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REBUILDING **PLAN**

Okanagan Chinook Salmon

Oncorhynchus tshawytscha

ntytyix | sk’lwis

This rebuilding plan was developed through a technical collaboration developed by DFO Pacific Region and Okanagan Nation Alliance.

Date stock was determined to be at or below the limit reference point: 2011

Date stock was prescribed to the Fish Stocks provisions: April 2022

Date rebuilding plan was approved: March 2024

Canada

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Foreword

In 2009, Fisheries and Oceans Canada (DFO) developed A Fisheries Decision-Making Framework Incorporating the Precautionary Approach (PA Policy) under the auspices of the Sustainable Fisheries Framework. It outlines the departmental methodology for applying the precautionary approach (PA) to Canadian fisheries. A key component of the PA Policy requires that when a stock has declined to or below its limit reference point (LRP), a rebuilding plan must be in place with the aim of having a high probability of the stock growing above the LRP within a reasonable timeframe.

In addition, under section 6.2 of the Fish Stocks provisions (FSPs) in the amended *Fisheries Act* (2019), rebuilding plans must be developed and implemented for prescribed major fish stocks that have declined to or below their LRP. This legislated requirement is supported by section 70 of the *Fishery (General) Regulations* (FGRs), which set out the required contents of those rebuilding plans and establish a timeline for each rebuilding plan's development.

The purpose of this plan is to identify the main rebuilding objectives for Okanagan Chinook, as well as the management measures that will be used to achieve these objectives. This plan provides a common understanding of the basic "rules" for rebuilding the stock(s). This stock is *prescribed* in the *Fishery (General) Regulations* (section 69) and thus *is* subject to section 6.2 of the *Fisheries Act* and regulatory requirements.

The objectives and measures outlined in this plan are applicable until the stock(s) has reached its rebuilding target. Once the stock is determined to be at the target, the stock(s) will be managed through the standard Integrated Fisheries Management Plan (IFMP) or other fishery management process to fulfill the requirements of the FSPs. Management measures outlined in this rebuilding plan are mandatory, and may be modified or further measures added if they fail to result in stock rebuilding.

This rebuilding plan is not a legally binding instrument which can form the basis of a legal challenge. The plan can be modified at any time and does not fetter the Minister's discretionary powers set out in the *Fisheries Act*. The Minister can, for reasons of conservation or for any other valid reasons, modify any provision of the rebuilding plan in accordance with the powers granted pursuant to the *Fisheries Act*.

Decisions flowing from the application of this rebuilding plan must respect the rights of Indigenous peoples of Canada recognized and affirmed by section 35 of the *Constitution Act* (1982), including those through modern treaties. Where DFO is responsible for implementing a rebuilding plan in an area subject to a modern treaty, the rebuilding plan will be implemented in a manner consistent with that agreement. The plan should also be guided by the 1990 *Sparrow* decision of the Supreme Court of Canada, which found that where an Aboriginal group has a right to fish for food, social and ceremonial purposes, it takes priority, after conservation, over other uses of the resource.

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1 Introduction and Context

1.1 Biology of the Stock

Okanagan[1] River Chinook (*Oncorhynchus tshawytscha)* is a transboundary stock management unit that migrates through both Canadian and American waters. A small portion of the population spawns in the Okanagan watershed within Canada and a large portion of the population spawns in the U.S. Okanagan River in Washington state. Okanagan River Chinook are the only remaining Chinook salmon in the Columbia River Basin within Canada and are genetically distinct from all other Chinook stocks in Canada. This rebuilding plan is developed to support increasing the population of Okanagan Chinook in Canada to a level where the objectives laid out in this report have been met. This population has primarily an ocean-type life history and is considered a Designatable Unit (DU) under the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), a Conservation Unit (CU) under Canada's Policy for Conservation of Wild Pacific Salmon and a Stock Management Unit (SMU) by Fisheries and Oceans Canada. The SMU includes summer Okanagan Chinook and focusses on the summer population, since these are the only fish for which we have information. Although we know that there is a spring run of Chinook, there is limited information available to quantify them. Note that it is likely that any measures in place to rebuild the summer-run component would also benefit the spring component. Within the last 15 years the spawning population has ranged from 5 to 80 fish, with the bulk of the population being of natural origin and a small portion being hatchery origin (Figure 3).

Chinook Salmon are the largest of the five salmon species in the genus *Oncorhynchus*. Chinook salmon, including Okanagan Chinook can grow to exceed 1 meter in length. Okanagan Chinook generally return to spawn in their natal rivers or streams in October as 4- or 5- year-olds but can range from 3 to 7 years at maturity. Once the eggs are deposited in the redds, adult salmon die and the eggs incubate until they hatch in late March to early April. Upon hatching, juvenile Chinook rear in freshwater before migrating to the ocean two to five months after hatching (ocean-type). Juveniles have been observed migrating downstream from the Okanagan River into Osoyoos Lake during late May and June, although little biological information has been collected on this life stage (COSEWIC 2017).

1.1.1 Distribution

Okanagan Chinook are anadromous; they spawn in the Okanagan watershed located within British Columbia and travel to the ocean via the Okanagan River which runs into the Upper Columbia River before entering the Pacific Ocean. Upon their return at four or five years old, Okanagan Chinook migrate back through Oregon and Washington State before returning to British Columbia into Osoyoos Lake in the summer and spawn from middle to end of October, predominantly in the Okanagan River.

Okanagan Chinook range of population habitat use have been defined as the area composed of (Figure 1):

a. The Okanagan River and all bodies of fresh water in Canada that flow directly or indirectly into the Okanagan River,
b. Wood Lake, Kalamalka Lake, Okanagan Lake, Skaha Lake, Vaseux Lake, portion of Osoyoos Lake north of the Canada and USA border,

[1] The Canadian spelling of Okanagan is used throughout this document for consistency instead of switching between the American (Okanogan) and Canadian spelling.

c. The Similkameen River and all bodies of fresh water in Canada that flow directly or indirectly into the Similkameen River; and
d. All bodies of fresh water in Canada that flow directly or indirectly into the part of waterbodies referred to in paragraph (b).

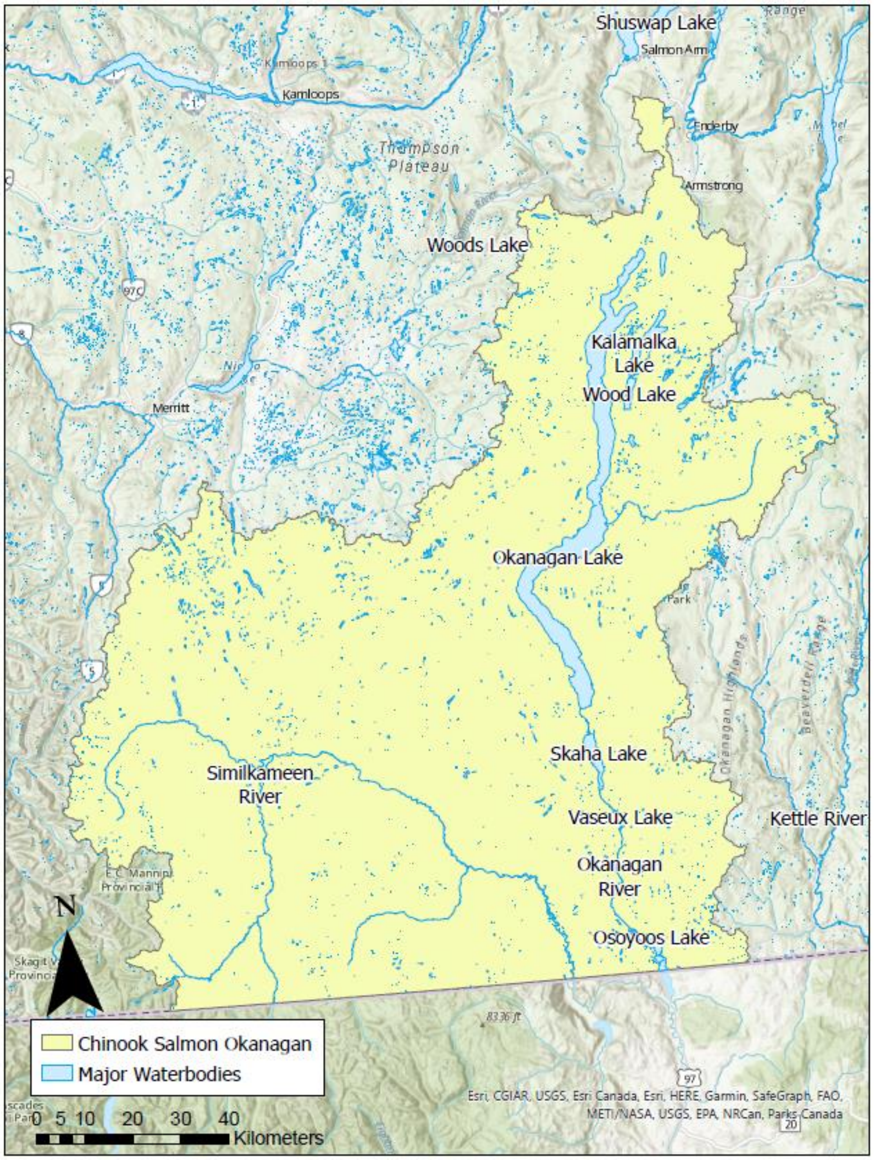

Figure 1. **Potential Canadian habitat use range for Okanagan Chinook.**

1.1.2 Relevant environmental conditions or ecosystem factors affecting the stock:

Okanagan Chinook spawn predominantly in an 8 km-long reach of natural/semi-natural habitat in the Okanagan River above Osoyoos Lake and require similar conditions to other Chinook stocks. This generally includes cool, well oxygenated water and suitable substrate for egg deposition and incubation, free from excessive fine sediment (see Mahony et al. 2021 for further details). The Okanagan River has had many human-made modifications including the building of dams, channels and dykes. These modifications have negatively impacted Okanagan Chinook passage to and from the spawning grounds. Along their route to and from the ocean Okanagan Chinook pass through up to 13 hydroelectric or water storage dams, three in British Columbia (Okanagan Lake Outlet Dam, Skaha Outlet Dam and McIntyre Dam) and 10 throughout Washington and Oregon state which alter the migration corridor. Juveniles must survive downstream passage over multiple dams and when they return as adults they must locate fishways and navigate reservoir slack water. Both life stages must tolerate elevated water temperatures in reservoirs and fishways, and high and variable flow releases in dam tailraces (COSEWIC 2017). Similar to other salmonid stocks, Okanagan Chinook are also impacted by rising ocean and river temperatures, invasive species, water withdrawal, pollution and habitat degradation/loss. More detailed information on conditions and ecosystem factors can be found in the Probable Causes of Decline Section.

