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Re: Is there a threat to Glade's drinking water supply?

The Glade Irrigation District (GID) has retained Aqua Environmental Associates to provide an expert opinion in response to the question: ***Is there a threat to the Glade community drinking water supply?*** If yes, GID further asks for a description of the threat and of how it is expected to change in the coming years. This letter provides my response in three parts:

1. A review of watershed disturbance information and assessments available for evaluation of Glade watershed condition and source-water quality.
2. A review of information concerning proposed forestry activities and assessments in the Glade watershed available to determine their potential impacts.
3. A discussion of potential threats to the Glade community drinking water source associated with existing and future watershed condition.

In addition to the opinion requested, the GID has also asked that I provide recommendations for addressing any threat that may be identified.

Preamble

The GID has approached me around its concern for its drinking water source because of my qualifications and experience relevant to the Glade watershed and the question you have posed. I have a PhD in hydrology, fluvial geomorphology and Resource Management Science from the University of British Columbia where I worked with Dr. Michael Church and Dr. Hans Schreier, who are world-renowned scientists in the fields of earth/water sciences and land management. For over twenty years, I have expanded on my Doctoral work, examining applied environmental water challenges with an emphasis on forestry issues and hydrologic risk assessment in the upper Columbia basin. I worked for the Ministry of Environment (Nelson) as a regional terrain and hydrology expert in the Columbia basin then later as a provincial watershed specialist (Victoria), quantifying the effects of forest loss and salvage on water values. During 2008-2009, I worked as Acting Director of Source Water Protection in the Health Protection Branch of the Ministry of Healthy Living and Sport (Victoria), leading policy development in relation to the effect of land-use practices, especially forestry, on human health. In 2001, I co-authored a detailed watershed analysis of the Glade Creek watershed, here called the "2001 Watershed Analysis", (Carver *et al.* 2001) which, to date, remains the most comprehensive study available examining the condition of this consumptive-use watershed.

Scientific publications are referred to in this letter and summarized at the end of the letter. For the purposes of this letter, the naming conventions in the watershed follow the terms established in the *2001 Watershed Analysis* which is available at:

<http://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=8767>.

Specifically, the Glade Creek “mainstem” extends from Siwash Lake to the community intake and on to the Kootenay River. Tributaries to Glade Creek are named as laid out in the *2001 Watershed Analysis*.

1. Watershed Disturbance and Assessment History

The disturbance history of the Glade watershed (to 2001) has been described in the *2001 Watershed Analysis*. In the early-to-mid 1900s, the mainstem creek and riparian areas were extensively disturbed with roads, trails, bridges, camps, fords, and a flume-catwalk to deliver logs to the Kootenay River. These activities created extensive and persistent channel instability and deposits in the mainstem, depleted the riparian area of old stabilizing coniferous trees, and were succeeded by a 1934 forest fire that burned off substantial amounts of the watershed that have subsequently been slow to regrow. Road construction during the 1970s on slopes above the lower mainstem has resulted in at least five landslides, including two associated with the BC Hydro power line. Atco Wood Products Ltd. (Atco) constructed a road and carried out harvest in four blocks (45.3 ha) in the headwaters of the Lower Tributary.

Subsequent to the *2001 Watershed Analysis*, West Kootenay Power (now Fortis) constructed a 500-kVA transmission line through the watershed. A recent *2016 Hydrologic Assessment* (Green 2016) has been provided by Kalesnikoff Lumber Company (KLC) and Atco in support of their proposed forestry activities discussed in the next section. In addition, Atco has provided a *2016 Terrain Stability Assessment* (Purdue 2016) for one of its future blocks in the Glade watershed (R10).

2. Proposed Forestry Activities

In 2016, both KLC and Atco indicated their intention to build new roads and harvest within the Glade watershed in 2017. In the *2016 Hydrologic Assessment*, Atco formally presented Block R10 (29.7 ha), located in the northeastern part of the watershed, in the Upper Face Units, and requiring a 1.5-km road connecting it to the Rover Creek road network outside of the Glade watershed. At the *2016 Public Meeting* (hosted by Atco and KLC in the Glade Community Hall on February 17, 2016), Ron Ozanne of Atco indicated Atco’s intent to pursue further road building and harvesting from the R10 road, but did not disclose details of those plans or their timing. The *2016 Terrain Stability Assessment* indicates that more than 735 m of this road will be built to a permanent standard, presumably to lead to these future roads within the watershed. Only where the proposed road passes above Class IV terrain was the geotechnical assessment carried out. Class IV terrain is expected to contain areas of moderate likelihood of landslide initiation following timber harvesting or road construction.

