HABITAT CONSERVATION TRUST FOUNDATION

PROJECT REPORT

1. **PROJECT NAME**: ECVI Water Storage Feasibility (Year 2 of 4)

2. **HCTF PROJECT FILE #:** 1-430

3. **FISCAL YEAR:** April 2009 to March 2010, Year 2 of 4.

4. **LOCATION:** East Coast Vancouver Island

5. **PROJECT EXECUTIVE SUMMARY**:

In the face of climate change in the Pacific Northwest resulting in longer and more severe droughts in southern BC watersheds, stream rearing trout and salmon stocks are likely to experience reduced productivity due to declines in habitat quantity and quality. Impact mechanisms include changes in growth rates, thermal mortality, oxygen stress, changes in prey density and changes in interspecific and intraspecific competition (Nelitz et al. 2007).

To address this issue, BC Conservation Foundation working with Ministry of Environment (MoE) continued feasibility assessments of potential stream flow improvement projects in east coast Vancouver Island (ECVI) watersheds in partnership with DFO, First Nations (FNs), local governments, Ducks Unlimited Canada and community stewards. Projects since 2006 have included structural modifications or operational refinements to existing storage sites as well as new designs at locations where potential biological benefits are high, impacts are low, implementation is determined to be cost effective, and sufficient partner funding exists. In addition to modeling expected fish production benefits, activities undertaken by BCCF and sub-contracted experts included environmental impact assessments (plants, fish, amphibians, birds, as required), extensive stakeholder consultation, hydrologic studies, conceptual and design engineering, and licensing.

Focusing on mainstems and sub-basins between Victoria and Port Hardy, flow improvements are designed to increase wild production of trout and salmon by providing elevated seasonal base flows and maintaining and/or increasing the area and quality of summer rearing habitat. Target species are mainly stream rearing salmonids including steelhead and cutthroat trout and coho salmon. Flow improvements may also benefit summer and early fall migrants such as adult summer run steelhead, pink salmon and Chinook salmon. Without investments to improve base flows, stocks will be less able to cope with stochastic population declines or support traditional sport fisheries and may need additional protection or more costly mitigation to ensure conservation levels are met.

During 2009/10, this project's objective was to bring at least two of seven high priority candidate sites to the implementation phase, and advance several others closer to completion stages. Storage feasibility was essentially completed at Keogh Lake and at Upper Quinsam/Wokas Lakes, though implementation of only the former will likely proceed in 2010. BC Hydro's prioritized project list for fiscal 2010/11 does not include implementation of negative storage development at Upper Quinam/Wokas Lakes in the Quinsam watershed. At a third site on Charters River in the Sooke River watershed, background

agreements with the Capital Regional District, T'Sou-ke FN and local ENGO were completed and fund-raising for implementation phases in 2010 commenced.

6.0 SITE SPECIFIC ACTIVITIES AND RESULTS (SOUTH TO NORTH; FIGURE 1)

6.1 Sooke River – Charters River

Working with DFO, T'Sou-ke FN, the Juan de Fuca Salmon Restoration Society and the Capital Regional District (CRD), BCCF focused in the fall of 2009 on improving base flows in Charters River, a significant tributary to Sooke River. Stakeholder meetings were organized to further the initiative of tapping into the new CRD domestic water supply line from Sooke Reservoir (pre-treatment), adjacent to lower Charters River. In exchange, the CRD would reduce their mandated release to Sooke River from Sooke Reservoir and Deception Gulch, a reduction that DFO states would be unmeasurable and insignificant to Sooke mainstem habitats. Increased summer water flows in Charters will support side channel construction on the lower river (preliminary design work completed; target build 2011) as well as a salmonid educational/interpretive centre (construction planned in 2010). For the water supply component, fund-raising for the implementation phase (planned for 2010) commenced. The majority of required resources were in place as of this writing (HCTF $19K; PSF $15K; DFO $5K, LR-GB/VI $10K), and the balance is likely to be covered by private sector donations and CRD.

6.2 Craigflower Creek – Thetis Lake

The potential for improving summer rearing conditions for salmonids in Craigflower Creek near Victoria was brought to BCCF's attention by MoE small lakes biologist T. Andrews in 2007. Thetis Lake supplies Craigflower Creek, a small, flow challenged but productive cutthroat and coho stream that drains into the Victoria area's Gorge Waterway. An opportunity exists to work with CRD Parks Department staff to re-establish beneficial water releases from Thetis Lake dam (in Thetis Lake Regional Park), a primary source of water to Craigflower Creek. Among specific directions in the CRD's regional parks management plan (CRD 2004) was a proposal to continue to work with MoE in releasing water from Thetis Lake to enhance conditions for salmon and trout in Craigflower Creek.

BCCF staff met on several occasions with CRD Parks staff in summer 2009. As the summer progressed, environmental conditions became extreme and the province experienced a severe drought, breaking many records on east coast Vancouver Island. BCCF co-ordinated communications between CRD Parks management and MoE's Water Stewardship Division (WSD), resulting in an emergency release of water from Thetis Lake in September to help improve fish habitat conditions in Craigflower. This action tested the valve infrastructure at Thetis Lake outlet (verifying it was operable) and served as a small trial of the CRD's ability to make changes and progress towards its stated goals.

Building on this success and at the request of CRD Parks management in November 2009, BCCF developed a **proposal** for a larger scale, trial water release in summer 2010 (Craig 2009). Submitted in February 2010, the proposal has the support of both fisheries agencies, the Songhees First Nation and Esquimalt Anglers' Association (EAA). Because CRD is the water license holder and the purpose of the storage is currently for "land improvement" (i.e., not conservation), CRD must be satisfied that releases will 1) sufficiently benefit the larger Craigflower Creek ecosystem, and 2) not overly impact Thetis Lake shoreline ecosystems or aesthetics. Accordingly and on CRD's behalf, BCCF sought and received confirmation from WSD and Fisheries and Oceans Canada that the water release will be conducted on a trial basis, with no obligation to continue releases in future years should park impacts identified in 2010 be considered excessive.

To provide evidence that water releases are indeed improving stream conditions in Craigflower, BCCF commenced re-establishing a hydrometric station on lower creek. This initiative is in partnership with

EAA which advocates for stream health and runs the lower river fish fence in the fall. A water level sensor was purchased, to be matched with SCADA equipment the association had already acquired. BCCF will assist EAA to develop a stage/discharge curve in 2010 to support a proper hydrographic record. Through a separate storm water initiative of the CRD, there is good potential for the District to take over the flow station in the future.

Figure 1. Existing and potential water storage sites, east coast Vancouver Island

6.3 Garnett Creek – Agricultural Storage Re-allocation

No work occurred on the Garnett Creek site in 2009/10 (see 2008/09 annual report for background).

6.4 Plantation Creek – Plantation Wetland

No work occurred on the Plantation Creek site in 2009/10 (see 2008/09 annual report for background).

6.5 Richards Creek – Crofton Lake

In 2009, a second year of flow augmentation occurred in Richards Creek, a tributary of Somenos Creek and Cowichan River. One of several completed project sites developed in part with HCTF storage feasibility funding, Richards Creek is supplied by Crofton Lake, previously a water supply for Town of Crofton operated by the District of North Cowichan (DNC). In spring 2008, Crofton Lake dam infrastructure was upgraded to enable the desired release to Richards Creek.

DFO reports that monitoring in 2009 of DNC's releases showed that habitat conditions were again much improved over those documented pre-augmentation, and established release strategies appeared acceptable to all stakeholders despite the drought conditions that occurred in 2009.

6.6 Chemainus River – Holyoak Lake

No work occurred on the Chemainus River/Holyoak Lake site in 2009/10. This site continues to be embroiled by legal issues between the Halalt First Nation and the District of North Cowichan (see 2008/09 annual report for background).

6.7 Millstone River – Westwood Lake

Similar to the Richards Creek/Crofton Lake project, Westwood Lake in the Millstone watershed (Nanaimo) is another completed project site developed in part with HCTF storage feasibility funding. The first full season of releases occurred in 2009, and monitoring showed that Millstone River and the Bowen Park bypass channel maintained connectivity despite a history of drying between riffles and the extreme drought conditions (6.8 litres/sec on August 24, 2009 downstream of Bowen Park Falls) experienced on BC's south coast in 2009.

In the final implementation phase at Westwood Lake in 2009, BCCF partnered with City of Nanaimo, DFO, the Snuneymuxw FN and area streamkeepers to license and construct a 15 cm weir at the outlet (a separately funded HCTF project; Powley 2009). This weir is now operational and, assuming DFO's request for a water license modification is accepted, will enable the first season-long release to occur in 2010.