1.2 Directed Fisheries and Incidental Catch

Due to the low population size, there are no Canadian directed fisheries on Okanagan Chinook. Okanagan Chinook are caught in Canada and the United States in the ocean Aggregate Abundance-Based Management (AABM) fisheries that target Chinook Salmon, but harvests are incidental to other, more abundant Chinook stocks (see Table 1 for Canadian exploitation rates). A detailed overview of fishery mortality (landed catch and incidental mortality) can be found in the recent Pacific Salmon Commission Okanagan Work Group report (PSC 2023) . More detailed information on historic fishing conditions can be found in the Probable Causes of Decline Section.

Table 1. **Canadian Exploitation Rate by year.**

Year	Canadian Exploitation Rate (%)
2008	6.4
2009	10.7
2010	11.6
2011	7.5
2012	12.9
2013	10.5
2014	6.9
2015	3.7
2016	10.6
2017	10.2
2018	8
2019	2.3
2020	0.6
2021	2.3

1.3 Fisheries management issues

Conservation of Okanagan Chinook is complicated by interception in mixed-stock fisheries and associated Pacific Salmon Treaty management regimes because of its low spawner abundance in Canada and its presence in the large AABM fisheries in Canada and the United States on the West Coast of Vancouver Island, Northern B.C. and Southeast Alaska. There have been very few detections in the Individual Stock Based Management (ISBM) fisheries in Canada with higher exploitation in U.S. ISBM fisheries in the Columbia River and on the coasts of Oregon and Washington (Mahony et al. 2021). The Canadian component of this stock is in low abundance, so fish mortalities are few, but the relative impacts to the stock and its recovery are high. Overall, the Canadian fishery impacts have been reduced substantially since 2019 because of Canada's fishery management actions for other Canadian Chinook stocks of concern.

The Columbia River mainstem fisheries in the U.S. currently have the highest exploitation rate on this stock (Mahony et al. 2021). There are directed recreational and tribal fisheries on Okanagan River Chinook salmon in the mainstem Columbia River, particularly in Wells Pool, and in the U.S. portion of the Okanagan River. Currently there are no ISBM fishery management arrangements under the Pacific Salmon Treaty (PST) for the Okanagan stock; however, this stock is currently under consideration as an Indicator Stock for the coordinated fishery regime management in both countries for the current PST agreement which expires after 2028.

1.4 Cultural impacts and Socio-economic impacts of the declines of the stock to date: (Johnson, S. 2024)

The following is the Executive Summary from an independent report prepared by Suzanne Johnson on behalf of the Okanagan Nation Alliance on the impacts of the decline of Chinook salmon stocks on their communities. The Okanagan Nation Alliance submitted the report to the Department of Fisheries and Oceans Canada (DFO) as part of the development of this rebuilding plan to convey their perspective to DFO. The views and conclusions expressed in this report are those of its author and the Okanagan Nation Alliance. Inclusion of this summary in this rebuilding plan does not indicate that DFO endorses or accepts any of the statements, claims or conclusions expressed in the report. The summary is included here solely to document and share the perspective of the Okanagan Nation Alliance in their own words. A full version of the report can be requested from the Okanagan Nation Alliance.

> "Syilx people identify as Salmon People and as such salmon is a key indicator of well-being (Bower, 2023; Johnson, 2020; Vedan, 2002). While Aboriginal Fishery rights are protected for food, social and ceremony purposes (Gaertner, 2004), Syilx applications of these rights have been minimized by colonial governments resulting in significant negative impacts to the socio-economic well-being of Syilx people. This well-being extends from the dinner table to the broader ecosystems that both humans and salmon are intertwined in. The important relationship that Syilx have with Chinook Salmon (sk̓lwist) (Oncorhynchus tshawytscha) as a part of the food system, has become increasingly difficult to maintain. As a result, declines in stocks contribute to many health problems that are increasing in acuity and has further impacted important economic, political, social and spiritual relationships as well as the physical well-being of Syilx people (Bower, 2023; Johnson, 2020; Raschke & Cheema, 2007).
>
> Syilx livelihoods have been threatened by declines in stocks limiting the ability to participate in the economy of salmon. Settler governments restricted the participation in the economy to sustenance while limiting opportunities for equitable livelihood, that kept average incomes historically low (Chief Bryon Louis, 2023). Restrictions to the Syilx governance of salmon that

included spiritual reciprocation and care for all who are present, contributed to a significantly impoverished income-based food insecurity and cultural food security for Syilx people (Blanchet, et al., 2022; Johnson, 2020). Food in-security is known to contribute to a dietary shift that results in excessive intakes of nutrients that contribute to high rates of chronic disease reported amongst Syilx adults as well as other aspects of ill-health (Blanchet, et al., 2020).

The decline in Chinook Salmon stocks had negative effects on numerous social relations that were normally fostered through activities related to governance, harvesting, processing and distribution of salmon. As well as the risk to cultural continuity (passing on culturally scientific knowledge through nsyilxcn), Syilx have been impacted by disharmony with decreased opportunities to work together as family. The decreased opportunity to share distinct teachings of specific roles with salmon has impacted a sense of identity for many who did not have the opportunity to fulfill their jobs in relation to salmon.

Eating salmon is linked to a strong sense of culture and well-being (Blanchet, et al., 2021) and there are numerous examples of how ceremony, songs and feasts with salmon are important to Syilx life ways (Ernst & Vedan, 2000; Okanagan Nation Alliance, 2017a). As a component of the colonial violence that has been inflicted on Syilx, declines in salmon have contributed to a decrease in spiritual connectedness for some Syilx people (Johnson, 2020). The many disconnections from salmon that have been experienced by Syilx are compounded to a state of un-wellness that may be expressed as the current crisis for many young people who are coping with substance use disorder and too frequently experiencing suicide (Chandler & LaLonde, 1998; First Nations Health Authority, 2017).

Declines in stocks have contributed to a threat to human survival by threatening the ecosystems that humans and salmon interact in. Syilx lifeways foster attachments to land and identity which serve as a primary prevention of illness (First Nations Health Authority, 2017). A stable ecosystem is a fundamental prerequisite to health of humans (World Health Organization, 2023). Sustainability and the survival of all living things is dependent on the restoration of Syilx social systems that facilitate the transmission of place-based knowledge to care for salmon as part of a broader food ecosystem."

1.5 Committee on the Status of Wildlife in Canada (COSEWIC) assessment status and the Species at Risk Act (SARA) listing decisions

COSEWIC assessed the Okanagan Chinook DU as Endangered in 2005 and re-assessed it as Threatened in 2006. This assessment triggered a process under SARA to support the Governor in Council's decision on whether to list Okanagan Chinook as Threatened under SARA. The Government of Canada declined Okanagan Chinook for SARA listing in 2010. Most recently, COSEWIC reassessed this population as Endangered in 2017 and, as a result, a new listing process has been triggered and is underway.

2 Description of Stock Status and Stock Trends

Science branch is currently carrying out work to formalize the process by which reference points under FSPs in the amended *Fisheries Act* (2019) are defined, and science advice is delivered to inform documents like Rebuilding Plans, which do not undergo scientific peer-review. A new document, called a Fisheries Science Advisory Report, or FSAR, is being developed Nationally to provide science advice on stock status relative to reference points that are consistent with the DFO Precautionary Approach, provide harvest advice, and inform the rebuilding plans. The timeline of this report did not enable for the associated FSAR document on Okanagan Chinook to be published beforehand, and so preliminary science advice is being provided in this document instead. While the information provided here was developed by DFO and Okanagan National Alliance (ONA) biologists, it should be noted that it has not undergone peer review and should therefore be considered preliminary and may be updated subsequently. Therefore the LRP provided in Table 2 should be considered preliminary, until the publication of the associated FSAR document (expected later in 2024).

Table 2. Summary of the Precautionary Approach Framework reference points for Okanagan Chinook.

PA reference point	Stock-specific value of the reference point
Limit Reference Point (LRP)	1,000 natural origin spawners + positive population growth over three generations
Upper Stock Reference (USR)	N/A
Target Reference Point (TRP)	N/A
Removal Reference (RR)	N/A

2.1 Stock History and Trends in Abundance

While quantitative data on the stock's historical range and abundance do not exist, Indigenous Knowledge can provide insight into the range and abundance of this stock prior to the large-scale habitat degradation, widespread dam building, and high fishing pressure this stock has experienced. Chinook were historically able to reach both Skaha and Okanagan lakes, and were said to have thrived throughout all accessible reaches of the Okanagan River (PSC OWG 2023). Chinook salmon were heavily fished at Okanagan Falls at the outlet of Skaha Lake and provided for abundant food fisheries and trade (Ernst 2000). Chinook salmon were an important food source for the Okanagan/Syilx people, and fish were said to be plentiful, and easy to harvest (Armstrong 2015).

In the late 1800's fishing practices (using fish fences) on the U.S. side of the Okanagan River likely entirely blocked passage for Canadian Okanagan Chinook during some years (Dept. of Fisheries, 1888). Throughout the 20th century, the Columbia and Okanagan rivers have been dammed in at least 13 locations (Mahony et al. 2021). When Grand Coulee Dam was constructed, the Grand Coulee Fish Maintenance Program trapped all Chinook that were migrating past Rock Island Dam to the Upper Columbia from 1939 to 1943. Columbia summer-run Chinook were transported to the Wenatchee, Entiat and Methow rivers but none were released in the Okanagan River (Matylewitch et al. 2019). After being virtually extirpated (i.e. only the age-6 cohort that spawned in 1938 may have had some fish return to the Okanagan in 1944), the stock has slowly re-established through a combination of natural upper Columbia summer Chinook spawners and hatchery releases into the U.S. Okanagan River, beginning in the late 1980s. While abundances of summer Chinook in the U.S. Okanagan River have increased and consistently achieve escapement goals, the Canadian portion of the population has not recovered. Its continued depressed state has mainly been attributed to a loss of spawning habitat due to straightening and channelizing of the Okanagan River, poor freshwater survival for egg-to-smolt life stages and for adults during return migration, and high fishing pressure (Mahony et al. 2021). Based on this historical knowledge, it is likely that the population dropped below its LRP in the late 1800's, but would have certainly been below any conceivable LRP following its virtual extirpation due to the Grand

Coulee fish maintenance program from 1939-1943. Since it began to re-establish in the 1980's, population levels have been severely depressed, and continues to be below any conceivable LRP.

