Problem Description

Historical Use of DDT and PCBs

In the Okanogan watershed, the history of land use for forestry, agriculture, and mining – and the accompanying use of pesticides and PCBs – are very similar on both sides of the international boundary. Land cover in the Okanogan watershed is primarily forest and rangeland, especially in the uplands. Near the valley bottom, orchards and pasture/hay are the primary agricultural uses. Fruit orchards have a long history in the Okanogan valley, with the first planted in 1857. By 1916, there were approximately 12,000 acres of irrigated orchards in the lower Okanogan River valley. Fruit orchards presently comprise about 2% or approximately 37,000 acres of the land area. The upper Okanogan River basin (north of the Canadian border) has a similar composition of orchard lands, providing over 99% of the tree fruit grown in British Columbia (Sinclair and Elliott, 1993).

Historical DDT[2] use in the Okanogan basin, primarily on orchard and other agricultural lands, has resulted in contamination of the aquatic environment. Although banned in the U.S. as a pesticide in 1972, DDT and its breakdown products have persisted. They have accumulated at high concentrations in lower Okanogan River and Osoyoos Lake fish as shown in the TMDL assessment study and other investigations (e.g., Johnson and Norton, 1990; Davis and Serdar, 1996; Serdar et al., 1998; Serdar, 2003).

PCBs, like DDT, have a similar history in the U.S. and Canada. Beginning in 1929, PCBs were used in many industrial applications where their flame resistance and thermal stability were particularly useful. The most common usage of PCBs was in electrical equipment, though they were put to a wide variety of uses including in some consumer goods. The U.S. and Canada banned the manufacture and most non-electrical uses of PCBs by 1979, with the last uses of PCBs scheduled to be phased out through equipment maintenance and replacement. PCBs are now a ubiquitous environmental contaminant. PCBs persist in the aquatic environment and continue to accumulate in fish tissue even though production of PCBs ended more than 25 years ago.

Documentation of DDT and PCBs in the Environment

Beginning in the early 1970s, Canadian investigators began documenting high DDT levels in fish collected from B.C. lakes along the mainstem Okanogan River (Northcote et al., 1972). In 1983, Ecology collected data which revealed DDT and PCB contamination in fish from the lower Okanogan River below the Canada border (Hopkins et al., 1985). Since then, a number of Ecology surveys have verified DDT and PCB contamination in the basin (Johnson and Norton, 1990; Davis and Serdar, 1996; Johnson et al., 1997; Serdar et al., 1998). These past studies led to a technical assessment in 2001-02 (Serdar, 2003) for the preparation of a TMDL for DDT and PCBs in the lower Okanogan basin (Peterschmidt, 2004).

[2] Unless stated otherwise, DDT refers to DDT and its breakdown products, DDE and DDD. The sum of these compounds is total DDT (t-DDT).

The Okanogan River basin, in both Canada and the United States, is traditional hunting and fishing grounds for the Native American people of the Colville Confederated Tribes (CCT). Many members of the CCT live near and along the river and regularly consume fish taken from its waters. The CCT is concerned about the presence and concentrations of PCBs and DDT found in the river and the affect that these pollutants may be having on the biology in the river and, especially, on the health of people using the river's resources as a food source.

The Washington State Department of Health reviewed data from Ecology's 2000-01 technical assessment for the Okanogan DDT and PCBs TMDL and determined that, based on the 2000-01 study and accepted consumption models, a fish consumption advisory for the river was not warranted. EPA is planning to perform a food consumption survey in the near future to determine if current consumption models are appropriate for the CCT (Stiffelman, 2008).

Findings from the 2001-02 TMDL study (Serdar, 2003) indicate DDT concentrations in edible fish tissues from the Okanogan River appear to be much lower than in the 1980s and 1990s (Hopkins et al., 1985; Davis and Serdar, 1996). In 2001-02 the maximum concentrations observed were 600 µg/Kg t-DDT compared with 3,200 µg/Kg reported in earlier studies. However, even with the reductions in concentrations noted during the 2001-02 TMDL assessment, 4, 4'-DDE still did not meet (exceeded) the criterion in 23 of the 24 samples collected and analyzed. Only one sample exceeded the 4, 4'-DDD criterion, and none of the samples exceeded the 4, 4'-DDT criterion. (Table 1.)

Data from 1984 and 1994 (Hopkins et al., 1985; Davis and Serdar, 1996)) had shown total DDT (t-DDT)* concentrations in several fish species from the lower Okanogan River among the highest ever recorded in Washington State (1,700 – 3,200 µg/Kg). Concentrations in Osoyoos Lake fish, collected primarily during a 1995 survey, showed more moderate levels (40 – 1,200 µg/Kg t-DDT), but concentrations were generally elevated above the National Toxics Rule criterion and Washington State's water quality standard for DDT (32 µg/Kg for 4,4-DDT and 4,4'-DDE, 45 µg/Kg for 4,4'-DDD).

A study by Johnson et al. (1997) also found DDT in several tributaries to the Okanogan River and Osoyoos Lake. Three streams had t-DDT concentrations above the Washington State water quality standard to protect aquatic life from chronic exposure to DDT (0.001 µg/L) (WAC 173-201A). Tallant Creek, flowing into the lower Okanogan River, had t-DDT concentrations up to 500 times the standard. However, while these concentrations were relatively high, the daily loads of DDT to the Okanogan River from all of the sources combined was low, approximately 0.3 grams/day (Johnson et al., 1997).