6.8 Millstone River – Brannen Lake

At 108 ha, Brannen Lake is the largest lake in the Millstone River watershed, 1.7 times the size of nearby Westwood Lake. Prior to 2007, Brannen Lake and its tributaries were inaccessible to anadromous fish, as was the portion of the Millstone River from Brannen Lake downstream to the falls in Nanaimo's Bowen Park. The culmination of several years of studies and assessments, a bypass channel was constructed in 2007 at Bowen Park to enable returning cutthroat, steelhead and coho salmon to migrate upstream and populate the watershed's upper reaches.

Brannen Lake, with its size and location in the Millstone's headwaters, is greatly suited to store additional water for targeted release to the Millstone and its new bypass channel. Between summer low and winter high, natural lake level fluctuation is approximately 2 m, and the lowest 15% of that amount (30 cm of storage) would retain 325,000 m^3 of water, potentially allowing up to 40 L/s to be added to summer base flows over a 90 day period. This addition would result in a doubling of August mean monthly flows in the Millstone.

Work in 2009/10 included lake level monitoring, further concept development with land owners and the fisheries agencies, public consultation, biological assessments, and detailed engineering surveys of the lake outlet channel. This work built on activities in 2008/09 (background and baseline data gathering, preliminary stakeholder consultations, and planning for baseline engineering surveys).

Stakeholders now have two years of accurate lake level data to discuss with shoreline property owners and consider with respect to storage structure design options. Shorelines have been photo-documented. All landowners and downstream water license holders have been contacted (telephoned and/or in writing). Given that project support has been varied, the design team has given preference to solutions that combine top and bottom storage to achieve the project's goal and address the majority of lake community's concerns.

BCCF contracted E. Wind Consulting to assess potential impacts of small scale storage on flora and non-fish fauna at Brannen Lake. The report predicted no significant impacts to amphibians, birds, plants or small mammals from proposed storage (Wind 2009). An aquatic macrophyte specialist, Dr. Patrick Warrington, was also contracted to examine the lake and predict effects of storage on the lake's aquatic plant communities (Warrington 2009).

BCCF coordinated DFO staff and an engineering consultant to complete surveys of the lake outlet and channel downstream to enable modeling flood flows and their effects on shorelines and lake levels. These surveys confirmed that storage options being considered as part of this project will have no effect on lake flood levels, as the outlet and stream channel configuration overwhelmingly control water levels during moderate and high flow events (a low head weir would effectively be drowned out and have no effect).

6.9 South Englishman River – Shelton Lake

Shelton Lake is located in the headwaters of the South Englishman River, the Englishman River's largest tributary. Essentially a wilderness lake, it has a small camping area accessed by rough logging roads maintained by TimberWest Forest Corp (landowner). The lake supports a small fishery for rainbow trout which were stocked until 2006. MoE found a "high density stunted RB population" during assessments in that year and subsequently discontinued stocking (Andrews 2007).

At 38 ha, Shelton is the largest lake in the sub-basin and has potential to deliver to downstream reaches an additional ~50 L/s for 90 days for each metre of storage developed. Natural lake level fluctuation has been preliminarily estimated at 1.5 m.

Storage feasibility work commenced in 2008. Work in 2009/10 included:

- documenting stream profile by mesohabitat type through the anadromous length of the South Englishman River;
- assessing juvenile standing stocks in anadromous reaches of the South Englishman River (electrofishing);
- continued lake level and outflow monitoring (Shelton/Healy lakes);
- surveying stream habitat/assessing juvenile stock presence/abundance between Shelton and Healy lakes;
- using an engineering consultant to finalize the hydrograph for the South Englishman sub-basin;
- developing a topographic survey of Shelton Lake outlet geo-referenced to digital aerial images;
- gathering Healy Lake temperature/dissolved oxygen data for expert opinion on flow-through effects from proposed Shelton Lake storage upstream; and,
- continuing stakeholder consultation.

Crews synoptically surveyed the entire anadromous length of the South Englishman to identify composition by mesohabitat type (riffle/glide/pool). This information will be used with previously collected width and suitability data to predict habitat gains relative to flow augmentation.

Steelhead and coho standing stock densities were evaluated on September 22, 2009 at three sites in the lower half of the South Englishman's 4.5 km of anadromous stream length. Steelhead fry densities ranged from 4.9 to 24.7 FPU (fry per 100 m^2), compared to 11 to 32 FPU in September 2008. Steelhead fry biomass averaged 16% of predicted (range: 3 to 35%) based on fry densities unadjusted for site depth/velocity characteristics and using alkalinity models developed by Ptolemy (1993). Up significantly, observed coho fry densities ranged from 41 to 136 FPU in sampled habitats, compared to 10 to 39 FPU in the same sites sampled in 2008. Across the three sites, unadjusted observed coho FPU averaged 81% of predicted using the Ptolemy biomass model. Mean weight of coho fry sampled was small (1.68 g; n=158) compared to steelhead fry (2.4 g; n=30) from the same sites, suggesting that habitat

was limiting (competition for food resources was high) and/or overseeded for coho. Standing stock coho densities suggest South Englishman rearing habitats were close to fully seeded in 2009, while juvenile steelhead densities suggest spring 2009 escapement continued to be poor. Mean condition factors for fry (1.09 for steelhead; 1.07 for coho) were less than those observed during 2008 assessments (1.12 for steelhead; 1.13 for coho).

Crews continued to collect Shelton Lake level data to assist in developing potential storage regimes and timing. Instruments were downloaded regularly, most recently in April 2010 (Figure 2). These and other data subsequently allowed KWL Associates to complete the engineering feasibility for storage at Shelton Lake (July 2010).