Hatchery releases of Okanagan Summer Chinook into the Canadian Okanagan River began in 2017 with eggs obtained from U.S. Okanagan broodstock and reared at the kł cp̓əlk̓ stim̓ hatchery in Penticton, B.C. Spawner abundances in Canada are usually too low to collect broodstock, but one to three fish were collected in 2017, 2020 and 2022. Fry release numbers have ranged from 0 to 42,000. Tagging studies carried out from 2019-2022 found that hatchery Chinook released from kł cp̓əlk̓ stim̓ hatchery into the Canadian Okanagan River had lower downstream survival than other Upper Columbia summer stocks (PSC 2023). Survival to Rocky Reach dam (about halfway from the spawning grounds to the Columbia River mouth) ranged between 4% to 24% across four years, whereas migration from spawning grounds to the same location for hatchery releases from Chief Joseph Hatchery (on the U.S. side of the Okanagan River) were close to 70% (PSC OWG 2023).

This population is managed along with other Upper Columbia Summer Chinook stocks, which collectively have an escapement target of 12,143. Since 1999, this stock group has consistently exceeded its escapement goal, and therefore harvest has not been restricted to the limits outlined in the 2019 Agreement for the Pacific Salmon Treaty. In the years for which there are escapement estimates for Canadian Okanagan Chinook, abundance has been highly correlated with the abundance of this larger aggregate of populations (85% correlated). Canadian Chinook has made up between 1 in 1,000 and 1 in 10,000 fish from this aggregate, meaning that at the escapement goal of 12,143, we would expect to see between 1 and 12 Canadian Okanagan Chinook, if the proportion stays within the range observed since 2006.

2.2 Data Availability

A time series of spawners exists, starting from 2006 (Figure 2). The current index of abundance represents spawners from above Osoyoos Lake, as far upstream as the outlet of Okanagan Lake (Figure 2). Although habitat above the outlet of Okanagan Lake was blocked in the past, some Chinook have been able to access Okanagan Lake, incidentally, by passing through the gates of Okanagan Lake Dam during high water, or when the fishway at the dam was opened for Sockeye spawner migration from 2019 onward. Following these few access opportunities, adult Chinook were observed as far north as Kalamalka Lake. Beginning in September 2022, the Penticton Dam fishway was open for Chinook passage, making all areas of Okanagan Lake accessible to Chinook, though passage into Kalamalka Lake is still partially impeded by a dam at its outlet. The Kalamalka Lake dam is a partial barrier because it is an undershot dam with low elevation difference and fish can swim up through the opening when it's open wide enough. It remains to be seen how many fish will migrate beyond the Okanagan Lake dam, and how they will distribute throughout the watershed. Established stream walk surveys in Okanagan Lake tributaries have targeted other species (e.g., Kokanee salmon) and do not coincide with the timing of Chinook spawning; therefore, there is limited evidence of spawning activity in the tributaries thus far. However, new programs with adjusted timing are under development and more closely algin with Chinook spawn timing.

The stream float/walk abundance estimates from the spawning grounds in the mainstem Okanagan River are based on area-under-the-curve analyses, which depend on estimates of survey life in spawning areas and observer efficiency. Since these values haven't been measured for this population, they are borrowed from other populations, introducing uncertainty in these estimates that is currently not quantified. These factors make the current abundance estimates uncertain, and preclude the use of more robust estimation and modelling methods, such as stock-recruitment analysis, for this population.

Recently, more accurate PIT-tag (passive integrated transponder) based mark-recapture surveys were initiated to develop a census of actual total spawner abundances rather than abundance indices. The first estimate was made in 2020, at 195 individuals (when natural origin spawners from the stream survey were estimated at 73), so true abundance is likely higher than estimates based on stream floats/walks. Unfortunately, due to low PIT release numbers in brood years 2017 and 2018 and a lack of sufficient recoveries in 2021 and 2022, producing mark-recapture estimates was not possible for these years. Brood year 2019 had larger PIT-tagged release, so a mark-recapture based estimate will likely be developed for return year 2023 so long as a sufficient number of tagged fish return from this release. Despite renewed focus on the Okanagan population, it still remains data-limited, as only a short time series of abundance index data exist, and uncertainties remain about how much of the population is being counted in this time series. Additionally, the population's accessible range is rapidly expanding due to creation of fish passage at the Okanagan watershed dams, and it remains to be seen how these changes in range could affect the proportion of the population captured in the current index of abundance.

2.3 Candidate Reference Points

An LRP was not identified for this SMU in advance of the development of this rebuilding plan, and this plan was triggered based on the knowledge that it has been in a severely depressed state since it began to re-establish itself. Therefore, we will discuss candidate reference points that could be used for this population, before suggesting an interim LRP, determined by the science participants of the rebuilding plan team. This LRP may change during the FSAR review process, planned to occur in Spring 2024.

A threshold of 1,000 mature individuals is often-used by COSEWIC (COSEWIC 2017) to delineate between Endangered (current Okanagan Chinook COSEWIC designation) and Threatened statuses, for small animal populations (COSEWIC 2021; criterion D1). For Pacific salmon, this value has been used as a recovery target (Arbeider et al., 2020, Weir et al. 2022), an indicator (among others) to determine stock status under the Wild Salmon Policy (Grant et al. 2020), and is commonly used as an estimate of a minimum viable population size (MVP; Bradford and Wood, 2004). When synthesizing genetic evidence for minimum viable population size, Allendorf and Ryman (2002) concluded that a population size of at least 1,000 is necessary to maintain genetic variability. Several studies have called into question whether this commonly-used value is adequate as an MVP (see Lynch and Lande, 1998 for an overview). A review of MVPs of vertebrate populations showed that 5,000-7,000 may be a more realistic minimum viable population size (Reed 2003), and another found a median value of approximately 4,000 across >100 papers spanning over 30 years (Traill et al. 2006).

Guidance exists for determining benchmarks under the Wild Salmon Policy for cases where stock-recruitment data are unavailable, where historic percentiles of spawner estimates can be used to estimate upper and lower benchmarks (Holt et al. 2018). However, the analysis showed unstable results for populations with high harvest (above 40%) and low productivity (below 2.5 recruits-per-spawner at low population size), and urges caution in applying those methods in such situations. Catch-year exploitation rates for this population have exceeded 50% every year from 2003-2019 (31% in 2020; Figure 4). Since no persistent growth trends have been observed for this population at harvest rates near 50% (20-year average 2001-2020 was 51.9%), we assume total productivity (including survival) remains near two recruits-per-spawner. Therefore, these methods would not be precautionary to use, and historical percentiles of spawner estimates are not recommended to determine upper and lower benchmarks.

Another potential benchmark available for this population is based on habitat area. This approach is based on Parken et al. (2006) and uses the accessible watershed area for this population, and a relationship between estimates of the spawning escapement that produces the maximum sustainable yield (S_{MSY}) and the accessible watershed area based on a regression relationship for populations of ocean-type Chinook ranging from coastal Oregon north to Southeast Alaska. The accessible watershed area estimate was updated for this report to represent the increase to accessible watershed area, from 604 km^2 to 1,132 km^2 due to dam passage actions that have happened since the estimate was generated in 2007 (Davis et al. 2007;Table 3). While this benchmark is rooted in the biology of this population, it doesn't align well with the current escapement time series, which only captures the spawners in the habitat that was available up until recent years.

Therefore, if this benchmark is to be employed, it should be compared to the in-development whole-population mark-recapture estimate. This benchmark likely has promise to be used in the future, assuming the population expands its range, but has limited utility currently. The lower benchmark is also below 1,000, which might not be adequately precautionary given what is known about the risks of small population sizes discussed above. In past Pacific salmon RPA processes (see Weir et al. 2022) when a recovery target was found to be below 1,000, a default to the COSEWIC criterion D1 of 1,000 was used to be precautionary. Following this convention, this lower reference point would not be used. The upper reference point may hold some utility as a potential upper reference point in the future, if the stock does recover.

Table 3. Original, and updated habitat-based benchmarks for Canadian Okanagan Summer Chinook[2].

Benchmark	Lower	Upper
Davis et al. (2007	328	2,890
Updated (2023)	641	4,610

Recent work by DFO (2022) to create guidelines for defining LRP's for Pacific Salmon have suggested that LRPs be based on not having any conservation units (CUs) in the red zone (DFO 2022). This leads to a "CU Status-Based LRP", which would be determined by assessing each component CU under Wild Salmon Policy (WSP) conventions. Additionally, recent work by DFO (2023b; Pestal et al. 2023) has streamlined the WSP assessment process, which up until now has generally been an expert-driven process (see DFO, 2015, 2016; Grant et al., 2020; Grant & Pestal, 2012) and has required significant effort to complete. In those assessments, experts are presented with a dashboard of status metrics, and integrate across them to determine status. The rapid status tool uses an algorithm, which employs a set of decision rules that approximate the expert-led decision-making process (DFO 2023b, Pestal et al. 2023). The first "bottleneck" in this process is meeting a minimum population size of 1,500 individuals – called the absolute abundance metric. This number was chosen because experts often wanted to

[2]Note: Upper benchmark is 85% of S_{MSY}, the number of spawners required to reach Maximum Sustainable Yield. Lower benchmark is $S_{gen,}$ the number of spawners required to reach S_{MSY} in the absence of fishing, in one generation. These two reference points are often used as lower and upper benchmarks for Wild Salmon Policy status assessments. These updated habitat-based benchmarks should be considered preliminary, as work is ongoing to improve their estimation, including better characterization of the uncertainty within these estimates.

employ some caution around the absolute abundance threshold of 1,000 (based on COSEWIC criterion D1) – and generally if a population was below 1,500, it would be designated as “red” by experts, regardless of other metrics. This tool produces dashboards, with a suite of metrics, depending on the data availability of the stock. The dashboard for this stock can be seen in Figure 2.

