Brannen Lake Water Storage and Release Proposal

RESULTS OF A FIELD SURVEY AND DATA ANALYSIS OF ANY POTENTIAL EFFECTS THAT MIGHT RESULT FROM A WATER STORAGE PROPOSAL IN BRANNEN LAKE, NANAIMO, ON THE AQUATIC FLORA OF THE LAKE

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The work was carried out in the spring and summer of 2009; field observations on the lake took place on July 31, 2009.

The proposed storage options include up to 30 cm of top storage, up to 15 cm of bottom storage or a combination of the two amounting to a maximum of 30 cm total storage over the summer growing season for bottom withdrawal and release in the fall after the flowering and growing season of most aquatic plants is over. This is up to about 7% of the secchi depth and 10% of the natural seasonal water level fluctuation. It is also only about 50% of the nominal ability of the most sensitive shallow water emergent species to adapt to changing water levels; specie such as *Dulichium arundinaceum* (L.) Britt. and *Lobelia dortmanna* L. A lake level very close to this desired elevation is currently being maintained by a beaver dam and a more permanent structure to achieve this level of storage poses no significant change to the current conditions; it will likely be more stable than relying on a beaver dam.

The conclusion is that the proposed maintenance of the elevation of the summer water level will have no perceptible effect on the aquatic plants growing currently growing in Brannen Lake; natural variation is greater than this. The Milfoil has had a much greater effect on the species composition of the aquatic flora than the proposed water level changes and the natural beaver dam has already changed the water level by about the proposed amount so the plants are pre-adapted to the proposed water-level regime. The historically-present aquatic species that were most likely to be minimally affected, if affected at all, were no longer found in the lake.

The Milfoil is an introduced, non-native, species and has no natural controls in Brannen Lake; such controls will likely evolve or become introduced to the lake over time and the Milfoil will then become just another component of the aquatic flora of the lake and not the dominant and major component it is now. No human intervention is economical, practical or recommended and most such activities will only delay the eventual establishment of a new stable equilibrium condition.

Historical Data: Selected cumulative records up to 1985 from personal data base of Dr. Patrick Warrington.

Shoreline Length: 4,298 m
Shoreline Index: 1.2
Surface Area 1,086,581 m^2
% littoral (up to 6 m deep): 75% or 814,935 m^2
Total Volume: 125,521,056 m^3
Maximum Depth: 20 m
Mean Depth: 12 m
Annual Depth Fluctuation: 2.2 m
Secchi Depths: maximum-3.1 m, minimum-2.7 m, mean 2.9 m (3 spot records)
Surface Temperature: May-14.6, June-19.0, July-23.5, August-24.0 (a few spot records)

FULL CUMULATIVE HISTORICAL AQUATIC SPECIES LIST UP TO 1985

Ceratophyllum echinatum Gray
Chara sp. L.
Dulichium arundinaceum (L.) Britt.
Elodea canadensis Rich.
Equisetum fluviatile L.
Fontinalis antipyretica L.
Lemna minor L.
Lemna trisulca L.
Lobelia dortmanna L.
Megalodonta beckii Greene
Menyanthese trifoliate L.
Myriophyllum spicatum L.
Najas flexilis (Willd.) R. & S.
Nitella sp. (Agardh) Leonhard
Nuphar polysepalum Engelm.
Potamogeton amplifolius Tucker.
Potamogeton gramineus L.
Potamogeton natans L.
Potamogeton pusillus L.
Potamogeton robbinsii Oakes
Potentilla palustris (L.) Scop.
Ranunculus aquatilis L.
Ranunculus flammula L.
Scirpus lacustris L.
Scirpus subterminalis Torr.
Sparganium angustifolium Mich.
Utricularia vulgaris L.

Group 1: These species float freely on the surface and are not affected by water level fluctuations.
Lemna minor L.

Group 2: These species float freely within the water column or are found lying on or near the sediment surface and are not affected by water level fluctuations less than the secchi depth in the growing season.
Lemna trisulca L.

