FINAL

OBJECTIVE 3 Task C
Okanagan River (Reach A and B) Spawning Area Restoration Feasibility

Contribution No. *5* to an *Evaluation of an Experimental Re-introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

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EXECUTIVE SUMMARY

The transboundary multi-agency workshop held in 1997, summarized the risks and benefits of re-introducing sockeye salmon (*Oncorhynchus nerka*) into Okanagan Lake (Peters et al. 1998). The discussions led to assessing an experimental re-introduction into Skaha Lake where previous surveys highlighted a lack of suitable spawning areas. Okanagan Lake drains into Skaha Lake by a short section of the Okanagan River. It is this stretch of water between the two lakes which has been identified as most promising for development of spawning areas. This report follows inventories done in year 1 and 2 by identifying restoration options to benefit spawning sockeye accessing Skaha Lake. This section of the Okanagan River was straightened and dyked in the mid 1950's and is essentially one long river glide; rip rapped for its entire length. The river has two distinct reaches; the upper most reach which runs 3 km from Okanagan Lake Outlet Dam to Green Mtn Road (hereafter referred to as Reach A) below which Reach B extends to Skaha Lake.

There is an opportunity in Reach A to use the existing slope to create spawning ramps having depths and velocities that mimic those found above Vertical Drop Structure 13 (located 1.3 km north of Oliver) where sockeye currently spawn. This can be accomplished by the construction of spawning ramps and is the highest priority for restoration, to produce spawning areas for both re-introduced sockeye and resident kokanee (*O. nerka*) and potentially rainbow trout (*O. mykiss*) and whitefish (*Coregonus* sp.).

The four spawning ramps could accommodate 4000 spawning pairs of sockeye and cost C$92,500. By placing suitably sized gravel on half of one ramp, 3750 pairs of kokanee could be accommodated at typical autumn flows. The ramps would be located in existing depressions and will not project above the existing low water profile thus maintaining the low water gradient and preserving existing flood capacity.

The creation of setback dykes, re-establishment of riparian vegetation and creation of off-channel areas in Reaches A and B, although not necessary for the effectiveness of spawning areas, would contribute to returning the river ecosystem to a more historically natural state. Construction of setback dykes and re-establishment of riparian vegetation along a 1000m section in Reach A and a 2250m length section in Reach B, both along the west bank of the river will provide shade and cover and increase the diversity and abundance of terrestrial and aquatic wildlife. The cost for setback dykes and vegetation in Reach A and B is C$538,000 and C$1,210,500 respectively.

Off-channel habitat creation in conjunction with setback dyking areas benefit rainbow trout under-yearlings which over-winter and rear in such areas particularly when summer droughts are a problem. This type of habitat was found in this section of river prior to channelization. Creation of off-channel habitat in Reaches A and B would cost C$130,000. Table 4 contains a summary of proposed works their benefits, risks and costs.

Considerable effort will be needed to ensure the necessary widespread support and funding.

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1.0 INTRODUCTION

During Year 2 of the study concerned with re-introduction of sockeye salmon *(Oncorhyncus nerka*) into Skaha Lake, the Okanagan Nation Fisheries Commission (ONFC) conducted an inventory of the amount, location and quality of habitat which could be accessible to sockeye introduced into Skaha Lake. Subsequently ONFC staff along with several other experts identified opportunities for possible sockeye habitat enhancement and in Year 3, the amount of spawning/ incubation area which could be created by acting on these opportunities was determined. There is also an interest in restoring lost elements of the river ecosystem by exercising such options as setback dyking, off-channel creation in the form of side channels and pools created in the riparian area adjoining the channel and planting riparian vegetation. This paper presents the design, benefits, risks and costs of such initiatives, expanding upon work by Gaboury *et al*. (2000) on restoring natural segments of the south Okanagan River to include Reach A and B, and it recommends instream and riparian works to enhance and restore salmon, trout and possibly whitefish (*Coregonus* sp.) spawning and rearing areas.

From Okanagan Lake to McIntyre Dam (Fig. 2), less than 1% ($63m^2$) of the total spawning areas surveyed was considered to be high quality (ONFC, 2002) as detailed in the year 2 report. Since the sockeye that will be used in any re-introduction currently spawn in the Okanagan River upstream of Osoyoos Lake, utilizing the Okanagan River upstream of Skaha Lake, where emerging sockeye fry can tavel downstream and populate Skaha Lake may be the best option for introducing this stock into Skaha Lake. In this section of river, the reach from the Okanagan Lake Outlet Dam to the Green Mt. Road crossing was considered most promising for development of suitable spawning areas. This 3.07km section of the Okanagan River (referred to hereafter as Reach A) was straightened and dyked in the mid 1950's. It is essentially one long river glide; rip rapped for its entire length and having little established riparian vegetation.

Figure 1. Okanagan River, 1930's

The Figure 1 photo was taken in the 1930's prior to channelization (Vedan, 2003), when the Okanagan River that flowed through Penticton contained oxbows bordered by thick riparian cover.

2.0 STUDY AREA

Reach A runs from Okanagan Lake Outlet Dam to the Green Mt. Road Bridge crossing (Fig. 2). The river from the end of Reach A to Skaha Lake (Reach B) is in a backwater zone produced by Skaha Lake. At higher flows, it has a very low hydraulic gradient and consequently the substrate becomes clogged with fine sediments.

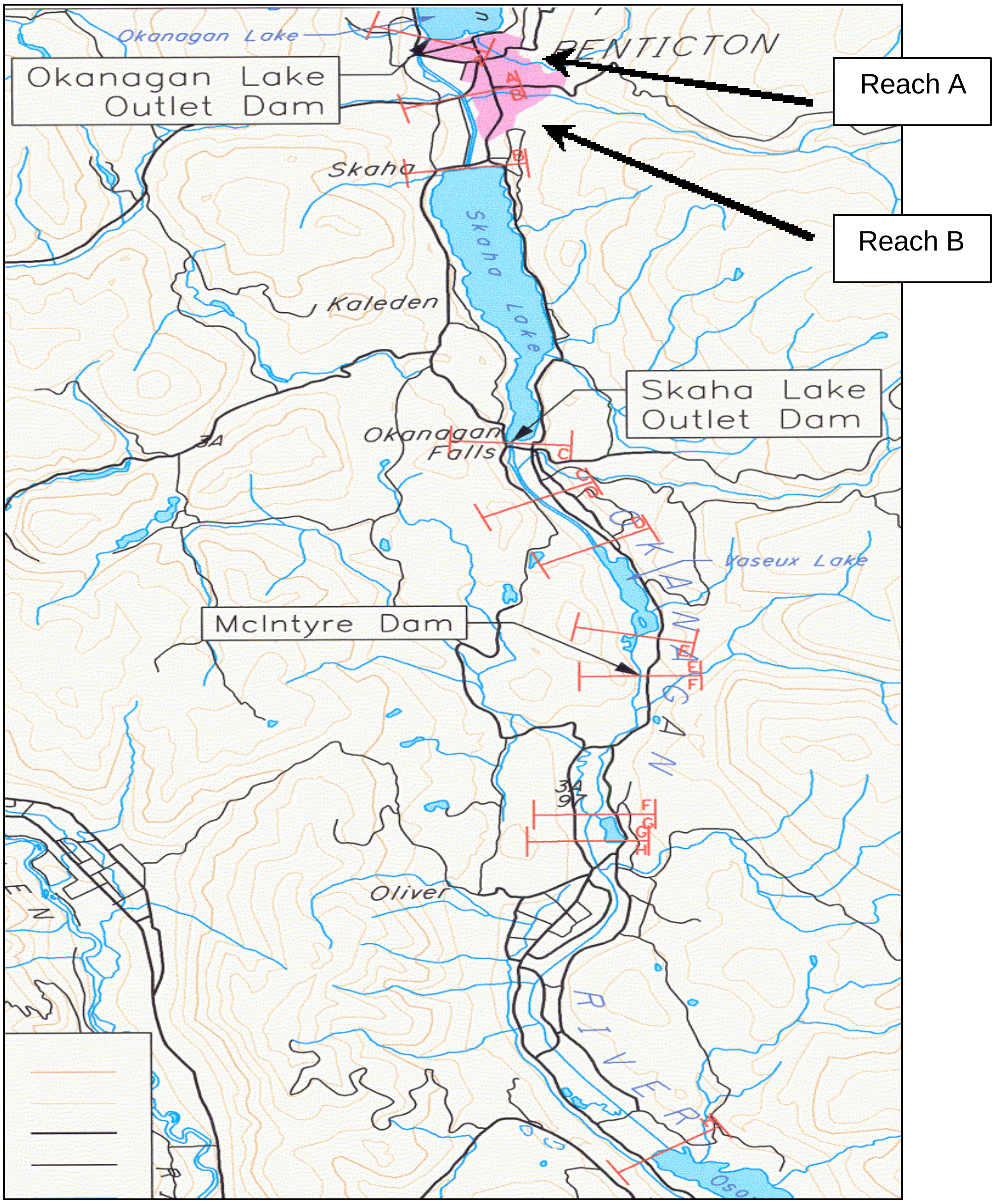

Figure 2. Location of Reach A and B within the southern Okanagan Basin.

3.0 RESTORATION OPTIONS

After reviewing restoration options that could restore salmonid spawning areas (Fig. 3) while protecting kokanee spawning areas and improving the overall health of the ecosystem, it is recommended that a series of coarse gravel with part of one finer-grained spawning ramps be built in Reach A to mimic both the areas where kokanee now spawn in the reach and where sockeye currently spawn above Vertical Drop Structure 13 (Newbury, 2002). Other restoration recommendations that could lead to improved long-term ecosystem health include;

- construct dykes set back from the ordinary high water mark of the river creating a strip of natural ground between the dike fill and the riverbank;
- re-establish riparian vegetation within the set back dyke and;
- create side channel pools or backwater areas also within the newly set back dykes; where such backwater areas off the main channel were present before channelization when the river supported salmonid spawners (Vedan, 2003).

Options such as meander re-establishment would be unlikely to be effective for creating spawning given the already low slope in Reach A and B (Newbury, 2002). The spawning ramps would not interfere with, or be harmed by this option if it were needed to expand spawning areas and/or facilitate fish passage in the future.

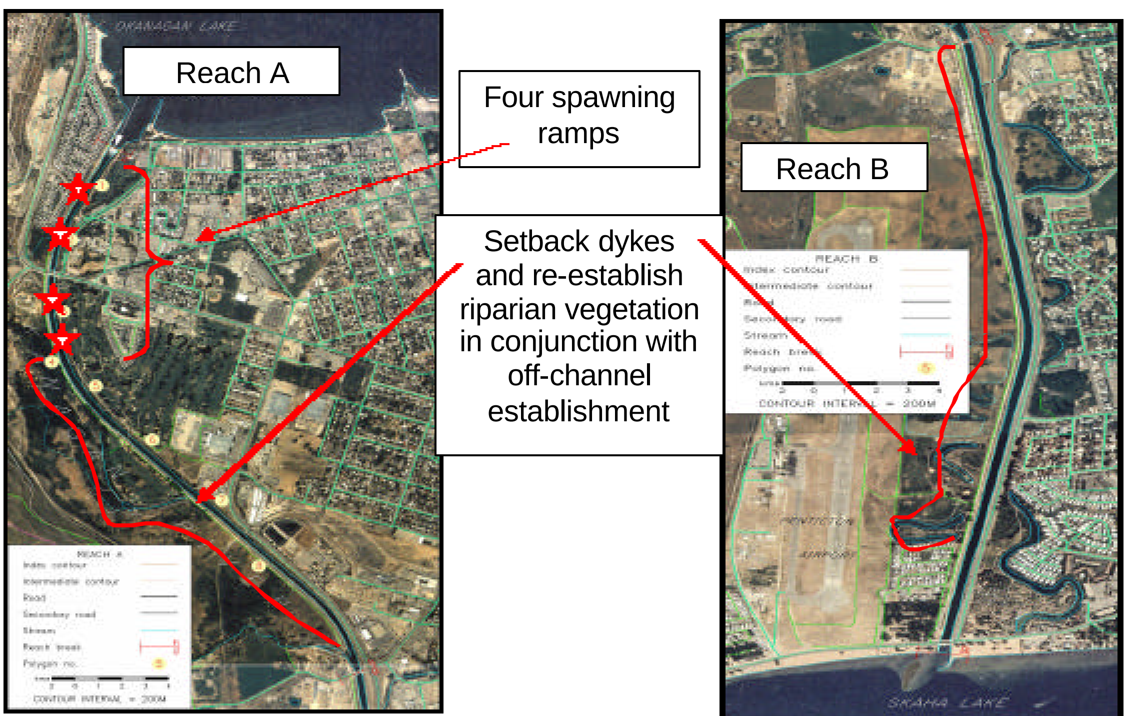

Figure 3. Location of restoration options

3.1 Ramp spawning platforms

3.1.1 Conceptual design

A 100m long gravel platform was constructed in Reach A for Skaha Lake kokanee spawners over 20 years ago (Bull, pers. comm. 2002). This flat gravel platform which supports the majority of local kokanee spawners has not changed visibly since installation. However no measure of egg survival has been made to determine its true effectiveness.

It has been suggested that Reach A could be modified to include productive spawning areas for sockeye, kokanee and small numbers of trout if suitable gravel was provided (ONFC, 2002). Unlike a gravel platform, a ramp type structure would allow the gradient to be modified while providing high stability, and mimicking conditions in other places where sockeye now spawn successfully

Four spawning ramps are proposed for the reach below the Okanagan Lake Outlet Dam (Fig. 4 and 5). The ramps should be located in existing depressions, and deep enough to ensure that they will not project above the surface at low water. The existing kokanee platform is located between planned sites of ramps 3 and 4. The ramp locations were chosen on the basis of the June 1980 profile and cross-section surveys undertaken in the Skaha – Okanagan Lakes reach (Shubert, 1983). However, final locations and gravel volumes should not be confirmed until further bed surveys are done.

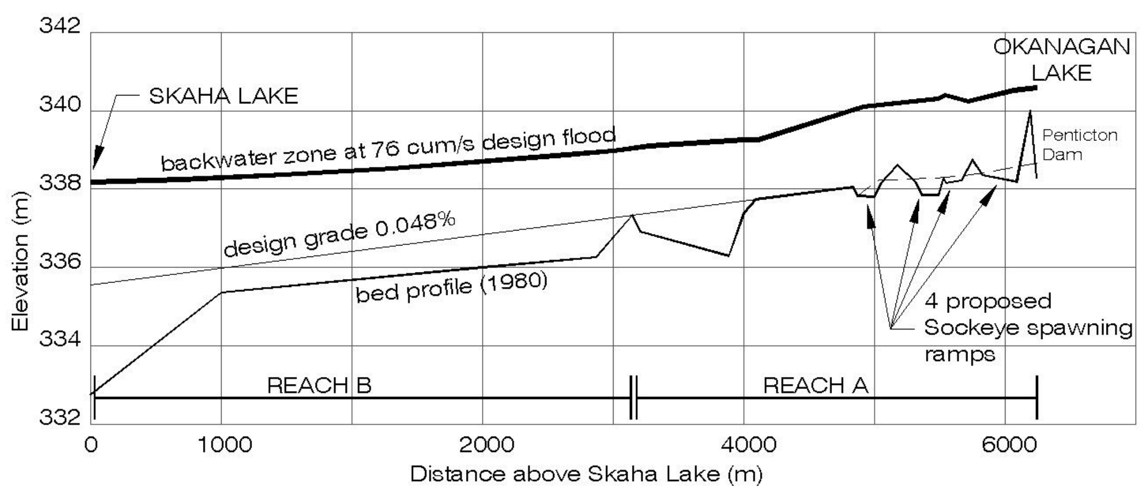

Figure 4. Profiles of the river bed, design grade and design flood water level

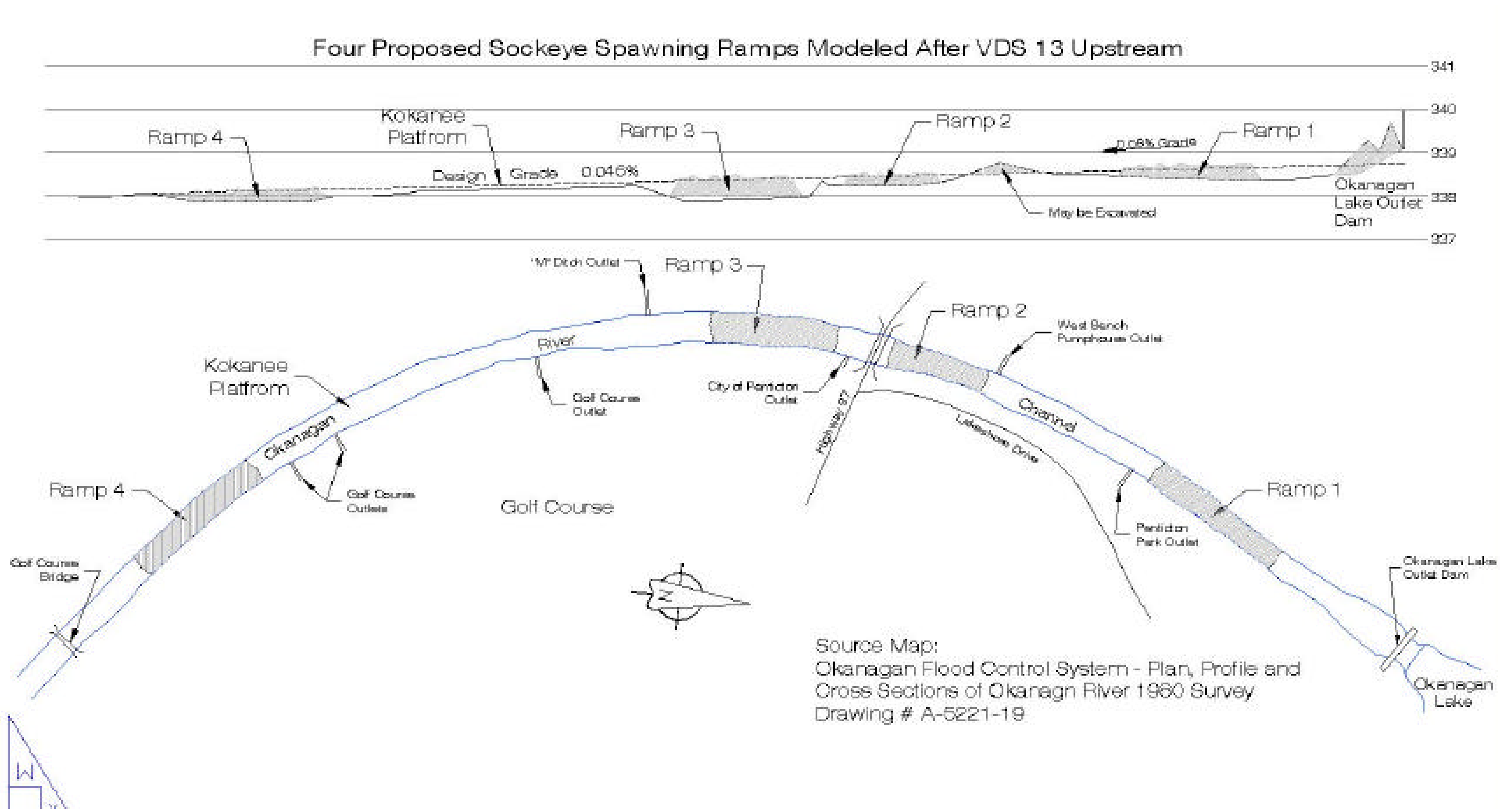

Figure 5. Profile and plan of proposed spawning ramps.

The depth of gravel on the ramps will vary between 22 and 50 cm to mimic conditions often found in natural spawning areas. All four ramps will be 24m wide with individual lengths varying between 100 and 150m (Table 1).

Table 1. Ramp dimensions

Ramp	***Length (m)***	***Width (m)***	***Area (m^2)***	**Gravel volume (m^3) required**
Ramp 1	150	20.8	3120	900
Ramp 2	100	25	2500	600
Ramp 3	125	25	3125	1200
Ramp 4	150	25	3750	1000
Total	***525 m***		***12,495 m^2***	***3,700 m^3***

The channel is designed so that the maximum gravel size relocated during very high water is less than 12 mm in diameter. The spawning gravel ramps will be built of stable 25 to 75 mm diameter gravel observed in successful sockeye redds. Sockeye are documented as utilising substrates of 13 to 102mm (Reiser & Bjornn, 1979) and in the channelized sections of the Okanagan River where gravel is found the median size in spawning beds is about 26mm (ONFC, 2002).

Ford et al. (1995) found kokanee to spawn in gravel at 15 to 100mm in diameter, and in the Okanagan River they are found to use gravel averaging about 30mm in diameter (ONFC, 2002). A portion of ramp 4 will receive additional gravels averaging about 30mm in diameter size to accommodate kokanee (ONFC, 2002) and trout spawners.

3.1.2 Benefits and Risks

The primary purpose of the ramps is to produce spawning areas for re-introduced sockeye and to increase areas for resident kokanee. Each spawning ramp should accommodate between 900 and 1300 spawning pairs of sockeye, based on an estimated need of 2.7m^2 per pair (Summit, 2000). The accumulated spawning area created for sockeye would be 10,625m^2, accommodating almost 4000 pairs (Table 2).

By placing gravel of a size suitable for kokanee in half of ramp 4, and given that kokanee require 0.5m^2 per pair (Bull, 2002) an additional 3750 pairs could be accommodated at this ramp. During 1992-2001, an average of 3500 spawner pairs/ year and in 2002, 47,250 spawner pairs were estimated to have utilized Reach A. (MoWLAP, 2002).

Table 2. Spawning areas potentially created for sockeye and kokanee

Spawning platform	**Spawning area (m^2) created**	**No. of Spawning pairs sockeye**	**No. of Spawning pairs kokanee**
ramp 1 (below dam)	3120	1157	
ramp 2 (above Hwy. 97)	2500	926	
ramp 3 (below Hwy. 97)	3125	1157	
ramp 4 (above golf course bridge) *	3750	694	3750
TOTAL:	**12,495 m^2**	**3934**	**3750**

* assuming half the area of ramp 4 is used by kokanee and half by sockeye

Because the proposed spawning ramps would be built so as not to interfere with the current kokanee ramp there should be no loss of the present kokanee spawning area. Potential risks associated with spawning ramps are considered manageable as shown in Table 3.

Table 3. Potential risks and their proposed management

Risks to ramps in Reach A	***Management plan***
Ramp blow-out and/or spawning gravel loss or displacement	The channel was designed so that the, maximum gravel size likely to be relocated is less than 12 mm diameter. The spawning gravel ramps will be stable and composed of 25 to 75 mm diameter gravels (i.e. of a size commonly found in successful redds).
Adverse effects on the dyke, particularly at flood levels	The ramps will be located in existing depressions and will not project above the existing low water profile thus maintaining the low water gradient and preserving existing flood capacity.
Issues for recreational rafters and tubers	Tubing or floating through Reach A will be unimpeded as the tops of the ramps have been designed to coincide with the water surface at lowest levels. Flat and rounded cobbles will be placed on the upstream face of the ramps to resist erosion and create smooth water at the entrance.

3.1.3 Costs

The ramps are simply constructed with sloping rounded cobble walls on the upstream and downstream faces. For preliminary estimates, the cost of purchasing and placing 3700m^3 of spawning gravels and cobble riprap is C$92,500 (at $25.^{00} per m^3). This cost includes all engineering, building and monitoring (see 4.5 below).

3.2 Setback dykes and riparian vegetation

3.2.1 Conceptual design

The setback dyke option is only feasible for the 1000m of Reach A along the west bank of the river north of Shingle Creek (Fig. 6) and downstream of the proposed spawning ramps. The river bank of Reach A has been developed except for a section owned by the Penticton Indian Band. If the Penticton Indian Band were agreeable this would be the only section along Reach A where setback dyking could occur without having to move homes, highways or businesses.

The dyke would be set back from the ordinary high water mark of the river creating a strip of natural ground between the dyke fill and the river bank. Another setback dyke could be developed along 2250m of the west bank of Reach B, where old meanders could be used as backwater or off channel habitat for several fish species.

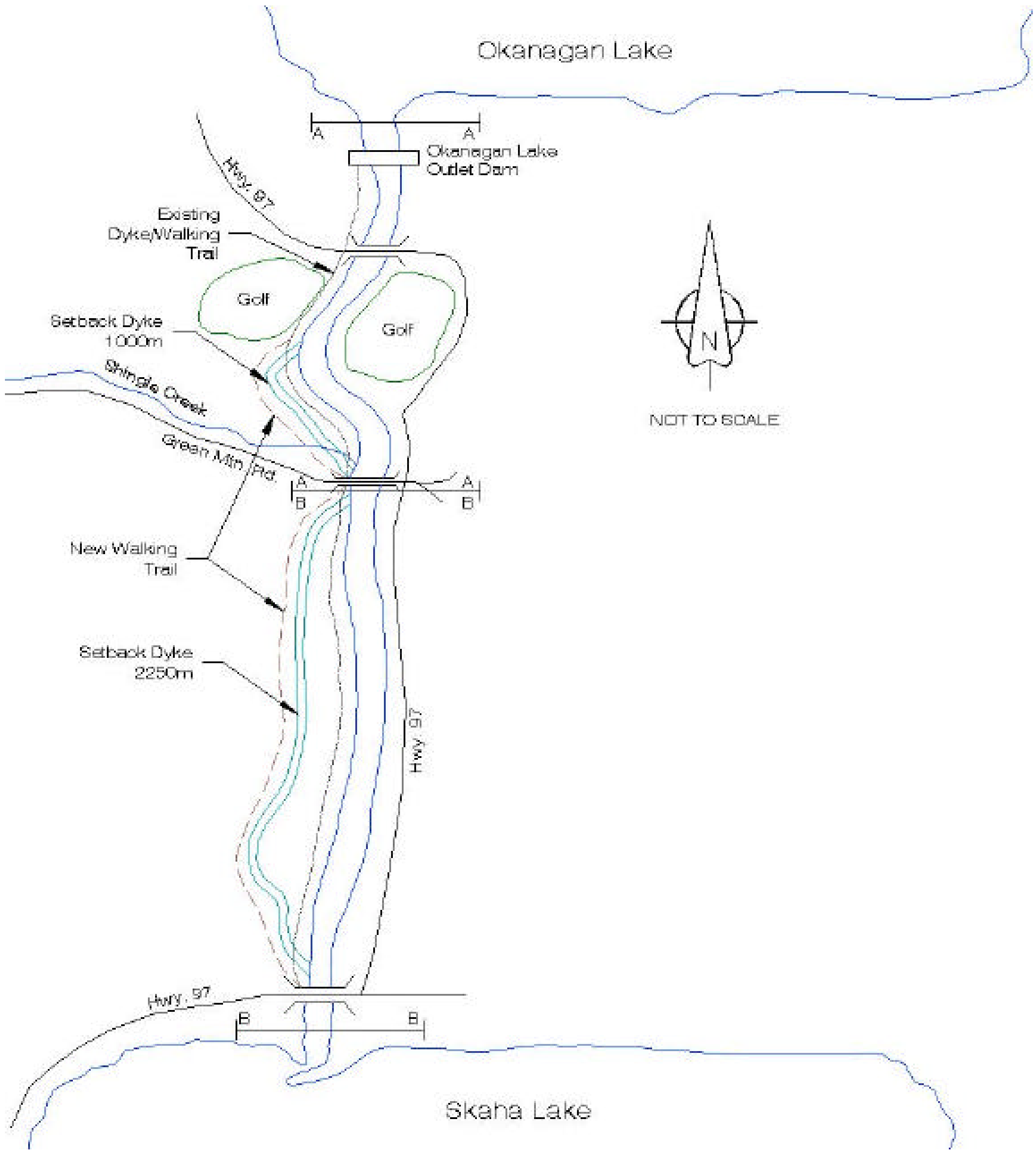

Figure 6. Map of setback dyking opportunities.