There are four primary metrics used in the algorithm to derive rapid status. The first is the relative abundance metric, which compares a time series of abundance to a provided benchmark. In our case, since we did not have a benchmark on the same scale as our relative abundance time series, we cannot glean status from this metric. Second is the absolute abundance metric, described above. In this case, we have gleaned status from this metric, since we believe our abundance time series has been capturing enough of the population, that this is a suitable number to be compared to 1,500 (giving a red status). The next two metrics are trend-based, the long-term trend metric uses the ratio of the current generational average abundance to the long-term average spawner abundance. The lower and upper benchmarks for this metric are values of 50% and 75%, delineating the Red, Amber, and Green metric status zones. The percent change metric measures the linear change in total spawner abundance. The slope of the time series is calculated over three generations, using log-transformed data. Lower and upper benchmarks for this metric are -25% and -15%, respectively. Despite these metrics giving green status, in the algorithm, the absolute abundance benchmark is prioritized, and the overall status is therefore red. The red status is given a high confidence rating, since having abundance below 1,500 guarantees red status in the algorithm, and there is confidence that this population is below this value.

The Okanagan Working Group of the Pacific Salmon Commission suggest a recovery target of a 4-year geometric mean spawner abundance of at least 1,000, paired with a positive population growth trend (PSC 2023). These objectives were used as the recovery target for the Recovery Potential Assessment for this stock (Mahony et al. 2021). Additionally, 1,000 is also listed as the LRP in the 2024 Integrated Fisheries Management Plan for the stock, which also provides a management target of 4,600 (DFO 2023a), based on the updated estimated S_{MSY} value (Table 3). Because the stock is in such a depressed state, and is currently expanding its range, setting a target reference point at this time is premature, as any value chosen likely won’t align with the potential size of the stock, if it is successful in re-colonizing previously inaccessible habitat. It is suggested that target reference points be revisited if/when the stocks status improves to at least above the LRP.

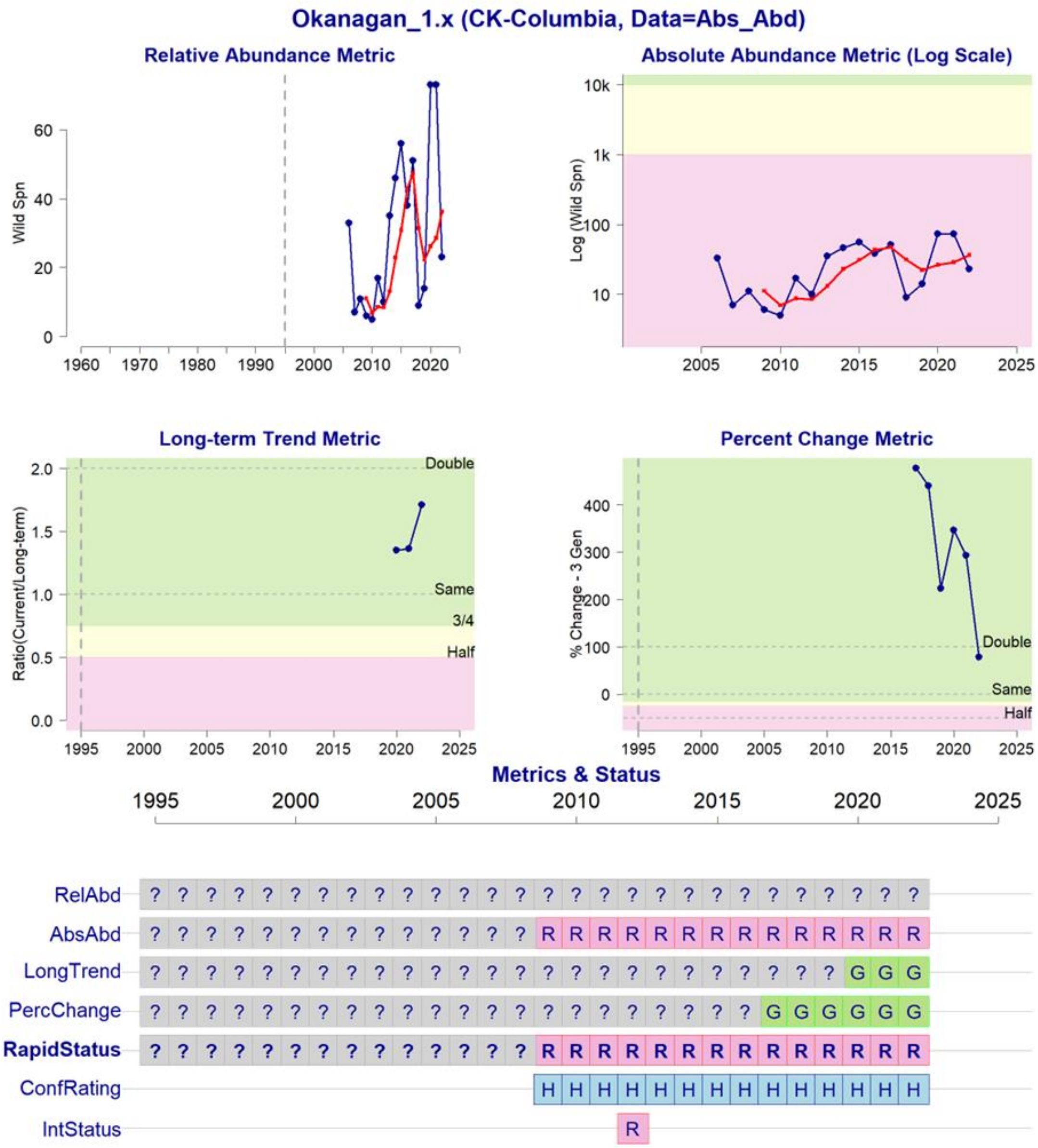

Figure 2. **Metrics and Status from Rapid Status Algorithm. Panels on top show the four standard WSP metrics, calculated based on the available time series of spawner abundances. Blue lines show raw data, red lines show generational averages. Bottom panel summarizes the status for each individual metric and shows the resulting rapid status for the CU for each year, along with a confidence rating ("H" indicating high confidence for all years in this case). Bottom line shows integrated status, which for this population is Red. For this CU, the relative abundance is currently not available, because there are no estimates of lower and upper benchmarks that match the scale of the spawner estimate. The absolute abundance metric is available, because the spawner estimate was categorized as captured most of the CU abundance. The absolute abundance metric, which drives status in this case, uses generational averages, so the first rapid status designation is available for 2009, four years after the start of the time series.**

2.4 Recent and Current Stock Status

The Okanagan Chinook DU was first assessed by COSEWIC on an emergency basis in 2005 as Endangered, due to its very small population size and impending increased exploitation in Columbia River fisheries (COSEWIC 2005). This DU was re-assessed by COSEWIC in 2006 at a lower status (Threatened), due to rescue potential from populations in adjacent areas of the Columbia River basin (COSEWIC 2006). In 2010 the Governor in Council declined to list this DU as Threatened under the *Species at Risk Act* (SARA), due to required commercial fishery closures costing millions of dollars to the BC economy to prevent bycatch, and because this reduction in Canadian catch would, by itself, not provide for the recovery of Okanagan Chinook (Canada Gazette, Part II 2010). Most recently, COSEWIC re-assessed Okanagan Chinook as Endangered in 2017, and rescue was deemed unlikely due to the uncertain status of source populations and viability of strays (COSEWIC 2017). In 2014, an integrated Wild Salmon Policy status assessment for all southern BC Chinook conservation units was carried out and listed the Okanagan Chinook CU's status as RED (poor status; DFO 2016).

This population is currently in a severely depressed state, as spawner abundance estimates based on stream floats/walks and carcass counts have ranged from 5-73 natural-origin spawners since 2006 (Figure 2). The only whole-population spawner estimate available, from 2020, estimated 195 spawning Chinook. Despite uncertainty in stock assessments, the population can be assumed to be in a state "below the LRP" due to its population size being well below any candidate abundance benchmark discussed above. Although the population does appear to be either stable or increasing in the past 10 years, and has not shown consistent signs of decline (Figure 2), any potential multiple-indicator approach will include an abundance benchmark to be met, and this stock is surely below it.

2.5 Definition of Interim Lower Reference Point

This population is currently in a state of flux, as more habitat is being made accessible, and as hatchery programs specific to this population are ramping up, therefore the LRP will need to be revisited as further information is gathered on how the population's range and abundance respond to these changes. Also, these factors make establishing a quantitatively-based benchmark difficult. The current index of abundance will not be consistent with future estimates of total abundances derived from the mark-recapture program that is currently being developed. Additionally, the data currently available does not lend itself to stock-recruitment analysis, and the current state of the population precludes it from percentile-based benchmarks, based on existing science advice. The habitat-based benchmarks for this stock do not currently align with the time series of abundance (but would align with future whole-population estimates) and since the LRP derived using this method is below 1,000, it is unlikely to be used. Alternatively, a Status-based benchmark is also an option for this population, based on the rapid status (provided here) or a manual integrated status assessment, which does not include explicitly determining an abundance-based LRP. It was determined that providing an abundance-based LRP was preferred by managers concerned with his stock, rather than a CU Status-based LRP.

Following the review of the above candidate benchmarks, the advice from DFO science members of the rebuilding team is to provide an interim multi-indicator, abundance-based LRP for this population. An LRP of 1,000 spawners, combined with positive population growth was identified as a preferred option. Positive population growth will be defined using the same method as the percent change metric from the rapid status algorithm (percent change in log-transformed spawners over three generations), except we will be placing the minimum slope at 0% (any positive growth). The recent DFO science guidance (2022), referenced above, for defining LRP's suggests the use of a "composite metric" approach for determining CU status, which should underly LRPs. Therefore, we believe an approach that defines more than one condition to be met to be considered above the LRP, is consistent with the current advice, while providing an abundance-based LRP, rather than a CU status-based LRP. This LRP will be reviewed through the FSAR process, planned for Spring 2024. Additionally, we suggest that the LRP (and other reference points) be revisited once the population has reached this very minimum threshold, and/or more consistent data becomes available. Until this occurs, the rebuilding target will be set at having the population above the LRP, with a high degree of certainty, knowing that the LRP is subject to change.

3 Probable Causes of the Stock's Decline

3.1 Historical Timeline

The Okanagan Chinook Stock Management Unit (SMU) has a long history and has seen many changes throughout the years. Written information on the stock dates back to 1888 in both Canada and the United States. There is ample evidence of historical Chinook migration above Okanagan Falls into Skaha and Okanagan lakes through oral stories and the existence of Syilx scaffolds for salmon fisheries at Skaha Lake bluffs, an area above the falls (Okanagan Nation Alliance 2003; Shepherd 1996; Vedan 2002). A robust trade economy existed for the Syilx Okanagan people as a result of these salmon (CRITFC 1995). Chinook salmon thrived throughout the accessible reaches of the Okanagan system prior to the extensive alterations of the watershed after the arrival of settlers.

