Draft 4

Plan of Study
for Renewal of the
International Joint Commission's Osoyoos Lake Orders

Prepared by
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This draft will likely be revised following public comment at meetings held in Osoyoos, BC and Oroville, Washington on February 13 and 14, 2006.

Glenfir Resources cannot accept responsibility for the performance or actions of any of the companies cited as possible Study Agents in this Plan of Study.

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EXECUTIVE SUMMARY

Zosel Dam stores water in Osoyoos Lake for irrigation, domestic, recreation, and fisheries uses. The dam is operated to maintain certain lake levels that are prescribed by the International Joint Commission (Commission) in "Orders of Approval". These orders terminate in 2013. At that time Commissioners will need to know whether to renew or modify them. This "Plan of Study," explores issues associated with the present Orders and recommends investigations that will inform the Commission about these issues. Included in this plan are descriptions of how the studies should be carried out, who should carry them out, estimated costs, and recommended timelines.

To set the stage for the studies the plan describes both the Canadian Okanagan River basin and the U.S. Okanogan River basin. The Similkameen River basin is also included because it frequently affects outflows from the system. The review of the basins shows that many changes have occurred in the 18 years since the Zosel Dam was reconstructed and the present Orders took effect. The population has grown to about 355,000 people, water demands have increased, waterfront properties have increased greatly in value and climate change has altered the valley's hydrology. All these factors should be considered when the Orders are reissued.

The first step in preparing the Plan of Study was to scope out the issues connected with the present Orders of Approval. This was done by notifying 492 groups or individuals and directly contacting about 90 parties known to have interests relating to Osoyoos Lake. In addition we looked for issues as we reviewed over 150 technical reports, meeting minutes, and government files.

Our research and consultations indicated that the biggest single issue is high water levels stored through the summer during drought years. The present orders allow the lake to be raised to 913.0 feet above sea level throughout the summer so that water will be available for irrigation and fisheries in the fall. This level reportedly exposes lakeside properties to erosion from boat wakes and waves caused by summer winds, soaks camping areas, covers beaches, and inundates hayfields. However, a reduction of only 6 inches reportedly solves these problems and appears to be acceptable to most stakeholders. To further investigate this issue we propose a study that will define the future water demand, examine several variations of the lake levels that would meet the demand, look at the impacts involved, and recommend the best options for lake levels during drought conditions.

Not only have people been impacted by the high water during droughts but they have also noticed that drought conditions have been declared in about half of all years since the new Zosel Dam was completed in 1988. As a result, many question the suitability of the criteria that are being used to declare a drought. The criteria are based on the amount of water in Okanagan Lake, the expected summer inflow to Okanagan Lake and the expected inflow to the Similkameen River. These are logical criteria but they are

employed in an all or nothing fashion that fails to take into account the severity of drought. A study is recommended to determine ways of setting water levels based upon the degree of drought.

Osoyoos Lake levels are regulated differently in the winter than the summer. The dates of switching between summer and winter schedules have been criticized for not conforming to the natural hydrograph. Some complainants say that filling the lake early removes any storage capacity that would otherwise be available to absorb flood waters. Others say that the hydrograph should be kept as natural as possible to benefit the ecosystem. We propose a study that would employ modeling techniques to examine the pros and cons of various scheduling dates.

Water quality in Osoyoos Lake is a major worry for many stakeholders since the economy of the area depends upon beach and water based recreation. Water quality in the lake has been poor for a long time as evidenced by high phosphorus levels, nuisance algal blooms, algae growing on the rocks, high water temperatures and low oxygen levels. Some people blame the dam and suggest either dam removal or increased flushing of the lake. Study 4 would examine existing water quality information that relates directly to water regulation and determine whether the operation of the dam could be modified to improve conditions in the lake. Results would be presented both in a technical format and in a brief and reader-friendly report for public review.

Many of those who are concerned about water quality have also expressed a concern for the effects of lake levels on the plants and animals living in and around the lake. Ecosystem values associated with Osoyoos Lake and its river systems are very high. There are fish populations of commercial, cultural and scientific importance and wetlands that house an impressive array of endangered wildlife and plants. Teams of scientists are investigating the effects of fluctuating lake and river levels on the ecosystem. Study 5 links their findings to conditions specified in the Orders of Approval.

The sixth study we suggest deals with climate change. The hydrologic patterns of the Okanagan and Similkameen basins are definitely shifting. Projections show reduced snowpacks, a more rain-dominated hydrograph, earlier peak runoff, and an extended period of low summer flows. To anticipate and prepare for these changes, Study 6 will capture climate change knowledge specific to the Okanagan and Similkameen basins and show how it can be applied to Orders of Approval.

The seventh study is meant to increase public awareness of the factors that control water levels in Osoyoos Lake during floods. Flooding in this system is frequent and unpreventable regardless of how the dams are operated. However, this has not been fully communicated to all stakeholders. Study seven would also determine more exactly what potential exists to control flooding and the Study would recommend the best method for preparing and distributing the information to interested parties and individuals.

The final study deals with the capability of the Okanogan River between Osoyoos Lake and the Zosel Dam to convey high levels of flow. Prior to the issuance of the 1982 and 1985 Orders, blockages sometimes formed in this portion of the river. These blockages reduced the channel's ability to convey flows and increased the risk of flooding. To ensure this does not happen again the capacity of the channel to pass flows is monitored. We propose a study that would determine the effectiveness of the present monitoring method and, if desirable, suggest alternative monitoring methods.

The concluding section of this plan is an implementation strategy that begins by suggesting this document should be transformed into an official Commission document in 2006/2007. Then the Commission should decide which studies to carry out. In the following year, budgets and contracting documents would be prepared and some initial surveys would be completed. The bulk of the studies would be carried out between the fiscal years 2008/09 and 2010/11. Commission and Board deliberations and decisions would be made throughout the process and nearly two years would be reserved to process the findings in preparation for the 2013 Orders of Approval.

INTRODUCTION

Osoyoos Lake straddles the Canada-US border between British Columbia and the State of Washington (Figure 1). Except during extreme high flows, water levels in the lake and outflows from the lake are controlled by Zosel Dam, situated on Okanogan River just downstream from the lake.

The dam was built in 1927 to form a millpond from which logs could be transported into the Zosel family sawmill. Over the years, however, the dam became indispensable as a control structure to store water and to maintain suitable lake and river levels. By 1980, Zosel Dam had fallen into disrepair, but because of its critical importance, Washington and British Columbia cooperated in building a replacement structure. The present dam is owned by the State of Washington Department of Ecology (the Applicant), but it is operated to the satisfaction of both countries under Orders of Approval (Orders) issued by the International Joint Commission (IJC or Commission).

In 1982, an Order was written for the dam that was about to be constructed. The Order specified a range of lake levels that should be maintained throughout the year and a flow capacity that should be maintained in the river channel between the lake and the dam. A Supplementary Order, written in 1985, allowed a change in the dam location and a change in the construction schedule for rebuilding the dam. Construction started in 1986 and was completed officially on February 22, 1988.

The 1982 and 1985 Orders of Approval terminate on February 22, 2013, 25 years after the new dam was completed. Washington State has indicated that it will apply for renewal, and when it does, the IJC will need to decide whether and how the Orders should be modified. To make informed decisions, the Commissioners intend to be fully aware of all the interests, issues and demands that could affect dam operations, Osoyoos Lake water levels and Okanogan River flows. This is particularly important since major changes have taken place in the valley in the 18 years since the previous Orders came into effect. Accordingly, the IJC has initiated this “Plan of Study”.

The Plan of Study will:

- provide sufficient background information to acquaint the reader with the area and the factors that affect water levels,
- reveal the methods used to prepare this plan,
- identify issues and areas where changes to the Orders may be warranted,
- recommend studies that will provide the information the Commissioners will require to renew the Orders for Osoyoos Lake,
- describe how the studies should be carried out and estimate costs, and timelines, and finally
- develop a practical strategy for implementing the studies.

AUTHORS NOTE - In the United States the basin is spelled Okanogan. In Canada it is spelled Okanagan. This plan uses both spellings depending upon the location being discussed but defaults to the Canadian spelling if the entire Canada/U.S. basin is being discussed.

DESCRIPTION OF THE BASIN

Historical Context

Many of the surface features of the Okanagan and Similkameen basins were formed by glacial activity some 15,000 years ago (Walker, 2004). Aboriginal peoples are thought to have moved into the area about 7,000 years ago, followed in the early 1800s by trappers and traders, gold miners and then ranchers and farmers. Throughout the 1900s, cattle, timber, and orchards provided the primary economic generators. Growth of the orchard industry demanded an inexpensive supply of water and elaborate irrigation systems were constructed throughout the Valley. As a result, the fruit industry flourished, and orchards together with vineyards are still economic mainstays.

The character of the Okanagan is, to a large extent, shaped by the lakes which moderate the climate and store the water necessary for agricultural and urban development, recreation, and fish and wildlife. Summer tourism has become a major activity because of the lakes, the favorable climate and attractive scenery.

Numerous events related to water management in Osoyoos Lake have taken place over the last 100 years. A chronicle is provided in Appendix V.

Physiography

The Okanagan basin including the Similkameen drainage is tributary to the Columbia River. It covers about 8,400 square miles (21,750 km²) and most of it (74%) lies within British Columbia (Northwest Hydraulic Consultants, 2004).

The Valley is wide, has a gentle slope and is defined by mountains on either side that rise to 8,200 feet (2,500 m) (Clay, 1959). In the valley bottom, a chain of six large lakes ranges in elevation from 1,282 feet (391 m) to 912 feet (278 m) above sea level.

Okanagan River begins at the outlet of Okanagan Lake, at Penticton, B.C., and runs south about 33 miles (54 km) to Osoyoos Lake. Okanogan River begins at the outlet of Osoyoos Lake and continues south for about 79 miles (127 km) to Brewster, Washington where it flows into the Columbia River (Figure 1).

The Similkameen River is the largest tributary in the system, and has many times the volume of the Okanogan. It is included in this description because under high flow conditions it blocks or restricts outflows from Osoyoos Lake and controls water levels in the lake. The Similkameen River originates in Manning Provincial Park, B.C. and enters the Okanogan River just south of Osoyoos Lake, near Oroville, Washington (Figure 1). It drains a total land area of 3,590 square miles (9,300 km²), 82% of which is in British Columbia (IEC Beak Consultants, 1984).

Climate

The Okanagan Basin lies in the rain shadow of the Coast and Cascade mountains, and has a semi-arid climate characterized by winters that are cold, snowy, and cloudy and summers that are hot, dry, and clear.

The climate gets hotter and drier going from north to south and from high elevation to low. Nearly 20 inches (50 cm) of precipitation fall annually at the northern extreme of the basin, compared with about 12 inches (30 cm) in the south. Osoyoos Lake lies within a particularly dry area that is the northern extremity of the Great Basin Desert. It is reported to be the warmest, driest area in Canada.

More information on climate can be found at the website of the Western Regional Climate Center: www.wrcc.dri.edu and Environment Canada's National Climate Archive: www.climate.weatheroffice.ec.gc.ca/.

Demographics

About 355,000 people live in the Okanagan basin; 315,000 in Canada and 40,000 in the U.S. (U.S. Census Bureau, 2004). Approximately 10,000 people live around Osoyoos Lake (www.bestofosoyoosbc.com). The Osoyoos Indian Band Reserve, located within the plan area along the eastern shore of Osoyoos Lake, has 370 members.

Land and Resource Management

In Canada, most of the land in the basin is owned and managed by the Province of British Columbia (Table 1). Most resources are also managed by the province and the province makes all the water allocation decisions. Local governments consisting of municipalities and regional districts regulate the use of private land. Indian Reserves are administered by the federal government and Band councils. Recent court decisions have ruled that First Nations must be consulted on land and resource management decisions. More information is available through the Okanagan Shuswap Land and Resource Management Plan (B.C. Ministry of Forests, 2001), and in Rae (2005).

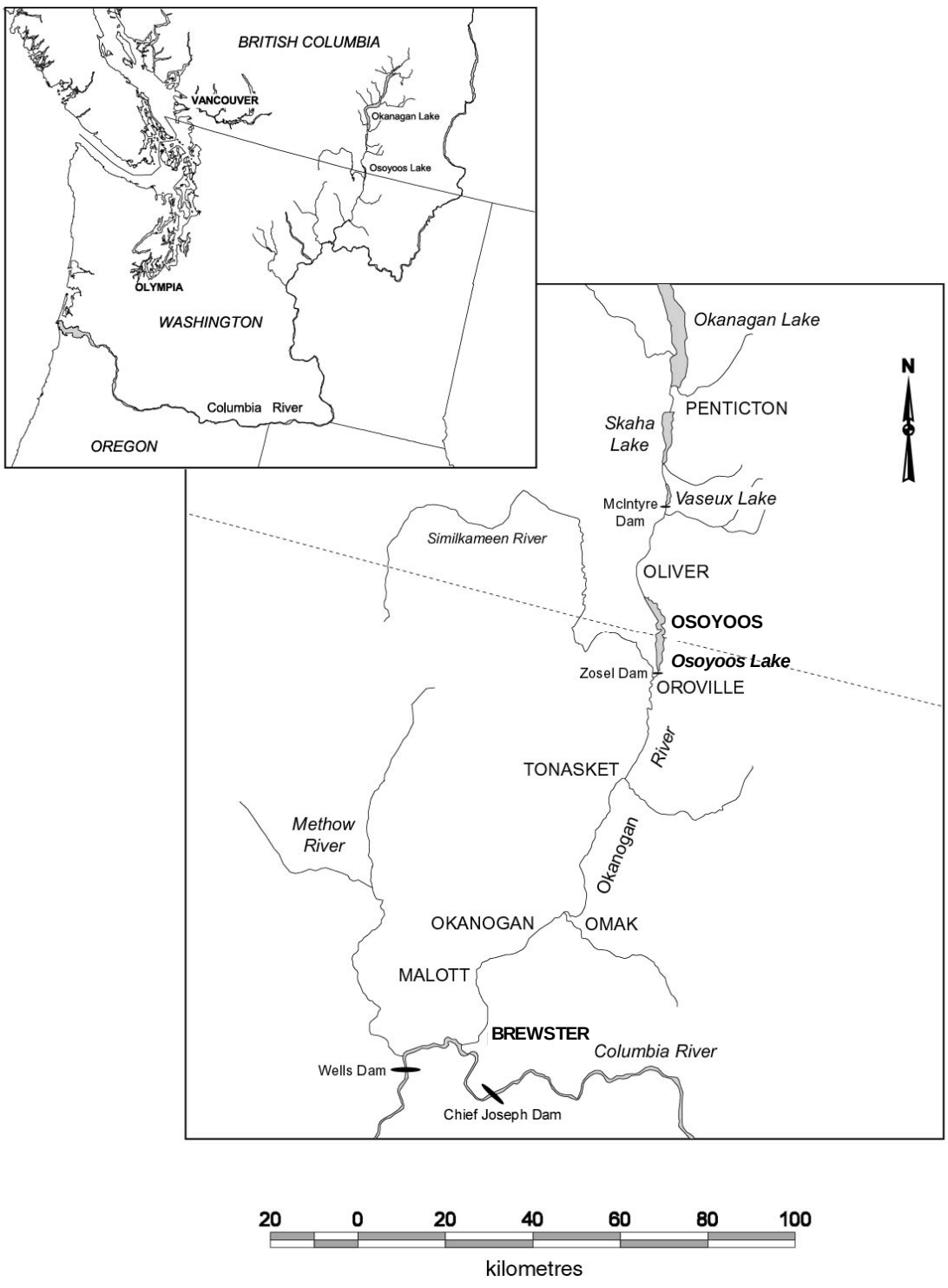

Figure 1. General location of the study area.

In the United States, public lands are jointly managed by the U.S. Forest Service and the State of Washington with a small portion administered by the Bureau of Land Management. The Colville Reservation consists of tribally owned lands mostly held in federal trust. More information is available through the Chief Joseph Dam Hatchery Program (Confederated Tribes of the Colville Reservation, 2004) and the Okanogan Sub-basin Plan (Northwest Hydraulic Consultants, 2004).

Table 1 – Land jurisdiction in the Okanogan/Okanagan Watershed (Northwest Hydraulic Consultants, 2004)

Land Jurisdictions in Okanogan/Okanagan Watershed		
(Percent of land area within each country)		
	U.S.	Canada
Public Land	41	83
Private Land	34	14
Indian (First Nation) Reserve Land	21	3

Ecological Significance

The Okanagan Basin is an area of notable ecological significance. Habitat types include wetland/riparian, grassland/shrub-steppe, coniferous forest, and rugged terrain. This wide assortment of habitats supports extensive biological diversity. Nearly half the bird species in Canada are found here along with many plants that exist nowhere else in North America, or in some cases the world. More than 23 species of plants and animals are currently at risk. The wetland and riparian habitats have suffered the greatest percentage loss and have reached a critical point. (www.ecoinfo.org/env_ind/region/sensitive_ecosystems/sensitive_eco_e.cfm).

Fish populations of the basin are important in their own right, plus they contribute to commercial harvests both at sea and in the Columbia River and have spiritual importance to the native culture. The basin supports half of the sockeye salmon in the entire Columbia drainage, steelhead listed under the U.S. endangered species act, Chinook salmon being considered for listing by the Committee for the Status of Endangered Wildlife in Canada, and numerous freshwater resident fish species.

In both countries the federal governments have clear trust obligations to protect native interest in fish and in the U.S. the Court of Appeals has ruled that the Colville Tribes possess federally reserved water rights to stream flows sufficient to preserve or restore tribal fisheries (Northwest Hydraulic Consultants, 2004).

Changes since the 1985 Orders of Approval were issued

In the 18 years since the last Orders of Approval came into effect for Osoyoos Lake, there have been substantial changes in human populations, agricultural activity, water demand, climate, and influx of exotic species.

The warm, dry climate of the Okanagan coupled with the large scenic lakes has attracted a major influx of retirees. This in turn has resulted in a rapidly increasing service sector. In the last 15 years the population has increased by about 45% and projections estimate 450,000 people will be living in the B.C. Okanagan by 2031 (B.C. Statistics: www.bcstats.gov.bc.ca).

A new wine industry has prospered and has helped to expand the tourism industry. On the Osoyoos Indian Band lands alone, 1,155 acres of vines have been recently planted and 25 million dollars has been spent to develop a winery, golf course, RV park, and conference centre (www.nkmipcellars.com). This is just one example of many extensive developments that are occurring in the Valley.

On the U.S. side the growth has been slower, but none-the-less significant. In Okanogan County the population in 2000 was 39,564, up 18.6% from 1990 (U.S. Census Bureau: www.census.gov/). On both sides of the border there has been a rapid rise in the demand for, and the price of, waterfront properties. This will, in all probability, substantially increase requests for carefully controlled lake levels.

Water demands have increased alongside the growth in population and agricultural activity. For example, in the B.C. Okanagan, the volume of water licensed for agriculture in 2004 was about 60% greater than water demand modeled for the 1961-90 period (Neilsen et al., 2004). Increased demands and recent dry years have resulted in water shortages in some parts of the B.C. Okanagan, and this has highlighted the potential conflicts between consumptive uses (agriculture, communities) and environmental uses (fish, wildlife).

The climate of the Okanagan and Similkameen basins has become warmer and wetter over the last century, altering the timing and amount of water flowing into streams (Leith and Whitfield, 1998, Cohen and Kulkarni, 2001), lengthening the agricultural season, and increasing the agricultural water demand. Since the last Orders were issued, the rate of climate change has increased. This topic is discussed in more detail under the climate change study.

Exotic or non-native aquatic species have been present in the lakes and rivers of the Okanagan for over 100 years but some of the greatest damages have occurred since the last Orders. Over the last century ten new species of fish have found their way into the system, damaging native fish populations (Matthews and Bull, 2002; Wright, Hyatt and

Bull, 2002). In addition to bringing in new species of fish, man introduced freshwater shrimp (*Mysis relicta)* into Okanagan Lake in 1966 in hopes of providing an additional food item for kokanee salmon. The shrimp turned out to be a major competitor and caused kokanee populations to decline so drastically that the multi-million dollar fishery had to be terminated. Mysid shrimp eventually drifted downstream and were first recorded in Osoyoos Lake in 1999 (Rankin and Hyatt, 2001). Since mysids have damaged salmonid populations wherever they are introduced (Nesler, 1991) they will likely have a major impact on sockeye salmon and kokanee in Osoyoos Lake.

Non-native plant species have also drastically changed the system. Many millions of dollars have been expended trying to first eradicate and then control Eurasian water milfoil (*Myriophyllum spicatum*) which plugs marinas, clogs intakes, hinders swimmers, washes up on beaches and may impede flows in some parts of the system. Another invasive plant, purple loosestrife (*Lythrum salicaria)*, has recently arrived in the Osoyoos wetlands and threatens to out-compete native riparian vegetation.

The next exotic species that may invade Osoyoos Lake is walleye (*Stizostedium vitreum*), a powerful predator of other fish. Walleye have entered the Columbia River from the reservoir of Grand Coulee Dam (Li et al., 1987) and are currently established at the confluence of the Okanogan and Columbia rivers (C. Fisher, biologist, Colville Confederated Tribes, personal communication).

SYSTEM HYDROLOGY AND WATER MANAGEMENT

Geology

The Okanagan Valley lies on the fault between the boundary of the North American and Pacific crustal plates. Prior to the Coastal Range intrusion, the eastern side of the valley formed the Pacific shoreline. The largest rift valley in North America was formed along the Okanagan fault line. It is bounded by the gneissic rock of the Monashee Highlands to the East and the granite, diorite and syenite rocks of the Thompson Plateau to the West (Roed et al. 1995).

During the last glaciation, more than 10,000 years ago, the entire Okanagan drainage was overridden by the Okanogan Lobe of the Cordilleran ice sheet. During the de-glaciation period, the valley was impounded by glacial lobes and outwash deposits. A major lobe near Okanagan Falls formed Glacial Lake Penticton, impounding the valley to elevation 1500 feet (457 m) A.S.L., which was 515 feet (157 m) higher than the present level of Okanagan Lake. Deep silt deposits on the bed of Lake Penticton were dissected by down-cutting flows as the blockage melted leaving high silt bluffs on the sides of the present valley.

Groundwater

As the glacier melted it deposited layers of silt, sand, gravel, and cobbles up to depths of 500 feet (Montgomery et al., 1995). These surficial deposits are the primary source of groundwater in the Valley. They are underlain by a floor of bedrock that is highly fractured and contains water but with yields generally limited to no more than a few gallons per minute. Walters (1974) estimates that 75% of the groundwater in the watershed is stored in deposits lying within the Okanagan River corridor. The aquifer is recharged from rain infiltration and interaction with lakes, rivers and streams. Individual wells in the valley yield from virtually nothing to over 5,000 gallons (19 m^3) per minute.

The interaction of surface and groundwater throughout the basin varies with the geologic conditions. In some areas flow is from the ground into the streams; in others the reverse occurs. Montgomery et. al. (1995) believe that most of the groundwater eventually flows to surface water or another aquifer that then discharges to the Okanagan River. No major inter-basin aquifers have been discovered.

In Washington groundwater in excess of 5,000 gallons per day is appropriated only by prior use claims through a permit from the State. As of 1995 there were:

- 2,417 groundwater claims covering 42,086 acre-feet per year (~52 million m^3 per year),
- 905 groundwater permits and certificates totaling 70,705 acre-feet (~87 million m^3), and
- 81 groundwater applications totaling 40,036 acre-feet per year (~50 million m^3 per year) (modified from Montgomery et al., 1995).

If this level of use is depleting aquifers, it is likely only on a local basis since the Okanogan watershed is estimated to contain more than 4,500,000 acre feet (~5.6 billion m^3) of groundwater (Walters 1974). A good discussion of groundwater on the American side of the basin can be found in Montgomery et. al. (1995) and more information about state law can be obtained from the Washington State Department of Ecology website (www.ecy.wa.gov) by selecting “Laws and Rules” from the main menu.

In British Columbia no licenses or permits are required for groundwater use and the knowledge of groundwater systems is limited. The state of knowledge is expected to improve in the near future with the Groundwater Assessment Project of the Okanagan Basin, a joint initiative of Natural Resources Canada, the Geological Survey of Canada, and the B.C. Ministry of Environment. This investigation aims to determine the geology and yield of major aquifers in the Okanagan basin and will identify possible sensitivities and impacts to these water resources (Grasby, 2005).

Surface Water

The Okanagan and Similkameen basins are snowmelt-dominated systems, with the spring freshet, from April through June, accounting for as much as 90% of the annual stream flow (Dobson 2004). By July, the freshet declines and water flows remain low for the

summer, fall, and winter. Because of the arid to semi-arid climate in the Valley, any precipitation that falls during the summer months generally evaporates or soaks into the ground and does not contribute directly to surface water flow.

Fluctuations between spring and summer flows are lessened somewhat by water regulation. Okanagan Lake receives about 80% of all the surface water draining into the basin above Osoyoos Lake and stores some of it. Storage during spring runoff reduces the risk of flooding and allows the water to be released later on during lower flow periods. With a surface area of 86,000 acres (~35,000 hectares) and an operating range of 4 feet (1.22 m) Okanagan Lake can store a large volume of water (340,000 acre feet or 420 million cubic meters) (Canada – British Columbia Okanagan Basin Agreement, 1974). This capacity is sufficient to influence the volume and the timing of inflows to Osoyoos Lake.

Water released from Penticton Dam flows south down the Okanagan River through Skaha and Vaseux lakes before entering Osoyoos Lake. Several tributary streams join the river on the way. For most of the year their contribution is relatively small but during a wet spring their composite volume can add 2,000 cfs (57 cms) to the volume released from Okanagan Lake (BC Lands, Forests & Water Resources, 1975). In combination with a Similkameen River blockage, this high water flow can result in flooding around Osoyoos Lake regardless of how Okanagan Lake Dam and Zosel dams are regulated.

Osoyoos Lake, with a surface area of 5,729 acres (2,318 hectares) and a drought year fluctuation of 2.5 feet, can store up to 14,323 acre feet (~17.7 million m^3) of water (Cronin, Bonham and Mitchell, 1987). Water leaving Osoyoos Lake flows 2.5 miles (4 km) down the Okanogan River past Tonasket Creek to Zosel Dam and then south for another 77 miles (124 km) to join the Columbia River near Brewster, Washington. The largest tributary to Okanogan River is the Similkameen River which joins the Okanogan River just downstream from Zosel Dam (Figure 1).

As would be expected, the flow increases as water moves downstream through the system and more tributaries contribute to the volume (Table 2). The B.C. portion of the Okanagan Basin contributes approximately 20% of the total volume of Okanogan River near its mouth, while the Similkameen River contributes 75%. Therefore, before these two rivers meet, the average annual flow of the Similkameen is about 3.5 times greater than the volume of the Okanogan.

Table 2. Average annual water flow at sites along the Okanagan, Okanogan, and Similkameen Rivers.

Location	Data Years	Average annual flow	
		Acre feet	Cubic metres (x 10^6)
Okanagan River at Penticton[1]	1944-2004	421,568	520
Okanagan River at Oliver[1]	1944-2004	462,104	570
Okanogan River at Oroville[2]	1942-1995	486,425	600
Similkameen River at Nighthawk[2]	1911-1995	1,653,846	2,040
Okanogan River at Tonasket[2]	1929-1995	2,132,164	2,630
Okanogan River at Malott[2]	1958-1995	2,221,342	2,740

[1] Water Survey of Canada 2005
[2] Wiggins et al. 1996

Uncontrollable Factors Regulating Lake Levels

Outflows from Osoyoos Lake, and therefore lake levels, are usually controlled by Zosel Dam. However, other factors take control under certain conditions. In the past, the Okanogan River channel between Osoyoos Lake and Zosel Dam has been partially blocked a number of times. Blockages have included a silt bar at the lake outlet caused by wind action, a fence installed for fisheries, a dyke constructed along the river to protect a creamery, and a series of blockages caused by deposits flushed into the river from Tonasket Creek (Webb & Veatch, 1946). All these obstructions have now been dealt with, and by Order the river is maintained so that it can pass at least 2,500 cfs (71 cms) when the lake level is at 913.0 feet above sea level.

A control point that remains a problem is the blockage caused when the Similkameen River is in freshet. In high runoff years, the Similkameen River can have ten to twelve times as much flow as the Okanogan River (BC Lands, Forests & Water Resources, 1975). The land at the Similkameen-Okanogan confluence is relatively flat, and when flows in the Similkameen River exceed about 10,000 cfs (283 cms), they back water up to the gates of the dam. This slows the outflows from the lake and causes the lake level to rise (McNeil, 2000). On rare occasions the Similkameen River rises to such a high level that water backfloods over Zosel Dam and flows upstream into Osoyoos Lake.

The flooding that occurs as a result of high flows in the Similkameen is an uncontrollable natural event that would occur even if Zosel Dam did not exist. This topic is explained in more detail and in simple terminology in a “Special Statement” posted on the IJC website at www.ijc.org/php/publications/html/osoyoos/special_statement.htm.