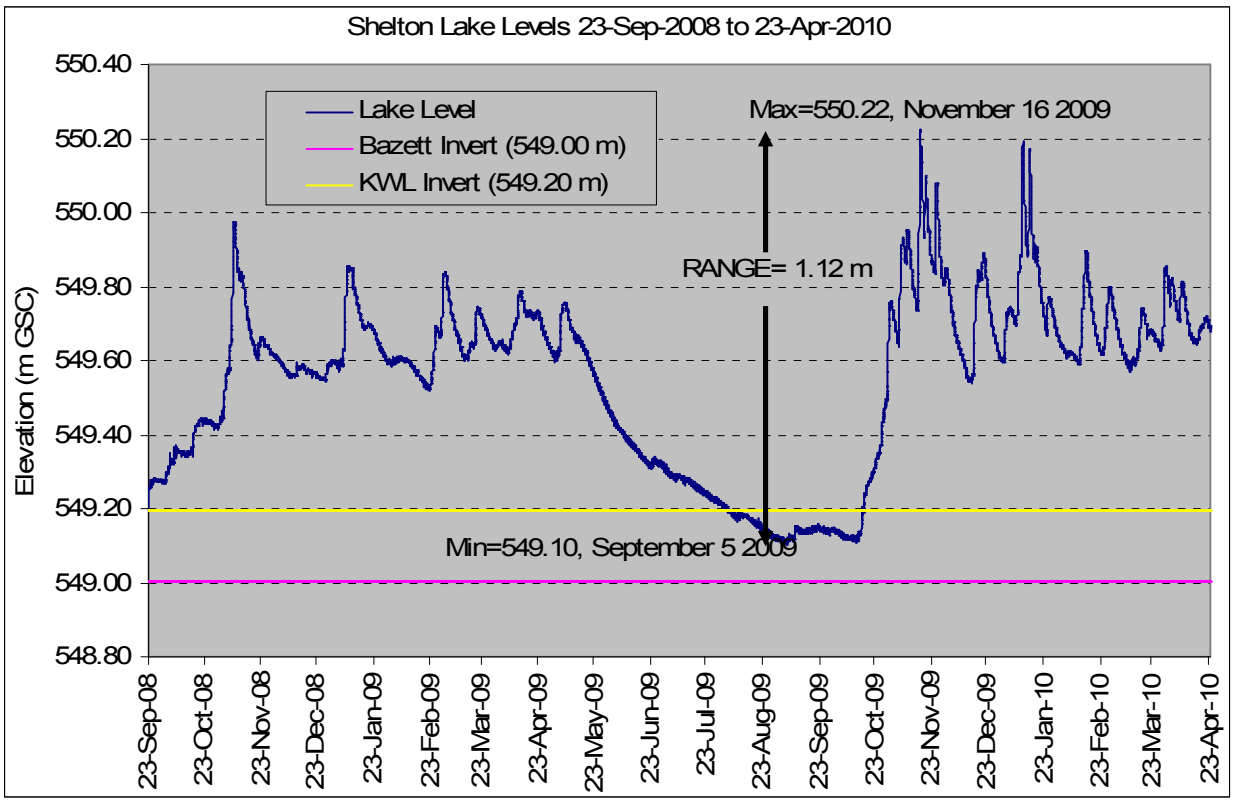


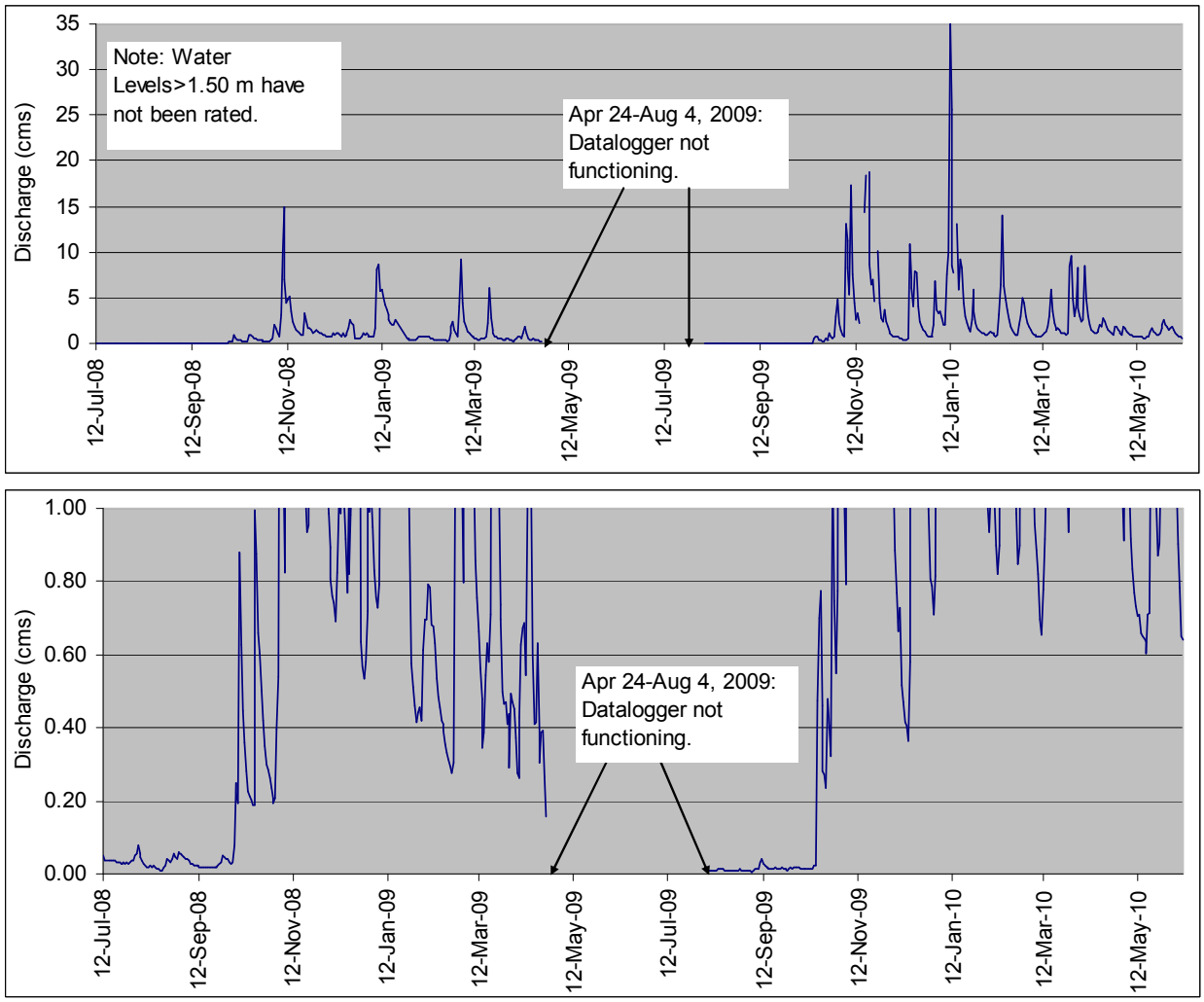
Figure 2. Shelton Lake level data, September 23, 2008 to April 23, 2010.

On May 14, 2009, the 800 m long stream draining Shelton Lake, unofficially known as Shelton Creek, was walked to its confluence with South Englishman River proper, and the latter was then walked (~300 m) to Healy Lake. Flowing at 162 litres/second, Shelton Creek had a well-defined, single thread channel with pool/riffle morphology for the first 300 m. It then braided and flowed north through low gradient, semi-open, marsh-like channels for 500 m before entering the South Englishman River. From that point, a defined channel with abundant LWD cover flowed northeast to Healy Lake. Habitat quality appeared high for fish, though deep pools were infrequent suggesting limited over-summering habitat during seasonal low flows. Small trout (15-25 cm in length) noted periodically throughout the channel may have been in spawning or post-spawning condition. Discharge in South Englishman River 300 m downstream of Healy Lake was subsequently measured at 659 litres/second, indicating that, during spring timeframes, the Shelton Lake drainage supplies approximately ¼ of the South Englishman's flow to that point in the upper sub-basin.

In contrast, surveys on September 21, 2009 found that surface flows had receded to zero, and that 85-90% of upper Shelton Creek had dried. Only small isolated pools remained, supporting small numbers of trout

fry and parr[1]. Surface flow in the South Englishman River 300 m downstream of Healy Lake was visually estimated at 5-6 litres/second. As 2009 was a very dry summer (several low flow records set on southeast Vancouver Island), stream habitat conditions were likely as poor as they get in the South Englishman sub-basin.

In the lower South Englishman River, the semi-permanent hydrometric station installed in 2008 was maintained and regularly downloaded. Instrument malfunction resulted in a loss of data between April 24 and August 4, 2009. KWL Associates used BCCF's regularly collected stream flow measurements, a stream channel morphology survey in the area of the station, and station data to construct a full hydrograph for the sub-basin (Figures 3a and b).



Figures 3a and b. South Englishman mean daily flows, July 12, 2008 to June 9, 2010. Hydrographs were developed using KWL Associates stage/discharge relationships built on daily logger data, multiple stream flow measurements to 3 m^3/sec, and stream channel-modeled flows from 3 to 35 m^3/sec. Figure 3b shows discharges to a maximum of 1.0 m^3/sec to better display low flows during summer periods.

Bazett Land Surveying Inc. was contracted to perform a field survey and related office calculations to prepare a topographic site plan of Shelton Lake outlet, including georeferenced digital imaging (Bazett

[1] Ranging in size from 35 to 74 mm, 13 trout fry (likely rainbow) were captured from four residual pools with a combined wetted area of 20.5 m^2. Maximum pool depths ranged from 8 to 25 cm. One parr-sized fish was observed but not captured.

2009; Figure 4). These products allowed KWL Associates Ltd. and their sub-contractor, Trow Associates Inc., to prepare technical memorandums on Shelton Lake storage feasibility, design and rationale (June 2010).

Figures 4a and b. Topographic site plan and aerial photo of Shelton Lake outlet used as the basis for conceptual dam design/drawings.

Adding to existing environmental impact assessments by E. Wind and Associates (2008), BCCF monitored Healy Lake dissolved oxygen and temperature profiles and consulted limnologists Dr. K. Ashley (BCIT) and Dr. T. Johnson (MoE) with respect to potential effects on lake productivity of increased flow-through in Healy Lake during the potential release period. The general consensus was that potential impacts were difficult to confidently forecast, possibly offset by nutrient loading from Shelton, and, from the sub-basin productivity perspective, likely outweighed by the benefits of additional flow in South Englishman.

Consultation continued with updates to the local watershed roundtable (Englishman River Watershed Recovery Plan steering committee), MoE and DFO. Nanoose FN fisheries staff have participated in field work in the South Englishman. Consultation has also been stepped up with Arrowsmith Water Service, a domestic water supply partnership of the Regional District of Nanaimo, the City of Parksville and the Town of Qualicum Beach.

In summer 2009, BCCF arranged local newspaper media coverage that focused attention on the low flows in the South Englishman (page A7, PQB News, August 25, 2009) and how they adversely affect fish production.

6.10 French Creek – Hamilton Marsh

Feasibility to establish 30 cm of storage on Hamilton Marsh in the French Creek watershed continued in 2009/10, lead by DFO staff working with Friends of French Creek and other local streamkeepers. Progress continues to be slowed somewhat due to ongoing discussions since 2007 about conservation/purchase of the marsh and surrounding forest between landowner Island Timberlands (ITLP) and various ENGOs interested in protection/enhancement. ITLP indicated it conceptually supports small scale storage on Hamilton Marsh, but required further information on design and associated forest land base impacts for it to further commit to the project.

