PROFILE OF A CANDIDATE SENSITIVE STREAM UNDER THE FISH PROTECTION ACT

LOWER OKANAGAN RIVER (BELOW VASEUX LAKE)

Overview

The Okanagan River, a tributary of the Columbia River system, drains an area of about 8280 km^2 in British Columbia (not including its tributary, the Similkameen River), and a large area of Washington State. The Okanagan River proper begins at the south end of Okanagan Lake at Penticton, and flows southward, passing through Skaha, Vaseux, and Osoyoos Lakes, before emerging from Osoyoos Lake south of the United States-Canada border. It then merges with the Similkameen River at Oroville before continuing farther south.

Only a small part of the Okanagan watershed in B.C.—an area of about 1420 km^2, consisting of that part of the watershed south of the south end of Vaseux Lake—is proposed for Sensitive Stream designation. The main reason for this proposed designation is a population of anadromous (sea-run) sockeye salmon which spawn in the Okanagan River below Vaseux Lake, and which has declined sharply over the last 40 to 50 years. Other parts of the Okanagan watershed which support threatened populations of kokanee- a landlocked form of sockeye salmon which spends its entire life in freshwater—have also been proposed as Sensitive Streams. These areas include the watersheds of Mission, Trepanier, Peachland, and Trout Creeks. In total, therefore, about 41% of the entire Okanagan watershed in B.C. is proposed for Sensitive Stream status. At the present time, no Sensitive Streams have been proposed for the adjacent Similkameen and Kettle River watersheds (totalling about 18,000 km^2 in area), which have significant but somewhat lower fisheries values compared with the Okanagan watershed.

The Lower Okanagan watershed, as defined above, ranges in altitude from 276 metres at Osoyoos Lake to 2310 metres at the summit of Mount Baldy, on the eastern edge of the watershed east of Oliver. There is a fairly narrow floodplain along the Okanagan River, rising rather steeply to a forested ridge on most of the west side of the valley, but rising much more gradually on the east to the divide between the Kettle and Okanagan watersheds.

The total human population of the Lower Okanagan is somewhere between 10,000 and 15,000. The two main settlements are the towns of Oliver and Osoyoos, with 1996 populations of 4285 and 4021, respectively. There are scattered small residential communities such as Twin Lakes and Willowbrook in the Park Rill watershed, and a widely-distributed rural population along the Okanagan River. The Osoyoos Indian Reserve occupies a large area on the east side of the valley, and has several hundred inhabitants.

Irrigated agriculture occupies much of the valley bottom. The major crops are tree fruits (apples, cherries, pears, peaches, plums and apricots) and wine grapes. Smaller acreages

are devoted to tomatoes, peppers, potatoes, and other vegetables. There are also substantial areas of forage crops. Cattle ranching is second in importance to crop production, but is significant. There are 549 current water licences in the watershed, plus 2 outstanding applications. The total licensed demand within the Lower Okanagan is about 91,900 acre-feet (113,300 dam^3), of which almost 99% is for irrigation. In fact, 64% of the total licensed demand is accounted for by a single irrigation licence held by the Town of Oliver.

During the 1950s, the South Okanagan Lands Project resulted in dyking and channelization of all but about 4 km of the Okanagan River between Vaseux and Osoyoos Lakes, with an expansion in irrigated area. This eliminated much of the original salmon spawning habitat along the river, and limits the potential for recovery, although some mitigation is possible.

The Lower Okanagan River is a candidate for designation as a Sensitive Stream because:

- It has important populations of sockeye salmon, kokanee, and rainbow trout, as well as historic populations of chinook and coho salmon and steelhead. The prospects for recovery are good for sockeye, but much more difficult for coho and chinook salmon and steelhead.
- The available water supply is inadequate in some years (more so in the tributaries than the Okanagan River mainstem) to support both sustainable fish populations and existing off-stream uses. High flows at some times of year, and resultant channel scouring, are as much of a problem as low flows. Ensuring adequate, but not excessive, rates of flow has been the subject of disagreement between water and fisheries agencies for years.
- A recovery plan could focus on promoting more efficient water use; restoring riparian vegetation and stabilizing streambanks on the tributaries, and where feasible, on the Okanagan River mainstem; removing some of the weirs in the channelized section of the river; improving instream spawning habitat in the Okanagan River and in at least lower Vaseux and Inkaneep Creeks; and if feasible, negotiating water release schedules from the Okanagan and Vaseux Lake dams that are more favourable to fish, without impacting flood control requirements or violating an international agreement governing water levels in Osoyoos Lake.

Important Fisheries Values

The lower Okanagan River system originally supported significant populations of anadromous (sea-run) sockeye, chinook, and coho salmon, as well as steelhead. Of these, coho salmon and steelhead have been extirpated, chinook salmon return in very small numbers (less than 10 per year) and the population is endangered, and only sockeye remain in significant numbers, although much reduced from past years.

The main spawning area for sockeye salmon appears to be the non-channelized section of the Okanagan River from the Vaseux Lake dam south to near Oliver, although a significant amount of spawning also takes place in the channelized section below Oliver. The peak spawning period is in the last 10 days of October. Channelization of most of the length of the lower Okanagan River, which was complete by 1957, undoubtedly destroyed much of the original spawning habitat. Sockeye originally penetrated farther up the Okanagan River beyond Vaseux Lake, but at present, there is no fish passage past the Vaseux Lake dam. A fishway was built, but has been inoperative for many years. Sockeye have been reported in the lower reaches of Vaseux Creek and Inkaneep Creek, the two largest Okanagan tributaries below Vaseux Lake, but at present, there is no evidence of spawning in these two streams.