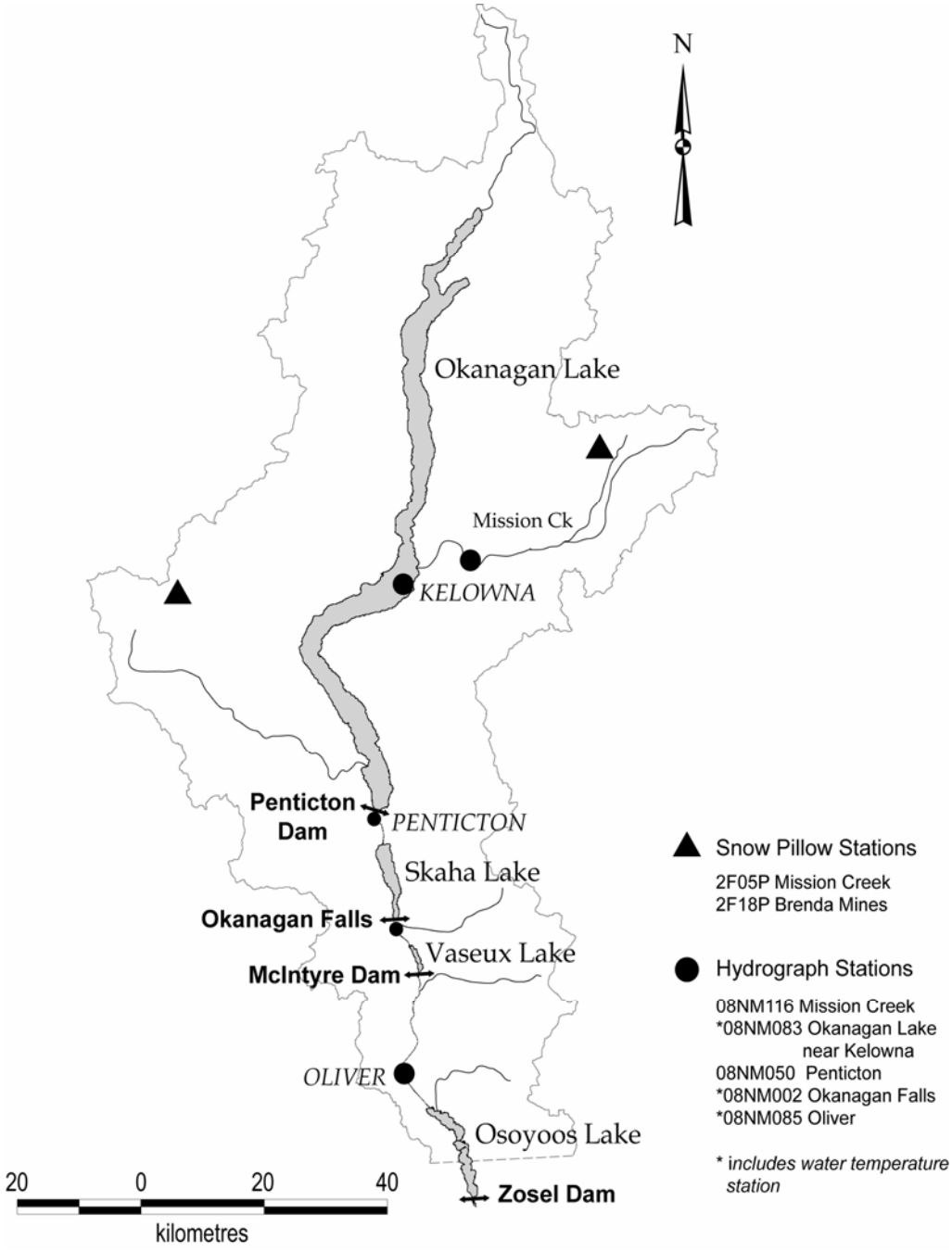

Figure 2. Map of major lakes, dam sites (Penticton, Okanagan Falls, McIntyre, Zosel), monitoring stations (snow-pack, water supply and temperature) and towns within British Columbia's Okanagan Basin (from Bull and Hyatt, 2005).

Another uncontrollable condition that can cause Osoyoos Lake levels to rise even if the gates at Zosel Dam are fully open is high inflows. When more than 2,000 cfs (~57 cms) enters the lake, water levels must rise to create enough head to force the water out of the lake. The greater the inflow, the higher the lake level. Occasionally the tributary streams entering Okanagan River have sufficient flow to surpass this level even if the flow from Okanagan Lake is minimized.

Impacts to System Hydrology

Channellization

Prior to the mid 1950s Okanagan River was largely unconfined. Between Okanagan and Osoyoos lakes there were wide meanders, active floodplains, and extensive riparian wetlands. Following a series of floods, the river was straightened, shortened, channellized and dyked from Okanagan Lake to Osoyoos Lake. The federal-provincial Agreement for construction of the system was signed in 1950 and construction took place between 1950 and 1958 (Bull, Gaboury and Newbury, 2000).

The channellization work has caused water to move through the system rapidly rather than being retained on the floodplain. This would normally result in higher freshet flows and lower minimum flows but storage on Okanagan Lake helps to offset these impacts by storing freshet flows and releasing water during low flow periods. Of concern are reports that annual low flows on the Okanagan River have decreased by about 40% since the 1940s. Montgomery et.al. (1995) attribute this decline to increased irrigation use, but this has not been thoroughly investigated.

The Okanogan River downstream from Osoyoos Lake has also been modified. As mentioned earlier, the river between the lake and Zosel Dam has been dredged and impediments have been removed. As a result Zosel Dam is the main control point except when Similkameen River is in freshet and forms a hydraulic block or when inflows are unusually high.

Water Withdrawals

The impacts that man’s activities have had on surface water are readily observable. Overuse of water is a concern. Statistics Canada has identified the Okanagan-Similkameen basin as having the lowest amount of water available per person in Canada (Alexander et. al., 2005). Furthermore, the Canadian Water Resources Association suggested that at present rates the water resources of the basin will be completely allocated in fewer than 25 years. Several Okanagan communities are already experiencing shortages in drought years and are taking steps towards demand management. On the US side, minimum instream flow targets have not been completely met for years (Kauffman, 1976).

Compared with surface water, the state of groundwater is not well understood. Neither the quality nor the quantity of water in various aquifers is well inventoried. Of concern is a statement by Montgomery et al. (1995): "…*it is generally agreed upon that continued development of the groundwater resources within the Okanagan River Watershed will ultimately result in loss of water in shallow existing wells and lower water levels in various surface bodies."*

Instream Flows for Fisheries

Provisions for maintaining instream flows at or above a prescribed minimum level have been established in three water management plans:

- Canada and B.C. established "preferred" flows for sockeye salmon in the Okanagan River (Okanagan Basin Implementation Board, 1982) .
- B.C. and Washington identified suitable transboundary flows in the non-binding Cooperation Plan (Anon., 1980).
- The State of Washington set instream flow targets for the Okanogan River at Oroville under the authority of the Revised Code of Washington (RCW 90.54).

The three sets of recommended flows serve different objectives and so they would not be expected to be identical. However they differ noticeably in some months (Appendix VII), perhaps pointing to the need for closer integration. No transboundary flows are provided under the existing Order and instream flows are non-binding suggested targets not guaranteed levels.

Dams and Regulation

As of 1998, 147 storage dams were situated on streams flowing into Okanagan Lake (Hall et al. 2001), but any potential effect of these dams on Osoyoos Lake is masked by the huge storage capacity of Okanagan Lake (340,000 acre feet or ~420 million m^3). Penticton Dam was initially built in 1914-15 to raise the lake so sternwheelers could navigate more easily. It was rebuilt four times and the primary uses changed through the years. The latest dam, constructed in 1954, is used to reduce flooding, stabilize lake levels, provide flows for irrigation and domestic use, and improve conditions for fish both in the lake and downstream. It is operated by the B.C. Ministry of Environment in consultation with Fisheries and Oceans Canada and the Okanagan Nation Alliance.

The operating plan for Penticton Dam provides a series of targets for lake elevation and river flows at various times of the year but annual inflows to the lake have varied from as little as 59,993 acre feet (74 million m^3) to as much as 1.14 million acre feet (approximately 1,400 million m^3) making compliance with the plan challenging (Bull, 1999). To improve compliance a "state-of-the-science" decision support system known as the Fish/ Water Management Tool has recently been developed. It is complex but well explained in Alexander et. al. (2005) and Bull and Hyatt, (2005). The important point for Osoyoos Lake is that the operational plan for Okanagan Lake reduces flood peaks to Osoyoos Lake and prolongs the period of higher runoff.

Skaha and Vaseux lakes, situated between Okanagan and Osoyoos lakes, have associated control dams (Okanagan Falls and McIntyre dams on Figure 2), but these lakes are relatively small and stable and consequently have little effect on Osoyoos Lake.

The Lake Osoyoos International Control Structure includes Zosel Dam, the river channel between the lake outlet and the dam, and bank improvements at the lake outlet. The structure, often simply called Zosel Dam, was constructed jointly by BC Ministry of Environment and Washington State Department of Ecology. The dam is owned by the Department of Ecology and operated under contract by Oroville-Tonasket Irrigation District. Operating methods are explained in a procedure pamphlet produced by Washington State Department of Ecology (1990).

The only dam on the Similkameen River is Enloe Dam, situated in Washington about 8.7 miles (14 km) upstream from the confluence with the Okanogan. The dam generated hydroelectricity from 1916 to 1923 (IEC Beak Consultants 1984) and is not operational, though there is discussion about re-licensing it. Enloe Reservoir has no storage capacity and therefore has little bearing on this Plan. Of historical interest, however, is an irrigation flume owned by Okanogan-Tonasket Irrigation District that begins in the general vicinity of Enloe Dam and ends at Osoyoos Lake. In 1992, a drought year, the flume was used to transfer water from Similkameen River to Osoyoos Lake. The scheme was of limited value since much of the diverted water is pumped from the river downstream from the Okanogan/Similkameen confluence and the water could have reached these pumps without the side trip to Osoyoos Lake. However, there could have been some advantage in retaining Osoyoos Lake levels for diversions from the lake (Brian Symonds, BC Ministry of Environment, personal communication). The idea proved impractical for supplying instream fishery needs because sockeye salmon underyearlings imprinted on the diverted water and returned as adults to the base of Enloe Dam rather than Osoyoos Lake (T. Scott, Oroville Tonasket Irrigation District, personal communication). The flume is now in disrepair and there is no apparent reason to rebuild it.

Orders of Approval

The operation of Zosel Dam follows the 1982 and 1985 Orders of Approval issued by the International Joint Commission and is overseen by the International Osoyoos Lake Board of Control (Appendix VI). The Orders require that Zosel Dam be operated, to the extent possible, to maintain the April 1 to October 31 water level in Osoyoos Lake between 911.0 and 911.5 feet (USCGS [US Coast and Geodetic Survey]). In winter months, the lake level can be drawn down to 909.0 feet (Figure 3).

When a drought year is declared, additional water can be stored by allowing the maximum lake level from April 1 to October 31 to be raised to 913.0 feet and the minimum level to be lowered to 910.5 (Figure 3). Drought years are declared when any one of the following three criteria are met:

- The flow of Similkameen River (measured at Nighthawk, Washington) in April-July is calculated or forecast to be less than 1.0 million acre feet (1.2 billion m^3), or
- The net inflow to Okanagan Lake in April-July is calculated or forecast to be less than 195,000 acre feet (240 million m^3), or
- The water level of Okanagan Lake in June or July does not reach or is forecast not to reach 1122.8 feet (342.23 m; Canadian Geodetic Survey Datum).

Drought declarations are rescinded when, in the opinion of the Osoyoos Board of Control, none of the criteria are met.

The higher lake level in drought years is meant to provide additional storage for domestic and irrigation use, and for fish flows. However, when the lake has been kept at an elevation of 913.0 feet for an extended period, negative impacts have been reported to lakeshore properties and to tourism (beaches are covered). To address the problem, Washington and BC water managers often agree informally that the Washington Department Ecology will try to limit Osoyoos Lake to no more than 912.5 feet provided BC Ministry of Environment agrees to supply the additional half foot of storage water from Okanagan Lake in May when flows are needed to flush sockeye smolts out of Osoyoos Lake.

In addition to specifying lake levels, the 1982 and 1985 Orders of Approval stipulate a conveyance capacity for both the Zosel Dam and the river channel between Osoyoos Lake and the dam. Both must be capable of passing 2,500 cfs (70.8 cms) of water when Osoyoos Lake is at 913.0 feet and the Similkameen River is not creating a backwater. To comply with that directive the Applicant agreed in its operational procedures plan (Washington State Dept of Ecology, 1990) to conduct annual surveys of the channel and to carry out dredging if the capacity was not met. In recent years an agreement was struck between the Applicant and the Board of Control that the surveys would not be necessary if the conveyance capacity of the river could be demonstrated by actually passing the required flows.

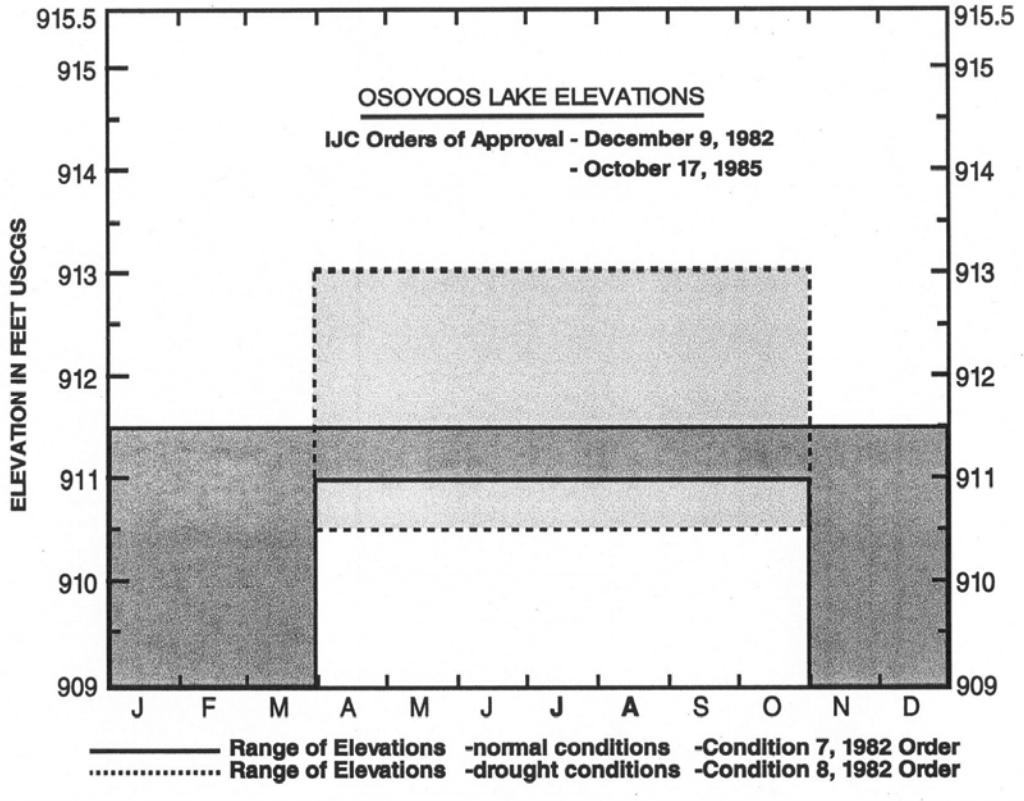

Figure 3 – Schematic diagram of the IJC Orders of Approval (Courtesy IJC and Osoyoos Lake Board of Control).

Compliance with the Orders

Lake elevations have exceeded the target levels in 11 of the 23 years since 1983 when the Orders of Approval were first written (Appendix VIII). However, in 4 of those years the lake did not rise above the problem threshold of 912.5 feet. In several of the other years exceedences were attributable to flooding conditions in which inflows were excessive and the Similkameen River impeded outflows. Such circumstances were beyond control.

Stakeholders and the general public need to be advised that exceedences will continue to be unavoidable during flood conditions (the subject of study 7). That said, there may be ways to adjust future Orders to lower the number of times that target lake elevations are exceeded (studies 1, 2 and 3).

METHODS FOR PREPARING THE PLAN OF STUDY

Information Sources

Many of the documents used to prepare this plan are cited in Appendix 1. The main sources for these plans were:

- International Joint Commission & International Osoyoos Lake Board of Control
- A wide variety US and Canadian websites
- Minutes of past public meetings and Orders of Approval
- The office and private library of Wilbur Hallauer, former Senator and Director of the Washington State Department of Ecology
- The files and library of BC Ministry of Environment (Water Stewardship and Environmental Stewardship Divisions)
- Files of Agriculture and Agri-foods Canada

A list of agencies, organizations, stakeholders and interested members of the public, which were contacted, is listed in Appendix II. The Canadian Okanagan Basin Technical Working Group newsletter "Watershed News" was used to notify 492 groups or individuals. Emails were sent directly to 90 groups or individuals known to have interests associated with water regulation on Osoyoos Lake. Seventeen meetings were held with groups or individuals and phone conversations were conducted as required. In addition public meetings were advertised and facilitated in Osoyoos, B.C. on February 13 and in Oroville, Washington on February 14, 2006.

Identification, Selection & Prioritization of Issues and Studies

The majority of issues (numbers 1 – 3 and 6 - 8) were directly identified by the IJC and the Osoyoos Lake Board of Control in the Statement of Work and issues 4 & 5 were discussed. Most of these issues were also raised by other agencies and organizations or by individuals during our consultation process. All issues that were raised were recorded. Those beyond the terms of reference (i.e., ones that do not relate directly to the Orders of Approval for Osoyoos Lake) are included in Appendix IV.

To select studies, we began with an issue and formulated a series of questions that would address that issue. Studies were then devised that would provide answers to the questions.

Issues and studies were prioritized according to the frequency with which they were raised, and by the magnitude of the risks that could arise if the issue was not addressed. Risks were not quantified but were generalized based upon research and consultations with affected parties, the Board members, and front line water managers.

Selection of Study Agents

Study Agents were companies that listed the skills demanded by the Study. Some companies are known to the authors but others were selected from web searches. Therefore the authors cannot attest to the competence of the listed companies.

Choice of Timelines

The Osoyoos Lake Orders of Approval are to be renewed in early February 2013. To make practical use of the study results, we assumed that the Commission would need to have all relevant information by the end of the fiscal year 2010/2011. We also assumed that this Plan of Study would need to be reviewed by the Board, approved by the Commission and rewritten as a final draft. Then, studies must be agreed upon, budgets approved, and contracting procedures carried out. Thus we thought it would be impractical to propose that any of the studies start before the fiscal year 2007/2008. See the final report section entitled “Implementation of Studies” for further details.

Cost Estimation

Costs were approximate based upon the sum of labor, equipment, travel, administration, and contingencies. Labor costs were based upon the type of expertise required, the amount of time and the approximate rate. The provision of very specific estimates at this stage would lead to inaccuracies and misleading costs, and so we have provided fairly broad ranges which will serve only as rough guides to the approximate cost. These should be re-estimated once the final scope of the projects has been decided.

KEY ISSUES AND RECOMMENDED STUDIES

STUDY 1 – AN ASSESSMENT OF THE MOST SUITABLE WATER LEVELS FOR OSOYOOS LAKE DURING DROUGHT YEARS.

ISSUES LEADING TO THE STUDY

The current maximum permissible water level for Osoyoos Lake during drought years is 913.0 feet above sea level (USCGS datum). At this height there are complaints of property damage and impacts on field crops, and recreation and tourism. This study will determine whether there are more suitable levels that will continue to meet water demands in dry years.

SIGNIFICANCE OF THE ISSUES

The 1982 IJC Order of Approval states that the Zosel Dam should be operated so that in a normal (non-drought) year the water in Osoyoos Lake should rise no higher than 911.5 feet above sea level (USCGS datum) unless there are appreciable backwater conditions and excessive inflows. During drought years, when additional storage water may be needed for irrigation, domestic use and fisheries, the lake elevation can be raised to 913.0 feet. This elevation was chosen after hydrological analyses showed that the lake had risen to this height by natural causes at least as frequently as every other year (IJC, 1982). In the last 20 years the lake has reached 913.0 feet less often than predicted but still fairly frequently (Appendix VIII and http://wa.water.usgs.gov/data/).

The 1982 Order of Approval notes that at public hearings "…*several witnesses testified that a maximum Osoyoos Lake level of 912.5 feet USCGS was preferred to elevation 913.0 feet ...".* In the years since the Order was signed, many stakeholders have continued to object to drought year maximum permissible levels of 913.0 feet.

In non-drought years high water levels are short-lived. The lake usually stays above 912.5 feet for only a few days and only in May and June before the beaching and boating season begins in earnest. Under drought declaration, on the other hand, water levels are allowed to remain high right through the summer. This reportedly exposes lakeside properties to erosion from boat wakes and waves caused by summer winds, soaks camping areas, covers beaches, and inundates hayfields.

Stakeholders affected may include waterfront property owners, the Osoyoos Indian Band, hotels and motels, campsites, parks, marinas, tourists and the local beachgoers. Complaints to water managers about high water problems allegedly cease when the lake levels are kept at or below 912.5 feet (Brian Symonds, BC Ministry of Environment and Tom Scott, Oroville/Tonasket Irrigation District, personal communication).

All the stakeholders we contacted preferred water levels less than 913.0 feet. However most people, especially boaters, preferred the lake level to be kept fairly high (about

912.0 feet) throughout the summer in both dry and wet years. Lower levels, we were informed, prevented access to favored water-ski areas and hindered the use of launching ramps and docks. Formal complaints start if summer levels get down to 911.5 (Brian Symonds, B.C. Ministry of Environment, personal communication). This study will confirm preferences for minimum as well as maximum lake levels.

Some of the water users feared an eventual shortage of water and expressed reluctance to give up any of the storage provided for by the Orders (Newkirk, 1993). The additional water storage is often used to meet late season minimum flow targets that could not otherwise be met in drought conditions. The need to try to meet minimum flow targets is not fully understood by all stakeholders and that has caused some to question whether the drought year storage is ever used.

In 1993, Washington State Department of Ecology and British Columbia Ministry of Environment (then called BC Ministry of Water, Land and Air Protection) devised a way to preserve the interests of most or all of the stakeholder groups. The two agencies agreed informally that during a drought year the Department of Ecology would not raise the lake above 912.5 feet provided British Columbia would supply the remaining 0.5 feet of water from Okanagan Lake sometime during April or May when pulsing flows were required to flush migrating sockeye salmon smolts out of Osoyoos Lake and downstream through Zosel Dam.

The agreement avoided complaints from stakeholders and had no apparent drawbacks and so it was employed in subsequent drought years (McNeil, 1996; Tom Scott, Oroville Tonasket Irrigation District and B. Symonds, BC Ministry of Environment, personal communication). The agreement was not binding and could be terminated at any time by either side. This provided the flexibility that reportedly made the arrangement more acceptable to both parties.

As the human population grows, and as droughts occur more frequently, debates as to how high to keep the lake level during a drought year are expected to intensify. Drought conditions have been declared in 11of the last 19 years (although 3 were rescinded), and climatologists expect them to occur even more frequently in the future (Cohen et al. 2004). Complaints and perhaps legal action are likely to continue if the lake is kept above 912.5 feet during a drought year without sound reason.

PRIORITY OF THE STUDY

The requirement of this study was identified by the Board (IJC, 2005), and water managers said that it was the most contentious issue related to lake levels. Our research also confirmed objections to the artificial maintenance of lake levels in excess of 912.5 feet. Evidence for this includes:

- A 1978 letter from the Okanogan County Board of Commissioners to the IJC recommending a maximum level of 912.5 feet.

- Text in the 1982 Order of Approval mentioning that many persons attending the 1981 Public Hearings preferred 912.5 feet to 913.0 feet.
- Complaints registered in 1992 when the lake level was maintained between 912.5 feet and 913.0 feet from June 18 to Sept. 30 (Symonds, 1992).
- 912.5 feet is considered a workable maximum by "front-line" water managers Brian Symonds and Tom Scott (personal communication).
- During our consultations, objections to sustained high water levels through the summer were received from lakefront property owners, resort operators, farmers and a rare plants recovery team (Appendix III).

Consequently, Study 1 was considered the highest priority.

STUDY REQUIREMENTS

Purpose of the Study

The purpose of this study is to provide the information needed to decide whether special conditions are required in drought years and what range of regulated lake levels would be most practical.

Questions to be Answered

Study 1 should address the following questions:

1. What is the volume of water that will be needed from Osoyoos Lake by the year 2040 (assuming the 2013 Orders will be in effect for approximately 25 years)?
    - What is the present volume of storage under license, water right, reserve or required for in-stream use? Calculating the volume of licensed water actually used would likely require more time and budget than would be practical for this Study, but any information on the extent of beneficial use that can be readily attained should be recorded.
    - To what extent are water demands expected to increase within the life of the 2013 Order of Approval?
    - To what extent are the increases likely to be offset by demand side management?
2. Can a portion of the required water be supplied from off-site locations? In addressing this question we assume that options such as the existing informal arrangement between the State of Washington and the Province of British Columbia for spring flows from Okanagan Lake will be discussed whereas major schemes such as those described by Kauffman (2000) and De Von (2001) and inter-basin water transfers as suggested by Anonymous (1969) are outside the terms of reference of this present Plan of Study.
3. What range of lake levels will meet the storage requirements?
4. What are the impacts of the lake levels necessary to store the required volume of water?

- Who, on both sides of the border and downstream, is affected by water levels? This question applies to the full spectrum of stakeholders including public and private agencies and organizations as well as individuals.
- How, and to what extent, are stakeholders affected at various lake elevations? Both positive and negative impacts must be considered. Both high and low water levels must be included because the storage can be accommodated at either end of the scale.
- How does the duration of the high or low lake level affect the impacts?
- Can some of the impacts be readily and practically mitigated? How and to what extent?
- What ranges of lake levels are acceptable to stakeholders at various times of the year? Why? What range is preferred?

5. Could wet and dry years be managed under a single set of lake elevation targets? What are the benefits, drawbacks and risks in doing so? What would those elevation targets be?

Description of Work

To answer question 1 the study should:

- Record current demand from listings of water rights and water licenses for surface water withdrawal, diversion and non-consumptive (in-stream) uses. The scope of investigation should include both the Canadian and U.S. portions of Osoyoos Lake and the U.S. Okanogan River. The amount and timing of each permitted withdrawal or diversion and the type of use should be recorded.
- If practical, record any readily available information indicating the portion of licensed water that is actually put to beneficial use.
- Record all available information on the depth of existing intake structures.
- Estimate future water demand to the year 2040 (approximately 25 years after the issuance of the 2013 Orders of Renewal) by:
  - summarizing available population growth projections
  - reviewing the increase in water license demand over the last 25 years
  - reviewing studies that predict water demand increases
  - include base flows and non-licensed flows for salmon migration and spawning as well as evaporation, transpiration and other losses
  - consider a full range of climatic conditions taking into account climate change
- Estimate the amount of storage needed in Osoyoos Lake to meet expected water demands in 2040.
- Within the terms of reference (i.e. not considering inter-basin transfers) investigate alternatives for meeting the Osoyoos Lake water demand.
- Calculate the lake elevations required to store the volume of water needed.
- Research demand side water management techniques and speculate on the degree to which they may be used to offset increases in demand.

- To provide answers to question 2 the study should consult with Water Managers to determine the extent of opportunities for meeting the future requirements.

To provide answers to question 3, the Study should:

- Determine the range of levels needed to accommodate storage demands
- Determine the maximum and minimum practical working levels
- Record the options for meeting requirements with the working levels

To provide answers to question 4, the Study should:

- Identify stakeholder groups in both the U.S. and Canada that would be positively or negatively affected by maximum lake levels in drought years. This will include, but not be limited to:
    - the Applicant
    - water licensees, water purveyors and all users of water both within and downstream from the lake
    - government agencies
    - waterfront property owners
    - Tribes and First Nations
    - those affected by water-based tourism such as motel/hotel operators, boaters, marina and campsite operators, and park operators
    - NGOs such as environmental societies and fish and game clubs.
- Consult key representatives of each stakeholder group and:
    - record their stated interests
    - describe how and to what extent they are impacted both negatively and positively at various water levels
    - describe how they are impacted over time (e.g. can they accept a greater range of levels for a restricted length of time)
    - record their perceptions of, and rationale for, the most suitable level and alternately levels that they could accept
    - garner their ideas regarding whether their interests could be mitigated
- Compile and review existing complaint logs, results of past public meetings and public hearings, complaint letters on agency files, newspaper articles and any other records of complaint. List:
    - the reason for the complaint
    - the lake levels that correspond to the date of complaints
    - the length of time the lake has been at or near that level

To address question 5 the study should use the information collected in 1,2 and 3 above to:

- Report on the risks of damages and the risks of water shortages at various water levels.
- Recommend (with accompanying rationale) preferred water levels for drought years (prioritize several options including the possibility of setting levels that could be followed in all years – both normal and drought).

Level of Detail

This study will need to be sufficiently detailed and extensive to accurately portray water demands and lake level impacts. The section on current water use should attempt to be accurate within 10%. Future demand should take into account the most recent and reasonable projections. The precautionary principle should be used to ensure that water demand is not underestimated.

The section on impacts must represent the complete range of interests, and stakeholder contact must be sufficiently extensive to accurately portray all the concerns. There must be a reasonably accurate idea of benefits and costs and risks resulting from various lake level alternatives.

Information must be sufficiently complete to allow the Commission to decide (after due public process) upon the requirements for the 2013 orders.

Study Product (Deliverables)

A report on:

- Water demand (present and 2040)
- Options for meeting demand
- Lake level options
- Impacts
- Necessity of drought year declaration

Estimated Cost

Based on rough estimates of the time and expertise we estimate that this study will cost between $60,000 to $80,000 USD.

Timeline

This study should be completed as soon as possible because the results will be of value when conducting Study 2. We suggest scheduling this Study in the 2008/2009 fiscal.

Selection of a Study Agent

This study would best be carried out by one or more of the government water resource management agencies. However, if this is not possible due to limited capacity and excessive workloads it could be offered through a “request for proposal” to a minimum of four consulting firms (preferably two based in the United States and two based in Canada).

All invited firms should have demonstrated experience and ability in dealing with similar types of study. Local knowledge and a thorough understanding of the issue would be an asset. Hydrological modeling, public survey and reporting expertise are required. Close direction is recommended by an assigned project monitor associated with the Commission, the Board of Control, or one of the government agencies.

Possible consultants include such companies as Dobson Engineering, Golder Associates, Hay & Company, Kerr Wood Leidal, Klohn Crippen, NW Hydraulics, or similar firms that have water management qualifications and experience.

Related Studies See Appendix I - 1

STUDY 2 – AN EVALUATION OF THE CRITERIA USED TO DECLARE DROUGHT

ISSUES LEADING TO THE STUDY

When a drought is declared Osoyoos Lake can be raised to 913.0 feet - 1.5 feet over the normal maximum. This level, if prolonged, damages properties and impacts businesses. Drought conditions, as defined by the current criteria, have been declared in 11 out of the 19 years since the 1987 supplemental Order of Approval was issued (although 3 of the declarations were rescinded midsummer when drought conditions abated). This rate of recurrence is sufficiently high that some stakeholders question the validity of the drought criteria.

SIGNIFICANCE OF THE ISSUES

If the maximum lake level allowable under drought conditions is prolonged through the summer it exposes properties to erosion, floods camping areas, beaches, and hayfields, exacerbates mosquito problems, and may raise the groundwater table, and cause septic fields to malfunction.

Climate studies indicate that if the same criteria are used in future, drought will be declared even more frequently. The frequency of drought declaration has resulted in numerous complaints and even threats of litigation (Symonds, 1992).