Accordingly, BCCF supported DFO engineering staff to conduct a storage feasibility investigation. Issued in February 2010, the report (Powley 2010) included conceptual designs and plans (Figure 5) and concluded storage was technically feasible, but:

- the amount of storage was somewhat limited;
- the full supply level could only be effectively raised 0.3 m above the level currently impounded by beaver dams; and,
- it appeared that almost all of the water stored in the marsh is currently allocated for irrigation.

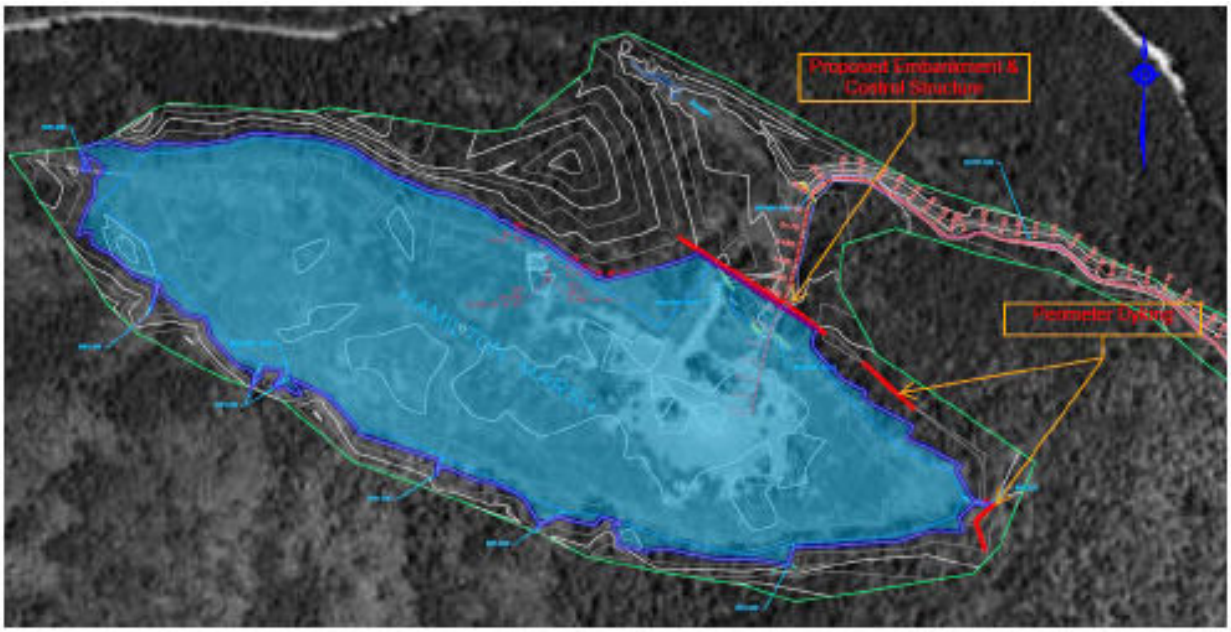


Figure 5. Plan view of conceptual storage infrastructure at Hamilton Marsh, French Creek (from DFO feasibility report).

Preliminary information suggests flow augmentation would be limited to 10 litres/sec, possibly higher if suspected (and unquantifiable) groundwater influences materialize. Without considering costs related to land acquisition or compensation, additional storage would cost approximately $230,000.

Further geotechnical and hydrogeological investigations were recommended to help determine impacts of potential residential development in the marsh's vicinity and land productivity losses related to increased groundwater levels. Lastly, as the landowner has yet to determine its longer term plans, it was recommended that further investigation of storage development be postponed until landuse is determined and use of/need for the existing irrigation license is better clarified.

6.11 Tsolum River – Wolf Lake

Several sites with potential to augment summer base flows exist in the Tsolum watershed. Wolf Lake, with its existing storage infrastructure and licensee (DFO), continues to offer a more immediate opportunity to improve flows to Headquarters Creek and the lower Tsolum River through facility improvements and modifying management practices to reflect current (and changing) priorities. Several undeveloped headwater lakes also offer potential to improve flows in the upper Tsolum, above the reaches currently augmented by Wolf Lake storage (Gooding 2007). The Tsolum River Restoration Society (TRRS) continues to lead most of the rehabilitation efforts in the watershed.

In 2009 through the Tsolum Augmentation Committee (TRRS, DFO, MoE, Comox Band, BCCF, TimberWest and local hydrology experts), recognition of the value of Wolf Lake storage increased, though additional operational/management improvements can still be achieved. Under contract to BCCF,

Gooding (2009) showed that while 6 ha of shoal area de-watered when Wolf Lake levels were drawn down 1.8 m (the maximum advocated by MoE in the mid 1990s), an additional 2, 3 and 6 ha of shoal area were exposed at 2.1, 2.4 and 2.7 m of drawdown, respectively. Committee members need to consider these values and agree on acceptable drawdowns or, if required, initiate a trial use of storage below 1.8 m of drawdown to answer any outstanding concerns over possible lake shoreline/shoal impacts.

Funded separately, Tsolum biophysical studies conducted in 2009 (Gooding 2010, Campbell 2010) assisted TRRS in developing a new multi-year strategic plan. Pending confirmation that recent ARD mine site remediation has been effective, both the studies and the resulting strategic plan support water storage as a key part of efforts to improve watershed health. BCCF will continue to urge stakeholders to support improved flow and agricultural withdrawal monitoring, as well as storage development at both new and existing sites in the Tsolum. In particular, modifications to the existing Wolf Lake storage rule curve will be sought to better support the requirements of stream-rearing salmonids (mainly steelhead, cutthroat and coho) in the month of July[2].

6.12 Black Creek – Sayer Creek

No work occurred in the Black Creek watershed in 2009/10 (see 2008/09 annual report for background).

6.13 Quinsam River – Upper Quinsam and Wokas Lakes

This project examined the feasibility around developing access to negative storage in Upper Quinsam and Wokas lakes, reservoirs operated under license by BC Hydro in the Campbell River watershed. The overall project goal (assuming feasibility was completed, and implementation occurred) was to ensure that, in the face of increasingly frequent droughts related to climate change, sufficient water remained available to meet new (higher) minimum fisheries flows proposed for the Quinsam River.

Documentation of potential environmental impacts stemming from additional drawdown (below current norms) in the lakes occurred in 2007 and 2008, and data analysis and reporting was completed in 2009 (Craig and Kehler 2009). In April 2010 and with significant Sustaining Capital Expenditures forecast for 2010[3], BC Hydro made the decision not to proceed with project implementation in summer 2010. Providing fish agency support persists for the project, BCCF will continue to encourage BCH to implement the project.

6.14 Cluxewe River – Skidder Lakes

Minimal flow data exist for the Cluxewe River near Port McNeill, Vancouver Island. To better characterize streamflow (and thus possible habitat limitations) in this important north Island steelhead, coho and pink producer, BCCF assisted DFO in 2009 in establishing a semi-permanent hydrometric station on the lower river. Kwakiutl First Nation fisheries staff remain very active in the watershed, and assisted with flow monitoring for the station. The goal remains building a case for storage augmentation, possibly at the river's headwater lakes, the Skidder Lakes chain. During preliminary examinations in 2007 and 2008, the limited range of this chain's natural water level fluctuations combined with their relatively small size inferred that the amount of storage able to be developed without significant environmental or forest land base impacts may be inadequate to justify implementation and future operational costs. By

[2] To date, DFO has managed Wolf Lake storage mainly to benefit returning pink salmon, releasing water only in August to encourage migration out of the water-rich Puntledge, into the Tsolum. However, base flows can become critical in mid and late July, shrinking mainstem habitats considerably and likely impacting growth rates (and therefore survivals) of stream rearing juveniles.

[3] Expenditures in 2010 are forecast at $1.635 billion (http://www.bcbudget.gov.bc.ca/2010/sp/pdf/agency/bchpa.pdf)

defining the river's flow limitations, the watershed roundtable will be better able to consider the potential cost/benefits of flow augmentation.

6.15 Keogh River - Keogh and O'Connor Lakes

Storage feasibility work continued on the Keogh River in 2009/10, the third year of such activities in the watershed (see 2008/09 annual report for background). This work was supported by the local restoration roundtable that currently focuses on the neighboring Cluxewe River. Roundtable representation includes Western Forest Products (WFP; area forest tenure holder), Kwakiutl FN, DFO, MoE, Nature Trust, Regional District of Mount Waddington, Northern Vancouver Island Salmonid Enhancement Society (NVISEA), Orca Sand and Gravel, and provincially contracted fisheries consultants operating the Keogh enumeration fence and weir. Feasibility work this fiscal focused on four major project components:

- finalizing pre-construction requirements for Keogh Lake weir maintenance;
- undertaking a mainstem flow/habitat study;
- environmental impact assessments at Keogh Lake and O'Connor lakes;
- monitoring stream temperature and lake levels; and,
- establishing/calibrating a semi-permanent hydrometric station.

