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MEMORANDUM

To:	Todd Goodsell	Date:	November 17, 2016
		File No.:	VA101-00246/47-A.01
From:	Stephanie Eagen	Cont. No.:	VA16-01671
Re:	Federal Round 2 Information Requests - Kamloops Lake Intake		

This memo is provided in response to three related second round Information Requests (IRs) received by KGHM-Ajax Mining Inc. (KAM) on the Ajax Project Environmental Assessment Application/Environmental Impact Statement (Application/EIS). These IRs, reproduced in Table 1, pertain to the Kamloops Lake intake and were received from Fisheries and Oceans Canada (DFO) via the Canadian Environmental Assessment Agency (CEAA).

Table 1 Kamloops Lake Intake Information Requests – Round 2

IR #	Information Request
CEAA-041.1	The proponent has not provided fish habitat and fish utilization assessments for the proposed Kamloops Lake intake location and Thompson River downstream habitats that may be affected by flow reductions. Per the original IR, **conduct fish habitat and fish utilization assessments in the area of the proposed intake** and Thompson River downstream habitats to support an understanding of **potential impacts to fish habitat and of potential risks of entrainment into the pipe and whether end of pipe screens are adequately sized**. As part of this assessment**, clarify whether any groundwater inflow locations are present** in the footprint of the area to be disturbed by the intake.
CEAA-042.1	Provide an assessment of foreshore and lake habitats that considers possible mortality from fish entrainment. DFO advises the proponent first consider avoidance and then mitigation of risks of fish mortality resulting from entrainment into the pipe. The proponent's response references impacts below the historic annual average water level of the lake. **Provide a definition of "historic annual average water level"**. Confirm whether this is different from mean annual water level, and if so **provide the area to be impacted which is below the mean annual water level**, consistent with standard practice.
CEAA-045.1	The proponent states that "since there will be no increased footprint of the intake within the lake there will be no effect on salmon migration or habitat." This statement does not address potential mortality to fish from impingement or entrainment into the pipe. The response states that the fish screen guidelines were designed for water extraction rates of up to 0.125 m^3/s but indicated their flow extraction rate would be higher. Provide the maximum water extraction rate anticipated for the water intake. The screens have been designed to meet an approach velocity of 0.038 m/s for the protection of fish with a minimum fork length of 25 mm at the lower water extraction rate of 0.125 m^3/s. **Clarify the anticipated entrainment / impingement risk to fish which utilise Kamloops Lake, including fish (juveniles) with fork lengths less than 25 mm**. If the anticipated entrainment / mortality is higher than zero, clarify if the intake would be designed to reduce and/or eliminate this risk and if not, include in the serious harm description and the offsetting plan. **Provide groundwater inflow information in the vicinity of the intake** in order to ensure it would not be situated in habitat of greater utilization by migrating salmonids. If groundwater inflows are present, clarify whether this risk can be avoided through redesign or relocation.

Since the IRs were the same or similar to IRs that had been received and responded to by KAM during the first round of IRs, KAM requested a teleconference with DFO, via CEAA, to seek clarification on the IRs in order to ensure that the underlying concerns of DFO were sufficiently addressed in the proponent response to allow DFO to make an assessment of the potential impacts of the freshwater intake on fish populations in Kamloops Lake. The purpose of this memo is to provide additional information on the following key topics discussed during this teleconference, held on November 3, 2016:

1. Design criteria for the fish screen on the freshwater intake and DFO guidance document applicability
2. Fish presence and habitat utilization in Kamloops Lake adjacent to the intake, and
3. Footprint disturbance of proposed refurbishment of the existing intake on fish habitat – historic vs. mean annual level.

1 – FISH PRESENCE AND HABITAT UTILIZATION IN KAMLOOPS LAKE ADJACENT TO THE INTAKE – RESPONSE TO CEAA INFORMATION REQUESTS 041.1 AND 045.1

Although the "Freshwater Intake End-of-Pipe Fish Screen Guideline"[1] recommends that fish screens be designed for fish with a minimum fork length of 25 mm, since most eggs and fish larvae remain in bottom substrates until they reach the fry stage, IR CEAA-045.1 requested an assessment of the potential entrainment/impingement risk to fish smaller than this.