3.2.2 Benefits and Risks

There is less risk associated with a setback dyke then with the current dyke. The primary benefit for developing such a short section of setback dyking surrounded by an area with extensive development is for the establishment of riparian vegetation. The benefits associated with setback dyking include;

1. Lower water level at flood stage as a consequence of a wider flood plane;
2. Increased stability of the river bed during floods and therefore increase stability of the ramp structures;
3. Increased shading and cover with the development of riparian areas; and
4. Increased diversity and abundance of various terrestrial and aquatic wildlife species by the establishment of new riparian areas, floodplain wetlands and sloughs (Gaboury *et al*. 2000). There is also the benefit of increasing the endangered cottonwood forest ecosystem, one of the rarest plant communities of the province (SOSCP, 2000; MELP, 1997).

An attractive additional benefit from establishing setback dykes would be the opportunity to develop an interpretative trail along the newly re-designed dyke. The dyke-trail currently used would need to be moved to be made continuous with the set-back dyke. The elevations of the setback dykes would match these of the existing ones. There may be some intakes in this area that would need conduits through the new floodplain.

3.2.3 Costs

Setback dykes in the lower Okanagan River could cost anywhere from $144/m to $400/m depending on the level of development. The higher cost would apply in a developed area where landscaping and new trails are required (Gaboury *et al*. 2000). Assuming a cost of $400/m, the 1000m of setback dyke created in Reach A, would cost $400,000; in Reach B the 2250 m of setback dyke would cost C$900,000. Based on past work near the channel by the ONFC (Alexis, pers. comm. 2002) re-establishing riparian vegetation in Reach A would cost approximately C$138,000 for plant purchases and labour. The 2250m of vegetation is Reach B would cost CAN$310,500. Planting costs also cover follow-up maintenance.

3.3 Off channel establishment

3.3.1 Conceptual design

The area available for the creation of off channel rearing habitat is limited to the same 1000m of river in Reach A, and 2250m of Reach B where setback dykes are proposed. Again, consultation with the Penticton Indian Band would be needed before making any further plans for development.

Side channels and backwaters provide comparatively stable flows year-round, moderate temperature regimes and useful complexes of channel and pool habitats (Lister & Finnigan, 1997). Construction of such an area could be done in conjunction with the setback dyking (Fig. 7). As in the case of the restoration options discussed above, the infrastructure of the dyke, water withdrawal and channel integrity would need to be addressed.

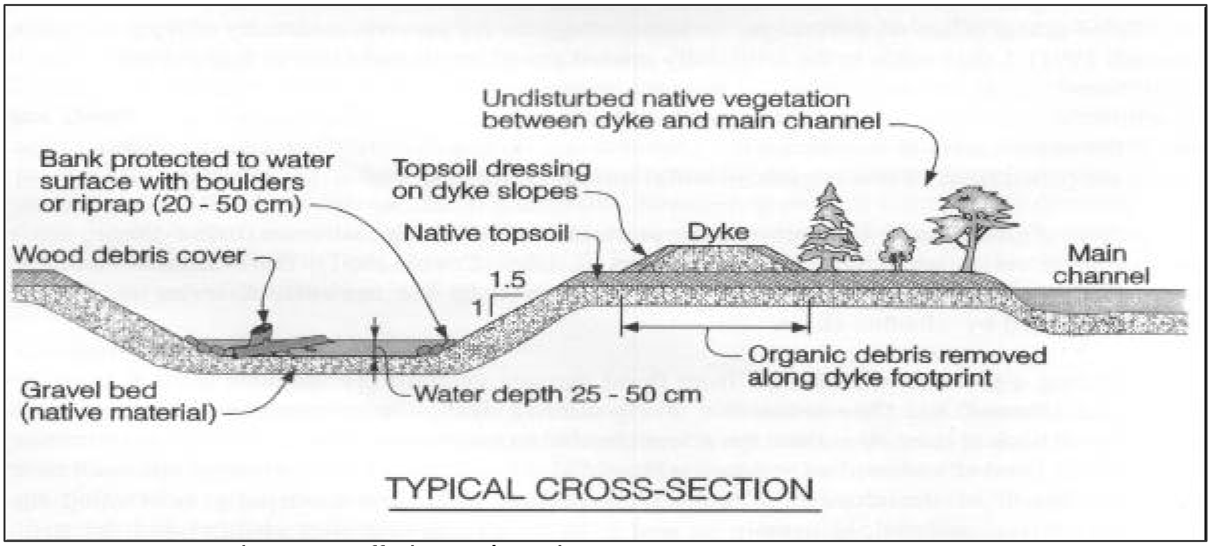

Figure 7. Off-channel rearing areas

3.3.2 Benefits and Risks

There are no risks to creating off-channel rearing areas but, such habitat would benefit rainbow trout under-yearlings which are known to grow and overwinter in these areas when available (Lister and Finnigan 1997; Adams & Whyte, 1990). Off-channel habitats contribute to salmonid production particularly where, as in the Okanagan, summer droughts accompanied by low flow can be a problem (Adams & Whyte, 1990). Because flows are more stable in the off-channel areas than in the main channel, the quality of habitat there is easier to maintain (Adams & Whyte, 1990).

3.3.3 Costs

Details of side channel and backwater design and construction will be site specific and require further surveys. Construction costs will vary with the complexity of the designs as well as with broader ecosystem provisions, (to include waterfowl habitats for example). As a preliminary cost-estimate, 10% of the setback dykes costs or C$130,000 may be anticipated as the cost of constructing pools and small access channels as the dykes are moved.

3.4 Summary of Recommended Works

Table 4. Summary of recommended works, benefits and risks

Recommended work	Location	Expected benefits	Expected Risks	Costs (C$)
Four sockeye and kokanee spawning ramps	In Reach A (360m to 1000m downstream of the dam) between the Okanagan Lake outlet dam and the golf course bridge. (see Fig. 4)	New spawning areas for approximately 4000 sockeye pairs and 3750 kokanee pairs. Built without impeding recreational tubing.	None: The increased slope of the ramps could be built without changing the slope of the overall reach and therefore preserve the capacity of the channel in the event of flooding.	$92,500 for 4 ramps
Setback dykes & Re-establish riparian vegetation	1000m in Reach A and 2250m in Reach B, both along the west bank of the river.	increase riparian induced shade and cover, increase diversity and abundance of terrestrial and aquatic wildlife species.	None: There is little risk of flood, and dyke integrity can be easily maintained.	Reach A Dyke $400,000 Veg: $138,000 Reach B Dyke: $900,000 Veg: $310,500
Off-channel habitat establishment	In setback dyking areas (see above)	Refuge for rainbow trout, during low summer flows and in winter.	None: There is little risk of flood and dyke integrity can be easily maintained.	Reach A & B $130,000

4.0 IMPLEMENTATION PLAN

4.1 Prioritization of works

The highest priority projects are the spawning ramps within the upper section of Reach A. Setback dyking, riparian vegetation re-establishment and off-channel habitat establishment are not necessary for effective spawning but would be a step toward a more natural stream bank like that which existed originally and which has been historically documented.

4.2 Agency approvals

Approvals will be required from the agencies listed in Table 5 based on Gaboury *et al.* (2000).

Table 5. Approvals needed

Agency	**Legislation/ Regulation**	**Description approvals**
Fisheries and Oceans Canada	Fisheries Act	Approval for activities that affect fish habitat
Ministry of Water, Land and Air Protection (Regional Operations)	Fisheries Act Fish protection Act	Approval for activities that affect fish habitat
Ministry of Water, Land and Air Protection (Regional Operations)	Provincial Wildlife Act	Permission to use lands within South Okanagan Wildlife Management Areas
Ministry of Water, Land and Air Protection (Regional Operations)	Water Act	Water license. Approval for alteration and work in and about a stream (Section 9)
Transport Canada	Navigable Waters Protection Act	Permit for activities around navigable waters.
British Columbia Ministry of Transportation & Highways		Access to travel along dyke to build ramps.
British Columbia Ministry of Health	Health Act	Approval of construction camp, sewage disposal and potable water supply
British Columbia Municipal Affairs, Recreation & Housing: Archaeology Branch	Heritage Conservation Act	Approval to excavate and alter sites of archaeological significance
Regional district of Okanagan /Similkameen	Municipal Act Regional Bylaws	Approval of zoning. Permits for construction
Okanagan Nation Fisheries Commission	Case law	Mandatory consultation
Penticton Indian Band	Contract and Agreement	Mandatory consultation
City of Penticton		Trail re-routing along the dyke
Special Interest Groups		e.g. Coyote Tours, SOSCP

4.3 Land negotiations

The river is accessible from the dykes along its entire length so private land would not be crossed when building ramps. However permission will be needed from the Penticton Indian Band and appropriate government agencies.

4.4 Community support and awareness

Community support is particularly important in the South Okanagan where numerous stewardship and restoration initiatives are on-going. A communications plan would need to be developed for this restoration project, as all work is along, or from the river dyke which functions as a public walkway frequented by residents and tourists. The river is also used by people floating down the channel on rafts and tubes during the summer months. It will be a benefit to the community and to continued stewardship of the Okanagan River, with its notable flora and fauna, to promote this area and describe species found within and along the river. The communication plan would need to include preparation of articles for local newspapers, radio and television as well as presentations to town council and other administrative bodies.

4.5 Pre and post-construction monitoring

As in all such developments, post construction monitoring will be needed to assess features such as water levels and sedimentation which could adversely affect fish populations – particularly sockeye, kokanee, rainbow trout and whitefish. An ecosystem based monitoring program would also include wildlife species that could be affected by the projects. The results of this monitoring will guide the implementation of any further restoration activities.

Sockeye and kokanee egg-fry survivals should be determined by counting spawners on the spawning ramps and assessing resulting fry densities. The effect of ramp construction over the full range of water levels can be determined by installing continuous recorders at strategic locations and periodic surveys of the channel and floodplain will show the transport and deposition of sediment and the relative stability of the streambed and adjacent channel.

5.0 CONCLUSION

The ramp spawning areas would provide benefits for sockeye and kokanee in the first spawning period after completion and likely for rainbow trout and whitefish as well. Widespread support and ample funding will be required as will access for sockeye through McIntyre and Skaha Lake dams. Multipurpose ponds and side channels proposed for the setback dyke zones will need detailed planning. Construction may only require a year, but planning, community dialogue and securing required agency approvals may be a more protracted process.

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FINAL

OBJECTIVE 3 Task D
Assessment of Juvenile *Oncorhynchus nerka* (Sockeye and Kokanee) Rearing Conditions of Skaha and Osoyoos Lakes 2002

Contribution No. *6* to an *Evaluation of an Experimental Re-Introduction of Sockeye Salmon into Skaha Lake: YEAR 3 of 3*

Presented to: Colville Confederated Tribes

Date: May 31, 2003

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EXECUTIVE SUMMARY

Data collected during the 2002 sampling season, and the relationship between total dissolved phosphorus and total biomass of fish, provide for estimates of the rearing capacity for Sockeye Salmon (*Oncorhynchus nerka*) smolts both 86mm and 100mm in length in three Okanagan Valley lakes: for Skaha Lake estimates of smolts per hectare are 2,781 and 1,977 and for Osoyoos Lake they are 2,981 and 2,119. Skaha Lake and Osoyoos Lake are similar in their rearing potential based on this relationship. However, there are many other factors, both biotic and abiotic, that affect the estimates
Secchi disc depths related well with the levels of productivity measured in both Skaha and Osoyoos Lakes where decreasing depths were associated with increases in phosphorus concentration. In terms of temperature and oxygen limitations, Skaha Lake had the greatest amount of optimal habitat for juveniles. Osoyoos Lake had suitable habitat in the north basin but was limited during the month of September. When comparing Skaha to current juvenile Okanagan sockeye rearing conditions (north basin of Osoyoos Lake), temperature and oxygen conditions are likely not an issue in Skaha Lake. In addition, in terms of adult holding habitat prior to spawning, Skaha Lake had conditions considered favourable when compared to Osoyoos Lake.

The total nitrogen to total phosphorus (TN:TP) ratio suggests that Skaha production is phosphorus limited and that the north basin of Osoyoos Lake is phosphorus limited from April to September but may be either nitrogen or phosphorus limiting in October and November. Chlorophyll *a* related well to the downstream increase in total phosphorus from Skaha Lake to Osoyoos Lake. Because silica levels did not vary greatly in both Skaha and Osoyoos lakes they are thought not to be limiting for either.

Zooplankton and *Mysis relicta* analysis were not completed in time for this report but preliminary results show that the mysid density in Osoyoos Lake has increased compared to 2001 sample session.

The kokanee escapement in Skaha Lake in 2002 was greater than 86,000 - the most observed since the early 1970's. Nevertheless, it is still thought to be low compared with historical numbers.

Physical and chemical features of Skaha Lake suggest that it has similar or better conditions for adult holding and juvenile rearing of Okanagan sockeye than those presently being used in Osoyoos Lake. Results from two years of monitoring of the rearing conditions suggest that an experimental reintroduction of sockeye to Skaha Lake is feasible.

However there are still, several unanswered questions arising from the second year of lake rearing assessment and subsequent monitoring during implementation and monitoring of experimental reintroduction project design:

1. Why has the kokanee population in Skaha Lake been smaller than historically except for 2002?
2. What part, if any has *M. relicta* played in the decline in Skaha Lake kokanee numbers?

3. What are the overall dynamics of *O. nerka* - *Mysis relicta* – zooplankton interactions in Skaha Lake?
4. Would these interactions affect the success of any re-introduction of sockeye into Skaha Lake?
5. Would these interactions affect the success of the present kokanee population in Skaha Lake?
6. Since preliminary results show that *Mysis relicta* abundance has increased in density in Osoyoos Lake, how will this affect the future survival of the Okanagan sockeye?

The following information is recommended to increase our rearing and limnological knowledge on the north basin of Osoyoos Lake and Skaha Lake.

1. A compilation of all available Skaha Lake kokanee information to begin to identify information gaps.
2. Compare historical predicted, versus observed kokanee population spawner numbers for Skaha Lake using the total phosphorus to fish biomass relationship to verify relationship.
3. Continue monthly water quality sampling regime (physical and chemical) of Skaha Lake and the north basin of Osoyoos Lake.
4. Biweekly *Mysis relicta* and zooplankton sampling from March to the bloom of cladoceran (usually June or July) and then monthly sampling to November. Sampling methodology used in 2001 and 2002 is recommended.
5. Continued collection of kokanee information from Skaha Lake and sockeye information on Osoyoos Lake to include juvenile abundance monitoring and growth rates of maturing fish.

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Thanks to Kim Hyatt and Paul Rankin of Fisheries and Oceans Canada at the Pacific Biological Station and Steve Matthews of the Ministry of Water, Land and Air Protection (MoWLAP), Penticton Fisheries Branch, for their support and review of methodology, data analysis, and reporting. Vic Jensen and Geri Huggins of the Ministry of Water, Land and Air Protection (MoWLAP), Penticton Pollution Prevention Branch, for their support with water chemistry analysis, lab access, data analysis, and reporting.

Carol Cooper and Al Hirst of AMC Services conducted the Zooplankton and *Mysis relicta* analysis respectively. PSC Analytical Services conducted the water chemistry analysis.

Howard Smith provided a thorough and insightful senior review and editing of the report.

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1.0 INTRODUCTION

One of the last two significant sockeye salmon populations of the Columbia River system spawns in the Okanagan River in British Columbia (Figure 1). However, despite high spawner returns in 2000 and 2001, their population has been declining to levels causing concern (Hyatt & Rankin 1999). A long-term restoration goal is to reintroduce sockeye into Okanagan Lake in order to increase adult holding lake habitat, spawning, and juvenile rearing habitat. It has been proposed to first reintroduce sockeye into Skaha Lake. With funding from the Columbia Basin Fish and Wildlife Program of the Bonneville Power Administration, the Okanagan Nation Fisheries Commission (ONFC) and the Colville Confederated Tribes (CCT) are currently evaluating the Skaha introduction proposal. One concern is that adult holding and juvenile rearing conditions in Skaha Lake, may be limiting factors to the success of the reintroduction. This is the second and final year of the evaluation of the limnological conditions of Skaha and Osoyoos lakes.

The objective of this report is to assess adult holding habitat and calculate the juvenile rearing capacity of Skaha and Osoyoos lakes in relation to the factors influencing their rearing capacities. Due to time constraints, this report provides a data summary of the physical and chemical limnology of Skaha and Osoyoos Lakes. A summary of the zooplankton and *Mysis relicta* data will be integrated into the final report when complete.

2.0 METHODOLOGY

Selection of sample stations was based on recommendations from Wright (2002) and from the year –end review meeting for the project. Key recommendations for this report from the year-two review meeting are:

- Discontinue assessments of the south and central basins of Osoyoos Lake and Vaseux Lake as there was little rearing habitat potential due to temperature and oxygen extremes;
- Have two sites for each of Skaha and Osoyoos Lakes for comparison purposes;
- Increase frequency of zooplankton and Mysis relicta sampling to biweekly intervals;
- Increase frequency of temperature and dissolved oxygen sampling to biweekly intervals except to weekly from late August to October.

Table 1 lists sampling stations. Site ID's for sample locations were kept consistent with sample stations from the previous year for comparability. Physical limnology, water chemistry, phytoplankton (not analyzed), zooplankton, and *Mysis relicta* were sampled at all sites. Zooplankton and *Mysis relicta* samples are in the process of being analyzed. Physical limnology and water chemistry methodology was based on (OLAP) methodology for comparability and consistency, (Andrusak et al. 2000). Zooplankton and Mysis relicta sampling was based on methodology as described in Rankin et al. (2000).

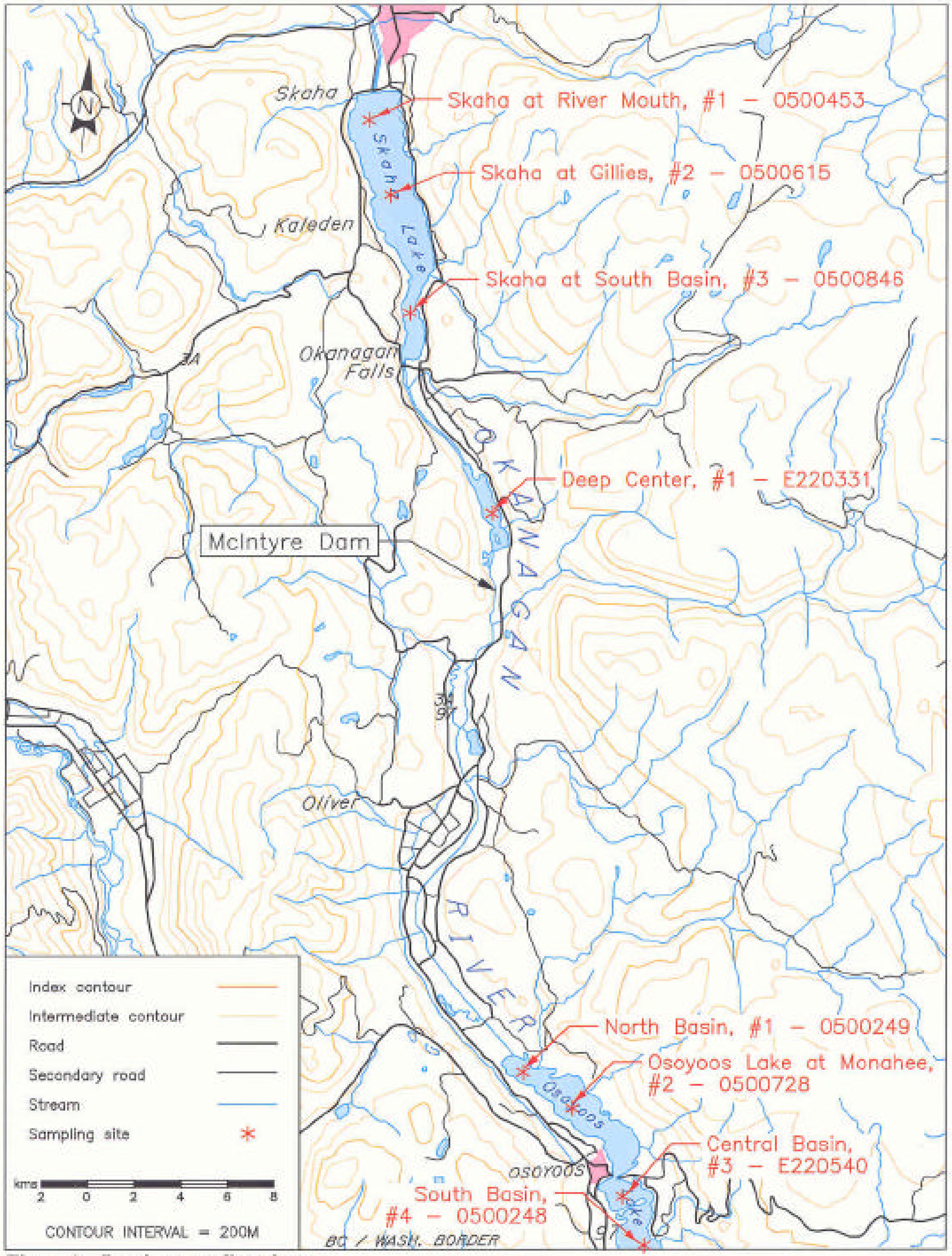

Figure 1. Rearing sampling sites.

Table 1. Summary of Sampling Stations

Lake	Site ID	Site No.	Site Name	Depth (m)
Skaha	0500615	2	Skaha @ Gillies	53.03
Skaha	0500846	3	Skaha @ South Basin	37.87
Osoyoos	0500249	1	Osoyoos @ North Basin	37.87
Osoyoos	0500728	2	Osoyoos @ Monashee Co-op	60.6 m

2.1 Rearing Capacity

For comparability and discussion of 2001 and 2002 data, the rearing capacities of Skaha and Osoyoos Lakes were calculated using the relationship between total phosphorus and total fish biomass (Downing et al. 1990; Hanson & Leggett 1982; Stockner 1987). This relationship is based on many years of data from northern temperate lakes and has also been used by Hyatt and Rankin (1999) to calculate the rearing capacity of Osoyoos Lake.. Total phosphorus concentrations and juvenile sockeye or kokanee biomass were used to develop a regression equation for predicting total fish biomass for lakes where total phosphorus concentrations are measured. It has worked well in other British Columbia lakes, including Osoyoos Lake and it also accounts for seasonal variability in environmental factors (Hyatt & Rankin 1999).

2.2 Physical Limnology and Water Chemistry

2.2.1 Physical Limnology

Temperature (^{0}C) and dissolved oxygen profiles (mg/L) were taken at least bimonthly for both lakes from April to August and weekly from September to early October. In addition, profiles were taken opportunistically when the field crew was out in the field.

At each sample site, temperature (^{0}C) and dissolved oxygen profiles (mg/L) were taken from the top surface down to 20 m in 2 m intervals and every 4 m thereafter to the bottom using a calibrated YSI model 52 dissolved oxygen meter and measurements to the nearest 0.1 mg/L. Secchi disk depth was also measured. A zone of tolerance was delineated for each lake, based upon water temperature (>17 ^{0}C), and dissolved oxygen (<4mg/L), tolerances of *O. nerka.* The zones of tolerance levels are approximately the amount of vertical habitat available in the hypolimnion (Rankin 2002, personal communication).

2.2.2 Water Chemistry

Water chemistry was measured monthly from April to November during daylight with three samples taken from each lake site. The samples from 1-10m depths were integrated, and in addition discrete samples of a volume equal to one third of a sample bottle were also taken at 1m, 5m, and 10m depths. Additional discrete samples were taken at 20m and as well a deep sample (32m and 45m at sites 1 and 2 respectively in

Osoyoos Lake and 36m and 45 m at sites 2 and 3 respectively in Skaha Lake). Plastic 1L bottles were rinsed three times prior to inserting samples. Separate bottles for total phosphorus bottle at each depth site, and lake and were taken to the field lab where Hydrogen Sulphate (H_2SO_4) was added.

Phytoplankton was collected at each site by an additional integrated sample and put in a clear 250mL glass jar and preserved with Lugol's iodine solution. The Lugol's preserved phytoplankton samples are stored at the Okanagan Nation Fisheries Commission storage in case it is later determined that phytoplankton analysis is required.

An additional integrated (0-10m) sample was taken and put in brown plastic 1 L bottles for chlorophyll *a* analysis. The samples were filtered and preserved with 2 drops of Magnesium Carbonate ($MgCO_3$), then frozen and shipped on ice in sealed plastic bags with a small amount of silica gel to the PSC Analytical Services Laboratory in North Vancouver along with water samples.

2.3 Macrozooplankton

Macrozooplankton sampling was conducted at biweekly intervals between April and November. Sampling was conducted at night using a plankton net (terminal mesh size of 105 microns). Flow measurements were also taken to determine net efficiency. Samples were put in 250mL glass jars and preserved in 4% formalin and shipped to the Pacific Biological Station (PBS) in Nanaimo, BC where they were picked up by AMC lab for analysis.

Sprules et al. (1981) provides a summary of the methodology used to analyze zooplankton and *Mysis relicta* samples. The samples were initially stained with methylene blue for contrast purposes (visibility) when measuring. The formalin solution was then decanted from the sample jar and poured into a Folsom splitter and split as required. Once the split number was determined it was poured into a round-bottomed graduated flask and the water level raised to 300 ml. Using an automatic pipette, subsamples of 3 mL and its multiples were taken and placed in a plankton wheel for identifying, enumerating, and measuring. Both a regular count and rare scan was conducted.

The samples were processed using an IBM computer based caliper measuring system and dissecting scope. A program called Zebra2 was used to generate a bench (summary) sheet and save individual measurements and counts to a file.

