Recommendation**
2010-04	Complete assessment and planning for any upgrades to this structure
2013-05	In summer 2013, expose and infill animal burrows located on the upstream face of the dyke.
2013-06	By spring 2013, establish and implement, at least temporarily, a public safety risk management plan for the dyke and maintain the program until upgrading of the dyke is completed or permanently if physical upgrading (lowering the slope or constructing a buttress) is not undertaken.

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) With respect recommendation 2010-04 regarding completing the assessment and planning for any upgrades for this structure, those activities were delayed. It is understood that the delay was due to effort being applied to the major upgrades of the Fish Lake Dyke in 2014. Northland has been informed that a design to lower the slope of the dyke is being prepared in 2015 and may be implemented through use of excess cut materials from the summer construction of the Franklin Diversion Channel. Northland recommends that ATCO at a minimum endeavor to finalize plans for the containment dyke in 2015.

(2) Recommendation 2013-05 regarding the infilling of the minor animal burrows is still pending and can be deferred until the proposed lowering of the dyke backslope is conducted.

(3) Recommendation 2013-06 regarding development and implementation of a public safety risk management plan for the dyke is currently outstanding. It is understood that the delay is attributed to issues described above for recommendation 2010-04 and the need to engage the resident of Lot 1087 who has been utilizing the dyke as an access for that property. If the proposed lowering of the dyke backslope is completed in 2015 this recommendation will not be necessary; however, if the slope of the dyke is not lowered in 2015, ATCO should proceed with implementation of this recommendation in 2015. In any case ATCO should specifically advise the resident of Lot 1087 of the present seismic risk that exists for the dyke.

Therefore, recommendations 2010-04, 2013-05, and 2013-06 are still pending resolution but current planning to resolve them appears appropriate.

6. Louise Lake Auxiliary Spillway

The Louise Lake Auxiliary spillway was observed in September 2014. The condition of the structure was consistent with past year's observation and is shown in Photographs #18 and #19. At the time of the site visit to the spillway it was discovered that that level monitoring instrumentation at the structure had been recently vandalized. The equipment has since been repaired.

6.1 Recommendations

On the basis of observations from 2014 Northland has no new recommendations in relation to this structure. With respect to pre-existing recommendations, Northland notes that there were six pre-existing recommendations related to spillway. These recommendations are presented in Table 4.

Table 4: Pre-existing Louise Lake Auxiliary Spillway

#	**Recommendation**
2013-07	Confirm the capacity and stage discharge relationship of the auxiliary structure.
2013-10	In summer 2013, remove accumulated sediment from within the spillway flume and continue to do so an annual basis.
2013-11	Evaluate the freeboard requirements for the Louise Lake Auxiliary spillway embankment and if necessary raise any low areas to achieve the necessary freeboard.

Table 4: Pre-existing Louise Lake Auxiliary Spillway (continued)

#	**Recommendation**
2014-05	Undertake planning to prepare for rehabilitation or replacement of this structure by 2020.
2014-06	The 2011 deformation survey should be repeated. If additional settlement has occurred, the survey should be completed annually to monitor settlement. The survey should include topographic pick up of the spillway dyke to assist in planning for future replacement and interim freeboard improvements.
2014-07	The missing plank on the right wall of the flume should be replaced and moss growth in joints should be removed.

On the basis of current observations Northland comments as follows on these pre-existing recommendations:

(1) With respect to confirmation of the capacity and stage discharge relationship of the structure (recommendation 2013-07), this work is still outstanding although flow monitoring data has been gathering data for this purpose. Further flow measurements will be required with stoplogs and the accumulated sediment within the flume removed. Ideally, flow measurements with the lake at or near FSL would provide the best data to calibrate the preliminary calculations of discharge capacity.

(2) The sediment that accumulated in the flume during its extensive use without stoplogs in 2012 and portions of 2013 still requires removal (Recommendation 2013-10). Removing this sediment will allow for better observation of the condition of the floor planking, identification of potential migration of fines from underneath the floor planking, and ensure that the full capacity of the flume is available for use if required. It is understood this will be completed in 2015.

(3) Evaluating the freeboard requirements of the spillway embankment (recommendation 2013-11) requires completion of the discharge capacity assessment and of the surveying of the embankment and structure both of which are still pending. ATCO is encouraged to address these matters in 2015.

(4) Planning for rehabilitation or replacement of the structure by 2020 (recommendation 2014-05) is pending and requires completion of other recommendations that are still pending. Nonetheless, there appears to be ample time to meet this timeline.

(5) The recommended survey of the structure and its adjacent embankment (Recommendation 2014-06) is currently planned for 2015.

(6) The missing plank (recommendation 2014-07) is still pending replacement.

Given the above, all of the pre-existing recommendations are still pending resolution; however they are relatively minor in nature or of low priority at this time. Nonetheless, ATCO is encouraged to move forward with addressing these matters such that the ultimate rehabilitation or replacement of the structure can occur as recommended by 2020.

7. Louise Lake Control Structure

7.1 Observations

The control structure was observed in September 2014 and is shown in Photograph #20. The structure, which was fully refurbished in 2011, was observed to be in good condition. One tree on the right-hand-side of the structure is still pending removal. Some fine cracking of concrete overlay on the upstream face of the structure (right hand side of inlet channel wall) was observed which could be an indication of potential delamination or merely thermal shrinkage cracking. This cracking should continue to be observed as part of routine observation of the structure.

7.2 Recommendations

In regards to recommendations for this structure, Northland has no new recommendations. In regards to pre-existing recommendations, there was one pre-existing recommendation for this structure. The recommendation is presented in Table 5.

Table 5: Pre-existing Recommendations Louise Lake Control Structure

#	**Recommendation**
2012-03	Remove remaining tree located on the structure

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) The planned removal of the tree on the upstream side of the structure was not completed in 2014. This should be undertaken when possible.

8. Ditch #1

8.1 Observations

Northland completed a visit to Ditch #1 in September 2014 to observe the performance of the dyke and intake structure. The condition of upstream slope of the Ditch #1 dyke was observed to be consistent with past inspections. This slope exhibits signs of shallow slope movements and tension cracks at some locations likely due to solifluction.

The tension cracks are visible in a number of locations along the upstream face of the containment dyke and are located between the crest and the normal water level of the Ditch. These observed solifluction movements are not a concern regarding the performance of the dyke.

In addition to solifluction movement some animal burrows have also been observed along the containment dyke. Where observed the burrows are located on very wide sections of dyke and are not considered to represent a hazard.

Vegetation growth on the dyke, primarily shrubs and willows is returning and is obscuring the condition of the upstream and downstream slopes.

8.2 Recommendations

On the basis of observations from 2014, Northland has no new recommendation in regards to the Ditch #1 and its intake structure.

With respect to pre-existing recommendations, Northland notes that there were two pre-existing recommendations for Ditch #1, its intake structure and penstock. These recommendations are presented in Table 6.

Table 6: Pre-existing Recommendations for Ditch #1

#	**Recommendation**
2011-09	An as-built survey drawing of the Ditch #1 channel and containment dyke should be produced and the minimum freeboard level identified for tying into remote monitoring activities.
2014-08	Repeat vegetation brushing along the upstream and downstream slopes of the Ditch #1 Dyke

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) The as-built drawing was completed in 2014 and remote monitoring was tied to freeboard requirements.

