July 27, 2007
05-01

Environmental Assessment Office
2nd Floor, 836 Yates Street
PO Box 9426 Stn Prov Govt
Victoria BC
V8W 9V1

Attention: Paul Finkel, Project Assessment Manager

Re: **Comments following Review of Solander Ecological Research Report**

Dear Paul,

GW Solutions Inc. (GW Solutions) has been retained by the Halalt First Nation (Halalt) to coordinate the environmental review of the draft report titled "Impact Assessment of Chemainus River Flow in Relation to the District of North Cowichan Proposed Chemainus Well Project", completed by Todd Hatfield from Solander Ecological Research (Solander), Victoria, BC. Our comments are not intended to address the concerns raised by Halalt First Nation regarding their aboriginal rights and title or the Crown's duty of consultation and accommodation.

This report includes comments submitted to Halalt by McNaughton Environmental Consultants. D.R. Clough Consulting comments are presented in a separate letter to Chief Robert Thomas, attached.

1. COMMENTS ON THE DRAFT REPORT

This section includes comments on the text and illustrations of the draft report. Some comments refer to a page(s) and/or section of the report, others follow excerpts from the report (in italics) and the comments are presented in bullet form. Bolding of part of the text in Solander's report has been done by GW Solutions to highlight pieces of information presented by Solander.

P. 2 3.1 Chemainus River Streamflow

There are few lakes in the watershed to store and attenuate flows, so the system is flashy, with variation in flows reflecting the pattern of frequent winter rainstorms. Storms typically cause large pulses in flow in the Chemainus, and the bulk of annual streamflow is a result of these storm events. Peak flows regularly exceed 500% MAD, yet approximately 70% of daily average flows are below MAD. Median August flows are less than 4% MAD and the lowest flows on record are below 1% MAD.

Patterns of streamflow show a clear indication of climate change over the period of record. This is most apparent as a broadening in the timing of low flows. This pattern is consistent with lower precipitation in spring and summer and a later onset of fall rains. Since 1980 there has been a ***marked increase in duration of the low flow period*** *during late summer and fall. I interpret these long term trends in flow as climate change induced, because water use is not likely to be sufficient to markedly affect the "shoulders" of the low flow season. There is also some evidence of trends in water levels during the low flow period, such that* ***low flows appear to be becoming lower through time****. The cause of declining low flows may be related to climate change and/or water use patterns in the watershed. The magnitude of decline in low flows is not large, but it should be emphasized that flows are already very low during this time, so trends may be difficult to detect.* ***That the trend is detectable and visible in graphs is somewhat surprising****. That the trend is not more obvious may be due to a general lack of sensitivity of gauging sites for detecting trends in low flows (Whitfield and Hendrata 2006).*

The Chemainus River has important fish resources, including chum, chinook, and coho salmon, steelhead, rainbow and cutthroat trout (resident and anadromous), and Dolly Varden char. Pink and sockeye salmon are occasionally observed. Life history timing of the main fish species is provided in Appendix B. ***The Chemainus is somewhat unusual in having a summer and fall run of chinook, and three runs of steelhead, including summer, early winter and late winter runs.*** *The first run of chinook is in March to May, followed by a subsequent run in late September. The summer steelhead run comes in during July to September, the early winter run in December to March, and the late winter run in April to June. Chum and coho return in mid to late fall. The migration timing of all fish species in the river* ***is somewhat flow dependent, in that migrations may be delayed if flows are insufficient to allow passage and provide spawning conditions.***

- ✓ This section proves the uniqueness of the Chemainus River and the recent modification of its flow with longer and more frequent periods of low flow. The Chemainus River appears to be under stress and requires attention.

P. 3

Fish production is assumed to be limiting by low nutrient levels, cold temperatures and extreme low flows.

- ✓ Warmer temperatures have a greater impact on production than low temperatures.

- ✓ Figure 4 (p6) shows (albeit limited data points) colder than active growth and higher than upper optimal data. Colder than active growth slows incubation in eggs, and stunts growth in fry. Sub-lethal and lethal temperatures can be responsible for significant mortality, unless suitable microhabitat is available.

- ✓ Eggs delayed by colder winter temperatures can “make up” the difference if the temperatures during the summer are within optimal for an extended period. Extended lethal periods will have greater impact on overall production.

- ✓ Suitable microhabitats include groundwater amongst cobble/boulder habitats, wetted side-channels and pools, and cooler tributaries.

- ✓ If fish did not seek out and use these habitats, there would be no fish surviving these lethal events (the river would be barren).

P. 5 3.5 Water Quality

Unfortunately, long term trend data are lacking for Banon Creek and Chemainus River, at least for most water quality elements.