2.4 Mysis Relicta

Mysis relicta sampling was also conducted biweekly between April and November. Sampling was conducted at night using a *Mysis relicta* net (terminal mesh size of 300 microns). Samples were preserved in 4% formalin in 250mL glass jars. Samples were forwarded and processed much as described in the macrozooplankton abundance methodology.

3.0 RESULTS

3.1 Juvenile Rearing Capacity

Lake rearing capacities for 2001 and 2002 as determined from the described sampling are given in Table 2. Factors influencing these data are discussed later. Figure 2 shows the relationship between total phosphorus and fish biomass used to calculate total fish biomass per hectare for each lake. Figure 3 shows the length-weight regression used to calculate the number of smolts per hectare for each lake. Sockeye smolt lengths of 86mm and 100mm were used for the calculations so as to be consistent and comparable with Hyatt and Rankin's (1999) rearing estimate of Osoyoos Lake. With this relationship, juvenile sockeye smolt lengths of 86mm and 100mm would have mean weights of 6.79g and 9.55g respectively. The average total phosphorus was measured from April to November 2002. All measurements per site were summed and divided by their totals. For example, Skaha Lake had two sites with a total of 48 samples (approximately 24 for each site). The sum of all the total phosphorus readings was 384µg/L. Therefore, the seasonal average for Skaha Lake was about 8µg/L. Using the Figure 2 regression equation, a fish biomass of 15.88kg/ha was determined. This 15.88kg/ha of total fish biomass was divided by the mean weight of 86mm and 100mm sockeye smolts to calculate the number of smolts per hectare. The number of smolts per hectare for 86mm and 100mm are 2,339 and 1,663 respectively.

Table 2. Summary of Predicted Juvenile *O. nerka* Rearing Capacities for Skaha Lake and Osoyoos Lake, 2001 and 2002

Year	Lake	Lake Area (ha)	No. of Sites	TP (μg/L)	Fish Biomass (kg/ha)	No. of 86mm smolts /ha (6.79g)	No. of 100mm smolts/ha (9.55g)
2001	Skaha	2,010	3	12.0	18.88	2,781	1,977
2002	Skaha	2,010	2	8.00	15.88	2,339	1,663
2001	Osoyoos**	1,505	3	14.2	20.24	2,981	2,119
2002	Osoyoos**	1,505	2	14.75	20.54	3,025	2,151

****Canadian Portion only for lake area**

For Osoyoos Lake calculations the lower depth measurements were omitted because of the anoxic conditions that cause an irregular increase in total phosphorus in the hypolimnion (Johannes 2002, personal communication). For example, the epilimnion reading (0-10m) for Osoyoos Lake in September was 0.008mg/L at both sites yet the deep sample was 0.026mg/L (Figure 10d and f). This would have resulted in a larger fish biomass estimate for the lakes that would not accurately represent environmental conditions.

The Osoyoos Lake average total phosphorus measurement for 2002 is slightly lower than Hyatt and Rankin (1999) used for their calculation of a total phosphorus concentration of 22μg/L. However, there are other abiotic and biotic factors that affect this relationship.

3.2 Physical Limnology and Water Chemistry

3.2.1 Physical Limnology

Skaha Lake

Skaha Lake Secchi depth measurements at the two sites averaged 4.8m (Figure 4a). A maximum depth of 6.6m at Site 2 in September and a minimum depth of 3.9m at Site 3 in July were recorded.

A maximum surface temperature of 22.7^{0}C occurred at both Skaha Lake sites during July (Figure 5s and u).

Skaha Lake began to stratify in early June when the epilimnion boundary was at about 10m (Fig 5 l and m) and remained stratified until late October. The epilimnion layer at sites 2 and 3 settled to a maximum of 14m and 18m depth respectively (Figures 5bb and mm).

Dissolved oxygen levels in Skaha Lake ranged from 5.6 -16.26mg/L at site 2, and 6.72-16.4mg/L at Site 3. Summer profiles were slightly clinograde suggesting waters of moderate productivity (Horne & Goldman 1994). Dissolved oxygen measurements were recorded to lake bottom and demonstrated little, if any anoxic conditions in Skaha Lake.

Osoyoos Lake

Osoyoos Lake Secchi depth measurements averaged 3.5m at the two sites (Figure 4b). The maximum depth recorded was 4.4m and minimum 2.6m (Figure 4b). Maximum surface temperatures occurred in August and were 23.7^{0}C for sites 1 and 2 (Figures 6uu and 6vv).

The lake began to stratify at both sites in late May (Fig. 6e and f) and remained stratified until early November (Fig. 6yy and 6zz) when isothermal conditions reappeared and the epilimnion layer at sites 1 and 2 settled to a maximum 18m.

Dissolved oxygen levels in Osoyoos Lake ranged from <4mg/L (low oxygen conditions for *O. nerka*) and 16.56mg/L at sites 1 and 2 (Figures 6a to bbb). Summer profiles were slightly clinograde suggesting waters of moderate productivity (Horne & Goldman 1994).

Zone of Tolerance

Figures 7a-d show the zone of tolerance for all sites at both lakes, based on maximum temperature (17^{0}C) and minimum dissolved oxygen (4mg/L) tolerances for juvenile *O. nerka*. No suitable vertical habitat is predicted if the temperature tolerance line and dissolved oxygen tolerance line meet or cross. This area is the space between the two lines in the figures and is hypothesized to be an approximation of the optimal vertical habitat available for juvenile sockeye in the pelagic zone (Rankin 2002, personal communication). In addition, this zone of tolerance can also be considered to approximate the conditions required for adult sockeye holding in a lake until river spawning temperatures are optimal (about 15^{0}C).

Skaha Lake sites 2 and 3 had conditions suitable for juvenile *O. nerka* throughout the monitoring period. One observation of dissolved oxygen constraint occurred during the month of September, at site 2 when a maximum of 30m of optimal habitat was available over a maximum of 14 days based on sampling frequency (Figure 7a). The layer posing a vertical temperature constraint of 17^{0}C lasted at least from June 19 – September 26 and reached a maximum depth of 14m, again based on sampling frequency. Site 3 in the south basin had no dissolved oxygen constraints during the monitoring period but a vertical temperature constraint of 17^{0}C lasted from June 12 – September 30 and reached a maximum depth of 18m.

In Osoyoos Lake, September was the most critical month at Site 1 where it is estimated that 20 vertical meters of optimal hypolimnion habitat was available and lasted at most from September 6 – 19 (Figure 7c). At Site 2, only about two vertical meters of habitat were available from September to the beginning of October. This (2002) condition lasted a maximum period from September 13 – October 2 (Figure 7d). This was also seen in 2001 where September was observed to be the most critical month in terms of optimal rearing habitat (Wright 2002). This ‘squeeze’ of optimal habitat is not new, but was poorly documented in previous years and with the long-term outlook of warmer conditions due to climate change, it could potentially become more severe (Rankin 2002).

During 2002 (as in 2001), Skaha Lake, in terms of temperature and oxygen limits, had more optimal habitat for sockeye adults holding, and juveniles rearing than did Osoyoos Lake. Based upon previous sampling, Osoyoos Lake is assumed to have suitable habitat in the north basin only and that becomes vertically constrained for both holding adult and rearing juvenile sockeye. In comparing Skaha conditions with those of the north basin of Osoyoos Lake it appears that temperature and oxygen are unlikely to be an issue in Skaha, and this may translate into increased survival for adult sockeye holding in the lake until spawning time.

3.2.2 Water Chemistry

Skaha Lake

Total nitrogen levels averaged 0.20mg/L from April to November at the two sites and ranged from 0.07 – 0.34mg/L (Figure 8a - c). Dissolved nitrogen (Nitrate-Nitrogen) levels averaged 0.003mg/L from April to November monthly sampling for the 0-10m integrated sample (Figure 9a - c). There were no differences in the Nitrate-Nitrogen concentrations at the two sample depths at Site 2 of Skaha Lake (Figures 9a - c). However, in Site 3, the dissolved nitrogen levels were greater (average 0.011mg/L) at the 36m sample depth (Fig. 9c). The difference may be due to photosynthetic biological uptake with limited mixing between the epilimnion and the hypolimnion, resulting in limited replenishment of nutrients from the hypolimnion into the epilimnion.

Total phosphorus levels averaged 0.008mg/L for the April to November monthly samples for all three sites and depths (Figures 10a- c). The 20m and deep section total phosphorus samples (45m and 36m) did not differ greatly from those of the epilimnion (Fig. 10a-c), nor did those for total dissolved phosphorus in the same period and depths (Fig. 11a-c).

Osoyoos Lake

Total nitrogen levels averaged 0.23mg/L from the April to November monthly samples at the two sites and ranging between 0.13 – 0.38mg/L (Figure 8d - f). Dissolved nitrogen (Nitrate-Nitrogen) levels averaged 0.005mg/L for the April to November monthly samples in the 0-10m integrated sample (Figure 9d). Both sites showed a difference between the 0-10m integrated sample and those from discrete sample depths (20m, 32m-site 1, and 45m-site 2) (Figures 9d - f). In addition, there was a large difference at both sites between the 20m discrete sample depth and the 32m-site 1 and 45m-site 2 (Fig. 9e and f). As in the case of Skaha Lake, the differences may be due to photosynthetic biological uptake with limited mixing between the epilimnion and the hypolimnion thus resulting in limited replenishment of nutrients from the hypolimnion into the epilimnion.

Total phosphorus levels averaged 0.014mg/L from April to November for all three sites and depths (Figures 10d- f) and the 20m and deep sections (32m-site 1 and 45m-site 2) samples did not differ appreciably from those of the epilimnion. The same was true of total dissolved phosphorous.

Nitrogen:Phosphorus Ratios

In most lakes there is a direct relationship between concentrations of the limiting nutrient and phytoplankton (Horne & Goldman 1994). Phosphorus is usually the limiting nutrient as most living matter requires a Total Phosphorus to Total Nitrogen (TN:TP) ratio of 16:1 (Horne & Goldman 1994). This can be further refined to: TN:TP>15, phosphorus limiting, TN:TP<10, nitrogen limiting, TN:TP between 10 and 15, can be neither, or both limiting (Andrusak et al. 2001; Wetzel 1983).

A measure of the available nutrients available to phytoplankton in the epilimnion is the amount of dissolved nitrogen and phosphorus in the 0-10m integrated sample depth (Andrusak et al. 2001). A ratio of 7:1 for nitrates to dissolved phosphorus (NO_3:TDP) is often used as an indicator of the bio-availability of nutrients. If the ratio is <7, then conditions are more favourable for cyanobacteria (blue-green algae) and if >7, then conditions are favourable for other phytoplankton such as diatoms. This is relevant in that blue-green algae are a poor food source for zooplankton (Andrusak et al. 2001).

At all Skaha Lake sites the TN:TP ratios were greater than 15 except for site 3 in October (N/P ratio of 9.33) suggesting that the lake is phosphorus limited (Figure 12a). Site 3 is in the south basin of Skaha Lake and nitrogen limiting during October but was close to 10 which translates to neither or both limiting. Considering the available dissolved nutrients (NO_3:TDP), the NO_3:TDP ratios were all <7 which suggests an environment favourable to blue-green algae (Figure 13a).

In Osoyoos Lake, average TN:TP ratios were above 15 from April to September and between 10-15 for October and November (Figure 12b). This suggests that the lake was either phosphorus limiting and then either, neither or both limiting. NO_3:TDP ratios, were all less than 7 suggesting conditions favourable for blue-green algae (Figure 13b).

Chlorophyll *a*

Chlorophyll *a* is often used as an indicator of phytoplankton standing crop (Horne & Goldman 1994). The average April-November chlorophyll *a* concentration in Skaha Lake, was 3.2µg/L (Figure 14a) whereas in Osoyoos Lake, was 4.87ug/L (Figure 14b). This relates well with the difference in average total phosphorus levels, which were greater in Osoyoos Lake than in Skaha Lake.

Silica

Silica is used by diatoms for their rigid cell walls, called frustules and it accounts for their success and if there is great variation in silica concentrations it may suggest that silica is potentially limiting (Horne & Goldman 1994). Diatoms are a preferred food source for zooplankton (Horne & Goldman 1994). Silica levels in all Skaha and Osoyoos lake sites averaged 4.7mg/L (Figure 15a - c; 15d - f). Silica does not seem to be limiting diatom production in either of these lakes as concentrations of silica did not fluctuate greatly.

4.0 DISCUSSION AND CONCLUSIONS

Based on data collected during the 2002 sampling season and on the relationship between total dissolved phosphorus and fish biomass of limnetic juvenile *O. nerka*, the rearing capacity for 86mm and 100mm *O. nerka* smolts in Skaha Lake is estimated to be 2,339 smolts/ha and 1,663 smolts/ha respectively. For Osoyoos Lake, the rearing capacity for 86mm and 100mm is estimated to be 3,025 smolts/ha and 2,151 smolts/ha.

As identified in the 2001 report, the carrying capacity of Osoyoos Lake was calculated by Hyatt and Rankin (1999) to be higher than this even though similar concentrations of total phosphorus were used. The main reason for the difference is the range of data used to develop the relationship between total phosphorus and fish biomass by Hyatt and Rankin (1999). They used a broader range of lake trophic conditions (<2µg/L-300µg/L of total phosphorus) while the lake trophic conditions used in Figure 2 of this report ranged only from <2µg/L-30µg/L. Another difference is that the lakes used in Hyatt and Rankin (1999) were not limited to those containing only *O. nerka*. Figure 2 of this report used lakes whose principal limnetic fish species was *O. nerka* but some also contained *Mysis relicta*. The impacts of *Mysis relicta* on the rearing production of sockeye or kokanee lakes are relatively unknown but may have some influence. The main outcome of these differences is a more conservative rearing estimate based upon our data. Nevertheless, the value is in comparing the lakes rearing capacities even though Skaha has slightly less productive capacity in their total phosphorus levels for 2002. Osoyoos Lake has a demonstrated capacity to sustain a relatively large biomass of juvenile sockeye, so this suggests that the rearing capacity of Skaha Lake is currently not limited.

In addition, the 2002 kokanee spawning escapement was over 86,000 (Matthews 2002) a population size which has not been seen since the early 1970's when Skaha Lake was considered to be in a eutrophic state. That was prior to tertiary treatment of the Penticton municipal wastewater treatment plant on the Okanagan River Channel (Truscott & Kelso 1979).

Secchi depths related well with the productivity of Skaha Lake and Osoyoos Lake decreasing in depth as phosphorus concentrations increased, In terms of temperature and oxygen limits, Skaha Lake had the greatest amount of suitable habitat for rearing juvenile *O. nerka*. Osoyoos Lake also had suitable habitat but had vertical plane habitat limitations for a period of about 14 days. This conclusion is based on increased sampling frequency in 2002 as compared to that of 2001. On the basis of the current somewhat marginal rearing conditions for sockeye in the north basin of Osoyoos Lake, and the comparatively favourable circumstances in Skaha Lake, temperature and oxygen conditions limitations are not seen in Skaha Lake. This temperature and oxygen squeeze seen in Osoyoos Lake is not a new physical feature, but is poorly documented. With the potential of climate change and warmer conditions in the Okanagan Basin, this 'squeeze' may be more extreme in the future (Rankin 2002, personal communication). Temperature and dissolved oxygen conditions are more suitable in Skaha Lake than in Osoyoos Lake for adult sockeye holding there until spawning conditions are favourable. Therefore, if sockeye are reintroduced into Skaha Lake through adult migration, it appears that over summer survival for adults and juvenile rearing survival in Skaha Lake would be greater.

The total nitrogen to total phosphorus (TN:TP) ratio suggests that both Skaha Lake and the north basin of Osoyoos Lake are primarily phosphorus limited. However, for Osoyoos Lake in October and November, the (TN:TP) ratio was between 10-15 and suggests that the lake was either phosphorus limiting and then either, neither or both limiting. Both lakes had a dissolved TN:TP ratio less than 7 indicating that conditions are likely favourable for cyanobacteria. Because Osoyoos Lake and Skaha Lake are quite similar in these respects one might expect that the conditions for sockeye in Skaha Lake would not be very different, if not improved, from those in the north basin of Osoyoos Lake.

The relationship of an increase in total phosphorus to an increase in chlorophyll *a* can be seen for Skaha and Osoyoos Lakes. Silica levels did not vary greatly which suggests that it is not limiting.

Zooplankton and *Mysis relicta* samples have been collected and are currently being analyzed and are thought likely to provide further insight into the juvenile rearing conditions in Skaha and Osoyoos Lakes.

Physical and chemical features of Skaha Lake suggest that it has similar or better conditions for sockeye adult holding and juvenile rearing than those presently being used in Osoyoos Lake. The information collected over the past two years suggest that, in terms of rearing conditions, an experimental reintroduction is feasible. However, several unanswered questions remain after the second year of lake rearing assessment:

1. Other than 2002, why have recent kokanee populations in Skaha Lake been smaller than historically?
2. What part, if any has *M. relicta* played in the decline in Skaha Lake kokanee numbers?
3. What are the dynamics of *O. nerka* and *Mysis relicta* interactions with zooplankton in Skaha Lake?
4. How might these interactions affect the success of any re-introduction of sockeye and the present kokanee population in Skaha Lake?
5. Since preliminary results suggest that *Mysis relicta* have increased in density in Osoyoos Lake, how might this affect the future survival of the Okanagan sockeye?

5.0 RECOMMENDATIONS

To help answer the foregoing questions during implementation of the experimental reintroduction, further physical limnology, water chemistry, zooplankton and *Mysis relicta* abundance sampling and comparison of these features in Skaha Lake and the north basin of Osoyoos Lake is recommended.

In addition, information on the Skaha Lake kokanee population and rearing behaviour of *O. nerka* in the north basin of Osoyoos Lake is lacking. The following information is recommended to increase our rearing and limnological knowledge on the north basin of Osoyoos Lake and Skaha Lake.

1. A compilation of all available Skaha Lake kokanee information to begin to identify information gaps.

2. Compare historical predicted, versus observed kokanee population spawner numbers for Skaha Lake using the total phosphorus to fish biomass relationship to verify relationship.

3. Continue monthly water quality sampling regime (physical and chemical) of Skaha Lake (two sites) and the north basin of Osoyoos Lake (two sites) as follows:
   - Measure temperature/oxygen profiles at or near lake-bottom at all sites.
   - During August - October on Skaha and Osoyoos Lakes when temperature and dissolved oxygen conditions for juvenile *O. nerka* habitat are most likely to become critical, increase the frequency of sampling to twice weekly at the sample sites.

4. Biweekly *Mysis relicta* and zooplankton sampling from March to the bloom of cladoceran (usually June or July) and then monthly sampling to November. Sampling methodology used in 2001 and 2002 is recommended. It is also recommended to increase the number of sites for *M. relicta* to 10 for each lake to increase the confidence limits (Rankin 2002, personal communication).

5. Continued collection of kokanee information from Skaha Lake and sockeye information on Osoyoos Lake to include juvenile abundance monitoring and growth rates of maturing fish. This can be accomplished by:
   - Hydroacoustic and trawl surveys to determine juvenile abundance. Fisheries and Oceans Canada is currently conducting this work.
   - Trawl surveys in Skaha Lake to determine age structure and species composition of limnetic fish from Hydroacoustic surveys.
   - Seasonal gill netting of Skaha Lake and sampling of Skaha adult spawners to collect biological information (age structure, growth rates, sex, diet analysis, and genetic analysis).

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APPENDIX A

Figures 2 through 15

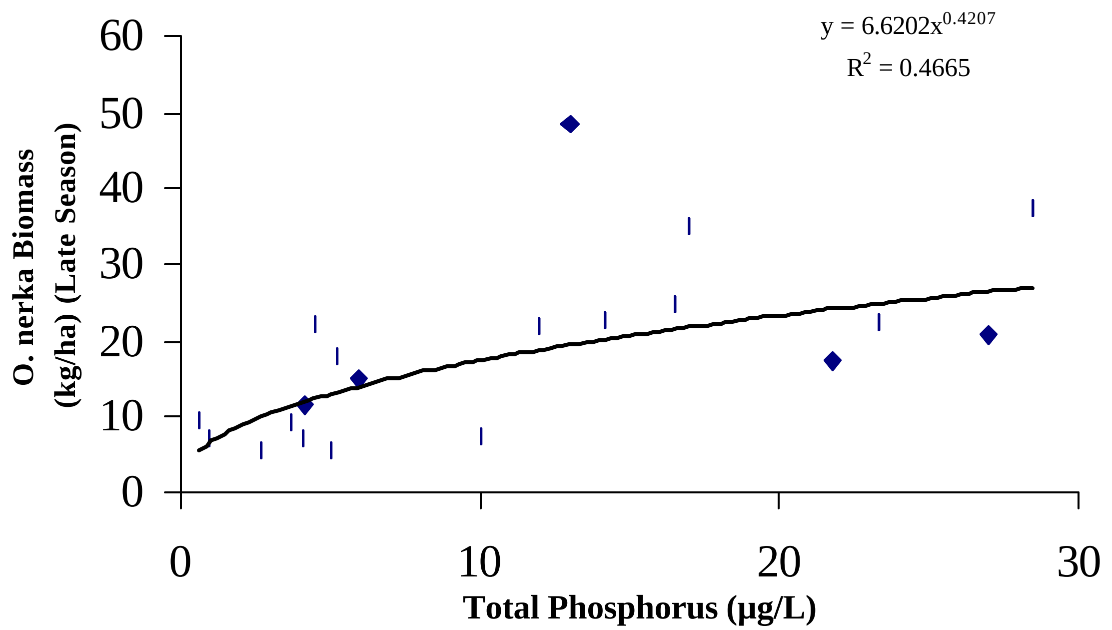


Figure 2: Total phosphorus – O. nerka biomass relationship. Data include biomass and TP estimates from a series of sockeye and kokanee lakes. Methods used to derive nerkid biomass estimates include standard acoustic / trawl surveys. For details see Stockner (1987), Hyatt and Rankin (1999)

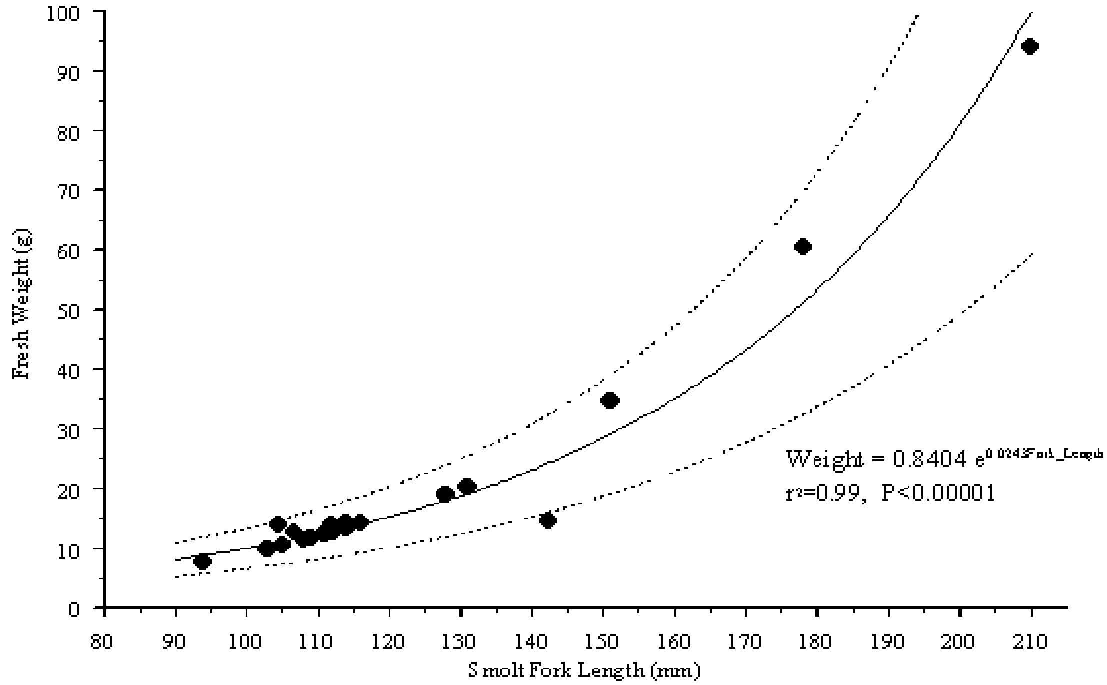


Figure 3: Length – Weight Regression for Osoyoos Lake Sockeye Smolts (1957-2000)
Weight = 0.8404 $e^{0.0243 * \text{Fork Length}}$

Figure 4: Secchi Depth Transparancies 2002

Figure 4a Skaha Lake

2002	Site 2	Site 3
F		
M		
A	4.1	4.1
M	5.0	4.8
J	4.3	4.2
J	4.5	3.9
A	4.6	4.4
S	6.6	6.0
O	5.4	5.4
N		
Average	4.9	4.7

Lake average 4.8

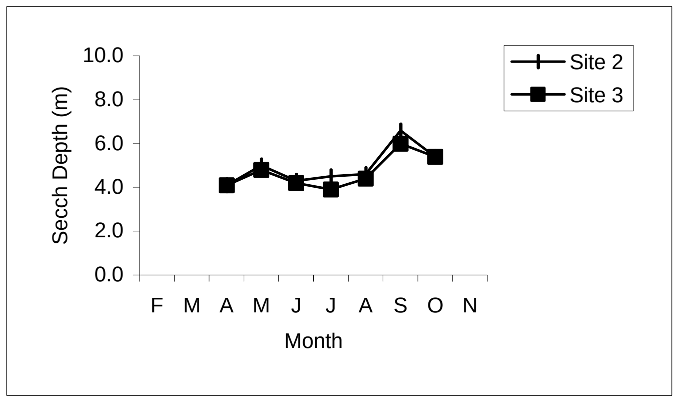


Figure 4b Osoyoos Lake

2002	Site 1	Site 2
F		
M		
A	3.3	3.9
M	3.0	3.1
J	3.0	2.6
J	2.6	3.0
A	4.1	5.0
S	3.6	3.6
O	4.4	4.4
N		
D		
Average	3.4	3.7

Lake Average 3.5

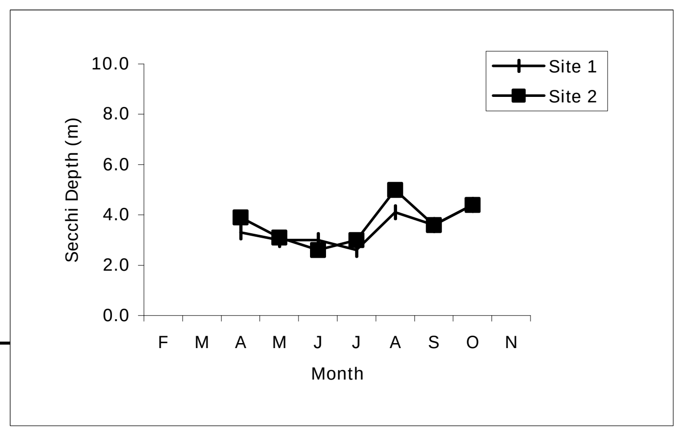


Figure 5: Temperature/Oxygen Profiles for Skaha Lake for 2002

Figure 5a Site 2 April 10

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
4.0	0	13.5	0
3.8	2	13.6	2
3.8	4	13.3	4
3.7	6	13.6	6
3.6	8	14.2	8
3.6	10	13.9	10
3.6	12	13.9	12
3.6	14	14.1	14
3.6	16	13.8	16
3.6	18	13.9	18
3.6	20	13.9	20
3.6	24	13.9	24
3.6	28	13.5	28
	32		32
	36		36
	40		40