(2) Brushing of the dyke is still pending. Northland encourages the brushing to be completed in 2015 and recommends it be completed no later than 2016.

Therefore, the recommendation 2011-09 has been addressed and recommendation 2014-08 is still pending.

9. Ditch #1 Spillway

9.1 Observations

The Ditch #1 spillway was observed on September 2014. Other than having some fine sediment accumulating on the spillway apron upstream of the inlet stoplogs, the spillway was observed to be in good condition. Photographs #21 and #22 show the condition of the spillway outlet in September 2014.

9.2 Additional Information

In contrast to the condition observed in September 2014, the spillway experienced a partial failure in January 2015. In January 2015 it appears that ice forces lifted the inlet headworks of the spillway, including the upstream apron, by roughly 11 cm. This movement created a void underneath the headworks that allowed flow to occur underneath and beside the discharge pipe. As a significant length of the discharge pipe is bedded on low strength concrete the flow around the pipe appeared to be stable and not accompanied by on-going erosion of fill soils.

A temporary soil and geotextile plug weighed down with concrete lok-blocks was established several days following the failure to close the created void and this has reduced seepage that is flowing beside the pipe to tolerable levels. Reconstruction or repair of the discharge structure will be necessary.

Photographs #23 and #24 identify the surveyed displacement of the inlet headworks and present the temporary repairs respectively.

9.3 Recommendations

On the basis of observations and additional information reviewed in 2014 and in early 2015, Northland has two new recommendations in regards to the Ditch #1 spillway.

(1) The temporary repair to plug the void under the headworks of the spillway was completed as a best effort at the time. Therefore the performance of the spillway should be carefully monitored through instrumentation readings until the spillway is fully repaired or replaced in summer 2015. In addition, the spillway should be inspected at least weekly to observe its performance and any further ice related loading until full repairs or replacement has been completed.

(2) Given the displacement of the spillway headworks in January 2015, the spillway must be repaired or replaced in summer 2015. Irrespective of whether it is repaired or replaced, the structure must be designed to resist future ice forces that appear to have led to the displacement of the headworks.

With respect to pre-existing recommendations, Northland notes that there were two pre-existing recommendations related to the Ditch #1 spillway. These recommendations are presented in Table 7.

Table 7: Pre-existing Recommendations Ditch #1 Spillway

#	**Recommendation**
2011-13	Develop as-built drawings and operational protocols for use of the spillway.
2013-12	Annually prior to the on-set of the freshet remove accumulated debris from the inlet and exit of the spillway to ensure that the full capacity of the structure is available, if required, to discharge the freshet. This recommendation should be incorporated into the OMS manual.

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) The as-built drawings and operational protocols may now need replacement depending on what repairs or replacement activities are completed to address the displacement of the spillway headworks. Hence this recommendation should be deferred until the repairs/replacement has been completed.

(2) The 2014 OMS update has included protocols for addressing debris accumulations at the spillway.

Therefore, recommendation 2011-13 will need to be deferred until 2015 or later, and recommendation 2013-12 has been resolved.

10. Pond #2

10.1 Observations

Pond #2, its dam and discharge structures were observed by Northland in September 2014. Both the downstream and the exposed upstream slopes of the dam were inspected in September 2014. The condition of the downstream slope was consistent with 2013 and vegetation was still appropriately suppressed.

The repair works for the spillway completed in 2013 were observed to be functioning appropriately and no concerns were identified. Photographs #25 and #26 show the condition of the repaired spillway in September 2014.

10.2 Recommendations

On the basis of observations and on the current planning of ATCO, Northland has no new recommendations in regards to the Pond #2.

With respect to pre-existing recommendations, Northland notes that there were four pre-existing recommendations related to Pond #2, its dam and discharge structures. These recommendations are presented in Table 8.

Table 8: Pre-existing Pond #2 Recommendations

#	**Recommendation**
2008-34	Repair concrete voids in the intake structure
2013-15	Until the spillway ~~maintenance~~ replacement is completed, make contingency provisions for the use of excavation equipment to remove stoplogs below elevation 796.53 m should it be required for passage of flood flows and include the planning provisions in the OMS manual.
2014-09	Replace the Dam #2 spillway with a new structure within the next three years.
2014-10	Inspection of the grouted low level pipe should be completed to identify if it has been fully grouted for decommissioning or whether additional grouting is required to complete the decommissioning.

On the basis of current observations and additional information Northland comments as follows on these pre-existing recommendations:

(1) As noted the previously reported freeze thaw damage to intake structure has been identified as poor quality concrete placement during the original construction. Nonetheless, the voids should be repaired. ATCO presently intends to repair the concrete voids when the Dam #2 spillway is replaced in 2016.

(2) As the fill soils in front of the spillway could not be fully removed due to concerns about damaging the stoplog guides, recommendation 2013-15 should remain in place until the spillway is replaced. Inclusion of this contingency measure in the OMS Manual is still pending but should be completed internally in 2015.

(3) As recommended in 2013, ATCO is planning on replacement of the spillway. Currently the spillway replacement is scheduled for 2016.

(4) Further inspection of the grouted outlet pipe is still pending and would ideally be completed prior to the planned replacement of the spillway.

Therefore, the four pre-existing recommendations are still pending but current planning to address them appears appropriate.

11. Closure

Northland trusts that this report on the inspections of the water management structures and the review of relevant additional information associated with the Fish Lake Hydro system is sufficient for your purposes. Should you require additional information or clarification please contact the undersigned at your convenience.

Yours truly,

Northland Earth & Water Consulting Inc.

Original Signed and Sealed by

Cord Hamilton

Cord Hamilton, M.Eng., P.Eng., FEC
Civil Engineering Consultant
Ph: (867) 633-8937
Email: chamilton@Northlandengineering.ca

Appendix A

Consolidated Dam Safety Recommendations

Table A1: Consolidated Dam Safety Recommendations

#	Structure	Recommendation
2008-06	Fish Lake Dyke	Extend the staff gauge to the new dyke crest level, and check the staff gauge against a known stable bench mark for elevation.
2013-01	Ditch #3	If the Franklin Lake diversion channel is not constructed in 2015, update the design parameters in the OMS manual for the temporary Ditch #3 spillway into the diversion channel to Franklin Lake to require a weir length of at least 25 m and an invert of 1030.10 m for passage of the peak IDF flow through Ditch #3 for the current operating conditions.
2013-02	Ditch #3	In association with proposed upgrades to the Fish Lake Dyke proceed with installation of a lateral overflow spillway into the Ditch #3 Diversion to Franklin Lake. The lateral overflow spillway should have a discharge capacity of at least 10.6 m^3/s at a Ditch #3 canal level of 1030.45 m.
2014-02	Ditch #3	Complete the proposed freeboard improvements of the remaining low area along the Ditch #3 dyke in association with the Franklin Lake diversion construction in 2015. If the diversion is delayed the freeboard improvements should be completed separately by 2015.
2014-03	Ditch #3	Further investigate the development of overflow ice at the proposed inlet to the Franklin Lake diversion channel and to the extent possible account for overflow ice development in the design and operation of the new control structure into the Franklin Lake diversion channel.
2014-04	Ditch #3	If overflow ice is found to be an issue that interferes with the use of the Franklin Lake diversion to manage early season freshet flows then proceed with the installation of the parallel spillway beside the Ditch #3 drop box.
2015-01	Ditch #3	In 2015, lower the backslope of the Ditch #3 breach section to control erosion on that slope and regrade the dyke crest at this location to direct runoff away from the backslope.
2010-04	Louise Lake Containment Dyke	Complete assessment and planning for any upgrades to this structure