During 2016, KLC carried out advanced field planning of roads and cutblocks in the western part of the Lower Basin (close to the community water intake) as evidenced by observation of its extensive labelled flagging tape in that area. The current field evidence suggests that roads and cutblocks are planned for locations on hillslopes several hundred meters upstream/uphill of the water intake. Many details are unclear because KLC has not provided the details regarding its road building and harvest plans, however, at least two cutblocks are suggested as well as roads which are on and/or in the vicinity of steep slopes close to the water intake. According to a recording of the *2016 Public Meeting*, when asked how long KLC will be logging in the watershed, Tyler Hodgkinson of KLC responded: “Forever. We’re going to be there forever.”

Limited assessments are available in relation to the proposed forestry activities. The *2001 Watershed Analysis* is the most comprehensive assessment available. It provides risk assessments for peak flow, riparian areas, suspended sediment and landsliding at a watershed scale. Although that study is now 15 years old, most of the concerns identified remain in place and the information provided continues to provide a comprehensive basis on which to proceed with further investigation, particularly around the chronic sedimentation issues experienced at the water intake. The *2016 Hydrologic Assessment* focuses on flood flow behaviour and melt dynamics within the watershed. Erosion issues are explicitly out of scope for that assessment (p.27): “Although a large landslide capable of causing long-term impacts to water quality at the intake is identified as a hazardous event a rigorous assessment of the likelihood of such an event is beyond the scope of this assessment”. The author of the *2016 Hydrologic Assessment* also indicated at the *2016 Public Meeting* that she had “nothing to do with logging plans”. The *2016 Terrain Stability Assessment* available for Block R10 indicates a very low potential of initiating a landslide able to affect the water intake, however, such a landslide would aggravate the chronic instability and sedimentation known to be associated with the mainstem and thus would potentially contribute to the persistent elevated downstream turbidity.

Other than these three assessments, there is little additional work available publicly against which to evaluate proposed forestry activities by Atco and KLC.

3. Considerations In Determining Threat to Drinking Water Supply

Existing Turbidity Concern

Turbidity is routinely used as a proxy measure for the risk of microbial contamination and the effectiveness of water treatment for consumptive purposes. Studies show that elevated turbidity levels in drinking water source areas are associated with increased hazards to public health (Egorov *et al.* 2003; Chevallier *et al.* 1981; Mann *et al.* 2007; Morris *et al.* 1996; Schwarz *et al.* 1997). Turbidity has been shown to be correlated with contamination with *Giardia* and *Cryptosporidium* and can serve as a surrogate measure of risk of contamination by these pathogens (Chevallier *et al.* 1991). Health Canada (2013) recognizes these hazards through the establishment of protective turbidity treatment objectives. Unfortunately, once water is contaminated with elevated turbidity levels, it can be difficult to remediate even with costly measures (Lusardi and Consonery 1999). In the present situation, the coupled potential for increased human access into the Glade watershed increases the public health hazard associated with turbidity due to the increased potential for biological contamination associated with human and animal waste, recreational activities, garbage dumping, and other factors that are known to increase with increased access to source areas. See for example RDNO (2014) concerning issues arising in Vernon’s Community Watershed (Duteau Creek), where costly interventions are required to stem the effects of watershed access.

The *2001 Watershed Analysis* (p 44) provides a detailed inventory of sediment sources based on a field investigation supported by airphoto observations. That inventory documented 17 landslides, at least 13 of which were determined to be related to the road system along the mainstem Glade Creek (including two above the Lower Tributary). Two were associated with the BC Hydro powerline road. The landslide locations are shown on the *Hydrologic Features and Sediment Sources Map* produced as part of that study. Both maps are available online at the link given above.

The *2001 Watershed Analysis* also determined that the “Upper Mainstem of Glade Creek contains a distributed series of sediment wedges which is partly responsible for a cycle of instability persisting in that channel.” The detailed channel assessment provided in the *2001 Watershed Analysis* (p 20-21 and

Table 4.2) describes severe instability in the channel within reaches 4 to 6 which extends from the confluence with the Lower Tributary to the confluence with the Upper Tributary. Particularly in the upper reach of this 2.5-km section of Glade Creek, there are widespread signs of instability (avulsions, dysfunctional wood, unstable steps, lack of riparian recruitment, etc) that have been active for many decades, dating back to the early 1900s, acting as a major source of stream sedimentation.

The Interior Health Authority (IHA) has identified the Glade system as one that is a high risk that requires a boil water notice. Glade Creek's repeated instances of high turbidity reflect this notice requirement. On the request of IHA, the Glade Irrigation District has been monitoring the turbidity of its source water intensively since 2012 (often daily). These data reveal numerous occurrences of turbidity exceeding 1 NTU and many between 5 and 50 NTU. These values of turbidity reflect the findings of the detailed *2001 Watershed Analysis* (summarized above) and the general impressions of the *2016 Hydrologic Assessment* in relation to instream sources within the unstable Glade Creek mainstem (and other sediment sources that may have access to the channel). At the *2016 Public Meeting*, the author of the *2016 Hydrologic Assessment* also emphasized the impacts that continue to be evident in the Glade Creek mainstem: "There really wasn't a single section of that North Fork channel [Glade Creek mainstem] that hadn't been directly impacted by the past logging, fire or flood."