Final plans for Keogh Lake weir maintenance were reviewed in spring 2009 by MoE Lakes and DFO Habitat Protection staff and submitted to MoE's Water Stewardship Division for approval. Funded in part by a separate HCTF grant, the maintenance phase was successfully implemented in August 2009 (Johnson 2010).

In May 2009 with provincial stream flow specialist R. Ptolemy (MoE, Victoria), a habitat study was conceptualized and established in the field. Study objectives were to determine relationships between stream flows and mesohabitat quantity/quality with the goal of predicting habitat gains that might arise with specific levels of flow augmentation. Determined by access and reach locations, crews identified five mainstem riffle habitat sites for study, spaced from 1.8 to 24.6 km upstream of the mouth (Keogh Lake: 31.8 km upstream). Using velocity meters, cameras and standardized procedures, sites conditions were repeatedly documented as the river reached four low levels over the summer: 14.9% 6.8%, 2.2%, 0.7% of mean annual discharge (MAD[4]; Figure 6).

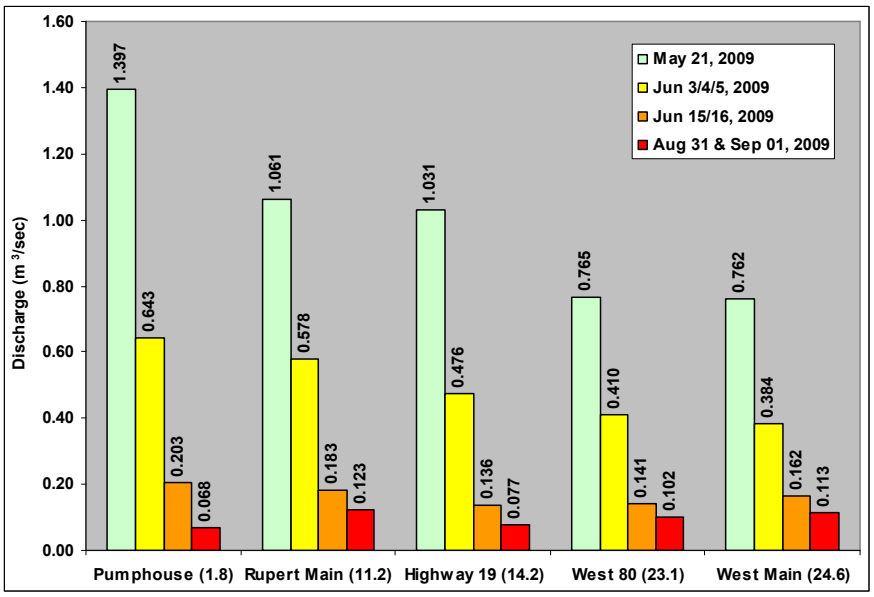


Figure 6. Keogh River discharges during which riffle habitat sites were studied, summer 2009. Flows at the Pumphouse site, 1.8 km upstream of the mouth, effectively represent the entire drainage, and were equal to 14.9%, 6.8%, 2.2% and 0.7% of MAD (assuming MAD=9.4 m^3/s).

[4] For the purpose of the study, MAD was assumed to be 9.4 m^3/s based on an estimate provided by R. Ptolemy in March 2009.

These data, and the corresponding set of riffle habitat transect data collected at the four stream flows, allow analysis of how changes in flow affect:

- mean wetted widths at riffle habitats (i.e., quantity); and,
- suitability of riffle habitats (i.e., quality; uses Habitat Suitability Index curves developed for BC Hydro's water use planning process; converted to equivalent riffle area 100% suitable for aquatic insects or various fish species by age class).

Results are preliminary but indicate that, for steelhead parr, average suitability at riffles experiencing flows of 6.8%MAD are 129% greater than that with flows of 0.7%MAD (Figure 7). Preferring relatively swift water habitats, steelhead parr are likely the species/age class most impacted by critically low flows. Further analysis and data reviews are required, and, in consultation with MoE Fisheries staff in Victoria and UBC, additional habitat data may be collected in summer 2010 to augment existing data sets.

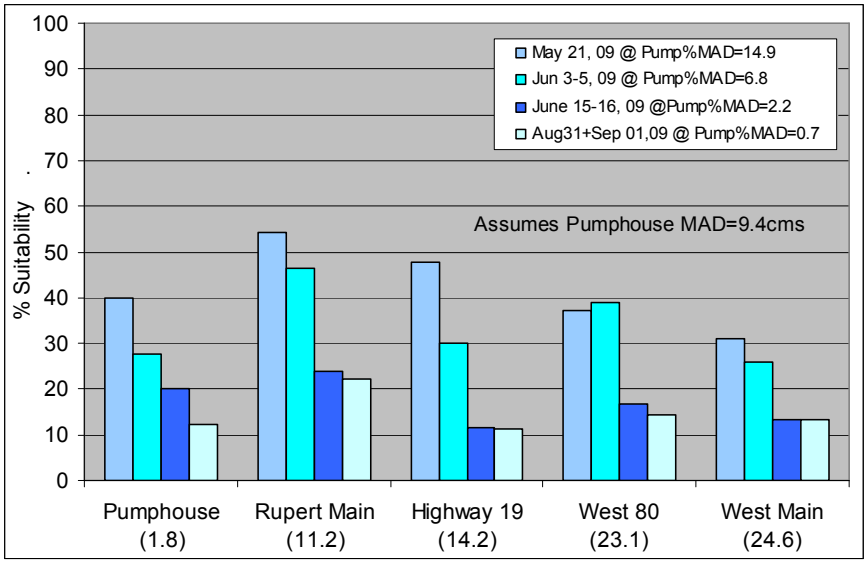


Figure 7. Riffle habitat suitability for Keogh River steelhead parr at a range of low summer flows.

Environmental assessments to determine potential impacts of additional storage on lake-resident fish (Keogh Lake) and non-fish species (Keogh and O'Connor lakes) were undertaken in 2009.

- On Keogh Lake, BCCF conducted shoreline and tributary surveys in response to concerns over the potential for kokanee spawning grounds to be affected as a result of lake elevation changes. Results showed that 1990s-installed lake outlet spawning gravel was sized for coho and steelhead adults and thus largely unsuitable for stream-spawning kokanee. Other factors (competition, lack of clean crevice habitat for shore-spawners) further reduced suitability of the outlet for kokanee. Few shore-spawning habitats were documented around the lake; a gravel fan on the lake's second largest tributary just east of the campground may be a key location and could support a small population. Because storage periods will see only minor changes and end (practically and legally) on September 30, the availability of shore-spawning habitat for kokanee that most likely spawn in November (P. Law, Biologist, MoE, Nanaimo, pers. comm.) is mainly dictated by the rate at which fall rains naturally recharge lake levels.

- E. Wind and Associates (Nanaimo) were contracted to identify potential impacts on plants, amphibians, birds and small mammals. No listed plant species were documented at Keogh Lake, though one blue-listed plant community (CWHvml-03 Western hemlock-Western redcedar/salal) was identified. Higher lake levels resulting from 15 cm of new top storage would occur in the spring and are expected to cause minor shifts in some shoreline vegetation/communities (Wind et al. 2009). Though the blue-listed Red-legged Frog and other non-listed amphibians were documented, the increase will likely not have any long term, negative impacts on amphibian species breeding at Keogh Lake (Wind et al. 2009). Impacts on birds and bird habitat are predicted to be negligible (Wind et al.

2009). Though no evidence of red-listed Vancouver Island water shrews being present at Keogh Lake was found, existing habitats are suitable. Storage-related shoreline changes may impact the habitat of this species, but the project will retain unchanged all of the best habitats for the shrew: the outlet creek, the large wetland at the lake's west end, and the input creeks (Wind et al. 2009).

- E. Wind and Associates also examined O'Connor Lake for potential impacts of 0.5 to1.5 m of proposed top storage. Results of a Conservation Data Centre search did not indicate any rare or threatened plants or vegetation communities, nor were any identified during on site surveys. A blue-listed forest community, CWHvm1-09 Sitka spruce/salmonberry Very Wet Maritime, was noted. A decrease in wetland community size and diversity was predicted for the generally narrow fringe of wetland vegetation around the lake. Depending on water depths, a seasonal increase in marsh or shallow-water habitats may occur in the western most wetland area. Some habitat components classified as bog may be threatened or lost depending on the length of the hydroperiod (Wind et al. 2009). Rising water levels may have negative effects on Western Toads unless habitat shifts upland. Impacts on birds are expected to be minor. Impacts on Vancouver Island water shrew habitat are possible but mitigation options do exist.