Table A1: Consolidated Dam Safety Recommendations (continued)

#	Structure	Recommendation
2013-05	Louise Lake Containment Dyke	Expose and infill animal burrows located on the upstream face of the dyke.
2013-06	Louise Lake Containment Dyke	Establish and implement, at least temporarily, a public safety risk management plan for the dyke and maintain the program until upgrading of the dyke is completed or permanently if physical upgrading (lowering the slope or constructing a buttress) is not undertaken.
2013-07	Louise Lake Auxiliary Spillway	Confirm the capacity and stage discharge relationship of the auxiliary structure.
2013-10	Louise Lake Auxiliary Spillway	Remove accumulated sediment from within the spillway flume and continue to do so an annual basis.
2013-11	Louise Lake Auxiliary Spillway	Evaluate the freeboard requirements for the Louise Lake Auxiliary spillway embankment and if necessary raise any low areas to achieve the necessary freeboard.
2014-05	Louise Lake Auxiliary Spillway	Undertake planning to prepare for rehabilitation or replacement of this structure by 2020.
2014-06	Louise Lake Auxiliary Spillway	The 2011 deformation survey should be repeated. If additional settlement has occurred, the survey should be completed annually to monitor settlement. The survey should include topographic pick up of the spillway dyke to assist in planning for future replacement and interim freeboard improvements.
2014-07	Louise Lake Auxiliary Spillway	The missing plank on the right wall of the flume should be replaced and moss growth in joints should be removed.
2012-03	Louise Lake Control Structure	Removing remaining tree located on the structure.

Table A1: Consolidated Dam Safety Recommendations (continued)

#	Structure	Recommendation
2014-08	Ditch #1	Repeat vegetation brushing along the upstream and downstream slopes of the Ditch #1 dyke.
2011-13	Ditch #1 Spillway	Develop as-built drawings and operational protocols for use of the spillway.
2013-12	Ditch #1 Spillway	Annually prior to the on-set of the freshet remove accumulated debris from the inlet and exit of the spillway to ensure that the full capacity of the structure is available, if required, to discharge the freshet. This recommendation should be incorporated into the OMS manual.
2015-02	Ditch #1 Spillway	The performance of the temporarily repaired spillway should be carefully monitored through instrumentation readings until the spillway is fully repaired or replaced in summer 2015. In addition, the spillway should be inspected at least weekly to observe its performance and any further ice related loading until full repairs or replacement has been completed.
2015-03	Ditch #1 Spillway	Given the displacement of the spillway headworks in January 2015, the spillway must be repaired or replaced in summer 2015. Irrespective of whether it is repaired or replaced, the structure must be designed to resist future ice forces that appear to have led to the displacement of the headworks.
2008-34	#2 Intake Structure	Repair concrete voids in the intake structure
2013-15	Pond #2 Spillway	Until the spillway ~~maintenance~~ replacement is completed, make contingency provisions for the use of excavation equipment to remove stoplogs below elevation 796.53 m should it be required for passage of flood flows and include the planning provisions in the OMS manual.
2014-09	Pond #2 Spillway	Replace the Dam #2 spillway with a new structure within the next three years (i.e. by 2017).
2014-10	Pond #2 Low Level Pipe	Inspection of the grouted low level pipe should be completed to identify if it has been fully grouted for decommissioning or whether additional grouting is required to complete the decommissioning.