The state of the current Okanagan Summer Chinook population results from the development of dams on the Columbia and Okanagan rivers, U.S. stock translocation programs to mitigate blocked fish passage, extensive habitat alterations and U.S. hatchery programs that intermixed multiple Upper Columbia Chinook populations (Matylewich et al. 2019). Okanagan Chinook disappeared following initial dam construction in the watershed in the 1930's, which is well documented in comprehensive Traditional Ecological Knowledge (TEK) interviews with elders of Syilx Okanagan communities (Ernst & Vedan 2000). Another impactful event was the channelization of the Okanagan River in the 1950's, where more than 90% of the spawning grounds and juvenile rearing habitat were destroyed (Hyatt and Stockwell 2019). Additionally, an irrigation system which diverted water from the river was implemented at this time. A long history of destruction of stream and riparian habitat greatly compromised the function of the salmon ecosystem in the Canadian sections of the Okanagan River basin. Water resource development has included extraction, diversion and dam construction without operational fish passage, river dredging and channelization. These actions reduced the quantity and quality of salmon habitat available for reproduction and juvenile rearing. Other types of rural and urban developments have impacted water quality and temperature, which reach levels that are harmful to salmon and impact their behavior, cause stress, and mortality (Wang et al. 2003).

Factors in the United States, including mainstem dams on the Columbia River and high fishing rates have also reduced Okanagan Chinook spawning numbers in Canada to less than 100 adults annually based on relative abundance visual surveys (Figure 2).

3.2 Population

The Okanagan Nation Alliance has been monitoring the Okanagan Summer Chinook population annually since 2005 and the population information is outlined below (Figure 3). Further information can be found in the Okanagan Chinook Recovery Potential Assessment (Mahony et al. 2021). Mean Smolt-to-Adult survival of the greater Okanagan summer Chinook population has been declining since brood year 2013, remaining well below 1% since then (PSC OWG 2023).

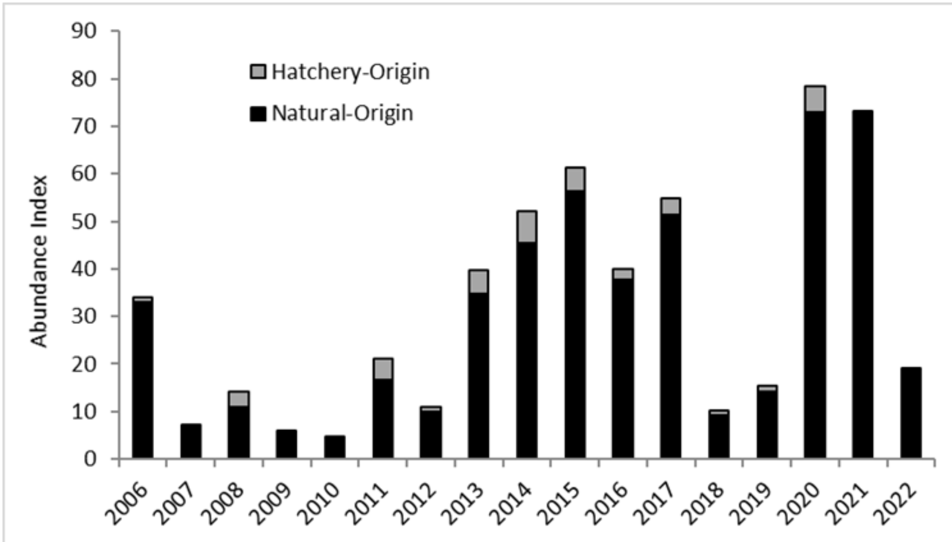

Figure 3. **Okanagan Summer Chinook Spawner Abundance Index 2006-2022.**

3.3 High threat and limiting factors to the Okanagan Chinook population

High-risk threats and limiting factors to the survival and recovery of Okanagan Chinook salmon are identified and discussed in the following section. We acknowledge that medium and low-risk threats and limiting factors exist for this species, however due to the scope of this report they were not included. Information on the extent and consequences of the medium to low-level threats and limiting factors can be found in Mahony et al. (2021) and the PSC OWG (2023).

3.3.1 Population declines due to resource use (i.e., fishing) (High population level risk, very high causal certainty)

There have been substantial historical fishing impacts for the Okanagan Chinook Salmon population. Historical catch estimates of Columbia River Chinook numbered in the millions but declined to the thousands by the early 1940s (Matylewich et al. 2019), reflecting the combined effects of fishing and dam construction. Harvest rates in the lower Columbia River during this time could have ranged as high as 90% but were reduced from the 1950s onward until 2008, after which they increased (Matylewich et al. 2019). The migration pattern and timing of Okanagan Chinook results in it being intercepted by multiple fisheries. Harvest rates are influenced by U.S. hatchery production levels in the Okanagan and Columbia watersheds which can cause increased fishing pressure on wild stocks. Due to wide ranging Chinook life history and distribution that overlaps with a number of fisheries targeting other stock or species, Okanagan Chinook become bycatch in the following fisheries: Commercial and Recreational fishing of the stocked Wells hatchery fish, the Pacific coast groundfish fishery, the Bering Sea- Aleutian Island and Gulf of Alaska groundfish fishery, and the Pacific Sardine fishery. Despite the absence of directed Canadian fisheries on the Okanagan Chinook population they may still experience harvesting impacts due to high levels of bycatch and incidental mortality during commercial harvesting in the ocean, ocean and freshwater recreational harvesting practices, and directed fisheries in the U.S. in Wells Pool and Okanagan River.

Figure 4 shows a condensed version of the percentage of adult equivalent (AEQ) total mortality in specific fisheries and escapement by calendar year. A northerly ocean distribution of Okanagan Chinook salmon is evident by the higher mortality percentages in both the Southeast Alaska (SEAK) and Northern

British Columbia (NBC) aggregate abundance-based management (AABM) fisheries, both of which have recently declined. AEQ mortality in the U.S. individual stock-based management (ISBM) fishery increased substantially in the mid-2000s and has been decreasing since 2014. Reflective of fisheries management changes in Canada to protect a number of Chinook salmon stocks, Canadian AABM fisheries percent of mortality was very low (< 2.5%) in 2019 and 2020.

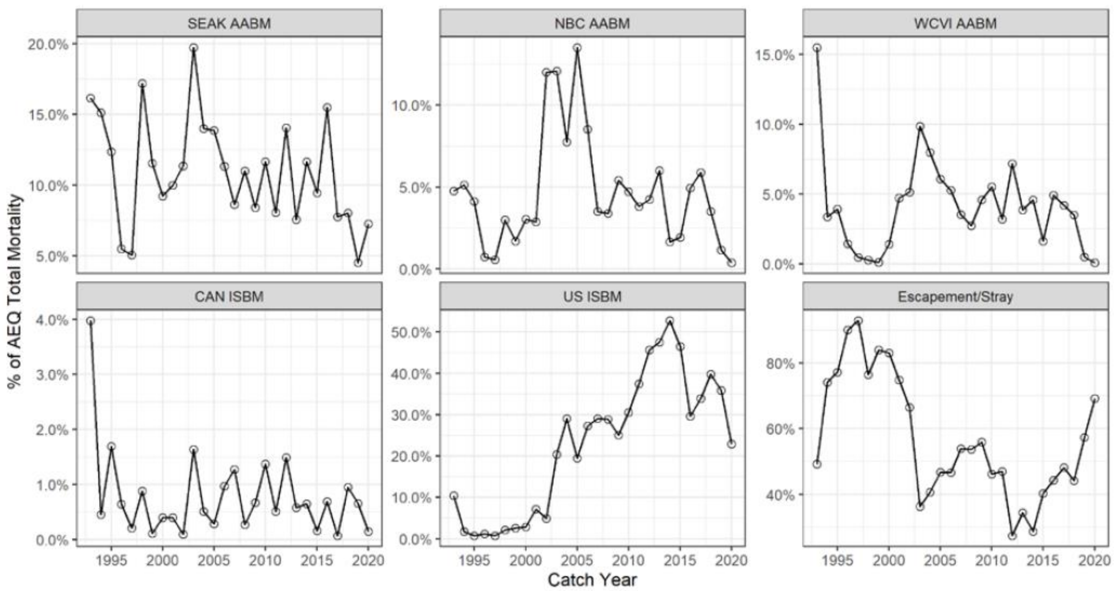

Figure 4. **Mortality distribution for catch years 1993 to 2020. Image from PSC OWG (2023). Note shifting y-axes between figures, which vary to allow more detailed views of each time series.**

3.3.2 Population declines and habitat impacts due to dams and water management use (high population level risk, high causal certainty)

3.3.2.1 Channelization

The Okanagan River system has been severely channelized in Canada resulting in significant degradation of Chinook salmon spawning and rearing habitat. Eighty-four percent of the river's mainstem was channelized in the 1950's, reducing the river length by 50% (Bull 1999; Bull et al. 2000; NPCC 2004). Only 16% of river in Canada downstream of McIntyre Dam remains in a natural or semi-natural state (Rivard-Sirois 2013) and spawning has been concentrated in an 8 km reach between Oliver and McIntyre Dam.

Channelization of a river system has multiple negative effects such as increased flow velocity, significant loss of riparian habitat, and elimination of off-channel habitat for juvenile rearing. Channelization and installation of gradient control structures in the Canadian Okanagan River created homogenous environments with increased sandy/fine substrates and less available spawning gravel, with reduced egg to fry survival in the channelized reaches (Greig et al. 2005). Off-channel habitat for rearing has been reduced to only short sections of natural (3 km) or semi-natural (2 km) states. Approximately 4% of potential off-channel rearing space is fully accessible to Chinook fry, 65% is very limited or partially connected via small diameter culverts through dikes, and 31% is inaccessible in the Canadian Okanagan River (McGrath et al. 2022). Several restoration projects have already been conducted along the

Okanagan River but habitat loss and degradation remain a substantial threat to the population's persistence.