To better understand Keogh mainstem temperature regimes and how they might be affected by proposed storage scenarios, BCCF installed tidbit temperature loggers at key locations to augment other loggers previously installed by provincial contractor Instream Fisheries Research (North Vancouver). Of particular concern is the potential in summer to reduce or lose a suspected cooling effect that O'Connor Creek, which enters the Keogh between West Main and West 80 logging roads, may have on Keogh mainstem temperatures. Preliminary results confirm that warm water leaving each lake is significantly cooled by flowing through downstream riparian corridors (Figure 8).

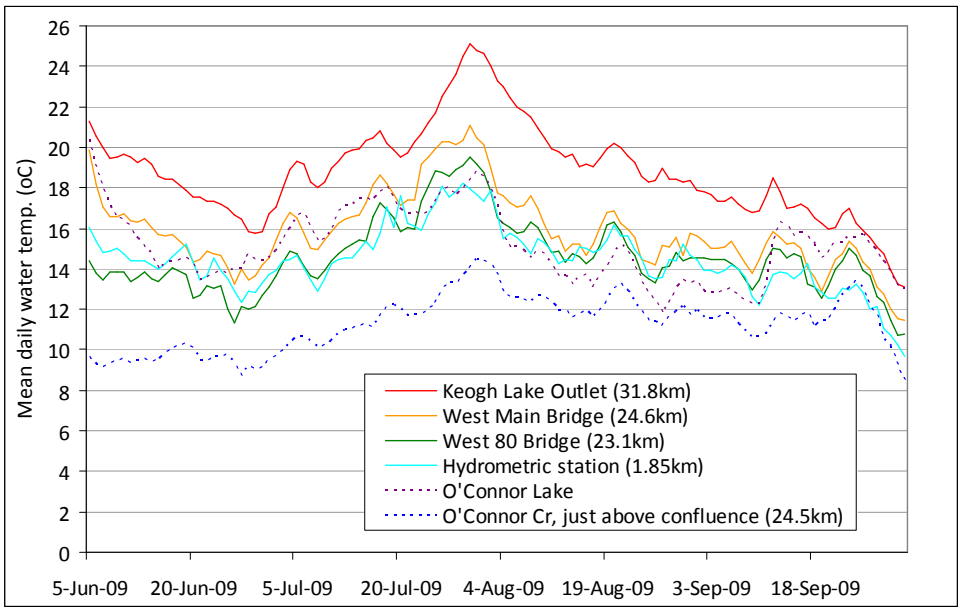


Figure 8. Keogh River water shed water temperatures, June 5 to September 30, 2009. O'Connor Creek flow contributions to Keogh mainstem were 50 L/sec on July 8, declining to 1.1 L/sec on September 1.

Stream flow observations confirm that O'Connor Creek receives substantial ground water and/or tributary inputs as it flows from the lake 750 m to its confluence with Keogh River. The creek likely does have a cooling effect on the Keogh mainstem, but the influence of intact riparian corridors may be more significant. Additionally, whatever cooling effect flow from O'Connor Creek may have on the Keogh mainstem during early summer is virtually lost as the season progresses and discharge from the sub-basin drops to seasonal lows (e.g., measured at 1.1 litres/second on September 1, 2009).

Lake level monitoring commenced at Keogh and O'Connor Lakes. Leveloggers (Solinst model 3001) programmed to read once per hour and record temperatures were installed in vented steel tubes in protected shoreline locations and benchmarked at each lake. A barologger was installed at Keogh Lake to corrected for atmospheric pressure. Dataloggers were downloaded regularly and data will be used to identify/justify proposed storage parameters which are typically within the range of the lake's natural fluctuation between summer lows and winter highs. Lake level fluctuation between summer 2009 and winter 2010 was approximately 0.75 m at O'Connor Lake (Figure 9), while that documented at Keogh Lake was 1.26 m.

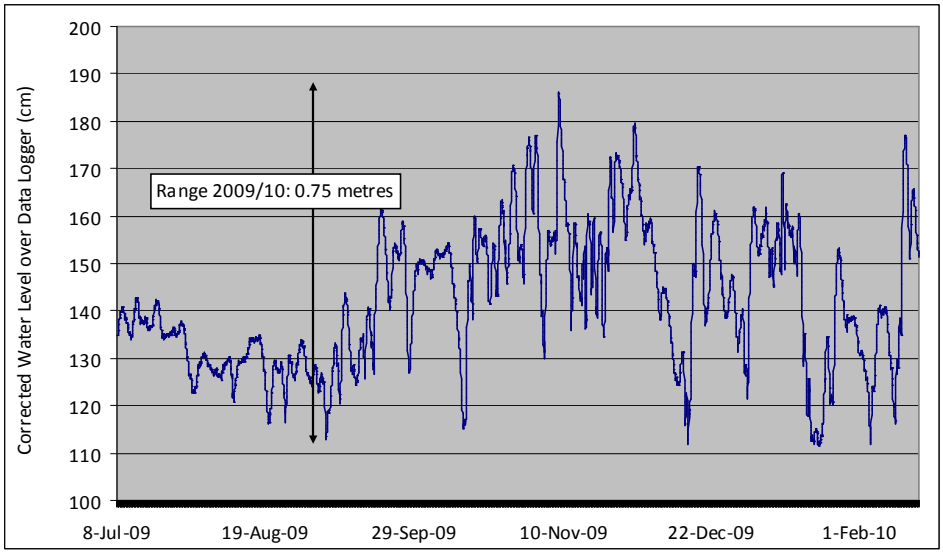


Figure 9. Lake levels documented at O'Connor Lake in the Keogh River watershed, July 8, 2009 to February 18, 2010.

In consultation with provincial contractors responsible for fence operation and MoE flow specialists, a semi-permanent hydrometric station (Solinst model 3001, logging hourly) was installed and benchmarked on lower Keogh River in June 2009. The station was attached to a large tree trunk located on right (south) bank, 261 m upstream of the concrete resistivity fence associated with the Keogh River research station. The location afforded protection for the datalogger, proximity to the river mouth (gauges whole watershed), and was far enough upstream of potential research station activities that may affect water levels (i.e., smolt fences, wolf trap operations, etc.). A staff gauge was also installed near the resistivity sill to provide a secondary (and back up) indicator of stage height to Keogh fence and BCCF staff. The station was regularly downloaded and checked for elevation. To develop a stage/discharge curve, stream flow measurements occurred throughout the summer and fall with assistance of the fence contractor and/or Kwakiutl FN fisheries staff.

To establish the relationship between stage and discharge at moderate and flood flows, Ecofish Research Ltd. (Courtenay) was contracted to measure flood flows from the Highway 19 bridge crossing in November 2009. Lastly, Northwest Hydraulic Consultants (Nanaimo) were contracted to survey the stream channel in the vicinity of the station and develop a hydraulic model to predict discharge at moderate and high flows (Arnold 2010). A final curve for the station for the 2009/10 season will be produced and modified as required to accurately reflect changes in station channel morphology.

6.16 Quatse River – Quatse Lake

In 2009/10, consultation occurred between BCCF and DFO with respect to updating the operations plan for storage at Quatse Lake to account for all species. Due to the presence of a small sockeye run in the Quatse, DFO committed to developing an appropriate periodicity table to frame discussions around, and further work is required to confirm critical flow levels in Quatse River.

7.0 Measures of Results

As a feasibility project, most of the direct benefits have yet to be realized – habitat and fish production improvements will materialize as specific projects evolve to an implementation stage. However, stakeholders and the public have, through consultations and media coverage, become more aware of the increasing value of water to local communities and aquatic ecosystems in general. For example, the Parksville/Qualicum News published a story on the South Englishman River (page A7, August 25, 2009; Figure 10), how the 2009 drought was affecting fish production and how projects such as this were improving conditions for wild fish.

www.pqbnews.com THE NEWS, Tuesday, August 25, 2009 • A7

South Englishman River is dangerously dry

By FRED DAVIES
News Reporter

Water flows in the main stem of the Englishman River are holding their own in comparison to other Island rivers — but the important salmon bearing stream's largest tributary is closer to a ditch.

That according to James Craig, a project manager with the BC Conservation Foundation, recently engaged in flow measurements in the South Englishman River — a waterway that does not benefit from water storage supplied by the Mount Arrowsmith reservoir.