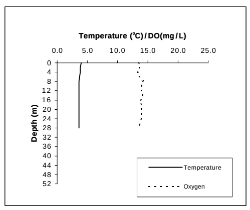


Figure 5b Site 3 April 10

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
4.6	0	14.0	0
4.5	2	14.0	2
4.4	4	14.3	4
4.3	6	14.3	6
4.3	8	14.3	8
4.3	10	14.5	10
4.2	12	14.4	12
4.2	14	14.5	14
4.2	16	14.2	16
4.2	18	14.4	18
4.2	20	14.1	20
4.2	24	14.2	24
4.2	28	14.1	28
	32		32
	36		36
	40		40

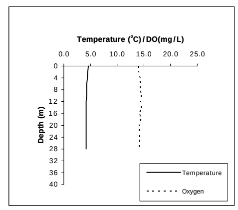


Figure 5c Site 2 April 25

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
7.0	0	14.34	0
7.0	2	16.00	2
7.0	4	16.13	4
6.8	6	16.18	6
6.6	8	16.26	8
6.4	10	15.72	10
6.3	12	15.91	12
6.2	14	15.56	14
6.2	16	15.50	16
6.2	18	15.49	18
6.1	20	15.32	20
6.0	24	15.19	24
5.9	28	15.06	28
	32		32
	36		36
	40		40

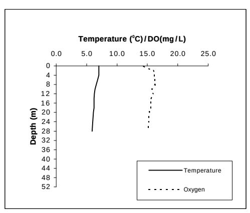


Figure 5d Site 3 April 25

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
6.8	0	13.6	0
6.6	2	15.5	2
6.5	4	15.8	4
6.4	6	16.3	6
6.2	8	16.1	8
6.0	10	16.3	10
5.8	12	16.4	12
7.9	14	15.0	14
7.3	16	15.5	16
7.4	18	14.9	18
7.3	20	14.5	20
7.3	24	13.4	24
7.3	28	13.1	28
	32		32
	36		36
	40		40

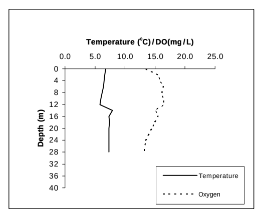


Figure 5e Site 2 May 8

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
11.7	0	14.77	0
10.7	2	12.15	2
10.4	4	10.96	4
10.2	6	10.38	6
9.9	8	10.20	8
9.7	10	9.81	10
9.5	12	9.67	12
9.3	14	9.76	14
9.2	16	9.85	16
8.4	18	9.86	18
8.3	20	9.90	20
8.2	24	9.94	24
7.7	28	10.40	28
7.0	32	9.92	32
6.4	36	9.73	36
	40		40

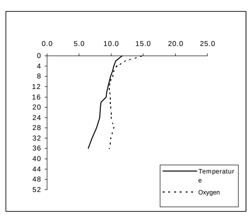


Figure 5f Site 3 May 9

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
10.40	0	8.40	0
10.00	2	8.40	2
9.70	4	8.00	4
9.10	6	8.08	6
9.00	8	8.09	8
9.00	10	8.11	10
9.00	12	7.99	12
8.90	14	8.10	14
8.60	16	8.16	16
7.10	18	8.23	18
7.00	20	8.33	20
6.60	24	8.27	24
6.30	28	8.24	28
6.20	32	8.89	32
6.00	36	6.29	36
6.00	40	5.14	40

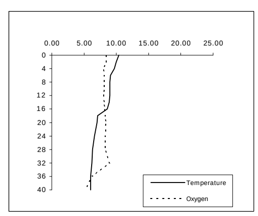


Figure 5g Site 2 May 23

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
12.4	0	11.20	0
12.3	2	10.58	2
12.3	4	9.86	4
12.2	6	9.66	6
12.3	8	9.52	8
12.2	10	9.58	10
12.3	12	9.56	12
12.4	14	9.38	14
12.4	16	9.39	16
12.1	18	9.58	18
11.2	20	9.52	20
9.9	24	9.79	24
8.6	28	10.32	28
7.9	32	10.51	32
7.7	36	10.59	36
7.7	40	10.55	40
7.4	44	10.71	44

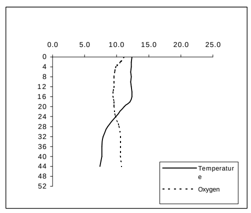


Figure 5h Site 3 May 23

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
13.2	0	9.2	0
13.8	2	9.4	2
13.8	4	9.0	4
13.9	6	9.0	6
13.9	8	8.9	8
13.8	10	9.5	10
13.8	12	9.4	12
13.6	14	9.5	14
13.5	16	9.3	16
13.2	18	9.5	18
13.1	20	9.7	20
12.8	24	9.9	24
12.1	28	10.2	28
10.4	32	10.5	32
9.0	36	10.9	36
	40		40

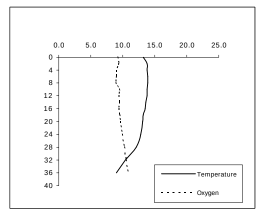


Figure 5i Site 2 May 28

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
15.3	0	10.79	0
15.2	2	12.02	2
15.2	4	11.95	4
14.8	6	13.16	6
13.2	8	13.31	8
12.6	10	13.38	10
12.1	12	13.55	12
11.8	14	13.55	14
11.2	16	13.55	16
10.9	18	13.45	18
10.6	20	13.44	20
9.4	24	13.66	24
7.6	28	14.10	28
7.6	32	13.85	32
7.5	36	13.59	36
6.9	40	13.56	40
	44		44

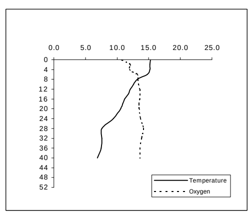


Figure 5j Site 2 June 7

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
10.4	0	11.73	0
12.2	2	11.73	2
13.1	4	10.56	4
13.2	6	10.08	6
13.4	8	10.55	8
13.3	10	10.91	10
13.1	12	10.56	12
12.5	14	11.14	14
12.1	16	11.21	16
11.6	18	11.21	18
11.1	20	11.17	20
10.5	24	11.26	24
9.3	28	12.17	28
8.7	32	11.98	32
8.4	36	11.94	36
7.8	40	11.96	40
7.4	44	12.02	44
7.0	48	12.38	48
6.6	52	12.51	52

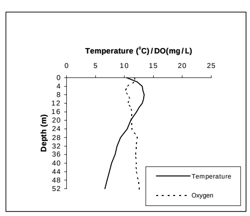


Figure 5k Site 3 June 7

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
9.6	0	12.01	0
11.3	2	10.79	2
12.8	4	12.10	4
13.7	6	11.45	6
14.2	8	10.82	8
14.4	10	10.39	10
14.3	12	10.16	12
14.1	14	10.49	14
13.6	16	10.59	16
12.2	18	10.07	18
11.5	20	10.66	20
10.5	24	10.75	24
9.5	28	10.62	28
9.1	32	10.67	32
8.5	36	11.03	36
7.9	40	11.23	40

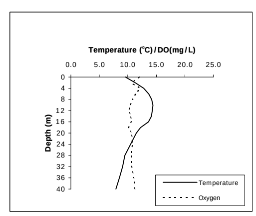


Figure 5l Site 2 June 11

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
15.3	0	10.44	0
14.5	2	13.44	2
14.2	4	13.60	4
14	6	13.60	6
14.2	8	13.60	8
13.8	10	12.70	10
13.7	12	12.14	12
13.6	14	12.11	14
12.8	16	12.07	16
12.3	18	12.18	18
10.8	20	12.11	20
10	24	12.02	24
8.2	28	12.96	28
7.6	32	13.99	32
6.7	36	13.90	36
6.5	40	14.40	40
6.2	44	14.17	44
6.1	48	13.81	48
6.0	52	13.59	52

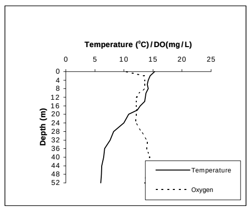


Figure 5m Site 3 June 11

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
15.1	0	8.42	0
14.9	2	8.95	2
14.4	4	9.30	4
12.4	6	9.87	6
11.8	8	9.82	8
10.6	10	10.20	10
8.7	12	10.84	12
8.5	14	11.82	14
8.2	16	11.87	16
8.0	18	11.42	18
7.9	20	11.51	20
7.7	24	11.82	24
7.2	28	12.12	28
6.9	32	12.10	32
6.9	36	12.02	36
	40		40

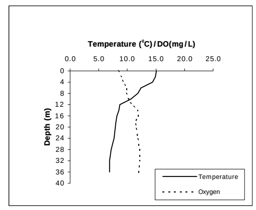


Figure 5n Site 2 June 19

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.0	0	7.56	0
17.1	2	9.16	2
16.9	4	10.33	4
14.7	6	10.30	6
13.5	8	9.10	8
12.6	10	9.80	10
11.6	12	9.48	12
10.4	14	9.81	14
9.2	16	10.17	16
7.9	18	10.64	18
7.3	20	10.40	20
6.9	24	10.59	24
6.5	28	10.60	28
6.2	32	10.80	32
6.1	36	10.75	36
6.1	40	10.70	40
5.8	44	10.60	44
5.8	48	10.16	48
6.0	52	9.45	52

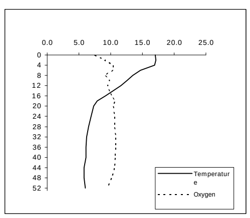


Figure 5o Site 3 June 19

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.5	0	6.8	0
17.7	2	7.7	2
17.4	4	8.7	4
17.4	6	9.4	6
15.4	8	9.1	8
12.6	10	10.2	10
9.6	12	10.3	12
7.8	14	11.7	14
7.5	16	11.5	16
7.2	18	11.0	18
7.2	20	11.1	20
7.1	24	11.0	24
7.1	28	10.8	28
6.9	32	10.8	32
7.1	36	10.7	36
7.2	40	4.2	40

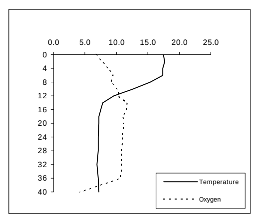


Figure 5p Site 2 June 27

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.8	0	9.66	0
21.9	2	9.98	2
19.0	4	11.29	4
17.9	6	11.75	6
17.3	8	11.55	8
16.6	10	11.39	10
12.3	12	12.00	12
11.2	14	12.04	14
10.2	16	12.30	16
9.2	18	12.76	18
8.6	20	12.87	20
8.1	24	13.04	24
7.3	28	13.59	28
6.6	32	13.08	32
6.4	36	13.92	36
6.1	40	13.70	40
6.2	44	13.34	44
5.6	48	12.20	48
	52		52

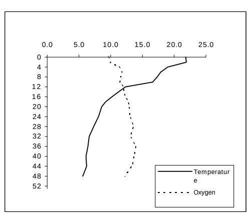


Figure 5q Site 2 July 10

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.3	0	9.57	0
19.2	2	9.81	2
18.4	4	10.25	4
18.2	6	10.38	6
17.9	8	10.41	8
16.5	10	10.25	10
12.2	12	10.34	12
10.9	14	10.75	14
10.2	16	10.89	16
9.5	18	11.15	18
8.3	20	11.67	20
7.6	24	12.45	24
7	28	12.84	28
6.7	32	13.34	32
6.3	36	13.37	36
6	40	13.46	40

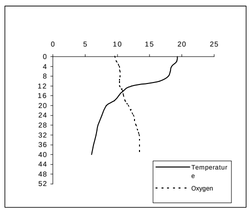


Figure 5r Site 3 July 10

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.7	0	9.91	0
20.6	2	9.31	2
20.2	4	9.52	4
19.5	6	9.75	6
18.9	8	9.75	8
16.4	10	9.76	10
14.7	12	9.80	12
11.9	14	9.98	14
10.3	16	10.52	16
8.7	18	10.81	18
8.1	20	11.11	20
7.4	24	11.47	24
7.0	28	11.57	28
6.9	32	11.46	32
6.8	36	11.39	36
6.7	40	10.04	40

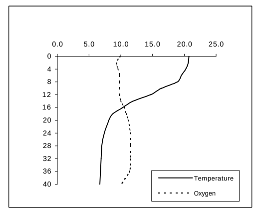


Figure 5s Site 2 July 17

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
22.7	0	9.58	0
22.2	2	10.05	2
21.6	4	10.29	4
21.1	6	10.71	6
18.7	8	10.87	8
16	10	10.73	10
13	12	10.21	12
11.2	14	10.90	14
9.2	16	11.60	16
8.5	18	12.00	18
8	20	12.30	20
7.5	24	12.80	24
7	28	13.12	28
6.6	32	13.47	32
6.4	36	13.47	36
6.2	40	13.24	40
6	44	12.60	44
5.8	48	12.54	48

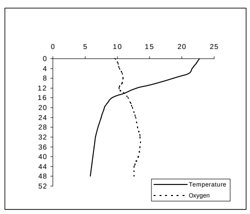


Figure 5t Site 2 July 23

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
22.3	0	8.25	0
22.1	2	8.32	2
22.0	4	8.39	4
21.8	6	8.22	6
19.9	8	8.32	8
17.0	10	8.35	10
13.6	12	8.20	12
11.9	14	8.05	14
10.2	16	8.60	16
9.3	18	8.86	18
8.7	20	9.25	20
7.8	24	9.90	24
7.2	28	10.28	28
6.8	32	10.35	32
6.4	36	10.59	36
6.2	40	10.30	40
6.0	44	10.13	44
5.9	48	9.20	48
5.7	52	7.14	52

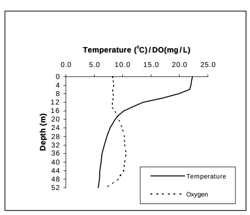


Figure 5u Site 3 July 23

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
22.7	0	8.14	0
22.5	2	7.90	2
22.4	4	7.69	4
22.2	6	7.90	6
16.8	8	8.26	8
14.8	10	8.32	10
12.2	12	8.50	12
10.0	14	9.11	14
9.3	16	9.10	16
8.6	18	9.25	18
8.1	20	9.33	20
7.7	24	9.61	24
7.4	28	9.55	28
7.3	32	9.56	32
7.2	36	8.40	36
7.2	40	2.56	40

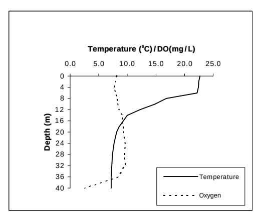


Figure 5v Site 2 August 9

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.2	0	9.43	0
20.1	2	9.29	2
19.9	4	9.34	4
19.8	6	9.38	6
19.5	8	9.44	8
19.3	10	9.40	10
17.4	12	8.64	12
11.5	14	8.55	14
10.0	16	8.94	16
8.9	18	9.47	18
8.6	20	9.93	20
7.8	24	10.33	24
7.3	28	10.64	28
6.9	32	10.55	32
6.3	36	10.98	36
6.1	40	10.80	40
5.9	44	9.51	44
5.8	48	8.30	48
5.7	52	7.49	52

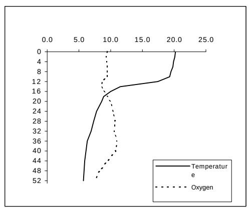


Figure 5w Site 3 August 9

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.6	0	8.77	0
20.6	2	8.98	2
20.3	4	9.11	4
19.8	6	9.24	6
19.7	8	9.20	8
19.5	10	9.16	10
15.3	12	8.81	12
12.7	14	8.98	14
11.0	16	9.16	16
9.4	18	8.47	18
8.4	20	9.69	20
7.8	24	9.74	24
7.4	28	9.74	28
7.3	32	9.64	32
7.3	36	9.46	36
	40		40

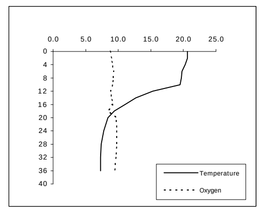


Figure 5x Site 2 August 18

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.6	0	8.57	0
20.0	2	8.96	2
19.7	4	9.27	4
19.7	6	9.36	6
19.6	8	9.45	8
19.5	10	9.54	10
18.2	12	9.23	12
11.3	14	9.34	14
10.5	16	9.66	16
10.0	18	9.60	18
9.1	20	9.91	20
8.2	24	10.62	24
7.6	28	11.00	28
7.1	32	11.21	32
6.8	36	11.29	36
6.5	40	11.21	40
6.2	44	11.21	44
5.9	48	9.72	48
5.9	52	9.34	52

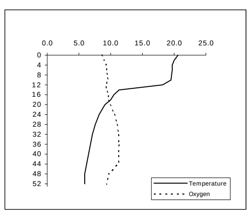


Figure 5y Site 3 August 18

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.8	0	8.31	0
20.7	2	8.39	2
20.5	4	8.77	4
20.4	6	9.08	6
20.3	8	9.17	8
19.7	10	9.41	10
16.3	12	9.27	12
9.5	14	10.34	14
9.4	16	10.39	16
8.3	18	10.45	18
8.1	20	9.83	20
7.9	24	9.98	24
7.7	28	10.14	28
7.5	32	10.21	32
7.4	36	10.18	36
	40		40

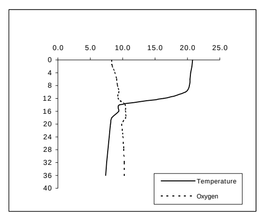


Figure 5z Site 2 August 21

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.9	0	8.55	0
19.8	2	8.80	2
19.8	4	9.09	4
19.7	6	9.21	6
19.6	8	9.37	8
19.6	10	9.28	10
16.8	12	8.79	12
11.1	14	9.28	14
9.9	16	9.35	16
8.9	18	9.66	18
8.5	20	9.81	20
7.8	24	10.20	24
7.3	28	10.27	28
6.9	32	10.40	32
6.5	36	10.24	36
6.2	40	9.86	40
6.0	44	8.91	44
6.0	48	7.96	48

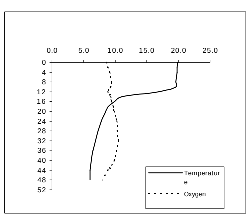


Figure 5aa Site 3 August 21

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.6	0	8.37	0
20.6	2	8.35	2
20.5	4	8.51	4
20.4	6	8.60	6
20.4	8	8.72	8
20.3	10	8.75	10
18.5	12	8.49	12
12.6	14	8.46	14
10.9	16	8.52	16
10.4	18	8.55	18
9.5	20	8.84	20
8.3	24	9.11	24
7.8	28	9.13	28
7.6	32	9.10	32
7.5	36	8.98	36
7.3	40	8.61	40

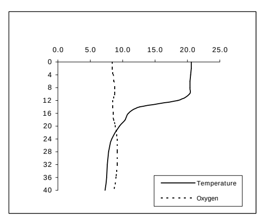


Figure 5bb Site 2 August 30

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
22.5	0	8.19	0
22.6	2	8.22	2
22.6	4	8.35	4
22.3	6	8.48	6
20.9	8	8.51	8
20.0	10	8.38	10
19.4	12	8.12	12
13.4	14	7.56	14
10.0	16	7.92	16
9.2	18	8.12	18
8.6	20	8.21	20
8.1	24	8.26	24
	28		28
	32		32
	36		36
	40		40
	44		44
	48		48

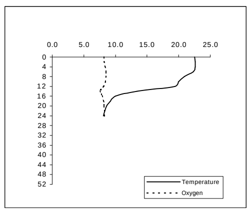


Figure 5cc Site 3 August 30

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.9	0	8.23	0
22.0	2	8.31	2
21.8	4	8.40	4
20.9	6	8.37	6
20.1	8	8.20	8
19.6	10	7.98	10
18.6	12	7.60	12
13.1	14	7.43	14
10.3	16	7.64	16
9.6	18	7.77	18
8.3	20	8.12	20
8.2	24	8.36	24
	28		28
	32		32
	36		36
	40		40

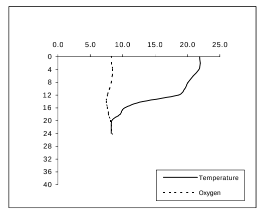


Figure 5dd Site 2 September 3

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
20.7	0	9.08	0
20.6	2	9.20	2
20.6	4	9.22	4
20.6	6	9.34	6
20.5	8	9.39	8
20.5	10	9.21	10
16.2	12	9.30	12
	14		14
	16		16
	18		18
	20		20
	24		24
	28		28
	32		32
	36		36
	40		40
	44		44
	48		48

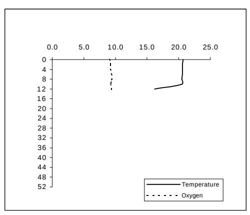


Figure 5ee Site 3 September 3

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
20.9	0	9.01	0
20.8	2	9.28	2
20.7	4	9.55	4
20.7	6	9.64	6
20.6	8	9.71	8
20.5	10	9.55	10
19.5	12	9.97	12
17.9	14	8.81	14
	16		16
	18		18
	20		20
	24		24
	28		28
	32		32
	36		36
	40		40

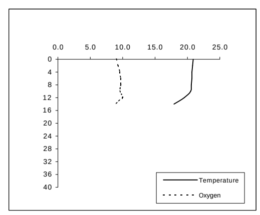


Figure 5ff Site 2 September 5

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
19.7	0	7.56	0
19.7	2	7.68	2
19.7	4	7.93	4
19.7	6	8.11	6
19.7	8	8.28	8
19.6	10	8.11	10
17.9	12	7.69	12
15.2	14	7.34	14
11.6	16	7.44	16
9.9	18	7.63	18
9.1	20	7.91	20
8.1	24	8.45	24
7.5	28	8.98	28
7.1	32	9.25	32
6.6	36	9.24	36
6.3	40	8.94	40
6.0	44	8.05	44

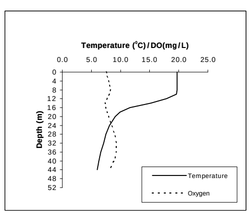


Figure 5gg Site 3 September 5

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
19.6	0	7.88	0
19.7	2	7.56	2
19.8	4	7.68	4
19.8	6	8.00	6
19.8	8	8.07	8
19.8	10	8.01	10
10.8	12	7.87	12
9.3	14	7.85	14
8.5	16	8.06	16
8.2	18	7.95	18
8.0	20	7.97	20
7.7	24	7.95	24
7.5	28	7.87	28
7.5	32	7.81	32
7.3	36	7.72	36
	40		40

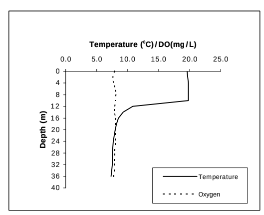


Figure 5hh Site 2 September 12

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.6	0	7.45	0
19.3	2	7.98	2
19.3	4	8.05	4
19.2	6	8.01	6
19.1	8	8.07	8
19.0	10	8.19	10
18.9	12	8.06	12
13.3	14	7.87	14
10.5	16	7.54	16
9.5	18	7.58	18
8.8	20	7.81	20
8.0	24	8.22	24
7.6	28	8.40	28
7.1	32	8.88	32
6.7	36	9.18	36
6.1	40	7.83	40
5.9	44	6.90	44
6.1	48	3.89	48

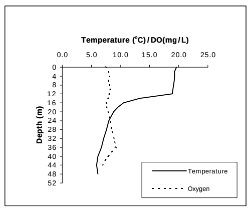


Figure 5ii Site 2 September 22

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
16.7	0	9.41	0
17.5	2	8.61	2
17.5	4	8.98	4
17.5	6	9.25	6
17.5	8	9.43	8
17.5	10	9.31	10
17.3	12	9.31	12
12.4	14	8.96	14
10.5	16	8.51	16
10.6	18	8.07	18
9.9	20	7.83	20
9.1	24	7.69	24
8.3	28	7.88	28
7.8	32	8.09	32
7.3	36	8.42	36
7.0	40	8.40	40
6.8	44	7.73	44
6.7	48	7.53	48
6.4	52	7.42	52

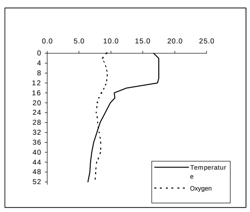


Figure 5jj Site 3 September 22

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
17.7	0	7.84	0
17.7	2	8.10	2
17.7	4	8.59	4
17.7	6	9.04	6
17.6	8	9.42	8
17.6	10	9.16	10
17.5	12	9.07	12
17.5	14	9.08	14
17.4	16	8.81	16
14.2	18	8.53	18
11.1	20	8.12	20
8.6	24	7.86	24
8.1	28	7.68	28
7.8	32	7.40	32
7.6	36	7.21	36
	40		40

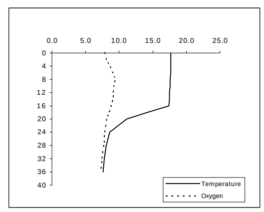


Figure 5kk Site 2 September 27

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
16.7	0	9.25	0
16.7	2	9.31	2
16.7	4	9.43	4
16.7	6	9.50	6
16.7	8	9.52	8
16.7	10	9.28	10
16.7	12	9.38	12
15.1	14	9.16	14
11.9	16	8.92	16
10.2	18	8.35	18
9.5	20	8.32	20
8.0	24	9.14	24
7.4	28	9.69	28
6.9	32	9.96	32
6.5	36	9.68	36
6.3	40	9.66	40
6.2	44	8.92	44
6.1	48	8.25	48
	52		52

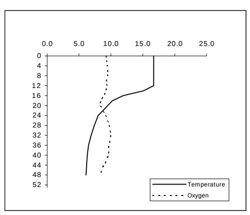


Figure 5ll Site 2 October 1

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
16.2	0	9.21	0
16.1	2	9.45	2
16.0	4	9.72	4
16.0	6	9.92	6
15.9	8	10.09	8
15.9	10	10.00	10
15.9	12	10.00	12
13.7	14	8.83	14
11.1	16	7.81	16
9.5	18	7.81	18
9.0	20	7.99	20
7.6	24	8.72	24
7.1	28	8.93	28
6.7	32	9.13	32
6.4	36	8.74	36
6.2	40	7.80	40
6.1	44	6.83	44
6.1	48	6.17	48
6.1	52	5.74	52