Table A2: Discharged or Superseded Dam Safety Recommendations

#	Structure	Recommendation
~~2008-01~~	~~General~~	~~Submit an implementation report to address recommendations of the 2007 Dam Safety Report to the Yukon Water Board by September 1, 2010 (Clause 25, HY07-018).~~
~~2008-02~~	~~General~~	~~Develop and submit an Operations, Maintenance and Surveillance Manual for the Fish Lake hydro system to the Yukon Water Board by September 1, 2009 (Clause 24, HY07-018).~~
~~2008-03~~	~~General~~	~~Conducted an annual inspection of all water management structures associated with the Fish Lake hydro system and provide the report with the annual report to the Yukon Water Board (Clause 31, HY07-018).~~
~~2008-04~~	~~Fish Lake Dyke~~	~~Previously planned construction to add riprap, to increase width and height of the dyke and to add an emergency spillway should be updated and completed.~~
~~2012-01~~	~~General~~	~~Re-assess passage of the inflow design flood for current and proposed future operating conditions for infrastructure located downstream of Fish Lake.~~
~~2008-05~~	~~Fish Lake Dyke~~	~~Inspect the gated culvert control structure for remaining service life and carry out replacement or life extension (corrosion protection) as required.~~
~~2008-07~~	~~Fish Lake Dyke~~	~~Cut existing trees and shrubs that are growing on the existing dyke.~~
~~2008-08~~	~~Fish Lake Dyke~~	~~Develop and implement a contingency plan to maintain adequate Freeboard until the dam height is increased~~
~~2011-01~~	~~Fish Lake Dyke~~	~~Modify flood management protocols to account for revised inflow design flood and capacity of Fish Lake discharge structure.~~
~~2011-02~~	~~Fish Lake Dyke~~	~~Add twice annual monitoring of Fish Lake dyke piezometer (BH01) to OMS manual and complete monitoring in spring and fall.~~
~~2008-09~~	~~Bonus Creek~~	~~Locate and document condition of this structure.~~
~~2008-11~~	~~Ditch #3~~	~~Evaluate the need to re-establish the Ditch #3 spillway structure~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2008-12~~	~~Ditch #3~~	~~Survey embankment crest to identify freeboard levels and correct any areas with insufficient freeboard~~
~~2010-01~~	~~Ditch #3~~	~~Establish Alarm levels for monitoring freeboard in Ditch #3 using the remote monitoring instrumentation~~
~~2010-02~~	~~Ditch #3~~	~~Plan on routine vegetation removal for the containment dyke upstream face, crest and downstream slope~~
~~2011-03~~	~~Ditch #3~~	~~As the proposed upgrading of the Fish Lake dyke will lead to higher freshet discharges routinely being passed downstream into Ditch #3, the ability of Ditch #3 to pass these routine flows as well as the inflow design flood from Fish Lake should be evaluated.~~
~~2011-04~~	~~Ditch #3~~	~~Repair or replace level monitoring instrumentation in 2011 to allow for remote monitoring of ditch water levels and application of determined alarm levels.~~
~~2013-03~~	~~Ditch #3~~	~~Annually monitor the potential erosion at the left hand side of the chute wall of the Ditch #3 Drop Box at its exit into the flip bucket.~~
~~2013-04~~	~~Ditch #3~~	~~In spring 2013, investigate the extent of the animal burrows roughly 80 m upstream of the Drop Box, expose, and infill the burrows with low permeability soils~~
~~2014-01~~	~~Ditch #3~~	~~Develop and implement a specific protocol for the removal of winter stoplogs from the Ditch #3 drop box and incorporate this protocol in the May 2014 revision of the OMS Manual.~~
~~2008-13~~	~~Ditch #3 Drop Structure~~	~~Monitoring of inflow to Ditch #3 in spring has to be carried out as often as required.~~
~~2010-03~~	~~Ditch #3 Drop Box~~	~~Complete an investigation of concrete erosion of the left chute wall and effect necessary repairs~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2008-14~~	~~Louise Lake Containment Dyke~~	~~Carry out a geotechnical investigation to confirm the dyke fill and foundation materials and then **analyze** seepage and **slope stability of the dyke.**~~
~~2008-15~~	~~Louise Lake Containment Dyke~~	~~Install piezometers in the dyke, foundation and abutments to monitoring seepage conditions.~~
~~2008-16~~	~~Louise Lake Containment Dyke~~	~~Complete a topographic survey of the dyke and determine potential inundation limits that would result from failure of the dyke.~~
~~2008-17~~	~~Louise Lake Containment Dyke~~	~~Frequently inspect this dyke to note seepage conditions~~
~~2011-05~~	~~Louise Lake Containment Dyke~~	~~A magnitude of order cost estimate to upgrade the structure to the deterministic standard for seismic performance recommended by the 2007 Guidelines should be developed.~~
~~2011-06~~	~~Louise Lake Containment Dyke~~	~~A risk management approach should be considered in decision making on whether upgrades to the dyke are required and the risk analysis provided to regulators within an application for long term management of the Fish Lake hydro system.~~
~~2011-07~~	~~Louise Lake Containment Dyke~~	~~Existing vegetation growth on the structure should be removed.~~
~~2013-08~~	~~Louise Lake Auxiliary Spillway~~	~~In summer 2013, evaluate potential piping that may be occurring underneath the timber floor of the spillway flume.~~
~~2013-09~~	~~Louise Lake Auxiliary Spillway~~	~~In summer 2013, obtain some specific measurements of the quality of the PWF timber within the flume. Some baseline measurements of the structure (width) should be made to monitor any future distortion that might develop due to degradation of the timber in the structure.~~
~~2008-18~~	~~Louise Lake Control Structure~~	~~Add Riprap to stop further bank toe erosion at south side of the downstream channel~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2008-19~~	~~Louise Lake Control Structure~~	~~Remove vegetation that is growing on the top of the cross beams~~
~~2008-20~~	~~Louise Lake Control Structure~~	~~Repair freeze thaw spalling of downstream wing walls~~
~~2010-05~~	~~Louise Lake Control Structure~~	~~Complete an assessment (if technically feasible) of the condition of the sluice gate timbers in 2010~~
~~2010-06~~	~~Louise Lake Control Structure~~	~~Plan on refurbishment of this structure within five years or less~~
~~2011-08~~	~~Louise Lake Control Structure~~	~~If technically feasible, the refurbished structure should include upstream stoplogs guides that would allow for stoplogs to be used for temporary flow control thereby allowing the replacement gate structure to be withdrawn for inspection and maintenance purposes~~
~~2012-02~~	~~Louise Lake Control Structure~~	~~Monitor the mine depressions observed on the dyke in 2011 and determine if further investigation is warranted.~~
~~2012-04~~	~~Louise Lake Control Structure~~	~~Complete as-built plans of the refurbished structure.~~
~~2008-21~~	~~Ditch #1~~	~~Remove shallow rooting trees from downstream dyke crest and side slopes.~~
~~2008-22~~	~~Ditch #1~~	~~Survey embankment crest elevation along Ditch #1 to identify low sections that require addition freeboard.~~
~~2009-01~~	~~Ditch #1~~	~~Maintain a minimum freeboard of 0.3 m at lowest point along the Ditch #1 channel and Pond #1~~
~~2010-09~~	~~Ditch #1~~	~~Raise the low freeboard section of the dyke crest in 2010~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2011-09~~	~~Ditch #1~~	~~An as-built survey drawing of the Ditch #1 channel and containment dyke should be produced and the minimum freeboard level identified for tying into remote monitoring activities.~~
~~2011-10~~	~~Ditch #1~~	~~Establish remote monitoring of the water level in Ditch #1.~~
~~2008-23~~	~~Ditch #1 Spillway~~	~~Investigate seepage at the downstream toe of spillway exit~~
~~2008-24~~	~~Ditch #1 Spillway~~	~~Access condition of timber mat that provides erosion protection for the spillway discharge.~~
~~2010-07~~	~~Ditch #1 Spillway~~	~~Complete a review of the serviceability of this spillway to manage excess flow in Ditch #1~~
~~2010-08~~	~~Ditch #1 Spillway~~	~~Complete additional repairs to the existing spillway and/or replace the spillway in 2010~~
~~2011-12~~	~~Ditch #1 Spillway~~	~~Complete remaining construction activities for the new spillway in summer 2011.~~
~~2011-14~~	~~Ditch #1 Spillway~~	~~Add observation of seepage in the former channel of Porter Creek between the inlet of Ditch #1 and the exit of the Ditch #1 Spillway to routine surveillance activities for Ditch #1 in the OMS Manual for Fish Lake hydro.~~
~~2012-05~~	~~Ditch #1 Spillway~~	~~Install a staff gauge at the structure to allow for recording of geodetic elevations at the inlet to the spillway.~~
~~2013-13~~	~~Ditch #1 Spillway~~	~~Install a remote monitoring station to monitor inflows into Ditch #1 upstream of the Ditch #1 spillway~~
~~2008-25~~	~~Pond #1 Intake~~	~~Confirm that stoplogs are functional and can be fully closed~~
~~2008-26~~	~~Penstock #1~~	~~Complete corrosion and pipe thickness assessment of the penstock.~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2008-27~~	~~Penstock #1~~	~~Expose and inspect Penstock ground anchors~~
~~2011-11~~	~~Penstock #1~~	~~An assessment of the stability of the penstock between the intake structure and Powerhouse #1 should be completed with the assumption that no ground anchors are present along the pipeline.~~
~~2008-28~~	~~Head Pond #2 Dam~~	~~Repair freeze-thaw damage to concrete components of spillway.~~
~~2008-29~~	~~Head Pond #2 Dam~~	~~Remove all trees and shrubs on both faces of the dam, around the spillway and for 6 m beyond the dam toe~~
~~2008-30~~	~~Head Pond #2 Dam~~	~~Clean low level outlet stilling basin and ensure that the basin has a functioning drain~~
~~2008-31~~	~~Head Pond #2 Dam~~	~~Install a weir downstream from the stilling basin to monitor seepage~~
~~2010-10~~	~~Head Pond #2 Dam~~	~~Complete an assessment of the low level outlet pipe to determine if it can be abandoned~~
~~2011-15~~	~~Head Pond #2 Dam~~	~~Remove debris from overflow spillway channel and build up low freeboard section of spillway channel~~
~~2013-14~~	~~Head Pond #2 Dam~~	~~Complete planned spillway maintenance in 2013 and reconfirm the spillway capacity following the maintenance activities~~
~~2008-32~~	~~#2 Intake Structure~~	~~Prepare a written procedure for dewatering and re-watering penstock #2~~
~~2008-33~~	~~#2 Intake Structure~~	~~Replace stoplogs and clean stop log guides~~