The intake is located 25 m from shore in at least 10 m of water whereas the intake screen will be located in the water column approximately 1.5 m to 2 m above the bottom of Kamloops Lake. Based on the habitat requirements of larval and young juvenile fish of velocity refugia and cover from predation it is unlikely that these age classes of fish will be present near the intake. KAM is confident that the intake will not entrain incubating eggs or fish larvae for two reasons:

a. Small fish of under 25 mm fork length will not be present at the intake, and
b. The intake has been conservatively designed to protect the smallest possible fish that may be present however unlikely it would be.

During the November 3, 2016 teleconference DFO noted that other projects may have designed intake screens with an approach velocity of zero to protect smaller fish. To assess the potential for fish smaller than 25 mm fork length being in the vicinity of the intake on Kamloops Lake, sizes and preferred habitat of juvenile fish species present in Kamloops Lake were compiled based on published values; these are provided in Table 2.

Table 2 Species and Preferred Habitat of Fish Recorded in Kamloops Lake

Species	Size (fry, mm)	Preferred Habitat	References
Bull Trout	54 - 78	Depth range for fry in the Chowade River was 2 - 41 cm; in Toboggan Creek reported as 20 - 40 cm	Salow. 2004. Population Structure and Movement Patterns of Adfluvial Bull Trout (*Salvelinus confluentus*) in the North Fork Boise River Basin, Idaho. T.D. Technical Report for Upper Snake River Biological Opinion # 1009.2700. U.S. Department of the Interior Bureau of Reclamation. (fry size) J.S. Baxter and J.D. McPhail. 1996. Bull Trout Spawning and Rearing Habitat Requirements: Summary of the Literature. B.C. Ministry of Environment, Lands and Parks. Fisheries Technical No.

[1] DFO, 1995. Available athttp://www.dfo-mpo.gc.ca/Library/223669.pdf

Species	Size (fry, mm)	Preferred Habitat	References
			98. (preferred habitat)
Dolly Varden	21 - 44	Young of year emerge from gravel during spring and stay closely associated with the bottom. In rivers, they use shallow (<0.5 m), low velocity areas that have ample cobble, boulder substrates, root-wads and woody debris as overhead cover. Size given for age 0 fish from Eva Creek. Alaska.	Scott and E.J. Crossman. 1973. Freshwater Fishes of Canada. W.B. Fisheries Research Board of Canada Bulletin 184
Salmon, trout, char	20 - 35	Newly emerged fry require velocities of less than 10 cm/s. Depths at sites used by age 0 salmonids in streams: • Steelhead: < 15 - 67 cm • Chinook: 15 - 122 cm • Coho: 30 - 122 cm	T.C. Bjornn and D.W. Reiser. 1991. Habitat Requirements of Salmonids in Streams. Chapter 4 in Influence of Forest and Rangeland Management on Salmonid Fishes and Their Habitats. American Fisheries Society Special Publication19: 83 - 138.
Mountain Whitefish	30 - 40	Newly hatched fry can be found in stream shallows for a few weeks but at lengths of 30 - 40 mm they move offshore	Scott and E.J. Crossman. 1973. Freshwater Fishes of Canada. W.B. Fisheries Research Board of Canada Bulletin 184
Burbot	21 - 50	Larvae are limnetic but by early summer, at a size range of 21 - 50 mm, larvae shift to a primarily benthic form	Scott and E.J. Crossman. 1973. Freshwater Fishes of Canada. W.B. Fisheries Research Board of Canada Bulletin 184
Largescale Sucker	(white sucker 12 - 179)	Small, larval largescale suckers are pelagic and are most commonly found along the river margins in low velocity areas; most juvenile largescale suckers are common at depths <1 m, but some occur over cobble substrates in backwater areas	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.
Longnose Sucker	10 - 80	Young of year move into quiet, shallow water with vegetation; when still small, juvenile longnose suckers are plankton feeders and inhabit shallow weedy areas; show extreme variability in growth from place to place	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.