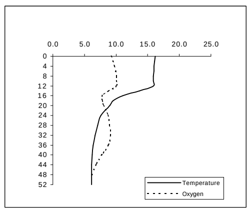


Figure 5mm Site 3 October 1

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
16.3	0	9.83	0
16.3	2	9.33	2
16.2	4	9.43	4
16.1	6	9.48	6
16.1	8	9.45	8
16.1	10	9.47	10
16.0	12	9.43	12
16.0	14	9.43	14
16.0	16	9.37	16
14.8	18	8.85	18
9.9	20	7.98	20
9.2	24	7.61	24
8.3	28	7.64	28
7.8	32	7.64	32
7.6	36	7.46	36
	40		40

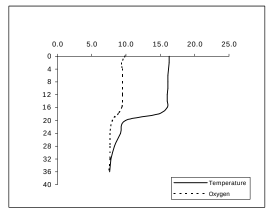


Figure 5nn Site 2 October 3

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
15.7	0	8.96	0
15.7	2	9.02	2
15.7	4	8.96	4
15.7	6	9.05	6
15.6	8	9.22	8
15.6	10	9.33	10
15.5	12	9.42	12
15.5	14	9.39	14
10.2	16	7.65	16
9.3	18	7.73	18
8.6	20	7.92	20
8.1	24	8.17	24
7.5	28	8.26	28
7.2	32	8.31	32
6.8	36	8.43	36
6.6	40	8.05	40
6.4	44	7.63	44
6.1	48	7.16	48

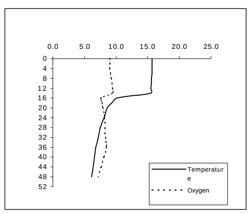


Figure 5oo Site 3 October 3

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
15.7	0	9.13	0
15.7	2	9.23	2
15.8	4	9.22	4
15.7	6	9.05	6
15.7	8	9.14	8
15.7	10	9.16	10
15.6	12	8.95	12
15.2	14	8.72	14
13.1	16	7.74	16
11.8	18	7.16	18
10.1	20	7.05	20
8.4	24	7.12	24
7.9	28	6.93	28
7.6	32	8.86	32
7.5	36	6.72	36
	40		40

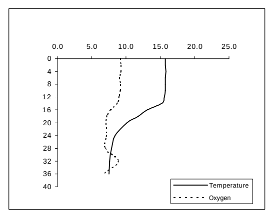


Figure 5pp Site 2 October 17

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
13.5	0	9.40	0
13.5	2	9.70	2
13.4	4	9.76	4
13.4	6	10.22	6
13.3	8	10.25	8
13.3	10	10.39	10
13.3	12	10.37	12
13.2	14	10.50	14
12.2	16	8.35	16
11.3	18	8.02	18
9.8	20	7.85	20
8.8	24	8.17	24
8.1	28	8.28	28
7.5	32	8.61	32
6.9	36	8.87	36
6.7	40	8.32	40
6.4	44	7.72	44
6.2	48	6.76	48
6.1	52	5.60	52

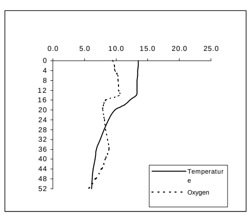


Figure 5qq Site 3 October 17

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
13.0	0	11.75	0
13.5	2	10.44	2
13.5	4	10.21	4
13.5	6	10.52	6
13.5	8	10.60	8
13.5	10	10.46	10
13.5	12	10.54	12
13.5	14	10.61	14
13.4	16	10.59	16
10.2	18	8.52	18
9.2	20	7.84	20
8.3	24	7.80	24
8.1	28	7.58	28
7.9	32	7.43	32
	36		36

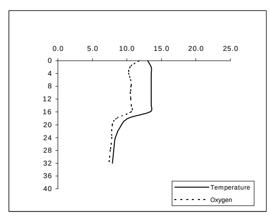


Figure 5rr Site 2 October 31

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
10.5	0	18.16	0
10.5	2	18.24	2
10.5	4	18.39	4
10.5	6	18.14	6
10.5	8	18.07	8
10.5	10	17.92	10
10.5	12	17.84	12
10.5	14	17.85	14
10.5	17	17.81	17
10.5	19	17.73	19
9.8	21	16.02	21
8.7	25	13.84	25
8.1	29	13.33	29

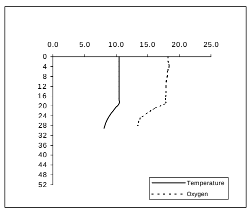


Figure 5ss Site 3 October 31

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
10.6	0	18.55	0
10.6	2	18.77	2
10.6	4	18.95	4
10.6	6	18.74	6
10.6	8	18.57	8
10.6	10	18.57	10
10.6	12	18.54	12
10.6	14	18.49	14
13.4	17	18.34	17
10.2	19	18.29	19
9.2	21	18.23	21
8.3	25	16.34	25
8.1	29	13.69	29

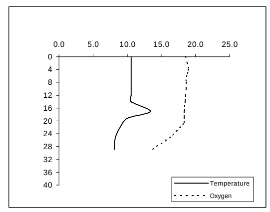


Figure 5tt Site 2 November 12

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
8.8	0	10.56	0
8.8	2	9.99	2
8.8	4	9.52	4
8.8	6	9.45	6
8.8	8	9.38	8
8.8	10	9.29	10
8.8	12	9.27	12
8.9	14	9.22	14
8.8	16	9.12	16
8.8	18	9.13	18
8.8	20	9.14	20
8.8	24	9.11	24
8.8	28	9.12	28
	32		32
	36		36
	40		40

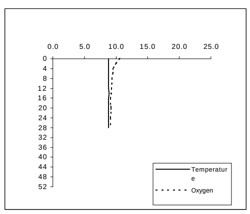


Figure 5uu Site 3 November 12

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
8.6	0	10.29	0
8.6	2	8.79	2
8.6	4	8.65	4
8.6	6	8.60	6
8.6	8	8.49	8
8.5	10	8.47	10
8.5	12	8.43	12
8.5	14	8.34	14
8.5	16	7.92	16
8.5	18	7.94	18
8.4	20	7.97	20
7.9	24	6.91	24
7.7	28	5.84	28
7.5	32	5.36	32
7.4	36	5.15	36
7.3	40	4.44	40

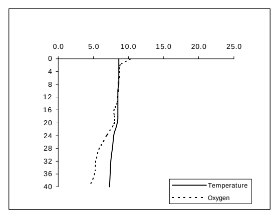


Figure 5vv Site 2 November 27

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
7.4	0	15.33	0
7.5	2	15.08	2
7.5	4	14.93	4
7.5	6	14.86	6
7.6	8	14.85	8
7.6	10	14.76	10
7.6	12	14.70	12
7.6	14	14.69	14
7.6	16	14.68	16
7.6	18	14.66	18
7.6	20	14.59	20
7.6	24	14.57	24
7.6	28	14.45	28
	32		32
	36		36
	40		40

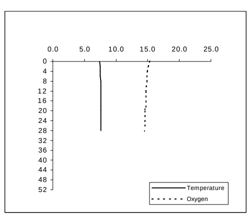


Figure 5ww Site 3 November 27

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
7.6	0	14.65	0
7.6	2	14.67	2
7.6	4	14.65	4
7.6	6	14.60	6
7.6	8	14.63	8
7.6	10	14.62	10
7.6	12	14.64	12
7.6	14	14.51	14
7.6	16	14.64	16
7.6	18	14.60	18
7.6	20	14.53	20
7.6	24	14.50	24
7.6	28	14.43	28
	32		32
	36		36
	40		40

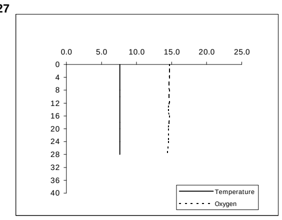


Figure 6: Temperature/Oxygen Profiles for Osoyoos Lake for 2002

Figure 6a Site 1 April 10

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
7.1	0	11.70	0
6.5	2	11.80	2
5.8	4	12.20	4
5.5	6	12.60	6
5.3	8	13.10	8
5.2	10	13.50	10
5.1	12	13.40	12
5.1	14	13.20	14
4.9	16	13.50	16
4.8	18	13.50	18
4.8	20	13.50	20
4.7	24	13.50	24
4.6	28	13.50	28
	32		32
	36		36
	40		40

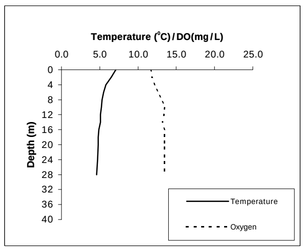


Figure 6b Site 2 April 10

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
5.7	0	13.50	0
5.4	2	12.70	2
5.2	4	13.70	4
5.1	6	14.00	6
4.9	8	13.80	8
4.8	10	13.90	10
4.6	12	14.10	12
4.5	14	13.90	14
4.4	16	14.10	16
4.4	18	14.00	18
4.4	20	14.00	20
4.3	24	13.70	24
4.2	28	13.90	28
	32		32
	36		36
	40		40

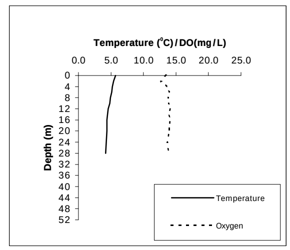


Figure 6c Site 1 April 24

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
8.0	0	11.25	0
7.9	2	12.28	2
7.9	4	12.84	4
7.9	6	13.01	6
7.9	8	13.08	8
7.8	10	13.35	10
7.7	12	13.15	12
7.4	14	13.44	14
7.4	16	12.87	16
7.3	18	12.64	18
7.0	20	12.99	20
6.5	24	12.99	24
6.4	28	12.97	28
	32		32
	36		36
	40		40

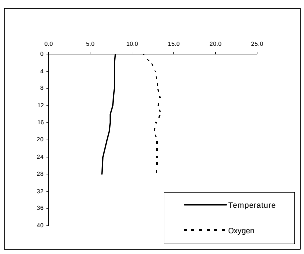


Figure 6d Site 2 April 24

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
8.2	0	10.78	0
8.0	2	11.36	2
7.9	4	11.69	4
7.9	6	11.97	6
7.9	8	12.20	8
7.9	10	12.21	10
8.1	12	11.98	12
7.7	14	12.23	14
7.4	16	12.11	16
7.3	18	12.21	18
7.3	20	12.13	20
7.3	24	12.16	24
7.3	28	11.97	28
	32		32
	36		36
	40		40

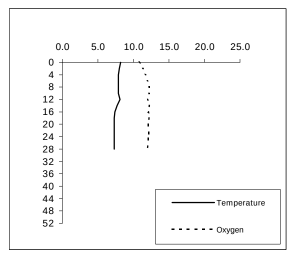


Figure 6e Site 1 May 8

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
9.8	0	7.99	0
9.3	2	6.82	2
9.2	4	7.40	4
9.1	6	8.66	6
9.1	8	8.89	8
9.1	10	9.40	10
9.0	12	10.07	12
8.5	14	9.95	14
7.6	16	9.85	16
6.8	18	10.07	18
6.6	20	10.00	20
6.2	24	8.22	24
6.4	28	2.72	28
6.4	32	2.61	32
	36		36
	40		40

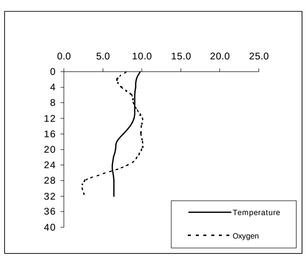


Figure 6f Site 2 May 8

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
10.8	0	12.7	0
9.9	2	12.7	2
9.7	4	12.8	4
9.6	6	12.2	6
9.6	8	12.0	8
9.5	10	11.7	10
9.1	12	11.8	12
8.1	14	11.8	14
7.0	16	11.9	16
6.7	18	11.7	18
6.5	20	11.3	20
6.4	24	10.4	24
6.3	28	10.7	28
6.3	32	10.2	32
6.2	36	10.1	36
6.1	40	9.6	40

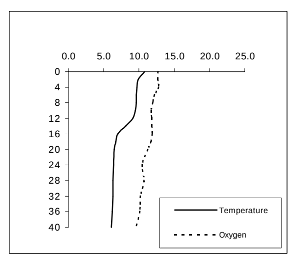


Figure 6g Site 1 May 22

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
13.4	0	9.60	0
13.0	2	11.32	2
12.6	4	12.15	4
12.5	6	12.34	6
12.1	8	12.50	8
11.8	10	12.39	10
11.5	12	12.33	12
10.9	14	13.57	14
10.5	16	13.80	16
10.0	18	12.88	18
9.2	20	13.91	20
8.2	24	14.82	24
7.6	28	14.97	28
7.4	32	14.78	32
7.3	36	14.45	36
7.2	40	11.63	40

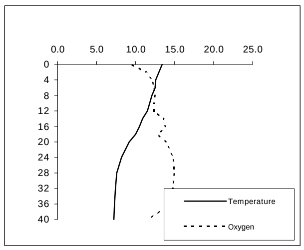


Figure 6h Site 2 May 22

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
13.4	0	14.05	0
13.4	2	12.00	2
13.4	4	13.17	4
13.3	6	12.89	6
13.3	8	12.90	8
13.2	10	12.84	10
13.2	12	12.76	12
13.0	14	12.70	14
12.6	16	12.71	16
12.5	18	12.65	18
12.3	20	12.65	20
11.5	24	12.76	24
9.5	28	13.21	28
9.0	32	13.32	32
8.7	36	13.25	36
8.3	40	13.23	40
8.2	44	13.10	44
8.2	48	12.87	48
7.9	52	12.69	52

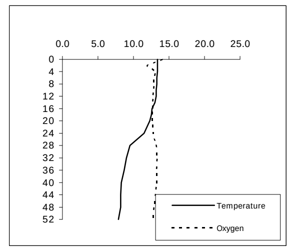


Figure 6i Site 1 June 6

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
12.6	0	10.40	0
12.7	2	12.80	2
13.2	4	13.40	4
13.9	6	12.10	6
14.4	8	11.80	8
14.5	10	11.37	10
14.3	12	11.96	12
13.8	14	11.31	14
13.4	16	11.52	16
12.9	18	12.21	18
12.0	20	11.80	20
11.3	24	12.05	24
10.4	28	12.46	28
9.7	32	12.98	32
9.0	36	13.39	36
9.1	40	17.38	40
	44		44

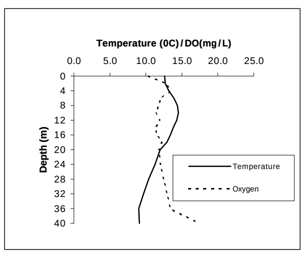


Figure 6j Site 2 June 6

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
12.1	0	11.81	0
13.1	2	14.80	2
13.6	4	15.30	4
14.0	6	14.51	6
14.6	8	15.18	8
14.9	10	14.39	10
15.1	12	14.89	12
15.2	14	14.95	14
15.2	16	14.74	16
15.3	18	14.94	18
15.2	20	13.53	20
14.7	24	14.53	24
13.1	28	13.59	28
12.4	32	13.63	32
11.3	36	14.69	36
10.4	40	14.27	40
9.4	44	16.56	44
8.7	48	15.93	48
8.3	52	15.67	52

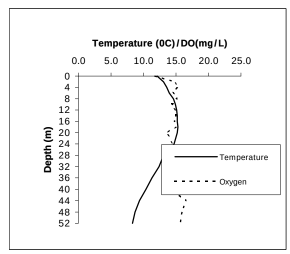


Figure 6k Site 1 June 10

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
15.8	0	10.93	0
14.7	2	9.99	2
14.3	4	10.25	4
14.4	6	10.57	6
14.4	8	10.34	8
14.3	10	10.42	10
14.3	12	10.32	12
14.2	14	10.71	14
13.9	16	10.61	16
13.5	18	10.41	18
12.4	20	10.44	20
8.6	24	11.25	24
8.0	28	11.48	28
7.6	32	11.64	32
7.7	36	11.56	36
7.6	40	11.35	40
7.5	44	10.34	44

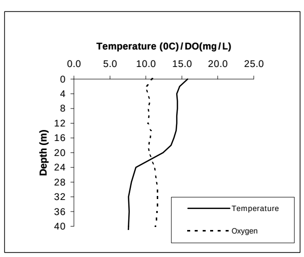


Figure 6l Site 2 June 10

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
16.3	0	10.43	0
14.9	2	10.56	2
14.6	4	11.04	4
14.4	6	11.10	6
14.3	8	11.08	8
14.2	10	10.96	10
14.1	12	10.96	12
14.0	14	10.96	14
13.9	16	10.87	16
13.9	18	10.81	18
13.8	20	10.62	20
13.6	24	10.48	24
13.6	28	10.42	28
12.3	32	10.58	32
9.3	36	10.84	36
8.0	40	11.10	40
7.8	44	11.29	44
7.6	48	11.77	48
7.4	52	11.87	52

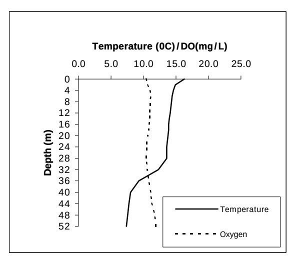


Figure 6m Site 1 June 18

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.2	0	9.16	0
16.9	2	9.04	2
16.6	4	9.43	4
16.4	6	9.50	6
15.0	8	9.51	8
14.9	10	9.41	10
13.3	12	9.49	12
12.1	14	9.61	14
9.7	16	9.98	16
10.7	18	9.55	18
9.3	20	9.98	20
8.3	24	10.34	24
7.9	28	10.38	28
7.7	32	10.42	32
7.7	36	10.35	36
7.5	40	10.56	40
7.4	44	10.53	44

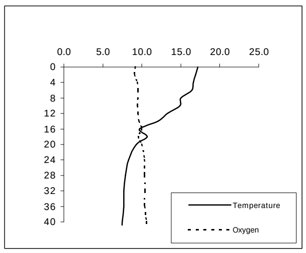


Figure 6n Site 2 June 18

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.5	0	9.77	0
17.5	2	9.93	2
17.5	4	10.24	4
17.5	6	10.61	6
17.4	8	10.30	8
13.2	10	10.30	10
13.1	12	10.27	12
17.7	14	10.41	14
11.6	16	10.61	16
10.4	18	10.99	18
8.2	20	11.20	20
7.8	24	11.72	24
7.7	28	11.20	28
7.5	32	11.18	32
7.4	36	11.39	36
7.4	40	11.08	40
7.4	44	11.17	44
7.3	48	10.66	48
7.3	52	10.72	52

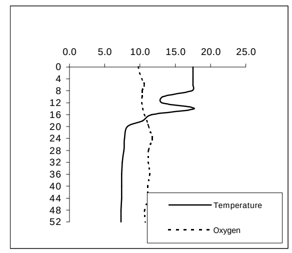


Figure 6o Site 2 June 25

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
22.7	0	6.51	0
20.3	2	7.14	2
19.8	4	8.31	4
19.4	6	8.23	6
17.6	8	8.19	8
15.9	10	8.28	10
14.6	12	7.77	12
12.2	14	8.39	14
11.1	16	8.10	16
9.7	18	8.25	18
8.5	20	8.70	20
7.9	24	8.96	24
7.7	28	8.90	28
7.5	32	8.73	32
7.5	36	8.53	36
7.5	40	8.42	40
7.4	44	8.18	44
7.4	48	8.01	48
7.4	52	7.86	52

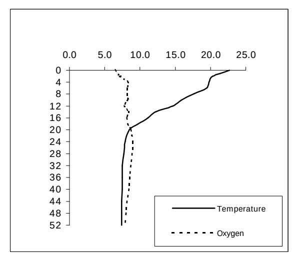


Figure 6p Site 1 July 9

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.9	0	8.76	0
21.3	2	9.41	2
19.6	4	9.89	4
18.9	6	10.21	6
18.4	8	10.13	8
18.0	10	9.71	10
14.8	12	9.32	12
12.2	14	9.01	14
9.7	16	9.28	16
8.5	18	9.49	18
8.1	20	9.68	20
7.8	24	9.73	24
7.7	28	9.45	28
7.7	32	9.04	32
7.6	36	8.05	36
7.5	40	6.04	40
7.5	44	1.47	44

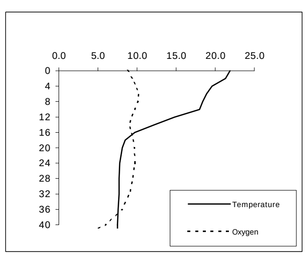


Figure 6q Site 2 July 9

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.0	0	8.56	0
20.3	2	8.55	2
19.3	4	9.07	4
18.8	6	9.23	6
18.4	8	9.20	8
17.8	10	9.07	10
14.8	12	9.06	12
13.1	14	8.25	14
9.8	16	9.13	16
8.9	18	9.43	18
8.5	20	9.70	20
8.0	24	9.83	24
7.8	28	9.95	28
7.8	32	9.81	32
7.7	36	9.66	36
7.7	40	9.45	40

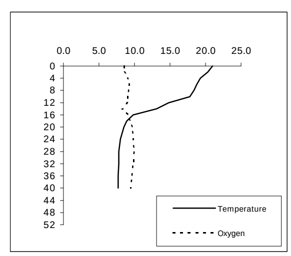


Figure 6r Site 2 July 15

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
22.0	0	8.95	0
21.3	2	9.08	2
21.1	4	9.11	4
20.9	6	9.16	6
20.5	8	9.19	8
19.3	10	9.25	10
16.8	12	7.78	12
14.7	14	7.44	14
12.9	16	7.62	16
10.9	18	8.04	18
9.7	20	8.41	20
8.2	24	8.68	24
7.9	28	8.83	28
7.8	32	8.73	32
7.7	36	8.66	36
7.7	40	8.61	40
7.7	44	8.91	44
7.7	48	8.88	48

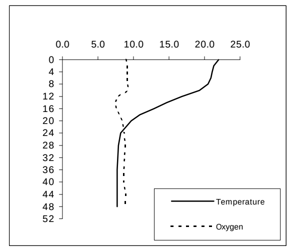


Figure 6s Site 1 July 22

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
23.2	0	8.34	0
22.2	2	8.44	2
21.6	4	8.60	4
21.4	6	8.65	6
20.8	8	8.35	8
19.4	10	7.91	10
14.7	12	6.66	12
12.1	14	6.73	14
10.0	16	7.39	16
8.7	18	7.75	18
8.5	20	7.72	20
8.2	24	7.63	24
8.0	28	7.61	28
7.8	32	7.23	32
7.8	36	6.20	36
7.9	40	5.08	40

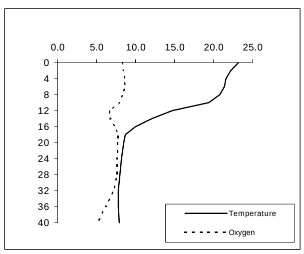


Figure 6t Site 2 July 22

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
23.5	0	8.34	0
21.8	2	8.24	2
21.7	4	8.45	4
21.7	6	8.45	6
21.3	8	8.47	8
19.1	10	7.75	10
15.4	12	7.03	12
12.8	14	7.01	14
10.0	16	7.67	16
9.2	18	7.79	18
8.6	20	7.86	20
8.2	24	7.91	24
8.0	28	7.75	28
8.0	32	7.54	32
7.9	36	7.55	36
7.9	40	7.48	40
7.9	44	7.31	44
7.8	48	7.34	48
7.8	52	7.29	52

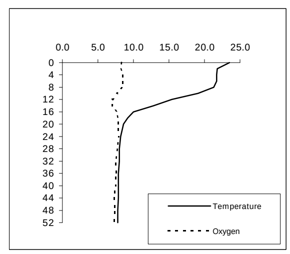


Figure 6u Site 1 August 7

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.7	0	8.35	0
19.6	2	8.11	2
19.6	4	8.13	4
19.6	6	8.10	6
19.2	8	7.77	8
18.8	10	7.14	10
17.4	12	6.12	12
10.9	14	5.71	14
9.5	16	6.18	16
8.6	18	6.41	18
8.5	20	6.54	20
8.2	24	6.53	24
8.1	28	6.41	28
8.0	32	6.18	32
7.9	36	4.60	36
	40		40

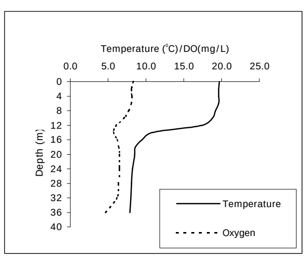


Figure 6v Site 2 August 7

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.8	0	8.52	0
19.6	2	8.32	2
19.6	4	8.36	4
19.5	6	8.30	6
19.5	8	8.35	8
19.4	10	8.31	10
15.8	12	5.84	12
13.0	14	5.78	14
10.0	16	6.31	16
9.0	18	6.51	18
8.8	20	6.49	20
8.5	24	6.26	24
8.3	28	6.23	28
8.2	32	6.22	32
8.1	36	6.30	36
8.1	40	6.14	40
8.0	44	6.08	44
8.0	48	6.07	48
8.0	52	6.04	52

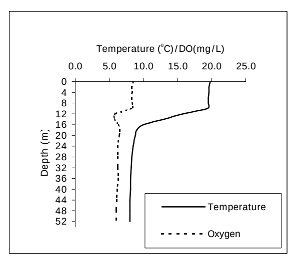


Figure 6w Site 1 August 8

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
21.4	0	9.29	0
21.2	2	9.31	2
20.1	4	9.41	4
19.7	6	9.63	6
19.5	8	9.30	8
19.2	10	8.57	10
18.4	12	7.87	12
11.5	14	6.82	14
9.6	16	6.82	16
9.0	18	7.11	18
8.6	20	7.15	20
8.3	24	7.27	24
8.1	28	7.24	28
8.0	32	6.94	32
7.9	36	2.34	36
7.9	40	1.45	40

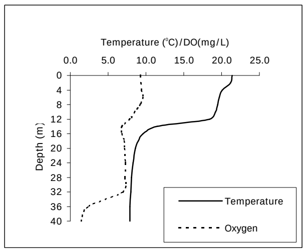


Figure 6x Site 2 August 8

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.4	0	9.44	0
20.4	2	9.32	2
20.0	4	9.57	4
19.8	6	9.65	6
19.6	8	9.37	8
19.5	10	8.95	10
18.8	12	8.35	12
14.1	14	6.01	14
11.0	16	6.57	16
9.7	18	6.74	18
9.1	20	6.85	20
8.4	24	6.84	24
8.2	28	6.69	28
8.2	32	6.61	32
8.1	36	6.51	36
8.1	40	6.47	40
8.1	44	6.43	44
8.0	48	6.40	48
8.0	52	6.22	52

