

2.0 Potential Effects on Water Quality

There is little data available on the water quality in Hotel Lake and there is no information on the seasonally or annual variations in water quality. The Area A Quality Water Association (AAQWA) reports two fish kills in 2004ⁱ. Temperature, oxygen, pH and conductivity data collected by Environment Canada when responding to the fish kill were all within the range to support aquatic life (temperature=20°C, DO=8.3 mg/L, pH=7.6 and conductivity=52.6). No cause of the fish kill is documented; however, the AAQWA has suggested that that it was due to poor water quality.

Hotel Lake is a designated water supply and there are no motorized boat or commercial uses of the lake that could affect water quality. Based on surrounding land uses, the primary nutrient sources to the lake are likely septic field seepage from the waterfront homes, runoff of fertilizers used on lawns and gardens surrounding the lake, and road runoff from perimeter roadways (Hotel Lake Road, Irvines Landing Road and Beaumont Road). Of these non-point sources, nutrients and bacteria from septic field seepage are likely to have the greatest impact on water quality in Hotel Lake. The primary effect of elevated nutrient concentrations (in particular phosphorus) is increased aquatic vegetation and algae growth.

Without water quality data it is not possible to draw a definitive conclusion on what effects, if any, could result from a minimum lake level of 0.6 m below the current outlet elevation. The water balance presented in the technical memorandum suggests that the total volume of water entering and leaving Hotel Lake would not change on an annual basis but the proportion of outflow via consumptive use would increase while the discharge via the outlet stream at Acadian Road would decrease. As a result, there should not be a net change in the overall nutrient balance in the lake.

While this suggests there isn't a net impact to nutrient levels there may be seasonal changes in water quality. It is recommended that a water quality sampling program be established and a nutrient mass balance analysis conducted to determine whether a seasonal effect on nutrient levels would result from the proposed water withdrawals.

3.0 Potential Effects on Fish

Recorded fish species in Hotel Lake (Watershed Code 900-147300-18900) include rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*O. clarki*), peamouth chub (*Mylcheilus caurinus*) and threespine stickleback (*Gasterosteus aculeatus*)ⁱⁱ. A fisheries assessment of Hotel Lake and the outlet stream conducted by Jacques Whitford in February 2003 confirmed the presence of rainbow trout and threespine stickleback. In addition, prickly sculpin (*Cottus asper*) previously undocumented in the lake, was also capturedⁱⁱⁱ.

To determine the potential effects of the recommended minimum lake level and the installation of stop logs it is necessary to understand the habitat requirements of the fish present during critical life periods. The primary concern is how the water levels or use of stop logs could affect spawning or rearing of fish species in Hotel Lake. Key timing and habitat requirements for spawning and rearing are summarized in Table 1 below.

Table 1. Spawning and Rearing Information for Fish Species in Hotel Lake

| Species | Spawning Requirements | Spawning Timing | Rearing Requirements |
|------------------------|---|---|---|
| Cutthroat trout | Stream or river habitat with the following characteristics: <ul style="list-style-type: none"> ▪ 25 mm Ø gravels ▪ 15 to 25 cm water depth ▪ 18 to 25 cm/s flow ▪ redd area 0.5 to 1 m² | December to May when water temperatures near 10°C. | Commonly rear in natal streams for 2+ years but can also migrated into lakes for rearing. |
| Rainbow trout | Stream or river habitat with the following characteristics: <ul style="list-style-type: none"> ▪ 15 to 35 mm Ø gravels ▪ 25 to 65 cm water depth ▪ 25 to 70 cm/s flow. ▪ redd area 0.9 to 5 m² | Spring, typically mid-April to late June with water temperatures from 10 to 15.5°C. | Shelter along the stream margins or protected lake foreshore. |
| Threespine stickleback | Builds nest of sticks and plant debris on aquatic vegetation or sandy substrates in shallow water | April to September, but more commonly June & July. | Shallow areas of lakes with and without aquatic vegetation. |
| Peamouth chub | Shallow lakes margins with rock for eggs to attach. | May & June with water temperatures near 12°C. | Shallow areas of lakes with aquatic vegetation. |
| Prickly sculpin | Slow velocity streams with less than 0.028 m ³ /s flow. Eggs laid under coarse substrates such as boulders, cobbles or logs. Eggs have been collected from lakes in Washington State suggesting lake spawning. | Spring, commonly between mid-March and June in coastal BC. | Quiet waters; avoids currents; found in lake shores. |

Adapted from: Scott and Crossman (1998) and Keeley and Slaney (1996).