Table A2: Discharged or Superseded Dam Safety Recommendations (continued)

#	Structure	Recommendation
~~2008-35~~	~~#2 Intake Structure~~	~~Rehabilitate or replace the penstock inlet valve to ensure that it can complete close to dewater the penstock~~
~~2008-36~~	~~#2 Penstock~~	~~Periodically inspect the wood stave pipe and seal the leakages by appropriate method.~~
~~2008-37~~	~~#2 Penstock~~	~~Reinforce any wood decay with appropriate means or consider wood stave replacement.~~
~~2008-38~~	~~#2 Penstock~~	~~Ponding of water next to penstock should be drained away by ditching.~~
~~2008-39~~	~~#2 Penstock~~	~~Cut all shrubs along the route (0.9 m on both sides) and remove any vegetation growth on the pipe.~~
~~2008-40~~	~~#2 Penstock~~	~~Expose and inspect penstock ground anchors~~

Appendix B: Photographs



Photograph #1: New discharge structure headworks at Fish Lake Dyke



Photograph #2: New discharge structure outlet works at Fish Lake Dyke



Photograph #3: Upstream armouring east of discharge structure



Photograph #4: Upstream armouring east of discharge structure



Photograph #5: Upstream armouring on West side of discharge structure



Photograph #6: Upstream side of dyke, west of discharge structure



Photograph #7: New discharge channel at Fish Lake dyke



Photograph #8: Access road and overflow spillway at Fish Lake dyke



Photograph #9: Ditch #3 Evidence of Erosion from flow off of aufeis buildup across Ditch #3 Dyke at former inlet to Franklin Lake Spillway



Photograph #10: Remnant of Glaciation across Ditch #3 at former Franklin Lake Spillway



Photograph #11: Thawing Ice Build Up in Franklin Diversion Channel below Ditch #3



Photograph #12: Clearing of Franklin Diversion Channel in fall 2014



Photograph #13: Gullies on backslope of repaired 2013 Breach Section of Ditch #3



Photograph #14: Ditch #3 Drop Box



Photograph #15: Drop Box exit in May 2014



Photograph #16: Louise Lake Containment Dyke



Photograph #17: crest of Louise Lake Containment Dyke



Photograph #18: Louise Lake Auxiliary Spillway



Photograph #19: Louise Lake Auxiliary Spillway



Photograph #20: Louise Lake Discharge Structure



Photograph #21: Ditch #1 Spillway



Photograph #22: Ditch #1 spillway exit



Photograph #23: Survey showing displacements of Inlet Headworks



Photograph #24: Temporary Repair of Ditch #1 Spillway



Photograph #25: Pond #2 Spillway



Photograph #26: Pond #2 Spillway

YUKON WATER BOARD

Pursuant to the *Waters Act* and Regulation, the Yukon Water Board hereby grants a Type A Water Use Licence for a power undertaking to:

Yukon Electrical Company Ltd.
100-1100 First Avenue
Whitehorse Yukon Y1A 3T4

LICENCE NUMBER: HY12-065

RENEWAL: This licence is deemed to be a renewal of HY10-083.

LICENCE TYPE: A **UNDERTAKING:** Power, Class 1

WATER MANAGEMENT AREA: 02

LOCATION: Fish Lake, Louise Lake, Franklin Lake, Jackson Creek, Porter Creek, West McIntyre Creek and interconnected drainages.

PURPOSE: Operation of the Fish Lake Generating Station and the Fish Lake Dam.

EFFECTIVE DATE: May 31, 2013 **EXPIRY DATE:** May 30, 2038

This licence shall be subject to the restrictions and conditions contained herein and to the restrictions and conditions contained in the *Waters Act* and the *Waters Regulation* made thereunder.

Approved this 28 day of
May, 2013

Witness

Minister, Executive Council Office
Government of Yukon

Issued this 29th day of
May, 2013

Witness

Chairperson
Yukon Water Board

PART A - DEFINITIONS

"Act" means the *Waters Act* and any amendments thereto.

"Application" and "Water Use Application" means Water Use Application HY12-065, including any additional submissions and/or revisions, submitted to the Board by the Licensee.

"Board" means the Yukon Water Board.

"Construction Phase" means the period of time from the issuance of this licence until December 31, 2015, during which all reconstructions have been completed.

"CPUE" means catch per unit effort, a common method for assessing fisheries populations.

"Dam Safety Guidelines" means the most current version of the Dam Safety Guidelines issued by the Canadian Dam Association.

"Decommissioning Plan" means the *Fish Lake Hydro Decommissioning Plan*, dated September 2, 2010, or the most current version.

"Franklin Lake Adaptive Management Study Period" means a five year period of time commencing at the end of the Construction Phase during which shoreline erosion mitigation and water quality optimization studies are conducted on Franklin Lake.

"General Operation Phase" means the period of time from the end of the major reconstruction phase until the expiry date of this licence.

"Inspector" means any person designated as an Inspector under the Act.

"Natural Boundary" means the visible high water mark of any lake, river, stream or other body of water where the presence and action of water is so common and usual and so long continued as to mark upon the soil of the bed of the lake, river, stream or other body of water a character distinct from that of the banks thereof, both in respect to vegetation and in respect to the nature of the soil itself. In addition, the best estimates of the edge of dormant or old side channels and marsh areas are considered to be Natural Boundaries.

"OMS" means the Operations, Maintenance and Surveillance Manual.

"Ramping" means the act of changing discharge from a control structure.

"Regulation" means the *Waters Regulation* made under the Act.

"Spill Contingency Plan" means the *Environmental Response Plan* (2012) included in exhibit 1.4.1 of the Application, or the most current version.

"Watercourse" means any stream, lake, pond, river, creek, spring, ravine or swamp whether ordinarily containing water or not.

"Wetted Perimeter" means the horizontal extent of the present water level while the work is taking place.

PART B – GENERAL CONDITIONS

Other Laws

1. No condition of the water use licence limits the applicability of any statutory authority.

2. All water uses and activities authorized by this licence shall occur on property that the Licensee has the right to enter upon and use for that purpose.

Correspondence

3. Where any direction, notice, order, or report under this licence is required to be in writing, it shall be given:

   a) To the Licensee, if left at, faxed to, or mailed by registered mail to the following address:

   Yukon Electrical Company Ltd.
   100-1100 First Avenue
   Whitehorse YT Y1A 3T4
   Telephone: (867) 633-7000
   Fax: (867) 633-5797

   and shall be deemed to have been given to the Licensee on the day it was left or faxed, or 7 days after the day it was mailed, as the case may be.

   b) To the Board, if left at, faxed to, or sent by registered mail to the following address:

   Yukon Water Board
   Suite 106-419 Range Road
   Whitehorse YT Y1A 3V1
   Telephone: (867) 456-3980
   Fax: (867) 456-3890

and shall be deemed to have been given to the Board on the day it was left or faxed, or 7 days after the day it was mailed, as the case may be.

c) The Board or the Licensee may, by notice in writing, change its address for delivery.

Non-Compliance

4. In the event that the Licensee fails to comply with any provision or condition of this licence, the Board may, with the approval of the Minister and subject to the Act, cancel the licence.

