

**SOA 2021-04**  
**Approved by HSC 4/21/2021**

**Priest Rapids Coordinating Committee's Hatchery Subcommittee**  
**Statement of Agreement**  
**Regarding the "Success" of the Okanagan Sockeye Salmon Reintroduction Program**

The Priest Rapids Coordinating Committee's Hatchery Subcommittee agree that the Okanagan Sockeye Salmon Reintroduction Program is successful based on those mitigation goals agreed to in the 08/26/2010 Statement of Agreement (SOA) and detailed in the comprehensive program assessment completed by the HCs in 2021. Mitigation goals outlined in the 2010 SOA included but were not limited to:

- Establishing natural production and new rearing habitats in Skaha Lake and Okanagan Lake;
- Providing funding for hatchery operations, monitoring and evaluation, and construction of a hatchery in Penticton to produce sufficient quantities of fry to support reintroduction efforts; and
- Acquiring the space and core infrastructure necessary to construct a hatchery to support an 8 million egg program.

The "Summary of the Comprehensive Program Review of the Skaha and Okanagan Lakes Sockeye Salmon Reintroduction Program" (Attachment 1) provides supportive documentation of the success of the program.

Attachment 1.

# Summary of the Comprehensive Program Review of the Skaha and Okanagan Lakes Sockeye Salmon Reintroduction Program



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## Introduction

Chelan PUD and Grant PUD (Districts) committed to fund the Skaha Lake and Okanagan Lake Sockeye Salmon (*Oncorhynchus nerka*) Reintroduction Program (Reintroduction Program) in accordance with a Statement of Agreement dated August 26, 2010 (2010 SOA) to meet their respective No-Net-Impact (NNI) hatchery compensation obligations for Sockeye Salmon in the Okanagan Basin (both Chelan and Grant PUDs) and Wenatchee Basin (Grant PUD only). The “mitigation goal” of the Reintroduction Program was to establish natural production and open significant new rearing habitats in Skaha Lake and potentially Okanagan Lake. In support of the Reintroduction Program, the Districts agreed to provide the funding for construction of a hatchery in Penticton for a 5 million Sockeye Salmon egg program with the space and core infrastructure necessary for an 8 million egg program; annual funding of hatchery operation costs; and annual funding of the monitoring and evaluation (M&E) program. The Penticton Hatchery is owned by the Okanagan Nation Alliance (ONA), the organization responsible for implementing all facets of the hatchery program and producing Sockeye Salmon fry to support the reintroduction efforts.

The 2010 SOA states that a comprehensive program review will be conducted by the Hatchery Committees (HCs) to determine success of the Reintroduction Program. The purpose of this document is to summarize the performance of the Reintroduction Program, as described in the 2010 SOA, over the period in which it has been implemented.

## Background

Reintroduction of Sockeye Salmon into lakes (i.e., Skaha and Okanagan lakes) with impassable barriers was identified as one of the major initiatives and activities (1998–2017) comprising the Canadian Okanagan Basin Technical Working Group (COBTWG) strategy for restoration of anadromous salmon to Canadian portions of the Okanagan River Sub-basin while continuing to balance other ecosystem and resident fish objectives (Alexander et al. 2015). ONA initiated the Skaha Lake Sockeye Reintroduction Program in 2004 as a District partnership project under the purview of COBTWG. In October 2003, the ONA initiated wild adult broodstock collection from the Okanagan River (using Osoyoos lake as a nursery stock) and in May 2004 released 352,500 Sockeye Salmon fry into Skaha Lake. The 12 year (2005 to 2016), full scale, experimental Reintroduction Program included hatchery fry-production, an extensive M&E program, and a risk assessment that guided the Reintroduction Program. The management goals for the experimental Reintroduction Program (Alexander et al. 2015) included:

- *Restore Sockeye Salmon back to their original range within the Okanagan Basin and enhance population abundance to support tribal ceremonial and subsistence fisheries.*
- *Determine whether Skaha Lake Sockeye Salmon could be produced in sufficient numbers to assist the Grant and Chelan Public Utility Districts in meeting their Sockeye Salmon out-migration requirements.*
- *Determine the effects that hatchery-reared Sockeye Salmon may have on abundance, productivity and angling quality of Skaha Lake Kokanee while accounting for the role played by *Mysis relicta*.*

- *Determine the impacts that changing physical-chemical conditions, such as declines in Osoyoos Lake hypolimnetic oxygen concentrations, may have on wild and hatchery-reared Sockeye Salmon.*
- *Assess potential losses to wild Osoyoos Lake Sockeye Salmon from genetic introgression and disease transmission.*
- *Assess the carrying capacities for both Skaha and Osoyoos lakes by quantifying the extent to which Sockeye Salmon growth rates are density dependent and determine how this limits stocking densities.*

The key obstacle for full-scale and long-term Sockeye Salmon reintroduction included concerns and uncertainties about potential impacts to other valued taxa. Uncertainties included key data gaps and studies as well as political and regulatory support from federal and provincial governments.