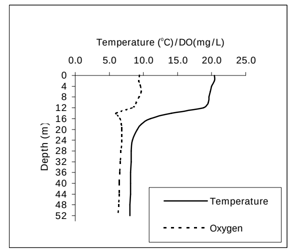


Figure 6y Site 1 August 17

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.8	0	9.00	0
19.5	2	9.08	2
19.3	4	9.03	4
19.3	6	8.98	6
19.3	8	8.60	8
19.2	10	8.69	10
19.0	12	8.35	12
17.0	14	7.68	14
12.5	16	6.58	16
9.0	18	6.18	18
9.0	20	6.42	20
8.6	24	6.45	24
8.5	28	6.49	28
8.3	32	7.02	32
8.1	36	3.39	36
	40		40

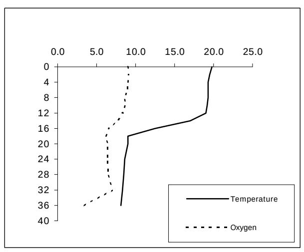


Figure 6z Site 2 August 17

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.9	0	9.31	0
20.3	2	9.50	2
19.8	4	9.47	4
19.6	6	9.57	6
19.5	8	9.47	8
19.5	10	9.65	10
19.3	12	9.52	12
17.8	14	9.05	14
12.3	16	8.29	16
9.0	18	9.30	18
9.0	20	7.18	20
8.7	24	7.08	24
8.5	28	6.92	28
8.4	32	6.83	32
8.4	36	6.80	36
8.3	40	6.71	40
8.3	44	6.61	44
8.3	48	6.50	48
8.2	52	6.37	52

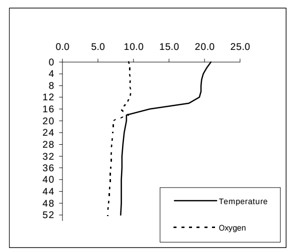


Figure 6aa Site 2 August 19

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
21.5	0	8.73	0
20.5	2	9.09	2
20.2	4	9.31	4
19.8	6	9.48	6
19.5	8	9.23	8
19.1	10	8.80	10
18.7	12	8.55	12
15.1	14	7.47	14
10.7	16	7.06	16
9.9	18	6.88	18
9.0	20	6.95	20
8.6	24	6.85	24
8.5	28	6.83	28
8.4	32	6.76	32
8.4	36	6.75	36
8.3	40	6.67	40
8.3	44	6.42	44
8.2	48	6.30	48
	52		52

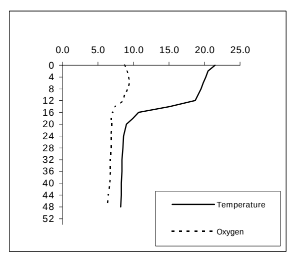


Figure 6bb Site 1 August 27

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
23.7	0	8.67	0
22.5	2	9.49	2
22.0	4	9.51	4
21.6	6	9.34	6
20.6	8	9.02	8
19.5	10	8.29	10
18.0	12	7.16	12
17.0	14	6.60	14
11.3	16	5.36	16
9.6	18	5.46	18
9.1	20	5.54	20
8.6	24	5.16	24
	28		28
	32		32
	36		36
	40		40

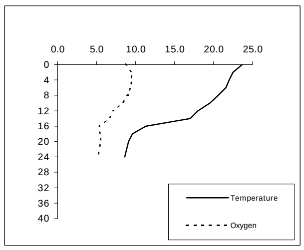


Figure 6cc Site 2 August 27

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
23.7	0	8.84	0
23.1	2	9.22	2
21.9	4	9.44	4
21.1	6	9.18	6
19.9	8	8.98	8
19.4	10	8.46	10
18.7	12	7.90	12
16.5	14	7.01	14
13.0	16	5.73	16
9.8	18	5.60	18
9.1	20	5.63	20
8.6	24	5.69	24
	28		28
	32		32
	36		36
	40		40
	44		44
	48		48
	52		52

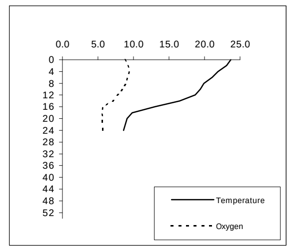


Figure 6dd Site 1 September 3

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.3	0	8.31	0
20.3	2	8.32	2
20.3	4	8.40	4
20.2	6	8.50	6
18.8	8	7.21	8
18.3	10	7.52	10
17.8	12	7.21	12
	14		14
	16		16
	18		18
	20		20
	24		24
	28		28
	32		32
	36		36
	40		40

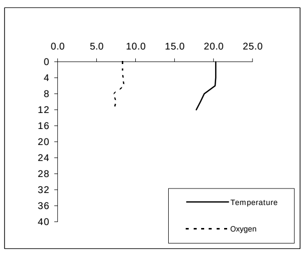


Figure 6ee Site 2 September 3

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
20.8	0	8.82	0
20.8	2	8.88	2
20.8	4	8.95	4
20.7	6	9.07	6
20.7	8	8.83	8
20.6	10	8.77	10
19.1	12	7.85	12
16.1	14	6.49	14
14.0	16	6.15	16
11.3	18	6.10	18
10.7	20	6.11	20
	24		24
	28		28
	32		32
	36		36
	40		40
	44		44
	48		48
	52		52

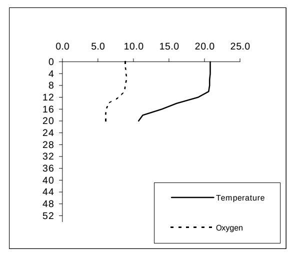


Figure 6ff Site 1 September 5

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.4	0	7.51	0
19.4	2	7.54	2
19.4	4	7.85	4
19.4	6	7.87	6
19.1	8	7.34	8
18.7	10	6.51	10
17.3	12	5.75	12
14.1	14	5.84	14
10.6	16	5.41	16
9.1	18	6.43	18
8.8	20	5.94	20
8.6	24	5.21	24
8.5	28	4.84	28
8.4	32	4.63	32
	36		36
	40		40

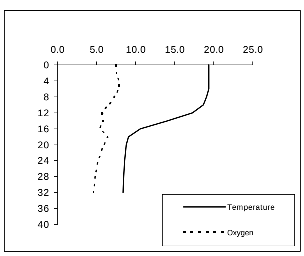


Figure 6gg Site 2 September 5

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
19.5	0	8.10	0
19.6	2	8.66	2
19.6	4	7.98	4
19.6	6	8.13	6
19.6	8	8.45	8
19.6	10	8.41	10
18.2	12	7.43	12
16.8	14	5.96	14
13.6	16	4.98	16
10.4	18	4.91	18
9.1	20	4.91	20
8.9	24	4.45	24
8.6	28	4.51	28
8.5	32	4.34	32
8.4	36	4.20	36
8.4	40	3.99	40
8.4	44	3.92	44
8.3	48	3.99	48
8.3	52	3.96	52

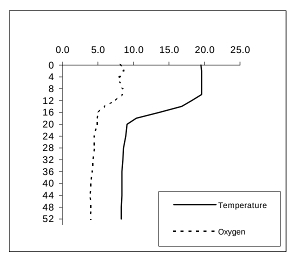


Figure 6hh Site 1 September 12

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.1	0	8.61	0
20.1	2	9.11	2
19.5	4	9.84	4
19.1	6	9.94	6
18.8	8	9.62	8
18.6	10	9.31	10
18.4	12	8.85	12
18.1	14	9.49	14
14.7	16	7.99	16
10.6	18	7.35	18
9.5	20	6.01	20
8.9	24	5.75	24
8.6	28	5.63	28
8.5	32	5.23	32
8.4	36	4.65	36
8.4	40	2.48	40
8.5	44	1.46	44

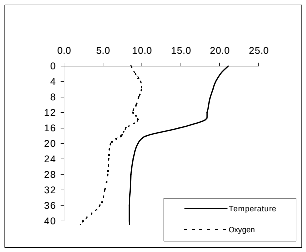


Figure 6ii Site 2 September 12

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
21.2	0	8.35	0
20.5	2	8.22	2
19.4	4	8.81	4
19.3	6	8.91	6
19.0	8	8.77	8
18.9	10	8.74	10
18.5	12	8.30	12
17.5	14	7.48	14
15.1	16	6.45	16
10.0	18	5.90	18
9.3	20	4.95	20
8.8	24	4.94	24
8.6	28	4.82	28
8.5	32	4.52	32
8.5	36	4.36	36
8.4	40	4.21	40
8.4	44	4.19	44
8.3	48	4.09	48
8.3	52	3.93	52

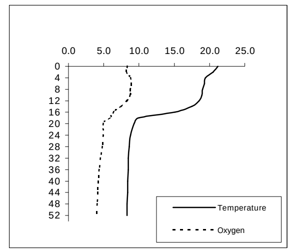


Figure 6jj Site 1 September 20

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.7	0	8.86	0
17.9	2	8.26	2
18.0	4	8.37	4
17.9	6	8.31	6
17.9	8	8.22	8
17.1	10	7.81	10
17.3	12	7.48	12
16.8	14	7.50	14
14.6	16	6.89	16
11.9	18	5.61	18
9.9	20	5.16	20
9.2	24	4.91	24
8.9	28	4.71	28
8.7	32	4.65	32
8.5	36	4.34	36
	40		40

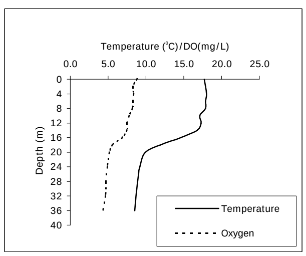


Figure 6kk Site 2 September 20

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
18.1	0	8.24	0
18.1	2	8.44	2
18.1	4	8.31	4
17.9	6	8.28	6
17.8	8	8.25	8
17.7	10	8.24	10
17.9	12	7.85	12
17.5	14	7.86	14
17.4	16	7.06	16
14.1	18	6.75	18
10.9	20	4.73	20
9.3	24	3.76	24
8.9	28	3.29	28
8.8	32	3.20	32
8.7	36	3.01	36
8.8	40	2.61	40
9.0	44	2.29	44
9.1	48	2.20	48
9.0	52	2.33	52

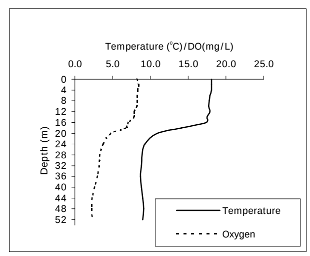


Figure 6ll Site 2 September 26

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
17.4	0	8.98	0
17.4	2	9.17	2
17.4	4	9.33	4
17.3	6	9.17	6
17.3	8	9.09	8
17.3	10	9.23	10
17.3	12	9.29	12
17.2	14	9.16	14
14.8	16	9.03	16
10.2	18	4.47	18
9.5	20	3.86	20
8.9	24	3.79	24
8.7	28	3.74	28
8.7	32	3.33	32
8.6	36	3.41	36
8.6	40	3.11	40
8.6	44	3.01	44
8.7	48	3.12	48
8.6	52		52

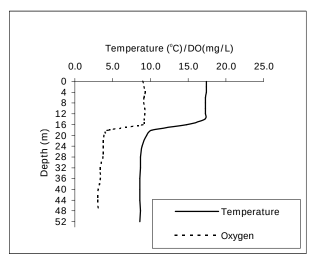


Figure 6mm Site 1 October 1

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
15.9	0	8.58	0
15.8	2	8.55	2
15.8	4	8.45	4
15.8	6	8.43	6
15.8	8	8.39	8
15.8	10	8.39	10
15.8	12	8.37	12
15.8	14	8.32	14
15.7	16	8.23	16
13.1	18	5.95	18
10.0	20	4.15	20
9.1	24	3.23	24
8.9	28	2.79	28
8.7	32	2.58	32
	36		36
	40		40

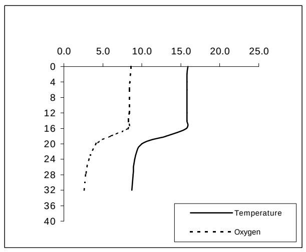


Figure 6nn Site 2 October 1

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
16.1	0	8.58	0
16.0	2	8.59	2
16.0	4	8.79	4
15.9	6	8.93	6
15.9	8	9.13	8
15.9	10	9.19	10
15.9	12	9.26	12
15.9	14	9.07	14
15.3	16	8.36	16
11.8	18	5.36	18
9.9	20	4.21	20
9.2	24	3.78	24
8.9	28	3.45	28
8.7	32	3.25	32
8.7	36	3.12	36
8.6	40	2.86	40
8.6	44	2.76	44
8.6	48	2.73	48
8.5	52	2.65	52

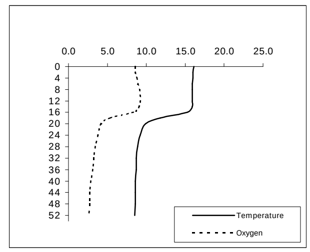


Figure 6oo Site 1 October 3

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
16.0	0	8.56	0
16.1	2	8.94	2
16.0	4	9.10	4
15.7	6	9.23	6
15.7	8	9.12	8
15.6	10	9.11	10
15.6	12	8.97	12
15.5	14	9.06	14
15.3	16	9.17	16
10.5	18	5.11	18
9.4	20	3.87	20
9.1	24	3.26	24
8.8	28	3.17	28
8.7	32	2.84	32
8.4	36	1.26	36
	40		40

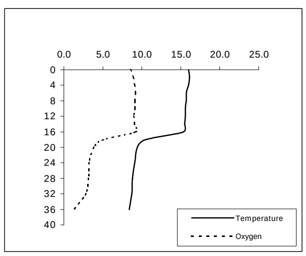


Figure 6pp Site 2 October 3

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
15.6	0	8.6	0
15.7	2	8.7	2
15.7	4	8.9	4
15.7	6	8.9	6
15.7	8	8.6	8
15.6	10	8.6	10
15.6	12	8.6	12
15.4	14	8.7	14
14.9	16	8.6	16
10.4	18	4.3	18
9.5	20	3.3	20
9.0	24	2.9	24
8.8	28	2.5	28
8.7	32	2.3	32
8.7	36	2.2	36
8.6	40	2.1	40
8.6	44	1.99	44
8.6	48	1.95	48
8.5	52	1.93	52

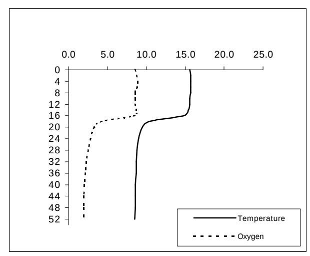


Figure 6qq Site 1 October 12

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
14.7	0	9.08	0
14.6	2	10.30	2
14.6	4	11.02	4
14.4	6	11.29	6
14.3	8	11.37	8
14.3	10	11.08	10
14.3	12	10.86	12
14.2	14	10.88	14
14.1	16	10.56	16
13.8	18	10.06	18
11.8	20	6.23	20
9.2	24	3.73	24
8.8	28	2.64	28
8.7	32	2.46	32
	36		36
	40		40

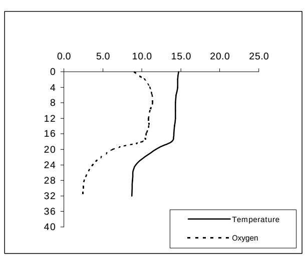


Figure 6rr Site 2 October 12

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
14.7	0	8.65	0
14.7	2	9.17	2
14.7	4	9.60	4
14.6	6	9.68	6
14.5	8	9.68	8
14.5	10	9.41	10
14.5	12	9.43	12
14.5	14	9.49	14
13.8	16	8.16	16
12.5	18	5.45	18
9.8	20	2.91	20
9.3	24	2.63	24
8.9	28	2.28	28
8.8	32	2.19	32
8.7	36	2.15	36
8.6	40	2.02	40
8.6	44	1.99	44
8.6	48	1.88	48
8.6	52	1.76	52

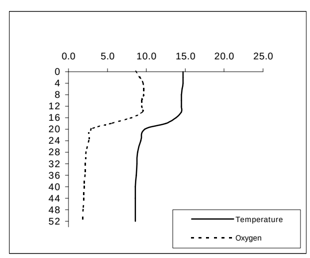


Figure 6ss Site 1 October 17

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
13.5	0	9.90	0
13.6	2	10.14	2
13.6	4	10.24	4
13.6	6	10.32	6
13.5	8	9.95	8
13.5	10	9.98	10
13.4	12	10.34	12
13.4	14	10.26	14
13.3	16	10.34	16
13.1	18	10.63	18
10.2	20	2.82	20
9.0	24	2.23	24
8.8	28	2.18	28
8.7	32	2.07	32
	36		36
	40		40

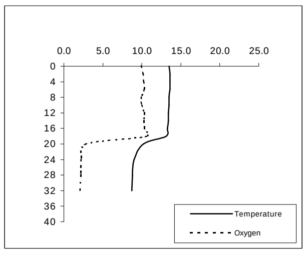


Figure 6tt Site 2 October 17

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
13.5	0	9.98	0
13.7	2	10.26	2
13.7	4	10.49	4
13.7	6	10.64	6
13.7	8	10.67	8
13.7	10	10.62	10
13.7	12	10.61	12
13.6	14	10.11	14
13.5	16	10.10	16
13.1	18	9.19	18
12.1	20	6.66	20
9.4	24	3.17	24
9.0	28	2.18	28
8.9	32	1.98	32
8.8	36	1.82	36
8.7	40	1.69	40
8.7	44	1.51	44
8.6	48	1.39	48
8.6	52	1.39	52

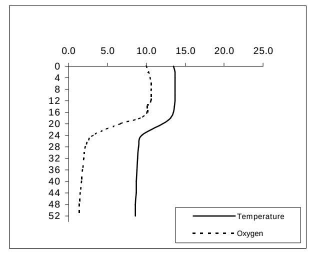


Figure 6uu Site 1 October 23

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
12.6	0	8.64	0
12.9	2	8.68	2
12.9	4	8.69	4
12.9	6	8.71	6
12.9	8	8.64	8
12.9	10	9.63	10
12.8	12	8.63	12
12.8	14	8.62	14
12.7	16	8.67	16
12.6	18	8.49	18
12.5	20	8.42	20
9.4	24	2.66	24
9.0	28	1.81	28
8.8	32	1.42	32
8.7	36	1.24	36
8.5	40	0.71	40
8.4	44	0.63	44

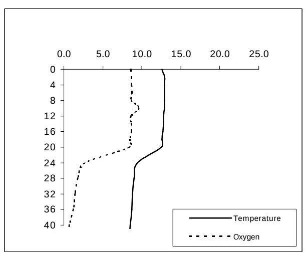


Figure 6vv Site 2 October 23

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
12.7	0	8.91	0
13.0	2	8.77	2
13.0	4	8.77	4
13.0	6	8.81	6
13.0	8	8.73	8
13.0	10	8.68	10
12.9	12	8.57	12
12.7	14	8.55	14
12.9	16	8.30	16
12.6	18	8.38	18
10.0	20	8.46	20
9.1	24	2.44	24
9.0	28	1.87	28
8.9	32	1.60	32
8.8	36	1.43	36
8.7	40	1.26	40
8.7	44	1.17	44
8.7	48	1.10	48
8.7	52	1.04	52

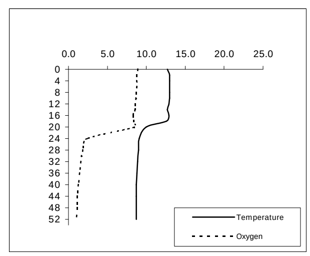


Figure 6ww Site 1 October 29

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
10.7	0	14.93	0
11.0	2	14.74	2
11.1	4	14.73	4
11.1	6	14.72	6
11.2	8	14.73	8
11.2	10	14.72	10
11.2	12	14.60	12
10.3	14	8.34	14
10.0	17	6.32	17
9.3	19	4.03	19
8.9	21	2.87	21
8.8	23	2.47	23
8.8	25	2.34	25
8.7	27	2.27	27
8.7	29	2.25	29

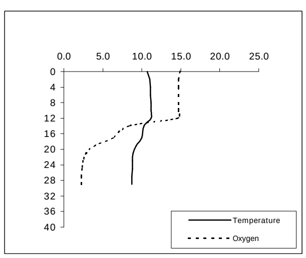


Figure 6xx Site 2 October 29

Temperature		Oxygen	
Temp	Depth	Oxygen	Depth
11.3	0	15.20	0
11.3	2	15.19	2
11.3	4	15.22	4
11.3	6	15.23	6
11.3	8	15.13	8
11.3	10	15.46	10
11.3	12	15.22	12
11.3	14	14.01	14
10.2	17	7.10	17
9.2	19	4.63	19
9.2	21	3.35	21
9.0	23	3.05	23
9.0	25	2.56	25
8.8	27	2.45	27
8.8	29	2.32	29

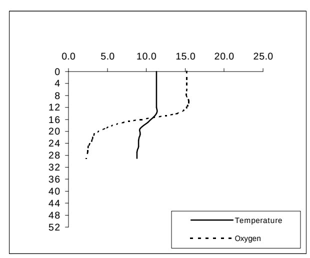


Figure 6yy Site 1 November 12

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
9.2	0	10.11	0
9.2	2	9.41	2
9.2	4	9.21	4
9.2	6	9.22	6
9.2	8	9.24	8
9.2	10	9.22	10
9.3	12	9.32	12
9.3	14	9.31	14
9.3	16	9.29	16
9.3	18	9.28	18
9.3	20	9.26	20
9.3	24	9.31	24
9.2	28	9.43	28
9.3	32	9.54	32
9.2	36	9.54	36
9.2	40	9.59	40

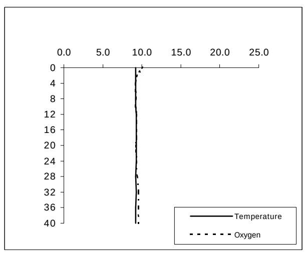


Figure 6zz Site 2 November 12

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
9.3	0	9.72	0
9.3	2	9.14	2
9.3	4	9.01	4
9.3	6	9.01	6
9.3	8	8.79	8
9.3	10	8.81	10
9.3	12	8.90	12
9.3	14	8.87	14
9.3	16	8.84	16
9.3	18	8.84	18
9.3	20	8.82	20
9.3	24	8.74	24
9.3	28	8.61	28
9.2	32	8.15	32
9.1	36	5.01	36
9.0	40	3.27	40
8.9	44	1.46	44
8.8	48	0.71	48
8.8	52	0.57	52

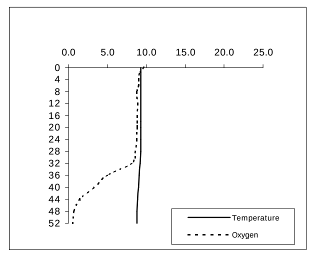


Figure 6aaa Site 1 November 25

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
7.9	0	10.69	0
8.1	2	9.78	2
8.1	4	9.76	4
8.1	6	9.62	6
8.1	8	9.60	8
8.1	10	9.56	10
8.1	12	9.53	12
8.1	14	9.49	14
8.1	16	9.49	16
8.1	18	9.49	18
8.1	20	9.47	20
8.1	24	9.46	24
8.1	28	9.54	28
8.0	32	9.61	32
7.8	36	9.62	36
	40		40

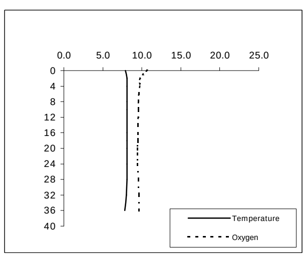


Figure 6bbb Site 2 November 25

Temperature		Oxygen	
Temp	Depth	Oxyger	Depth
7.4	0	7.53	0
8.1	2	7.16	2
8.2	4	7.09	4
8.3	6	6.99	6
8.3	8	6.95	8
8.3	10	6.92	10
8.3	12	6.89	12
8.3	14	6.91	14
8.3	16	6.90	16
8.3	18	6.90	18
8.3	20	6.88	20
8.3	24	6.87	24
8.3	28	6.70	28
8.3	32	6.70	32
8.3	36	6.78	36
8.3	40	6.82	40
8.3	44	6.81	44
8.3	48	6.81	48
8.3	52	6.81	52

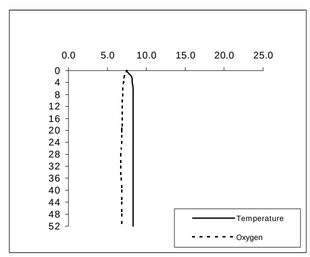


Figure 7: Zones of Tolerance for *Oncorhynchus nerka* in Skaha and Osoyoos Lakes

Figure 7a Skaha Lake Site 2 Gillies

Temp (17 ^{0}C)		DO (4 mg/L)	
Month	Depth	Month	Depth
J		J	
F		F	
M		M	
A 10	0	A 10	53
A 25	0	A 25	53
M 8	0	M 8	53
M 23	0	M 23	53
M 28	0	M 28	53
Jn 7	0	Jn 7	53
Jn 11	0	Jn 11	53
Jn 19	0	Jn 19	53
Jn 27	10	Jn 27	53
Jl 10	10	Jl 10	53
Jl 17	10	Jl 17	53
Jl 23	10	Jl 23	53
A 9	14	A 9	53
A18	14	A 18	53
A 21	12	A 21	53
A 30	14	A 30	53
S 3	12	S 3	53
S 5	14	S 5	53
S 12	14	S12	44
S 22	14	S 22	53
S 27	0	S 27	53
O 1	0	O 1	53
O 3	0	O 3	53
O 17	0	O 17	53
O 31	0	O 31	53
N 12	0	N 12	53
N 27	0	N 27	53
D		D	