PCBs have also been found in some Okanogan River and Osoyoos Lake fish (Hopkins et al., 1985; Davis and Serdar, 1996; Serdar et al., 1998). Concentrations of total PCBs (t-PCBs, sum of Aroclors) in muscle tissues were relatively low (20 – 40 µg/Kg) in fish from the lower reaches of the mainstem Okanogan River. Osoyoos Lake fish had no detectable PCBs in muscle tissues, but detectable concentrations in whole fish indicate that PCBs are present in the lake. During sampling in 2001-2002 the maximum PCB concentrations in fish tissue from the Okanogan River appeared to be similar to earlier findings, with a maximum concentration of 42 µg/Kg compared to 45 µg/Kg in a previous study Serdar, 2003). The criterion for PCBs was exceeded in 17 of the 24 samples analyzed during the 2001-2002 TMDL investigation (Serdar, 2003). (Table 1.)

A complete data set for previous Ecology studies for DDT and PCBs in the Okanogan basin can be found in Appendix F in the *TMDL Technical Assessment of DDT and PCBs in the Okanogan Basin* (Serdar, 2003). The report is available on the Department of Ecology website at. www.ecy.wa.gov/pubs/0303013.pdf .

Since external sources account for only a small fraction of the contaminant levels in Osoyoos Lake and lower Okanogan River fish tissue, it is assumed that the major source of DDT and PCB is from internal loading, particularly from bottom sediments already in the river and lake.

An element of the original TMDL assessment of DDT contamination in the watershed included sediment core sampling in the southern end of Osoyoos Lake and investigating layers of sediments to determine the historic deposition of DDT in the lake (Serdar, 2003). A large spike in DDT concentrations was seen in sediments deposited around late 1998 or early 1999 (Figure 3). Concentrations of DDT were triple those seen during the 1980s and 1990s. The anomalous concentration suggests the source of the spike was a spill, dumping, or other introduction of concentrated DDT into the aquatic environment during the late 1990s (Peterschmidt, 2006).

It appears that the Okanogan River continues to be dosed with contaminated Osoyoos Lake sediments which are re-suspended and transported downstream, especially during high flows. This effectiveness monitoring project will not be examining the bottom sediments in Osoyoos Lake but that activity may be appropriate during periodic monitoring projects in the future.

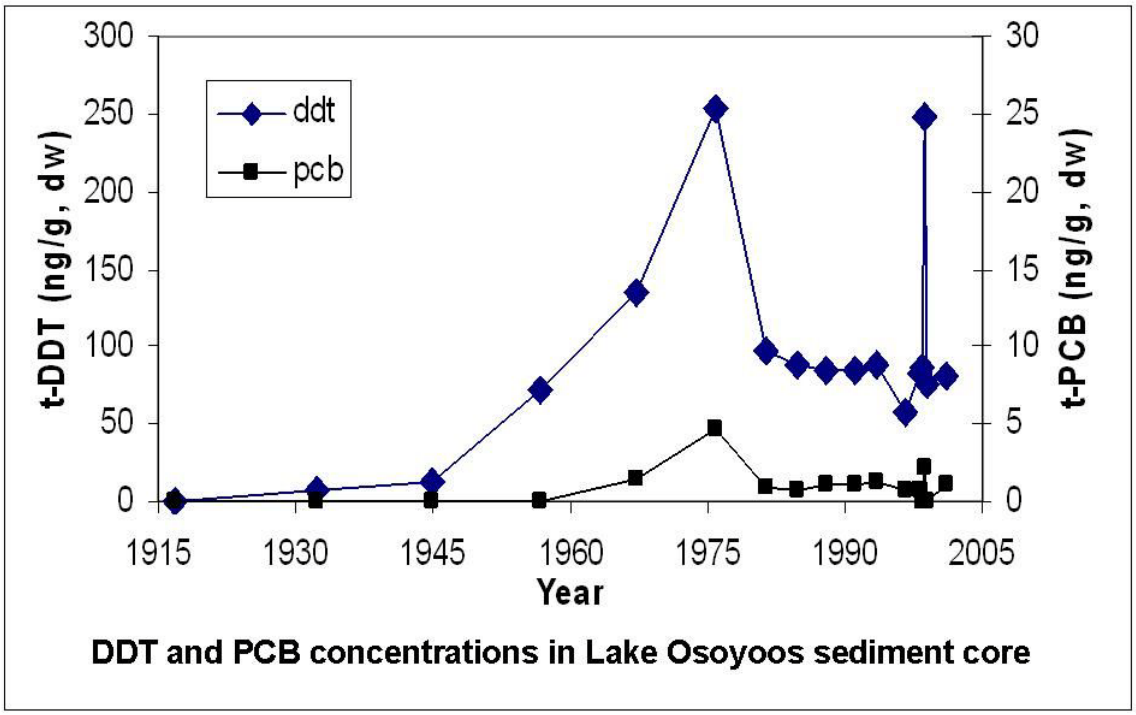

Figure 3. DDT and PCB concentrations in Lake Osoyoos sediment core.