The Districts' participation in and funding of the Reintroduction Program began prior to the 2010 SOA and included hatchery production (at Shuswap Hatchery), implementation of a M&E program, and risk assessment study activities. The intent of these activities was to reduce scientific uncertainties to the extent that Canadian governmental organizations could make decisions about reintroduction. There were no guarantees that these activities would result in reintroduction, but the natural production potential in the blocked lakes of the Okanagan Basin was deemed worthy of the financial risk for the Districts. The review provided herein focuses on the Districts' hatchery compensation obligations within the period of performance specified within the 2010 SOA:

*The HC agrees to support the District's funding and implementation of the Skaha program, from 2010 through 2021 (i.e., release of the 2020 brood year), in order to meet the District's No Net Impact (NNI) sockeye obligation for the Okanagan Basin.*

After approval of the 2010 SOA, the Districts began the design of the Penticton Hatchery (preliminary planning was ongoing prior to 2010). The ONA and Districts developed a robust set of design standards in 2010 and agreed to construct a facility that would support fry production for 5 million eggs, and expansion capacity to increase production to 8 million eggs in the future, if warranted. Final designs were completed, and construction began in 2013. Hatchery construction was completed, and the facility was commissioned in 2014. The first group of Sockeye Salmon eggs, from the 2014 brood year (BY 2014), were brought on-station at the Penticton Hatchery in 2014 and were raised to fry, and subsequently released in Skaha Lake during the spring of 2015. After rearing for a year in Skaha Lake, the first hatchery-origin smolts from the Penticton Facility emigrated in the spring of 2016 and produced adult returns beginning in 2017.

As Sockeye Salmon from the Okanagan Basin typically spend between 1-3 years in the ocean, returns from BY 2014 were complete in 2019. In total, the Penticton Hatchery has produced complete age-class returns for two brood years (BY 2014 and 2015; Table 1), but spawner information from 2020 is not yet available.

Table 1. Summary of adult return years for the 2014-2017 brood years.

Brood Year	Adult Returns		
	1-Ocean	2-Ocean	3-Ocean
2014	2017	2018	2019
2015	2018	2019	2020
2016	2019	2020	2021
2017	2020	2021	2022

Note: Blue shading highlights the return years for age classes that have already returned from the ocean.

## Metrics Related to Program Performance

A detailed M&E and risk assessment program was developed by COBTWG and included the following key performance measures: in-lake survival, growth and abundance of Sockeye Salmon and kokanee; *Mysis* and zooplankton monitoring and modelling; limnological monitoring; Sockeye Salmon smolt outmigration enumeration and survival; abundance of spawning kokanee; assessment of potential losses to wild Osoyoos Lake Sockeye Salmon from genetic introgression and disease transmission; and carrying capacities for both Skaha and Osoyoos Lakes; and Sockeye Salmon adult spawner monitoring (Smith 2003; Wright and Smith 2003; Long et al. 2005; McQueen et al. 2014; Alexander and Hyatt 2015). Details of the Reintroduction Program are described in the annual reports which include results from 1) *Nerkid* spawner enumeration and biological sampling, 2) collection and rearing of Okanagan Sockeye Salmon for the Skaha and Okanagan Lakes Reintroduction Program, and 3) Sockeye Salmon smolt out-of-basin survival: purse seining and PIT tagging (citations for the reports are in the reference section). Additionally, a summary of the pelagic food web data gathered from Skaha and Osoyoos Lakes during 2005-17 (BY2004-16) is provided in McQueen (2019).

### Juvenile and Adult Metrics

The juvenile metrics described here summarize information collected after the Penticton Hatchery began releasing fry into Skaha and Okanagan Lakes. Table 2 illustrates the annual release numbers from the Penticton Hatchery. Table 3 provides estimates of smolt production from Skaha and Osoyoos Lakes. Table 4 shows survival estimates from release to Rocky Reach and McNary hydroelectric projects. Table 5 provides an estimate of smolt-to-adult return rates for the one brood year with available data during the operational period of Penticton Hatchery. Table 6 summarizes the adult conversion rates between Rock Island and Wells Hydroelectric Projects. Table 7 provides estimated spawners originating from Skaha and Osoyoos Lakes. Table 8 illustrates the general ocean-age composition of Sockeye Salmon from Skaha and Osoyoos Lakes.