3.1 Stream Spawning Species

Spawning habitat requirements of cutthroat trout, rainbow trout and prickly sculpin consist of streams characterized by gravel and cobble substrates. The only stream present on Hotel Lake is the outlet channel at Acadian Road, which flows into Mixal Lake. Jacques Whitford's February 2003 habitat assessment determined that the culvert under Beaumont Road, approximately 55 m downstream of the lake, is a barrier to upstream fish passage therefore spawning opportunities are limited to this upper portion of the outlet channel. The initial 15 m from the outlet of the lake averages 1.5 m in width with a 1% gradient and substrates dominated by gravel, with some cobble and angular rock along the creek edge. The channel morphology was riffle-glide, but the glides were small and the water levels were less than 10 cm.

The cobble and angular rock substrates present the creek are considered to be suitable for sculpin spawning. In addition, the gradient of the creek in the initial portion of the channel is gentle and the water velocity is low. Therefore it is likely that this outlet area is the primary spawning location for prickly sculpin.

While the gravel substrates and gradient are suitable for trout spawning, water levels in the creek were less than the range used for cutthroat and rainbow spawning and the depth of gravel and available area were limited. As the hydraulic characteristics and morphology of the outlet channel do not meet the criteria for trout spawning habitat, it is unlikely that the trout in Hotel

Lake are a self sustaining population. The presence of trout in Hotel Lake is therefore attributed to stocking efforts. Database records from the BC Ministry of Environment shows that stocking efforts have introduced trout into Hotel Lake a total of 31 times between January 1933 and November 2006^{iv}. As a result, no specific habitat protection requirements for trout are recommended.

To avoid negative impacts to sculpin populations in Hotel Lake the stop logs should be located on the outlet creek at least 15 m downstream of the lake. This will ensure that prickly sculpin are not isolated from the limited area of available spawning habitat. In addition, drawdown below the lake outlet creek level should not occur before mid-May to ensure adequate spawning opportunities.

3.2 Lake Spawning Species

Threespine stickleback and peamouth chub both spawn in the shallow littoral zone of lakes in spring and summer. This habitat type is not limited in Hotel Lake. Hotel Lake has a perimeter of approximately 2,900 m and a surface area of approximately 27 ha. Approximately 42% of the lake is shallower than 6 m depth (the shoal area as defined by the BC Ministry of Environment). Emergent and aquatic vegetation is present surrounding the most northwesterly island and downed trees are common in the water around the perimeter of the lake providing ample cover to juvenile fishes.

The draft *Technical Memorandum – Hotel Lake Hydrologic Analysis* indicates that draw-down to 0.6 m below the outlet channel will reduce the shoal area of the lake by approximately 6%. This drawdown would not substantially affect the available littoral area of the lake for stickleback or chub spawning or rearing. With the additional mitigation of water level provided by the proposed use of stop logs, drawdown would primarily occur from mid-June to September. Therefore drawdown will not likely have a measurable effect on spawning or rearing for either species.

4.0 Conclusions

Although the water withdrawals from Hotel Lake are not expected to affect the annual nutrient mass balance of Hotel Lake, there is insufficient information to determine whether seasonal effects will result from the water withdrawal or changes in water level. Therefore, Jacques Whitford-AXYS recommends that a water quality sampling program be initiated and a month-by-month nutrient mass balance analysis be conducted once sufficient data is collected. A calculation of seasonal nutrient levels will allow the prediction of potential ecological effects due to any changes in water quality.

Of the five fish species documented in Hotel Lake, only prickly sculpin, threespine stickleback and peamouth chub are thought to be resident populations. Trout in Hotel Lake are stocked and there is no suitable spawning habitat to allow establishment of a resident population. The recommended minimum lake level of 0.6 m below the lake outlet and the suggested use of stop logs to mitigate drawdown are not expected to have a negative impact on fish populations in Hotel Lake. Both peamouth chub and threespine stickleback spawn in lake margins and this habitat type is not limiting. To ensure that prickly sculpin spawning in the outlet creek channel is

not adversely affected, we recommend the stop logs be located at the edge of the Acadian Road right-of-way, approximately 15 m downstream of the lake.

4.0 References

- i) <http://www.aaqwa.org/lakes/fishkill.html>, accessed January 16, 2007.
- ii) <http://pisces.env.gov.bc.ca/FishWizardFrames.asp>, accessed January 15, 2007.
- iii) Jacques Whitford Environment Limited. 2003. Draft Application for Authorization under the Fisheries Act: Hotel Lake Water Supply. Prepared for Johnston Allen Properties Ltd. April 2003.
- iv) <http://srmapps.gov.bc.ca/apps/fidq/>, Stocking Query for Hotel Lake conducted January 15, 2007