Spills and Unauthorized Discharges

5. Where a spill or an unauthorized discharge occurs, that is of a reportable quantity under the Yukon *Spills Regulations,* the Licensee shall immediately contact the 24-hour Yukon Spill Report number, (867) 667-7244 and implement the Spill Contingency Plan. A detailed written report on any such event including, but not limited to, dates, quantities, parameters, causes and other relevant details and explanations, shall be submitted to the Board not later than 10 days after the occurrence.

6. The Licensee shall apply the relevant procedures in the Spill Contingency Plan. The Licensee shall review the Spill Contingency Plan annually and shall provide a summary of that review, including any revisions to the plan, as a component of the annual report.

7. The Licensee shall maintain a log book of all spill or unauthorized discharge occurrences, including spills that are less than the reportable quantities under the Yukon *Spills Regulations.* The log book shall be made available at the request of an Inspector. The log book shall include, but not necessarily be limited to the:

a) date and time of the spill;
b) substance spilt or discharged;
c) approximate amount spilt or discharged;
d) distance between the spill or discharge and the nearest Watercourse; and
e) remedial measures taken to contain and clean-up the spill area or to cease the unauthorized discharge.

8. The Licensee shall include a summary of all spills or unauthorized discharges that occurred during the year reported, as part of the annual report.

9. All personnel shall be trained in procedures to be followed and the equipment to be used in the containment of a spill.

10. The Spill Contingency Plan shall be posted at all generating stations and job sites.

Environmental Management and Safety Plan

11. Prior to commencement of use of heavy equipment adjacent to or in close proximity to the Wetted Perimeter or Natural Boundary of any Watercourse, the Licensee shall submit to the Board an *Environmental Management and Safety Plan* as described in Exhibit 1.4.2 of the Application, including, but not limited to:

    a) notification of the site supervisor and contact phone number;
    b) the location of the work site;
    c) the schedule for undertaking the work activities; and
    d) details of the proposed activities to be undertaken.

Hazardous Materials Storage

12. A complete inventory of chemicals, fuels, oils and other hazardous materials and their locations shall be maintained by the Licensee. An up to date Spill Contingency Plan suitable for such materials shall be maintained. Any revisions to the Spill Contingency Plan shall be submitted to the Board within 60 days of the revision.

Annual Reports

13. Annual reports shall be submitted to the Board by the Licensee. The initial report shall cover the period from the effective date of this licence to December 31, 2013 and shall be submitted to the Board on or before February 28, 2014. Subsequent reports shall cover the period from January 1st to December 31st of each year and shall be submitted to the Board on or before February 28th immediately following the end of the reporting period.

14. Annual reports shall include the information required by this licence and by the Regulation, including, but not necessarily limited to:

    a) maximum, minimum and mean daily water levels reported by month on:

        i) Fish Lake;
        ii) Franklin Lake;
        iii) Louise Lake;
        iv) Headpond #1; and
        v) Headpond #2.

    b) maximum, minimum and mean daily water flows reported by month at:

        i) Fish Creek below the Fish Lake Dam;
        ii) Ditch #3;

iii) Ditch #3 diversion;
iv) Jackson Creek below Franklin Lake;
v) Ditch #2;
vi) Penstock #1;
vii) Penstock #2;
viii) McIntyre Creek below Plant #2; and
ix) McIntyre Creek at Range Road.

c) maximum, minimum and mean daily power production from all operational turbines, reported by month;
d) progress toward completion, status and inspection records of scheduled construction for major system improvements, including the:

i) Fish Lake Control Structure;
ii) Ditch #3 Channel;
iii) Ditch #3 Diversion;
iv) Ditch #3 Drop box; and
v) other planned upgrades;

e) information regarding the purpose, nature and extent of any significant maintenance work carried out;
f) comprehensive descriptions of changes to, compliance with and deviation from the control guidance detailed within the Fish Lake Hydro OMS along with detailed descriptions of any corrective actions;
g) details of any updates to the Spill Contingency Plan;
h) details of any work undertaken under an Environmental Management and Safety Plan, and
i) any other information or reports required by this licence or the Regulation.

Quarterly Reports

15. Quarterly reports shall be submitted to the Board by the Licensee. The reports shall cover the periods ending March 31st, June 30th, September 30th and December 31st of each year and shall be submitted to the Board within 30 days of the end of each reporting period.

16. Quarterly reports shall include the information required by this licence and by the Regulation, including, but not necessarily limited to:

a) mean daily water levels on Fish Lake, Franklin Lake, Louise Lake, Head Pond #1 and Head Pond #2;
b) mean daily flow through the gates of the Fish Lake Control Structure;
c) mean daily flows through the Fish Lake Generating Station turbines;
d) mean daily flows through Ditch #1 and the overflow spillway;
e) mean daily flows through Pond #1 and Pond #2;
f) flows and water levels for spills from Pond #2;
g) flows from Louise Lake Control Structure, Louise Lake Auxiliary Spillway, Plant #1 and Plant #2;

h) flows through Ditch #3 and the Ditch #3 diversion;
i) mean daily power production from all operational turbines; and
j) any other information or reports required by this licence or by the Regulation.

Reports

17. The Licensee shall provide to the Board one unbound, single-sided, paper copy of all reports required by this licence. All reports must be reproducible by standard photocopier.

18. The Licensee shall upload electronic copies of all reports required by this licence to the Board's online licensing registry, the WATERLINE. Electronic copies shall be submitted in one of the following formats: Word 97 - 2003, Excel 97 - 2003 workbooks, or Adobe .pdf format. Water quality results uploaded to the WATERLINE must be presented in Excel 97-2003.xls format.

PART C - OPERATING CONDITIONS

Description of Water Use - Construction Phase

19. All works associated with this licence shall be constructed and maintained by the Licensee in good order, consistent with sound engineering and environmental practices.

20. The Licensee is authorized from the effective date of this licence through to December 31, 2015, to conduct improvements and upgrades to the Fish Lake Hydro System. Construction of the improvements and upgrades to the Fish Lake Hydro system, include:

    a) the Fish Lake Control Structure;
    b) Ditch #3;
    c) Ditch #3 Diversion; and
    d) the Ditch #3 Dropbox,

    as described in Exhibit 1.2, Section 2.8, 'Project Infrastructure and Planned Upgrades', and subject to the conditions of this licence. Where there is discrepancy between the Application and this licence, the conditions of this licence shall prevail.

21. At least 10 days prior to the commencement of construction, the Licensee shall submit to the Board final detailed design construction drawings for the structures authorized within clause 20 of this licence. The final detailed design drawings must be consistent with the drawings which were submitted as part of the Application in Water Use Register HY12-065 and shall be sealed by a Professional Engineer

licensed to practice in Yukon. All construction shall be carried out in accordance with the final design drawings.

22. Where site conditions require modifications to the final detailed design submitted to the Board, the Licensee shall submit to the Board a minimum of 10 days prior to the commencement of the construction schedule:

    a) written details of the modifications proposed to be made to the specifications and quality assurance/quality control procedures previously submitted to the Board as part of the Application;
    b) a written detailed construction schedule and the name and contact number(s) of the construction superintendent; and
    c) an explanation, signed by a Professional Engineer licensed to practice in Yukon, for the change, including an assessment of the potential impact on the performance of the works.

23. Within 60 days of completion of construction of the structures authorized within clause 20 of this licence, the Licensee shall submit to the Board, as-built design drawings, sealed by a Professional Engineer licensed to practice in the Yukon.