PRIORITY OF THE STUDY

The requirement for this study was identified by the Board. In addition, several persons attending IJC meetings held in 1999, 2002, 2003 and 2004 questioned the suitability of the criteria used to declare drought. The topic was also raised during our consultation work in 2005. For these reasons this study listed second in priority.

STUDY REQUIREMENTS

Purpose of the Study

Drought conditions are declared when any of the following criteria are met:

- The calculated or forecasted volume of flow in the Similkameen River at Nighthawk, for the period April through July as calculated or forecasted by the United States authorities, is less than 1.0 million acre-feet, or
- The net inflow to Okanagan Lake, for the period April through July as calculated or forecasted by Canadian authorities, is less than 195,000 acre-feet, or
- The level of Okanagan Lake fails to, or is forecasted by Canadian authorities to fail to, reach during June or July elevation 1122.8 feet (Canadian Geodetic Survey Datum).

Drought operations are terminated when, in the opinion of the Board, none of the 3 criteria exist.

The Similkameen River inflow is a logical criterion considering a combination of flows from Osoyoos Lake and the Similkameen River are needed to service irrigation pumps located downstream from the confluence of the Okanogan and Similkameen Rivers. The other two criteria are also sound choices since inflows to and from Okanagan Lake influence levels in Osoyoos Lake. Since the present criteria are valid, conducting a search for replacement criteria would not likely be productive (Brian Symonds, BC Ministry of Environment, personal communication). However, an investigation of the levels at which the criteria call for a drought would be very worthwhile.

Currently a full drought is declared regardless of whether only one or all three of the criteria are met and regardless of the degree to which those criteria are satisfied. For example, a slight water shortage in the Similkameen with sufficient water in the Okanagan is treated as a full drought – no differently than if both the Okanagan and the Similkameen were extremely dry. The purpose of Study 2 is to explore alternatives to the all or nothing approach to drought declaration. Methods are sought for rating the severity of each drought and then using the severity rating to prescribe the levels of storage water needed over time. For purposes of clarification an example of one possible method is shown in tables 3 and 4.

Table 3 – Example matrix for rating drought severity (values may be inappropriate and are listed only for purposes of illustration). Highlighted values are the ones selected for this fictitious example year.

Criterion	Stage	Drought Severity Rating (score)	Severity Rating Selection
Okanagan Lake Level (feet above sea level CGS Datum)	>1122.8	Low (1)	1
	1121.0 – 1122.8	Medium (2)	
	<1121.0	High (3)	
Okanagan Lake Inflow (acre-feet)	>195,000	Low (1)	
	130,00 - 160,000	Medium (2)	
	<130,000	High (3)	3
Similkameen River Inflow (acre-feet)	>1,000,000	Low (1)	
	500,00 - 750,000	Medium (2)	
	<500,000	High (3)	3
Total Severity Score			**7/9 = 78%**

Table 4 – Lake elevation ranges allowed at various levels of drought severity (fictitious example for illustrative purposes only)

Drought Severity	June	July	August	September	October
0-25%	911.0 - 913.0	911.0 – 912.5	910.5 – 912.5	910.5 – 912.5	910.5 – 912.0
25-50%	911.0 - 913.0	911.0 – 912.5	910.5 – 912.5	910.5 – 912.5	910.5 – 912.0
50 -75%	911.0 - 913.0	911.0 – 913.0	910.5 – 912.5	910.5 – 912.5	910.5 – 912.0
75 -100%	911.0 - 913.0	911.0 – 913.0	910.5 – 912.5	910.5 – 912.5	910.5 – 912.0

Questions to be Answered

Study 2 addresses the following questions:

1. What methods are in use in other places to define different levels of drought severity?
2. Which, if any, of these methods could be applied to the Osoyoos Lake water regulation program?
3. What advantages and disadvantages would the methods have in comparison with the present method?
4. How would the recommended methods have performed under the conditions experienced in the Okanagan/Similkameen basin over the last 20 years?
5. How acceptable would the revised system be to the stakeholders?

Description of Work

- Research and report on the methods used to manage droughts in other areas.
- Based on the research conducted, describe methods for drought declaration that take into account drought severity.
- Discuss and prioritize methods most suitable for the conditions experienced in the Okanagan. Provide reasons for the choices.
- Use retroactive analysis techniques to determine the outcome had the method of choice been used over the last 20 years. Report results.
- Consult with the Board and other experienced frontline water managers and decisions makers experienced with the Osoyoos Lake situation to get their advice on the pros and cons of the recommended system. Record results.
- Provide a summary report on all findings.

Level of Detail

This study will require extensive research and close consultation with a limited number of persons. Details must be sufficient to provide a complete description of the selected systems and a thorough understanding of potential performance in the Okanagan/Similkameen.

Study Product (Deliverables)

A report is required supporting the present system for drought declaration or listing one or more alternatives for establishing a severity-based drought declaration method.

Estimated Cost

The study will require research, consultation time and write up and is expected to cost between $30,000 and $40,000 U.S.. Added to this, will be a cost to agencies of involving their resource managers. This is expected to be contributed on an in-kind basis and is consequently not listed.

Timeline

The results of Study 1 would be valuable as a background to this study. Consequently the implementation of this study is recommended for 2009/2010.

Selection of a Study Agent

This study would best be carried out by one of the government agencies associated with water resource management and Osoyoos Lake (for example the U.S. Army Corps of Engineers, US Geological Survey, State of Washington Department of Ecology or the B.C. Ministry of Environment River Forecast Centre). The next choices (in order of priority) would be:

- a government sponsored drought research unit such as is found in the U.S. National Oceanic and Atmospheric Administration (NOAA), USGS, U.S. Dept. of Agriculture or Environment Canada's National Water Research Institute.
- a drought research unit associated with an academic institution such as the National Drought Mitigation Center in the School of Natural Resources at the University of Nebraska, the Earth Observatory Institute of Columbia University, the Climate Assessment Group of University of Arizona etc.. These types of institutions already will have researched similar topics.
- a company or private proprietorship that deals with hydrology (several are suggested in Study 3). Demonstrated experience and ability in dealing with similar types of study would be preferred.

Regardless of who is chosen to carry out the Study, close direction by the Board of Control, or one of the associated government agencies is recommended.

Related Studies See Appendix I - 2

STUDY 3 - A REVIEW OF THE DATES FOR SWITCHING BETWEEN SUMMER AND WINTER OPERATION

ISSUES LEADING TO THE STUDY

Osoyoos Lake levels are regulated differently in the winter than the summer. Summer operating conditions begin April 1 and end October 31. These dates conform to the irrigation season but not to the natural hydrograph which would peak between mid May and mid June and begin to subside soon after (Alexander et. al., 2005; Summit Environmental, 2002). This lack of synchrony with the natural cycle has been criticized because it fails to accommodate spring freshets and because it may impact natural biological processes.

SIGNIFICANCE OF THE ISSUES

Affect of timing on flood risk

Lake levels of at least 910.5 are reached by the end of March and are necessary to ensure that irrigation intakes are submerged sufficiently to avoid cavitations (International Joint Commission 1982). Only 1 foot of storage is available between this level and the normal year maximum. This equates to 5,660 acre feet (Washington State Department of Ecology, 1990).

The flood control benefits of one foot of storage are minimal. With the gates fully open, Zosel Dam can pass 2,500 cfs. In the last 55 years, the average monthly inflows in May have exceeded that level in only 3 years and so there is seldom a need for the storage. In the years in which average monthly inflows were greater than the capacity of the dam gates (1990, 1996 & 1997) there were major flood events and backwatering from the Similkameen River (as explained in the hydrology section). Under such conditions the one foot of storage would have been filled in just a few days and would not have reduced the maximum lake height.

Affect of timing on biological processes

Some individuals and agencies have suggested that the hydrograph (i.e. water levels and timing) should be kept as natural as possible to benefit biota around Osoyoos Lake and in the Okanogan River. As mentioned in the description of the basin, the South Okanagan is considered vitally important biologically and supports an amazing array of endangered animals and plants.

The present hydrograph cannot be changed much given that:

- most of the inflowing water originates from Okanagan Lake which is regulated under a set of rules outside of the jurisdiction of this Plan, and
- the rules established for Osoyoos Lake have been working to most peoples satisfaction and
- a complex mix of practices, expectations and physical structures has developed based upon existing lake levels and river flows.

Nevertheless, the maximum lake level allowed during a drought year might be tapered off as the irrigation season progresses and less water storage is required. This would provide lake levels that more closely resembled an unregulated situation and some species may benefit. On the other hand the water would not be available later when needed to boost instream flows for salmon and steelhead spawning in the Okanogan River. Earlier lowering of the lake is also likely to be opposed by boaters. The negative and positive biological benefits of altering the timing of flows need to be more closely defined.

Our consultations indicated that there was less concern for the date of changes than for the speed at which changes were made. It was suggested that a more gradual "ramping" of changes would be easier on fish and less likely to leave deposits of flotsam on the beaches. The fish issue was brought to the attention of the Board and the IJC by the Applicant in 2004. At that time additional flows were released to comply with a drought rescindment and these may have affected salmon migration and contributed to a fish kill (International Osoyoos Lake Board of Control, 2004 – Attachment A and Appendix 5).

Two citizens we contacted suggested that once drought has been declared and lake levels have been raised to 912.5 they should be kept there. One person specifically suggested the Plan of Study should include an investigation to define the ideal ramping rate.

PRIORITY OF THE STUDY

This study was identified by the Board, raised at public meetings in 1999 and 2003 and mentioned to us by lakeside residents, Ducks Unlimited and an endangered species recovery team (Appendix III). Consequently it rates number 3 in order of importance.

STUDY REQUIREMENTS

Purpose of the Study

This study is designed to examine practical alternatives to the present timing of lake levels and outflows and determine the advantages and disadvantages of switching to them.

Questions to be Answered

To address the purpose of this study, the following questions must be answered:

1. In a wet year what are the pros and cons of delaying the start of the summer schedule?
    - Could the maximum lake level be reduced (i.e. could flood waters be absorbed)? To what extent?
    - Could the duration of high water (>912.5 feet) be reduced? To what extent?
    - Would delaying the fill pose a risk of water shortage at any time?

    - Would it assist or hamper the out-migration of sockeye salmon smolts?
    - Would it have negative or positive impacts on other interests?
2. In a drought year, what are the pros and cons of switching to the winter schedule progressively by establishing target levels?
    - Who or what would benefit and to what extent?
    - What are the disadvantages? Who or what would be negatively affected? In what way? To what extent?
3. When changing lake levels and river flows what is the optimal rate of change (ramping rate)? Why?
4. What level of stakeholder acceptance is associated with the alternatives recommended?

Description of Work

- Reconstruct the hydrographs (lake levels over time) that occurred for each year since the last Orders were put into effect.
- Construct other alternative hydrographs that could have been used if seasonal timing was altered.
- Determine and record the pros and cons of each of the hydrographs from the point of view of
    - Flood control
    - Irrigation and domestic water use
    - Ecosystem benefits
- Evaluate and prioritize the various timing regime alternatives

Note that these tasks could readily and effectively be carried out by using a simulation model. As an example, the recently developed model called the "*Fish and Water Management Tool"* was built to predict the effect of various river flows and lake levels on irrigation demand, flooding, fisheries, and recreation in Okanagan Lake and River. The company that constructed the tool reports that it could readily be adapted to this use by adding in known hydraulic parameters and modifying the computer code (Clint Alexander, ESSA Technologies, personal communication). Other models such as the "*Water Use Analysis Model"* (Environment Canada) may be appropriate also.

Level of Detail

Modeling exercises can inflate errors in estimation. Therefore it is important that all values and estimates be as accurate as possible. Levels of confidence in the data should be stated.

Study Product (Deliverables)

The study product will be a report that provides an analysis of timing alternatives, shows positive and negative impacts on a wide variety of interests as a result of adopting various scheduling dates and recommends the order of priority of the various timing schedules.

Estimated Cost

Based upon discussions with a reputable hydraulic modeling company our estimate of cost for this Study is between $50,000 – 60,000 U.S..

Study Timeline

Decisions on the timing of lake levels and flows is somewhat dependent on the maximal allowable lake level. Thus this Study (like Study 2) would benefit from the results of Study 1. It should be scheduled in the 2009/2010 fiscal.

Selection of a Study Agent

The study agent should be selected through a request for proposal and should include government agencies such as the US Army Corps of Engineers and companies with a proven track record in hydraulic modeling such as ESSA Technologies, NW Hydraulics, Hay and Company, Klohn Crippen, or Golder Associates. Demonstrated familiarity with the Fish/Water Management Tool would be advantageous.

Related Studies See Appendix I - 3

STUDY 4 – AN INVESTIGATION OF THE EFFECTS, IF ANY, OF WATER REGULATION ON WATER QUALITY IN OSOYOOS LAKE

ISSUES LEADING TO THE STUDY

Many stakeholders are concerned about the water quality in Osoyoos Lake and have repeatedly asked the IJC to consider it when renewing the Osoyoos Lake Orders of Approval. The Commissioners have stated that water quality matters are handled by other agencies and are mostly beyond the terms of reference for this Plan of Study. However, the Commissioners have agreed to the inclusion of aspects of water quality that are directly affected by the operation of Zosel Dam.

SIGNIFICANCE OF THE ISSUES

Water quality in Osoyoos Lake has been poor for a long time. Nuisance algal blooms and excessive growths of algae on the rocks were recorded as far back as 1969 (Stockner et. al., 1972, and Truscott and Kelso, 1979). In fact, they detracted from most people's enjoyment of the beaches (Colins, 1973). In 1970 the Oroville Chamber of Commerce asked the IJC to look into pollution of the lake and they enclosed 49 additional letters of complaint from local residents.

Water quality continues to be a concern. It was brought up during public meetings the IJC held in 1999, 2004 and 2005 and it prompted the formation of the Osoyoos Lake Water Quality Society and the Osoyoos Lake Oxbow Restoration Society. Recent complaints include sediment buildup, mucky beaches, and declining salmonid populations (Eike Scheffler, president of the Osoyoos Lake Oxbow Restoration Society, personal communication). Some blame water quality on the lack of lake flushing, which they attribute to Zosel Dam (Scheffler and Linn, 2004). Both dam removal and increased flushing of the lake have been suggested to improve water quality.

Research confirms the fact that water quality is poor (BC Ministry of Environment,1996). However, studies on both sides of the border indicate that water quality has remained stable since the late 1970s and may even be improving slightly (Jensen and Epp, 2002; Rector, 1991, 1992, 1993).

Present problems include an excess of phosphorus and algae, low oxygen levels in the bottom waters and high water temperatures in the upper levels (Rankin et. al., 1998). These problems may be either exacerbated or improved by altering the timing and flow of water through the system. Whether and to what extent the dam affects water quality is not presently known but can be investigated.

PRIORITY OF THE STUDY

Beach and water based recreation is perhaps the most important economic driver on both sides of the border and it is dependent on good water quality (Collins, 1973). As stated by the Osoyoos Lake Water Quality Society "*Osoyoos Lake IS the focal point of the beauty of our Town and of*

our tourism industry. Without a healthy and attractive lake, our Town could very well become a "ghost" town. The water of Osoyoos Lake is, in fact, the LIFEBLOOD and the ESSENCE of our community's future".

Given the critical importance of this issue, it would be valuable to know whether changes could be made in the regulation of water levels and flows to benefit water quality. Although water quality is extremely important, it appears to be stable and the factors most responsible for poor water quality (diffuse, non-point phosphorus inputs) are not thought to be connected with water regulation. Consequently we have listed this study at the mid-point in list of priorities.

STUDY REQUIREMENTS

Purpose of the Study

The purpose of this study is to determine whether changes could be made to the operating plan for Zosel Dam that would improve water quality while maintaining the present purposes of the dam.

Questions to be Answered

1. What aspects of water quality are of concern (e.g. water clarity, algae, temperatures, oxygen levels etc)?
2. Why are they a concern (e.g. nuisance algae blooms, fish survival etc.)?
3. At what times of the year are they a problem?
4. What environmental factors control them (e.g. phosphorus inputs, water temperatures, lake stratification, winds, water levels, lake residence time)?
5. Which of these factors are affected by lake levels or flows? How?
6. What changes to the water regulation plan would benefit water quality? To what extent?
7. What impact would those changes have on other uses (flooding, water availability, etc.)?
8. Given the above, are recommendations to the regulation plan recommended?

Description of Work

- List and review existing studies of water quality for both the U.S. and Canadian portions of Osoyoos Lake that relate directly to the regulation plan.
- Determine the aspects of water quality that are beyond acceptable limits and at what times of the year.
- Confer with the Osoyoos Lake Water Quality Society, the Washington State Department of Ecology, and the BC Ministry of Environment to determine what features of water quality are of concern, and why, and at what times of the year.
- Review existing research and confer with acknowledged experts to define the environmental factors responsible for the water quality problems. Determine which of these are influenced by lake levels and flows.
- Review existing research and confer with acknowledged experts to determine whether and how Zosel Dam could be operated to benefit lake quality without unduly impacting existing uses. Include a consideration of flushing (speeding lake residence time) and consult the key

persons who operate the Fish Water Management Tool since their work is directly related. They include Brian Symonds, BC Ministry of Environment, Penticton; Dr. K. Hyatt, Canada Fisheries and Oceans, Naniamo; and C. Alexander, ESSA Technologies, Kelowna.

- Identify knowledge gaps that could be filled if additional studies were undertaken (e.g paleolimnological examinations of lake sediments to determine the extent of anthropogenic eutrophication in Osoyoos Lake).
- Report methods and results.
- In addition to the technical report prepare a summary of report findings suitable for a general audience that could be used for public distribution. Consult the IJC Project Monitor, Osoyoos Lake Board of Control and Water Quality Sections of Washington State Dept. of Ecology and BC Ministry of Environment for approval of final product.

Level of Detail

The Study should be limited and focused. The purpose is not to conduct water quality research and the focus is limited to the relationship between water quality and water regulation. All statements must be defensible, and backed by cited scientific evidence.

Study Product (Deliverables)

- A report defining water quality concerns in Osoyoos Lake and providing evidence of the links (or lack thereof) with dam operations.
- A short, clear, understandable, and appealing version of the report meant for the general public but approved before release by the IJC.

Estimated Cost

A considerable quantity of information is readily available on the subject so research time should be minimized. The cost (based on experience Glenfir Resources has had with similar projects) should be $25,000 to $35,000 USD for the combined time and work of the study agent and the limnologist. Printing and graphics costs will be a necessity, but because IJC would coordinate printing and distribution, we do not include a cost estimate for printing.

Timeline

This task should be completed as soon as possible (2008/2009) so that anecdotal information can be replaced with factual information.

Selection of a Study Agent

This study can be conducted in house by one of the agencies associated with the Board of Control or the IJC. Alternately it could be carried out by a governmental water quality group such as the BC Ministry of Environment Environmental Stewardship Division. If contracted the Study should go to a team consisting of a qualified and experienced limnologist with experience in water quality and hydrology plus a person with proven writing skills. Such a team may be housed within a University Water Study or be an outside contractor. Examples include:

University of BC Okanagan; Summit Environmental Consultants, Glenfir Resources, KWA Ecological Services.

Related Studies See Appendix I – 4

STUDY 5 – AN INVESTIGATION OF METHODS FOR INCLUDING ECOSYSTEM REQUIREMENTS IN ORDERS OF APPROVAL

ISSUES LEADING TO THE STUDY

Osoyoos Lake and Okanogan River support fish populations of commercial, cultural and scientific importance. Recent studies carried out cooperatively by the U.S. and Canada show that the volume of water pulsing through Osoyoos Lake may be critical for the survival of salmon.

Wetlands and riparian areas beside Osoyoos Lake and Okanogan River are home to an impressive array of endangered wildlife and plants. Fluctuations in lake levels directly affect their survival.

Teams of scientists are investigating the factors that limit these important populations. What is needed to ensure the 2013 Orders of Approval are receptive to ecosystem needs is a compilation of the local findings and a link between the present knowledge base and the conditions specified in the Orders.

SIGNIFICANCE OF THE ISSUES

Fish

Several notable fish species depend upon the operation of Osoyoos Lake. The Okanagan sockeye population is one of only two stocks remaining viable in the entire Columbia Basin (Bull, 1999). Upper Columbia steelhead are listed under the U.S. Endangered Species Act and Okanagan Chinook have been recommended for listing by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Adfluvial rainbow trout (lake dwellers that spawn in streams) also live in Osoyoos Lake and are considered the most vulnerable and important of the freshwater salmonids in the Canadian portion of the basin (Matthews and Bull, 2003).

A real time modeling program called the Fish and Water Management Tool (the Tool) is demonstrating that the flow of water through Osoyoos Lake is more critical for fish survival than had previously been realized (Alexander et. al., 2005). In summer, surface waters of the lake become intolerably hot while deep portions of the lake run low in oxygen (Rankin et. al., 1998). Only the mid-water “meta-limnion” is habitable and its size and condition depend in part on the volume and timing of water flowing through the lake. The Tool is being considered as a way to determine the extent of benefits that can result from “pulsing” flows through the lake in August and September.

In addition to suitable conditions in the lake, fish require water in the Okanogan River downstream from the lake. Suitable flows are required for migration, spawning, incubation, rearing, and passage through the dam. Years of inventory work have shown a consistent loss of about 50% of the adult sockeye salmon run during their migration between the Columbia River and spawning grounds in the Okanagan River (Bull, 1999). The reasons for those losses are yet to be proven but river flows and temperatures are suspected.

Colville Confederated Tribes have just begun a 20 year monitoring of salmon and steelhead passing Zosel Dam (John Arterburn, technician, personal communication). The Tribes are experiencing equipment malfunction (cavitation around the sensors) and are witnessing alterations of fish migratory behavior depending on lake levels and river flows (Appendix III). Likewise, the Canadian Okanagan Basin Technical Working Group has pointed out the need for continuing input into the water management process particularly since ongoing research is pointing out new information regularly.

Wildlife

The south Okanagan is one of Canada's most biologically diverse, species rich and endangered ecosystems (Sarell and Scott, 1995; Klenner and Scudder, 1999). Of all the habitat types the wetlands and riparian ecosystems are the most critical for wildlife (BC Ministry of Environment, Lands and Parks 1998). Despite their importance, wetlands have been impacted to a greater degree than any other type of habitat. Flood control and irrigation are blamed for much of the damage.

Nature Trust and Ducks Unlimited have purchased wetlands at the north end of Osoyoos Lake for wildlife. Similarly wetlands have been preserved in the U.S. between the lake outlet and Zosel Dam. Water level fluctuations affect these and other wildlife areas.

Plants

Water level is a fundamental element determining the location, biomass and annual production of riparian plants (Environment Canada, 2005).

British Columbia's Southern Interior Rare Plants Recovery Team has identified 3 endangered species of plants growing at the edge of Osoyoos Lake. These include Scarlet Ammania (*Ammania robusta*), Toothcup (*Rotala ramosier*), and Small-flowered Lipocarpha (*Lipocarpha micrantha*).

For Lipocarpha the COSEWIC (Committee on the Status of Endangered Wildlife in Canada) reports that "*Four of seven documented populations in Canada have been extirpated. The remaining populations are subject to extreme natural fluctuations, and are very sensitive to development and artificial manipulation of water levels… Artificial manipulation of water levels also threatens the viability of existing populations…Approximately 28 km of appropriate Lipocarpha micrantha habitat once occurred on Lake Osoyoos…70% has been lost to shoreline development…The remaining habitat is found on Indian Reserve land."* (*www.sararegistrt.gc.ca/)* For the other species the reports are similar – very limited distribution and abundance with viability threatened by habitat destruction and artificial lake level manipulation.

PRIORITY OF THE STUDY

In September, 2004 Governor Gary Locke of Washington advised the US Chair of the Commission that the State intends to apply for renewal of the Order. In that letter of intent he recommended that water quality and fishery issues be dealt with through existing venues not related to the Order. However, without encroaching on the management of these resources this

study could determine whether there are aspects of water regulation that would help to ensure the continued survival of native populations of fish, wildlife and plants. This is extremely important in an area as ecologically valuable as the Okanagan and it is made even more necessary with the prospect of continued climate change.

Apart from the moral duty to save threatened populations there are unmistakable legal obligations. The Columbia River Intertribal Fish Commission (CRITFC, 1996) clearly points out that the US government is legally bound to protect fish and tribal fisheries. Courts have acted in instances where uses of water have impacted fish habitat. For instance, a court order ruled that water had to be released from a dam in the Yakima River system to protect salmon redds from destruction.

Similarly, in Canada there is a legally binding fiduciary responsibility for federal fisheries authorities to protect the interests of aboriginal people. Many court decisions have supported it. For both ethical and legal reasons this study is not only included but listed fifth in order of priority.

STUDY REQUIREMENTS

Purpose of the Studies

This study is not meant to duplicate the work of agencies defining the factors limiting biotic populations or providing solutions for improving them. Rather, this study will link the Orders with ecosystem based concerns.

Questions to be Answered

1. Which agencies and groups are working on natural resource problems affected by Osoyoos Lake water levels and Okanogan River flows?
2. Which plant and animal species of special importance are affected by the operations of Zosel Dam?
3. How and when are these species affected?
4. Are there ways of lessening or mitigating these impacts?
5. Are there gaps in the present information base that should be filled in order to understand the effect of water regulation on the Osoyoos Lake ecosystem?
6. Which clauses could be included in the 2013 Orders of Approval for Zosel Dam to minimize the impacts of water regulation on the ecosystem?

Description of Work

Contact key agencies working on fish, wildlife, and plant stocks that are, or may be affected by the Osoyoos Lake water management program. This will include but not be limited to the 21 agencies named in Appendix I - G.

- Interview persons in charge of the studies by email, phone and when practical in person.
- Obtain and review key reports.

- Prepare a report briefly describing all studies relating to the fish, wildlife and plants that are affected directly or indirectly by the operations at Zosel Dam. Describe critical data gaps.
- Consult with Tribes, First Nations and ecological organizations.
- Devise practical ways in which the key ecological information might be considered in the 2013 Orders of Approval. Discuss these with the Board members to determine their practicality.
- Formulate, list and prioritize recommendations for ensuring that 2013 Orders of Approval reflect due diligence and best management practices in regard to fish, wildlife and plants and their habitats.

Level of Detail

This study should capture concepts only and cite references for those interested in details. A brief summary of ongoing and anticipated activities is needed with a clear indication of the connection to Osoyoos lake levels and Okanogan River flows. Consultation with the agencies, Tribes, and First Nations needs to be sufficiently thorough to scope out and record any concerns. The research and consultation stage needs to be followed by a discussion with the IJC regarding how the 2013 Orders might be worded to practice due diligence and best practice in regard to rare, endangered and ecologically important species.

Study Product (Deliverables)

- A report briefly documenting ongoing and planned studies.
- A record of consultations.
- A short list of recommendations in regard to the 2013 Orders.

Estimated Cost

This task will require extensive research, some travel for consultation, and write-up. The estimate is based upon the costs for similar projects recently completed. We estimate about $40,000 U.S.

Timeline

This study could be conducted at any time between 2008 and 2011. However, since the results might prove valuable to the other studies we suggest that this study be carried out in 2008/2009.

Selection of a Study Agent

This task could be conducted in house by an existing resource management agency such as the Washington Department of Ecology or one of the agencies of the Canadian Okanagan Basin Technical Working Group. Alternately it could be contracted out to a company or sole proprietorship specializing in biological studies. The agent should be able to demonstrate practical experience with several projects of a similar type. Assets would include knowledge of the area, knowledge of the agencies and issues both in Canada and the U.S., experience in

working with First Nations, and ability to cover fish, wildlife and botanical aspects. Examples of companies capable of carrying out this task would include: Glenfir Resources, KWA Ecological Services, and Summit Environmental Consultants.

Related Studies See Appendix 1 - 5

STUDY 6- AN INVESTIGATION OF METHODS FOR INCLUDING CLIMATE CHANGE INFORMATION IN ORDERS OF APPROVAL

ISSUES LEADING TO THE STUDY

Climate change is altering hydrologic patterns in the Okanagan and Similkameen basins. Changes in water supply and demand as well as the frequency and severity of floods and droughts are making it increasingly necessary to incorporate current science into water management decisions such as the renewal of Orders of Approval for Osoyoos Lake.

SIGNIFICANCE OF THE ISSUES

For about a century, increasing greenhouse gas concentrations have been warming the earth's global climate (IPCC 2001). The international scientific community has agreed that the changes are real and are likely to continue. Models have projected that in the Okanagan and Similkameen basins there will be reduced snowpacks, a more rain-dominated hydrograph, earlier peak runoff, and an extended period of low summer flows (Cohen and Kulkarni 2001; Cohen et al. 2004;Leith and Whitfield 1998; Leung et. al., 2004; Miles et al. 2000; Merritt and Alila 2004). In addition, both the frequency and severity of droughts are likely to increase in the future (Neilsen et al. 2004; Bill Taylor, Environment Canada, personal communication). The altered timing and magnitude of water flow into Osoyoos Lake will affect both lake levels and the operation of Zosel Dam.

Several scientists are aware of the need to apply information from large-scale global projections to finer-scale models that are useful to resource managers within a specific hydrologic basin. This procedure, known as downscaling is being investigated by several researchers, including Dr. Alan Hamlet, University of Washington, Seattle, who works with models for the Columbia Basin, and Dr. Younes Alila, University of BC, Vancouver, who works with models for the Okanagan Basin. The downscaling studies that have been completed or are underway may provide information that can be used in the renewal of Orders of Approval for Osoyoos Lake.

PRIORITY OF THE STUDY

Climate change was identified as an issue by both the IJC and the Board (IJC, 2005). Their decision is supported by the fact that the Okanagan Basin is one of the driest areas in Canada and is dependent on limited water supplies. Impacts have already begun to occur and are likely to continue (personal communications with Denise Neilsen, Agriculture & Agri-Food Canada; Bill Taylor, Environment Canada; Seshu Vaddey, US Army Corps of Engineers). Methods for putting climate change information to practical daily use are in their infancy but the subject is of sufficient importance that it deserves to be included in this Plan of Study.

STUDY REQUIREMENTS

Purpose of the Study

This study will prepare decision makers for possible alterations to the hydrology of the Okanagan and Similkameen basins that could occur because of climate change. Results will support decisions about thresholds for drought criteria, suitable lake levels, and the timing of lake level adjustments.