Two species on the provincial "blue list" of fish species (considered to be vulnerable) are present in the Lower Okanagan. These include mottled sculpin, known to be present in the Okanagan River mainstem, and chiselmouth chub, reported from Hester Creek (south of Oliver) as well as from the Okanagan mainstem.

Native game fish species (other than anadromous salmonids) present in the Lower Okanagan include rainbow trout (widespread in the watershed); kokanee (present in Osoyoos Lake); lake whitefish, and mountain whitefish.

Several species of introduced game fish are present in sufficient numbers to allow angling in some areas. These include smallmouth and largemouth bass, black crappie, yellow perch, and brook trout.

In summary, the Lower Okanagan River and tributaries support a variety of native and introduced fish species of commercial or sport importance, plus two blue-listed species. However, the main reason for the proposed Sensitive Stream designation is the threatened sockeye salmon population. Prospects appear favourable for at least partial recovery of the sockeye population, but much less so for chinook, coho, and steelhead.

Trends in Numbers of Sockeye and Other Salmon Species

The escapement (number returning after harvest) of sockeye salmon has varied significantly since the first of a series of annual estimates was made in 1955, but the overall trend has been downward (Figures 1 and 2). When numbers are shown graphically by 4-year averages (which corresponds with the 4-year life cycle of sockeye), they drop sharply from an average of 55,000 fish from 1955-57 to averages of 15,000 to 25,000 fish from 1958 through 1973. Numbers averaged between 5,000 and 10,000 from 1974 through 1981, rose to an average of 17,000 to 20,000 from 1982 through 1989, then dropped to less than 10,000 again from 1991 through the present.

An estimate of 750,000 sockeye entering the Okanagan River was made in 1935 (not shown on graph). Even if this estimate was a very rough one, it suggests that a major decline in sockeye had occurred long before the 1950s.

The size of sockeye runs in individual years (since 1955) has varied from an estimate of 75,000 in 1955 to only 700 in 1994, and of course has fluctuated much more than the 4-year averages. However, the Okanagan population seems to be not nearly so dominated by a single year-class as in populations in Shuswap Lake or some other areas. There are significant numbers of sockeye attempting to spawn in the Okanagan River every year.

The only estimate available for coho escapement in the Okanagan River is 75 in 1935; none have been reported in escapement data since then.

An estimate of 200 chinook salmon was made in 1936, but they have not been reported most years since 1955. Reported numbers are less than 50 in 1977; 3 in 1984; 5 in 1997, and 4 in 1998. A few chinook are evidently still returning, but this population appears to be on the verge of complete disappearance. On the other hand an average of 995 chinook per year returned to the lower Similkameen River (in Washington State, just above Oroville) from 1992 through 1996, and it seems possible that salmon from this population could stray into the Okanagan River system above Oroville.

Recovery potential for salmon populations

The decline in salmon populations in the lower Okanagan River is a result of several factors, of which water shortage is only one, and probably not the most important. The other two key factors are loss of spawning habitat and barriers to migration caused by the Columbia River dams in the United States. However, all the Columbia River dams below the Okanagan River mouth have fishways. The listing of some salmon populations under the Endangered Species Act in the U.S. has focussed much attention on efforts to restore these populations. It is likely that numbers of sockeye, and possibly of other salmon species, entering Osoyoos Lake and the Lower Okanagan River will increase in future. If so, limits on numbers would be set by available spawning habitat and by streamflow factors, not by migration barriers. Thus, efforts to improve the quantity and quality of spawning habitat in B.C., and to keep streamflow within acceptable limits for sockeye in fall and winter, are likely to cause population increases.

The prospect for recovery of chinook, coho, and steelhead seems much poorer, if only because the Okanagan populations have already disappeared (or nearly so, in the case of chinook). It is much harder to re-establish a species in an area where it is already gone than to bring back a population which has declined but is still significant, as with sockeye. In the case of the other species, unique genetic stocks may already have been lost.

Water Licensing Information

The Okanagan River mainstem presently has no restrictions on licensing, despite data which indicate a heavy demand on the system throughout the year. Vaseux Creek (watershed area, 297 km^2), a major tributary, has relatively low licensed demand and also has no licensing restrictions. However, other important tributaries of the Lower

Okanagan River, including Inkaneep Creek (188 km^2), Park Rill (165 km^2), and Haynes Creek, have restrictions ranging from Possible Water Shortage to Fully Recorded.

There are two ways of looking at licensed demand for the Lower Okanagan River. One measure of licensed demand is the demand from water licences located within the proposed Sensitive Stream area (below Vaseux Lake). This is substantial, but does not tell the whole story.

The second measure of licensed demand is the demand on the entire Okanagan watershed, including that from the thousands of water licences located above the Vaseux Lake dam. This figure is more than four times the demand from within the Lower Okanagan area proper, and is more indicative of the degree of water shortage that might be experienced by fish.

Water Licensing within the proposed Sensitive Stream area

There are a total of 549 water licences within the Lower Okanagan River watershed, plus 2 outstanding applications. These include 344 for irrigation purposes; 117 for domestic purposes; 41 for storage; 6 for conservation purposes; 6 for waterworks, and 37 for other purposes. Out of a total licensed demand of 91,888 acre-feet, 98.7% is for irrigation; 1.0% is for waterworks; 0.1% is for domestic use; and 0.2% is for other purposes. One licence, an irrigation licence for 58,656.8 acre-feet, held by the Town of Oliver, accounts for 63.8% of the entire demand in the Lower Okanagan.

Water Licensing Within the Entire Okanagan Watershed

In the entire Okanagan watershed, there are about 3742 water licences (not including outstanding applications). These include 1503 irrigation licences; 1285 for domestic purposes; 451 for storage; 246 for waterworks; 59 for conservation; and 198 for other purposes.