*max depth, assume ≥ 4mg/L

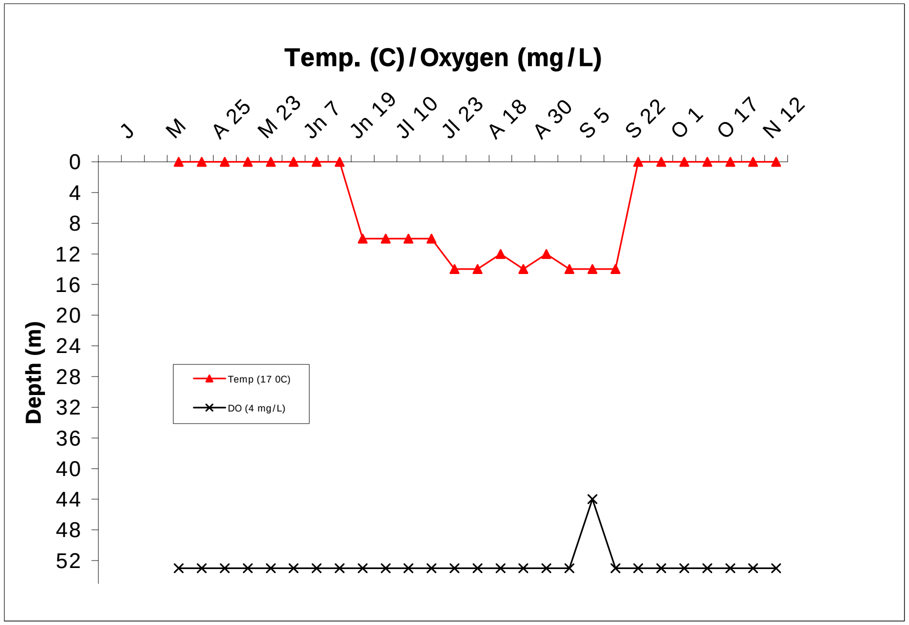


Figure 7b Skaha Lake Site 3 South Basin

Temp (17 ^{0}C)		DO (4 mg/L)	
Month	Depth	Month	Depth
J		J	
F		F	
M		M	
A 10	0	A 10	37
A 25	0	A 25	37
M 9	0	M 9	37
M 23	0	M 23	37
Jn 7	0	Jn 7	37
Jn 11	0	Jn 11	37
Jn 19	8	Jn 19	37
Jl 10	10	Jl 10	37
Jl 23	8	Jl 23	37
A 9	12	A 9	37
A 18	12	A 18	37
A 21	14	A 21	37
A 30	14	A 30	37
S 5	12	S 5	37
S 22	18	S 22	37
O 1	0	O 1	37
O 3	0	O 3	37
O 17	0	O 17	37
O 31	0	O 31	37
N 12	0	N 12	37
N 27	0	N 27	37
D		D	

*max depth, assume ≥ 4mg/L

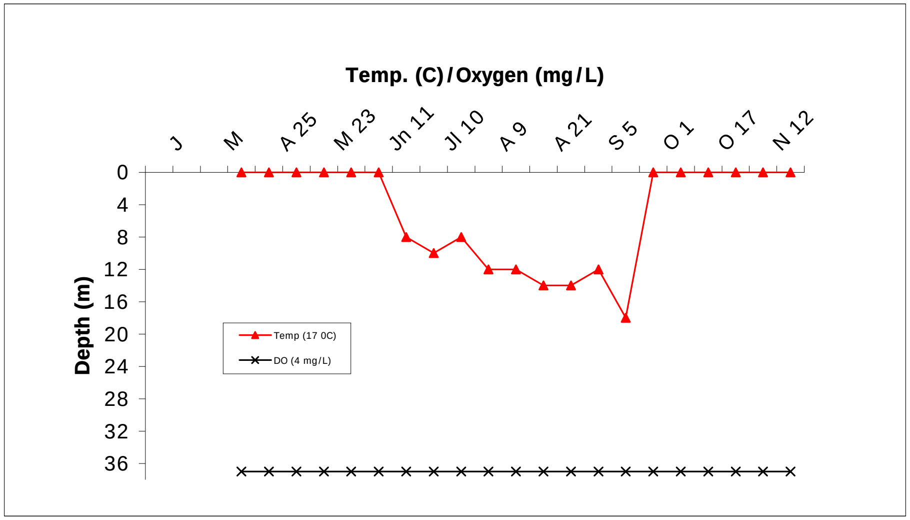
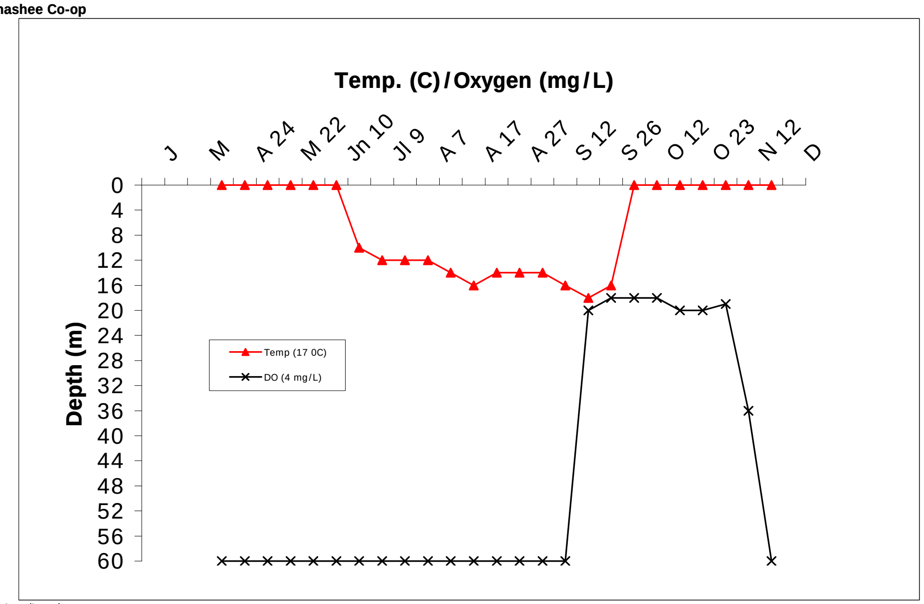


Figure 7c Osoyoos Lake Site 2 Monashee Co-op

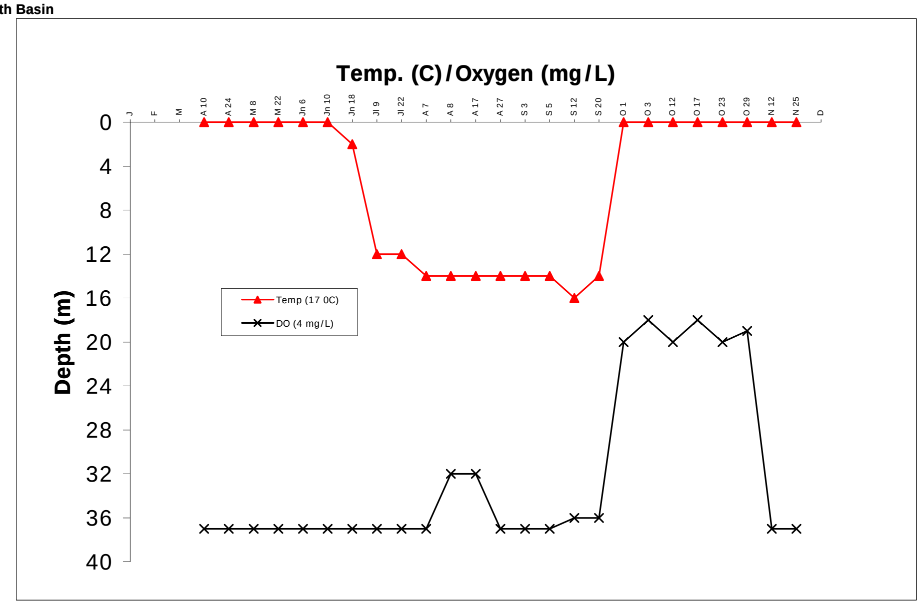
Temp (17 ^{0}C) Month	Depth	DO (4 mg/L) Month	Depth	
J		J		
F		F		
M		M		
A 10	0	A 10	60	
A 24	0	A 24	60	
M 8	0	M 8	60	
M 22	0	M 22	60	
Jn 6	0	Jn 6	60	
Jn 10	0	Jn 10	60	
Jn 18	10	Jn 18	60	
Jl 9	12	Jl 9	60	
Jl 22	12	Jl 22	60	
A 7	12	A 7	60	
A 8	14	A 8	60	
A 17	16	A 17	60	
A 19	14	A 19	60	
A 27	14	A 27	60	*
S 5	14	S 5	60	
S 12	16	S 12	60	
S 20	18	S 20	20	
S 26	16	S 26	18	
O 3	0	O 3	18	
O 12	0	O 12	18	
O 17	0	O 17	20	
O 23	0	O 23	20	
O 29	0	O 29	19	
N 12	0	N 12	36	
N 25	0	N 25	60	
D		D		



*measured only to 24m assume above 4mg/L to bottom

Figure 7d Osoyoos Lake Site 1 North Basin

Temp (17 ^{0}C) Month	Depth	DO (4 mg/L) Month	Depth	
J		J		
F		F		
M		M		
A 10	0	A 10	37	
A 24	0	A 24	37	
M 8	0	M 8	37	*
M 22	0	M 22	37	
Jn 6	0	Jn 6	37	
Jn 10	0	Jn 10	37	
Jn 18	2	Jn 18	37	
Jl 9	12	Jl 9	37	
Jl 22	12	Jl 22	37	
A 7	14	A 7	37	
A 8	14	A 8	32	
A 17	14	A 17	32	
A 27	14	A 27	37	
S 3	14	S 3	37	
S 5	14	S 5	37	
S 12	16	S 12	36	
S 20	14	S 20	36	
O 1	0	O 1	20	
O 3	0	O 3	18	
O 12	0	O 12	20	
O 17	0	O 17	18	
O 23	0	O 23	20	
O 29	0	O 29	19	
N 12	0	N 12	37	
N 25	0	N 25	37	
D		D		



*assumed

Figure 8a: Total Nitrogen Levels at 0 to 10m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.18	0.19
	M	0.20	0.19
	J	0.21	0.20
	J	0.28	0.25
	A	0.21	0.21
	S	0.19	0.20
	O	0.34	0.07
	N	0.19	0.20
	D		
	Average	0.23	0.19

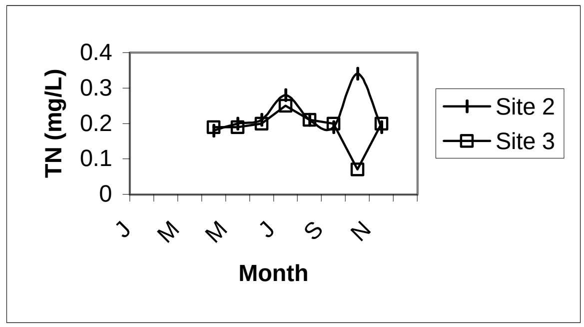


Figure 8b: Total Nitrogen Levels at 20m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.19	0.19
	M	0.20	0.19
	J	0.24	0.18
	J	0.20	0.19
	A	0.20	0.19
	S	0.19	0.19
	O	0.15	0.07
	N	0.19	0.21
	D		
	Average	0.20	0.18

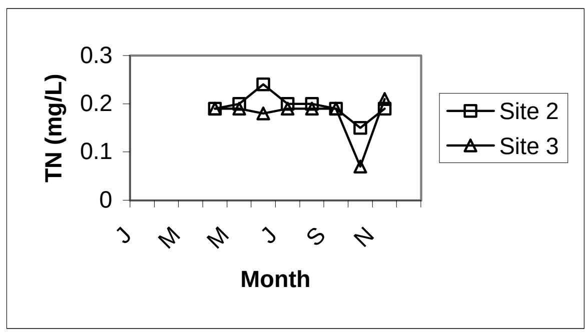


Figure 8c: Total Nitrogen Levels at Deep Sections for Skaha Lake

	Depth	45m	36m
Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.18	0.18
	M	0.18	0.22
	J	0.17	0.18
	J	0.26	0.17
	A	0.17	0.19
	S	0.17	0.20
	O	0.08	0.12
	N	0.20	0.25
	D		
	Average	0.18	0.19

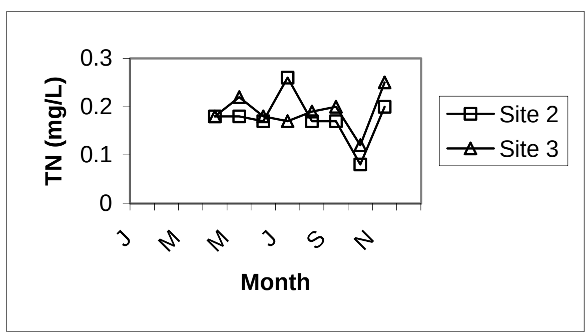


Figure 8d: Total Nitrogen Levels at 0 - 10 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.22	0.22
	M	0.24	0.24
	J	0.24	0.23
	J	0.38	0.21
	A	0.22	0.23
	S	0.25	0.28
	O	0.36	0.13
	N	0.25	0.24
	D		
	Average	0.27	0.22

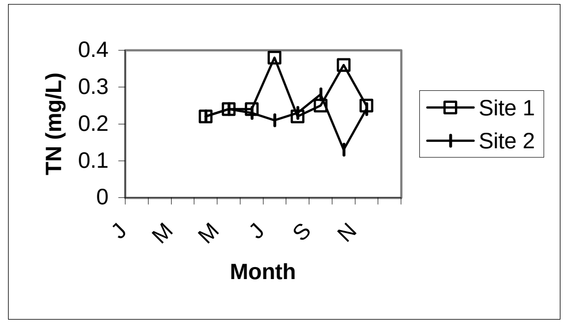


Figure 8e: Total Nitrogen Levels at 20 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.21	0.21
	M	0.21	0.20
	J	0.22	0.22
	J	0.19	0.28
	A	0.22	0.20
	S	0.20	0.19
	O	0.20	0.18
	N	0.25	0.25
	D		
	Average	0.21	0.22

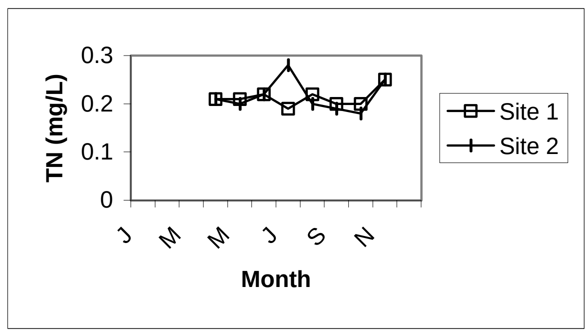


Figure 8f: Total Nitrogen Levels at Deep Sections for Osoyoos Lake

	Depth	32m	45m
Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.19	0.21
24m	M	0.21	0.20
	J	0.21	0.21
	J	0.20	0.21
	A	0.22	0.25
	S	0.25	0.30
	O	0.26	0.30
	N	0.24	0.31
	D		
	Average	0.22	0.25

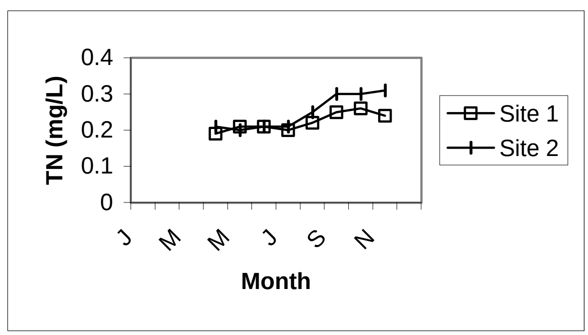


Figure 9a: Nitrate-Nitrogen levels at 0-10m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.002	0.002
	M	0.002	0.002
	J	0.005	0.005
	J	0.002	0.002
	A	0.005	0.004
	S	0.002	0.002
	O	0.002	0.002
	N	0.002	0.002
	D		
	Average	0.003	0.003

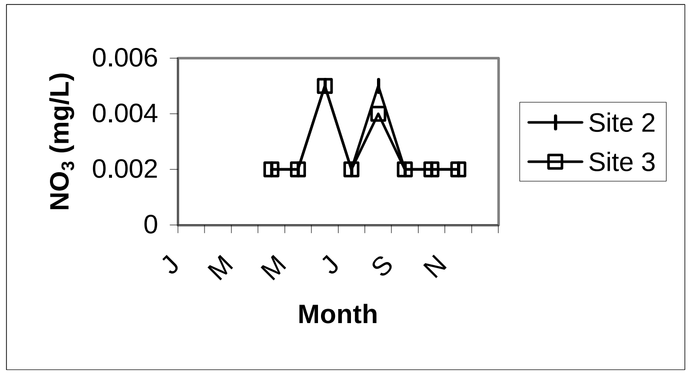


Figure 9b: Nitrate-Nitrogen Levels at 20m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.002	0.002
	M	0.002	0.002
	J	0.005	0.004
	J	0.002	0.002
	A	0.005	0.006
	S	0.002	0.008
	O	0.002	0.002
	N	0.003	0.004
	D		
	Average	0.003	0.004

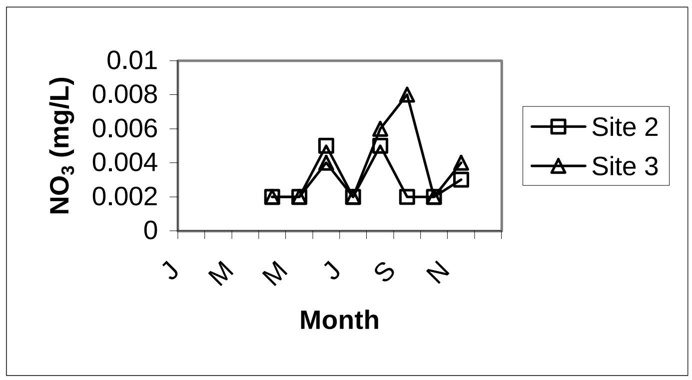


Figure 9c: Nitrate-Nitrogen Levels at Deep Sections for Skaha Lake

	Depth	45m	36m
Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.002	0.002
	M	0.002	0.002
	J	0.007	0.013
	J	0.002	0.002
	A	0.005	0.005
	S	0.004	0.024
	O	0.002	0.034
	N	0.003	0.003
	D		
	Average	0.003	0.011

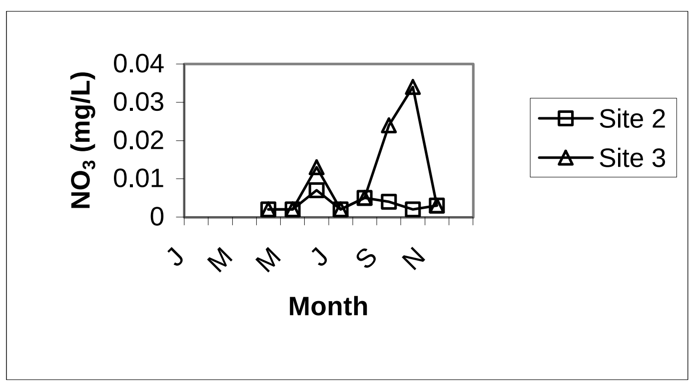


Figure 9d: Nitrate-Nitrogen Levels at 0 - 10 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.002	0.002
	M	0.002	0.002
	J	0.003	0.007
	J	0.002	0.002
	A	0.003	0.003
	S	0.005	0.002
	O	0.002	0.002
	N	0.010	0.016
	D		
	Average	0.004	0.005

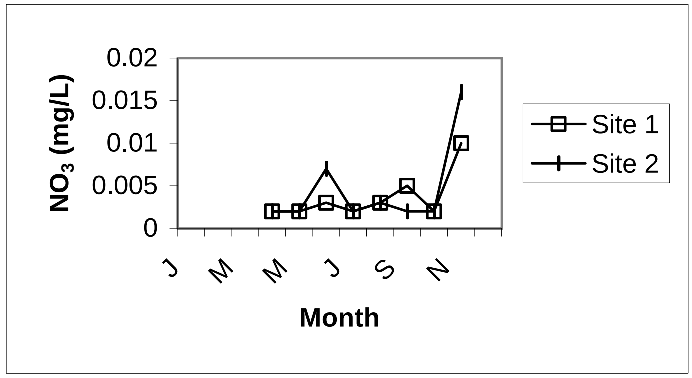


Figure 9e: Nitrate-Nitrogen Levels at 20 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.002	0.002
	M	0.002	0.002
	J	0.002	0.003
	J	0.002	0.002
	A	0.004	0.003
	S	0.002	0.002
	O	0.066	0.065
	N	0.009	0.015
	D		
	Average	0.011	0.012

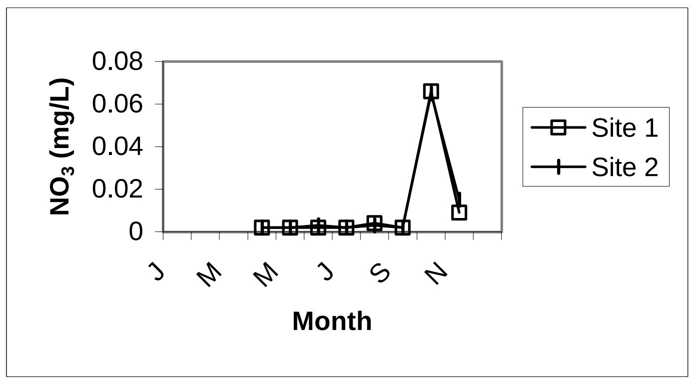


Figure 9f: Nitrate-Nitrogen Levels at Deep Sections for Osoyoos Lake

	Year	Depth / Month	32m / Site 1	45m / Site 2
	2002	J		
		F		
		M		
		A	0.002	0.002
24m		M	0.002	0.003
		J	0.006	0.002
		J	0.002	0.006
		A	0.002	0.002
		S	0.009	0.044
		O	0.111	0.121
		N	0.002	0.094
		D		
		Average	0.017	0.034

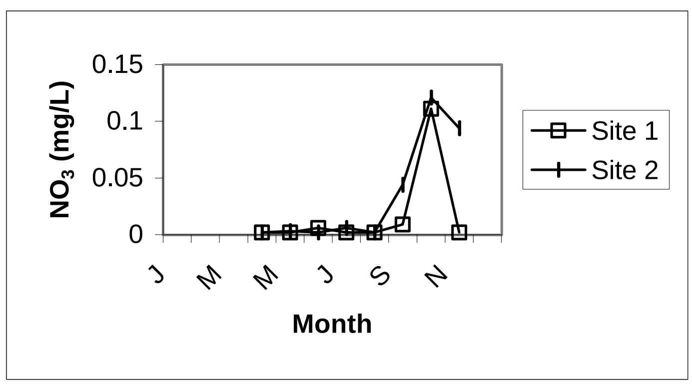


Figure 10a: Total Phosphorous Levels at 0 to 10m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.005	0.011
	M	0.007	0.009
	J	0.010	0.016
	J	0.005	0.005
	A	0.008	0.007
	S	0.010	0.005
	O	0.005	0.007
	N	0.010	0.006
	D		
	Average	0.008	0.008

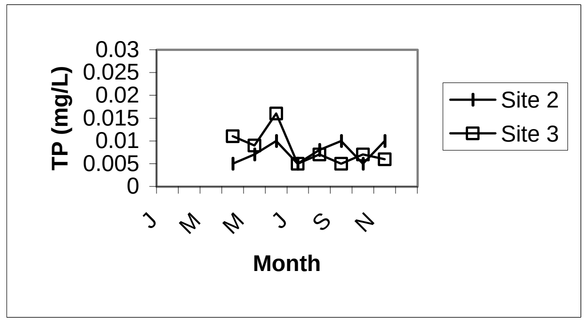


Figure 10b: Total Phosphorous Levels at 20m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.015	0.009
	M	0.005	0.009
	J	0.010	0.009
	J	0.005	0.004
	A	0.014	0.007
	S	0.009	0.008
	O	0.006	0.005
	N	0.008	0.012
	D		
	Average	0.009	0.008

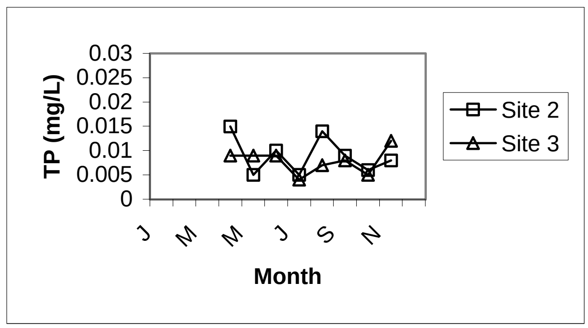


Figure 10c: Total Phosphorous Levels at Deep Sections for Skaha Lake

	Depth	45m	36m
Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.005	0.006
	M	0.005	0.009
	J	0.006	0.009
	J	0.003	0.006
	A	0.007	0.010
	S	0.004	0.012
	O	0.006	0.015
	N	0.008	0.012
	D		
	Average	0.006	0.010

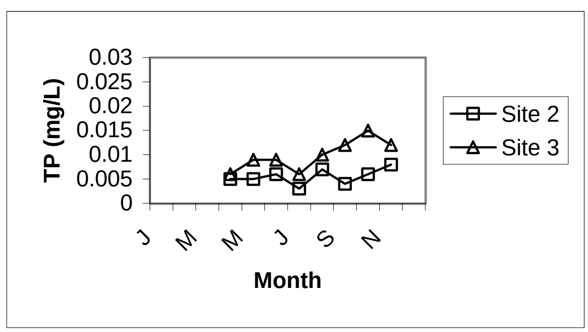


Figure 10d: Total Phosphorous Levels at 0 - 10 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.009	0.008
	M	0.015	0.007
	J	0.018	0.013
	J	0.020	0.017
	A	0.013	0.012
	S	0.010	0.008
	O	0.016	0.006
	N	0.023	0.019
	D		
	Average	0.016	0.011

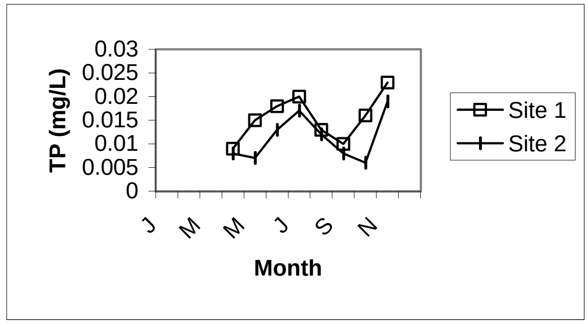


Figure 10e: Total Phosphorous Levels at 20 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.012	0.009
	M	0.008	0.007
	J	0.012	0.010
	J	0.004	0.014
	A	0.010	0.009
	S	0.009	0.005
	O	0.011	0.013
	N	0.022	0.019
	D		
	Average	0.011	0.011

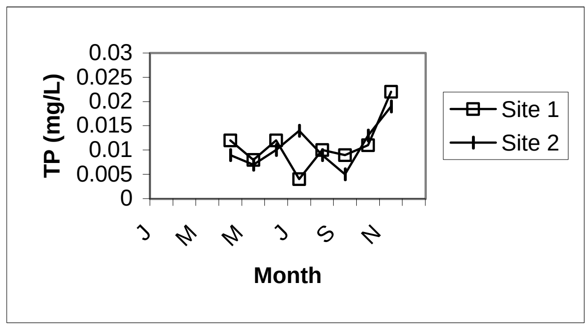


Figure 10f: Total Phosphorous Levels at Deep Sections for Osoyoos Lake

	Depth	32m	45m
Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.007	0.009
24m	M	0.012	0.012
	J	0.009	0.009
	J	0.005	0.019
	A	0.019	0.021
	S	0.012	0.026
	O	0.022	0.032
	N	0.018	0.034
	D		
	Average	0.013	0.020