Study 6 must capture the current state of climate change knowledge, and identify gaps in this knowledge, specific to Osoyoos Lake and its inflows, Similkameen River, and Okanogan River.

Questions to be Answered

1. How sensitive is the hydrology of the Okanagan and Similkameen basins to trends and variations in the climate? Specifically, how have drought frequency and lake levels responded to the climate during the past century?

2. What do existing model simulations of future hydrologic conditions say about the potential effects of climate change on the hydrology of the Okanagan and Similkameen basins? How will climate change affect future demand for water? What is the magnitude of these changes relative to past experience?

3. What are the confidence levels surrounding the existing information and model projections?

4. How might climate change projections be incorporated into future Orders of Approval for Zosel Dam?

5. Given that the climate is expected to continue to change in the future, how can Orders of Approval be made sufficiently adaptive to incorporate future conditions?

Description of Work

To provide answers to the foregoing questions, the Study should:

- Review all climate change studies that have been conducted to date in the Pacific Northwest and specifically in the Okanagan and Similkameen basins. Report on the findings of climate studies over the past century. Specifically report any information that is directly relevant to Osoyoos Lake hydrology, inflows to Osoyoos Lake, and Similkameen River hydrology. Consult study authors and record additional information.
- Based on the above information, discuss how existing information from climate change models project hydrologic conditions in the Okanagan and Similkameen basins. Specify how, according to the model projections, inflows to Osoyoos Lake and Similkameen River may be affected in the future. Indicate the consequences for water supply, demand, and management. Report on the degree of confidence with the information.
- Following consultation with the Osoyoos Board of Control, recommend whether current model projections and other information should be incorporated into Osoyoos Lake water level Orders. If it appears practical to incorporate climate change science in the Orders of Approval, recommend methods for doing so.

- Identify gaps in the current knowledge of climate change in the Okanagan and Similkameen basins if, and as, they relate to the management of water levels in Osoyoos Lake. For any gaps identified, discuss whether current projects and initiatives in the Okanagan and Similkameen basins will provide information to address the gaps. If current projects and initiatives will not fill the gaps, specify the studies that would be required to do so.
- Recommend ways in which adaptive management could be used to incorporate future climate change information as it becomes available.
- Identify existing organizations and initiatives that the Commission could maintain contact with to stay informed with new climate science and information.

Level of Detail

The level of detail in Study 6 must be sufficient to provide a sound understanding of the current state of climate change science and the details specific to the Okanagan and Similkameen basins. The study must provide detailed recommendations stating how current climate change science could be incorporated in the Orders of Approval, or, if this is not possible, the study must specify how identified gaps could be filled to provide the necessary information.

Study Product (Deliverables)

A report summarizing applicable climate change knowledge and recommending how to apply it to 2013 Orders of Approval.

Estimated Cost

This Study is not meant to carry out new research but rather to analyze existing information that will support decisions directly related to the IJC Orders of Approval for Osoyoos Lake. The work should be very specific and assigned to an existing climate research group possessing the skill sets and information required to ensure the project is cost effective. The Study may necessitate travel to the Okanagan Basin and interviews with authors of current research initiatives. The estimated cost, based on consultations with leading climatologists is $40,000 to $60,000 U.S..

Timeline

The results of Study 6 could affect the decision made relative to the other studies Therefore it should be conducted as soon as possible. A minimum of 6 months should be allowed from start to completion but since this is a skilled task that should go to an existing science group it may have to be scheduled alongside other demands. Consequently, the longer the span between start and completion the better. Thus we are suggesting the entire fiscal year 2008/2009 be allowed for completion. The Study agent should be selected and informed in 2007/2008 if at all possible.

Selection of a Study Agent

The most efficient and cost-effective method of conducting Study 6 would be to issue a contract directly to one of the existing climate research groups in the Pacific Northwest. Possible groups include:

- U.S. Army Corps of Engineers (contact: Seshu Vaddey, Hydraulic Engineer, Seattle office);
- Climate Impacts Group, University of Washington, www.cses.washington.edu/cig/ (contact: Alan Hamlet, Water Resources Engineer);
- Canadian Institute for Climate Studies, University of Victoria, www.cics.uvic.ca/ (contact: Trevor Murdock, Associate Director);
- Adaptation and Impacts Research Group, Meterological Service of Canada and Institute for Resources, Environment and Sustainability, UBC, www.ires.ubc.ca/ (contact: Stewart Cohen, Research Scientist and Adjunct Professor).

These groups are closely involved with climate change research in the Pacific Northwest and will have much of the existing information available.

Related Studies and Existing Information Sources

See Appendix I - 6

Current climate change studies and organizations:

- Pacific Climate Impacts Consortium (under development) has the goal of bridging the gap between climate change researchers and resource managers, decision-makers, and other users of climate change information. www.PacificClimate.org

- Incorporating climate change into water resources planning in the Pacific Northwest. Contact: Seshu Vaddey, US Army Corps of Engineers, Seattle office.

- Adaptive management strategies for the Columbia River basin in response to climate change (part of the Accelerated Climate Prediction Initiative, ACPI). Contact: Alan Hamlet, Climate Impacts Group, University of Washington, Seattle.

- Decision support tool for Okanagan water resources. Contact: Stacy Langsdale or Stewart Cohen, Institute for Resources, Environment and Sustainability, UBC, Vancouver.

- Okanagan water balance study. Contact: Wendy Mason, Drought Response Division, Ministry of Environment, Victoria.

- Groundwater assessment in the Okanagan Basin. Contact: Vicki Carmichael, Groundwater Hydrologist, Ministry of Environment, Victoria.

STUDY 7 –A DEMONSTRATION OF THE FACTORS THAT GOVERN LAKE LEVELS DURING FLOODS

ISSUES LEADING TO THE STUDY

Sometimes Osoyoos Lake water levels rise above the maximums specified in the Orders. In most cases this is unpreventable and happens regardless of how Zosel Dam or other dams upstream are operated. However, many people living in the vicinity of Osoyoos Lake have not been fully informed that major flood events cannot be controlled by operating the dams.

SIGNIFICANCE OF THE ISSUE

Flooding occurs irregularly but frequently around Osoyoos Lake (see the chronicle in Appendix V). This raises the question of why the dams are not be used to control flood waters. In fact, this is not possible when unusually large volumes of water enter the system from upstream or when the Similkameen River restricts outflows from Osoyoos Lake. On these occasions flooding occurs regardless of how the dams are operated.

That said there has not been an independent review of the capability (or lack thereof) to achieve a measure of flood control through water storage and regulation. When a review has been carried out, an outreach program should be desigened to provide the information to stakeholders and the general public.

PRIORITY

The requirement for this study was identified by the Board. In addition, during our consultation sessions we often encountered misunderstandings about how the system works. Although this study is important it is not essential to either the operation of Zosel Dam or the Orders for the dam. Therefore we have listed it on the lower end of the priority list.

STUDY REQUIREMENTS

Purpose of the Study

The purposes of this study are twofold:

1. To conduct an independent professional review of the factors that effect flooding and the role played by Zosel Dam.
2. To design an outreach program that would inform and educate the public about:

- How water flows into and out of the Osoyoos Lake,
- How drought, normal, and high flow years differ,
- How system operations and lake levels differ depending on the type of flow year, and
- How natural circumstances can result in very high water levels regardless of how the regulatory structures in the system are operated.

Questions to be Answered

The independent review portion of the study should answer the following questions.

1. What circumstances result in Osoyoos Lake levels surpassing the normal year target level of 911.5? How often have such circumstances arisen?
2. Under the conditions of flooding that have occurred since the present dam was constructed, did Zosel Dam afford a degree of flood control? How? To what degree?
3. Under the conditions of flooding that have occurred since the present dam was constructed could the dam have been operated to provide a greater level of flood protection? How? What additional level of protection could have been achieved?
4. If operating Zosel Dam in a different manner would have had flood control benefits what negative or positive impacts would have been experienced in regard to other operational objectives?

The outreach portion of the study should answer the following questions.

1. Who is the target audience?
2. What medium or combination of media would best capture and explain the points above?
3. How should the product or products developed with the above media be delivered so as to reach the target audience?
4. Would there be any benefit to evaluating the effectiveness of a public outreach campaign to ensure the results were accomplished?
5. What types of companies should be contracted to implement the project?
6. How long will it take?
7. How much will it cost?

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Description of Work

The Study Agent for the independent review should:

- Consult with the Board and with water managers who have been involved with flooding events on Osoyoos Lake to:
  - Fully understand the hydrological patterns that occur in Osoyoos Lake
  - Clearly define the capacity to control floods through water regulation and the limitations on that capacity
- Document the instances since construction of the present dam when Osoyoos Lake has exceeded the normal year maximum level of 911.5 feet ASL.
- For each flood event determine whether the dam could have been operated to lessen the degree of flooding. Calculate the degree of improvement and comment on affects to other stakeholders
- Provide a professional assessment of the degree to which the present potential for water storage might be used to offset future flood events and recommend a course of action based upon those results.

The Study Agent of the outreach portion of the study should:

- Consult with the Board and with water managers who have been involved with flooding events on Osoyoos Lake to:
  - Identify specific problems and complaints that have arisen from a lack of understanding amongst the public

  - Understand the Board's desired outcomes from a public outreach campaign.
- Review meeting minutes, correspondence, notes and reports documenting public concerns relating to 1996, 1997 and other flood years (most of this information is on file at Washington Department of Ecology, the Oroville Tonasket Irrigation District, and the British Columbia Ministry of Environment). This review will identify the sectors of the public that would benefit most from an outreach and education campaign
- Using the information gathered above, as well as professional expertise and experience, identify the target audience and the key concepts and messages that need to be explained.
- Recommend the medium or media that would best convey the message to the target audience. Examples that should be considered include, but are not limited to: brochures, posters, webpostings, newspaper or TV ads showing still or animated cartoon-style clips, and a web-based interactive presentation.
- Identify how the key concepts would be depicted for each recommended medium and what each final product would contain.
- Recommend the type of campaign that would best deliver to the target audience the product or products resulting from use of the above media. Provide alternatives where practical.
- Advise the Board on the possibility and utility of conducting an effectiveness evaluation to determine how well the public outreach and education campaign worked.
- Provide time and cost estimates to develop the identified products and to develop and implement the campaign.
- Prepare a report on the results of the study.

Note, however, that a less effective but much cheaper and easier alternative to the aforementioned tasks is outlined under the "Estimated Cost" Section of this Study.

Level of Detail

The independent review of flood control need not be detailed but must fully cover all the conceptual aspects. For example, there is no need to detail each flood event but there is a need to detail the general mechanisms that have resulted in flood events.

The outreach portion must provide enough details to allow the Board to determine whether it is possible to reach their target public in a cost-effective and timely manner, and whether a public outreach campaign will produce the desired results.

Study Product (Deliverables)

The independent review of flood events should produce a report (signed off by a certified professional engineer) clearly stating the reasons for flooding and estimating the degree to which Zosel Dam might, or might not, be used to offset flooding.

The outreach portion should provide a report showing several options for implementing an awareness program complete with implementation methods and costs. The options presented should cover a wide range from simple (eg a brochure or short report) to more complex (a flash animated interactive presentation) with an estimate of benefits and costs for each option.

Estimated Cost

The time required to complete the independent review of flooding will be minimal since all the necessary background information is compiled and accessible. Furthermore, water managers with first hand experience with floods on this system are available for consultation. Thus the task is not an onerous one and could probably be completed by a competent and experienced company within 10 – 15 working days. On the other hand, it is unlikely that a credible engineering company will provide a professionally signed assessment in a high risk area such as flooding without a sufficient margin of profit. Thus we have estimated the independent review will cost in the neighborhood of $20,000 US.

The outreach portion of this study will likely also require 10 - 15 working days. Once again experienced professionals are needed. However, the lower risk in dealing with outreach rather than flood engineering may reduce the cost slightly ($15,000 US).

It is worth noting that the deliverable for the outreach program is advice and project design only. Costs of actually conducting the outreach program will be estimated in the design phase and will be dependent upon the outreach option chosen by the Board. If the Board feels that a major outreach program on flooding such as a flash animated interactive display is not warranted the Board should forego the outreach design portion of this Study and hire a small local graphics design/print shop to publish the review results in a brochure format. This would implement, not just recommend, the outreach project and could be carried out for about $10,000 US.

Timeline

Study 7 could be conducted at any time but it would be a valuable asset during the next flood event. This would suggest completion at the earliest possible opportunity. However, the study could conducted at a later date (2010/2011) in order to spread the costs of implementing the entire Plan of Studies over several years. Note, however, the possibility of saving money by combining study 1,7 and 8 (outlined in the Implementation Section).

Selection of a Study Agent

The independent review of flooding should involve a Study Agent with demonstrated experience and ability in dealing with similar types of hydrological assessments. Possible consultants include such companies as Dobson Engineering, Golder Associates, Hay & Company, Kerr Wood Leidal, Klohn Crippen, NW Hydraulics, or similar firms that have water management qualifications and experience.

The outreach portion of this Study is effectively a marketing design calling for a communications consulting firm that specializes in public outreach campaigns. Ideally, the consulting firm would have experience working with government or non-profit organizations. Examples of communications consulting firms that may be suitable candidates are:

- Concepts, Inc., www.conceptspr.com/
- Smith Marketing, Inc. www.smithmarketing.net/home.html
- Casals & Associates, Inc. www.casals.com/aboutus.htm
- IntegriMark, www.integrimark.com/

If the Board and the Commission chose to eliminate this portion of the Study in favour of a simple brochure production a local low cost graphics/print firm could be contracted such as

- Allegra
- Print Three
- Magpye Productions

All the aforementioned firms are found in Penticton but similar firms can be found in any moderate sized town or city.

Related Studies and Existing Information Sources

Studies related to this Study are provided in Appendix I – 7. In addition, an example of a relatively inexpensive flash animated interactive tool which could be very similar to the type needed for the Osoyoos Lake project can be found by using control click to select the following website, then selecting the Siphon example and clicking on the picture. The website is http://grow.arizona.edu/SPT--AdvancedSearch.php?vn=Format&vv="application/flash"&Debug=

The type of information that should be included is provided in the Special Statement on the IJC website (control click to view) http://www.ijc.org/php/publications/html/osoyoos/special_statement.htm

STUDY 8 - AN ASSESSMENT OF THE METHODS USED TO MONITOR FLOW CAPACITY IN THE OKANOGAN RIVER

ISSUES LEADING TO THE STUDY

Orders of Approval require the Applicant to ensure that the Okanogan River is able to pass as much water as Zosel Dam. Accordingly, the capacity of the river is monitored. Assurance is required that the monitoring methods can be depended upon to detect reductions in the capacity to convey flows. An independent review of the present method is recommended and if required alternative methods of monitoring should be investigated.

SIGNIFICANCE OF THE ISSUES

Prior to the issuance of the 1982 and 1985 Orders, blockages formed occasionally in Okanogan River between Osoyoos Lake and the Zosel Dam. These impediments reduced the channel's ability to convey flows. If similar blockages are allowed to form in future, conveyance capacity will be reduced, the control point for lake levels will be shifted from the dam to the river, the ability to regulate storage will be reduced or lost, and the risk of flood events will be increased.

Being fully aware of this, the IJC wrote Condition 4 into the 1985 Supplementary Order of Approval which stated:
"The Applicant shall take all measures necessary to ensure that the flow capacity of the Okanogan River, upstream and downstream from the control structure, enables the control structure to pass at least 2,500 cubic feet per second when the elevation of Osoyoos Lake is 913.0 feet USCGS and there is no appreciable backwater effect from the Similkameen River."

Shortly after the Orders were issued the Applicant surveyed the river at 4 cross sections every year (Washington State Dept. of Ecology, 1990). However, in 1983, 1984,1990, 1991, 1993, 1996 and 1997 surveys were unnecessary because the prescribed flows (at least 2,500 cfs) passed when the lake level was less than 913.0 feet. Hence, in 1998 the Applicant and the Board of Control agreed that annual hydrological records could be used to verify the channel capacity provided that:

- Four control sections were resurveyed every 10 years.
- If hydrological conditions to verify the channel's capacity did not occur for five consecutive years, the control sections would be resurveyed.
- A HEC-2 or equivalent backwater hydraulic analysis would be made whenever a resurvey was conducted.

Prior to the issuance of new Orders of Approval in 2013 the IJC and the Board need assurance that the present method of using hydrological records is the most practical and risk averse method for measuring channel capacity.

PRIORITY OF THE STUDY

The requirement for this study was identified by the Board. It was not raised as a concern during our consultation sessions, but this is not surprising, since most people are probably unaware of

the monitoring program. The importance of monitoring the capacity to convey high rates of flow is obvious but the priority of is lowered by the fact that the present monitoring methods appear to work adequately. Therefore, this study is recommended but is not rated as highly as the preceding ones.

STUDY REQUIREMENTS

Purpose of the Study

The purpose of this study is two fold.

1. to determine the adequacy of the present river monitoring program (Phase I)
2. if inadequacies are identified in Phase I - to prioritize and fully describe more suitable alternatives for monitoring the river (Phase II).

Questions to be Answered

Phase I

1. Has the conveyance capacity of Okanagan River between Osoyoos Lake and Zosel Dam been reduced since the last survey was completed (i.e. has the present method worked so far)?
2. What is the risk that reductions in the river's flow carrying capacity could escape detection under the present monitoring program?
3. Is the present monitoring program adequate or are there more effective alternatives?

Phase II (dependent on the outcome of Phase I)

1. What other methods could be used to predict channel capacity?
2. How do alternative methods compare with present monitoring techniques in regard to efficacy, practicality and cost effectiveness?
3. What is the recommended procedure and frequency for future monitoring of channel capacity?

Description of Work

In Phase I the Study Agent should:

- Consult with the Applicant, the contracted Operator (Oroville Tonasket Irrigation District) and members of the Osoyoos Lake Board of Control to gain a thorough understanding of the study objectives and particulars.
- Review existing channel surveys and HEC–RAS (Hydrologic Engineering Centre – River Analysis System) simulation models (US Army Corps of Engineers, 1970, 1982, 2005) to determine if flow constrictions have occurred since the present works were constructed and the channel was dredged.
- Provide an expert hydrologic engineering opinion, with accompanying arguments, on the risk and practicality of continuing to use the present monitoring system.
- If Phase II is required describe in greater detail the steps involved and the anticipated costs.

If Phase II is required, the Study Agent should carry out the steps outlined in Phase I. These will likely include:

- Provide a written review of monitoring methods used in similar situations elsewhere (e.g. stage/discharge rating curves and others). Discuss the practicality of using these methods to assess flow conveyance on the Okanogan River.
- Rate the present and alternative methods based upon efficacy, practicality, cost, benefit and risk and record rating rationale.
- After consultation with the Applicant and the Operator, prepare a detailed description of the selected monitoring system that can be included in the Applicant's Operating Procedures Plan for Zosel Dam and can be referred to in the 2013 Orders of Approval.

Level of Detail

The study will require careful attention to detail since minor changes must be detected prior to problems arising. However to minimize cost, Phase I should use existing analyses and avoid re-surveying the channel if possible.

If Phase II becomes necessary the review of alternate methods must be thorough and fairly extensive. Historical channel cross-sections may need to be re-surveyed and river monitoring may be required at selected stages and locations in Phase II. Modeling of the flow may be required at various daily mean discharges.

Study Product (Deliverables)

Phase I - a report assessing the efficacy of the present monitoring method and recommending whether the adequacy needs to be improved.
Phase II – a report on:

- Alternative methods (prioritized)
- Full assessment of the highest priority system of measurement

Estimated Cost

Dr. R. Newbury, consulting hydrologist, provided an estimate of $80,000 to $100,000 U.S. for both phases based upon the required tasks, estimated time for completion and fee schedule generally used by consulting firms. Further discussion with the Board indicated that costs should be lowered by Phasing the project and by using existing survey information to complete Phase I. Based upon the greatly reduced scope Phase I might be completed for about $35,000 US.

Costs for Phase II (if required) will be provided by the contractor for Phase I once that contractor has fully described the second phase.

Timeline

This study can be conducted at any time because the present monitoring method seems to be working adequately. Fiscal year 2010/2011 is recommended in order to spread the costs of all

Plan of Study projects over several fiscal years. Note, however, the possibility of reducing costs even further by implementing studies 1, 7 and 8 as mentioned in the Implementation Section.

Selection of a Study Agent

This study will require complex skills to analyze and model the channel hydraulics. The Study Agent must have demonstrated training, experience and skills in hydraulic engineering. The job could be done in-house by the Applicant or the US Army Corps of Engineers or contracted to a hydrology consultant such as Dobson Engineering, Golder Associates, Hay & Company, Kerr Wood Liedal, Klohn Crippen, NW Hydraulics, or similar firms.

Related Studies See Appendix I - 8

IMPLEMENTATION OF STUDIES

The first step for implementing this plan is to approve this draft and then transform it into an IJC document. Once this is done the IJC will be able to decide which studies will be carried out. These steps are expected to require the remainder of the 2006/2007 fiscal year. The following year is allowed for preparation of budgets and contracting documents.

The first study to be completed should be Study 1. The results of this study will help IJC decide whether drought years should need to be continued. It will also recommend a range of lake levels. This information is needed prior to conducting Study 2, which recommends lake levels in drought years, and Study 3, which assesses the dates for changing between winter to summer operations. These two studies (2 and 3) should be implemented in 2009/2010 when the results are in from Study 1.

Studies 4 and 5 evaluate the effects of dam operations on water quality and ecosystem values. Study 6 recommends how climate change information may be used in future Orders. All three of these studies are suggested for implementation in 2008/2009 so that the information is available for the Studies to be carried out in the following year.

Study 7 examines the adequacy of the present method of monitoring river capacity. Study 8 determines the degree to which water regulation can reduce flooding. Both of these studies should be carried out by a competent hydrologist - the same type of Study Agent contracted for Study 1. A cost saving could be realized by combining Studies 1, 7 & 8. However, Study 1 is the most essential task whereas 7 & 8 are the least essential of the Studies. Therefore we recommend leaving 7 & 8 until 2010/2011 in case funding restrictions preclude their completion. This also spreads the expenditures over several fiscal years.

The schedule outlined in Table 4 allows IJC to begin their deliberations based on study results in 2008/2009 and complete them in 2010/2011. There is then nearly two years to process the full set of findings in preparation for the 2013 Orders of Approval.

Table 4 Timing (US fiscal years) and approximate cost (US dollars) of the tasks needed to implement the Plan of Studies

Action	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013
Revise penultimate draft of Plan of Studies, select studies and prepare budget submissions							
Secure approval and budget for studies							
Conduct Study 1, decide whether to continue with drought declarations. Establish the maximum lake level.			**$70K**				
Subject to the results of Study 1, conduct Study 2 and establish lake levels for drought years.				**$35K**			
Considering the findings of Studies 1 & 2, conduct Study 3. Set dates for starting and finishing the summer seasons and set maximum ramping speed.				**$55K**			
Conduct Study 4 and determine whether changes in water management would improve water quality			**$30K**				
Conduct Study 5 and decide how to include Osoyoos Lake ecosystem requirements in Orders of Approval			**$40k**				
Conduct Study 6 and determine how to include climate change science in Orders of Approval.			**$50k**				
Conduct Study 7 to assess the factors governing lake levels during flood years and to relay results through a public outreach program.					**$35k**		
Complete Phase I of Study 8 and decide on necessity for revised river monitoring methods.					**$35K**		
Prepare Orders of Approval based upon Study Results							
Issue Orders of Approval							

PUBLIC INVOLVEMENT

Some of the persons contacted during the preparation of this plan proposed strengthening the public involvement process connected with the Orders of Approval. Ideas that were suggested included:

- Contacting stakeholders more frequently than once a year
- Establishing a public advisory committee with a local coordinator
- Establishing subcommittees to investigate topical issues if and when necessary,
- Setting up an easily accessible database to centralize a complete collection of information about Osoyoos Lake water regulation and flooding
- Providing official responses to those who make suggestions at public meetings
- Listing all measurements in metric and English and using both Canadian and US elevation measurements
- Publishing annual operational instructions not just drought declarations.
- Finding a “adaptive management” method which allow future Orders to meet changing conditions and incorporate new information.

The Board and the Commission have suggested that all those who attend the public meetings to be held in Osoyoos and Oroville on February 13 and 14, 2006 be invited to discuss these and other ideas for improving public input. The idea will be to include the salient points of the discussion in the Penultimate Draft of this Plan of Studies to be completed by the end of February, 2006.

Appendices for Plan of Study for Renewal of the International Joint Commission's Osoyoos Lake Orders

Prepared by
Glenfir Resources
December 14, 2005

LIST OF APPENDICES

APPENDIX I - REFERENCES

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- B C Ministry of Environment (Fisheries and Wildlife)
- Colville Confederated Tribes
- Columbia River Intertribal Fish Commission
- Chelan County Public Utility District
- Douglas County Public Utility District
- Ducks Unlimited
- Environment Canada
- Fisheries and Oceans Canada
- Grant County Public Utility District
- National Marine Fisheries Service
- Okanagan Nation Alliance
- Osoyoos Indian Band
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- The Nature Trust
- US Fish & Wildlife Service
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Appendix I I – References related to Study 8 (cited and additional)

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Appendix II – List of Contacts

Interest	Organization	First Name	Surname	Type of Contact	Date
Applicant	Washington State Dept. of Ecology	Ray	Newkirk	Meeting	4-Oct-05
Climatology	Agriculture & Agri-food Canada	Denise	Neilsen	Meeting	5-Oct-05
Climatology	Canadian Climate Impact and Adaptation Research Network	Josie	Cleland	COBTWG Newsletter	28-Nov-05
Climatology	Environment Canada	Bill	Taylor	Meeting	6-Oct-05
Climatology	Meteorlogical Service of Canada	Paul	Whitfield	COBTWG Newsletter	28-Nov-05
Climatology	Univ. Washington	Alan	Hamlet	Meeting	5-Oct-05
Climatology	US Army Corps of Engineers	Sashu	Vaddey	Meeting	5-Oct-05
Consultants	Alliance Professional Services	Joann	de Vries	COBTWG Newsletter	28-Nov-05
Consultants	Aqua Resource Management Inc	Kevin	Morris	COBTWG Newsletter	28-Nov-05
Consultants	Aquatic Resources Ltd.	Les	Brazier	COBTWG Newsletter	28-Nov-05
Consultants	BigSage Resources	Jane	Ritchie	COBTWG Newsletter	28-Nov-05
Consultants	Columbia Envrionmental Consulting Ltd.	Dwight	Shanner	COBTWG Newsletter	28-Nov-05
Consultants	consultant	Erik	Karlsen	COBTWG Newsletter	28-Nov-05
Consultants	Dobson Engineering	Don	Dobson	COBTWG Newsletter	28-Nov-05
Consultants	Eagle Eye Consulting	Jay	Johnson	COBTWG Newsletter	28-Nov-05
Consultants	Ecoscape Biological Consultants	Kyle	Hawes	COBTWG Newsletter	28-Nov-05
Consultants	Ed James Lake Forest Resources Ltd.	Howard	Smith	COBTWG Newsletter	28-Nov-05
Consultants	ESSA Technologies	Dave	Marmorek	COBTWG Newsletter	28-Nov-05
Consultants	Fisheries Development Services	Dave	Moore	COBTWG Newsletter	28-Nov-05
Consultants	ForeCon Consulting Services	Deborah	Clarke	COBTWG Newsletter	28-Nov-05
Consultants	Geostream Consulting	Lorne	Davies	COBTWG Newsletter	28-Nov-05
Consultants	Golder	Jay	Hammond	COBTWG Newsletter	28-Nov-05
Consultants	Golder	Duncan	Hendricks	COBTWG Newsletter	28-Nov-05
Consultants	Jackson Environmental	Caroline	Jackson	COBTWG Newsletter	28-Nov-05

Consultants	Katim Enterprises	Leanne	Atkinson	COBTWG Newsletter	28-Nov-05
Consultants	Kier Associates	Bill	Kier	COBTWG Newsletter	28-Nov-05
Consultants	KWA Ecological Sciences Inc.	Keith	Wolf	COBTWG Newsletter	28-Nov-05
Consultants	Landfall Consultants Ltd	Bruce	Fraser	COBTWG Newsletter	28-Nov-05
Consultants	Mould Engineering	Stuart	Mould	COBTWG Newsletter	28-Nov-05
Consultants	Naito Environmental	Gerry	Naito	COBTWG Newsletter	28-Nov-05
Consultants	Outdoor Discoveries	Roseanne	Van Ee	COBTWG Newsletter	28-Nov-05
Consultants	Redfish Consulting	Harvey	Andrusak	COBTWG Newsletter	28-Nov-05
Consultants	Regional District of Central Okanagan	Les	Gyug	COBTWG Newsletter	28-Nov-05
Consultants	Restoration Biologist	Sean	Bennett	COBTWG Newsletter	28-Nov-05
Consultants	Rural Resource Associates	Michelle	Boshard	COBTWG Newsletter	28-Nov-05
Consultants	Snowy River Consulting	Doug	Wahl	COBTWG Newsletter	28-Nov-05
Consultants	Summit Environmental	Brian	Guy	COBTWG Newsletter	28-Nov-05
Consultants	Summit Environmental	Brent	Phillips	COBTWG Newsletter	28-Nov-05
Consultants	Summit Environmental	Lars	Uunila	COBTWG Newsletter	28-Nov-05
Consultants	Summit Environmental Consultants	Brian	deJong	COBTWG Newsletter	28-Nov-05
Consultants	Summit Environmental Consulting Inc.	Hugh	Hamilton	COBTWG Newsletter	28-Nov-05
Consultants	Wildstone Resources Ltd.	Glenn	Smith	COBTWG Newsletter	28-Nov-05
Consultants		Sue	Austen	COBTWG Newsletter	28-Nov-05
Consultants		Robert	Hawes	COBTWG Newsletter	28-Nov-05
Environment	Adventure Okanagan Cooperative	Paul	Cabaj	COBTWG Newsletter	28-Nov-05
Environment	Agriculture Environment Initiatives	Brian	Baehr	COBTWG Newsletter	28-Nov-05
Environment	BC Conservation Foundation	David	Cassidy	COBTWG Newsletter	28-Nov-05
Environment	BC Environmental Network	Olga	Schwartzkopf	COBTWG Newsletter	28-Nov-05