Species	Size (fry, mm)	Preferred Habitat	References
Northern Pikeminnow	25 - 102	Bottom feeders and piscivores, often found in the nearshore area of lakes; YOY use shallow (<0.25 m), low velocity, sandy and fine bottomed areas within the mainstem or backwaters of large rivers	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.
Peamouth Chub	<20	Bottom feeders; typically form small schools and inhabit shallow, vegetated waters of lakes and rivers; In lakes, YOY remain in shallow nearshore areas until the end of their first summer, when they move into deeper water Fry hatch in 2nd or 3rd week of June and inhabit shallow shore areas through the summer; by mid-July when fry are >20 mm they exhibit diurnal migration, staying onshore during the day and offshore at night	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p. J. C. MacLeod. 1960. The diurnal migration of peamouth club Mylocheilus caurinus (Richardson) in Nicola Lake, British Columbia. University of British Columbia.
Redside Shiner	5 - 55	Spawn in riffles over gravel substrate in shallow water (0.1 m); in the Nazko River drainage, BC, juveniles are found in slow moving backwater areas in water <0.5 m deep, over gravel substrate; often shiner associated with vegetation in lakes.	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p.
Prickly Sculpin	35 - 175	Size range given for fish captured by Hatfield in 2015 in Kamloops Lake upstream and downstream of the Teck intake; inhabit a range of habitats, all of which are characteristic of slow flowing water; preferred spawning sites have flow of 0.03 m^3/s; abundant in the nearshore environment in some lakes	M. Roberge, T. Slaney and C.K. Minns. 2001. Life History Characteristics of Freshwater Fishes Occurring in British Columbia, With Major Emphasis on Lake Habitat Requirements. Can. Manuscr. Rep.Fish. Aquat. Sci. 2574: 189 pp. Hatfield Consultants. (Jun 2015)Fish Collection Permit KA15-166343 Thompson River.
Sculpin (General)	n/a[1]	<u>Coastrange sculpin</u> larvae are planktonic, residing within the top 6 m from the surface, for the first 32 - 35 days before taking up benthic living; generally inhabit the benthic zone in deep-water, or sandy or muddy nearshore areas in quiet water near lake shores and tributary mouths <u>Slimy sculpin</u> young-of-year captured in a lake at 0.5 - 1.5 m depth near gravel and sand substrate with boulders and rocks.; remain in shallow water where they are	M. Roberge, T. Slaney and C.K. Minns. 2001. Life History Characteristics of Freshwater Fishes Occurring in British Columbia, With Major Emphasis on Lake Habitat Requirements. Can. Manuscr. Rep.Fish. Aquat. Sci. 2574: 189 pp. Hatfield Consultants. (Jun 2015) Fish Collection Permit KA15-166343 Thompson River

Species	Size (fry, mm)	Preferred Habitat	References
		nocturnal feeders	
Lamprey (General)	0.2-118 (Pacific lamprey Ammocoetes)	Pacific lamprey Larvae emerge from the gravel within 2 - 3 weeks and move passively downstream to soft bottomed areas where they burrow and grow into ammocoetes. Ammocoetes spend up to 4 - 6 years in the mud before transforming into a parasitic adult Western brook lamprey ammocoetes burrow in the mud and silt at the stream margins and remain there for up to 6 years	M. Roberge, J.M.B. Hume, C.K. Minns, and T. Slaney. 2002. Life history characteristics of freshwater fishes occurring in British Columbia and the Yukon, with major emphasis on stream habitat characteristics. Can. Manuscr. Rep. Fish. Aquat. Sci. 2611: xiv + 248 p. Hatfield Consultants. (Jun 2015)Fish Collection Permit KA15-166343 Thompson River

NOTES:

1. Information on size of young of year fry and peamouth chub not available in published literature sources reviewed.

Based on this information, while fish smaller than 25 mm fork length may be present in Kamloops Lake because small juvenile fish (including alevin, fry and other young of the year species) require shallow, low-velocity, near shore areas they are highly unlikely to be present near the Ajax Project freshwater intake, which is located offshore in deep water and off the bottom where water velocities would restrict presence of small juvenile fish. The intake will be approximately 10 m deep at low water levels and approximately 25 m from shore (Figure 1). The balance between habitat disturbance and risk of intake impingement is an important trade-off to consider. To reduce approach velocity the intake design is adjusted to spread the force of the water flowing into the intake across a larger area of screen (i.e., area is equal to flow divided by velocity). The proposed screen design includes a surface area of 11 m^2 for each screen: to attain an approach velocity of 10 times less than the proposed 0.038 m/s the screens would require an area of 110 m^2. The proposed conceptual screen design is shown below in Figure 2. Note that these drawings are conceptual and may change as part of detailed engineering design. However the design criteria will remain the same to achieve a screen approach velocity of 0.038 m/s for maximum water withdrawal of 1,505 m^3/h which results in a required screen area of 11 m^2.