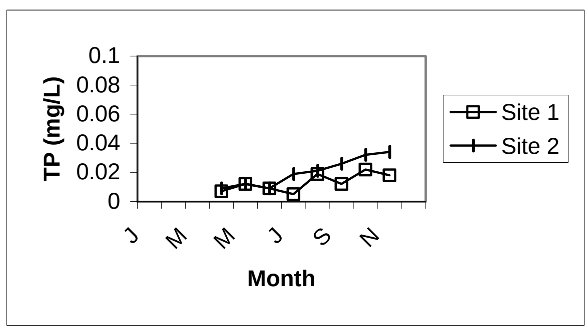


Figure 11a: Total Dissolved Phosphorous Levels at 0 to 10m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.006	0.003
	M	0.006	0.004
	J	0.007	0.009
	J	0.004	0.007
	A	0.010	0.005
	S	0.007	0.004
	O	0.009	0.011
	N	0.004	0.003
	D		
	Average	0.007	0.006

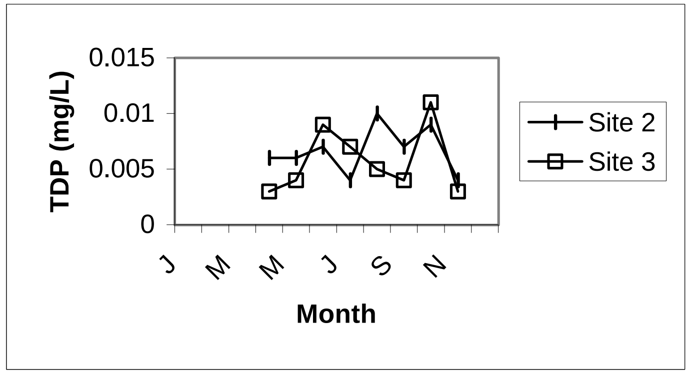


Figure 11b: Total Dissolved Phosphorous Levels at 20m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.002	0.005
	M	0.005	0.004
	J	0.006	0.006
	J	0.005	0.003
	A	0.004	0.007
	S	0.005	0.004
	O	0.007	0.007
	N	0.005	0.007
	D		
	Average	0.005	0.005

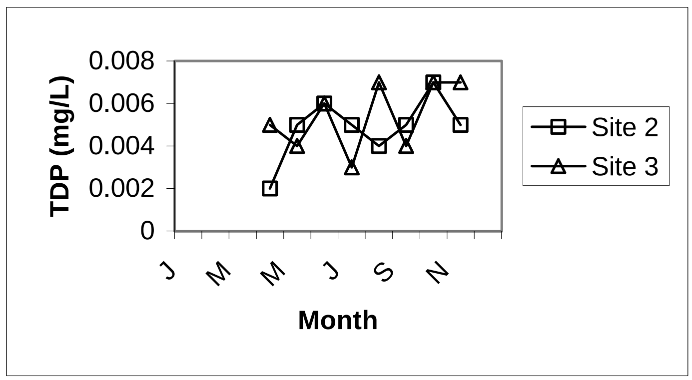


Figure 11c: Total Dissolved Phosphorous Levels at Deep Sections for Skaha

	Depth	45m	36m
Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	0.002	0.004
	M	0.003	0.004
	J	0.006	0.005
	J	0.003	0.003
	A	0.005	0.006
	S	0.003	0.007
	O	0.008	0.005
	N	0.005	0.008
	D		
	Average	0.004	0.005

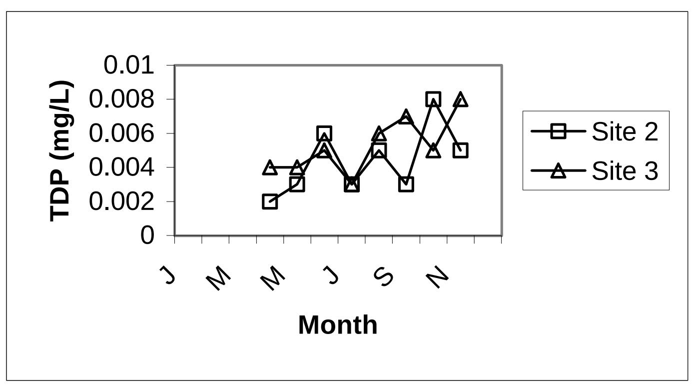


Figure 11d: Total Dissolved Phosphorous Levels at 0 - 10 m for Osoyoos Lak

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.008	0.004
	M	0.008	0.006
	J	0.011	0.005
	J	0.012	0.003
	A	0.007	0.007
	S	0.007	0.004
	O	0.010	0.005
	N	0.012	0.010
	D		
	Average	0.009	0.006

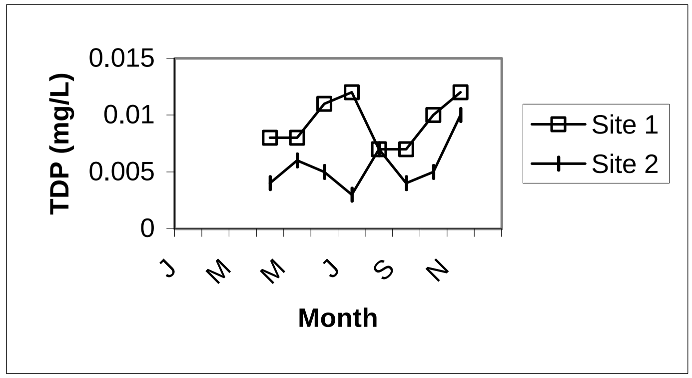


Figure 11e: Total Dissolved Phosphorous Levels at 20 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.003	0.002
	M	0.008	0.005
	J	0.007	0.008
	J	0.003	0.005
	A	0.011	0.005
	S	0.005	0.003
	O	0.005	0.007
	N	0.012	0.010
	D		
	Average	0.007	0.006

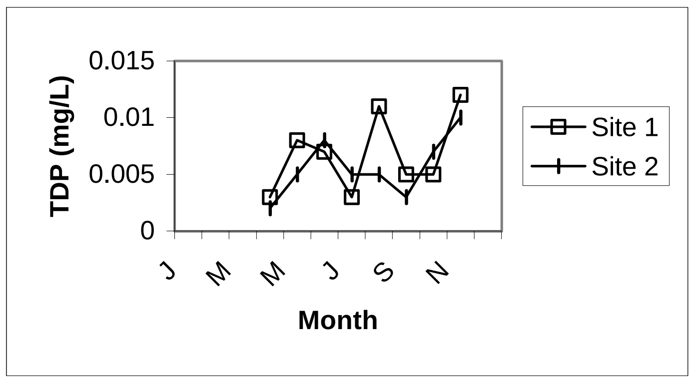


Figure 11f: Total Dissolved Phosphorous Levels at Deep Sections for Osoyo

	Depth	32m	45m
Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	0.004	0.004
	M	0.007	0.005
	J	0.002	0.004
	J	0.005	0.009
	A	0.005	0.011
	S	0.008	0.022
	O	0.011	0.024
	N	0.013	0.028
	D		
	Average	0.007	0.013

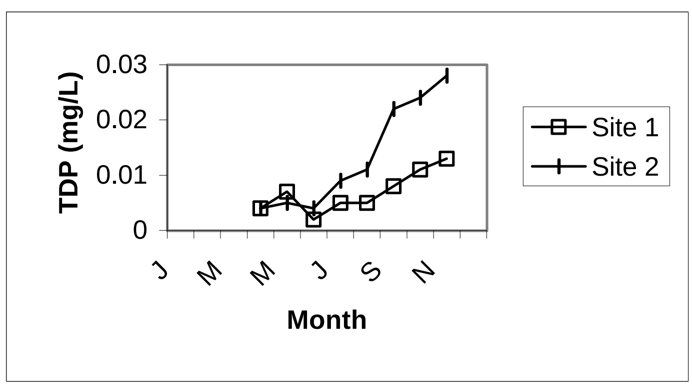
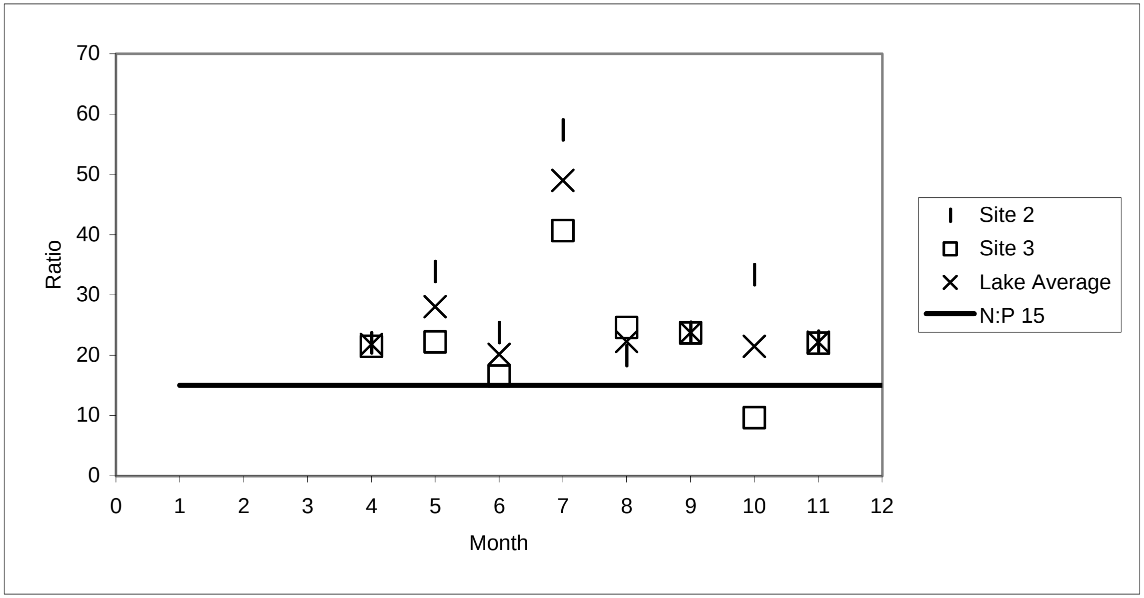
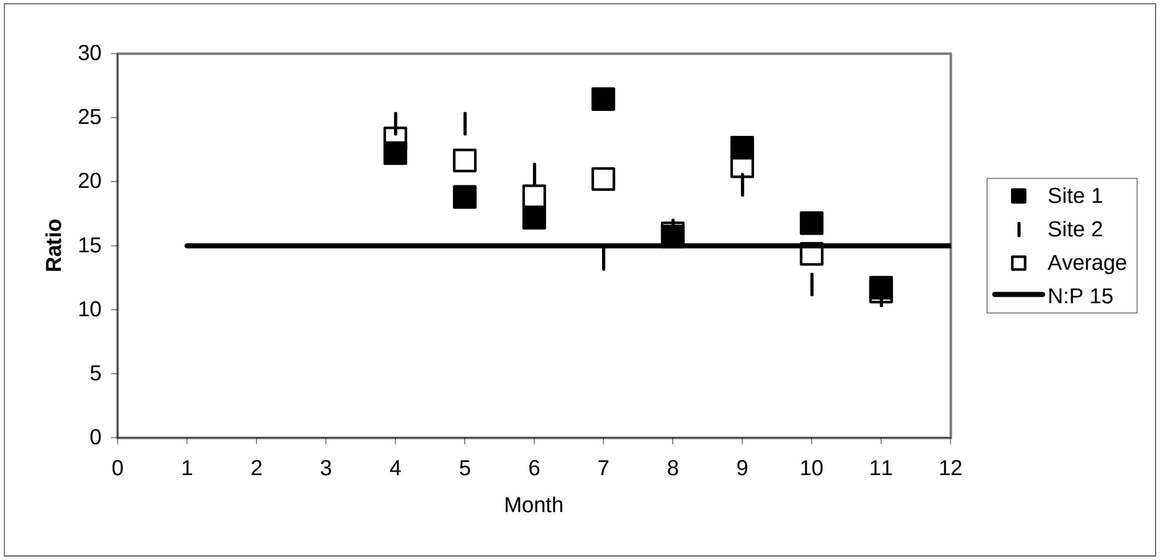


Figure 12a: Total Nitrogen:Total Phosphorous Ratio for Skaha Lake



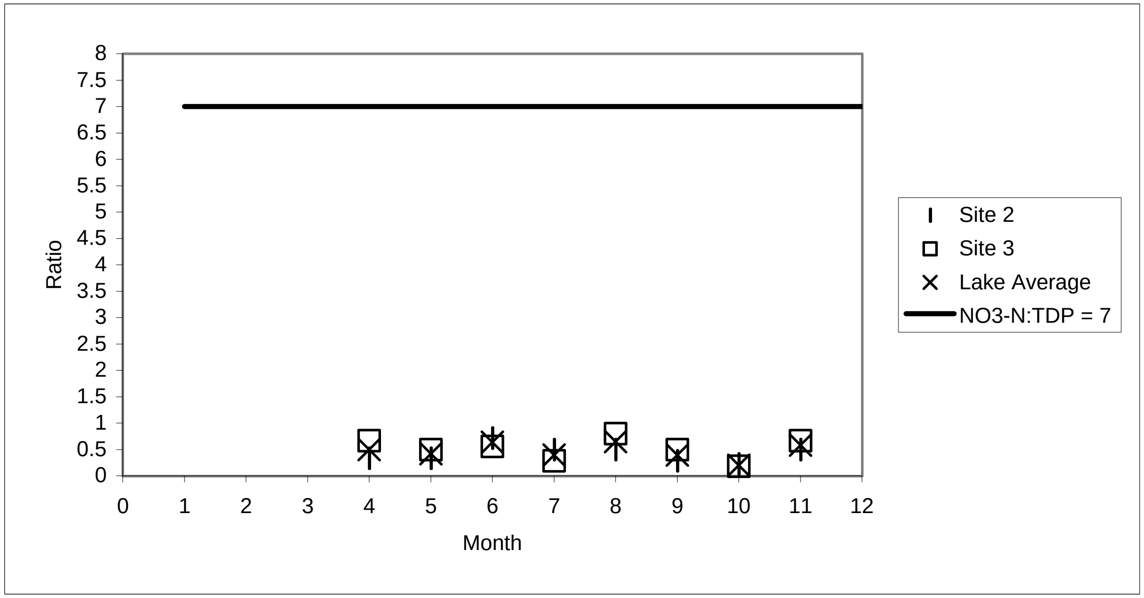
Year		TN:TP		
2002	Month	Site 2	Site 3	Lake Average
January	1			
February	2			
March	3			
April	4	22.1	21.5	21.8
May	5	33.9	22.2	28.1
June	6	23.8	16.5	20.1
July	7	57.4	40.7	49.0
August	8	19.9	24.6	22.3
September	9	23.8	23.7	23.8
October	10	33.3	9.6	21.5
November	11	22.3	22.0	22.2
December	12			

Figure 12b: Total Nitrogen:Total Phosphorous Ratio for Osoyoos Lake



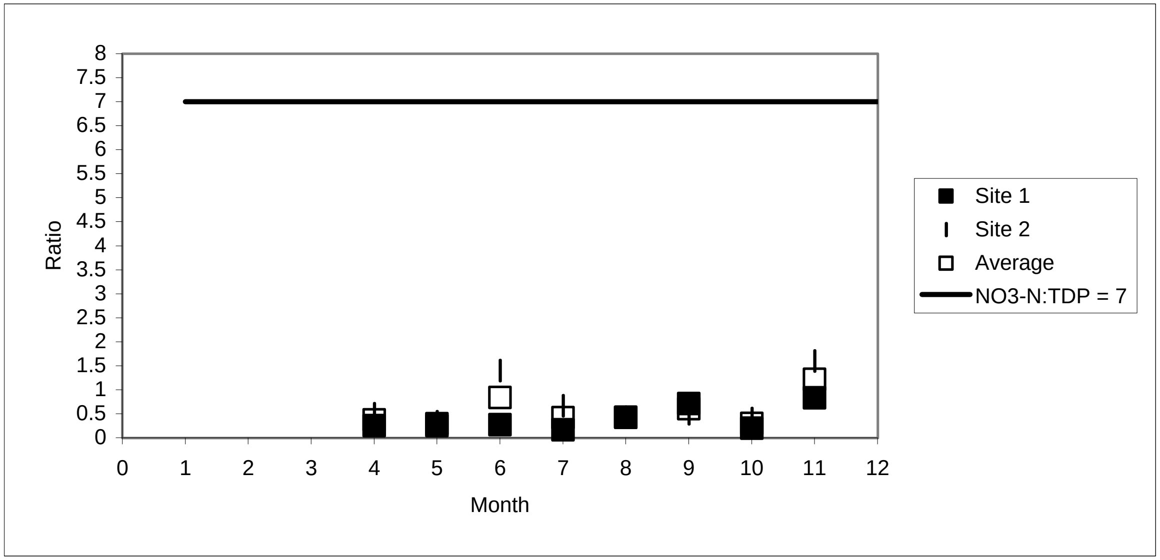
Year 2002	Month	Site 1	Site 2	Average
January	1			
February	2			
March	3			
April	4	22.2	24.5	23.4
May	5	18.8	24.5	21.7
June	6	17.2	20.6	18.9
July	7	26.5	14.0	20.2
August	8	15.7	16.2	16.0
September	9	22.7	19.7	21.2
October	10	16.8	12.0	14.4
November	11	11.7	11.1	11.4
December	12			

Figure 13a: N03/TDP ratio at 0 to 10m for Skaha Lake



Year		N03:TDP		
2002	Month	Site 2	Site 3	Lake Average
January	1			
February	2			
March	3			
April	4	0.33	0.67	0.50
May	5	0.33	0.50	0.42
June	6	0.71	0.56	0.63
July	7	0.50	0.29	0.39
August	8	0.50	0.80	0.65
September	9	0.29	0.50	0.39
October	10	0.22	0.18	0.20
November	11	0.50	0.67	0.58
December	12			

Figure 13b: N03/TDP ratio at 0 to 10m for Osoyoos Lake



Year 2001	Month	Site 1	Site 2	Average
January	1			
February	2			
March	3			
April	4	0.25	0.50	0.38
May	5	0.25	0.33	0.29
June	6	0.27	1.40	0.84
July	7	0.17	0.67	0.42
August	8	0.43	0.43	0.43
September	9	0.71	0.50	0.61
October	10	0.20	0.40	0.30
November	11	0.83	1.60	1.22
December	12			

Figure 14a: Chlorophyll a levels at 0-10m for Skaha Lake

	Month	Site 2	Site 3
###	J		
	F		
	M		
	A	4.50	2.70
	M	2.40	2.10
	J	3.10	3.50
	J	3.40	3.20
	A*		
	S	3.00	2.50
	O	4.30	3.60
	N	3.20	3.30
	D		
	AVERAGE	3.41	2.99

*Samples lost

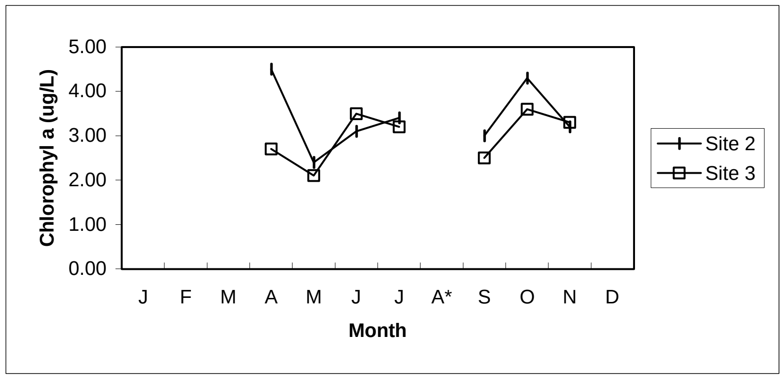


Figure 14b: Chlorophyll a levels at 0-10m for Osoyoos Lake

	Month	Site 1	Site 2
###	F		
	M		
	A	5.50	5.00
	M	3.20	3.60
	J	2.90	4.00
	J	2.60	3.50
	A*		
	S	4.60	6.80
	O	5.30	6.30
	N	7.50	7.40
	D		
	AVERAGE	4.51	5.23

*samples lost

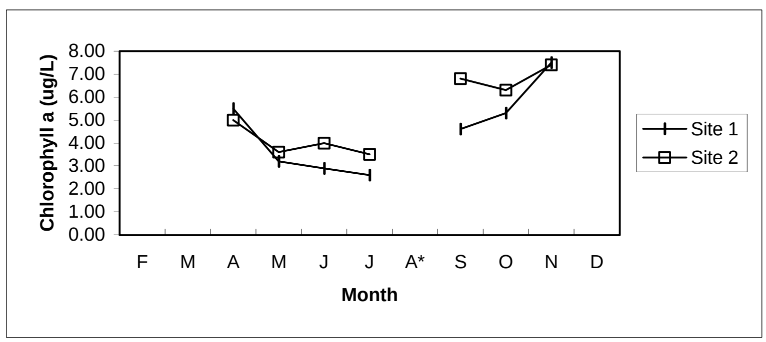


Figure 15a: Silica Levels at 0 to 10m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	3.2	3.1
	M	4.0	3.7
	J	5.5	5.4
	J	5.7	5.6
	A	6.4	6.3
	S	5.9	5.9
	O	5.9	5.8
	N	5.3	5.2
	D		

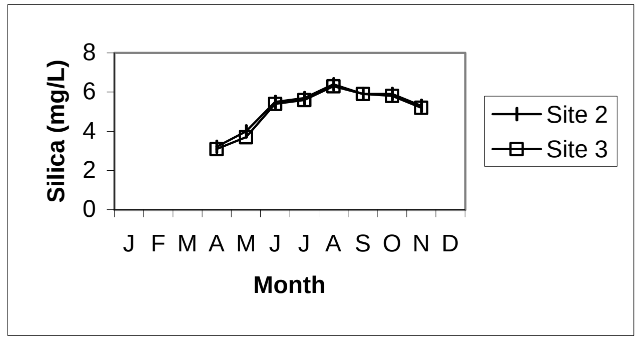


Figure 15b: Silica Levels at 20m for Skaha Lake

Year	Month	Site 2	Site 3
2002	J		
	F		
	M		
	A	3.2	3.0
	M	3.8	3.6
	J	5.2	4.4
	J	5.7	4.8
	A	5.3	5.3
	S	4.9	5.1
	O	4.7	5.1
	N	5.3	5.2
	D		

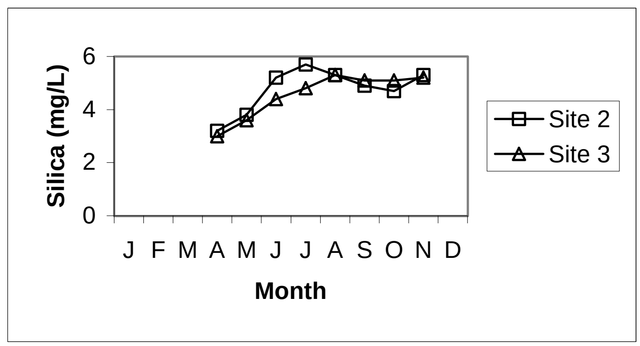


Figure 15c: Silica Levels at Deep Sections for Skaha Lake

	Depth	45m	36m
Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	3.2	3.1
	M	3.6	3.6
	J	3.8	4.2
	J	3.8	4.3
	A	4.6	5.3
	S	4.8	5.2
	O	4.7	5.7
	N	5.2	5.3
	D		

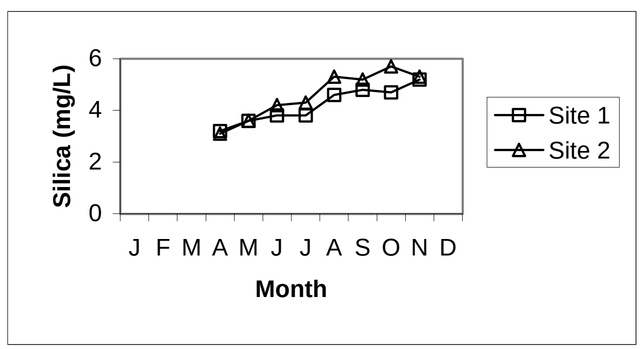


Figure 15d: Silica Levels at 0 - 10 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	2.4	1.5
	M	3.4	3.0
	J	5.4	5.4
	J	5.6	5.4
	A	5.9	5.8
	S	6.1	5.9
	O	6.2	6.1
	N	6.5	6.6
	D		

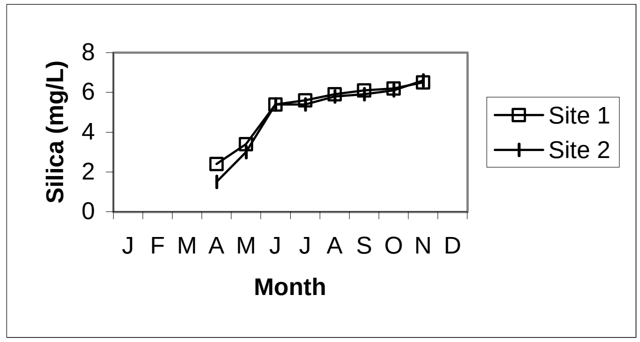


Figure 15e: Silica Levels at 20 m for Osoyoos Lake

Year	Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	1.7	1.5
	M	2.8	2.3
	J	5.1	5.3
	J	4.9	4.6
	A	4.6	5.0
	S	5.5	5.3
	O	5.8	6.4
	N	6.6	6.6
	D		

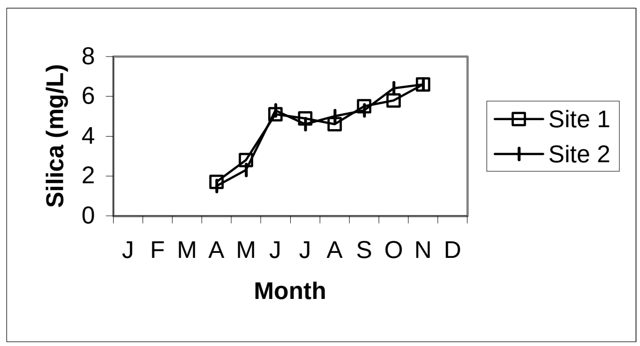


Figure 15f: Silica Levels at Deep Sections for Osoyoos Lake

Year	Depth Month	Site 1	Site 2
2002	J		
	F		
	M		
	A	1.8	1.5
	M	2.9	2.0
	J	3.0	3.0
	J	3.4	3.6
	A	4.5	4.9
	S	5.0	5.9
	O	6.4	7.2
	N	6.6	7.4
	D