"The mighty South Englishman River has been reduced to a mere ditch," said Craig. "Low water flows impact salmon and Steelhead reproduction by reducing habitat capacity, can stress or kill adult and young fish through increased summer water temperatures, interrupt the passage of adult and juvenile fish to spawning and rearing areas and limit food resources."

Abnormally dry conditions have precipitated water flows well below what's considered optimal to sustain the fisheries resource for spawning and rearing.

Flow monitoring has been occurring across east Vancouver Island in areas considered particularly susceptible to drought, part of BCCF's Living Rivers Georgia Basin/Vancouver Island program in association with the province's Living Water Smart initiative.

The results thus far have not been encouraging.

In the South Englishman, near the bottom of the 83 square kilometre sub-basin, BCCF has been operating a hydrometric station. Total discharge was measured at 18 litres per second in July, or 0.65 per cent of mean annual discharge.

"That's a far cry from what most experts suggest is an adequate base flow of 20 per cent MAD," said Craig, noting water temperatures ranged from 19.8 to 23 degrees C., further compromising fisheries habitat.

"I suspect the numbers indicate an all time record low flow," he continued and added study shows there's a dearth of the insects that salmonids feed on as well.

"There is competition as the wetland area shrinks and there are fewer food resources. That means each fish does not grow to the full extent they might.

"They need reserves of fat to hold them over through the winter. Large smolts survive at much higher rates."

Craig said the foundation is engaged in feasibility work towards development of small scale water storage to alleviate the problem.

The Englishman River watershed supports all five species of anadromous salmon as well as resident rainbow and cutthroat trout. In 2000, the province designated the Englishman as a sensitive stream under the Fish Protection Act. Young coastal cutthroat trout spend up to three years rearing in coastal rivers.

Some gauged Island rivers are near their low flow record for the date of Aug. 10 and are near 20 to 30 year return period low flows.

These include: Tofino Creek, Harris Creek near Lake Cowichan and Oyster River near Campbell River.

The Nanaimo River and Englishman River have higher flows relative to others and are near two to four year return period low flows.

reporter@pqbnews.com

Submitted Photo

Recent flow measurements in a tributary of the Englishman River indicate abnormally dry conditions are having a negative impact on fish habitat.

Figure 10. Newspaper article explaining drought scenario, effects on fish, and storage feasibility work to improve rearing conditions.

As projects near the "blue print" stage, benefits such as increased rearing area and habitat quality parameters are better quantified. Using suitability index curves specific to cutthroat, coho, rainbow and aquatic insects developed by the province and BC Hydro in water use planning, flow studies confirm the level of improvement to habitat quality. With increased wild fish production, many wildlife species (bear, mink, otter, fish-eating birds, etc.) will also benefit from higher escapements (fish biomass). A specific example is Keogh River, where feasibility was largely completed for additional storage on Keogh Lake, and modifications are scheduled in 2010 as soon as the additional water license is granted.

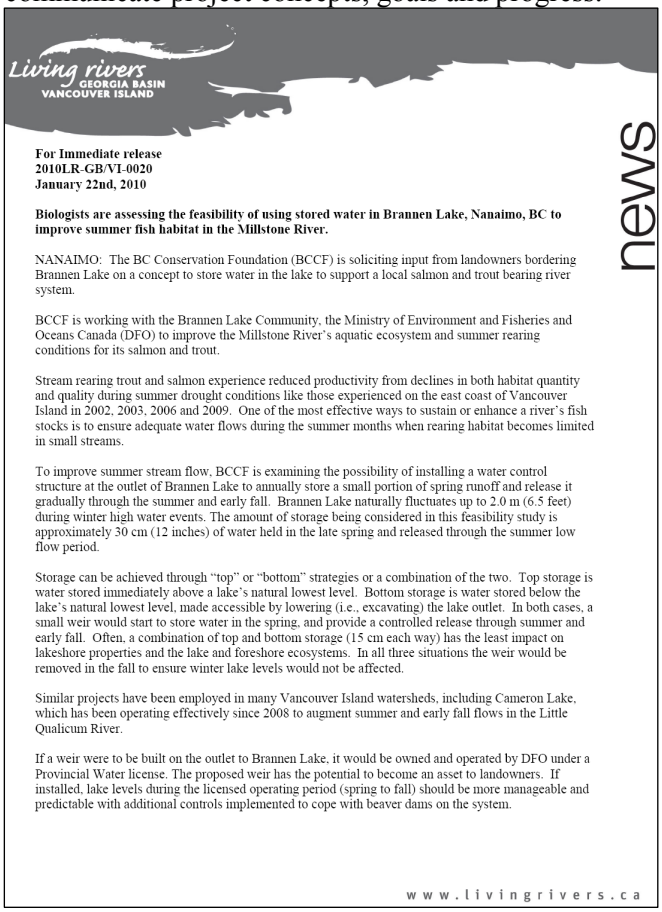
BCCF continues to work with local governments that hold water licenses and own/operate dams/weirs typically for domestic water supply purposes, and these relationships are a key indicator of project success. The goal is to ensure fish flows are maintained and/or improved through new storage or best use older facilities as they are replaced. When summer stream flow is improved through storage re-allocation or release timing adjusted to achieve fish habitat improvements, the municipality will typically continue to operate the facility and assume liability, a tremendous advantage to this project.

Risk directly related to this feasibility project is minimal. If institutional barriers arise unexpectedly, or public support is not forthcoming, project benefits may be reduced and investments to date seen as less

effective. However, project screening developed in year one and reviewed by MoE, DFO and DU Canada helps minimize this risk.

7.0 EXTENSION/PUBLIC INFORMATION/PARTICIPATION/PARTNERS

BCCF's website was used to circulate study information concerning storage feasibility. Specifically, several reports were made available for stakeholders on Brannen Lake (Millstone watershed, Nanaimo). This followed phone calls, letters to shoreline property owners and press releases (Figure 11) to communicate project concepts, goals and progress.



Living rivers
GEORGIA BASIN
VANCOUVER ISLAND

news

For Immediate release
2010LR-GB/VI-0020
January 22nd, 2010

Biologists are assessing the feasibility of using stored water in Brannen Lake, Nanaimo, BC to improve summer fish habitat in the Millstone River.

NANAIMO: The BC Conservation Foundation (BCCF) is soliciting input from landowners bordering Brannen Lake on a concept to store water in the lake to support a local salmon and trout bearing river system.

BCCF is working with the Brannen Lake Community, the Ministry of Environment and Fisheries and Oceans Canada (DFO) to improve the Millstone River's aquatic ecosystem and summer rearing conditions for its salmon and trout.

Stream rearing trout and salmon experience reduced productivity from declines in both habitat quantity and quality during summer drought conditions like those experienced on the east coast of Vancouver Island in 2002, 2003, 2006 and 2009. One of the most effective ways to sustain or enhance a river's fish stocks is to ensure adequate water flows during the summer months when rearing habitat becomes limited in small streams.

To improve summer stream flow, BCCF is examining the possibility of installing a water control structure at the outlet of Brannen Lake to annually store a small portion of spring runoff and release it gradually through the summer and early fall. Brannen Lake naturally fluctuates up to 2.0 m (6.5 feet) during winter high water events. The amount of storage being considered in this feasibility study is approximately 30 cm (12 inches) of water held in the late spring and released through the summer low flow period.

Storage can be achieved through "top" or "bottom" strategies or a combination of the two. Top storage is water stored immediately above a lake's natural lowest level. Bottom storage is water stored below the lake's natural lowest level, made accessible by lowering (i.e., excavating) the lake outlet. In both cases, a small weir would start to store water in the spring, and provide a controlled release through summer and early fall. Often, a combination of top and bottom storage (15 cm each way) has the least impact on lakeshore properties and the lake and foreshore ecosystems. In all three situations the weir would be removed in the fall to ensure winter lake levels would not be affected.

Similar projects have been employed in many Vancouver Island watersheds, including Cameron Lake, which has been operating effectively since 2008 to augment summer and early fall flows in the Little Qualicum River.

If a weir were to be built on the outlet to Brannen Lake, it would be owned and operated by DFO under a Provincial Water license. The proposed weir has the potential to become an asset to landowners. If installed, lake levels during the licensed operating period (spring to fall) should be more manageable and predictable with additional controls implemented to cope with beaver dams on the system.

www.livingrivers.ca

Figure 11. Example of media advisory for Brannen Lake storage feasibility work, circulated to local VI media outlets.

HCTF also created an opportunity to discuss storage feasibility amongst other habitat improvement practitioners when they hosted a workshop in Kelowna in March 2010. Our progress and results were well received, as were ideas and practices from other BC regions.