According to Hyatt and Stockwell (2019):

*The project demonstrated that hatchery-origin fry stocked into Skaha Lake survived at, or close to, projected levels to produce an annual smolt run without signs of any significant retention of residual Sockeye Salmon maturing to adulthood in Skaha Lake. Smolt-to-adult survival rates of hatchery-origin Sockeye Salmon from Skaha Lake do not differ significantly from wild-origin Sockeye Salmon from Osoyoos Lake (McQueen et al. 2014).*

Table 2. Annual Sockeye Salmon fry release numbers for Penticton Hatchery.

Brood Year	Fry Release Year	No. Fry Released	Release notes
2014	2015	1,761,794	
2015	2016	357,578	Production reduced by population crash/drought conditions
2016	2017	4,493,577	
2017	2018	1,232,712	All released into Skaha with 10,110 released into Okanagan Lake
2018	2019	4,107,296	Okanagan Lake releases with approximately 54,000 into Skaha Lake
2019	2020	641,182	All released into Skaha Lake

Table 3. Estimated number of smolts originating from Skaha and Osoyoos Lakes during the operational period of Penticton Hatchery.

Brood Year	Fry Release Year	Skaha Natural and Hatchery-origin Presmolts	Osoyoos Natural-origin Pre-smolts	% Originating from Skaha Lake
2014	2015	1,498,420	5,491,638	21.4%
2015	2016	217,952	2,200,014	9.0%
2016	2017	973,000	3,262,701	23.0%
2017	2018	585,746	1,350,051	30.3%
2018	2019	704,452	2,397,810	22.7%
	Average	795,914	2,940,443	21.3%

Table 4. Survival estimates for emigrating juvenile PIT tagged<sup>1</sup> Okanagan Basin Sockeye Salmon during the operational period of the Penticton Hatchery.

Brood Year	Tagged & Released Year	Juvenile Survival Estimates <sup>2</sup> (SE)		
		RRH	RRH to MCN	Release to MCN
2014	2016	0.561 (0.0162)	0.796 (0.0738)	0.446 (0.0397)
2015	2017	0.676 (0.0256)	0.944 (0.1053)	0.638 (0.0672)
2016	2018	0.617 (0.0242)	0.870 (0.0848)	0.537 (0.0482)
2017	2019	0.510 (0.0224)	0.828 (0.1172)	0.422 (0.0571)

Note:

1. PIT tag data obtained from Columbia River DART <http://www.cbr.washington.edu/dart>
2. Insufficient numbers of tagged fish to generate individual survival estimates for fish of Skaha and Osoyoos Lake origins

Table 5. Smolt to adult return (SAR) estimates for PIT Tagged<sup>1</sup> Sockeye Salmon originating from Skaha and Osoyoos Lakes during the operational period of the Penticton Hatchery.

Year	Release Site	# Juveniles Released	# Total Adults Detected at BON	SAR
2016 <sup>2</sup>	Osoyoos	4,798	24	0.5%
2016 <sup>2</sup>	Skaha	5,439	55	1.0%
2012-2015 <sup>3</sup>	Osoyoos	8,230	127	1.5%
2012-2015 <sup>3</sup>	Skaha	8,520	162	1.9%

Note:

1. PIT tag data obtained from Columbia River DART <http://www.cbr.washington.edu/dart>
2. Originated from BY 2014
3. Brood years prior to completion of Penticton Hatchery

Table 6. Summary of PIT tag-based conversion rates of adult Okanagan River Sockeye Salmon between Rock Island and Wells Hydroelectric Projects.

Return Year	Rock Island Observations	Wells Observations	Conversion Rate <sup>1</sup>
2019	19	19	1.00
2018	30	30	1.00
2017	46	44	0.96
Cumulative	95	93	0.98
		Per project (RR & RI)	0.99

Note:

1. Annual conversion rates obtained from Columbia River DART <http://www.cbr.washington.edu/dart>

Table 7. Spawners originating from Skaha Lake and Osoyoos Lake<sup>1</sup>

Return Year	Skaha Lake-origin Spawners (Hatchery and Natural-origin)	Osoyoos Lake-origin Spawners (Natural-origin)	Percent Skaha Lake-origin of Total Okanagan River Spawners
2019	2,240	NA <sup>2</sup>	-
2018	23,500	31,011	43%
2017	5,600	10,400	35%