Environment	BC Grasslands Council	Bruno	Delesalle	COBTWG Newsletter	28-Nov-05
Environment	BC Heritage Rivers Society	Eva	Durance	COBTWG Newsletter	28-Nov-05
Environment	BC Lake Stewardship Society	Daryl	Arsenault	Email	20-Oct-05
Environment	BC Lake Stewardship Society	Kristi	Carter	COBTWG Newsletter	28-Nov-05
Environment	BC Lake Stewardship Society	Angie	Cleveland	COBTWG Newsletter	28-Nov-05
Environment	BC Lake Stewardship Society	Heidi	Hicks	COBTWG Newsletter	28-Nov-05
Environment	BC Lake Stewardship Society	Stephen	Legris	COBTWG Newsletter	28-Nov-05
Environment	BC Lake Stewardship Society	Dawn	Roumieu	COBTWG Newsletter	28-Nov-05
Environment	BC Nature Trust	Jim	Hope	Email	20-Oct-05
Environment	BC Nature Trust	Carl	McNaughton	Email	20-Oct-05
Environment	BC Rivershed Society	Fin	Donelly	COBTWG Newsletter	28-Nov-05
Environment	BC Wetlands Society	Dave	Ingram	COBTWG Newsletter	28-Nov-05
Environment	BC Wildlife Federation	Ed	Garay	COBTWG Newsletter	28-Nov-05
Environment	BC Wildlife Federation	Lisa	Mose	COBTWG Newsletter	28-Nov-05
Environment	Boundary Creek Restoration Initiative	Bill	Baird	COBTWG Newsletter	28-Nov-05
Environment	Canadian Earth Care Foundation	Lloyd	Manchester	COBTWG Newsletter	28-Nov-05
Environment	Canadian Wildlife Service	Coral	deShield	COBTWG Newsletter	28-Nov-05
Environment	Christina Lake Stewardship Society	Marion	Beatty	COBTWG Newsletter	28-Nov-05
Environment	Christina Lake Stewardship Society	Brenda	Lacroix	COBTWG Newsletter	28-Nov-05
Environment	Coldstream Round Table	Coldstream	Roundtable	COBTWG Newsletter	28-Nov-05
Environment	Creek Clean up	Ron	Chmelyk	COBTWG Newsletter	28-Nov-05
Environment	Ducks Unlimited	Ken	Johnson	Phoned	20-Oct-05
Environment	Ducks Unlimited	Brad	Arner	Email	20-Oct-05
Environment	Ducks Unlimited	Ian	Barnett	COBTWG Newsletter	28-Nov-05
Environment	Ducks Unlimited Canada	Nichole	Rae	COBTWG Newsletter	28-Nov-05

Environment	Earthwild	Nola	Poirier	COBTWG Newsletter	28-Nov-05
Environment	Ecotrust	Edward	Backus	COBTWG Newsletter	28-Nov-05
Environment	Environmental Equity	Mike	Romaine	COBTWG Newsletter	28-Nov-05
Environment	Fraser Basin Council	Phil	Hallinan	COBTWG Newsletter	28-Nov-05
Environment	Grand Forks Watershed Coalition	Donald	Pharand	COBTWG Newsletter	28-Nov-05
Environment	Habitat Conservation Trust Fund	Liz	Stanlake	COBTWG Newsletter	28-Nov-05
Environment	Heritage Rivers Network	Mark	Angelo	COBTWG Newsletter	28-Nov-05
Environment	Kelowna and District Fish & Game	Dave	Henshaw	COBTWG Newsletter	28-Nov-05
Environment	Kettle Range Conservation Group	David	Heflick	COBTWG Newsletter	28-Nov-05
Environment	Kingfisher Interpretive Centre	Susan	Saloka	COBTWG Newsletter	28-Nov-05
Environment	Lake Country Watershed Roundtabe	Sky	Sigal	COBTWG Newsletter	28-Nov-05
Environment	Landing Nursery	Dave	Enns	COBTWG Newsletter	28-Nov-05
Environment	Mission Creek Greenway	Dorothy	Mills	COBTWG Newsletter	28-Nov-05
Environment	Mission Creek Greenway	Gail	Wright	COBTWG Newsletter	28-Nov-05
Environment	Mission Round Table	Mission	Roundtable	COBTWG Newsletter	28-Nov-05
Environment	Naramata Citizen's Association			COBTWG Newsletter	28-Nov-05
Environment	Naramata Creek Round Table	Ulli	Holdenried	COBTWG Newsletter	28-Nov-05
Environment	Nature Conservancy of Canada	Andrew	McDonald	COBTWG Newsletter	28-Nov-05
Environment	Nature Conservancy of Canada	Barb	Pryce	Email	20-Oct-05
Environment	Nature Conservancy of Washington	Nancy	Warner	COBTWG Newsletter	28-Nov-05
Environment	Nature Trust BC	Carl	McNaughton	Meeting	15-Nov-05
Environment	North Okanagan Naturalists Society	Ray	Arlt	COBTWG Newsletter	28-Nov-05
Environment	Northwest Environmental Training Center	Erick	McWayne	COBTWG Newsletter	28-Nov-05
Environment	NW Wildlfe Council	Stacey	Stacey Horton	Email	20-Oct-05
Environment	Okanagan Region Wildlife Heritage Fund Society	John	Holdstock	COBTWG Newsletter	28-Nov-05

Environment	Okanagan Region Wildlife Heritage Fund Society	Larry	Wunder	COBTWG Newsletter	28-Nov-05
Environment	Okanagan Simililkameen Conservation Alliance	Dick	Cannings	COBTWG Newsletter	28-Nov-05
Environment	Okanagan Similkameen Conservation Alliance	Judy	Brock	Email	24-Oct-05
Environment	Okanagan Similkameen Conservation Alliance	Peter	Ord	Meeting	1-Nov-15
Environment	Okanagan Similkameen Riparian Coordination Group	Sue	Austen	Meeting	15-Nov-05
Environment	Okanagan Similkameen Riparian Coordination Group	Karen	Millar	Meeting	1-Nov-15
Environment	Okanagan Similkameen Riparian Coordination Group	Lisa	Scott	Meeting	1-Nov-15
Environment	Okanagan Similkameen Riparian Coordination Group	Chris	Wood	Meeting	1-Nov-15
Environment	Okanogan Conservation District	Craig	Nelson	Email	20-Oct-05
Environment	Okanogan Valley Land Council	Christine	Olsen	Email	1-Oct-23
Environment	Osoyoos Desert Centre	Sara	Bunge	COBTWG Newsletter	28-Nov-05
Environment	Osoyoos Desert Society	Susan	Adams	Email	1-Oct-21
Environment	Osoyoos Lake Oxbow Society	Sheri	Linn	Email	20-Oct-05
Environment	Osoyoos Lake Oxbow Society	Eike	Schefler, Preident	Meeting	4-Oct-05
Environment	Osoyoos Lake Water Quality Society	Dennis	Potter	Email	23-Oct-05
Environment	Outdoor Recreation Council of BC	Jennifer	Grenz	COBTWG Newsletter	28-Nov-05
Environment	Pacific Streamkeepers Federation	Zoanne	Morton	COBTWG Newsletter	28-Nov-05
Environment	Pinchot Institute for Conservation	Naureen	Rana	COBTWG Newsletter	28-Nov-05
Environment	Restoration News	Eva	Johansson	COBTWG Newsletter	28-Nov-05
Environment	Salmon River Watershed Roundtable	Erin	Roberts	COBTWG Newsletter	28-Nov-05
Environment	Sierra Club of BC	Dave	Loewen	COBTWG Newsletter	28-Nov-05
Environment	Sierra Club of BC	Keith	Symington	COBTWG Newsletter	28-Nov-05
Environment	Similkameen River Conservation Committee			COBTWG Newsletter	28-Nov-05
Environment	South Okanagan Conservation Alliance	Lee	McFadyen	COBTWG Newsletter	28-Nov-05

Environment	South Okanagan Similkameen Conservation Program	Rick	McKelvey	Meeting	1-Nov-15
Environment	South Okanagan Similkameen Stewardship Program	Anthea	Bryan	COBTWG Newsletter	28-Nov-05
Environment	South Okanagan Sportsman's Association	Jay	Tipman	COBTWG Newsletter	28-Nov-05
Environment	South Okanagan Sportsman's Association	Maurice	Toporowski	COBTWG Newsletter	28-Nov-05
Environment	The Land Conservancy of BC	Shawn	Black	Email	1-Oct-21
Environment	The Land Conservancy of BC	Bill	Turner	COBTWG Newsletter	28-Nov-05
Environment	The Land Conservancy of BC	Nichola	Walkden	COBTWG Newsletter	28-Nov-05
Environment	Tidepool.org	Derek	Reiber	COBTWG Newsletter	28-Nov-05
Environment	West Coast Environmental Law	Barbara	Everdene	COBTWG Newsletter	28-Nov-05
Environment	WhiteValley Resource Centre	Tom	Minor	COBTWG Newsletter	28-Nov-05
First Nations	Columbia River Intertribal Fish Commission	Olney	Patt	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Canadian Columbia River Intertribal Fisheries Commission	Bill	Green	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Carrier Sekani Tribal Council	Marcel	Shepert	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	City of Penticton	Carolyn	Stewart	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Colville Confederated Tribes	Jerry	Marco	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Colville Confederated Tribes	Patti	Stone	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Colville Confederated Tribes	Bill	Towey	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	En'owkin Centre	Tim	Lezard	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	En'owkin Centre	Geraldine	Manossa	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Lower Similkameen Indian Band	Chief	Allison	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Lower Similkameen Indian Band	Jeremy	Crow	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Lower Similkameen Indian Band	Les	Louis	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Lower Similkameen Indian Band	Carrie	Terbasket	COBTWG Newsletter	28-Nov-05

First Nations & Tribes	Lower Similkameen Indian Band	Dixon	Terbasket	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Lower Similkameen Indian Band	Lauren	Terbasket	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Nk'mip Desert and Heritage Centre	Charlotte	Sanders	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Nk'Mip Desert Centre	Shelley	Witzky	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Indian Band	Chief	Alexis	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Indian Band	Okanagan	Band	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Indian Band	Holly	Brewer	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Indian Band	Keith	Louis	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Indian Band	Dan	Wilson	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Nation Alliance	Shayla	Lawrence	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Nation Alliance	Byron	Louis	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Nation Alliance	Vanessa	Mitchell	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Nation Alliance	Christina	Rowland	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Okanagan Nation Alliance	Pauline	Terbasket	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Osoyoos Indian Band	Herb	Alex	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Osoyoos Indian Band	Tony	Baptiste	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Osoyoos Indian Band	Steve	Bryson	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Osoyoos Indian Band	Yvonne	Weinert	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Richard	Armstrong	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Greg	Gabriel	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Marnie	Kruger	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	John	Kruger	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Travis	Kruger	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Duane	Marchand	COBTWG Newsletter	28-Nov-05

First Nations & Tribes	Penticton Indian Band	Henry	Michel	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Joan	Phillip	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Penticton Indian Band	Chief Stewart	Phillip	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Secwepmc Fisheries Commission	Murray	Ross	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	SenPokChin School	Ruth	Laurie	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Shuswap Nation Fisheries Commission	Pat	Matthew	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Turtle Island Native Network	Bob	Kennedy	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Upper Nicola Indian Band	Chief	Holmes	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Upper Nicola Indian Band	John	Stewart	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Upper Similkameen Indian Band	Phillippe	Batani	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Upper Similkameen Indian Band	Brenda	Gould	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Westbank First Nation	Paul	Birzins	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Westbank First Nation	Connie	Clough	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Westbank First Nation	Barb	Coble	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Westbank First Nation	Rose	Lube	COBTWG Newsletter	28-Nov-05
First Nations & Tribes	Westbank First Nation	James	Montain	COBTWG Newsletter	28-Nov-05
First Nations & Tribes		Marie	Baptiste	COBTWG Newsletter	28-Nov-05
First Nations & Tribes		Tracey	Jack	COBTWG Newsletter	28-Nov-05
First Nations & Tribes		Amanda	Montgomery	COBTWG Newsletter	28-Nov-05
First Nations & Tribes		Betty	Rebellato	COBTWG Newsletter	28-Nov-05
First Nations & Tribes		Alfred	Snow	COBTWG Newsletter	28-Nov-05
First Nations and Tribes	Columbia River Intertribal Fish Commission	Jeff	Fryer	Email	26-Oct-05
First Nations and Tribes	Columbia River Intertribal Fish Commission	Jim	Heffernan	Email	26-Oct-05
First Nations and Tribes	Colville Confederated Tribes	Joe	Peone	Phone/Email	21-Oct-05

First Nations and Tribes	Colville Confederated Tribes	Kathyrn	Brightman	Email	26-Oct-05
First Nations and Tribes	Colville Confederated Tribes	Chris	Fisher	Email	21-Oct-05
First Nations and Tribes	Colville Confederated Tribes	Gary	Passmore	Email	21-Oct-05
First Nations and Tribes	Nez Perce Tribe	Robert	Taylor	Email	26-Oct-05
First Nations and Tribes	Okanagan Nation Alliance	Kari	Long	Meeting	1-Nov-15
First Nations and Tribes	Okanagan Nation Alliance	Deana	Machin	Meeting	1-Nov-05
First Nations and Tribes	Okanagan Nation Alliance	Howie	Wright	Meeting	17-Oct-05
First Nations and Tribes	Osoyoos Indian Band	Ron	Hall	Phoned	24-Oct-05
First Nations and Tribes	Osoyoos Indian Band	Chief Clarence	Louie	Phoned	24-Oct-05
First Nations and Tribes	Osoyoos Indian Band	Mike	Watson	Phoned	24-Oct-05
Fisheries	Canadian Okanagan Basin Technical Working Group	Elmer	Fast	Meeting	30-Nov-05
Fisheries	Canadian Okanagan Basin Technical Working Group	Elmer	Fast	Meeting	28-Nov-05
Fisheries	Canadian Okanagan Basin Technical Working Group	Jillian	Tamblyn	Email	24-Oct-05
Fisheries	BC Federation of Flyfishers			COBTWG Newsletter	28-Nov-05
Fisheries	BC Wildlife Federation	Bill	Otway	COBTWG Newsletter	28-Nov-05
Fisheries	BPA	Linda	Hermeston	COBTWG Newsletter	28-Nov-05
Fisheries	British Columbia Freshwater Institute	Nelson	Jatel	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Terry	Bedard	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Anita	Bedo	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Patricia	Carlson	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Mike	Crowe	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Dennis	Demontier	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Elmer	Fast	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Mike	Flynn	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Cindy	Harlow	COBTWG Newsletter	28-Nov-05

Fisheries	Canada Fisheries & Oceans	Jeremy	Heighton	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Don	Lawseth	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Elizabeth	Leboe	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Fred	Lockwood	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Brad	Mason	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Brad	Parker	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Paul	Rankin	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Cameron	West	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Timber	Whitehouse	COBTWG Newsletter	28-Nov-05
Fisheries	Canada Fisheries & Oceans	Ed	Woo	COBTWG Newsletter	28-Nov-05
Fisheries	Columbia Basin Trust	Kindy	Gosal	COBTWG Newsletter	28-Nov-05
Fisheries	Columbia Basin Trust	Columbia	Trust	COBTWG Newsletter	28-Nov-05
Fisheries	Committee on the Status of Endangered Wildlife in Canada	Mart	Gross	COBTWG Newsletter	28-Nov-05
Fisheries	Environment Canada	Trish	Hayes	COBTWG Newsletter	28-Nov-05
Fisheries	FishingwithRod.com	Rodney	Hsu	COBTWG Newsletter	28-Nov-05
Fisheries	Freshwater Fisheries Society of BC	Mark	Siemens	COBTWG Newsletter	28-Nov-05
Fisheries	Governor's Salmon Recovery Office	Bob	Bugert	COBTWG Newsletter	28-Nov-05
Fisheries	Kalamalka Flyfishers	Kerry	Parks	COBTWG Newsletter	28-Nov-05
Fisheries	Lonely Loon Flyfishers	Dave	Hamilton	COBTWG Newsletter	28-Nov-05
Fisheries	Lonely Loon Flyfishers	Paul	Phillips	COBTWG Newsletter	28-Nov-05
Fisheries	Lonely Loon Flyfishers	Glen	Wittur	COBTWG Newsletter	28-Nov-05
Fisheries	Lonely Loons Club	Mike	Brown	COBTWG Newsletter	28-Nov-05
Fisheries	Ministry of Environment	Jerry	Mitchell	COBTWG Newsletter	28-Nov-05
Fisheries	Nooksack Salmon Enhancement Association	Wendy	Scherrer	COBTWG Newsletter	28-Nov-05

Fisheries	North Olympic Salmon Coalition	Kevin	Long	COBTWG Newsletter	28-Nov-05
Fisheries	Northwest Power Planning Council	Tony	Grover	COBTWG Newsletter	28-Nov-05
Fisheries	NW Chinook Recovery	John	Sayre	COBTWG Newsletter	28-Nov-05
Fisheries	Oceola Fish and Game	Bill	Bosch	COBTWG Newsletter	28-Nov-05
Fisheries	Oceola Fish and Game	Ron	Taylor	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Fisheries Resource Conservation Council	Gordon	Ennis	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Fisheries Resource Conservation Council	John	Fraser	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Commission	Garnet	Jones	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Commission	Russ	Jones	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Commission	Gerry	Kristianson	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Foundation	Paul	Kariya	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Foundation	John	Macdonald	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Foundation	Angus	MacKay	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Foundation	Brenda	McIntyre	COBTWG Newsletter	28-Nov-05
Fisheries	Pacific Salmon Foundation	Lucy	Reis	COBTWG Newsletter	28-Nov-05
Fisheries	Peachland Sportmens Association			COBTWG Newsletter	28-Nov-05
Fisheries	Penticton Flyfishers	Tom	Dellamater	COBTWG Newsletter	28-Nov-05
Fisheries	Penticton FlyFishers	Jon	Pew	COBTWG Newsletter	28-Nov-05
Fisheries	Penticton Flyfishers	Kevin	Smith	COBTWG Newsletter	28-Nov-05
Fisheries	Penticton Flyfishers	Bruce	Turnbull	COBTWG Newsletter	28-Nov-05
Fisheries	Salmon Recovery Funding Board	Marc	Duboiski	COBTWG Newsletter	28-Nov-05
Fisheries	Salmon River Watershed Roundtable	Mike	Wallis	COBTWG Newsletter	28-Nov-05
Fisheries	Skagit Fisheries Enhancement Group	Alison	Studley	COBTWG Newsletter	28-Nov-05
Fisheries	Sport Fish Advisory Board	Bob	Otway	COBTWG Newsletter	28-Nov-05

Fisheries	Summerland Trout Hatchery	Darren	Greiner	COBTWG Newsletter	28-Nov-05
Fisheries	Trout Unlimited	Todd	Cashin	COBTWG Newsletter	28-Nov-05
Fisheries	UCRFEG	Vanessa	Richter	COBTWG Newsletter	28-Nov-05
Fisheries	Upper Columbia Region Fisheries Enhancement Group			Email	24-Oct-05
Fisheries	Upper Columbia Regional Fish Enhancement Group			Email	23-Oct-05
Fisheries	Upper Columbia RFEG	Lael	Duncan	COBTWG Newsletter	28-Nov-05
Fisheries	Washington Department of Fish and Wildlife	Mark	Cookson	COBTWG Newsletter	28-Nov-05
Fisheries	Washington St Dept. Fish and Wildlife	Dale	Swedberg	COBTWG Newsletter	28-Nov-05
Fisheries	Washington State SRFBoard	Barb	McIntosh	COBTWG Newsletter	28-Nov-05
Fisheries	WDFW	Heather	Bartlette	COBTWG Newsletter	28-Nov-05
Fisheries	WildSalmon			COBTWG Newsletter	28-Nov-05
Government (BC)	B C Ministry of Environment	Andrew	Wilson	Meeting	1-Nov-15
Government (BC)	B C Ministry of Environment - Fisheries	Steve	Matthews	Meeting	1-Nov-15
Government (BC)	BC Ministry of Environment - Waste	Vic	Jensen	Meeting	1-Nov-15
Government (BC)	BC Ministry of Water, Land, and Air Protection	Tom	Ethier	COBTWG Newsletter	28-Nov-05
Government (BC)	BC Parks	Blake	Dixon	COBTWG Newsletter	28-Nov-05
Government (BC)	BC Parks	Dave	Goertzen	COBTWG Newsletter	28-Nov-05
Government (BC)	Evironment Canada	Gretchen	Harlow	COBTWG Newsletter	28-Nov-05
Government (BC)	Interior Health	Mike	Adams	COBTWG Newsletter	28-Nov-05
Government (BC)	Land & Water BC	Kevin	Dickenson	Email	21-Oct-05
Government (BC)	Land & Water BC	Wenda	Mason	COBTWG Newsletter	28-Nov-05
Government (BC)	Land & Water BC	Jim	Mattison	COBTWG Newsletter	28-Nov-05
Government (BC)	Land & Water BC	Don	McKee	COBTWG Newsletter	28-Nov-05
Government (BC)	Land & Water BC	Michele-Lee	Moore	COBTWG Newsletter	28-Nov-05

Government (BC)	Ministry of Agriculture & Lands	Wray	MacDonnell	Email	21-Oct-05
Government (BC)	Ministry of Agriculture & Lands	Carl	Withler	Email	26-Oct-05
Government (BC)	Ministry of Agriculture and Fisheries	Ted	van der Gulik	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Agriculture and Lands	Kevin	Murphy	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Jamie	Alley	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Drew	Carmichael	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Tony	Cheong	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Ted	Fuller	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Geri	Huggins	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Brian	Jantz	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Rob	Knight	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Sue	Latimer	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Terry	MacDonald	Email	26-Oct-05
Government (BC)	Ministry of Environment	Laura	Nield	Meeting	1-Nov-15
Government (BC)	Ministry of Environment	Brian	Nuttall	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	David	Ranson	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Kevin	Rieberger	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Ron	Smith	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	David	Tesch	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Daymon	Trachsel	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment	Nancy	Wilkin	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment - Fisheries	Albert	Chirco	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment - Habitat	Andrew	Witt	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment - Parks	Rose	Gunoff	notice drop off	17-Oct-05

Government (BC)	Ministry of Environment - Water	Ray	Jubb	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment - Water	Brian	Symonds	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Environment Rare Species Recovery Team	Brenda	Costanzo	Email	1-Oct-20
Government (BC)	Ministry of Environment Rare Species Recovery Team	Orville	Dyer	Email	1-Oct-20
Government (BC)	Ministry of Environment Rare Species Recovery Team	Terry	McIntosh	Email	1-Oct-20
Government (BC)	Ministry of Environment Rare Species Recovery Team	Bryn	White	Email	1-Oct-20
Government (BC)	Ministry of Forests & Range	Rita	Winkler	COBTWG Newsletter	28-Nov-05
Government (BC)	Ministry of Health	John	Beaupre	Phone	3-Nov-05
Government (BC)	MWLAP	Des	Anderson	COBTWG Newsletter	28-Nov-05
Government (BC)	MWLAP	Alec	Dale	COBTWG Newsletter	28-Nov-05
Government (BC)	MWLAP	Ted	Down	COBTWG Newsletter	28-Nov-05
Government (BC)	MWLAP	Orville	Dyer	COBTWG Newsletter	28-Nov-05
Government (BC)	MWLAP	Phil	Epp	COBTWG Newsletter	28-Nov-05
Government (BC)	Provincial Emergency Program	Bob	Bugslag	Email	23-Oct-05
Government (BC)	Washington Dept of Natural Resources	Wes	Culp	Email	24-Oct-05
Government (Canada)	Agriculture Canada (PARC)	Barry	Grace	Email	29-Oct-05
Government (Canada)	Canada Fisheries & Oceans	Richard	Bailey	COBTWG Newsletter	28-Nov-05
Government (Canada)	Canada Fisheries & Oceans	Daryl	Hussey	Email	1-Oct-21
Government (Canada)	Canada Fisheries & Oceans	Bruce	Runciman	Email	1-Oct-21
Government (Canada)	Canada Fisheries & Oceans	Garth	Traxler	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Mary	Berube	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Stewart	Cohen	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Xin	Gao	COBTWG Newsletter	28-Nov-05

Government (Canada)	Environment Canada	Bruce	Kay	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Paul	Kluckner	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Beverly	McNaughton	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Daniel	Millar	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Tina	Neale	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada	Bill	Taylor	Meeting	5-Oct-05
Government (Canada)	Environment Canada	Lisa	Vitols	COBTWG Newsletter	28-Nov-05
Government (Canada)	Environment Canada - Canadian Wildlife Service	Christine	Bishop	Email	1-Oct-20
Government (Canada)	Environment Canada Pacific & Yukon Region	Mary	Pender	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries & Oceans Canada	Barry	Rosenberger	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries & Oceans Canada	Margot	Stockwell	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries and Oceans Canada	Kim	Hyatt	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries and Oceans Canada	Lidia	Jaremovic	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries and Oceans Canada	Adrian	Wall	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries and Oceans Canada	Dean	Watts	COBTWG Newsletter	28-Nov-05
Government (Canada)	Fisheries and Oceans Canada - Habitat	Lisa	DeGoes	COBTWG Newsletter	28-Nov-05
Government (Canada)	Transport Canada - Navigation	John	Mackie	Email	1-Oct-21
Government (Canada)	Water Survey of Canada	Grant	McGillivray	COBTWG Newsletter	28-Nov-05
Government (County)	Okanogan County	Andy	Lampe	Email	21-Oct-05
Government (County)	Okanogan County	Bud	Hover	Email	21-Oct-05
Government (County)	Okanogan County Board of Commissioners	Nick	Christoph	Email	21-Oct-05
Government (County)	Okanogan County Board of Commissioners	Bud	Hover	Email	1-Oct-21
Government (County)	Okanogan County Board of Commissioners	Andy	Lampe	Email	1-Oct-21
Government (County)	Okanogan County Board of Commissioners	Mary Lou	Peterson	Email	1-Oct-21

Government (County)	Okanogan County Office of Planning and Development	Julie	Dagnon	COBTWG Newsletter	28-Nov-05
Government (County)	Okanogan County Public Health	Gary	Robbins	Phone	31-Oct-05
Government (County)	Okanogan County, Office of planning and Development, Natural Resource Division	Nick	Christoph	Email	1-Oct-20
Government (Municipal)	City of Kelowna	Corey	Davis	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Kelowna	Danielle	Drieschner	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Kelowna	Tracy	Guidi	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Kelowna	Fred	Schaad	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Kelowna	Mark	Watt	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Kelowna Env. Dept.	Michelle	Kam	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Penticton	Brent	Edge	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Penticton	Berne	Udala	COBTWG Newsletter	28-Nov-05
Government (Municipal)	City of Vernon	Dan	Passmore	COBTWG Newsletter	28-Nov-05
Government (Municipal)	District of Summerland	Dave	Hill	COBTWG Newsletter	28-Nov-05
Government (Municipal)	District of Summerland	Tim	Palmer	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Municipality of Summerland	George	Redlich	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Princeton	Michael	McLaughlin	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Town of Oliver	Bob	Grant	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Town of Oliver	Bruce	Hamilton	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Town of Oliver	Tom	Szalay	COBTWG Newsletter	28-Nov-05
Government (municipal)	Town of Oroville			Dropoff Notice	19-Oct-05
Government (Municipal)	Town of Osoyoos	Ron	Doucette	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Town of Osoyoos	Elsie	Lemke	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Town of Osoyoos			Dropoff Notice	1-Oct-21
Government (Municipal)	Town of Osoyoos			Dropoff Notice	1-Oct-21

Government (Municipal)	Town of Princeton	Keith	Olsen	COBTWG Newsletter	28-Nov-05
Government (Municipal)	Township of Spallumcheen	John	Pardell	COBTWG Newsletter	28-Nov-05
Government (Regional)	Ok Basin Water Bd			Email	1-Oct-17
Government (Regional)	Okanagan Basin Water Board	Greg	Armour	Phone/Email	21-Oct-05
Government (Regional)	Regional District of Central Okanagan	Robert	Hobson	COBTWG Newsletter	28-Nov-05
Government (Regional)	Regional District of Central Okanagan	Brent	Magnan	COBTWG Newsletter	28-Nov-05
Government (Regional)	Regional District of Central Okanagan - Parks & Recreation	Alison	Urness	COBTWG Newsletter	28-Nov-05
Government (Regional)	Regional District of Okanagan Similkameen	Eike	Schefler, Regional Director	Meeting	4-Oct-05
Government (Regional)	Regional District of Okanagan Similkameen	Susan	Theuror	Email	1-Oct-21
Government (Regional)	Regional District Okanagan Similkameen	Andrew	Reeder	Phone (message)	22-Oct-05
Government (Regional)	Regional District Okanagan Similkameen	Susanne	Theurer	Email/Phone	21-Oct-05
Government (Regional)		A.	Reeder	Email	1-Oct-21
Government (US)	Bureau of Land Management	Bob	Troiano	COBTWG Newsletter	28-Nov-05
Government (US)	Bureau of Reclamation	Greg	Knott	Email	21-Oct-05
Government (US)	Bureau of Reclamation	Scott	Willey	Phone/Email	21-Oct-05
Government (US)	National Marine Fisheries Service	Lynn	Hatcher	Email	21-Oct-05
Government (US)	National Marine Fisheries Service	Kristine	Petersen	Email	21-Oct-05
Government (US)	National Oceanic & Atmospheric Administration	Bob	Lohn	Email	21-Oct-05
Government (US)	US Bureau Land Mgmt	Sharon	Morse	COBTWG Newsletter	28-Nov-05
Government (US)	US Bureau of Land Management	Joe	Kelley	Email	1-Oct-21
Government (US)	US Coast Guard	K	Brown	Email	5-Nov-05
Government (US)	US Dept. Agriculture - Washington	Randy	Kelley	Email	1-Oct-21
Government (US)	US Fish & Wildlife	Greg	van Stralen	Email	1-Oct-21
Government (US)	US Fish & Wildlife Service	Mark	Miller	Phone and Email	26-Oct-05