Public reaction to these projects is generally supportive, with occasional exceptions from landowners whose shoreline properties may potentially be affected. A large component of the work is assembling the required information to educate stakeholders on the various proposals and their impacts, and working through incorrect assumptions.

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8.0 PHOTOGRAPHIC RECORD

Sooke/Charters: November 2009 view of the old CRD domestic water pipeline that has been recently replaced. Over the past few decades, leakage from this pipeline provided the majority of base flows to Charters River during the summer. Feasibility continues to establish a permanent release to the river from the new pipeline.

Craigflower/Thetis: Discussing Craigflower Creek flows and potential hydrometric station locations with local streamkeeper, January 2010.

NANAIMO NEWS BULLETIN

Brannen Lake water storage studied

By Chris Bush - Nanaimo News Bulletin

Published: January 27, 2010 3:00 PM
Updated: January 27, 2010 3:34 PM

0 Comments

One of the best ways to keep a stream producing fish is to make sure it never dries out.

The B.C. Conservation Foundation is studying ways to store more water in Brannen Lake – headwaters of the Millstone River – that could be released during late summer and early fall to support salmon and trout rearing habitat.

The foundation is asking for input from lakeshore property owners about the project and working with both the provincial Ministry of Environment and federal Department of Fisheries and Oceans as part of its feasibility study.

"The project will increase the capacity for raising more juveniles – coho, steelhead, cutthroat – and it also has the possibility to help migration flows in the fall," said Michelle Kehler, the foundation's biologist for the project.

Similar projects already operate in other Island watersheds, including at Cameron Lake, which supplies water to the Little Qualicum River.

"The Millstone River traditionally in summer gets down to about 10 litres per second," Kehler said. "So picture two four-litre milk jugs of water flowing down every second. It's not a lot of water in a river that has the capacity to support up to 30,000 coho."

Biologist Michelle Kehler is looking for input from lakeshore property owners around Brannen Lake about increasing the lake's water storage, which could raise water levels.

CHRIS BUSH/The News Bulletin

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- Meeting told weir doesn't hold back water in winter
- Skating showcase at lake arena on Sunday

Text

Brannen Lake's water level naturally fluctuates by two metres annually. The additional water stored has the potential to raise the lake surface by 30 centimetres.

The trick lies in adding the water without raising the lake much.

Methods include building a water control structure at the lake's outlet into the Millstone River – known as top storage. The other method is to create bottom storage by dredging to make the lake deeper near its outlet.

Usually both methods are combined.

Kehler said she needs to determine what impact changing water levels could have on bordering properties, including farms with low-lying land.

There are also potential impacts on fish, birds and small mammals dependent on the lakeshore environment.

"In any one of these projects, which we've done up and down the Island, the benefits have to outweigh the potential impacts, otherwise we just wouldn't go ahead," Kehler said.

A beaver could already be providing an excellent model.

Neighbours around the lake told Kehler about the beaver. She started documenting its work in 2008 and discovered its dam holds back about 30 centimetres of water.

"He's essentially creating the very conditions that we hope to replicate, but of course, we'd have more control," she said. "In essence, we're looking to see whether or not there would actually be a perceivable difference to anybody on this lake if we do it or the beaver does it."

Funding for the project – $100,000 to $150,000 per year over the past four years to cover 12 feasibility studies on the Island – is provided by the Living Rivers – Georgia Basin/Vancouver Island, the Habitat Conservation Trust Foundation and the Pacific Salmon Commission.

Thus far, $30,000 was spent on the Brannen Lake feasiblity study.

Results of studies to date, including surveys of flora and fauna and lake level monitoring are available on the BCCF website at www.bccf.com/index.php/employee-downloads/cat_view/62-steelhead-documents.

For more information or to provide input into the project, please call Kehler at 250-716-8776 ext. 222 or James Craig, project manager, at 250-716-8776 ext. 223.

Millstone/Brannen: January 2010 press coverage of Brannen Lake storage feasibility work in the Millstone River watershed (Nanaimo). This article stems from a coordinated media release and preceded telephone and letter campaigns to inform lakeshore property owners of the storage weir being considered and gauge their opinions on the project. Landowners include a mix of residential, agricultural and institutional interests, often with differing preferences towards top storage, bottom storage or top/bottom combination options.

Though BCCF always acknowledges funders of feasibility work to reporters, there is little control over what editors choose to publish. In this case, support is properly recognized.

S. Englishman/Shelton: Measuring stream flows and rearing habitat conditions with Nanoose First Nation fisheries staff in the South Englishman River during the July 2009 drought. Total discharge was measured at 18 litres/second, or just 0.6% of mean annual discharge for this sub-basin (20%MAD is provincial ideal).

Keogh River: Data logger installed June 4, 2009 and used to record daily water levels on lower Keogh River; measuring the location for the gauging station housing.

7. FINANCIAL DETAILS

PROJECT FINANCIAL REPORT

Proponent / Project Leader: James Craig
HCTF Project #: 1-430 (e.g. 6-125)
Conditional Grant #: CAT10-1-430
(if applicable - e.g. CATXX-X-XXX)

HCTF Approved Budget Amount: $25,000

Project Name: ECVI Water Storage Feasibility

Reporting Period: 04/01/09 (mm/dd/yy) to 03/31/10 (mm/dd/yy)

Reporting Purpose:
☒ Annual Report
☐ Final Report

PART 1. FINANCIAL REPORTING (HCTF MONIES ONLY)

A. Labour Costs

i. Human Resources – Wages & Salaries

Position	# of Crew	# of Work Days	Rate/day	HCTF Amount
BCCF Fisheries Staff	3	8.79	350	9,230.29
Person Days (# of crew x work days)			**Subtotal i**	$9,230.29

ii. Subcontractors & Consultants (provide details in text)

Contractor	# of Crew	# of Work Days	Rate/day	HCTF Amount
Various consultants, biological assessments				3,297.56
Various consultants, engineering assessments				4,525.50
			Subtotal ii	$7,823.06
			A. Total Labour Costs	$17,053.35

B. Site / Project Costs

	Details	HCTF Amount
Travel	Accom, fuel, mileage, per diem	1,219.55
Small Tools & Equipment	Water level sensor	2,068.79
Site Supplies & Materials	Mat, supplies, courier	408.28
Equipment Rental	Velocity meter and survey instrument rental	389.06
Vehicle Rental (incl. Helicopters)	4 x 4 pickup truck w canopy	700.00
Work & Safety Supplies	Safety equip	58.72
Repairs & Maintenance		
Permits		
Technical Monitoring		
Other Site / Project Costs	Misc	320.03

GST	GST	245.31
	B. Total Site / Project Costs	$5,409.74

C. Overhead

Details		HCTF Amount
Office space, utilities, etc.		
Insurance		
Office supplies		
Telephone & long distance		
Photocopies & printing		
Administration fees (Details required)	~12.5%	2,536.10
Other overhead costs		
	C. Total Overhead Costs	$2,536.10

PART 2. SUMMARY OF EXPENDITURES FROM ALL FUNDING SOURCES (Please list all partnership funding for the project and identify the partner)

	HCTF Funding Amount (Use data from Part 1)	Other Funding				Total – (HCTF and Other)
		Source	In-kind	Cash	Sub-total Other Funding	
A. Labour Costs	17,053.35	Living Rivers-GB/VI		~95,000.00	95,000.00	112,053.35
		Various local govts	~8,000.00		8,000.00	8,000.00
		Various ENGOs	~1,000.00		1,000.00	1,000.00
		Kwakiutl FN	~1,000.00		1,000.00	1,000.00
		Town of QB		5,248.00	5,248.00	5,248.00
		MoE	~4,000.00		4,000.00	4,000.00
		DFO	~12,000.00		12,000.00	12,000.00
B. Project / Site Costs	5,409.74	Living Rivers-GB/VI		~45,550.38	45,550.38	50,960.12
C. Overhead Costs	2,536.10	Living Rivers-GB/VI		~20,078.63	20,078.63	22,614.73
Total Costs	$24,999.19		~26,000.00	165,877.01	191,877.01	$216,876.20

PART 3. EQUIPMENT PURCHASE SUMMARY

Equipment (list items >$1000 purchased and quantity)	Serial Number	Dollar Value	Location Stored	Contact
OTT Pressure Level Sensor, model PLS-L	259016	2,117.13	Craigflower Creek Station	James Craig

Certified that the project has been satisfactorily completed and all purchases and equipment over $1000 per item have been returned in satisfactory condition.

Project Proponent Signature | Date | Print Name

HCTF USE ONLY – Financial Report Accepted by:

Controller, Habitat Conservation Trust Foundation | Date