

Investigation of Anomalous Hydrology in Somenos Creek and an Assessment Effects from Beaver Dams Near the Confluence with the Cowichan River.

Somenos Rapid Science Communication 2018-01

submitted to:

Shaun Chadburn
Environmental Programs Coordinator
Engineering & Operations
Municipality of North Cowichan
7030 Trans-Canada Highway
Duncan, BC V9L 6A1

submitted by:

Dave Preikshot, PhD, RPBio
Somenos Marsh Wildlife Society
and
Tim Kulchyski
Cowichan Tribes



Investigation of the Anomalous Hydrology in Somenos Creek and Assessment of Effects of Beaver Dams Near the Confluence with the Cowichan River

Summary

On Tuesday 12 June, 2018, Dave Preikshot (Aquatic Scientist, Somenos Marsh Wildlife Society) and Tim Kulchyski (Biologist, Cowichan Tribes) visited two Beaver dams on lower Somenos Creek. The purpose of our visit was to assess the effect that these structures had on water flow and ecosystem processes in Somenos Creek, Figure 1. We were also interested to learn more about water movement in lower Somenos Creek given observations of upstream movement of water at the Lakes Road footbridge, approximately 1km above the confluence of Somenos Creek and the Cowichan River in late May and early June. In our estimation leaving the dams in place is the lowest risk option to ecosystems in the Somenos Basin and the lower Cowichan River.

Observations

The first dam is near the mouth of the creek at the Cowichan River, while the second was approximately 100m upstream, Figure 2. We observed water to be moving over spillways, i.e., flowing downstream, at both dams. Because the discharge at the dams is similar in magnitude to that associated with the creek without beaver activity, it is our opinion that the dam is not impeding the passage of water or interfering with biological processes in Somenos Creek.

The first Beaver dam is approximately 10m upstream of the confluence of Somenos Creek and the Cowichan River. This dam appears to be an opportunistic structure in which the Beavers have added sticks and other material around a mid-channel sand and gravel bar, Figure 3. These gravel bars are common on the Cowichan River and occur regularly near the mouth of Somenos Creek. The photograph in Figure 3 shows one such bar in summer 2017. Historical imagery in Google Earth shows similar gravel bars at the mouth of Somenos Creek in the summers of 2016, 2015, 2013, and 2012. Such bars were not observed in pre-2012 imagery but it should be noted that the photo record becomes sparser before 2012. The water depth appeared to be between 1 and 1.5m for much of the reach between dams 1 and 2. The water surface elevation difference between the downstream and upstream sides is no more than 50mm. The pool created by dam 1 was observed to hold several dozen juvenile trout and salmon. The water upstream of dam 1 was significantly less turbid than water observed in other parts of Somenos Creek that day, e.g., at the Lakes Road foot bridge, at Tzouhalem Road, and upstream of dam 2.

The Second Beaver dam is approximately 100m upstream of the confluence of Somenos Creek and the Cowichan River. Dam 2 is much more robust and is entirely constructed from sticks between 0.5 and 1m long, Figure 4. Dam 2 is constructed in a small ravine in which the creek channel narrows to a width of about 5m. The water surface elevation difference between downstream and upstream sides of dam 2 was estimated to be 500mm. Water was seen to be running over a spillway on the eastern side of dam 2.

An interesting observation was that dam 2 appears to be functioning as a barrier to the downstream movement of Parrot's Feather. Significant patches of Parrot's Feather were observed upstream of dam 2. We also observed fragments of Parrot's Feather accreting on the upstream side of dam 2.

In order to observe potential upstream effects of the Beaver dams we made observations of water movement and water quality at the Lakes Road foot bridge. Upstream flow, i.e., backwatering, was seen on Somenos Creek between 28 May 2018 and 11 June 2018. These observations appear to be supported by measurements made by municipal staff on 25 May, 2018 and 01 June, 2018 in which the gauge at Lakes Road showed higher water levels, than the Somenos Lake gauge.

The apparent movement of water from Somenos Creek into Somenos Lake is also supported by observations recorded by the Somenos Lake Salmon Habitat monitoring program. On 29 May 2018 the lake gauge at the BC Forest Discovery Centre Trestle showed 4.8m. On 05 June 2018 the gauge was recorded to be at 4.96m. Therefore, over the intervening week the lake level had increased by approximately 160mm. Given the estimated lake surface area of about 100 ha, this increase represents $160,000\text{m}^3$, 160 million litres. Measurements of the lake gauge by municipal staff on 01 June 2018 (4.98m) and 08 June, 2018 (5.06m) suggest continued backwatering by Somenos Creek of a similar magnitude.

Water Quality Measurements in Somenos Creek at the Lakes Road foot bridge between 28 May and 11 June, 2018 show that throughout the backwatering period dissolved oxygen levels were 4mg/l or lower and that pH was consistently lower than 6.6 and often as low as 6.4. These observations are very different from surface water quality measurements made in Somenos Lake on 29 May, 05 June and 12 June, 2018 when both dissolved oxygen and pH were much higher.