3.3.2.2 Dams

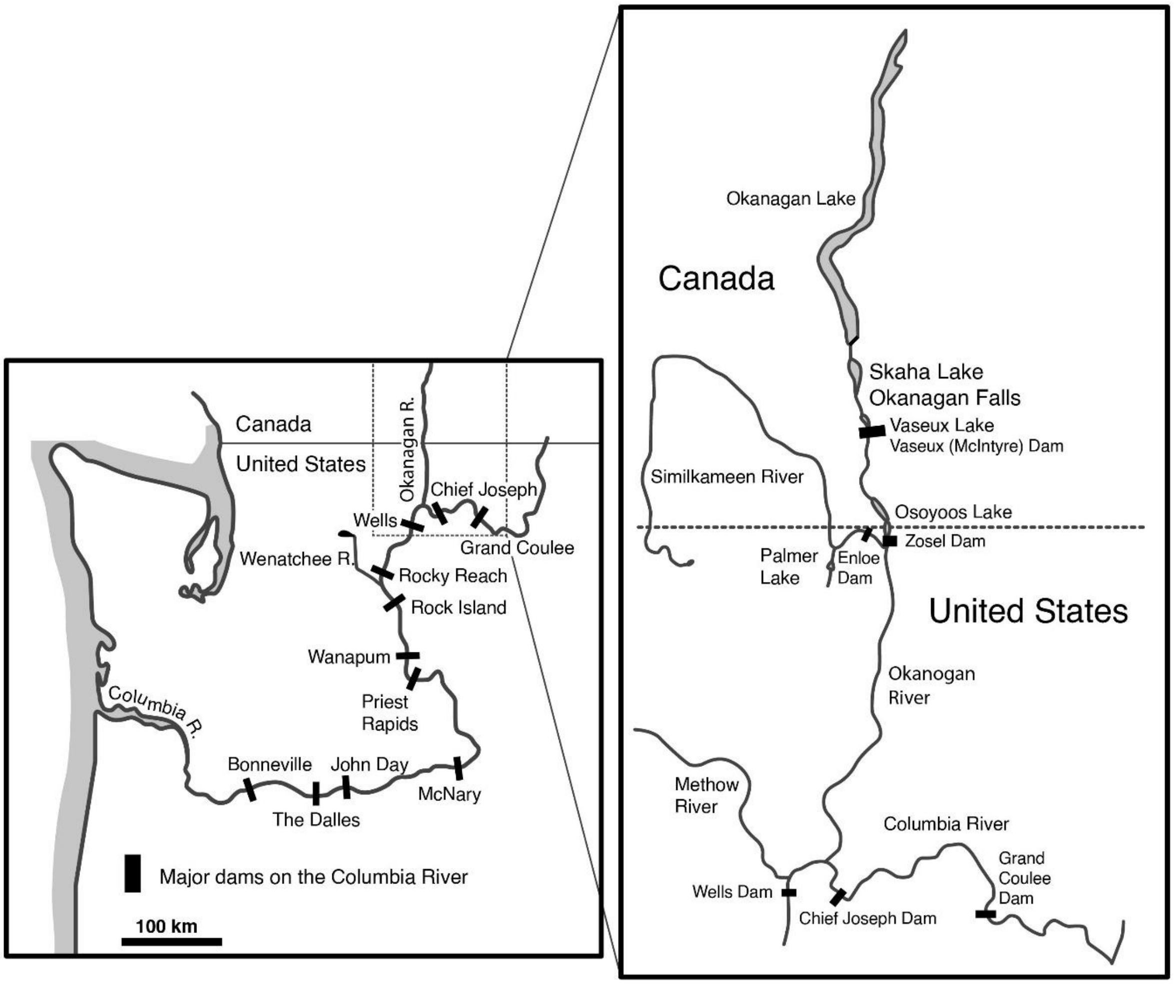

Figure 5. **Major dams on the Columbia River. Image from Nelitz et al. (2007).**

There have been many dams constructed along the Okanagan Chinook's migration route in both Canada and the USA that have resulted in increased migration challenges (see Figure 5). Dams alter water quality and freshwater habitats for juveniles and migrating adults. Decreased water flow from dam presence results in less dilution of runoff from agriculture and industry and it reduces the recruitment of gravel and wood from the riparian areas which are necessary for suitable spawning and rearing for Chinook. Dam reservoirs increase solar gains and water residence time, causing thermal stratification upstream and temperature gradients within fishways which can slow or terminate upstream migration by adults (Caudill et al. 2014). Declines in successful spawning events and dewatering of redds have resulted from rapid changes in water discharge rates from dams (Geist et al. 2008, Harnish et al. 2014). Further, dams have been known to block access to diverse habitat (Anderson et al. 2014), which Schindler et al. (2008) speculate to be an important buffer for salmon against climate change. The increased temperatures and slowed velocity of flow due to dams have been known to increase predation of out-migrating juveniles (Petersen and Kitchell 2001); and delay ocean entry (Marschall et al. 2001), respectively.

3.3.2.3 Fish Passage

From 1939 to at least 1943 the Grand Coulee Fish Maintenance program caught and relocated all summer Chinook from the Rock Island Dam to the Wenatchee, Entiat and Methow Rivers for spawning (Johnson et al. 2019). There is no record of releases of Chinook into the Okanagan during this time frame, which would have greatly affected the genetic distinctiveness of the historic Okanagan Summer Chinook population and effectively eliminated five consecutive brood years from their U.S. and Canadian range (Matylewich et al. 2019). Fish passage at Rock Island Dam was re-established in 1943, once again providing passage for Okanagan Chinook to their spawning grounds.

Many adaptations have been made to the dams obstructing the Okanagan and Columbia Rivers in recent decades. In 2009 a gate retrofit of McIntyre Dam was completed which enabled Chinook to access Skaha Lake, 7 km of Okanagan River mainstem habitat, Vaseux Lake, and one tributary. In 2014, activation of the fish ladder at Skaha Lake outlet dam enabled Chinook access up to the outlet of Okanagan Lake, including Skaha Lake, 6 km of mainstem river habitat upstream, and two tributaries. Partial fish passage was restored at the Okanagan Lake outlet dam, giving access to most of their historic range beginning in 2019, although modifications to the fish ladder are needed to improve passage through all flow conditions.

Though many alterations have been made to improve fish passage, not all have achieved the desired outcome and many more are still needed. Most dams on mainstem Okanagan River lakes have undershot gates, however, juvenile salmonids typically emigrate in the upper portion of the water column (Davidsen et al. 2005; Evans et al. 2001). In the diked river sections, side channels are partially connected through small diameter culverts. These culverts are open or regulated by sluice gates, often creating sub-optimal conditions for migrating juveniles. Fish may enter the side channels through strong currents and their passage back into mainstem is reduced through debris blocked culverts, possibly leading to fish entrainment and mortality (McGrath et al. 2022). Enloe Dam on the Similkameen River prevents adult Chinook passage into Canada. Taken together, these results indicate that further modifications to improve fish passage are required to achieve meaningful restoration outcomes.

3.3.2.4 Mortality

Juvenile salmon smolt mortality in the mainstem of the Columbia River is predominantly due to the immediate and delayed effect of passage through hydroelectric dams. In the case of the Okanagan Chinook, at least 9 dams must be passed in order to reach the ocean. Mortality is both directly (for example, through gas bubble disease during dam passage) and indirectly (e.g. by increased predation in reservoirs) attributed to the dams (Elston et al. 1997). There are many low head dams in the Canadian Okanagan including 17 vertical drop structures which present unfavorable hydraulic conditions for migrating adults and potentially for juveniles, delaying migration, and increasing vulnerability to predation and fishing. Okanagan summer yearling Chinook released from kł cp̓əlk stim̓ Hatchery generally have lower survival compared to all other U.S. Okanagan yearling release groups after accounting for distance, currently the cause of this lower survival is uncertain. The highest mortality rate occurs between the north end of Osoyoos Lake and Zosel Dam and is speculated to be due to a high predation rate in this area (see Description of Stock Status and Stock Trends).

3.3.3 Increased mortality or sub-lethal effects due to climate change (varying ocean and freshwater conditions) (High population level risk, high causal certainty)

The vast habitat range of the Okanagan Chinook makes them vulnerable to environmental change at multiple stages in their lives (see Table 4). Likely the most critical limiting or threatening climatic factor is increasing water temperature which could render certain habitats unusable, and hinder migration. Air and water temperatures are rapidly rising globally, with warm-ocean anomalies, such as marine heat waves occurring more often. The North Pacific Gyre Oscillation now better predicts emigration survival of Columbia River juvenile Chinook salmon than the Pacific Decadal Oscillation (Miller et al. 2014). Large scale transitions from snow-dominated basins to rain-dominated basins have been observed (Payne et al. 2004, Sawaske and Freyberg 2014) and will likely be the case for Columbia basin, impacting recovery efforts.

Climate change could have a devastating effect on the Okanagan Summer Chinook population. The Okanagan watershed is susceptible to increasing stream temperatures due to its low gradient, hot summer climate and water extraction (e.g. municipal and agricultural uses) which is further exacerbated by the extensive salmon habitat alterations seen throughout the watershed. Peak summer water temperatures often exceed the B.C. aquatic life guideline of 18 °C (Dessouki 2009). Combined with air temperatures predicted to continue to steadily increase (Porter et al. 2013), the Okanagan River Basin may rapidly be approaching lethal temperatures for salmonid species, except in areas of thermal refugia. Although there is high variability between salmon populations' thermal tolerances, a maximum thermal tolerance of 14.5°C for spawning adults, 21°C for migrating adults, and temperatures above 25°C being lethal (Richter and Kolmes 2005) serve as good benchmarks for temperature limits for this species.

The Okanagan Summer Chinook population relies on several cool water areas for holding during the summer before temperatures in the Okanagan River are cool enough for migration to their final spawning grounds. They encounter the first thermal barrier at the confluence of the Okanagan and Columbia Rivers. This disrupts their migration with a portion of the population holding in Wells pool in the Columbia River for 1-6 weeks (Pearl et al. 2022). Historical mean daily temperature data indicate that there is an average of 17 days at the beginning of July prior to establishment of the thermal migration barrier of 22°C, where adult summer Chinook can enter the U.S. Okanagan River (PSC OWG 2023). Often, the thermal barrier in Osoyoos Lake has already established during this time and fish must hold in the 2-3°C cooler waters of the Similkameen River, the primary pre-spawn holding habitat in the U.S. portion of the Okanagan River (PSC OWG 2023). The thermal barrier in Osoyoos Lake typically begins earlier and lasts longer than that in the U.S. Okanagan River due to the cooling influence of the Similkameen River in this area. Average surface water temperatures in Osoyoos Lake rarely drop below 22°C once they attain this temperature for the summer season, and Canadian-bound Chinook may complete a portion of their pre-spawning holding in Osoyoos Lake. It is possible that the use of the Similkameen river for pre-spawning holding could lead to a higher stray rate to that system, resulting in lower adult escapement to the Canadian Okanagan (PSC OWG 2023). Alternatively, a response to the changing temperature conditions could shift the periods for suitable migratory conditions earlier or later in the year (Isaak et al. 2017 & EPA 2020).