The total licensed demand for the Okanagan watershed is about 400,758 acre-feet. A breakdown by purpose shows that 63.9% of the total demand is for irrigation; 30.7% is for waterworks; 0.3% is for domestic use; and 5.1% is for other (mainly industrial) purposes.

It should be noted that the figures for total demand probably overestimate the amount of water removed from the system for any large watershed, but probably more so for the Okanagan than for most others. First of all, the actual demand, in terms of water withdrawn from streams and lakes, is nearly always lower than the licensed demand, in part because some licenses may not be used, or only part of the licensed volume used, in any particular year. Second, and perhaps more importantly, it is estimated that about 30% of the water removed by irrigation eventually finds its way back into the stream, and a higher percentage for waterworks licenses. Third, because of the long, narrow shape of the Okanagan watershed, it seems likely that some water withdrawn lower in the

watershed has already been withdrawn and returned to the system somewhere in the upper watershed (i.e., it is recycled water.)

Despite these considerations—and even if the net rate of withdrawal of water from the system were only half of the licensed demand, or about 200,000 acre-feet—the Okanagan watershed, taken as a whole, clearly has quite a heavy demand in relation to the available supply of water.

Hydrologic Information

The hydrographs presented in Figures 5 and 6 are based on Water Survey of Canada gauging station 08NM127, located at Oroville, Washington, just below the south end of Osoyoos Lake but above the confluence of the Similkameen River. This station has 55 years of continuous, year-round data. These hydrographs represent actual flow values, rather than "naturalized" one (estimates of flow in the absence of water diversion and regulation). Please see Appendix QQ for an explanation of the hydrologic assumptions.

Shortages of water for fish

The Okanagan River has a significant water shortage when measured by some criteria, but not by others. If we use the standard approach of adding the licensed demand to the measured mean annual discharge (645.8 cfs) to get an estimate of the original ("naturalized") rate of discharge for the entire year (1199.3 cfs), it would appear that up to 46% of the original flow of the river—on a year-round basis—is diverted for offstream use. This is a higher rate of diversion than on any other of the 15 proposed Sensitive Streams in the Southern Interior Region. The next closest are Peachland Creek and Canoe Creek in Salmon Arm, both with about 39%.

On the other hand, if we follow the arguments above (under "Water Licensing Within the Entire Okanagan Watershed"), and assume for purposes of discussion that about half of the water removed finds its way back into the river, the number would be about 23% rather than 46%. This is still a higher rate of year-round diversion than on most of the other proposed Sensitive Streams, and indicates that water demand on the Okanagan River is quite heavy in relation to supply.

On the other hand, the Okanagan River appears to suffer from extreme low flows less than any other river in the region. This is largely because of the "damping" effect on extreme flows (reduction of high flows, augmentation of low flows) caused by the large lakes in the valley—especially Okanagan Lake itself—plus the additional regulation of flow by the dams at the south ends of Okanagan, Skaha, and Vaseux Lakes. The mean annual summer low flow at Oroville (332.1 cfs) is 51% of the mean annual discharge. This is a higher percentage than on any of the other proposed Sensitive Streams, several of which have a comparable figure of less than 10%.

Thus we have the apparent paradox of a river with very high rates of diversion, both in the summer and on a year-round basis, but which does not suffer from extreme low

flows. Despite the latter, the former must have resulted in some decrease in flow during salmon spawning and incubation periods. In conjunction with other factors, this has probably helped to account for the decrease in sockeye numbers.

A flow of less than 30% of the mean annual discharge (MAD)—in the case of the Lower Okanagan River, less than 5.49 cms—is considered to be below the minimum necessary for the needs of migrating and spawning salmon. Mean monthly flows of 5.5 cms or less, during the sockeye migration and spawning months of September through November, have occurred only in 1943 (September), 1944 (September and October), 1967 (November), 1970 (November), and 1988 (September and October). In addition, mean monthly flows of not much more than 5.5 cms were recorded in November of 1966 and 1987.

It is acknowledged that 7-day low flows (as opposed to mean monthly flows) may have dropped below the 5.5 cms value in several additional years. Furthermore, it is acknowledged that the 30% of MAD level is a minimum, not an optimum, for sockeye, and flows may have been less than optimum in several additional years. Nevertheless, it appears that significant water shortages on the lower Okanagan River occur no more than once or twice a decade, and have been very infrequent since 1970. Water shortages on the Okanagan River are more evident in terms of reduction of overall flow throughout the year than in terms of the severe short-term shortages that occur on some other streams.

SUMMARY OF KEY DATA-- OKANAGAN RIVER (BELOW VASEUX LAKE)

WATERSHED AREA: 1420 km^2 (approx.)
WATERSHED CODE: 310
TRIBUTARY OF: Osoyoos Lake
IMPORTANT FISH SPECIES:
- Sockeye Salmon (avg. escapement, 8757 (1989-1998); max., 75,000 (1955)
- Chinook Salmon (avg. escapement, 3 (1989-1998); max., 200 (1936)
- Coho Salmon (historical presence; max., 75 (1935))
- Steelhead (historical presence)
- Kokanee
- Rainbow Trout
- Brook Trout
- Mottled Sculpin (blue-listed)
- Chiselmouth Chub (blue-listed)
- Largemouth Bass
- Smallmouth Bass
- Yellow Perch
- Black Crappie
- Black Bullhead