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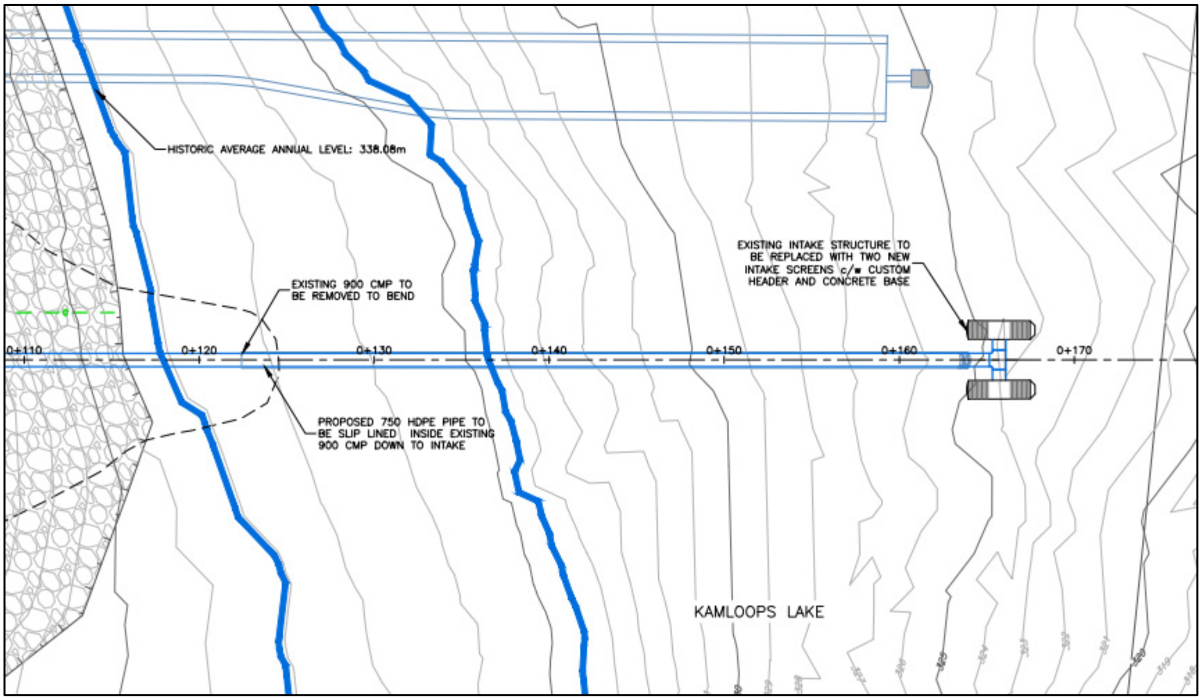

Figure 1 Fresh Water Intake Plan (Urban Systems Drawing No. C-02 (IBS) KGHM Drawing No. C165-KA39-6620-10-002.