In Canada, cold water holding habitats are limited. The central and southern basins of Osoyoos Lake experience a temperature-oxygen squeeze during late summer in most years, reducing lake habitat for migrating fish to the North Basin, which is deeper and experiences temperature-oxygen squeezes less frequently. Temperatures in the Okanagan River mainstem typically exceed 22°C from mid-July to the third week of August. Thus, cool water holding habitats are limited to the North Basin of Osoyoos Lake, Skaha and Okanagan lakes, and potentially some deep pools in the natural reach of the Okanagan River between Skaha and Osoyoos Lake. Climate change related increases in air temperature are projected to increase the frequency and duration of time that the 22°C thermal migration barrier is exceeded, further delaying or preventing Okanagan Chinook migration to Canada.

Climate change may impact reproductive success through elevated water temperatures on spawning grounds in late September and October and could create a selective pressure for later spawn timing. Eggs have a significantly lower (~10°C) heat tolerance than adult fish and rely on placement in habitat that will avoid heat stress, hypoxia and scouring. The habitat occupied by Chinook and Coho juvenile and fry stages was found to be the most vulnerable in an assessment of mid-Columbia Basin salmonids (Hatten et al. 2014). Altered thermal regimes can result in ecological mismatches in aquatic ecosystems such as fry emerging before suitable food availability is present. Salt water is being pushed further upstream due to sea water rise, which is affecting estuary habitat and is predicted to be of increased importance to juvenile salmonids in response to climate change (Crozier 2015).

Table 4. Observed and predicted climate change-induced ecological effects on Chinook Salmon and other species of salmon. Table is from Mahony et al. (2021).

Impact	Relative Change	Qualification	Location/Salmon species	Reference
Spawning date	With an increase of 2 Degrees Celsius spawning occurs one week later since 1950	Observed	Columbia River/Chinook	Hayes et al. (2014)
Migration range	Northward Shift	Observed	Norway/Atlantic Salmon	Jensen et al. (2014)
Smolt Timing	2.5 days earlier/decade relative to 50 years ago	Observed	Atlantic Salmon	Otero et al. (2014)
Spawner Number	Decrease by 4-7% with a corresponding temperature of >17 Degrees Celsius	Predicted	Wenatchee/Spring Chinook Salmon	Honea et al. (2016)

3.3.4 Invasive and non-native/ alien species (High population level risk, Medium causal certainty)

Invasive species often become predators and/or competitors to resident fish (Scott and Crossman 1973, Alexis et al. 2003) and may reduce habitat options available for Chinook rearing. Walleye (*Sander vitreus*), Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieu*), and Northern Pike (*Esox lucius*) are likely to have the greatest predation impact on Okanagan Chinook salmon juveniles, and the invasive Eurasian Watermilfoil (*Miriophyllym spicatum*) creates prime habitat for these predators in the lakes and the Okanagan River mainstem. Zebra mussels (*Dreissena polymorpha*), Quagga mussels (*D. bugensis*), New Zealand Mud Snails (*Potamopyrgus antipodarum*), Didymo (*Didymosphenia geminata*), and Cyanobacteria dominance within the phytoplankton community cumulatively elevate the threat level faced by Chinook salmon through indirect interactions. See **Error! Reference source not found.** for more information.

Walleye have been found in the main stem of the Columbia River and rated as the highest risk for direct interaction with native salmonids in the U.S. (Alexis et al. 2003). Studies have shown that approximately 13% of juvenile salmonids were consumed by Walleye in the John Day Reservoir (Beamesderfer and

Rieman 1991), and would pose an additional threat to Okanagan Chinook if Walleye were to establish in the Okanagan River.

Northern Pike can consume up to 1.1 metric tons of salmon in one summer with age 3-4 Northern Pike capable of consuming the most fish (Sepulveda et al. 2015). A study conducted in the Columbia River found that salmonids made up 50% of Northern Pike diets (Doutaz 2019). Northern Pike up to 1 meter in size have been found in the Canadian portion of the Columbia River upstream of the confluence with the Okanagan River (Doutaz 2019). Although they have small home ranges (Craig, 1996b) pike can migrate up to 100 kms (Doutaz 2019) and could colonize the Okanagan River Basin given the right circumstances.

Smallmouth and Largemouth bass were introduced to many lakes in the Columbia River basin, including the Okanagan River and Osoyoos Lake (Brown et al. 2009). Salmon recovery goals may be hindered by nonnative smallmouth bass presence and have been identified in the U.S. as a critical management priority (Rubenson and Olden 2020). Increased habitat overlap with Chinook salmon has already been observed in the Columbia River (Lawrence et al. 2014). Competition between Chinook and Smallmouth Bass is expected to increase as bass habitat expands with climate change (Beamesderfer and Rieman 1991, Rubenson and Olden 2020). Predation by Smallmouth Bass has been discovered to be most intense on subyearling Chinook Salmon, with juvenile Chinook salmon comprising 16-59% of all salmonids ingested by Smallmouth Bass in the Columbia River (Naughton et al. 2004, Carey et al. 2011).

The risk of Zebra and Quagga mussels spreading to Okanagan Lake has been assessed as high. Mussels are potentially threatening to salmonids by altering lake ecosystems and food webs through the removal of phytoplankton and zooplankton, a food source for juvenile salmon (Mackie 2010, Self and Larratt 2013). Mud Snails and Didymo would highly impact the salmonid environment if established in the Okanagan River by competing with native macroinvertebrate fauna for food and habitat (Self and Larratt 2013, Benson et al. 2017). Mud snails have been detected in the Columbia River estuary (Hoy et al. 2012) and Didymo found in the middle of the Columbia River near Revelstoke (Schleppe and Larratt 2016). Reduced food availability of zooplankton for young salmon has been speculated to occur because of Cyanobacteria dominance in the phytoplankton community (Stockner and Shortreed 1989). Human activity can increase the rate of spread of the above-mentioned species if not adequately controlled for (Johnson et al. 2001, Bax et al. 2003, Vander Zanden and Olden 2008).

Table 5.A Exotic species identified in the Okanagan basin (Direct or potential competition with salmonid species). Data adapted from Alexis et al. (2003).

Exotic species of concern	Geographical range	Habitat preferences and species interactions	Areas thought to be colonized	Exotic fish risk assessment
Black Crappie	Osoyoos Lake oxbows; not above McIntyre Dam	Lake littoral zone. Adults feed on very small fish.	Skaha Lake littoral zone	Little interaction with salmonids.
Bluegill	Osoyoos Lake	Littoral zone; adults move into limnetic open-water; feed predominantly on limnetic zooplankton and rarely eat fish.	Skaha Lake littoral zone as juveniles, then limnetic open water as adults.	Occupy different habitat and feed on zooplankton. Likely little interaction with pelagic species such as salmon.
Tench (*Tinca tinca*)	Vaseux and Osoyoos lakes	Littoral areas of lakes, or swamps, particularly where organic material is substantial.	Skaha Lake littoral area and Okanagan River oxbow areas. Rare in Osoyoos Lake.	Little interaction with salmonids.
Zebra and Quagga mussels	Not detected so far	Establish on rock surfaces. If established would physically impact spawning areas for salmon as well as alter food availability for young salmonids.	NA	Potentially a very high risk.
Didymo	-	-	Middle Columbia River near Revelstoke	Potentially a very high risk.
New Zealand Mud Snails	-	Underside of rocks in shallow waters.	Columbia River estuary	Potentially a very high risk.
Pumpkinseed	-	Likely competitor, may reduce the habitat options available for Chinook rearing.	-	-
Yellow Perch	Throughout Okanagan River and lakes	Likely competitor, may reduce the habitat options available for Chinook rearing.	Found in Skaha, Vaseux, and Osoyoos Lakes	Limited information, unknown level of risk.

Table 5.B Exotic species identified in the Okanagan basin (Direct or potential predation on salmonid species). Data adapted from Alexis et al. (2003).

Exotic species of concern	Geographical range	Habitat preferences and species interactions	Areas thought to be colonized	Exotic fish risk assessment
Largemouth Bass	Skaha Vaseux and Osoyoos lakes, Okanagan River oxbows	Warm, shallow, weedy areas and river margins. Piscivorous but predation is greatest on littoral species and during emigration of smolts.	Skaha Lake littoral zone	Would feed on salmonids passing through the littoral zones and in the Okanagan River.
Smallmouth Bass	Throughout Okanagan River and lakes	River margins	-	Potentially a very high risk; active during summer Chinook Salmon emigration.
Walleye	Established population in the Columbia River mainstem. Absent in Osoyoos, Skaha and Okanagan lakes so far	Littoral and pelagic areas of lakes. Seasonally inhabit the same areas and are known to prey on juvenile salmonids.	Suitable habitat in Skaha and Osoyoos lakes	Would have an impact on resident salmonids if they established in the Okanagan River basin.
Yellow Perch	Throughout Okanagan River and lakes	Known to prey on juvenile salmonids when in sympatry	Found in Skaha, Vaseux, and Osoyoos Lakes.	Limited information, unknown level of risk
Northern Pike	Not yet present in the Okanagan.	Known to prey on juvenile salmonids when in sympatry.	Found in the Canadian portion of the Columbia River (Doutaz 2019). Juveniles have been found in Castlegar, B.C. indicating that spawning is occurring in the area. Although mainly sedentary, northern pike can migrate up to 100 kms (Doutaz 2019) and could colonize the Okanagan River Basin.	Would have an impact on salmonids if they establish in the Okanagan River basin due to their high consumption rate of juvenile salmonids seen when co-inhabiting (Sepulveda et al. 2015, Doutaz 2019).
Pumpkinseed	-	Potential predator	-	-

3.4 Habitat impacts due to transportation and service corridors (High population level risk, medium causal certainty)

Results from an overall assessment of habitat quality in the Okanagan River basin are reported in the Wild Salmon Policy (WSP) report card which connects Conservation Units (CUs) with a measure of habitat quality (Porter et al. 2013). Using methods of cumulative habitat impacts based on a composite risk scoring system, the 2013 publication of the Okanagan CU reported the area as being high risk (Porter et al. 2013). Increased road saturation within an area results in increased cleared land and impervious surface area. These features increase run-off of vehicle-related pollution and fine sediment entering the waterway (Jorgensen et al. 2009).