RECOVERY POTENTIAL: Sockeye, high; chinook, moderate; coho, moderate
MEAN ACTUAL ANNUAL FLOW: 18.3 cms (645.8 cfs)
NOTE: cms = cubic metres/second, cfs = cubic feet/second
MEAN NATURALIZED ANNUAL FLOW: 34.0 cms (1199.3 cfs)
MEAN NATURALIZED AUG FLOW: 57.7 cms (2037.2 cfs)
MEAN NATURALIZED SEPT FLOW: 39.8 cms (1405.1 cfs)
ANNUAL LICENSED WATER DEMAND: 492,933 dam^3 (400,759 acre-feet)*
LICENSED STORAGE CAPACITY: 173,557 dam^3 (140,760 acre-feet)* **
STORAGE CAPACITY AS % OF LICENSED DEMAND: 35% **
AUG WATER USE AS % OF MEAN AUG FLOW: 62% *
SEPT WATER USE AS % OF MEAN SEPT FLOW: 59% *
AUG USE AS % OF MEAN SUMMER 7-DAY LOW FLOW: 108% *
SEPT USE AS % OF MEAN SUMMER 7-DAY LOW FLOW: 72% *
MEAN SUMMER 7-DAY LOW FLOW AS % OF MEAN ANNUAL FLOW: 51% *
NUMBER OF CURRENT WATER LICENCES: 549 (344 irrigation, 117 domestic, 40 storage, 6 conservation, 6 waterworks, 36 other types)
NUMBER OF LICENCE APPLICATIONS: 2
WATER LICENCING STATUS: No licensing restrictions on mainstem; flow regulated by upstream lakes and dams

* NOTE 1: These figures are for the entire Okanagan River watershed in Canada, not just the portion below the Vaseux Lake dam.

**NOTE 2: These figures for storage are incomplete. They do not include the major storage potential of the Okanagan, Skaha, and Vaseux Lake dams, which are unlicensed.

KEY DATA ON WATERSHEDS RECOMMENDED AS SENSITIVE STREAMS

SOURCES OF INFORMATION

WATERSHED AREA, WATERSHED CODE-- B.C. Watershed Atlas

STREAMFLOW DATA-- Figures for streamflow are based on long-term averages, through 1997. "Actual" flow is that measured at a gauging station; "naturalized" flow is an estimate of the original flow that would have occurred in the absence of any offstream diversion. For August and September (often two of the most critical months for water shortages) naturalized flow values are derived by adding licensed demand for August and September to the mean actual flow figures for those months.

LICENSED DEMAND AND STORAGE CAPACITY—These figures were obtained by running Licensed Demand Reports in WLIS (the Water Licensing Information System) during January 2000. The total annual demand and storage capacity are expressed both as cubic decametres (dam^3) and acre-feet.

SENSITIVITY INDICES (Aug water use as % of mean Aug flow, Aug use as % of mean 7-day summer low flow, mean summer 7-day low flow as % of mean annual flow, etc.)— The mean summer 7-day low flows were calculated from daily Water Survey of Canada flow records. We then calculated the ratios (sensitivity indices) as described by Rood and Hamilton (1995).

NUMBER OF CURRENT WATER LICENCES AND APPLICATIONS-- Tabulated between Nov. 1998 and July 1999, from data in WLIS (Water Licensing Information System). Licences with 2 or more separate uses (e.g. irrigation plus domestic use) were treated as if they were 2 separate licences, hence totals are slightly higher than those given by WLIS.

IMPORTANT FISH SPECIES—Figures for average escapement of salmon (usually 1981-1992, except 1981-1990 for North Thompson tributaries), and for peak escapements, are from a series of reports prepared for Fisheries and Oceans Canada (Harding et al. 1994, Komori 1997a, 1997b, 1998a, and 1998b). Figures for steelhead are from Robert Bison, MELP Fisheries, Kamloops (pers. comm.), and for kokanee are from a 1998 MELP Information Bulletin (Ministry of Environment, Lands, and Parks 1998), and from Brian Chan, MELP Fisheries, Kamloops (pers. comm.)

Information on the presence and absence of other fish species is mainly from FISS, the database jointly maintained by the BC Ministry of Fisheries and Fisheries and Oceans Canada, supplemented by personal communications from MELP and Fisheries and Oceans staff in the Southern Interior.

RECOVERY POTENTIAL-- These subjective ratings are from the series of Fisheries and Oceans reports, but were not done for North Thompson tributaries.

WATER LICENCING STATUS—This information is from WLIS, supplemented by information from Water Management Program files in Kamloops. All streams on this list except for Lemieux Creek and the Okanagan River mainstem have some kind of restriction applied to future water licensing.

Hydrograph Assumptions:

1) In the hydrographs, **actual** Water Survey of Canada discharge data were used. Water Survey of Canada stations (usually located immediately upstream of the stream mouth) were used for hydrologic data. For those watersheds where the WSC gauge was not at the creek mouth, a unit hydrograph (by land area) was constructed, and the actual flow at the mouth was projected accordingly.
2) Licensed demand information is included in the visual presentation. Irrigation demand is distributed on a monthly basis (as a percentage of total annual irrigation demand) according to the following chart:

Month	Percent of total demand
April	5
May	10
June	20
July	25
August	25
September	15

3) Waterworks demand, domestic demand, and stockwatering were distributed on a monthly basis (as a percentage of annual demand) according to the following chart. This chart was based on actual long-term average data from the City of Kamloops, River Street (Central Main) waterworks plant (1982-1999 data).

Month	Percent of total demand
January	5
February	5
March	5
April	5
May	10
June	15
July	15
August	15
September	10
October	5
November	5
December	5

4) Storage demand (off-stream demand creating during time of water storage) was modelled according to the following chart (as a percentage of total water volume stored). These percentages are based on the period of storage as permitted by issued water storage licences.