Group 3: These species are rooted in the sediment, do not grow very tall or emerge above the surface of the water. They are not affected by water level fluctuations less than the secchi depth in the growing season.
Ceratophyllum echinatum Gray
Chara sp. L.
Najas flexilis (Willd.) R. & S.
Nitella sp. (Agardh) Leonhard
Potamogeton robbinsii Oakes
Utricularia vulgaris L.

Group 4: These species are rooted or anchored in the sediment and do not emerge into the air but generally reach to just below the surface. They are not affected by water level fluctuations less than their capability of reaching the surface which is generally several meters.
Elodea canadensis Rich.
Megalodonta beckii Greene
Myriophyllum spicatum L.
Potamogeton pusillus L.
Ranunculus aquatilis L.

Group 5: These species are rooted or anchored in the sediment and emerge into the air; some have floating leaves on the surface. They are not affected by water level fluctuations less than their capability of reaching the surface which is generally several meters.
Equisetum fluviatile L.
Nuphar polysepalum Engelm.
Potamogeton amplifolius Tucker.
Potamogeton gramineus L.
Potamogeton natans L.
Scirpus lacustris L.
Scirpus subterminalis Torr.
Sparganium angustifolium Mich.

Group 6: These species are rooted in the sediment of shallow water and along lake margins and may be completely out of the water in the summer as water levels drop but will grow in shallow water as long as their flowers can be above water. Some are found on exposed sloping shorelines were there is seepage through the sediment to keep their roots wet or on hummocks in the shallows of the exit or inflow ends of a lake. They may migrate up or down the shoreline slope to find their optimum depth and can adapt to water level changes of about 30 cm or so from year-to-year. This is primarily the group of species that could potentially be affected by water level fluctuations that are too fast for them to adapt if the fluctuation was too wide or if the shoreline was not naturally extensive enough in depth range on a seasonal basis to allow them to find a new optimal zone.

Dulichium arundinaceum (L.) Britt.
Lobelia dortmanna L.
Menyanthese trifoliate L.
Potentilla palustris (L.) Scop.
Ranunculus flammula L.

FULL AQUATIC SPECIES LIST ON JULY 31, 2009

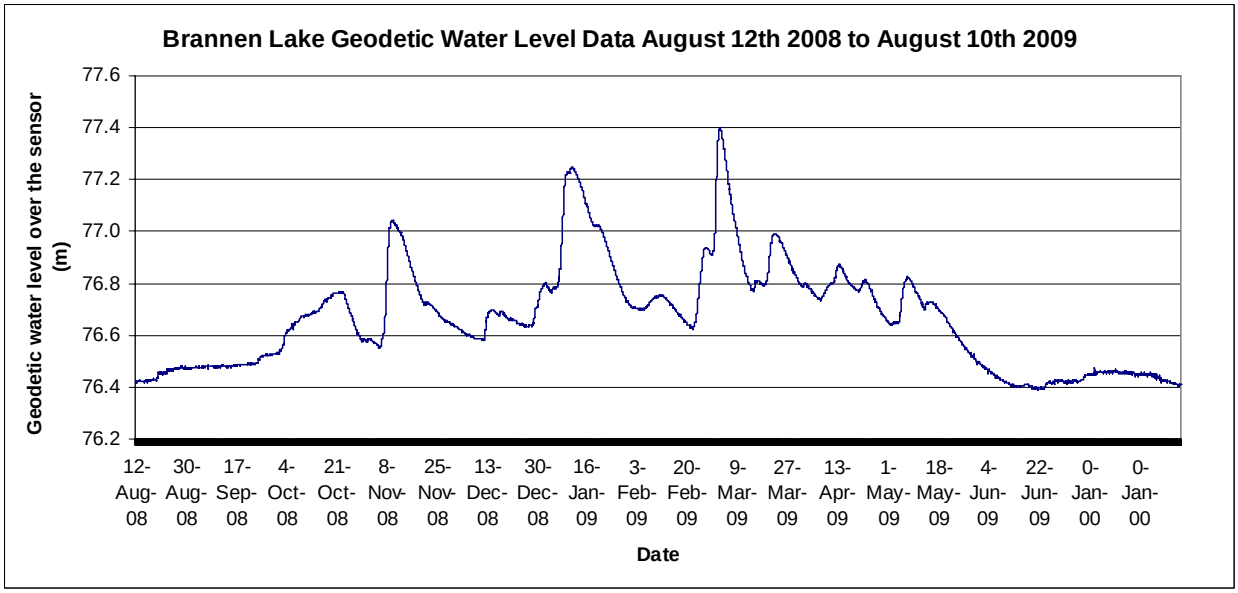
Eleocharis acicularis (L.) R. & S. (Group 5)
Elodea canadensis Rich.
Isoetes L. (Group 3)
Myriophyllum spicatum L.
Najas flexilis (Willd.) R. & S.
Nuphar polysepalum Engelm.
Potamogeton amplifolius Tucker.
Potamogeton gramineus L.
Potamogeton natans L.
Potamogeton pusillus L.
Potamogeton robbinsii Oakes
Scirpus lacustris L.
Typha latifolia L. (Group 5)