24. During the Construction Phase, the Licensee shall comply with the following:

    a) the water surface elevation on Fish Lake shall be maintained between a controlled minimum of 1110.72 metres and a controlled maximum of 1112.29 metres as measured from geodetic datum;

    b) the water surface elevation on Louise Lake shall be maintained between a controlled minimum of 1013.73 metres and a controlled maximum of 1014.61 metres as measured from geodetic datum;

    c) the water surface elevation in Head Pond #2 shall be maintained between elevation 796.00 metres and 797.00 metres as measured from geodetic datum;

    d) a minimum instantaneous flow of 0.28 m^3/s to maximum instantaneous flow of 2.00 m^3/s shall be discharged through the Fish Lake control structure;

    e) a minimum instantaneous flow of 0.14 m^3/s to maximum instantaneous flow of 2.00 m^3/s shall be discharged through the Louise Lake control structure; and

    f) a minimum instantaneous flow of 0.60 m^3/s to maximum instantaneous flow of 2.00 m^3/s shall be discharged out of Head Pond #2 from December to April.

25. The Licensee shall complete the authorized activities during the Construction Phase prior to commencing activities authorized for the General Operations Phase.

26. The Licensee shall notify the Board, in writing, when Construction Phase has been completed.

Description of Water Use – General Operation Phase

27. All works associated with this licence shall be maintained by the Licensee in good order, consistent with sound engineering and environmental practices.

28. The Licensee is hereby authorized to:

    a) commence the General Operations Phase on January 1, 2016;
    b) obtain and discharge up to 2.00 m^3/s of water from Fish Lake, Louise Lake, Porter Creek, and West McIntyre Creek;
    c) store water in Fish Lake, Louise Lake, Head Pond #1 and Head Pond #2;
    d) divert the flow of Fish Creek into Louise Lake Ditch #3;
    e) divert flows to Franklin Lake via the Ditch #3 diversion subsequent to its construction/upgrade;
    f) divert the flow from Louise Lake into Porter Creek via Ditch #2;
    g) divert the flow of Porter Creek into Head Pond #1;
    h) use stored and/or diverted water for the purpose of power generation at Hydro Plant #1 and Hydro Plant #2;
    i) discharge water into McIntyre Creek from Hydro Plant #2 at a maximum rate not to exceed 2.00 m^3/s;
    j) divert the flow between Louise Lake and Franklin Lake via the auxiliary spillway; and
    k) discharge water to Franklin Lake, Porter Creek and West McIntyre Creek.

    as described in the Application and subject to the conditions of this licence. Where there is discrepancy between the Application and this licence, the conditions of this licence shall prevail.

Water Surface Elevations – General Operation Phase

29. The water surface elevation on Fish Lake shall be maintained between a controlled minimum of 1111.04 metres and a controlled maximum of 1112.79 metres as measured from geodetic datum.

30. The water surface elevation on Louise Lake shall be maintained between a controlled minimum of 1013.73 metres and a controlled maximum of 1014.61 metres as measured from geodetic datum.

31. The water surface elevation on Franklin Lake during the Franklin Lake Adaptive Management Study Period shall be maintained below a maximum of 1004.20

metres and between 1001.50 to 1003.50 metres, as measured from geodetic datum, from June through August.

32. The water surface elevation in Head Pond #2 shall be maintained between elevation 796.00 metres and 797.18 metres as measured from geodetic datum.

Minimum Instantaneous Flows

33. A minimum instantaneous flow of 0.15 m^3/s shall be discharged through the Fish Lake control structure.

34. A minimum instantaneous flow of 0.10 m^3/s shall be discharged through the Louise Lake control structure.

35. A minimum instantaneous flow of 0.60 m^3/s shall be discharged out of Head Pond #2 from December to April.

Operations, Maintenance and Surveillance Manual

36. On or before May 30, 2014, the Licensee shall submit to the Board an updated OMS including at a minimum, but not necessarily limited to, the following specific and updated provisions:

    a) updated maximum historical drawdowns for Fish Lake and Louise Lake to be used as maximum winter drawdowns;

    b) protocols for the management of system-wide hydrology in the event of prolonged drought or flood for best protection of fish and fish habitats, including salmon use in McIntyre Creek, including establishment of specific communication and coordination protocols during these events;

    c) protocols for response and mitigation procedures in the event of fisheries population declines and age class anomalies occur in Fish Lake and Louise Lake;

    d) details of the specific operational protocols and water management strategies utilized to maintain the operation of the systems in a manner that avoids exceeding the full supply level at Fish Lake and maintains Whitefish habitat;

    e) protocols and provisions for limiting the proliferation of Rainbow Trout within and outside of the Fish Lake catchment;

    f) protocols for protecting, minimizing and mitigating any damage to shorebird habitat during Construction and General Operation Phases;

g) enhanced protocols for maintenance of Louise Lake water surface elevations levels at the minimum possible range and amplitude, balancing the needs to reduce erosion, protect fisheries and fish habitat and convey water for hydro operations;

h) protocols for identification, protection and mitigation of heritage resources within the catchment during Construction and General Operations Phases;

i) updated reporting protocols; and

j) consolidated adaptive management plans for system operations and response during both the Construction Phase and General Operations Phase.

37. On or before, December 31, 2020, the Licensee shall submit to the Board an updated OMS including at a minimum, but not necessarily limited to, the following specific and updated provisions:

a) protocols and operational levels relating to fisheries habitat protection in Louise Lake as determined from the Louise Lake Fisheries Migration and Louise Lake Littoral Connectivity Threshold Studies and including specification that the maximum winter drawdown during the ice cover season at Louise Lake not exceed 0.50 metres; and

b) updated provisions for minimizing and mitigating fish stranding at all hydrologic control and discharge locations, as required by condition 34 of this licence, and minimization and mitigation of fish entrainment through the turbines.

Franklin Lake Shoreline Erosion Study

38. The Licensee shall submit to the Board, a Franklin Lake Shoreline Erosion Study no later than December 31, 2020. The Franklin Lake Shoreline Erosion Study shall be conducted in order to identify the potential for shoreline erosion of the lake and develop an appropriate mitigation strategy.

Louise Lake Fisheries Migration Protocol and Littoral Connectivity Threshold

39. On or before August 29, 2013, the Licensee shall submit to the Board a Louise Lake Fisheries Migration Protocol that includes at a minimum, but is not limited to, specifying the frequency, time periods and water surface elevation of a two-week period necessary to allow fish migration to Louise Lake from associated wetlands.

40. The Licensee shall monitor the results of the Louise Lake Migration Protocol to determine the effectiveness of a two-week migration period and adjust, if necessary, the length of that period. The Licensee shall make appropriate adjustments to this

protocol, update those changes within the OMS and detail any updates as required in the annual report.

41. The Licensee shall establish the spring/summer littoral connectivity threshold, update the OMS to include this operational level and report the change as required in the annual report.