- ✓ Little is known on the water quality of the Chemainus River and its tributaries. Therefore there is an urgent need to start collecting water quality data in order to understand factors promoting, controlling, or limiting the sustainability of the fluvial and riparian ecosystems. This data will also provide required information prior to the proposed transfer of water from one part of the watershed to another without jeopardizing the balance of ecosystems.

P. 6 and 7 3.3.2 Banon Creek - Turbidity

- ✓ Solander’s report refers to Turbidity below 5 NTU. However, DNC wrote in a letter to VIHA dated May 16, 2007 that the wells would operate when the turbidity exceeds 1 NTU. The report should indicate when turbidity was monitored at values greater than 1 NTU, and for how long, during the June 15 to October 15 period. If the wells have to operate for several days in a row during the summer month, this could have significant effect on the river flow and create a thermal barrier to the movement of fish in the river.

P. 7 and 8 Temperature

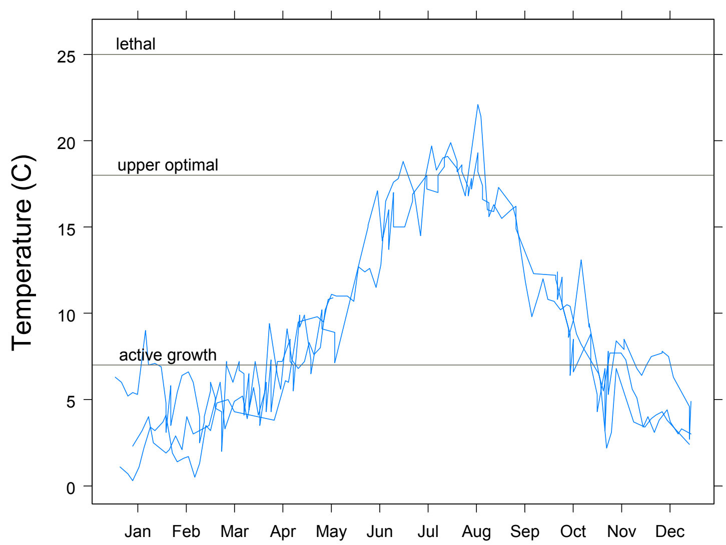


Figure 6. Temperature trends in Banon Creek, 2002 to 2005. Approximate temperature thresholds are indicated for rainbow trout. Optimal and lethal temperatures for cutthroat are slightly lower.

- ✓ Figure 6 indicates that the temperature from June 15 to October 15 ranges between approximately 8 ˚C and 20 ˚C. Any water added to the Chemainus River in July, August, and September will be above 15 ˚C (and likely up to or above 20˚C), compared to groundwater typically at 11˚C.

- ✓ The assessment of temperatures is unsophisticated, cursory, does not include the Chemainus River and does not take into considerations the findings of Halalt (although those findings are acknowledged – p14).

P. 9 and 10 Fish versus flow

- ✓ These curves are an oversimplification. Each habitat unit would have its own curve based on gradient, bank slope/channelization, availability of flood plain habitat, etc. For example, higher flows/water levels could open up extensive off-channel habitats on a flood-plain, potentially double or multiply up to 10 times the habitat which could be available.

P. 12 to 14 3.5 Surface water – Groundwater Interactions

There has been a growing appreciation of the chemical and physical interactions between surface water and groundwater, as mediated in large part by the rich invertebrate biota dwelling in the hyporheic zone — the saturated sediment zone that is a transitional gradient between surface water and deeper groundwater — and the temperature differences between surface and groundwater (Edwards 1998).

- ✓ In this section, Todd Hatfield provides a very good summary of the interaction between surface water and groundwater and the fact it is a relatively new "field". The health and sustainability of river ecosystems is very dependant upon this dynamic and complex interaction.

Groundwater release can be important in winter too, as upwelling areas are often warmer and prevent freezing of spawning and rearing areas (Baxter and McPhail 1999; Bradford et al. 2001).

- ✓ This situation probably applies to rearing areas and side channels near the proposed well field. **The beneficial role of the aquifer in the winter should therefore be better assessed**.

Groundwater and surface water can be influenced directly by a number of factors, including climate, land use, water use, and industrial activities. How each of these act within a particular watershed is rarely straightforward, but there are many examples linking human activities to changes in quality and quantity of groundwater and surface water, and interactions between the two water sources.

- ✓ GW Solutions strongly agrees with this comment.

Results of the Thurber study indicate that the area most influenced by groundwater abstraction is the area immediately adjacent to the DNC production wells — surface water monitoring wells upstream and downstream did not show changes in river stage.

- ✓ Solander should note that a reason for the absence of observed impact on the river and the aquifer downstream is that the pumped water was re-injected back to the river at an approximate distance of 350 m from the pumping wells.