Notes:

1. Data obtained from Ryan Benson of Okanagan Nation Alliance
2. Adult returns numbers for the Osoyoos Lake population were not available at the time of this report

Table 8. Ocean Age of Returning Adults by Origin Based on PIT-Tags Detected at Bonneville Dam<sup>1</sup>

Year Tagged and Released	Origin	Age		
		1-Ocean	2-Ocean	3-Ocean
2016 <sup>2</sup>	Skaha	0.36	0.64	0.00
2016 <sup>2</sup>	Osoyoos	0.08	0.79	0.13
2012-2015 <sup>3</sup>	Skaha	0.34	0.64	0.02
2012-2015 <sup>3</sup>	Osoyoos	0.18	0.76	0.06

Note:

1. PIT tag data obtained from Columbia River DART <http://www.cbr.washington.edu/dart>
2. Originated from BY 2014
3. Brood years prior to completion of Penticton Hatchery

## Sockeye Salmon/Kokanee Salmon Interactions

Potential impacts of re-introducing Sockeye Salmon to Skaha Lake were hypothesized by COBTWG which included competition for food resources and spawning habitat between re-introduced Sockeye Salmon and resident kokanee in Skaha Lake, in addition to other risks such as disease and genetics. Addressing these risks was a prerequisite for the Province of British Columbia and Fisheries and Oceans Canada (DFO) to authorize the reintroduction of Sockeye Salmon. As anticipated in the 2010 SOA, the Penticton Hatchery has provided a source of fish to both test interaction hypotheses and to colonize habitats.

The ONA recently prepared a comprehensive report documenting the Districts' funded studies that have been conducted to evaluate Sockeye Salmon-kokanee interactions in Skaha Lake (McQueen, 2019). The most important conclusion was that rearing Sockeye Salmon does not negatively impact resident kokanee population density:



*Since the experiment began in 2005 (BY2004), densities and biomasses of Skaha Lake kokanee and Sockeye Salmon have increased. During the last year of the study (2017, BY2016) when hatchery Sockeye were stocked at the highest density on record (4,493,577 fry per lake), kokanee biomass was the highest recorded (23.1 kg ha<sup>-1</sup>) over 12 years. Also, during the last year of the study (2017, BY2016), densities of age-0 nerkids (i.e. age-0 kokanee, age-0 wild Sockeye and age-0 hybrids) averaged 830 ha<sup>-1</sup>. Finally, during the last year of the study (2017, BY2016), the density of age-0 kokanee alone averaged 445 ha<sup>-1</sup> which is higher than age-0 kokanee densities (183 ha<sup>-1</sup>) recorded in 2005 (BY2004), when the experiment began. Based on empirical data, we conclude that the introduction of hatchery-origin age-0 Sockeye have not had a negative effect on the resident kokanee population density.*

## Summary

The results described in McQueen (2019) document the scientific foundation that was established for 1) allowing adult passage to Skaha Lake and 2) the basis for refocusing the Reintroduction Program on Okanagan Lake (Hyatt et al. 2019). Ultimately, the Reintroduction Program, and its hatchery production and monitoring and evaluation components, have been the driver for the successful reopening of both Skaha and Okanagan Lakes to adult anadromous Sockeye Salmon in 2013 and 2019, respectively<sup>1</sup>. In short, because of the Districts' investments that were made to make it possible to reintroduce Sockeye Salmon, the natural production that occurred from these efforts is a direct result of those investments.

It is important to recognize that the NNI mitigation for Okanagan Sockeye Salmon is a unique program as compared to other PUD hatchery compensation programs that have specific smolt production targets (Chelan and Grant PUDs Hatchery Compensation, Release Years 2014-2023 SOAs, December 14, 2011). The HCs agreed in 2011 that Sockeye Salmon mitigation was best achieved by re-establishing natural production into previously blocked habitats. The HCs also agreed that releases of hatchery produced fry into Skaha Lake was necessary to conduct a risk assessment used to inform COBTWG's decision to open passage to Skaha Lake, and ultimately Okanagan Lake. The successes of the Reintroduction Program have been the catalyst for the governments of Canada and the ONA to allow seeding of previously blocked habitats.

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<sup>1</sup> Adult Sockeye Salmon entered Skaha Lake in 2011 because of a high flow event, but passage was officially restored by reactivation of the fish ladder at the Skaha Lake Outlet Dam in 2013. Another downstream barrier, McIntyre Dam, had passage restored in 2009.

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