Month	Percent of total demand
January	5
February	5

March	5
April	15
May	30
June	25
July	0
August	0
September	0
October	5
November	5
December	5
January	5

5) For those watersheds with irrigation "backed by storage", the percentage "backed by storage" is shown within the chart (i.e.: 83% "backed by storage" for Bessette Creek; 59% "backed by storage" on Mission Creek).
6) **Minimum** fish flow requirements were modelled according to the following assumptions, by life history stage (after Tennant, 1975). As better fish periodicity charts are forthcoming, the fish flow requirements below are subject to change.

Month	**Flow (% MAD)**
Rearing/over-wintering	20%
Short term surival	10%
Migration/spawning	30%

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Rood, Kenneth M. and Roy E. Hamilton. 1995. Hydrology and water use for salmon streams in the Thompson River watershed. British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2297. 57 pages, plus 5 appendices.

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FIGURE 1. SOCKEYE ESCAPEMENT, OKANAGAN RIVER, BY 4-YEAR PERIODS

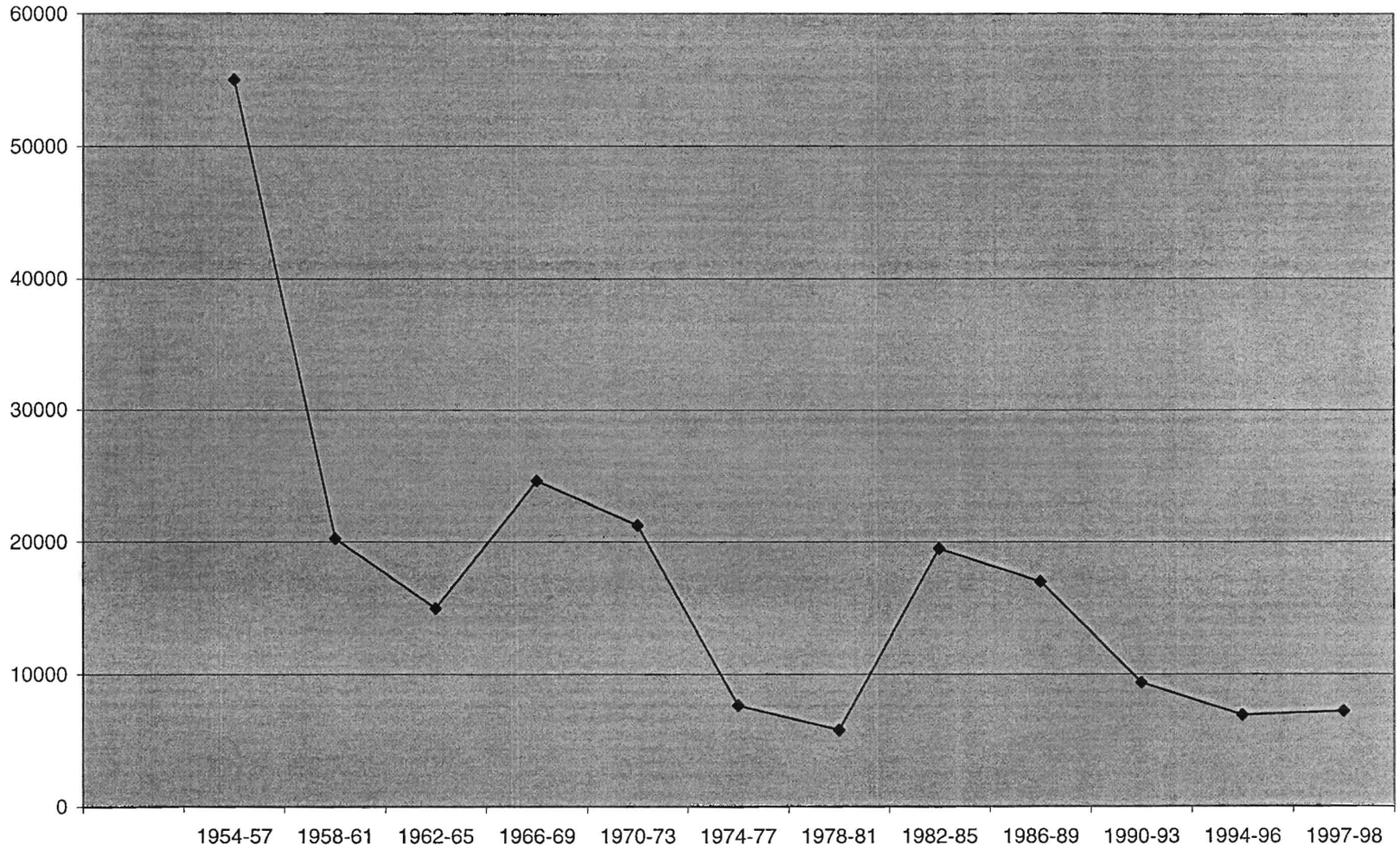


FIGURE 2. SOCKEYE SALMON ESCXAPEMENT, OKANAGAN RIVER, 1955-1998

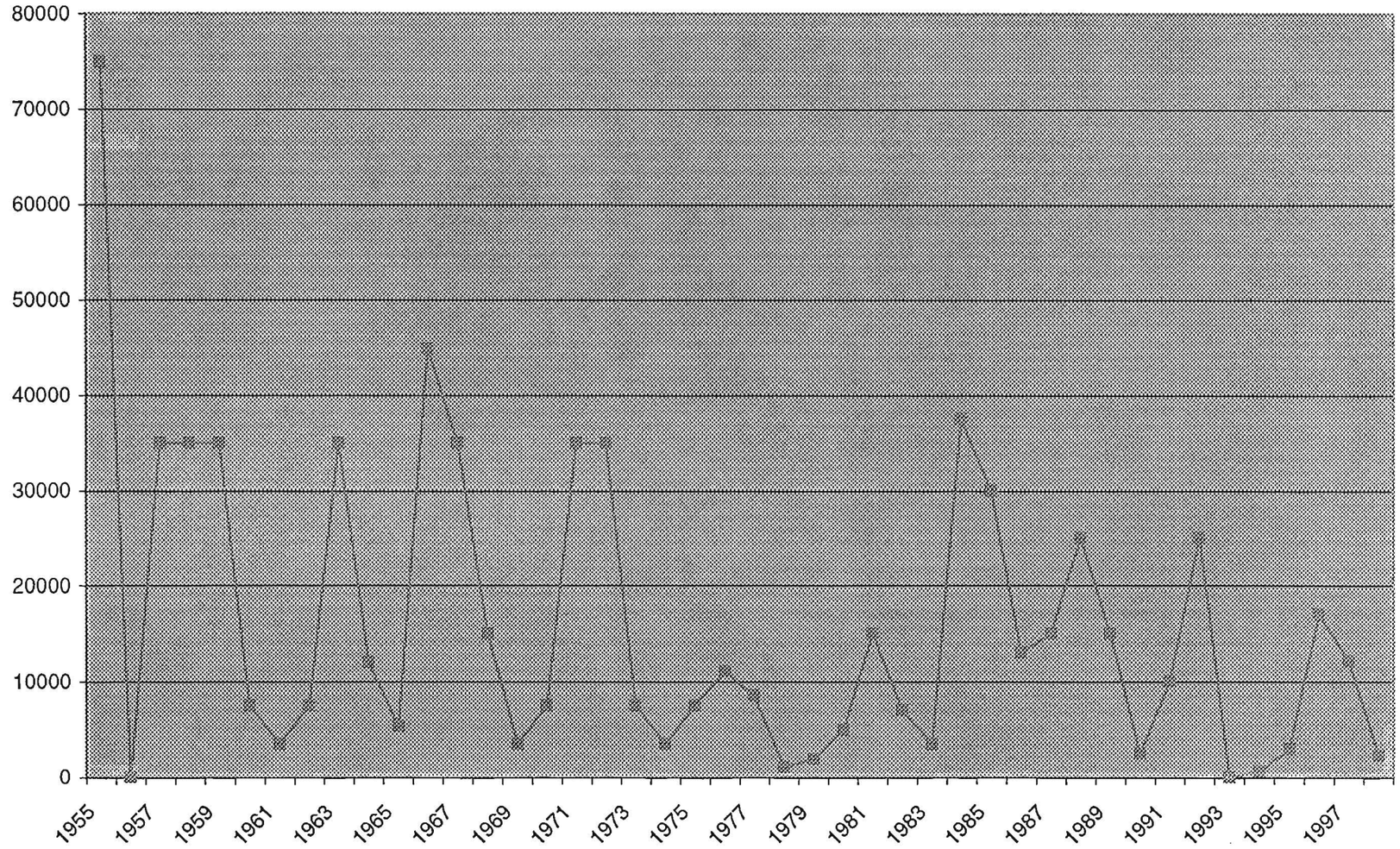
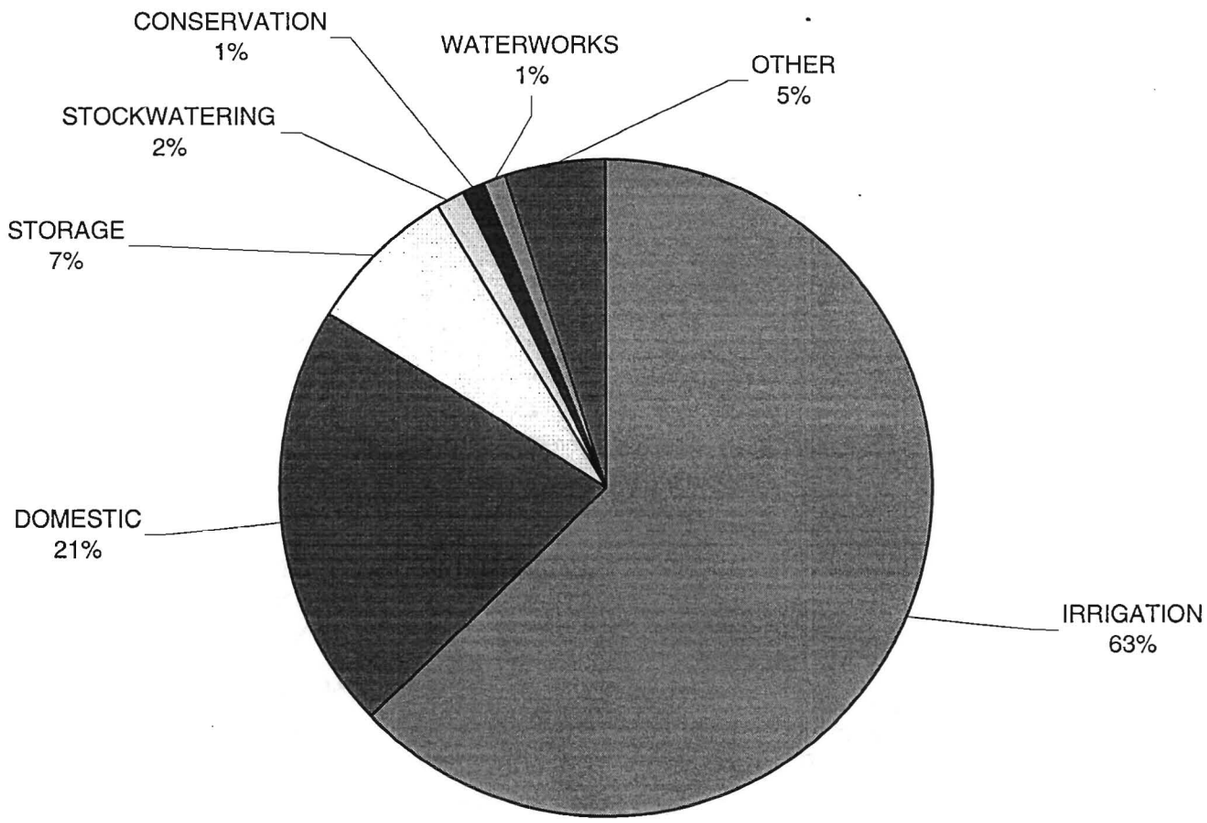
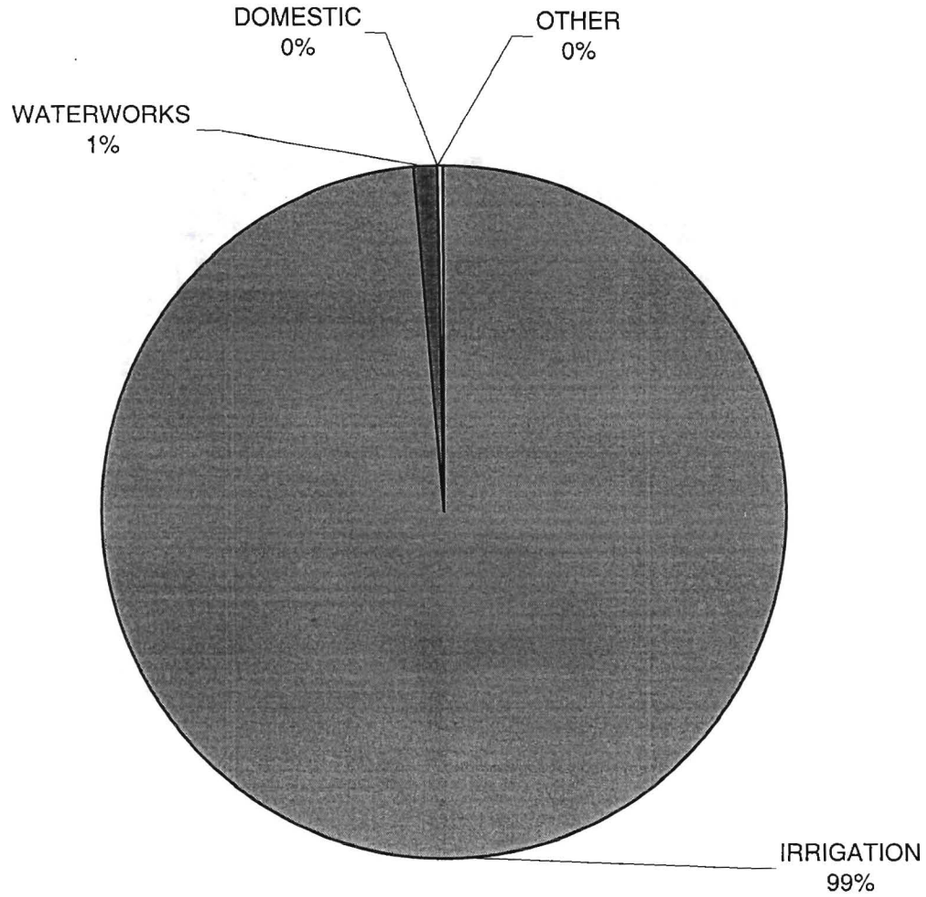