The interaction of surface and groundwater in the Chemainus River is indicated by data collected by Halalt First Nation in August and September 2006 and presented by Gilles Wendling at an EAO-led project assessment meeting on December 6, 2006. The data include surface and near-bed temperatures at several stations along a 2.7 km length of the Chemainus River. Most notable is an abrupt decline in surface temperature along the data series — exfiltration of cool groundwater at or near the measuring site is the assumed cause of the temperature decline. As noted earlier, such locations may be used by fish to regulate their body temperatures within tolerance limits (e.g., Torgersen et al. 1999; Geist 2000).

- ✓ The monitored sites in the lower reach of the river demonstrate the close interaction between the river and the aquifer. The input of groundwater regulates both the flow and the quality of the water in the river, channels and rearing ground, both in the summer (cooling effect) and in the winter (warming effect). Extraction of groundwater and local depression of the water table in these sensitive areas may have an impact on fish spawning and rearing capacity. The value of the side channels was observed by Todd Hatfield, as indicated below:

P. 18 4.2 Chemainus River

As part of this overview assessment I also walked the length of the sidechannel on the Halalt Reserve from its downstream outfall near the railway bridge. This is a sidechannel of substantial length containing abundant fish and wildlife habitat. I understand that this sidechannel is an important spawning and incubation area for chum salmon, and that eggs from returning chum are incubated at Nanaimo Hatchery and outplanted here in late winter by the Halalt First Nation. The sidechannel shows evidence of numerous salmon enhancement activities. I did not observe an inlet channel, and it appears that the channel is fed primarily by groundwater. I would anticipate that levels in the sidechannel rise and fall in relation to surface levels in the Chemainus River.

P. 19 5.1.3 Magnitude of Water Releases

- ✓ Where does the release come from above or below the metalimnion? Does the character or design of the reservoir allow for cold release? Will future releases include pulse flows?

P. 20

- ✓ The benefit to resident fish species within the Banon Creek to the point of extraction portion of the Chemainus River is noted; however the benefit is limited as these species tend to be more prevalent in the headwaters of the watershed. Releases of water should be less concerned about overall discharge on the Chemainus River, but more a function of temperature. As high air temperatures (heat wave) are forecasted, increases in discharge from the reservoir should be planned for and implemented.

P. 20 5.1.5 Recommended Mitigation Flows

- ✓ Total volume released equals total volume extracted: There should be an allowance for evaporation included. This could be significant with higher temperatures, waterfalls of Banon Creek and exposure to sun in Chemainus River.

P. 21 6.2.1 Extent

The groundwater pumping study (Thurber 2006) indicated a measurable effect within 24 hours on Chemainus River flows in the vicinity of the DNC production wells. Short term effects were not detected at surface water monitoring wells approximately 1 km upstream or downstream of the production wells. Thus, over the short term the physical extent of streamflow reductions in the Chemainus River appears to be confined to a relatively small stretch of river.

- ✓ Solander should note that a reason for the absence of observed impact on the river and the aquifer downstream is that the pumped water was re-injected back to the river at an approximate distance of 350 m from the pumping wells.

P. 25 6.2.7 Level of confidence

This level of knowledge is sufficient to make confident impact determinations for fisheries resources in the Chemainus River. The ***level of confidence*** *in this impact determination is therefore rated as high.*

- ✓ GW Solutions would not rate the level of confidence as high. There are still many unknowns on the aquifer and river interaction and long term impacts. For example, the study completed by Solander was done under winter conditions and according to a specific and limited scope of work (e.g., the risk of siltation and erosion resulting from the release of water from Banon reservoir). The identification of vulnerable biotic components has not been addressed. In Section 7.2, Response Monitoring, Todd Hatfield states: "*One is typically concerned with biotic components (i.e., fish populations, fish habitat, invertebrate production, etc.) and their response to physical changes like streamflow alterations, but it makes more sense for this project to focus directly on streamflow and temperature than on biotic responses, which are typically highly variable and difficult to monitor with sufficient statistical rigour.*" GW Solutions acknowledges that one cannot know everything and understand everything when designing a project. However, it is important to identify what is voluntary "overlooked" or "left aside" and the potential implications of such limitations and decisions. To date, this project has shown that major assumptions were made and proven wrong (e.g., the Chemainus River and the Chemainus Aquifer **are** connected near the well field[1] - although it was assumed not to be the case – and the impact of groundwater extraction on the Chemainus River is **not** acceptable[2] – although it was assumed to be acceptable[3] - please note "the high level of confidence" expressed by Thurber in 2006). Therefore, the level of confidence on the potential impacts this project will have on the Chemainus River watershed should reflect our level of ignorance.

