COURSIER RESERVOIR: THE PLANNING AND COSTS ASSOCIATED WITH THE RECONSTRUCTION AND REVEGETATION OF A SUBALPINE LAKE.

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Coursier Lake is a 200 hectare(ha) reservoir situated at 1270 metres(m) above sea level approximately 45 kilometres southwest of the City of Revelstoke. The dam was built in 1963 by the City of Revelstoke and purchased by B.C. Hydro in 1972. As part of a regular dam safety investigation in 1993, sink holes were discovered in the upstream face of the earthfill dam. The abandonment of the dam was one of several alternatives studied as part of an assessment to address the problem. In order to prepare a cost estimate for reclaiming the reservoir after abandonment, the following environmental issues were assessed: a review of the pre-disturbance habitat using historic air photos, a hydrological study of outlet channel reconstruction, a reclamation plan for the shoreline and original stream channel and a revegetation plan.

Pre-disturbance Habitat and Existing Conditions

Historic photographs and air photos indicate a small 45 ha lake occupied a U-shaped valley before the dam was built. The forested valley slopes extended to the lake shore and the original stream channel meandered through an area of flat wetlands and marshes. Air photo interpretation was used to measure the surface areas of the pre-dam vegetation conditions. Of the 210 ha of land area disturbed by the construction of the earthen dam and flooding of the lake bed, approximately 45 ha was the original lake basin, 87 ha was forested and 70 ha was wetlands.

The flooded shoreline was established at an elevation of 1283 m, 17 m above the pre-dam lake shoreline of 1266 m. The flooded area was cleared of trees and the original soils are now buried under a thin layer of silt and clay which has settled out from the reservoir. The original drainage pattern along the valley bottom appears well-preserved, although somewhat obscured by siltation, as does the original lake shoreline. The limits of the forested areas are clearly defined by the remnant tree stumps.

Breach of the Dam and Reconstruction of the Outlet Channel

Breaching of the dam would involve the removal of approximately 85,000 cubic metres of fill to reduce the elevation of the dam from 1285 m to the original lake level of 1266 m. The

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breach would be a 20 m deep notch in the existing earthfill dam. The outlet channel would be 20 m wide increasing to a width of 120 m wide at the top of the notch with terraced slopes of 2.5:1. The main purpose of this design was to create a stable slope that would withstand flood conditions and that would support revegetation of the slopes. The excess fill would be used to reclaim the spillway, intake and tailrace channel structures.

The reconstructed outlet channel must provide a final grade that would allow fish passage and withstand a 1 in 10,000 year flood. Based on these criteria a channel almost 50 m in length with a maximum grade of 2.5% was designed. A main feature of this plan was the construction of 6 large boulder riffles which reduce the steep gradient and water velocities to allow fish access. The total cost for this stage of the lake reconstruction would be approximately $770,000.

Reclamation of Shoreline and Original Tributary

The flooded shoreline at 1283 m has developed a small scarp that would require protection from slope runoff to reduce sedimentation into the lake. Revegetation of this scarp would control erosion in most of the areas with the exception of large gullies formed by intermittent streams along the shoreline. Approximately 20 large gullies would need to be reinforced with large riprap blankets to accommodate the high flows during the spring freshet.

The original tributary is relatively unaltered by decades of inundation and would require only minor stabilization. This would involve the construction of steepened boulder rapids at the entrance to the original lake. Rather than remove any silts accumulated in the original tributary it is anticipated that within 2-3 years the finer materials would be flushed out naturally. The estimated cost to complete this stage of lake reconstruction would be $100,000.

Revegetation Plan

The revegetation plan for the 87 ha of forested and 70 ha of wetland vegetation would be in two phases. Phase one would entail heli-seeding the entire shoreline and dam surface with an annual plant species, such as fall rye, to reduce erosion and act as a nurse crop for natural vegetation. Initial greenhouse experiments with shoreline sediments indicate a viable seedbank is still present and may be able to re-establish a large percentage of the original plant species.

Phase two would include the planting of wetland and forested plant species. Depending on the success of the natural vegetation, some of the 70 ha of wetland area may require additional plantings including willow, sedge and grass species. Based on previous studies possible species to use could include:

- *Carex sitchensis* (Sitka Sedge)
- *C. aperta* (Columbia Sedge)
- *C. aquatilus* (Water Sedge)
- *C. languinosa* (Woolly Sedge)
- *Deschampsia caespitosa* (Tufted Hairgrass)

- *Salix scouleriana* (Mountain Willow)
- *S. glauca* (Greyleaf Willow)
- *S. bebianna* (Beaked Willow)
- *Populas balsamifera ssp. Trichocarpa* (Black Cottonwood)

AIM Ecological Consultants have successfully cultivated these species using cuttings and seeds grown in a greenhouse and then hand-planted into disturbed areas for other B.C. Hydro projects. The approximate cost to grow and transplant these species is $1.25 - 2.00 per plant. Planting spacing for sedges, grasses and rushes is in general 2 plants per square metre and for willows 0.5 plants per square metre. This amounts to $12,500 per hectare to revegetate with sedges and $3,125 per hectare for willows. To reflect the original habitat balance these plantings would cover a maximum area of 55 hectares of sedges and 25 hectares of willow - this would total a cost of $750,000. This cost would likely be less if the native vegetation was even somewhat successful in re-establishing from the sediment seedbank.

The 87 hectares of forest habitat would be replanted to a density of 1200 stems per hectare with Ministry of Forests recommended species such as *Picea engelmannii* (Engelmann spruce) and *Abies lasiocarpa* (Subalpine fir). This would cost approximately $100,000. It is expected that this stand density would produce a self sustaining forest in an excess of 700 stems per ha within 9 - 15 years after planting.

Summary

The entire process of abandoning the dam would include these three main reclamation activities as well as an initial environmental approval review and a monitoring phase prior to returning the land to the Crown. It was estimated that the approval process would take two years, the reconstruction and revegetation work two years and the regrowth and monitoring phase 15-20 years for a total project cost of $1.5 million.

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