FIGURE 3. NUMBER OF WATER LICENCES BY PURPOSE-- LOWER OKANAGAN RIVER WATERSHED



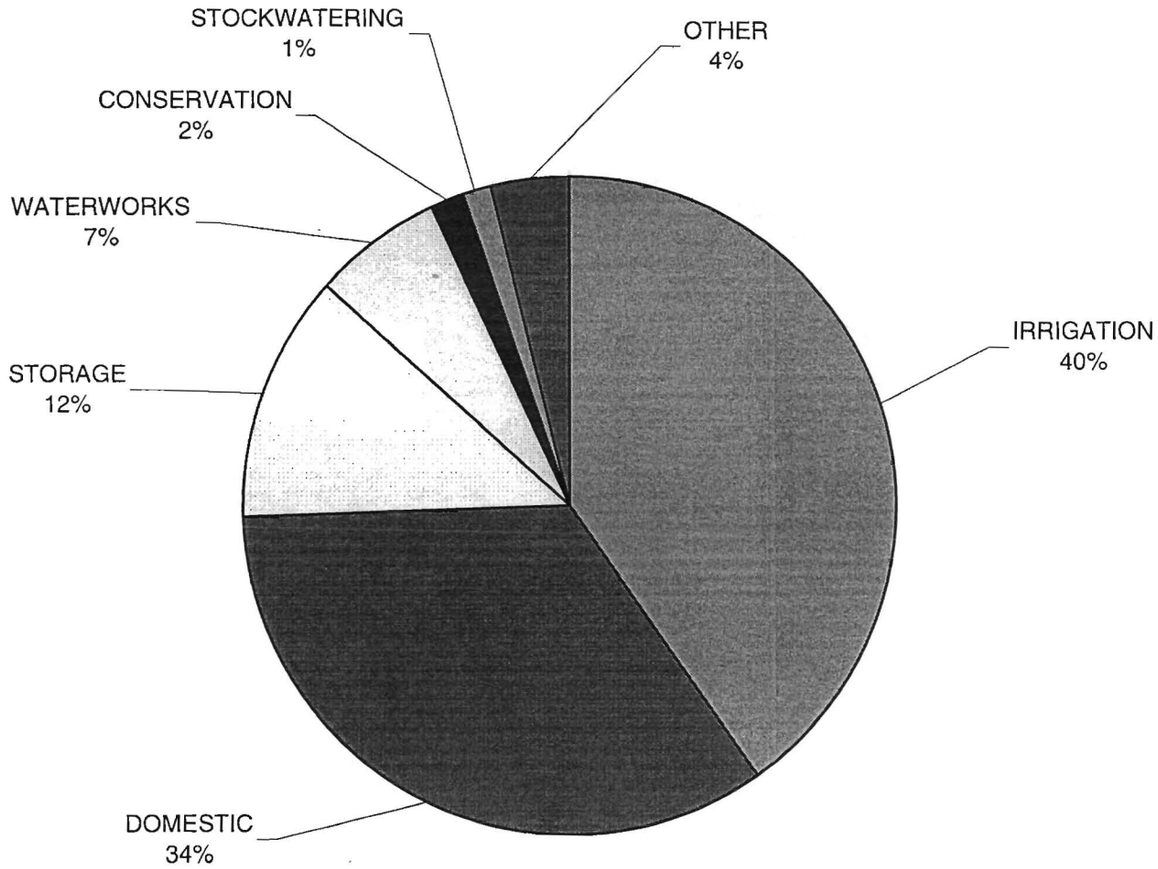
TOTAL LICENCES: 549 (PLUS 2 APPLICATIONS)