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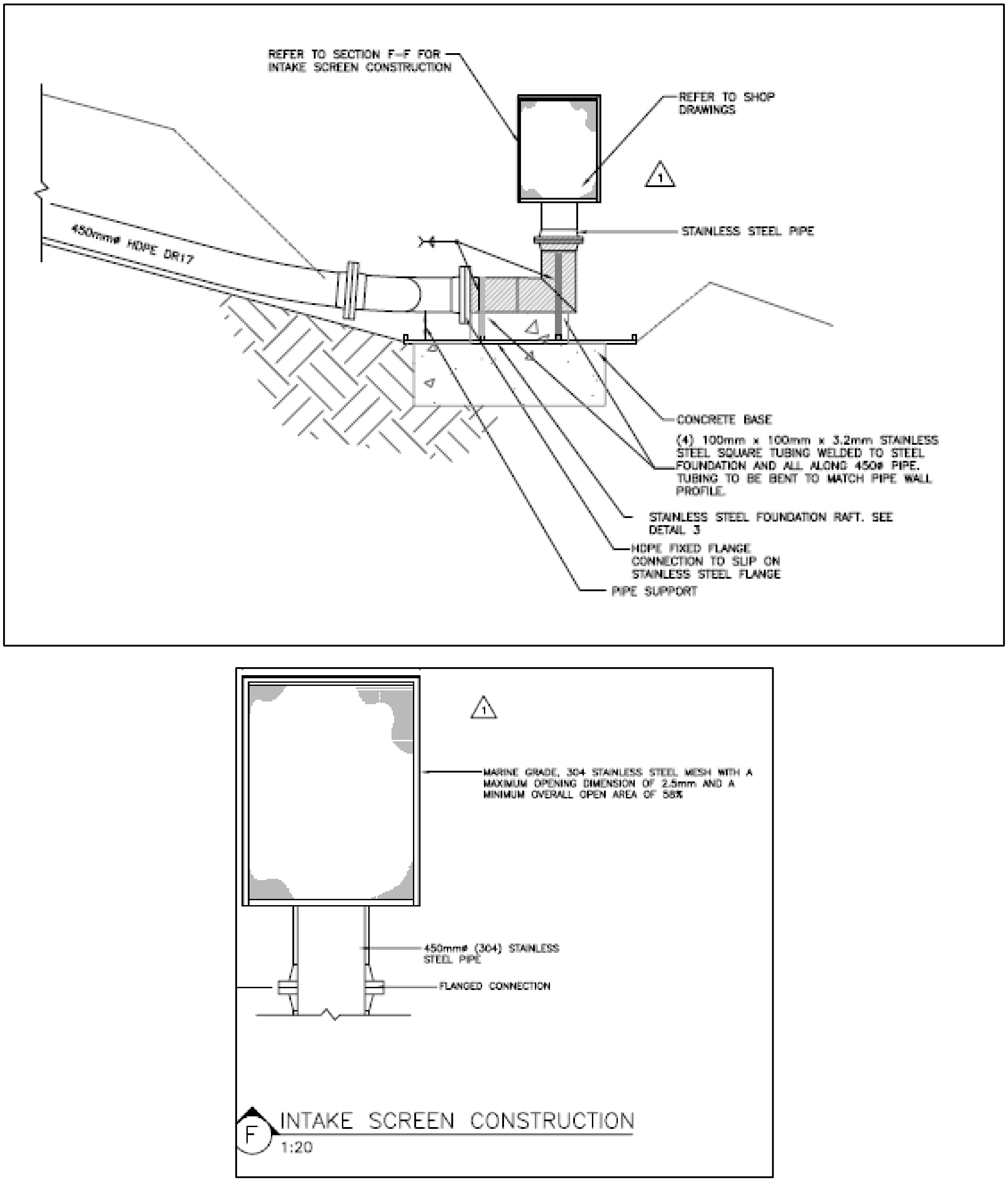

Figure 2 Conceptual Fresh Water Intake Design Cross Section and Detail (from Urban Systems)

The request for groundwater inflow information in the vicinity of the intake was related to the spawning habitat requirements of many species for groundwater upwelling areas and the concern that the intake would entrain incubating eggs. KAM has not conducted groundwater upwelling surveys in the vicinity of the existing intake. However KAM has designed the intake using the conservative assumption that groundwater upwelling may be present and therefore attractive for fish spawning habitat. As stated above, the intake screen has been designed to be located in the water column approximately 1.5 m to 2 m above the existing lake bottom, and therefore will not entrain incubating eggs or other aquatic organisms if present (Figure 3).