Government (US)	US National Marine Fisheries Service	Lynn	Hatcher	Email	1-Oct-21
Government (US)	US National Oceanic & Atmospheric Administration (NOAA)	Bob	Lohn	Email	1-Oct-21
Government (Washington)	Dept of Ecology, Water Resources Program	Ken	Slattery	Email	1-Oct-21
Government (Washington)	Dept of Natural Resources	Wes	Wes	Email	1-Oct-22
Government (Washington)	Washington Department of Ecology, Ecology Central Regional Office, Shorelands & Environmental Assistance	John	Monahan	COBTWG Newsletter	28-Nov-05
Government (Washington)	Washington Dept of Ecology	Kathy	Hamel	Email	21-Oct-05
Government (Washington)	Washington Dept of Fish & Wildlife	Carmen	Andonaegui	Email	26-Oct-05
Government (Washington)	Washington Dept of Fish & Wildlife	Dennis	Beich	Email	21-Oct-05
Government (Washington)	Washington Dept of Fish & Wildlife	Bob	Jateff	Email	1-Oct-21
Government (Washington)	Washington Dept of Fish & Wildlife	Bob	Twiet	Email	1-Oct-21
Government (Washington)	Washington Dept of Fish & Wildlife	Curt	Vail	Email	21-Oct-05
Government (Washington)	Washington Dept of Natural Resources	Ken	Slattery	Email	21-Oct-05
Government (Washington)	Washington State Parks	Joyce	Riley	Email	24-Oct-05
Governments (BC)	Ministry of Environment	Ross	Porcheron	Meeting	15-Nov-05
Governments (Canada)	Indian and Northern Affairs Canada	Marion	Lightly	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Ken	Campbell	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Denis	Davis	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Glen	Deacoff	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Deborah	Greaves	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Leah	Hartley	COBTWG Newsletter	28-Nov-05
Governments (Regional)	Regional District of Central Okanagan	Sabine	Maxwell	COBTWG Newsletter	28-Nov-05
Governments (Regional)		Sandie	Evanchu	COBTWG Newsletter	28-Nov-05
Governments (Regional)		Monty	Horton	COBTWG Newsletter	28-Nov-05

Governments (Regional)		Stephen	Juch	COBTWG Newsletter	28-Nov-05
Interested		Harold	King	COBTWG Newsletter	28-Nov-05
Interested		Judie	Steeves	COBTWG Newsletter	28-Nov-05
Interested Citizen	Walt Ulrich		Oroville	Phone	19-Oct-05
Interested Citizen	Web Hallauer		Oroville	Meeting	19-Oct-05
Interested Citizen		Richard	Henson	Phone	24-Oct-05
Interested Citizen		Ivo	Tyl	Meeting	9-Nov-05
Interested Individuals	Bellevue Creek	Myrna	Tracy	COBTWG Newsletter	28-Nov-05
Interested Individuals	District of Peachland	Joe	Mocilac	COBTWG Newsletter	28-Nov-05
Interested Individuals	Habitat Policy and Regulatory Affairs	Catherine	Gee	COBTWG Newsletter	28-Nov-05
Interested Individuals	Joe Rich Watershed Monitoring Committee	Jules	Morris	COBTWG Newsletter	28-Nov-05
Interested Individuals	KFS	Rachelle		COBTWG Newsletter	28-Nov-05
Interested Individuals	Kidston Elementary	Sharon	MacKenzie	COBTWG Newsletter	28-Nov-05
Interested Individuals	OK Falls Elementary	Barbara	Paterson	COBTWG Newsletter	28-Nov-05
Interested Individuals	Penticton Rotary Club	Ken	Davis	COBTWG Newsletter	28-Nov-05
Interested Individuals	SD23 Career Opportunities Program	Pauline	Kereluk	COBTWG Newsletter	28-Nov-05
Interested Individuals	Selah Canoeing	Jordie	Bowen	COBTWG Newsletter	28-Nov-05
Interested Individuals	Shannon Lake Community Association	Don	Guild	COBTWG Newsletter	28-Nov-05
Interested Individuals	V0H 1N0 Naramata News	Crystal	Froese	COBTWG Newsletter	28-Nov-05
Interested Individuals	Vernon Social Planning Council	Eric	Kowalski	COBTWG Newsletter	28-Nov-05
Interested Individuals		Charlotte	Armstrong	COBTWG Newsletter	28-Nov-05
Interested Individuals		Natasha	Audy	COBTWG Newsletter	28-Nov-05
Interested Individuals		Rene	Barone	COBTWG Newsletter	28-Nov-05
Interested Individuals		Stacey	Bonneau	COBTWG Newsletter	28-Nov-05

Interested Individuals		Shona	Bruce	COBTWG Newsletter	28-Nov-05
Interested Individuals		Dave	Buckmiller	Phone	24-Oct-05
Interested Individuals		Jeff	Carmichael	COBTWG Newsletter	28-Nov-05
Interested Individuals		Barry	Chilibeck	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jane	Coady	COBTWG Newsletter	28-Nov-05
Interested Individuals		J	Conrad	COBTWG Newsletter	28-Nov-05
Interested Individuals		Linda	Conrad	COBTWG Newsletter	28-Nov-05
Interested Individuals		Reg	Crane	COBTWG Newsletter	28-Nov-05
Interested Individuals		Leo	Croteau	COBTWG Newsletter	28-Nov-05
Interested Individuals		Marcia	Croy Vanwely	COBTWG Newsletter	28-Nov-05
Interested Individuals		Sue	Curly	COBTWG Newsletter	28-Nov-05
Interested Individuals		Lynn	Dallas	COBTWG Newsletter	28-Nov-05
Interested Individuals		Terry	Dyck	COBTWG Newsletter	28-Nov-05
Interested Individuals		Aaron	Enquist	COBTWG Newsletter	28-Nov-05
Interested Individuals		Dave	Evans	COBTWG Newsletter	28-Nov-05
Interested Individuals		Scott	Fitken	COBTWG Newsletter	28-Nov-05
Interested Individuals		Kylah	Forbes	COBTWG Newsletter	28-Nov-05
Interested Individuals		Ron	Fowler	COBTWG Newsletter	28-Nov-05
Interested Individuals		Kim	Fulton	COBTWG Newsletter	28-Nov-05
Interested Individuals		Donald	Gabbi	COBTWG Newsletter	28-Nov-05
Interested Individuals		N	Galynch	COBTWG Newsletter	28-Nov-05
Interested Individuals		Laena	Garrison	COBTWG Newsletter	28-Nov-05
Interested Individuals		Kevin	Glowa	COBTWG Newsletter	28-Nov-05
Interested Individuals		Juergen	Hansen	COBTWG Newsletter	28-Nov-05

Interested Individuals		Glen	Harshenin	COBTWG Newsletter	28-Nov-05
Interested Individuals		Mark	Hecht	COBTWG Newsletter	28-Nov-05
Interested Individuals		Margaret	Holm	COBTWG Newsletter	28-Nov-05
Interested Individuals		Corinna	Hoodicoff	COBTWG Newsletter	28-Nov-05
Interested Individuals		Sue	Horne	COBTWG Newsletter	28-Nov-05
Interested Individuals		Elizabeth	Howe	COBTWG Newsletter	28-Nov-05
Interested Individuals		John	Huby	COBTWG Newsletter	28-Nov-05
Interested Individuals		David	Johner	COBTWG Newsletter	28-Nov-05
Interested Individuals		Holley	Johnston	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jorma	Jyrkkanen	COBTWG Newsletter	28-Nov-05
Interested Individuals		Mike	Kamann	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jason	Kamin	COBTWG Newsletter	28-Nov-05
Interested Individuals		Rick	Kellow	COBTWG Newsletter	28-Nov-05
Interested Individuals		Petra	Keppner	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jessica	Klein	COBTWG Newsletter	28-Nov-05
Interested Individuals		Nicole	Klimuk	COBTWG Newsletter	28-Nov-05
Interested Individuals		Gayle	Konkl	COBTWG Newsletter	28-Nov-05
Interested Individuals		Lynn	Kriwoken	COBTWG Newsletter	28-Nov-05
Interested Individuals		Leanne	Kruger	COBTWG Newsletter	28-Nov-05
Interested Individuals		Shannon	Kuhn	COBTWG Newsletter	28-Nov-05
Interested Individuals		Kerri	Lanaway	COBTWG Newsletter	28-Nov-05
Interested Individuals		Donna	Lane	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jess	Leatherdale	COBTWG Newsletter	28-Nov-05
Interested Individuals		Ralph	Longanecker	COBTWG Newsletter	28-Nov-05

Interested Individuals		Mary Lou	Louie	COBTWG Newsletter	28-Nov-05
Interested Individuals		Travis	Lowe	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jennifer	Lynn	COBTWG Newsletter	28-Nov-05
Interested Individuals		Shelley	Macissac	COBTWG Newsletter	28-Nov-05
Interested Individuals		Irene	Mallory	COBTWG Newsletter	28-Nov-05
Interested Individuals		Bruce	McFarlane	COBTWG Newsletter	28-Nov-05
Interested Individuals		Martin	McGinnis	COBTWG Newsletter	28-Nov-05
Interested Individuals		Milt	McLaren	COBTWG Newsletter	28-Nov-05
Interested Individuals		Don	McQueen	COBTWG Newsletter	28-Nov-05
Interested Individuals		Adam	Moss	COBTWG Newsletter	28-Nov-05
Interested Individuals		Joanne	Nicklas	COBTWG Newsletter	28-Nov-05
Interested Individuals		Elle	Noble	COBTWG Newsletter	28-Nov-05
Interested Individuals		Michael	Noseworthy	COBTWG Newsletter	28-Nov-05
Interested Individuals		Willy	O'Neil	COBTWG Newsletter	28-Nov-05
Interested Individuals		Maggie	Paquet	COBTWG Newsletter	28-Nov-05
Interested Individuals		Janelle	Parchomchuk	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jeff	Pedersen	COBTWG Newsletter	28-Nov-05
Interested Individuals		Mark	Peterschmidt	COBTWG Newsletter	28-Nov-05
Interested Individuals		Mike	Pidwirny	COBTWG Newsletter	28-Nov-05
Interested Individuals		Matt	Price	COBTWG Newsletter	28-Nov-05
Interested Individuals		Chris	Prosser	COBTWG Newsletter	28-Nov-05
Interested Individuals		Diane	Ramage	COBTWG Newsletter	28-Nov-05
Interested Individuals		Carol	Rifka	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jim	Ripley	COBTWG Newsletter	28-Nov-05

Interested Individuals		L	Ross	COBTWG Newsletter	28-Nov-05
Interested Individuals		G	Russell	COBTWG Newsletter	28-Nov-05
Interested Individuals		Rick	Sagayadan	COBTWG Newsletter	28-Nov-05
Interested Individuals		Wendy	Schebel	COBTWG Newsletter	28-Nov-05
Interested Individuals		S	Schopff	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jodie	Sexmith	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jim	Shaver	COBTWG Newsletter	28-Nov-05
Interested Individuals		Hoss	Short	COBTWG Newsletter	28-Nov-05
Interested Individuals		Richard	Simpson	COBTWG Newsletter	28-Nov-05
Interested Individuals		Steven	Smith	COBTWG Newsletter	28-Nov-05
Interested Individuals		Paddy	Smith	COBTWG Newsletter	28-Nov-05
Interested Individuals		Mason	Squakin	COBTWG Newsletter	28-Nov-05
Interested Individuals		John	Stormon	COBTWG Newsletter	28-Nov-05
Interested Individuals		Caryn	Stroh	COBTWG Newsletter	28-Nov-05
Interested Individuals		Allan	Sutton	COBTWG Newsletter	28-Nov-05
Interested Individuals		Peter	Tassie	COBTWG Newsletter	28-Nov-05
Interested Individuals		Jill	Taylor	COBTWG Newsletter	28-Nov-05
Interested Individuals		J	Vandereerden	COBTWG Newsletter	28-Nov-05
Interested Individuals		Adrienne	Vedan	COBTWG Newsletter	28-Nov-05
Interested Individuals		B	Wagner	COBTWG Newsletter	28-Nov-05
Interested Individuals		Eleanor	Walker	COBTWG Newsletter	28-Nov-05
Interested Individuals		Dick	Wallace	COBTWG Newsletter	28-Nov-05
Interested Individuals		Lynnea	Wiens	COBTWG Newsletter	28-Nov-05
Interested Individuals		Ed	Wietrick	Phone	24-Oct-05

Interested Individuals		Marnie	Williamson	COBTWG Newsletter	28-Nov-05
Interested Individuals		Vicky	Young	COBTWG Newsletter	28-Nov-05
Interested Public	406 Eastlake Rd Oroville 98844 PH 509 476-2486	Wilber	Hallauer	Meeting	Oct 19 & 26
Interested Public	Miner	Joe	Falkoski	Meeting	17-Oct-05
Local government	Town of Osoyoos	Elsie	Lemke	Meeting	17-Oct-05
Local government	Town of Osoyoos	Elsie	Lemke	Meeting	17-Oct-05
Navigation	Transport Canada	Terry	Weber	Email	31-Oct-05
Power	Douglas County PUD	Rick	Rick	Email	1-Oct-20
Power	Chelan County PUD	Chuck	Pevan	Email	26-Oct-05
Power	Chelan County PUD	Shawn	Seaman	Email	26-Oct-05
Power	Grant County PUD	Tom	Dresser	Email	26-Oct-05
Power	Grant County PUD	Stuart	Hammond	COBTWG Newsletter	28-Nov-05
Power	Northwest Power & Conservation Council	John	Fazio	Email	1-Oct-21
Power	Northwest Power & Conservation Council	John	Harrison	Email	1-Oct-21
Power	Northwest Power & Conservation Council	Stacey	Horton	Email	1-Oct-21
Power	Northwest Power & Conservation Council	Doug	Marcker	Email	1-Oct-21
Power	Northwest Power & Conservation Council	John	Shurts	Email	1-Oct-21
Power	Okanagan PUD 1	Larry	Felton	Email	24-Oct-05
Process	IJC	Glen	Davidson	COBTWG Newsletter	28-Nov-05
Process	International Joint Commission	Jack	Blaney	COBTWG Newsletter	28-Nov-05
Process	International Joint Commission	Murray	Clamen	COBTWG Newsletter	28-Nov-05
Process	International Joint Commission	Kirk	Johnstone	COBTWG Newsletter	28-Nov-05
Process	International Joint Commission	Tom	McAuley	COBTWG Newsletter	28-Nov-05
Recreation / Tourism	Cabana Beach Osoyoos	Gary	Jackle	Meeting	17-Oct-05
Recreation / Tourism	Don's Fly Tying	Don	Haaheim	COBTWG Newsletter	28-Nov-05

Recreation / Tourism	Gateway Marina Osoyoos		Employee	Meeting	17-Oct-05
Recreation / Tourism	Holiday Inn/Starlite Marina Osoyoos		Manager via staff	Meeting	17-Oct-05
Recreation / Tourism	Island View RV Resort Osoyoos		manager	Meeting	17-Oct-05
Recreation / Tourism	Lakeshore Deck and Lift Osoyoos	Harry	Heyduck	Meeting	17-Oct-05
Recreation / Tourism	Oasis Beach Private Resort Osoyoos		Manager	Meeting	17-Oct-05
Recreation / Tourism	Okanogan Valley Bass Club	Ottis	Fleming	Email	24-Oct-05
Recreation / Tourism	Oro Beach RV Resort		manager	Email	28-Oct-05
Recreation / Tourism	Oroville Chamber of Commerce	Tao	Stadler	Email	24-Oct-05
Recreation / Tourism	Osoyoos Chamber of Commerce			Email	24-Oct-05
Recreation / Tourism	Osoyoos Yacht Club Commodore	Dave	Eastbury	Phone	29-Oct-05
Recreation / Tourism	Tamri Campground Osoyoos		Owner	Meeting	17-Oct-05
Recreation / Tourism	Willow Shores Osoyoos	Pearl	Quintal	Meeting	7-Nov-05
Recreation/ Tourism	Osoyoos Lake State Park	Joyce	Ritey	Email	23-Oct-05
Recreation/ Tourism	Safari Beach Resort & Marina	manager	manager	Meeting	1-Oct-17
Recreation/ Tourism	Super 8 Motel	Staff	Staff	Meeting	1-Oct-21
Research	BC Hydro	Vic	Lewynsky	COBTWG Newsletter	28-Nov-05
Research	Centre for Coastal Studies	Jennifer	Penikett	COBTWG Newsletter	28-Nov-05
Research	Department of Earth and Environmental Science	David	Scott	COBTWG Newsletter	28-Nov-05
Research	ESSA Technologies	Clint	Alexander	COBTWG Newsletter	28-Nov-05
Research	Forest Research Extension Partnership	Robin	Pike	COBTWG Newsletter	28-Nov-05
Research	Forest Research Extension Partnership	Rob	Scherer	COBTWG Newsletter	28-Nov-05
Research	Northwest Ecosystem Institute	Mark	Johannes	COBTWG Newsletter	28-Nov-05
Research	Okanagan College	Howie	Richardson	Phoned	Oct. 19
Research	Okanagan University College	Peter	Dill	COBTWG Newsletter	28-Nov-05
Research	Okanagan University College	Kelli	Giest	COBTWG Newsletter	28-Nov-05

Research	Okanagan University College	Kathleen	Jagger	COBTWG Newsletter	28-Nov-05
Research	Okanagan University College	Derek	Reid	COBTWG Newsletter	28-Nov-05
Research	Okanagan University College	Tanya	Seebacher	COBTWG Newsletter	28-Nov-05
Research	Okanagan University College	Ian	Walker	COBTWG Newsletter	28-Nov-05
Research	Okanagan University College	Adam	Wei	COBTWG Newsletter	28-Nov-05
Research	Pacific Wildlife Research Centre	Ken	Brock	COBTWG Newsletter	28-Nov-05
Research	SDRI--UBC	Phillippa	Shepard	COBTWG Newsletter	28-Nov-05
Research	SFU	Ben	Bradshaw	COBTWG Newsletter	28-Nov-05
Research	Sustainable Development Research Institute	Stacey	Langsdale	COBTWG Newsletter	28-Nov-05
Research	Sustainable Environment Network	Patrick	Allen	COBTWG Newsletter	28-Nov-05
Research	T Buck Suzuki Foundation	David	Lane	COBTWG Newsletter	28-Nov-05
Research	Trent University	Dave	Lasenby	COBTWG Newsletter	28-Nov-05
Research	UBC Okanagan	Bernard	Bauer	Meeting	28-Oct-05
Research	UBC Okanagan	Bill	Cohen	COBTWG Newsletter	28-Nov-05
Research	UBC Okanagan	Jeff	Curtis	Meeting	28-Oct-05
Research	Univ BC	Ken	Hall	COBTWG Newsletter	28-Nov-05
Research	Univ BC	Tom	Northcote	COBTWG Newsletter	28-Nov-05
Research	Univ BC	Hans	Schrier	COBTWG Newsletter	28-Nov-05
Research	University College of the Cariboo	Brian	Heise	COBTWG Newsletter	28-Nov-05
Research		Tom	Johnston	COBTWG Newsletter	28-Nov-05
Research		Heather	Larratt	COBTWG Newsletter	28-Nov-05
Unkown	BCAFC	Jen	Thomas	COBTWG Newsletter	28-Nov-05
Unkown	Ministry of Agriculture and Fisheries	Brian	Harper	COBTWG Newsletter	28-Nov-05
Unkown	South Okanagan Conservation Society	Jennifer	French	COBTWG Newsletter	28-Nov-05
Water User	Orchardist	John	Biele	Meeting	4-Oct-05
Water User	Washington Water Trust			Email	1-Oct-22

Water User or Purveyor	Alta Vista Irrigation District	Brian	Kirchner	Phone and mail	26-Oct-05
Water User or Purveyor	BC Agriculture Council	Hans	Buchler	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	BC Fruit Growers	David	Dobernigg	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	BC Hydro	Alan	Caverly	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	District of Lake Country	Michael	Mercer	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Glenmore-Ellison Improvement District			COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Greater Vernon Water	Tricia	Brett	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Greater Vernon Water	Renee	Clark	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Oroville Tonasket I. D.	Tom	Scott	Meeting	19-Oct-05
Water User or Purveyor	Rutland Waterworks			COBTWG Newsletter	28-Nov-05
Water User or Purveyor	SE Kelowna Irrigation District	Kimberly	Iandolo	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	South East Kelowna Irrigation District	Toby	Pike	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	South East Kelowna Irrigation District			COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Washington Water Trust	Lisa	Pelly	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Washington Water Trust		Susan Adams	Email	20-Oct-05
Water User or Purveyor	Water Supply Assoc. BC	Robert	Hrasko	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Water Supply Association of BC	Cheryl	Halla	COBTWG Newsletter	28-Nov-05
Water User or Purveyor	Water Supply Association of BC	Bruce	Wilson	COBTWG Newsletter	28-Nov-05

Appendix III – Responses

Written Responses

Response number: 1
From: ivo tyl [mailto:tylovi@telus.net]
Regarding:

- Adopt a basin-wide approach
- Issue notices in both metric and English and using both types of elevation measures
- Consider 6 month climate forecast before declaring drought
- Do not declare drought solely on Similkameen River criterion
- Lake levels and timing are not based on solid scientific data.
- Formalize BC / Washington agreement for 912.5 maximum in Orders
- Provide real time written direction to the Applicant and publish for public review
- Act on Osoyoos Town Councils 1999 request for a public hearing
- Act on public comments and notify public regarding action taken
- Set a maximum lake level of 909.0 during winter

Received: November 9, 2005
Text:
Thanks for the opportunity to express mine opinion of the operation of Zosel Dam in WA,as it affects the Osoyoos Lake and Osoyoos town residents. Following are summaries of the points as discussed by us during our meeting in Osoyoos on 2005/11/09.
1.Hydro Situation
The Osoyoos Lake is the segment of the chain of lakes Okanogan, Skaha, Wasa, Osoyoos, being the major water bodies of the Okanagan Basin of BC. All manmade objects, built within this Basin should be operated respecting this fact. The Order of Approval of the dam built under IJC, dated 1982 and amended in 1985 does not stipulate it and does not reflect that correlation
2.Drought Forecast:
The Order allows and regulates water level of Osoyoos Lake in respect of technical assumption of drought condition in Okanagan Basin based on calculation of waterflow in Similkameen River. Within the period of 1987 and 2005 the drought condition was declared in majority of years, even if such condition should be an exceptional. The Canadian Department of Environment does study indicating the forecast of precipitation of the region for up to 6 months. This study should be part of the declaration and should reflect it in the definition if a drought is expected. The declaration should not be based on other basin and the Board of Control should declare it only after some combined study.
3. Regulated Water Level:
The Order regulates the level to be within the level 909,911,913 of feet a.s.l. of the USA Geological Survey definition. There is a difference between USA and Canada elevation by few inches. In mine opinion, because Canada has metric units and only metric units are position in Town Osoyoos, the level should be indicated in both units, imperial and metric in order the residents of Osoyoos may check the existing level at the marker located under the bridge.

The levels 909, 911, 913 were set in the Order arbitrarily and those levels were not examined by the standard Environmental Assessment Study required by any construction project in Canada.
The dates in which the operation of the Zosel Dam should regulate the water level were set arbitrarily at 1.April,1.November of each year, notwithstanding the period of spring run-off falls in to days around the end of May, beginning of June in spring. The level of 911 is prescribed by the Order for a normal year, 913 is prescribed by the Order for years defined to be in the drought condition.

4.Maximal prescribed water level:

In the IJC letter addressed to me by the Secretary Canadian Section, Mr.Murray Clamen writes: ",the 913 feet maximum level is reduced by a half foot when an agreement on water storage and delivery is concluded between British Columbia and Washington state. The Commission's International Osoyoos Lake Board of Control has recently reported that the agreement is now in place, and the level of Osoyoos Lake will be limited to 912.5 feet.
Notwithstanding that, the Notice of Osoyoos Lake Draught Year Operation issued for 2003 and subsequent years does not stipulate it still reports level up to 913 feet.

5.International Osoyoos Lake Control Board

In mine opinion, the Board does not govern the operation of the Zosel dam in any authority. I do not recall to see any Board order to the operator to prescribe any operating level caused by day to day situation .It only publishes the Notice about drought year. Its public meetings did not bring any improvement in existing operation and hence the attendance at yearly meetings call by the Board are not well attended by the public. The Board should be more pro-active towards the operator of the Dam.

6.Resolution by The Council of Town of Osoyoos.

On 1999/05/27 Town of Osoyoos forwarded to International Control Board Resolution 225/99 stating:
We, the elected representatives of the Town of Osoyoos, BC, are asking the Federal Government of Canada to examine in collaboration with the USA the twelve year experience of the operation of the Zosel Dam by a public hearing to examine if the existing order could be modified to fully and better satisfy provisions of Article VIII of the Treaty. This request was never proceeded by IJC.

7.Discrepancy in the Order and winter conditions.

The existing Order allows winter operation above 911 feet, even if for summer allows only maximum 911feet and does prescribe level for winter operation within 909 and 911.5 feet. In mine opinion it should indicate the normal winter operation not exceeding 909 feet a.s.l. The higher level in winter causes substantial damage to the shore by the ice pressure.

The above points more or less outlines my points to the operation of the Zosel Dam. I trust it might be useful for Your examination and feel free to contact me for any detail of the above points or any further information.
Truly Yours
Ivo Tyl

Response number: 2
From: Lake front property owners - Bob and Deb Sherwood, 6 Bayview Crescent Osoyoos, BC V0H 1V6
Regarding: Objection to sustained high water levels in drought years
Received: October 24, 2005
Text:
We are responding to your offer via the Osoyoos Times for comments on Osoyoos Lake water levels.

Our property has beachfront on the lake. Over the years we have noticed increasing foreshore erosion that is detrimental to fisheries, water quality, beaches, land ownership and tourism. This has been caused primarily by keeping the lake levels artificially high during the summer to support irrigation in Washington State during 'drought' years. A secondary factor in the last two to three years has been the ever greater number of wake boats designed to create large waves for wakeboarding.

We do not understand why the Osoyoos Lake level must be kept so high from June to September. It may be justifiable during flood peaks in late May to early June, but why for the following three months?

One alternative from our point of view would be to maintain a level of about 912 instead of 913+. That should satisfy Washington State's requirements, but should it fail to do so, Okanagan Lake could be kept just a little higher in the summer months for reserve capacity. As Okanagan Lake has a huge volume compared to Osoyoos Lake, the additional height in Okanagan Lake would hardly be noticeable.

We look forward to your responding to our comments.

If you have any questions, please do not hesitate to e-mail us or phone us at 250-495-7475.

Sincerely,
Bob and Deb Sherwood

Response number: 3 (Paraphrased to avoided politically sensitive wording)
From: Shayne Quintal
Regarding: Spring and summer lake levels are too high
Received: November 13, 2005
Text:
My name is Shayne Quintal we own the land on the north end of Osoyoos Lake. The water levels on Osoyoos Lake in the spring and summer are kept 1 feet too high. This creates roughley 60 acres of flooded meadow which produces nasty numbers of mosquitos which in turn spreads diseases. If there is a need to hold back water for

irrigation in September why not close Zosel gates Sept 5th? Call me 250-495-6192. Thanks

Response number: 4 (shortened and paraphrased)
From: Campsite owner Shayne Quintal
Regarding: Spring and summer lake levels are too high
Received: November 14, 2005
Text:
The lake levels are too high every spring and last year they kept it extremely high all summer. Our campsite had no beach and the fields on my property and the east side "Osoyoos Indian Reserve" were flooded with 6" to 8" of hot stinky mosquito infested water.
Every spring they come up with their favorite line "we are expecting a drought season" this allows them to raise our lake to their ignorant levels. Osoyoos is "Canada's only Desert" it should be normal to have dry summers without someone hitting the panic button and flooding us out every spring. We would be happy if Zozel Dam would lower the lake levels just 6 inches in the spring. It would make working along the lakeshore and running a business a lot easier.
Thank you,
Shayne Quintal

Response number: 5
From: Campsite owner Shayne Quintal
Regarding: Spring and summer lake levels are too high
Received: November 15, 2005
Text:
The lake levels are too high every spring and last year they kept it extremely high all summer. Our campsite had no beach and the fields on my property and the east side "Osoyoos Indian Reserve" were flooded with 6" to 8" of hot stinky mosquito infested water.
Every spring is declared a drought season and this allows the lake to be raised too high (*this sentence was paraphrased by C. Bull to avoid unnecessary inflammatory remarks*). Osoyoos is "Canada's only Desert" it should be normal to have dry summers without someone hitting the panic button and flooding us out every spring. We would be happy if Zozel Dam would lower the lake levels just 6 inches in the spring. It would make working along the lakeshore and running a business a lot easier.
Thank you,
Shayne Quintal

Response number: 6
From: John E. Biele, 334 Eastlake Road, Oroville, Washington 98844
Regarding: Unlimited use of water in Canada coupled with global warming could deplete water supplies.
Received: October 28
Text:

I have had some time to think about the water situation in the weeks after the IJC meeting. Chris Kaufman has filled me in on some the facts and history of this project as well as giving me a primer in Washington water law. He states that BC water users are not restricted in the amount or source of water for new projects. Washington state has restricted Okanogan Basin water rights for 30 years, with increasingly stricter rules on the development of new sources of water for growth, especially for population.

Is there room in this dialogue to discuss water flows over Zosel Dam? I would be interested in any schedule of meetings in the next month or so. We are finishing harvest in the next two weeks and anticipate a break from farming for November and December.

Grape vines use 1/4 of the water an apple, pear or cherry orchard uses. There is some amount of excess water in agriculture which buffers the Okanagan Valley water users for a number of years until the true limits are discovered. As an irrigator with Lake Osoyoos water rights, I watch this issue with interest, hoping that global warming doesn't take any excess more rapidly.

I am looking forward to these meetings mentioned in your presentation.

John E. Biele
Hi Oasis Orchards
334 Eastlake Road
Oroville, Washington
98844

Response number 7
From: BC Ministry of Environment Rare Plant Recovery Team (Terry McIntosh)
Regarding: Effect of lake levels on rare plants
Received: October 26, 2005
Text:
Although a great deal of work needs to be done re. habitat 'management' and rare species mapping, most of the plant species of concern that grow along the lake (both federally-listed and provincial Red-listed species) seem to have survived and have done reasonably well for a long period of time...decades. I am, however, new to the area (first year along the lake) and have not witnessed water level changes. George Douglas thinks that the fluctuation of levels reduces plant numbers of some species some years.

Receding water levels on mud flats in summer, followed by desiccation in late summer/early autumn causes harm to weedy perennials first by the anoxic mud of freshly exposed flats (deadly to most perennial root and shoot systems), then by the difficulty of obtaining water and oxygen in the sun-baked mud later on. *Ammania* and *Rotala* are specialists in this type of mudflat niche, as are some of the B.C.-listed species, like *Marsilea vestita*.