Discussion

The water elevation difference estimated for dam 2, ~500mm, is similar to differences of water level observations between Lakes Road and the mouth of Somenos Creek on 01, 04 and 08 June, 2018, 590mm, observed by municipal staff. However, we observed water moving downstream over the beaver dams and upstream at the Lakes Road foot bridge. If the only effect of the Beaver Dam was simply stopping water flow we would not expect to see the lake level rising. Although water does enter Somenos Lake from its three tributary streams, Richards, Bings and Averill Creeks, this discharge is not sufficient to explain the observed rise in lake level.

An informal estimation of discharge in Somenos Creek at the foot bridge suggests that $17,000\text{m}^3$ per day was flowing into the lake, about $120,000\text{m}^3$ over the course of 7 days. This was calculated from an observed surface flow of 0.02m/s and a creek cross section of 5m wide and 2m depth, i.e., $0.2\text{m}^3/\text{s}$. Other obvious water input to the lake can be estimated from discharge estimates for Bings Creek from Environment Canada. During the end of May Bings Creek discharge was about $0.064\text{m}^3/\text{s}$. Given that Richards and Averill Creek together have a similar discharge to Bings Creek (NHC 2005), I estimate that in total $0.2 + 2*(0.064) = 0.328\text{m}^3/\text{s}$ was

moving into Somenos Lake during this period. Over a period of 7 days this represents 198,000m³. This is approximately 38,000 m³ larger than estimated lake level rise estimated between 29 May and 05 June, 2018 (160,000m³) but does not account for loss due to evaporation. The Penman evaporation model (Linacre 1977) uses mean temperature (16.6°C), mean dew point (16.6°C), elevation (6m), and latitude (48.8°N) to estimate evaporation. During the 7 day example period I estimate that 22,000 m³ evaporated from the lake.

Therefore the total estimated input minus evaporation is 178,000m³ versus the estimate about 160,000 m³ based on observations of lake level. Given the likely measurement error in discharge and evaporation models these numbers suggest that backflow water from the Cowichan River, moving via Somenos Creek was the primary mechanism causing the observed rise in Somenos Lake level contributing about 75% of all surface water to the lake.

One reason that Beaver dams have been of some concern on Somenos Creek is their potential interference with drainage. However, our observations show that the beaver dams were allowing water to flow freely at a magnitude similar to an undammed state. Furthermore, the constant back watering and its relative magnitude compared to other surface water sources for Somenos Lake, suggests that water is entering the system at some point between dam 2 and the Lakes Road foot bridge. The two most obvious candidate sources for this water input are the pond at the Cowichan Sportsplex and groundwater from the higher land to the east which holds Quamichan Lake. Observations of the creek connecting the Sportsplex pond to Somenos Creek suggest that the quantity water moving out of the pond is completely insufficient to explain the backwatering. The most likely explanation is therefore groundwater moving into Somenos Creek from surrounding lands with the higher elevation land to the east providing an obvious source.

Ecological effects which may be associated with the Beaver dams include restricting fish passage and the spread of Parrot's Feather. Fish passage is unlikely to be affected in any meaningful way because juvenile trout and salmon have either already moved to the sea in their second year or selected summer habitat to wait out the dry season in their first year of life (Burns 1999 and Preikshot 2016). Indeed, the only viable habitat for trout and salmon appears to be the 100m run observed between the first and second dam. Much of the remainder of Somenos Creek has poor habitat for salmon and trout as a result of slow moving water exacerbated by invasive Parrot's Feather. Oxygen levels in Somenos Creek have been consistently measured as well below minimum standards established by the BC Ministry of the Environment (2015).

Because one method of Parrot's Feather spread is colonisation by fragments it may be unwise to remove the Beaver Dams as these appear to be preventing the downstream movement of Parrot's Feather fragments, see Figure 4. If Parrot's Feather were to move into the lower Cowichan River it is not difficult to imagine it being spread to back channels and side channels there and compromising salmon and trout habitat in the main stem. During periods of low discharge between July and September there could be a real threat of Parrot's Feather in the lower Cowichan River being spread upstream by adhering to aquatic birds, and mammals like Beavers and Muskrats.

Secondly, it has been observed that Parrot's Feather grows most aggressively in stream environments that dry significantly (Kelly and Maguire 2009). Therefore, to the degree to which the beaver dams help to keep water levels slightly higher in the summer, they may serve to slow the growth of Parrot's Feather in patches already established in Somenos Creek.

In our estimation, while the Beaver dams have slowed the normal spring/summer decline of Somenos Lake surface elevation this slowing is also likely caused by a large input of ground water. Given the state of the Somenos Creek ecosystem before dam construction, there is no evidence that the consequent modification of the hydrological regime has degraded aquatic habitat in the lake or the creek. It is more likely that the dams are actually serving to marginally improve certain portions of the creek as fish habitat and may actually be serving to help prevent the spread of Parrot's Feather to other parts of the Lower Cowichan River.