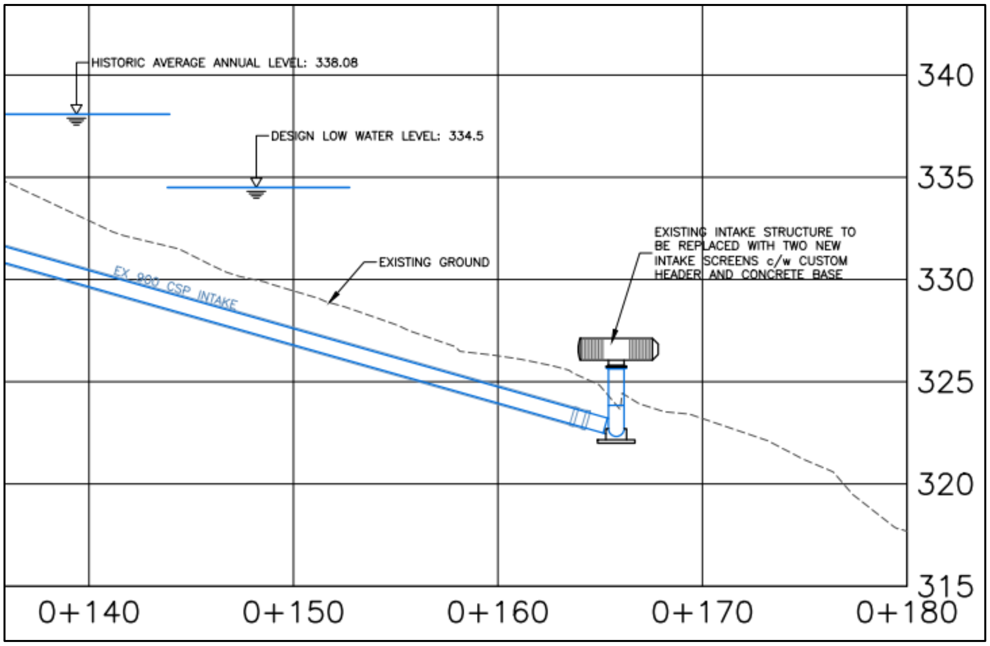

Figure 3 Fresh Water Intake Profile (Urban Systems Drawing No. C-02 (IBS) KGHM Drawing No. C165-KA39-6620-10-002.

2 – FISH SCREEN DESIGN CRITERIA– RESPONSE TO CEAA INFORMATION REQUEST 045.1

The design of the proposed Kamloops Lake Intake screen for the Ajax Project incorporates the following fish protection measures for screens listed on the DFO website under “Measures to Avoid Causing Harm to Fish and Fish Habitat”[2]:

- Screen any water intakes or outlet pipes to prevent entrainment or impingement of fish.
- Screens should be located away from natural or artificial structures that may attract fish that are migrating, spawning, or in rearing habitat.
- The screen face should be oriented in the same direction as the flow.
- Ensure openings in the guides and seals are less than the opening criteria to make “fish tight”.
- Screens should be located a minimum of 300 mm (12 in.) above the bottom of the watercourse to prevent entrainment of sediment and aquatic organisms associated with the bottom area.
- Structural support should be provided to the screen panels to prevent sagging and collapse of the screen.
- Large cylindrical and box-type screens should have a manifold installed in them to ensure even water velocity distribution across the screen surface. The ends of the structure should be made out of solid materials and the end of the manifold capped.
- Heavier cages or trash racks can be fabricated out of bar or grating to protect the finer fish screen, especially where there is debris loading (woody material, leaves, algae mats, etc.). A 150 mm spacing between bars is typical.
- Provision should be made for the removal, inspection, and cleaning of screens.
- Ensure regular maintenance and repair of cleaning apparatus, seals, and screens is carried out to prevent debris-fouling and impingement of fish.
- Pumps should be shut down when fish screens are removed for inspection and cleaning.

Although these measures do not provide guidance on preventing impingement or entrainment of fish, screen size was calculated using the mesh size and approach velocity for fish provided in the DFO “Freshwater Intake End-of-Pipe Fish Screen Guideline”[1]. The guideline recommends a 2.54 mm maximum screen opening to

[2] DFO, 2013. Available at http://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures/index-eng.html

protect fish with a minimum fork length of 25 mm, since most eggs and fish larvae remain in bottom substrates until they reach the fry stage (DFO, 1995). The guideline also stipulates that approach velocities of approximately 0.11 m/s and 0.038 m/s be used to design intake screens for subcarangiform and anguilliform groups of fish, respectively[1].