[1] Thurber (2006): "At Site B (well field), it appears that the river drops in elevation, from being perched above the aquifer immediately above the well field, to being in connection with the aquifer in an area down gradient of the pumping wells."

[2] Solander (2007, section 3.4.1) "The observed flows during the low flow period are well below the optimum for all life stages, and are within a range that can be described as critically low for fish in the river. In essence any reduction in flow, natural or anthropogenic, results in rapid loss of fish habitat, as indicated by the steep slope of the habitat-flow curves in Fig. 8.

[3] Thurber (2006): "Based on the results of the 2005 investigations, we believe, with a high level of confidence, that groundwater extraction at a maximum daily demand not to exceed 131 L/s will not have a long term significant impact on the Chemainus River discharge and water level, on the current pumping of neighbouring wells and the aquifer as a whole."

P. 25 7. Monitoring

Two types of monitoring are recommended for this project (compliance and response monitoring) and two parameters are recommended for monitoring (streamflow and water temperature).

- ✓ These two parameters are obvious and relatively simple parameters to monitor. However they will only partially provide indication on the improvement or deterioration of the habitat and ecosystems in the river and within the riparian zone. Representative biotic parameters should be included in the monitoring program.

P. 26 and 27 7.2. Response monitoring.

- ✓ Monitoring of temperatures needs to be more sophisticated and include the monitoring of groundwater influenced microhabitats that are refuge during hot spells and the potential for a thermal barrier to be created in the vicinity of the wells.

The assessment program should operate through the low flow period for a minimum of two years to ensure adequate sample size.

- ✓ Historical data show a significant modification of the river flows in the last 10 years and it is still presently difficult to assess how climate change will exacerbate the observed trends. Therefore, any monitoring program should be designed with a minimum ten year time frame, with periodic adjustment of the plan based on gathered information and improved definition of the system being monitored.

P. 28 8 Conclusions

The impact of the proposed production well project is deemed to be less than significant provided mitigation and monitoring are implemented.

- ✓ The study was completed under a limited time, limited budget and within a limited scope. Therefore the whole complexity of the problem was not addressed and the statement made in conclusion should reflect this limitation.

2. KEY QUESTIONS AND CONCERNS

- ✓ Will the winter use be small enough and the natural recharge, including bank recharge (through the banks of the Chemainus River) be large enough that there will be a “reset” of the groundwater regime every year, or will some areas of the aquifer (e.g. side channels) undergo a cumulative deficit in recharge over time?

- ✓ In the case of deterioration of the water quality between June 15th and October 15th, there is a high chance that the wells would be used in response to an order from Vancouver Island Health Authorities. Their use will reduce the river flow and could produce a thermal barrier. Both effects will have significant impacts on fish population and biotic parameters. The trigger for having to operate the wells could be higher turbidity, the risk of outbreak of waterborne diseases, or bacteria or algae bloom. The presence of algae is not presently regulated both by Health Canada or BC Ministry of Health. It may become in the future as it is regulated in other countries and under the World Health Organization.

- ✓ How do we know the 50 l/s release at Banon reservoir will reach the section of the River that may potentially be affected by a water deficit? What is the likelihood that the surface water will be directed to the subsurface along 8 km between the point of release and the area of the well field due to increased leakage resulting from the lowering of the water table upstream and at the right of the area of the well field?

- ✓ The water to be released will be at a higher temperature than the water which is released by the aquifer. This will affect the temperature balance at a period of the year when water temperature is critical for the fish.

- ✓ The aquifer also regulates water temperature during the winter. Continuous operation of the wells during the winter will lower the water table in the aquifer. Side channels within the cone of depression of the well field, and which may only flow with higher water table between the fall and the spring will be most impacted. Their shallow water may freeze due to the reduced discharge of groundwater.

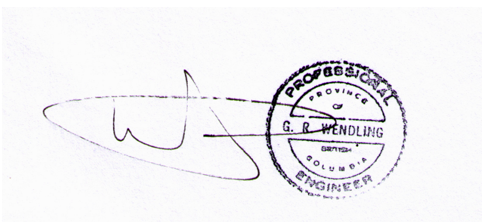
3. CLOSURE

Conclusions and recommendations presented herein are based on information provided in part by others. The work has been carried out in accordance with generally accepted engineering practice. No other warranty is made, either expressed or implied. Engineering judgment has been applied in developing the recommendations in this report.

GW Solutions was pleased to produce this document. If you have any questions, please do not hesitate to contact me.

Yours truly,

GW Solutions Inc.



Gilles Wendling, Ph.D., P.Eng.
President

CC: Chief J. R. Thomas, Halalt First Nation

Attachment: Letter from D.R. Clough Consulting to Halalt dated July 6, 2007