References

- Burns, T. 1999. The Somenos-Quamichan basin: watershed atlas and fish production plan. Fisheries and Oceans Canada: 36 p.
- Kelly, J., and C.M. Maguire. 2009. Parrots Feather (*Myriophyllum aquaticum*) Invasive Species Action Plan. Prepared for NIEA and NPWS as part of Invasive Species Ireland: 12 p.
- Linacre, E. T., 1977. A simple formula for estimating evaporation rates in various climates, using temperature data alone. Agric. Meteorol. 18: 409-424.
- Ministry of Environment. 2015. British Columbia Approved Water Quality Guidelines Summary Report. British Columbia Ministry of Environment, Victoria: 36 p.
- Northwest Hydraulic Consultants Inc. 2005. Somenos Lake Hydraulic Model. Northwest Hydraulic Consultants Inc., North Vancouver: 65 p.
- Preikshot, D. 2016. Somenos Basin Coho Salmon Summer Habitat Assessment (Year 2). Somenos Marsh Wildlife Society, Duncan, BC: 20 p.

Figures

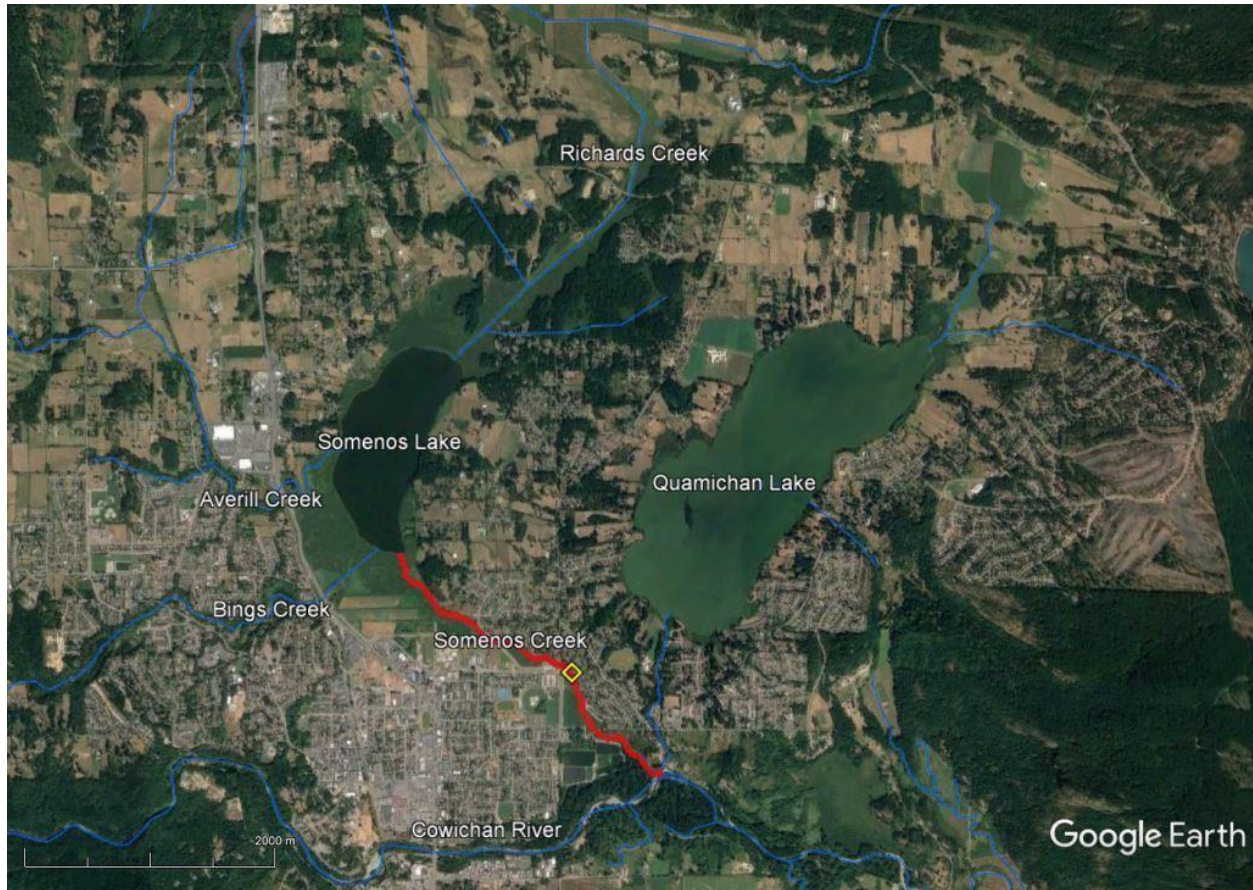


Figure 1: Somenos Creek, red line, with connected lakes and streams in the lower Cowichan River area. The Lakes Road foot bridge is marked by the yellow diamond.



Figure 2: Lower Somenos Creek at the confluence with the Cowichan River.



Figure 3: Photograph of Beaver Dam 1 near the confluence of Somenos Creek and the Cowichan River. Water can be seen flowing over the spillway at the eastern portion of the dam towards the bottom left of the picture. The Cowichan River can be seen at the upper left corner.



Figure 4: Photograph of Beaver Dam 2 100m above the confluence of Somenos Creek and the Cowichan River. Water is flowing over the unseen spillway at the eastern shore of the creek. A mat of Parrot's Feather can be seen accumulating as the light green material on the upstream side of the dam near its center.