There has been a major change in the composition of the aquatic flora since the last previous records which included data up to 1985. The species in red are new additions to the aquatic flora not previously recorded. There is a band of *Scirpus lacustris* around much of the shallow marginal portion of the lake with some *Typha latifolia* behind it and up against the shoreline in some areas. In the shallow water zone on the littoral shelf there are extensive beds of *Myriophyllum spicatum* that were surfacing and flowering in most areas on July 31, 2009. On the bottom beneath most of the *Myriophyllum* is a fairly extensive cover of the fully-submerged *Potamogeton robbinsii*. Within these beds are scattered and isolated specimens of *Potamogeton natans*, *Potamogeton amplifolius*, *Potamogeton gramineus*, and *Elodea canadensis*. In a few areas, generally in shallower water than the *Myriophyllum*, there are fairly large beds of *Elodea*. In shallower water, shoreward of the *Myriophyllum*, there are areas with *Nuphar polysepalum*, *Najas flexilis*, *Potamogeton pusillus* and a little *Isoetes*. The number of species is considerably reduced, by more than one-half, from previous records; *Myriophyllum* has taken over and dominated most of the littoral zone. Groups 1, 2 and 6 are apparently absent or at least very rare and were not found on July 31, 2009. Most species in Groups 3, 4 and 5 were apparently absent or at least very rare and not found; those still present were scattered and infrequent. Human influences and impacts in this lake and its watershed are extensive and many have occurred since the previous species record cutoff date of 1985.