PART D - MONITORING

42. Annually, the Licensee shall carry out an inspection of all water management structures authorized by this licence. The inspection shall be carried out by a qualified Professional Engineer licensed to practice in Yukon, and shall follow, at a minimum but not limited to, the recommendations contained in the Dam Safety Guidelines. The findings and recommendations from the inspection shall be submitted as part of the annual report and shall include but not be limited to:

    a) documentation of the inspection locations and methodologies;
    b) the results of the inspection;
    c) all problems identified;
    d) remedial measures recommended; and
    e) the status of any remedial measures recommended in the previous year's report with an explanation regarding any recommendation not implemented.

43. The Licensee shall collect, assure and report all routine hydrologic data from the system-wide telemetry locations necessary to comply with operations and reporting licence conditions.

44. On or before May 30, 2014, the Licensee shall install at Louise Lake a calibrated, within-lake, manual water surface gauge site readily available for visual inspection and indicate the location of the gauge as part of the annual report. The Licensee shall cross-calibrate the gauge against the existing telemetry installation and note any offsets or biases within the OMS.

45. On or before May 30, 2014, the Licensee shall submit to the Board a plan for a fisheries monitoring program. The purpose of the monitoring plan is to confirm assessments of the effects of long-term hydro system operations on fish populations. Upon submission, the Licensee shall implement the plan submitted to the Board. The monitoring plan shall include, but not necessarily be limited to, the following:

    a) at Fish Lake, monitor Round Whitefish recruitment and year-class strength every 10 years;
    b) at Fish Lake, Louise Lake, and Franklin Lake, undertake CPUE monitoring every 5 years of all adult fish populations, including Arctic Grayling and Lake Trout;
    c) at Louise and Franklin Lakes, monitor water quality, including oxygen and water temperature during the period that the lakes are stratified. This

monitoring is to be conducted annually until profiles representative of the operating regime have been established for these lakes;

d) at Louise and Franklin Lakes, develop and implement a fisheries abundance and age structure monitoring program;

e) monitor the water balance of Franklin Lake including inflows, outflows and water levels during the Franklin Lake Adaptive Management Study Period;

f) monitor the potential for fish stranding in ditch #3 diversion to Franklin Lake once the diversion is operational; and

g) review the reported downstream flow information, including flows in diversion channels, for the purpose of maintaining the ongoing, long-term habitat productivity and health of fish populations throughout the hydro system.

46. The Licensee shall monitor fish stranding during diversion events in all spillway channels and monitor the effectiveness of Ramping, fish salvages and other means of reducing fish stranding. The findings of this monitoring shall be submitted as part of the annual report.

47. Where fish stranding occurs as a result of the use of diversion channels, the Licensee shall conduct fish salvage, subject to any permit or authorization by Fisheries and Oceans Canada.

48. On or before May 30, 2014, the Licensee shall submit to the Board a plan for monitoring nesting shorebirds to confirm assessments regarding the effects of long-term operations on nesting success of shoreline nesting birds at Fish Lake. The monitoring plan shall be implemented in the first year of operations following the reconstruction of the Fish Lake dyke and shall be carried out for a 3 year term. The monitoring plan shall include at a minimum, but not limited to: a schedule for monitoring, duration of monitoring, methods to be used, species and location(s) of monitoring.

APPENDIX 1

Table of Deliverables

Clause	Deliverable	Frequency	Due
5	Spill report	As required	No later than 10 days after occurrence
6, 8, 12	Updated Spill Plan, summary of all spills as part of annual report	• Annually • As required	• Feb 28/14 • Feb 28th of the year following the reporting period • Within 60 days of revision if hazardous materials are updated within the plan
11	Environmental Management and Safety Plan	As required	Prior to commencement of use of heavy equipment
13, 14, 17, 18	Annual reports	• Effective date to Dec. 31/13 • Annually: Jan. 1 to Dec. 31	• Feb. 28/14 • Feb. 28 of the year following the reporting period
15, 16, 17, 18	Quarterly Reports	• Period ending March 31 • Period ending June 30 • Period ending Sept. 30 • Period ending Dec. 31	• Within 30 days of the end of each reporting period
20, 21, 22	Final design drawings and minor modifications to final design drawings	As required	At least 10 days prior to commencement of construction
23	As-built design	As required	Within 60 days of

Clause	Deliverable	Frequency	Due
	drawings		completion of construction
26	Notification when Construction Phase has been completed	As required	By December 31, 2015 at the latest
36, 14	Operations, Maintenance & Surveillance Manual	• Once for Initial Submission • Annually, if updated as part of annual report	• On or Before May 30, 2014 • Feb. 28/14 • Feb. 28 of the year following the reporting period
37, 14	Updated Operations, Maintenance & Surveillance Manual	• Once for Initial Submission • Annually, if updated as part of annual report	• On or Before Dec. 31, 2020 • Feb. 28/14 • Feb. 28 of the year following the reporting period
38	Franklin Lake Shoreline Erosion Study	• Once	• No later than Dec. 31, 2020
39, 40, 41, 14	Louise Lake Fisheries Migration Protocol	• Once • Annually, if updated as part of annual report	• On or Before Aug. 29, 2013 • Feb. 28/14 • Feb. 28 of the year following the reporting period
42, 14	Water Management Structure Inspection Report	• As required, as part of annual report	• Feb. 28/14 • Feb. 28 of the year following the reporting period
44, 14	Report on Louise Lake Water Surface Gauge Installation & Maintenance	• As required, as part of annual report	• Feb. 28/14 • Feb. 28 of the year following the reporting period
45	Plan for a Fisheries Monitoring Program	• Once	• On or Before May 30, 2014
46	Reporting Fish Stranding Events	• As required, as part of annual report	• Feb. 28/14 • Feb. 28 of the year following the reporting period

Clause	Deliverable	Frequency	Due
48	Plan for Monitoring Nesting Shorebirds	• Once	• On or Before May 30, 2014

APPENDIX 2

Summary of Principal[1] Hydrologic Licence Conditions

Clause	Term	HY12-065 Construction Phase	HY12-065 General Operation Phase
Cover page, 20	Length of Licence 25 years	May 31, 2013 to December 31, 2015	January 1, 2016 to May 30, 2038
24, 29	Fish Lake Level	max: 1112.29m min: 1110.72m	max: 1112.79m min: 1111.04m
24, 30	Louise Lake Level	max: 1014.61m min: 1013.73m	max: 1014.61m min: 1013.73m
31	Franklin Lake Level	N/A	max: 1004.20m min: 1001.50 – 1003.50m (Annually June through August) max. and min. water elevations subject to change pending results of Franklin Lake Adaptive Management Study
24, 32	Head Pond #2	max: 797.00m min: 796.00m	max: 797.18m min: 796.00m
	Minimum Instantaneous Flow		
24, 33	Fish Lake Control Structure	$0.28m^3/s$	$0.15m^3/s$
24, 34	Louise Lake Control Structure	$0.14m^3/s$	$0.10m^3/s$
24, 35	Head Pond #2	$0.60m^3/s$	$0.60m^3/s$
	Maximum Instantaneous Flow		
24, 28	Fish Lake Control Structure	$2.00m^3/s$	$2.00m^3/s$

Clause	Term	HY12-065 Construction Phase	HY12-065 General Operation Phase
24, 28	Louise Lake Control Structure	$2.00m^3/s$	$2.00m^3/s$
24, 28	Head Pond #2	$2.00m^3/s$	$2.00m^3/s$

[1]*Other site and time specific hydrologic licence conditions may also apply – refer to licence conditions for additional detail.*