The applicability of the 1995 DFO guideline, however, was raised by CEAA-045.1, and during the November 3, 2016 teleconference, as the guideline was developed for water extraction rates of up to 0.125 m^3/s for fish screens for irrigation, construction, municipal, and private water supplies. DFO does not provide guidance for fish screen design for water extraction rates greater than 0.125 m^3/s or recommend approach velocity criteria for fish smaller than 25 mm, therefore a literature review was conducted to elicit this information.

The National Marine Fisheries Service (NMFS) provides advice on fishway facility design standards for hydroelectric, irrigation, and other water withdrawal projects in the U.S. Northwest Region[3]: this document states:

"*The life stage and size of juvenile salmonids present at a potential screen site usually is not known, and may change from year to year based on flow and temperature conditions. Thus, adequate data to describe the size-time relationship requires substantial sampling efforts over a number of years. For the purpose of designing juvenile fish screens, NMFS will assume that fry-sized salmonids and low water temperatures are present at all sites and apply the appropriate criteria … unless adequate biological investigation proves otherwise.*"

The NMFS approach velocity criteria for passive screens is 0.20 feet/sec (0.06 m/s) to minimize screen contact and/or impingement of juvenile fish[3]. The NMFS guidance document recommends calculating effective screen area by dividing the maximum screened flow by the allowable approach velocity, and is not restricted to low flows[3]:

A technical report by the Electric Power Research Institute (EPRI) on cooling water intake structures concluded that all fish assemblages (estuarine, riverine, etc.) have a range of good to poor swimmers, with the lowest average values near 0.5 feet/sec (0.15 m/s)[4]. Based on a technical literature review and data analysis of juvenile and adult swimming capabilities, EPRI concluded that a screening criteria value of 0.5 f/s (0.15 m/s) would delineate cooling water intake structures where significant impingement would be unlikely except under unusual environmental circumstances such as unusual cold snaps[4].

Several Environmental Impact Statements for various projects in the U.S. reference an approach velocity of 0.4 feet/sec, or 0.12 m/s (e.g., Volume II Klamath Facilities Removal Final Environmental Impact Statement/ Environmental Impact Report Appendices)[5].

No studies or other environmental assessments were found that made reference to approach velocities for fish smaller than fry or juvenile stages. Therefore, a screen mesh size of 2.54 mm and an approach velocity of 0.038 m/s for the Ajax Project is considered a conservative design and protective of fish species and life stages present near the intake.

3 – HISTORIC AVERAGE ANNUAL WATER LEVEL – RESPONSE TO CEAA INFORMATION REQUEST 045.1

Historic average annual water level is equivalent to the mean annual water level. Therefore the proponent response to CEAA-042 regarding construction impacts along the foreshore and within the wetted area of Kamloops Lake is valid.

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[3] NMFS (National Marine Fisheries Service). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.
[4] EPRI. 2000. Technical Evaluation of the Utility of Intake Approach Velocity as an Indicator of Potential Adverse Environmental Impact under Clean Water Act Section 316(b), EPRI, Palo Alto, CA, 2000. 1000731.
[5] U.S. Department of the Interior and California Department of Fish & Game, 2013. State Clearinghouse # 2010062060

KAM has stated that there will be no increased footprint of the intake below the mean annual water level and construction will be undertaken when water levels are below the mean annual level. Therefore, there will be no effect on salmon migration or habitat.

KAM proposes to restore the closed water intake infrastructure previously operated by Teck to provide freshwater for the Ajax Project. Upgrades to this existing intake and pump house will be required to provide freshwater for mineral processing at the Project plant. These improvements include modifications and replacement of the existing pumps, piping and electrical systems – in order to complete the work around the intake line pipe near the pumphouse approximately 300 m^2 will require excavation, of which approximately 60 m^2 will be below the annual mean water level of the lake. A coffer dam will be required around the edge of the excavation and a plug in the intake pipe will likely be required for this portion of the excavation to keep water out if this work is conducted at high lake levels - no disturbance to wetted areas will be necessary because the work is planned to be completed during early spring when lake levels are low. The existing intake structure below the design low water level will be fitted with two new intake screens and a concrete base. Installation will be completed by commercial divers - no additional footprint area is associated with the intake in the lake.

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Approval that this document adheres to Knight Piésold Quality Systems: OG.