Proposed Forestry Disturbance

As discussed in section 2 above, considerable disturbance in the form of road building and forest harvest is planned for the summer of 2017 by forest tenure holders. Atco's initial plans expose the upper portion of the watershed to a variety of human-use impacts (motorized recreation, garbage dumping, hunting/wood-cutting, domestic animals, etc) that may potentially lead to biological and chemical contamination and future road building and harvesting will expand those risks. While adding to the same concerns around increased human access, KLC's planned development also creates risks directly related to sedimentation potential through both landsliding and waterborne erosion mechanisms. KLC's activities create additional hazards due to their location in proximity to the water intake. Any sediment resulting from KLC's road building and/or harvesting has much less distance to travel to reach the intake, and therefore the likelihood of sediment delivery to the intake is significant.

Climate Change Disturbance Risks

There is extensive evidence of profound changes expected in the climate and associated hydrology of the West Kootenay, including areas such as the Glade watershed. In its *Guidance to Practitioners and Government Staff* (MFLNRO 2016), the BC Ministry of Forests, Lands and Natural Resource Operations states:

"The most profound changes to BC's forests in this century are expected to be the result of more frequent and severe natural disturbances. In the Kootenay Boundary Region, the shift to warmer, drier conditions across low elevations is predicted to result in a significant increase in fire frequency, especially in the West Kootenay. As well, increased temperatures during all seasons are expected to result in more frequent, intense, and longer insect and pathogen outbreaks. In addition to increases in wildfire and forest insects and diseases, the Kootenay Boundary Region is expected to experience an increase in floods and mass wasting primarily due to extreme storm events, shifts in hydrologic regimes, and the interacting effects of these and other natural disturbances."

Projected resulting hydrologic changes detailed in *Guidance to Practitioners and Government Staff* include increased wildfire (and its hydrologic consequences), more intense precipitation, increased slope

instability, lower low flows, smaller snowpacks, earlier freshets, and longer summer dry periods. These increasing risks are not limited to the distant future, as illustrated by the extreme precipitation events leading to the deadly Johnson's Landing 2012 landslide and the 2013 debris floods in Hamill, Fry, Campbell and Schroeder Creeks.

MFLNRO, in *Guidance to Practitioners and Government Staff*, recognizes that "slow regulatory or administrative change may pose a challenge to implementing timely management responses to changing conditions." Fortunately, there is broad agreement within the stakeholders associated with the Glade Creek watershed that there is need for a long-term watershed management plan. For example, in reference to a question about the need for a watershed management plan, KLC's hydrologic consultant stated at the *2016 Public Meeting*: "It's very important.... You have to have a watershed management plan that is based on science." Similarly, the Regional Director for Area I has advocated strongly for a long-term integrated watershed management plan. Without such a plan, there is a high likelihood that the risks to the biological, chemical and physical water quality of the Glade community's drinking water source will rise due to piecemeal resource development that is not aligned with the changes that are already underway and are expected to accelerate in the coming years and decades. Water quantity and timing of flow are also expected to be affected and warrant careful consideration within the context of a long-term watershed plan so as to reduce the threat and thereby minimize the potential risks. To maintain forest cover in a changing climate, any forest harvesting must shift focus from maximizing the timber resource, to maximizing ecosystem resilience.

Interface-Wildfire Disturbance

Decades of fire suppression in the West Kootenay have resulted in high fuel loads in the Crown forests adjacent to the Glade community. Recent climate change assessments for the West Kootenay have also indicated that wildfire risk has likely begun to increase over the past decade, and is projected to continue to increase over the coming decades (Utzig *et al.* 2011). Throughout various Areas of the Regional District of Central Kootenay, landscape-level planning is underway to reduce the forest wildfire risk within community interface areas. Community Watershed Protection Plans (CWPPs) are being developed to identify how Wildland Urban Interface (WUI) locations (forests within about two km of communities) should be treated and managed to protect communities from wildfire risk.

The Glade community is within Area I which is participating in this landscape-level planning initiative and the cross-jurisdictional collaboration that is required for it to succeed. Industrial logging operations are often not compatible with appropriate treatments for WUI areas and may actually increase wildfire risk in the short- and/or medium-term. Thus, it is important that forest harvesting plans be consistent with the CWPP under development within Area I and particularly nearby the Glade community.

Timeline Implications due to BC's Present Regulatory System.