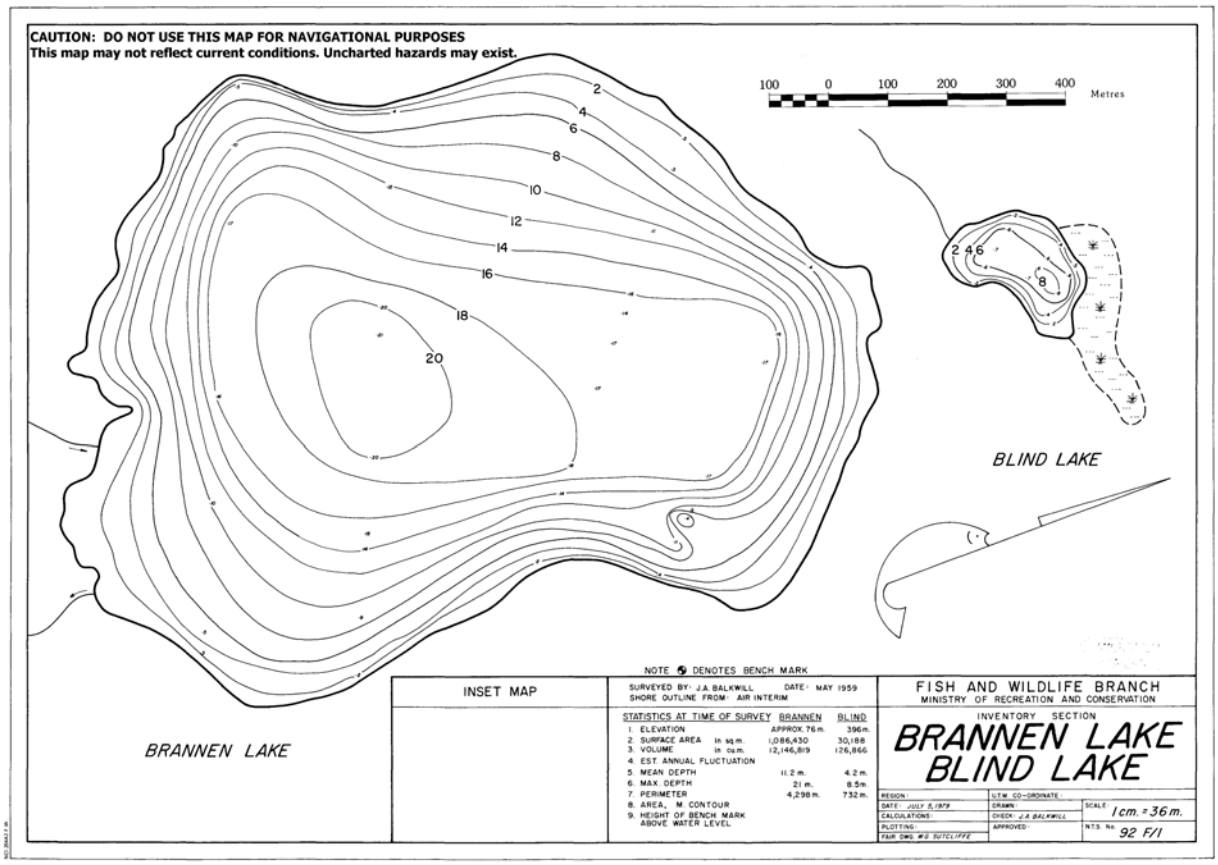
Historical Data: Provided by British Columbia Conservation Foundation.

There is virtually no inflow to or outflow from Brannen Lake in the July, August and September period of the year (see tables and graphs below) and thus little, if any, water available to exit the lake and provide flow in the river below for migrating fish in the late September and early October period when it is most required. The proposed storage is to provide such water at this critical time.

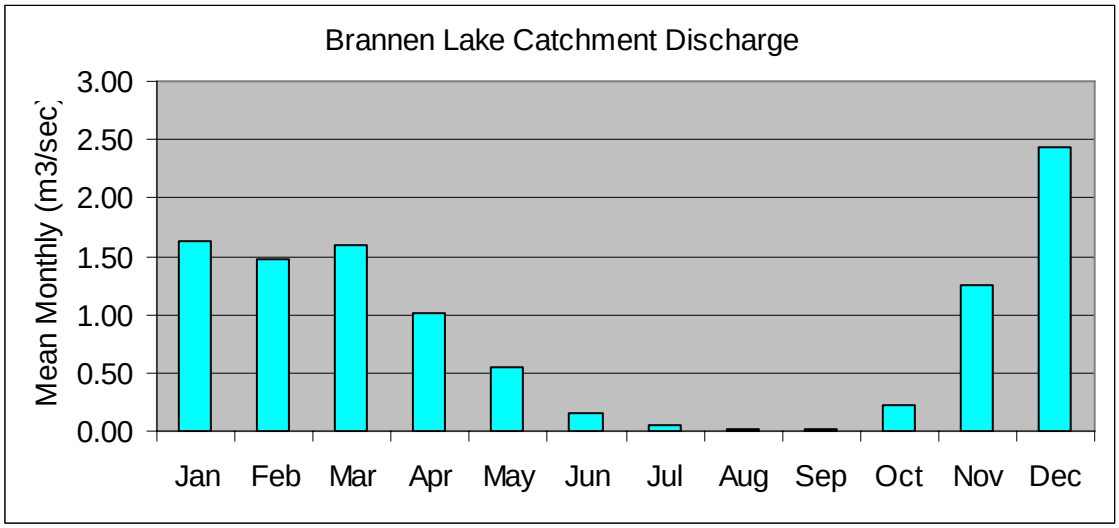
Brannen Lake Water Level Data



Bathymetric Map of Brannen Lake.



Brannen Lake Catchment Area Discharge Rates



Brannen Lake Turnover Rates by Month