FIGURE 4. LICENSED DEMAND BY PURPOSE-- LOWER OKANAGAN RIVER WATERSHED



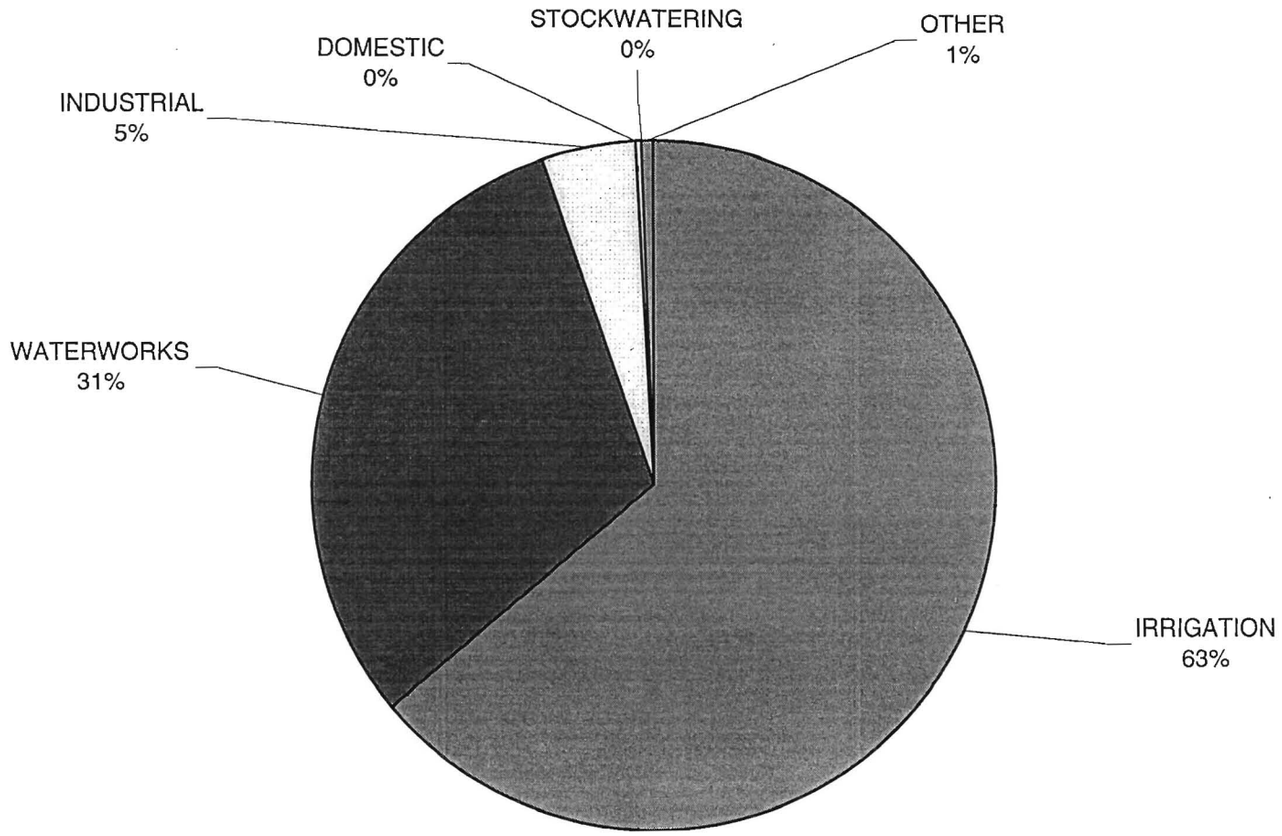
TOTAL LICENSED DEMAND: 91,888 ACRE-FEET

FIGURE 5. NUMBER OF WATER LICENCES BY PURPOSE-- ENTIRE OKANAGAN RIVER WATERSHED



TOTAL LICENCES: 3742

FIGURE 6. LICENCED DEMAND BY PURPOSE-- ENTIRE OKANAGAN RIVER WATERSHED



TOTAL LICENSED DEMAND: 400,759 ACRE-FEET