One of the better examples Curtis has seen to support these ideas is where the non-native

form of *Phalaris arundinacea* (a very aggressive rhizomatous perennial grass) grows to the exclusion of nearly all else in some wet swales and shorelines in eastern Washington. But after the very wet/cool winter and spring of 1996-1997, most of it died from the persistent flooding and a profusion of ephemeral annuals germinated from their seed banks and bloomed in its place. Since then, the winters have been unusually dry, and in the absence of persistent winter flooding has allowed the *Phalaris* to recover to its pre-1996 levels, excluding the native flora once again.

I think another concern at the Osoyoos site is about the small to large cut banks being eaten away by wave action. The persistent lake levels seem to be the main cause of this--when the wave action is kept at one constant elevation for too long, the natural gently sloped mud and sand flats on the east shore have been gradually turned into benches with cut banks. The sand- and mud-binding rhizosphere of the weedy perennial graminoids may be helping this erosional process along by preventing the sifting and shifting effect of fluctuating shorelines. Instead, erosion proceeds in chunks of material with their binding vegetation falling into the water. I saw an alarming amount of this "chunky" erosion along most of the shoreline at the Osoyoos study site. Some of the cut banks have reached more than 2 meters in height above the water level, with 2-meter tall, 1-meter deep chunks actively toppling into the water.

I think that as long as the lake shores are kept at one level for too long, the cut banks will always be there; it'll be very difficult if not impossible then to develop the open sand and mud habitats that favor the rare annuals, because the artificial benches will keep eroding back chunk by chunk while the eroded material incorporates into the benthic mud of the lake.

Curtis thinks that the best situation possible for the Osoyoos Lake rare annuals is to develop extensive and very gently sloped sand and mud flats that are "wiped clean" annually by the right timing of changing water levels. The best example I can think of of this type of habitat is on the shores of Shuswap lake near Salmon Arm. The inlet and outlet systems of the lake fluctuate naturally with changes in surface and ground water, creating the winter flooding/summer recession of water levels that maintain open mudflats. The flats that result from the natural processes there are spectacular--really rich in diversity of ephemeral annuals like the very rare *Coleanthus subtilis*--and it's an important site for shorebirds as well. I think that with a flood control dam on the lake, those flats would turn into the sort of benches with perennial vegetation that we're dealing with at Osoyoos Lake.

Another threat appears to be the increase in invasive rhizomatous grasses (at first we thought that this was a response to the lack of grazing by cattle over the past few years, but this may not be accurate). *Ammania, Rotala* and *Lipocarpha* will have their best chance of long term survival if their weedy competition is prevented from creating a "lawn" on the mud and sand flats. I also want to add that grazing may reduce vertical growth of the perennial competition, but it's not likely to reduce much of the horizontal growth (and may encourage it), so I think the best that grazing would do is to create small interspaces of open sand/mud for the rare annuals and the worst it would do is to

encourage the development of the "lawn" effect. From my experience, flooding in winter (if it's done right) kills most perennials, and allows sand and silt to sift and shift creating new, fresh flats available for ephemeral annuals.

Also, somewhere below (I don't know where exactly) I think someone mentioned that summer flooding may be appropriate. I strongly disagree as this would not help (and is not 'natural' for this area). Many perennial grasses can survive summer flooding (and may actually benefit) whereas winter flooding and summer drought appears to do them in. And our rare species need the dry-down period.

Terry MacIntosh

Response number: 8
From: Orville Dyer RPBio , Senior Wildlife Biologist, Ministry of Environment Penticton
Regarding: Effect of water levels on rare plants
Received: October 18, 2005
Text: (Paraphrased for Clarity)

Many rare plants are known to survive at the edge of Osoyoos Lake. Three that are federally listed as endangered include the Scarlet Ammania, Toothcup and Small-flowered Lipocarpha. Several others are under consideration for listing. The Southern Interior Rare Plants Recovery Team is working on a recovery plan as required by the Species at Risk Act. There are a lot of data gaps and unknowns but we do know that water levels are very important.

These species require flooding during the winter/spring and water level reduction during the summer/fall to allow germination and growth. According to David Fraser (Endangered Species Specialist, Biodiversity Branch, Ministry of Water, Land and Air Protection) the draw-downs must occur early enough in the year that the plants are able to germinate and set seed.

We don't know what lake levels or timing is needed to ensure survival and reproduction of these plants. We assume, based on all our site visits, that the plants would do well if the water level was around 912.40 ft. in late July or early August. Some flexibility is likely available around this measurement but we don't know how much. Since seed banks can remain viable in the soil for at least a few years, water levels to benefit these plants need not be maintained every single year. However, since these plants are rare, maintaining regular seed production may be an important conservation factor and actions that support increased germination and survival would be beneficial.

The inundation levels appeared okay in the winter-spring of 2000-2001 and probably in 2002-03 and 2003-04. If management of the water level was relatively consistent with these years, the plants will likely be okay.

Orville Dyer RPBio
Senior Wildlife Biologist
Ministry of Environment Penticton,

Response number 9
From: Colville Confederated Tribes (John Arterburn – Fisheries Biologist)
Regarding: Fisheries – request that lake levels and dam operations consider the requirements necessary to monitor fish at the dam
Received: October 26, 2005
Text:
The Okanogan Basin Monitoriing and Evaluation Project (OBMEP) BPA project number 2003-022-00 is designed to provide status and trend monitoring information for anadromus fish populations and there habitat throughout the Okanogan River basin. As part of this project the Colville Tribes are currently installing video counting equipment on the fish ways at Zosel Dam. The lake levels of Osyoos Lake could influence our ability to accurately count the number of anadromus fish that pass this facility. Several questions relating to fish passage, fall back, and counting technology at this facility include but are not limited too;

1) At what gate opening do fish "pass through" this structure and how does this impact video fish counts conducted at the fish ladders? (past work suggest that sockeye can pass through at openings getter than 12 inches but no information is available for steelhead or Chinook). Can operational changes at the dam reduce "pass through"? What other solution are possible to help eliminate this problem (i.e. using stop logs to force fish to use the ladders)?

2) What percentage of Chinook, sockeye or steelhead detected at the fish ladders "fall back" down stream through the spill bay? Can "fall back" be reduced through operational changes?

3) Video counting chambers need to be fully submerged to provide for best picture quality and most accurate counts. Can the lake elevations be controlled so that this equipment stays fully submerged (6 feet depth at fish ladder) year round?

We certainly do not want to restrict high priority considerations (i.e. flood control or irrigation) but would like fish counting to be considered at the Zosel dam fish ladders whenever possible.

To begin with we plan to monitor fish passage at Zosel dam year round. As more data are collected we hope to reduce this monitoring effort but a minimum of effort will likely occur for at least the next 20 years. The minimum effort will likely include counting passage at all times of the year when adult anadromus fish are present in the Okanogan River system (all months except for June, July, and August).

In return for consideration in the operation of Oysoos Lake the fish counting conducted by the Colville Tribes at Zosel Dam will provide accurate, near real-time data on adult Chinook, Sockeye, and Steelhead, abundance, run-timing, number with ad-clip, and potentially other information.

John Arterburn
Fisheries Biologist

Response number: 10
From: Washington Dept. Fish & Wildlife (Bob Jateff -District Six Fish Biologist)
Regarding: Fisheries – need to have sufficient water in the lake that fish can enter tributaries to spawn.
Received: November 28, 2005
Text:
There is one thing that has recently been discovered in Osoyoos and that is the identification of adult steelhead passing the dam. The Colvilles have been doing the spawning ground surveys for steelhead in the Okanogan system and I know that they plan on doing them again this year. If they locate tributaries that steelhead are spawning in, then I would think that we need to maintain a level in the lake that would insure access to these spawning areas. Now this is something that you probably already know, but I wasn't too sure. Let me know what you think.
Bob Jateff

Response number: 11
From: Northwest Power and Conservation Council (John Shurts)
Regarding: Fisheries
- Need to refer to the Okanagan Subbasin Plan
- Need to provide for fisheries interest above and below Zosel Dam

Received: October 28, 2005
Text:
While lake levels at Osoyoos are not an issue for the Council's Fish and Wildlife Program, Osoyoos sits right in the middle of a number of things the Program does care about. I don't know if the lake level regulation affects any of these, but I'd certainly inquire -- even if these items are peripheral or incidental to the question of the direct effects of the lake level regulation itself at the site of the lake. And the one document I'd particularly point them to, if they do not already have it, is the Okanogan Subbasin Plan. http://www.nwcouncil.org/fw/subbasinplanning/okanogan/plan/.

First, the Program has an interest in habitat conditions for anadromous fish in the Okanogan River downstream of Osoyoos. I do not know if lake level regulation at Osoyoos is an issue for in-river conditions downstream, in terms of quantity, flow patterns or quality. I'm curious what if anything the subbasin plan says about this. But I'd at least inquire about the relationship between flows from the lake as part of lake level regulation and downstream conditions if I were doing a study of the effects of the lake level regulation, even as I recognize that the IJC focus is in the lake and not

downstream, and in the physical characteristics of the lake and not the fish and wildlife habitat conditions related to those physical characteristics.

Second, the Program has been funding work by biologists in both countries to try to reintroduce sockeye into Skaha Lake north of Osoyoos. See http://www.nwcouncil.org/fw/stories/okanagan.htm. Again, I have no idea if the way the lake itself is regulated affects the success of this sockeye project, but I'd ask and I'd look to the subbasin plan.

Finally, the 1994-95 version of the Program called for anadromous fish passage at Enloe Dam on the Similkameen. I'm not sure what the Okanogan Subbasin Plan calls for with regard to Enloe. If passage at Enloe is still an issue, incidental to that issue would be the question whether there is anything about the regulation of Osoyoos that would affect the chances of success.

I emphasize that I have no idea whether the way Osoyoos Lake levels are regulated has any effect on any of these matters above. I'm simply noting the interests the Program does have in the area, which would cause me to ask about the relationship between them and the effects of lake level regulation.

John Shurts

Response number 12
From: Okanogan Valley Land Council (Christine Olsen)
Regarding: Desire to keep informed
Received: November 3, 2005

Our board met last evening and decided we would not comment on the upcoming studies into issues surrounding operating rules of Zosel Dam. It is too far removed from our mission statement and our current priorities. However, we thank you for including us in the initial contact, and we'd be interested in seeing the results of your work when it is made public.
Best wishes,
Christine Olson, Administrative Assistant
Okanogan Valley Land Council

Response number: 13
From: E. Scheffler - Area Director of Regional District of Okanagan Similkameen + President of Osoyoos Lake Restoration Society + Member of Osoyoos Lake Water Quality Society
Regarding: Effect of water regulation on water quality
Received: October 22, 2005
Text:

Thanks for asking me for some input to your study. I am so concerned about what the IJC and their Osoyoos Board of Control is doing or not doing that I am almost sick to my stomach. In addition the neighbourly PUD is hoping to reactivate Enloe Dam with probably additional storage licences. They have made an azgreement with the Colville Tribal Council on the Similkameen and our Canadian members of the IJC don't seem to care and or understand the resulting long term consequences. the first hearings are on the 9th of November. We probably will need some of our Canadian Water in the Similkameen Basin to eventually clean up, renew and flush Osoyoos Lake and supplement our water supplies in this Basin. Osoyoos Lake should not be utilized as the sludge pond of the Okanagan in the futurte, in order to supply our Southern neighbours with water at their whim. Zosel Dam under the existing Orders simply serves to fill up our reservoir lake with sludge and nutrients and sediments. How do you separate quantity and quality issues if we don't even want to formally recognize the connection. Without Zosel Dam, the Lake would periodically be drawn down and frequently flush itself during high water in a natural manner. Continuous water storage by damming the Lake and the unnatural controls and manipulation of inflows and outflows greatly contribute to the quality issues and concerns as *I see them.*

The Prov. Gov. only monitors some P and N levels but does not seem to understand (neither obviously does this IJC Board of Control) what makes our Lake healthy, attractive and sustainable. Let someone look at the many bays in our Lake full of sediments and sludge, in addition to the milfoil growth, and make them inspect the shoreline gravels and shallow sandy bottoms covered with slime and you can understand what I mean by the deteriorating quality of our controlled reservoir. I would not swim in Osoyoos Lake if you paid me to. What happened to the Kokannee and native fish populations? I realize coarse fish survive better in milfoiled waters and sludge, as bottom feeders. Manipulating the Okanagan River flows through our waterways and Lake to simply accommodate sockeye salmon recovery in addition to the needs of our southern neighbours unfortunately ignores the real concerns and issues. All existing orders forget about the beaches and quality problems that are becoming real in our Lake. Proper water quality standards for the entire international Lake/ River system, including the Similkameen River, in my opinion, must become part and parcel of the next set of control orders that manage our Lake and River system. Obviously without these orders we could manage the natural flows with quality of water as well as quantity issues in mind.

Eike G. Scheffler

Response number: 14
From: E. Scheffler
Regarding: Effect of water regulation on water quality
Received: October 28, 2005
Text:

Please use my ideas and comments as you wish. I just cannot believe that anyone cannot see and understand that when you have a twisted toilet bowl, i. e. Osoyoos Lake reservoir, that is being plugged, Zosel Dam, at will and under international orders for fifty years, read storage and flow controls; and you have a straight shooting canal that can and does bring in sediments and all kinds of diluted effluent from upstream, the

channelized Ok. River, and the remaining Oxbows hold all kinds of potential disease problem (WNV) , that in todays modern times we want to ignore the resulting quality issues and not fix some of the problems, i. e. reconstitute the Oxbows and bring in fresh sources of water for flushing.
Eike G. Scheffler

Response number: 15
From: Osoyoos Oxbows Restoration Society (Sherry Linn -Secretary/Treasurer)
Regarding: Effect of water regulation on water quality
Received: October 28, 2005
Text:
I believe that Eike Scheffler, on behalf of the Osoyoos Oxbows Restoration Society, has forwarded comments with regards to your request. We are concerned about the effects on Osoyoos Lake by the Zosel Dam with regards to not only water levels (i.e. no beach at peak summer season) but also the hindrance to free water flow that would normally allow the lake to cleanse itself of contaminants. We are quite adamant that water quality be an issue included in the new Orders. This would not be a first for the IJC and is important to everyone on both sides of the border.
Thank you - Sherry Linn
Osoyoos Oxbows Restoration Society

Verbal Responses

Response number: 16
From: Susanne Theurer (Regional District of Okanagan Similkameen - Planner) verbally
Relayed through: Dave Smith (Glenfir sub-contractor)
Regarding: RDOS need to be involved
Received: October 28, 2005

- Regional District of Okanagan Similkameen (RDOS) Planning is an interested party in Osoyoos lake levels and dam operation and would like to be made aware of any initiatives of the IJC regarding Osoyoos Lake.
- No specific public complaints/comments regarding Osoyoos Lake water levels have been directed to RDOS Planning

RDOS Planning could be involved in issues around flooding, low water levels, public access, foreshore construction (including multi agency jurisdiction confusion on foreshore issues)

Response number: 17
From: Brian Symonds, Director, Regional Operations, BC Ministry of Environment
Relayed through: C. Bull (Glenfir Resources)
Regarding: Water Levels

Received: Undated

- In summer people object to sustained levels of more than 912.5 because of flooding and of minimum levels of less than 911.5 for boating
- Sockeye smolts seem to get hung in the forebay of Zosel Dam and a pulse of water is useful to flush them through
- We have never had to draw on reserves in drought years
- Low levels in winter prevent ice damage to retaining walls, docks etc

Response number: 18
From: Gary Robbins (Environmental Health Specialist - Okanogan County Public Health)
Relayed through: Dave Smith (Glenfir sub-contractor)
Regarding: Septic Tank Systems
Received: October 31, 2005

- high water does not appear to be causing leaching problems (in 17 years of working with systems in the Osoyoos Lake area I have tested some systems that have had complaints filed and have not found any problems with seepage into the lake)
- there may be a few older (failed) systems, but as they come up for renewal the new regulations will kick in.
- the seepage issue is more a public perception problem.

Response number: 19
From: Cindy Volk Manager of Public Health for Interior Health Authority, South Okanagan, Penticton
Relayed through: Dave Smith (Glenfir sub-contractor)
Regarding: Septic Tanks
Received: October 31, 2005

- we have not received any direct complaints regarding seepage of septic from the Osoyoos Lake area tanks at high water.
- septic systems even under old regulations had to be located 100 feet from the high water mark,
- any seepage was more likely due to failure of old systems not yet replaced.

Response number: 20
From: Tom Scott (Okanagan Tonasket Irrigation District)
Relayed through: Chris Bull
Regarding: Water level regulations
Received: October 19, 2005

- Levels are working well.
- OTID will organize the complaint sheets into a log this winter
- Most of the complaints are of summer levels being too low for good boating. Boaters want 912.0
- Flows requested for salmon are unrealistically high and should be revised. At least 95 cfs is passed through the fishways and observations throughout the river have indicate that all the redds are covered at 100cfs.

- Rapid re-adjustment of water levels when a drought declaration is lifted leads to depositions of debris on the beaches . Once the level is raised it should stay up.

Response number: 21
From: Kevin Dickenson (BC ministry of Agriculture and Lands**)**
Relayed through: Chris Bull
Regarding: Water Levels
Received: October 22, 2005

- No problems - We look to Brian Symonds for advice on these issues

Response number: 22
From: Web Hallauer of Oroville (Property owner / Lakefront Developer, former Senator and Director of Washington Dept. of Ecology)
Relayed through: Chris Bull
Regarding: Flooding, lake levels and pollution
Received: October 19, 2005

- The biggest problem is the flooding caused when the Similkameen River is in flood. This could and should be addressed by creating storage.
- Lake levels of 911.0 – 911.5 work well on US side, levels over 913.0 are hard on docks
- Water quality has deteriorated since 1936

Response number: 23
From: Joe Falkoski (Bridesville) Concerned Citizen
Relayed through: Chris Bull
Regarding: Similkameen River flooding
Received: October 19, 2005

- To solve flooding problems, store water for irrigation and create power the Similkameen River should be dammed at Princeton

Appendix IV Issues beyond the Terms of Reference

Issue 1 – Insufficient Public Involvement

Several persons suggested that the process of issuing Orders of Approval and managing water supplies for Osoyoos Lake is weak in terms of meaningful public involvement. It was also listed as an issue by Milton (1995). While public meetings are held annually there is no contact between meetings and there is no feedback on the suggestions offered by the those who speak out at the meetings. Complainants suggest that this is the reason why attendance at the meetings is poor.

Suggestions for improvement include:

- Establish a public advisory committee with a local coordinator
- If and when necessary, establish subcommittees to investigate topical issues
- Set-up an easily accessible database to centralize a complete collection of information about Osoyoos Lake water regulation and flooding
- Provide responses to those making suggestions
- List all measurements in metric and English and using Canadian and US Datums
- Publish annual operation instructions not just drought declarations.

Issue 2 – Oversubscription of Water

Concerns were heard that water supplies will eventually run out. Those who are worried point to:

- The recent increases in water use on the Canadian side of the basin.
- The lack of a legally binding agreement on cross border flows
- Undisclosed volumes of water held in trust for the Confederated Tribes of the Colville Reservation
- In ability to meet present base flow requirements

This is a continuing concern that has been around for at least 30 years (Kauffman, 1976). It will be addressed to some extent if Study 1 is carried out.

Issue 3 – Development of storage on Similkameen River

The suggestion that storage and diversion dams should be constructed on Similkameen River has been around for a long time and two of the persons we spoke with expressed strong support of the idea. They pointed out that:

- Shankers Bend in the US and the Town of Princeton in Canada are ideal storage sites
- Storage could be used to control flooding, create power, and supply water in low flow periods (IEC Beak Consultants, 1985; Hall, 1992)
- A diversion scheme has been identified that could divert Similkameen River water into Osoyoos Lake (DeVon, 2001;Kaufman, 2000)

However, our research indicated that this subject was investigated in detail by the Government of British Columbia and the idea was ruled out on the basis of insufficient storage (BC Water Investigations Branch, Undated; Leach, 1968; Obedkoff, 1973). Furthermore, interbasin water transfers are not permitted by both Canadian federal policy and British Columbia policy.

Issue 4 – Pollution

The issue of pollution not connected with water regulation is raised frequently on the Canadian side (e.g. by the Osoyoos Lake Water Quality Society) but has also been a concern on the US side. In the lake issues revolve around high nutrient levels, algae growth, high temperatures and low oxygen levels. In the Okanagan and Similkameen Rivers temperature is again a problem but there have also been worries about heavy metals, DDT, suspended sediment and lack of monitoring (Kauffman, 1976; Milton, 1995; Passmore, 1995).

Issue 5- Lack of Adaptive Management

Sherry Linn (Osoyoos Water Quality Society) and others were concerned that the process of issuing Orders of Approval is not amenable to adaptive management. She suggests there ought to be a way to meet changing conditions and incorporate new information.

Appendix V - Chronicle of Events Relating to the Management of Water Levels in Osoyoos Lake

DATE	EVENT	REFERENCE
1846	The 49th parallel was established as the International Border between the United States and Canada	Westridge Inn Resort, 2005
1894	Severe floods resulted in the highest Osoyoos Lake level ever recorded (919.6 feet USGS according to some 918.5 GSC according to otheres).	Webb & Veatch, 1946: BC Lands, Forests & Water Resources, 1975
Jan. 11, 1909	Boundary Waters Treaty establishes International Joint Commission	Google
1912, 1916, 1919, 1939, 1940, 1974 and other years not specifically recorded	Deposits from Tonasket Creek reduced the conveyance capacity of Okanogan River. In early years river currents eventually removed the deposits but in later years dredging was often carried out.	Webb & Veatch, 1946
1915	Okanagan Lake dam was built to raise the lake for navigation of large ships.	Webb & Veatch, 1946
1915	A dike, constructed along the Okanogan River in Oroville to protect a creamery building, partially restricted lake outflow.	Webb & Veatch, 1946
1919	British Columbia provided 22,000 acres of land along the Okanagan River to war veterans and constructed the South Okanagan Lands Project - a major irrigation scheme. Southern Okanagan Lands Irrigation District (SOLID) canal has a capacity to carry 200 cfs but about one third is reportedly returned directly to the river and another third returns through deep seepage.	Oliver and District Chamber of Commerce, 2005; Webb & Veatch, 1946
May 1927	Zosel Dam was constructed to maintain a pool for delivering logs to Zosel Mill. A permit was obtained from the State and the mill was equipped with a fish ladder but apparently neither Canada nor the International Joint Commission was consulted.	Webb & Veatch, 1946, McNeil, 2001
1927	Water from the South Okanagan Lands Project was extended to Osoyoos opening up new orchards.	Westridge Inn Resort, 2005
1928-9	Okanagan Lake dam was replaced with a dam meant to control the lake at 1120.4 to 1125.9 feet. This reduced flood peaks but prolonged the period of higher runoff.	Webb & Veatch, 1946

1928	Flood year. Permanent international gauging stations set up at Osoyoos Lake and on Okanogan River at Tonasket.	Webb & Veatch, 1946
1929 - 1931	Major drought years. In one instance Okanagan River flows were reduced to 4.6 cfs. Osoyoos lake lake levels hit 908.82 the lowest level on record.	
1934 & 1938	Flood years. Similkameen River flowed upstream past Zosel Dam. Levels at the dam and on the lake exceeded 914 ft.	Webb & Veatch, 1946
Dec 5 1938	Backwater from Zosel dam or Similkameen River submerged Tonasket Bar	Webb & Veatch, 1946
March 31,1939	Major deposits from Tonasket Creek completely cut off the Okanogan River. The river scoured through the right bank of the main channel in May and human dug a channel through the bar.	Webb & Veatch, 1946
July 14, 1939	At request of the US Fish & Wildlife Service, the US Bureau of Reclamation installed a fish screen across Osoyoos Lake outlet. This screen reduced conveyance until it was removed (pickets were removed in 1940 and foundations at various times between 1942 & 1943).	Webb & Veatch, 1946
Summer 1942	Widespread flooding occurred throughout Okanagan Valley. A silt bar formed at the outlet of Osoyoos Lake as it had repeatedly over the years due to wave action. IJC Board of engineers reported the bar increased in height about 3 feet between 1897 and 1943. It was cleared periodically by natural scouring and also by humans attempting to increase outflows.	Webb & Veatch, 1946
Sept. 26, 1942	State of Washington Dept of Conservation & Development applied to have IJC look into the effects of Zosel Dam and the bars and dikes that affect the level of Osoyoos Lake	Webb & Veatch, 1946
1942	IJC Board of Engineers reported that the backwater effect in Osoyoos Lake (ie the difference between the measured lake level and the level that would occur without any obstructions in Okanogan River) increased by 1.7 ft between 1929 and 1942. Contributing factors included the bar at Tonasket Creek, Zosel Dam, the bar at the lake outlet, the fish screen in the river, and the dike near the creamery.	Webb & Veatch, 1946
Spring 1943	As a result of flooding in 1942 a Canada/British Columbia Board of Engineers was appointed to report on control and disposal of water in	IJC, Order of Approval 1946

	Okanagan Basin	
July 10 & 12, 1943	Complaints about high lake levels resulted in Washington State asking the IJC to hold hearings. Hearings are held at Penticton & Oroville following which the IJC appointed a Board of Engineers to investigate.	McNeil, 1996
March 30, 1944	Backwater from Zosel dam submerged Tonasket Bar	Webb & Veatch, 1946
1945	Similkameen River backwatered the Okanagan River to Zosel Dam	Webb & Veatch, 1946
June 21 & 22, 1946	IJC held public hearings in Osoyoos and Oroville. The Indian Agent for Osoyoos Indian Reservation stated that a level of 911.1 and 911.6 would be acceptable.	IJC, 1943.
Sept 12, 1946	On the advice of the Board of Engineers, the IJC ruled that Zosel Dam sometimes raises the level of Osoyoos Lake and ordered the owner to rebuild it with suitable openings and control gates. IJC ruled that the dam must be capable of passing 2500 cfs at 911.0 ft or less measured not more than 300 feet upstream from the dam. No mention was made of Osoyoos Lake levels. IJC appointed an International Osoyoos Lake Board of Control to "retain jurisdiction over the Zosel dam".	IJC, 1946 and McNeil, 1996
1946	131 irrigation dams with a storage capacity of 75,000 acre-ft were located above Okanagan Lake. A further 15 dams with a capacity of 7,000 acre ft were located on tributary streams between Okanagan lake and the international boundary.	Webb & Veatch, 1946
1948	Severe floods caused Similkameen River to flow north into Canada. Osoyoos Lake reached 916.5.	BC Lands, Forests & Water Resources, 1975.
1950	US Army Corps of Engineers removed 40,000 yards of material from Tonasket Creek Bar and 8,000 yards from the outlet of Osoyoos Lake and used it for fill at the State Park. High water year.	Hallauer, 1985
1955	Okanagan River upstream from Osoyoos Lake was channellized to prevent flooding. Over 80% of the floodplain was diked off and became non-functional	Glenfir Resources, 2002
1959	High water levels in Osoyoos Lake for 60 days blocked septic tanks, flooded basements, undermined foundations, threatened property values and impacted recreation and tourism. Osoyoos Board of Trade blamed the	Village of Osoyoos Board of Trade, 1959.

	channellization scheme, improper regulation of Okanagan Lake storage, blockages in Okanogan River and Zosel Dam.	
1960s	Zosel lumber stopped using the millpond to dam forebay to deliver logs to their sawmill.	McNeil, 1996
1961	High water year	
1964	High water year	
1971	The Water Resources Act provides Ecology with the Authority to develop management and use plans for Washington State Waters.	
1972	Severe floods caused the Similkameen River to reach 45,800 cfs and flow north into Canada. Osoyoos Lake reached 916.8 – the second highest level on official record. 130 private residences on the Canadian side were damaged. 70% of properties with septic tanks were affected by seepage and mosquitos were a problem. 21,000 hours of labor were spent on flood control and cleanup on the Canadian side.	BC Lands, Forests & Water Resources, 1975.
1974	Severe flooding caused the Similkameen River to reach 31,500 cfs and flow north into Canada. Osoyoos Lake reached 915.5 and would have reached 916.9 if flows had not been held back at the Okanagan Lake Dam.,.	BC Lands, Forests & Water Resources, 1975.
1974 & 1975	Partial collapse of Zosel dam necessitated emergency repairs by State of Washington and US Army Corps of Engineers.	McNeil1992; McNeil, 1996
1976	Ecology sets minimum instream flows for the Okanogan basin. The Washington Administrative Code requires all future water rights connected with Osoyoos Lake to be subject of lake elevations of 910.5 USCGS.	Washington State Department of Ecology, 1990
1978	US Army Corps of Engineers ruled Zosel Dam unsafe. IJC called hearings in regard to the condition of the dam. Washington and BC agreed to rebuild the dam.	McNeil, 1996
1978	The Okanogan County Board of County Commissioners recommended Osoyoos Lake be maintained at 912.5 maximum, 909.5 minimum and at an average level of 911.5 to 911.75 feet.	Okanogan County Board of County Commissioners, 1978
1979	US Army Corps of Engineers produced a plan for replacing Zosel Dam	McNeil, 1996
December 28, 1980	State of Washington Dept of Ecology applied to IJC for approval to rebuild Zosel Dam. Submitted with the application was the “British Columbia Washington State Cooperation Plan for Osoyoos	IJC Order of Approval 1982

	Lake Levels and Trans-Border Flows". This plan did not guarantee any transboundary flow and was not enforceable but it provided guidelines to be satisfied as far as practical. The IJC stated that the minimum level for satisfactory operation of irrigation pumps in BC is 910.3	
December 8, 1981	The IJC held public hearings in Oroville and Osoyoos to gather local input to the proposed dam.	IJC Order of Approval 1982
1982	IJC issued an Order of Approval for the construction of Zosel Dam. The Order specified the required capacity at the dam and the range of allowable lake levels.	McNeil, 1996
September 19,1985	IJC held public hearings in Oroville and Osoyoos to discuss relocation of Zosel Dam from the proposed site near the lake outlet to a site very close to the original dam location further downstream.	IJC Order of Approval 1985
September19 & 25, 1985	Chief Clarence Louie of the Osoyoos Indian Band requested compensation for the loss of land resulting from Zosel Dam and requested that the IJC determine damage and liability. IJC rejected the request.	IJC Order of Approval 1985
October 25, 1985	IJC issued a Supplemental Order of Approval to allow relocation of the dam and other minor changes.	IJC Order of Approval 1985
1986	Construction of the new dam began.	McNeil, 1996
May 20, 1987	Washington State Department of Natural Resources, decided that the level of State ownership of the bed and shores of Osoyoos Lake extended up to 911.5 feet.	Washington State Department of Natural Resources, 1987.
1987	Construction of new dam was completed in April. Drought was declared and then rescinded. This leads to discussions on how best to lower the lake level following rescindment. Suction dredging cleaned out channel above dam.	McNeil, 1996. Cronin et. al., 1987. Washington State Department of Ecology, 1990.
1988	A drought declaration resulted in elevated lake levels from May 6 to August 25. An MOU was established between Washington Departments of Ecology, Fisheries and Wildlife to establish fisheries considerations for operation of Zosel Dam	McNeil, 1996; Washington State Department of Ecology, 1990
1989	Washington State Dept. or Ecology signs an agreement that authorizes Oroville – Tonasket Irrigation District to operate Zosel Dam.	Washington State Department of Ecology, 1990.