The timeframe for responding to threats due to forestry activities is shaped by the consultation requirements of the present regulatory system. Through most of 2016, when asked for plan details, Tyler Hodgkinson (KLC Woodlands Manager) indicated that they would eventually be shared but were unavailable because they were still in preparation. Later in the year, at a meeting on November 18 (2016) with MFLNRO and IHA, Tyler Hodgkinson told a Glade committee member that the Glade community would be given only the legal 30-day minimum period to review the Site Plan before application would be made for the permits. This minimal timeframe would make it very difficult for the Glade community to undertake a suitably thorough review of potential impacts of the Site Plan on the community water source. Additionally, under the Forest and Range Practices Act (FRPA), once a permit is applied

for, it is virtually impossible, for the permits to *not* be granted by the Ministry. There is also no legal requirement for KLC to make changes to the Site Plan based on input from affected parties.

The nature of FRPA's consultation and planning requirements in relation to KLC's road building and harvesting underscore that any concerns that come to light during the brief formal consultation period can be addressed effectively only much earlier because *waiting until they have been made public would be essentially equivalent to waiting until it is too late to do anything about their threat contribution*. An appropriate course is to act on knowledge of them now based on what has been made public (including what is evident in the field), rather than wait until the summer for the full details to be disclosed legally following FRPA's minimum requirements, in their final stages of planning.

4. Is There a Threat to Glade's Drinking Water Supply?

According to the Drinking Water Protection Act, in relation to drinking water, *threat* means "a condition or thing, or circumstances that may lead to a condition or thing, that may result in drinking water provided by a domestic water system not being potable water".

Based on the information available, there exists a threat to the Glade community's drinking water supply. It may become non-potable due to elevated turbidity and potential contamination. In addition, potential changes in the timing of flow may threaten the supply of water during seasonal periods of low flow. This threat is increasing with the forestry activities being planned, particularly those that are situated close to the water intake. As the climate continues to change, the magnitude of the threat is rising and can be expected to rise further in the coming decades and beyond.

5. Recommendations

As per your request, in addition to the above opinion, I am also including four recommendations that, if implemented, would begin to address the threat to your drinking water source:

#1. Secure Effective Coordinated Forestry Planning and Informed Public Consultation

Request the Interior Health Authority, under its authority via the Drinking Water Protection Act, to require forest-license tenure holders to modify their approach to planning forestry activities in relation to potential community impacts, as follows:

- Provide a complete watershed analysis that addresses watershed-level erosion concerns and all relevant cumulative hydrologic effects based on terms of reference jointly developed by all stakeholders.
- Prepare integrated long-term development plans for the entire watershed based on watershed analysis (not one block/road at a time).
- Work jointly with the Glade Irrigation District and its sub-committee, the Glade Watershed Protection Committee, as well as other stakeholders, transparently, as development planning proceeds, not only "after the fact" (*i.e.*, once all the development planning, including field layout, has taken place, rather than following the legal "minimums" mandated under FRPA).

#2. Address Risk of Interface Wildfire

Engage closely with the RDCK's regional interface-wildfire planning initiative, and as follows:

- Work with the RDCK to assure that a qualified professional with appropriate education and relevant experience is involved in developing the Community Wildfire Protection Plan (CWPP) and the eventual prescriptions that will be required to implement it.
- Alert KLC that RDCK should lead inside the Wildland Urban Interface and explain to KLC that its development plans must be consistent with all direction provided in the CWPP.

#3. Conduct Sediment Source Assessment and Mitigation (Building on the 2001 Assessment)

Building on the Sediment Source Survey included in the *2001 Watershed Analysis*, conduct a field-based investigation to narrow down and confirm the cause of the elevated turbidity levels experienced at the water intake. Where feasible, develop and implement prescriptions to address any sediment sources identified as a contributor to elevated hazards to drinking water. Catalogue any additional existing and potential sediment sources.

#4. Create a Long-Term Watershed Plan

Engage the services of a qualified professional with appropriate education and relevant experience to create a long-term watershed management plan. In creating the plan, include the following:

- Identification of preferred stable low-risk locations for any access roads required and specify appropriate construction and maintenance standards/practices to minimize sediment production.
- Identification of management objectives and strategies that will increase watershed and ecosystem resilience within the context of projected future climates.
- Identification of stand treatments that are compatible with existing and future interface wildfire risk reduction.
- Development of an access management strategy appropriate to minimizing risk to water quality.
- Coordination with FLNRO, IHA and tenure holders to gain support for plan implementation.

I would encourage you to not delay in addressing these concerns associated with your water source. The management issues are time sensitive because of the make-up of the current regulatory framework and the hydrologic issues are becoming only more problematic and likely with time.

If you require additional information, please do not hesitate to contact me.

Yours sincerely,



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Principal and Senior Hydrologist

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