1992	A drought results in elevated lake levels (912.5 to 913.0 feet from June 18 to September 30). Water is imported into the lake from the Similkameen via the old Okanagan-Tonasket Irrigation flume. Lake level peaked at 912.63. Many complaints about high lake levels were received and Osoyoos Lake Board of Control wrote "*…this prolonged exposure to higher lake levels adversely affected a number of lake front owners and resulted in a significant public protest.*".	McNeil, 1996 Osoyoos Lake Board of Control, 1994.
1993	Osoyoos Lake Board of Control (OLBOC) requests "*…that operation of the lake be carefully managed as some lakefront owners could be affected by prolonged lake levels above 912.5 feet.*" This was a drought year when the Order allowed 913.0 but because of the 1992 experience a memorandum of understanding (MOU) was signed by Washington State and British Columbia (1993 only) agreeing that B.C would release up to an additional 2850 acre-feet (1450 cfs-days) from Okanagan Lake to assist the downstream migration of juvenile sockeye salmon during May in return for Washington agreeing to make the upper target elevation of Osoyoos Lake not more than 912.5 feet. A relatively constant lake level was maintained during May June and July causing the OLBOC to say "*…storage was not required…the Board has information that shows why this waster was stored nor what purpose it served when released or otherwise used but the State has stated on several occasions their principal interest in the stored water is for protection and propagation of fish…*"	Osoyoos Lake Board of Control, 1994.
1993 or 1994	A large portion of the Okanagan River sockeye run strayed into the Similkameen River. This was thought to be due to imprinting on water brought in to Osoyoos Lake in 1992.	Tom Scott, Oroville Tonasket Irrigation District personal communication.
1994	Drought was declared. The arrangement stipulated in the 1992 MOU was used informally (no MOU) in this and subsequent drought years.	IJC Website
1996	Major flood year.	
1997	Major flood year.	
1998	Drought was declared and then rescinded.	IJC Website
2001	Drought years the MOU. BC supplies 6 inches of water in return for Washington holding maximum	McNeil, 1996

	level to 912.5.	
2003	Drought was declared.	IJC Website
2004	Drought was declared.	IJC Website
2005	Drought was declared. Plan of Study was intitiated.	IJC Website

Appendix VI – Orders of Approval

Note to Reader: Clauses in this Order that were revised with the October 17, 1985 Supplementary Order of Approval are herein highlighted for clarity with "~~strikethrough~~."

INTERNATIONAL JOINT COMMISSION

IN THE MATTER OF THE APPLICATION OF THE STATE OF WASHINGTON FOR APPROVAL TO CONSTRUCT A CONTROL STRUCTURE NEAR THE OUTLET OF OSOYOOS LAKE

ORDER OF APPROVAL

December 9, 1982

Whereas Osoyoos Lake is a stream flowing across the boundary within the meaning of Article IV of the Boundary Waters Treaty signed on 11 January 1909.

Whereas in accordance with the Treaty the State of Washington, hereinafter referred to as the Applicant, under date of 24 December 1980 submitted through the Secretary of State for the United States of America an application to the Commission for approval for the construction of works for regulating the levels of Osoyoos Lake in the Province of British Columbia and the State of Washington, the effect of which would raise the natural level of waters on the other side of the boundary, hereinafter referred to as the works.

Whereas pursuant to the said Treaty the Commission is to require, as a condition of its approval that suitable and adequate provision, approved by it, be made for the protection and indemnity of all interests on the other side of the boundary which may be injured thereby.

Whereas on 12 September 1946 the Commission in response to an application by the State of Washington issued an Order of Approval for Zosel Dam subject to several conditions which included alterations that would provide a capacity of 2500 cubic feet per second when its forebay elevation is 911.0 United States Coast and Geodetic Survey (USCGS) and Zosel Dam is now unable to meet that requirement.

Whereas the proposed works are intended to replace Zosel Dam, a timber structure originally built in 1927, repaired from time to time, but now in a deteriorated condition and overstressed when the water level immediately upstream from Zosel Dam is at elevation 911 USCGS.

Whereas the United States Coast and Geodetic Survey (USCGS) datum for Osoyoos Lake levels gives readings 0.26 feet greater than the Geodetic Survey of Canada (GSC) datum. For example, elevation 911.0 USCGS equals elevation 910.7 GSC.

Whereas submitted with the application was a co-operation plan entitled British Columbia Washington State Co-operation Plan for Osoyoos Lake Levels and Trans-Border Flows", prepared by the Department of Ecology of the State of Washington and the Ministry of Environment of the Government of

British Columbia, the implementation of which depends upon the physical capability of the proposed works.

Whereas notices that the application had been filed were published in accordance with the Rules of Procedure of the Commission.

Whereas Statements in Response were received by the Commission and the Applicant filed a Statement in Reply with the Commission. Copies of the Statements in Response and the Statement in Reply are on file and available for examination at the offices of the Commission in Ottawa and Washington.

Whereas pursuant to published notices public hearings were held at Oroville, Washington on the morning of 8 December 1981 and at Osoyoos, British Columbia on the afternoon of the same day, at which all persons attending and interested were afforded opportunity of presenting, under oath, evidence to the Commission. Copies of the transcript of the public hearings are on file and available for examination at the offices of the Commission in Washington and Ottawa.

Whereas the spokesman for the Applicant stated that failure of Zosel Dam to maintain established lake levels would result in appreciable damage and financial loss to agriculture, recreational and municipal interests on both sides of the International Boundary; that the cooperation plan provides for emergency storage in Osoyoos Lake during water-short years; that this emergency storage would be used for fisheries protection, domestic use and irrigation in both countries; and that the Applicant and the Province of British Columbia, hereinafter called the Province, are now working together to develop suitable financial arrangements for funding the proposed works.

Whereas the spokesman for the Province stated that the Province endorsed the application; that the Province does not consider the co-operation plan to be part of the application; and that the co-operation plan does not guarantee any transboundary flow but outlines procedures and flows which will be satisfied as far as practicable.

Whereas during a period of drought the natural inflow to Osoyoos Lake is near zero in the latter part of the summer and the evaporation from Osoyoos Lake for July and August may exceed 12 inches, that the minimum level for the satisfactory operation of pumps in British Columbia supplying water from Osoyoos Lake for irrigation is 910.3 USCGS, and that future periods of drought will require careful management of releases of stored water.

Whereas the Commission heard expressed and shared the concern that if the flows provided for in the co-operation plan were given effect, then such flows could jeopardize the maintenance of Osoyoos Lake levels designed to protect and indemnify interests generally, and more particularly, applicants for new water licenses.

Whereas the Commission's consideration of the present Application in no way affects the right of the upstream country as set out in Article II of the Boundary Waters Treaty of January 11, 1909 to construct, maintain and operate such works as it may consider necessary or desirable for the purpose of making the most advantageous and reasonably practicable use on its own side of the International Boundary by diversion of the upstream waters as regulated by headwater storage reservoirs lying entirely within the upstream country and constructed wholly at the expense of the upstream country or at the expense of the upstream country's interests.

Whereas the spokesmen for the Applicant and the Province stated that notwithstanding the relationship of the co-operation plan to the proposed works, it is their view that the Co-operation Plan does not create an enforceable obligation to provide or any enforceable right to receive transboundary flows, but rather constitutes an expression of intention to satisfy the objectives therein, consistent with satisfaction of water needs as they arise in British Columbia, and so far as may be practicable while maintaining lake levels provided for in this Order.

Whereas several witnesses testified that a maximum Osoyoos Lake level of 912.5 feet USCGS was preferred to elevation 913.0 feet as requested in the application.

Whereas hydrological analyses indicate that the level of Osoyoos Lake has, and probably will again, exceed elevation 913.0 USCGS at least every other year and for a duration varying from two days to two months, that the probable recurrence interval of the lake level exceeding elevation 915.0 is 12 years and that in 1972 Osoyoos Lake level peaked at elevation 917.1 feet USCGS.

Whereas flood flows of the Similkameen River create a backwater in the Okanogan River at Oroville thereby reducing the outflows from Osoyoos Lake, raise the water level of Osoyoos Lake above that which would have occurred in the absence of a backwater and in some years causes the Okanogan River to reverse its direction and flow north into Osoyoos Lake.

Whereas Tonasket Creek during freshets frequently carries a large bedload of sand, gravel and boulders which are deposited in the Okanogan River channel about a mile below the outlet of Osoyoos Lake forming a natural obstruction which reduces the capacity of the Okanogan River channel and this natural obstruction has been removed a number of times only to form again.

Whereas detailed analysis of recorded water levels of Osoyoos Lake from 1948 to 1981 inclusive indicates that for the period 1 April to 31 October in those years the levels have been 911.0 USCGS or above 82 percent of the time, 911.5 USCGS or above 50 percent of the time, 912.5 USCGS or above 11 percent of the time, and 913.0 USCGS or above 6 percent of the time. Moreover, the level of Osoyoos Lake has been maintained between elevation 911.0 and 911.5 USCGS 32 percent of the time.

Whereas the Commission on April 28, 1982 issued an Order of Approval for the works described herein; the Applicant by letters dated July 8 and November 30, 1982, and the Province of British Columbia by letters dated July 29 and December 2, 1982, submitted comments with respect to the said Order; the Commission, having concluded that none of the items raised in those letters involved issues of substance not raised at the public hearings, has reconsidered the wording of the April 28, 1982 Order and has issued this Order of Approval.

The Commission concludes that there is an urgent need to replace Zosel Dam, that the works would facilitate control of the water levels of Osoyoos Lake for the benefit of agriculture, tourism and other interests, and that the works would not create flood levels any more extreme than would have occurred if Zosel Dam had remained in place and been maintained and operated in accordance with the 1946 Order of Approval.

The Commission concludes further that if the works are constructed, operated and maintained in accordance with the conditions and other provisions of this Order, suitable and adequate provision will have been made for the protection and indemnity of all interests in Canada that may be affected thereby.

NOW THEREFORE THIS COMMISSION ORDERS AND DIRECTS that the construction, maintenance and operation, by the Applicant, of a control structure and related works, herein called the works, on the Okanogan River downstream from the outlet of Osoyoos Lake be and the same are hereby approved, subject to the following conditions:

1. ~~The control structure shall be located on the Okanogan River, approximately 300 feet downstream from the Cherry Street Bridge in Oroville, Washington, and upstream from the existing Zosel Dam, as shown in the concept plan submitted by the Applicant.~~

2. ~~The principal works shall include a reinforced concrete control structure with appropriate power operated control gates, piers having adequate capability for breaking ice, a stilling basin, fish passage facilities, compacted earth embankments on each flank of the~~

~~structure, the relocation of Tonasket Creek, and necessary dredging in the Okanogan River.~~

3. The top of the piers and sidewalls shall not be lower than elevation 917.5 feet United States Coast and Geodetic Survey (USCGS) datum. Wing walls and training walls may be at a lower elevation. The control gates shall be of sufficient number and size so as to have a capacity of at least 2500 cubic feet per second when the elevation of Osoyoos Lake is 913.0 feet USCGS and there is no appreciable backwater effect from the Similkameen River.

4. ~~Tonasket Creek shall be relocated so that its confluence with the Okanogan River is at the oxbow immediately upstream from Zosel Dam, as shown on the concept plan submitted by the Applicant. The channel of the Okanogan River between the control structure and the location of Zosel Dam shall be dredged whenever necessary so as to ensure that it has the same capacity as the control structure when the elevation of Osoyoos Lake is at 913.0 feet USCGS.~~

5. ~~Before commencing construction of the said works, the Applicant shall deliver to the Commission four copies of the necessary permits, approvals and certifications from the Washington State Departments of Ecology, Fisheries, and Game as well as Okanogan County and the United States Army Corps of Engineers.~~

6. During construction of the said works, the Applicant shall operate all available facilities and carry out construction so as to maintain levels as nearly as possible in conformance with those prescribed in Conditions 7, 8, 9 and 10.

7. Upon completion of construction the Applicant, in consultation with the Board of Control appointed under Condition 14, shall operate the works so as to maintain the levels of Osoyoos Lake between elevation 911.0 and 911.5 feet USCGS to the extent possible from 1 April to 31 October each year except under drought conditions in the Okanogan Valley (in Canada Okanagan Valley), as defined in Condition 8 and also during the appreciable backwater conditions and excessive inflows described in Condition 9. Furthermore, the Applicant shall operate the works so as to maintain the levels of Osoyoos Lake between elevation 909.0 and 911.5 feet USCGS from 1 November to 31 March each year.

8. During a year of drought as determined by the Board of Control in accordance with the criteria set forth below, the levels of Osoyoos Lake may be raised to 913.0 feet USCGS and may be drawn down to 910.5 feet USCGS during the period 1 April to 31 October. The criteria are:

   (a) the volume of flow in the Similkameen River at Nighthawk, Washington for the period April through July as calculated or forecasted by United States authorities is less than 1.0 million acre-feet or

   (b) the net inflow to Okanagan Lake for the period April through July as calculated or forecasted by Canadian authorities is less than 195,000 acre-feet or

   (c) the level of Okanagan Lake fails to or is forecasted by Canadian authorities to fail to reach during June or July elevation 1122.8 feet Canadian Geodetic Survey Datum.

   Drought year operations shall be terminated when in the opinion of the Board of Control none of the three criteria defining a drought year exist. The level of Osoyoos Lake shall then be maintained in accordance with Condition 7.

9. During appreciable backwater conditions caused by flows in the Similkameen River, particularly during the freshet period, and during abnormal excessive flows in the Okanagan River, the works

shall be operated so as to maintain the level of Osoyoos Lake as near as possible to the elevations prescribed in Conditions 7 and 8 herein. In such an event every effort shall be made to lower the level of Osoyoos Lake in the shortest practicable time.

10. In the event of circumstances including but not restricted to a prolonged drought coupled with high evaporation from Osoyoos Lake, activities to destroy milfoil, or underwater construction, the Commission upon written advice and recommendation from the Board of Control may allow a temporary deviation from the levels prescribed in Conditions 7 and 8.

11. In the event of water supplies in excess of the recorded supplies the said works shall be operated to provide levels on Osoyoos Lake no more extreme than would have occurred had the works not been built and had Zosel Dam remained in place and maintained and operated in accordance with the 1946 Order of Approval.

12. Upon completion of the works the existing Zosel Dam shall be completely removed so that it is no longer an obstruction in the Okanogan River.

13. All levels of Osoyoos Lake shall be defined as those measured at the International Gauging Station known as "Osoyoos Lake near Oroville" and shall be expressed in terms of USCGS datum.

14. The Commission shall appoint a Board of Control to be known as the International Osoyoos Lake Board of Control with an equal number of members from each country to ensure compliance with the provisions of this Order including operation and maintenance. The Board shall keep the Commission currently informed of all matters relating to this Order including the occurrence and termination of drought conditions and report promptly any violation of this Order to the Commission and compliance by the Applicant with any instructions of the Commission as may be issued from time to time with respect to this Order. The Board shall submit reports to the Commission at such times as the Commission may determine. These reports shall include all hydrological, operational, maintenance information and diversions from Osoyoos Lake as may be required. In the event of a disagreement amongst the members of said Board of Control which they are unable to resolve, the matter shall be referred by them to the Commission for decision.

15. The Applicant shall maintain the works in a manner satisfactory to the Board of Control.

16. During the period April 1 to October 31 each year, the Applicant shall maintain the level of Osoyoos Lake at or above elevation 910.5 feet USCGS to the extent possible through the regulation of outflow and the adherence to the terms of the "Report of Findings of Fact and Decision" approved by the State of Washington on October 19, 1981 pertinent to the State of Washington's decision on the water right application for change in point of diversion and place of use by the Oroville-Tonasket Irrigation District. In this regard also, the Applicant shall require that all future licenses issued subsequent to the date of this Order and for the diversion of water upstream from the control structure contain the condition that the diversion be terminated when the elevation of Osoyoos Lake drops below elevation 910.5 feet USCGS.

17. The Applicant shall be responsible for the disposition of claims for physical injury or damage to persons or property occurring in Canada in connection with the construction, maintenance and operation of the works and for the satisfaction of any such claims that are valid.

And it is further ordered that the Commission retains jurisdiction over the subject matter of this application and after giving such notice and opportunity to all interested parties to make representations as the Commission deems appropriate may make further order or orders relating thereto as may be necessary in judgment of the Commission.

This approval will terminate:

(a) ninety (90) days after the date of signing of this Order unless within that time the Applicant informs the Commission in writing that it accepts all of the conditions set forth herein;

(b) three years after the date of signing, unless before that date the control structure and appurtenant works are essentially complete and operational according to the provisions of this Order;

(c) twenty-five (25) years after completion of construction, unless renewed.

Signed this 9th day of December, 1982

(Original signed by…)

E. R. Olson
R. C. McEwen
C.M. Bedard
L. K. Bulen
D. L. Totten

INTERNATIONAL JOINT COMMISSION

IN THE MATTER OF THE APPLICATION OF THE STATE OF WASHINGTON FOR APPROVAL TO CONSTRUCT A CONTROL STRUCTURE NEAR THE OUTLET OF OSOYOOS LAKE

SUPPLEMENTARY ORDER OF APPROVAL

October 17, 1985

WHEREAS the Commission issued an Order of Approval on December 9, 1982 which, subject to certain conditions, approved the construction, maintenance and operation by the State of Washington, hereinafter referred to as the Applicant, of a control structure and related works on the Okanogan River downstream from the outlet of Osoyoos Lake to replace Zosel Dam;

WHEREAS the Applicant, by a letter from Governor Gardner dated August 21, 1985, has amended its application to change the location and design of the control works; to provide for adequate flow capacity in the channel of the Okanogan River without necessarily relocating Tonasket Creek; and to extend the time for completion of the control structure and appurtenant works;

WHEREAS the Commission's International Osoyoos Lake Board of Control, appointed under Condition 3 of the Commission's Order of Approval of September 12, 1946, advised the Commission in a letter dated September 12, 1985 that, based on a review of the preliminary design documents, these changes will satisfy the conditions contained in the Commission's 1982 Order of Approval subject to certain comments and actions set out in the Board of Control's letter;

WHEREAS a spokesman for the Province of British Columbia has expressed the province's support for the Applicant's amended application;

WHEREAS the Commission's Order of Approval of December 9, 1982 provides that the Commission retains jurisdiction over the subject matter of that Order and after giving such notice and opportunity to all interested parties to make representations as the Commission deems appropriate may make further order or orders relating thereto as may be necessary in the judgment of the Commission;

WHEREAS pursuant to published notices, public hearings were held at Oroville, Washington on the morning of September 19, 1985 and at Osoyoos, British Columbia on the afternoon of the same day at which all interested persons were afforded the opportunity of being heard by the Commission;

WHEREAS the Commission's International Osoyoos Lake Board of Control, appointed under Condition 3 of the Commission's Order of Approval of September 12, 1946 informed the Commission at the public hearings that no further structural improvements are required to Zosel Dam if the new control structure and appurtenant works are completed by the middle of 1987;

WHEREAS Chief Clarence Louie of the Osoyoos Indian Band by letters dated September 19 and September 25, 1985 requested the Commission to provide for compensation for loss of land as a result of Zosel Dam; requested the Commission to investigate damages caused by Zosel Dam as well as damage which could be caused by the works which have been proposed by the Applicant to replace Zosel Dam; and requested the Commission to determine liability for any such damages;

WHEREAS the Commission held public hearings in 1943 and 1946 prior to issuing an Order of Approval for Zosel Dam and the Indian Agent interested in Osoyoos Indian Reserve №1 stated at the public hearings held in Penticton, British Columbia on July 10, 1943 that Indian Reservation lands had been flooded;

WHEREAS the Indian Agent interested in Osoyoos Indian Reserve №1 stated at the public hearings held in Osoyoos, British Columbia on June 21, 1946 that a level for Osoyoos Lake between 911.1 and 911.6 "would be quite satisfactory to us", and that others with property on Osoyoos Lake also said that they would have no objections to such levels;

WHEREAS the Commission's 1946 Order of Approval contained requirements for Zosel Dam which took into account the wishes of Osoyoos Indian Reserve №1 and of other persons with lakefront property concerning the effects of the dam on the level of Osoyoos Lake, as stated at the public hearings;

WHEREAS the Commission held public hearings in 1978 to receive comments concerning the possible improvement of water levels on Osoyoos Lake, and the Okanagan River above Zosel Dam, and about the possible structural improvement or replacement of Zosel Dam, and, at those hearings, Chief Baptiste of the Osoyoos Indian Band requested compensation for land lost as a result of Zosel Dam;

WHEREAS Chief Baptiste attended public hearings held by the Commission prior to issuing its 1982 Order of Approval for a new control structure and appurtenant works to replace Zosel Dam, and did not at that time express concern regarding the flooding of lands belonging to the Osoyoos Indian Band but asked whether the new works would be capable of releasing enough water to keep the level of Osoyoos Lake from rising above 913 feet even during flood conditions;

WHEREAS the Commission's 1982 Order of Approval, retained essentially the regime for the level of Osoyoos Lake established in the Commission's 1946 Order of Approval;

WHEREAS the Commission's present Supplementary Order of Approval does not change the requirements for the new works which relate to the level of Osoyoos Lake and which were established in the Commission's 1982 Order of Approval;

WHEREAS the Commission has decided that it will not accede to Chief Louie's request that it investigate this matter further and provide for compensation for loss of land caused by Zosel Dam; and

WHEREAS, as stated in the Commission's Order of Approval of December 9, 1982, there continues to be an urgent need to replace Zosel Dam, the replacement works proposed by the Applicant would facilitate control of the water levels of Osoyoos Lake for the benefit of agriculture, tourism and other interests, and the replacement works would not create flood levels any more extreme than would have occurred if Zosel Dam had remained in place and been maintained and operated in accordance with the 1946 Order of Approval.

NOW, THEREFORE, it is ordered that the Commission's Order of Approval of December 9, 1982 is hereby amended as follows:

1. Condition 1 is deleted and the following substituted therefor:

"1. The control structure shall be located on the Okanogan River between the Cherry Street Bridge in Oroville, Washington and the present site of Zosel Dam."

2. Condition 2 is deleted and the following substituted therefor:
"2. The principal works shall include a reinforced concrete control structure with appropriate power operated control gates, an overflow weir section, stop logs, piers having adequate capability for breaking ice, a stilling basin, fish passage facilities, appropriate seepage and erosion controls, and measures required pursuant to Condition 4."

3. Condition 4 is deleted and the following substituted therefor:
"4. The Applicant shall take all measures necessary to ensure that the flow capacity of the Okanogan River, upstream and downstream from the control structure, enables the control structure to pass at least 2500 cubic feet per second when the elevation of Osoyoos Lake is 913.0 feet USCGS and there is no appreciable backwater effect from the Similkameen River."

4. Condition 5 is deleted and the following substituted therefor:
"Before commencing construction of the said works, the Applicant shall obtain written confirmation from the Board of Control, appointed under Condition 14, that the final design for the works appears capable of satisfying the Conditions contained in this Order of Approval."

This approval will terminate:

(a) ninety (90) days after the date of signing of this Supplementary Order, unless within that time the Applicant informs the Commission in writing that it accepts all of the conditions set forth in the Commission's Order of Approval of December 9, 1982 as amended by this Supplementary Order;

(b) on July 31, 1987, unless before that date, the control structure and appurtenant works are essentially complete and operational according to the provisions of this Order;

(c) twenty-five (25) years after the Board of Control has informed the Commission that construction has been completed, unless renewed.

Signed this 17th day of October, 1985.

(Original signed by…)

Robert C. McEwen
L. Keith Bulen
P.-André Bissonnette
Donald L. Totten

Appendix VII Instream Flows

Instream flows for the Okanagan watershed in cubic feet per second (cubic meters per second). Flow information from Canada – British Columbia Okanagan Basin Agreement, 1974; Washington State Department of Ecology (1990) and Montgomery et al., 1995.

Date	**Preferred Flow at Oliver**	**Transboundary Flow**	**Instream Flow at Oroville**
Reference	**Canada – British Columbia Okanagan Basin Agreement, 1974**	**Washington State Department of Ecology, 1990**.	**(Washington Administrative Code)**
Jan 1 - 31	175 (5.0)	175 (5.0)	320 (9.1)
Feb 1- 28	175 (5.0)	200 (5.7)	320 (9.1)
March 1 – 31	175 (5.0)	200 (5.7)	320 (9.1)
April 1 – 14	Not Stated	200 (5.7)	330 (9.3)
April 15 - 30	Not Stated	200 (5.7)	340 (9.6)
May 1 - 14	Not Stated	250 (7.1)	350 (9.9)
May 15 - 31	Not Stated	250 (7.1)	500 (14.2)
June 1 - 30	Not Stated	250 (7.1)	500 (14.2)
July 1 – 14	Not Stated	250 (7.1)	420 (11.9)
July 15 - 31	Not Stated	250 (7.1)	350 (9.9)
Aug. 1 – 14	300 (8.5)	340 (9.6)	320 (9.1)
Aug. 15 - 31	300 (8.5)	340 (9.6)	300 (8.5)
Sept. 1 – 14	300 (8.5)	320 (9.1)	300 (8.5)
Sept. 15 - 30	350 (9.9)	320 (9.1)	300 (8.5)
Oct. 1 – 14	350 (9.9)	300 (8.5)	330 (9.3)
Oct. 15 - 31	350 (9.9)	300 (8.5)	370 (10.5)
Nov. 1 – 14	175 (5.0)	175 (5.0)	370 (10.5)
Nov. 15 – Dec 31	175 (5.0)	175 (5.0)	320 (9.1)

Appendix VIII – Compliance with the Orders of Approval (drought years are bolded and shaded).

Year	Months	Target Range	Actual Range	Days Not In Compliance	Comment
1983	Jan - March	909.0-911.5	910.4-912.9	27	
1983	April – Oct.	911.0-911.5	910.4-914.5	164	Similkameen reached 20,500 cfs
1983/4	Nov-March	909.0-911.5	909.9-911.9	25	
1984	April – Oct.	911.0-911.5	910.8-913.6	151	
1984/5	Nov-March	909.0-911.5	910.1-910.4	0	
1985	April – Oct.	911.0-911.5	910.3-911.2	0	
1985/6	Nov-March	909.0-911.5	909.9-911.6	3	
1986	April – Oct.	911.0-911.5	910.8-914.3	85	Similkameen reached 23,200 cfs
1986/7	Nov-March	909.0-911.5	909.8-911.2	0	
1987	**April – Oct.**	**910.5-913**	**910.0-913.0**	**0**	
1987/88	Nov-March	909.0-911.5	909.4-911.7	9	
1988	**April – Oct.**	**910.5-913**	**910.3-912.6**	**0**	
1988/89	Nov-March	909.0-911.5	911.2-911.4	0	
1989	April – Oct.	911.0-911.5	911.0-911.5	0	
1989/90	Nov-March	909.0-911.5	911.1-911.4	0	
1990	April – Oct.	911.0-911.5	911.0-913.8	90	
1990/91	Nov-March	909.0-911.5	910.5-911.3	0	
1991	April – Oct.	911.0-911.5	911.0-914.7	52	Similkameen reached 25,400 cfs
1991/92	Nov-March	909.0-911.5	909.4-911.3	0	
1992	**April – Oct.**	**910.5-913**	**910.6-912.9**	**0**	
1992/93	Nov-March	909.0-911.5	910.9-911.3	0	
1993	**April – Oct.**	**910.5-913**	**910.7-912.5**	**0**	
1993/94	Nov-March	909.0-911.5	909.7-911.2	0	
1994	**April – Oct.**	**910.5-913**	**910.6-912.4**	**0**	
1994/95	Nov-March	909.0-911.5	910.1-911.0	0	
1995	April – Oct.	911.0-911.5	911.1-912.0	28	No concern (<912.5)
1995/96	Nov-March	909.0-911.5	910.1-911.3	0	
1996	April – Oct.	911.0-911.5	911.0-914.0	74	Uncontrollable natural flood.
1996/97	Nov-March	909.0-911.5	910.3-911.3	0	
1997	April – Oct.	911.0-911.5	911.0-915.1	157	Uncontrollable natural flood.
1997/98	Nov-March	909.0-911.5	909.6-911.2	0	
1998	**April – Oct.**	**910.5-913**	**911.1-912.8**	**0**	
1998/99	Nov-March	909.0-911.5	909.6-911.2	0	
1999	April – Oct.	911.0-911.5	911.1-912.5	54	No concern (<912.5)
1999/00	Nov-March	909.0-911.5	909.4-911.2	0	
2000	April – Oct.	911.0-911.5	910.6-911. 5	0	
2000/01	Nov-March	909.0-911.5	909.5-911.4	0	
2001	**April – Oct.**	**910.5-913**	**911.4-912.5**	**0**	
2001/02	Nov-March	909.0-911.5	909.5-911.4	0	
2002	April – Oct.	911.0-911.5	911.0-912.5	23	No concern (<912.5)
2002/03	Nov-March	909.0-911.5	909.3-911.2	0	
2003	**April – Oct.**	**910.5-913**	**910.5-912.9**	**0**	
2003/04	Nov-March	909.0-911.5	909.5-910.8	0	
2004	April – Oct.	910.5-913	910.8-912.7	0	
2004/05	Nov-March	909.0-911.5	N/A	N/A	
2005	**April – Oct.**	**910.5-913**	**N/A –912.5**	**0**	