The Okanagan region has 2.6 km of developed roads for every square kilometer, far surpassing the 0.4 km/km2 higher risk benchmark suggested by Stalberg et al. (2009). Fine sediment reduces water percolation through spawning gravel which maintains oxygen and temperature levels and is critical for eggs and alevin survival (Healey 1991). Since the Okanagan is highly developed, siltation of spawning beds will undoubtedly pose a problem for Okanagan Chinook salmon. Another impact of roads results from their footprint in the riparian zones, which adversely affects recruitment of woody debris, spawning gravels, reduces shading and cooling of the stream margins and reduces the amount of habitat for prey that are needed for juvenile Chinook growth and survival.

As aforementioned, road density is negatively correlated with riparian habitat. Due to land development, the Okanagan watershed has very little riparian habitat left intact. A loss of riparian habitat directly affects Chinook salmon by reducing availability to shaded refuge and increasing water temperatures from increased sun exposure. Further, it alters insect availability for food and habitat availability for predator avoidance.

3.5 Challenges outside of Canada/ uncertainty

Summer Chinook hatchery supplementation programs are extensive in the U.S. Columbia and Okanagan rivers, but only recently began in the Canadian Okanagan (brood year 2016, release in 2017). Since Okanagan Summer Chinook spawner abundances in Canada have been too low to collect sufficient broodstock, nearly all of the summer Chinook production from ONA’s kł cp̓əlk stim̓ Hatchery in Penticton has been based on supply from U.S. Chief Joseph Hatchery. With the U.S. objectives focusing on prioritizing U.S. Okanagan Chinook enhancement, the supply of eggs to Canada has been unreliable and varied among years (with as few as 0 eggs provided some years). Canadian hatchery production of Okanagan Summer Chinook are over an order of magnitude smaller than in U.S. and are not meeting Canadian enhancement objectives.

Table 6. **Chinook releases from the ONA kł cp̓əlk̓ stim̓ Hatchery.**

Brood Year	Release Timing	Total Release	PIT Release	Age	Source
2016	June 2017	10,396	3,417	subyearling	Chief Joseph Hatchery
2017	June 2018	3,383[a]	0	subyearling	Chief Joseph Hatchery
2017	April 2019	8,229	8,220	yearling	Chief Joseph Hatchery
2018	-	-	-	-	-
2019	Nov. 2020	20,390	4,728	large subyearling	Chief Joseph Hatchery
2019	April 2021	21,847	17,225	yearling	Chief Joseph Hatchery
2020	April 2021	6,137	0	subyearling	Okanagan River (Canada)
2020	Jan. 2022	22,550	22,550	yearling	Chief Joseph Hatchery
2021	May 2022	364[b]	0	subyearling	Chief Joseph Hatchery
2022	May 2023	2,066	2,011	subyearling	Okanagan River (Canada)
2022	May 2023	9,842	9,580	subyearling	Chief Joseph Hatchery

a all coded wire tagged

b 296 acoustic tagged and all thermal marked

4 Measurable Objectives Aimed at Rebuilding the Stock

4.1 Rebuilding Target and Timeline

Okanagan Chinook currently has a severely depressed population size, with its index of abundance not exceeding 73 natural origin spawners since the start of the time series in 2006. The stock does not have a stock-recruitment time series, and only a time series of an escapement index that represents a proportion of the total spawners. Therefore, the stock's demographic parameters, like productivity and survival, are highly uncertain, and unavailable to be used to quantitatively assess a rebuilding timeline. Additionally, new habitat has recently been made available, and therefore the stock range is expanding and also currently highly uncertain. We believe the stock is likely to be slow to rebuild past its LRP under prevailing conditions, given the stock's low population size, poor survival, high USA exploitation, and low hatchery enhancement. Therefore, a rebuilding timeline has not been calculated; instead, a review of the rebuilding plan will be done every 2 years in order to reassess the stock to determine whether a rebuilding target and timeline can be calculated with available data. This transboundary stock is currently being considered as a new Canadian indicator stock under the PST (Pacific Salmon Treaty), however, it is currently not an indicator stock to inform and affect the management of Individual Stock-Based Management (ISBM) fisheries. The interim goal for this rebuilding plan is for the population to exceed its LRP with a high level of confidence (i.e., above 1,000 natural origin spawners and positive percent change in spawner numbers over three generations). The LRP, and its use in the rebuilding target, should be considered interim, as explained in the Stock Status and Trends section. Even beyond this initial review of the LRP through the FSAR process, due to the populations current state of flux, it should be reexamined based on new science advice before the decision is made about rebuilding being complete.

4.2 Additional Measurable Objectives and Timelines

Okanagan Chinook has multiple groups and organizations supporting its rebuilding. DFO supports on many of these initiatives but has limited funding and resources. The additional objectives outlined in the table below are kept high level to encompass all of the efforts and work underway from all groups and organizations.

Additional Objective	Timeline
1. DFO manages Canadian fisheries to allow as many Okanagan Chinook to pass through fisheries to the spawning grounds as possible.	Every two years
2. Habitat restoration efforts by communities and organizations are supported by DFO wherever possible.	Every two years
3. Okanagan Chinook continue to be explored as a Canadian Columbia River indicator stock under the Pacific Salmon Treaty.	Ongoing and 2029
4. Okanagan Chinook is highlighted as a stock of concern in the Integrated Fisheries Management Plan.	2 years
5. Maintaining and where possible improving sampling standards and coordination between Okanagan Nation Alliance, other supporting bodies, and DFO.	Ongoing
6. DFO supports Okanagan Nation Alliance’s hatchery supplementation program through funding and expertise wherever possible.	Ongoing

5 Management Measures Aimed at Achieving the Objectives

Objective 1. DFO to facilitate the allowance of as many Okanagan Chinook fish to pass through the spawning grounds as possible, this could be measured by analysis of Canadian exploitation rates

Table 7.1 Commercial salmon fisheries.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Since 2019, the Area F commercial troll AABM fishery is closed to Chinook retention until August 10 or later (depending on the specific year) to reduce impacts on Fraser River, Skeena River and WCVI Chinook stocks of conservation concern. If management measure adjustments are being considered, an evaluation of the impacts to Okanagan Chinook will be done through the Integrated Fisheries Management Planning Process.	Northern BC Area F commercial salmon troll	DFO	Okanagan Chinook co-migrate through this area while this fishery is occurring putting them at risk of becoming bycatch.	Reduced risk of by-catch of Okanagan Chinook.	Based on stock assessment and timing information.
Time and area restrictions in place with specific annual dates set out in the IFMP. If management measure adjustments are being considered, an evaluation of the impacts to Okanagan Chinook will be done through the Integrated Fisheries Management Planning Process.	Northern BC Area F commercial salmon troll	DFO	There is possibility of Chinook bycatch in July and August in Area F Troll targeting Pink and Coho.	Reduced risk of by-catch of Okanagan Chinook.	Based on stock assessment and timing information.
All troll fisheries require the use of single barbless hooks and revival boxes for non-retention species.	Northern BC Area F commercial salmon troll, West Coast Vancouver Island (WCVI) Area G commercial Chinook troll (AABM)	DFO		Reduced risk of mortality if caught and released.	Salmon physiology
The Area G commercial troll AABM fishery is closed from March 16 until August 1 to reduce impacts on Fraser River Chinook stocks of concern. A 27-day rolling time and area closure for Interior Fraser River Steelhead migration has also been implemented during September and October with specific annual dates set out in the IFMP. If management measure adjustments are being considered, an evaluation of the impacts to Okanagan Chinook will be done through the Integrated Fisheries Management Planning Process.	WCVI Area G commercial Chinook troll (AABM)	DFO	Okanagan Chinook co-migrate through this area while this fishery is occurring putting them at risk of becoming bycatch.	Reduced risk of by-catch of Okanagan Chinook.	Based on stock assessment and timing information.

Table 7.2 First Nations salmon fisheries.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
First Nations opportunities to harvest salmon for FSC purposes are provided through communal licences issued by DFO.	WCVI FSC – offshore Pacific fisheries	DFO	Due to low estimated encounter rates with Okanagan	Continued low estimated encounter	

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Expected annual catch of WCVI AABM Chinook is identified for Chinook fishery planning based on past FSC reporting. Each year, the FSC catch is estimated based on recent years catches. The AABM provides for a total allowable Chinook catch annually. FSC is the first priority after conservation in fishery planning and is accounted for prior to planning for other fisheries. Chinook retention throughout the year is permitted for FSC purposes.	management area (PFMA) 121 to 127		Chinook, closures are not anticipated to be necessary but have been included to show that encounters are possible.	rates with Okanagan Chinook	
First Nations opportunities to harvest salmon for FSC purposes are provided through communal licenses issued by DFO. Chinook retention throughout the year is permitted for FSC purposes.	WCVI FSC - inshore PFMA 21 to 27	DFO	Due to low estimated encounter rates with Okanagan Chinook, closures are not anticipated to be necessary but have been included to show that encounters are possible.	Continued low estimated encounter rates with Okanagan Chinook	
The Domestic allocations for salmon under the Maa-nulth First Nations Final Agreement are “an amount of Ocean Chinook Salmon equal to 1,875 pieces plus 1.78% of the Ocean Chinook Salmon Canadian Total Allowable Catch.” Chinook retention throughout the year is permitted.	WCVI Maa-nulth domestic fishing area (AABM)	DFO	Due to low estimated encounter rates with Okanagan Chinook, closures are not anticipated to be necessary but have been included to show that encounters are possible.	Continued low estimated encounter rates with Okanagan Chinook	
Retention of Chinook in the T'aaq-wiihak troll fishery in Areas 123-127 one nautical mile seaward of the surfline is not permitted for sale purposes from April 1 - July 14 to minimize impacts on Fraser River Chinook stocks of conservation concern. Additional conservation measures are also outlined in the Fishery Management Plan for the Five Nations multi-species fishery.	WCVI Five Nations multi-species rights-based sale fishery (AABM)	DFO	Though not a target for this fishery, Okanagan Chinook co-migrate through this area while this fishery is occurring putting them at risk of becoming bycatch.	Reduced risk of by-catch of Okanagan Chinook.	
From July 15 to July 31, there is a maximum size limit of 80cm for Chinook retention. Additional conservation measures are also outlined in the Fishery Management Plan for the Five Nations multi-species fishery.	WCVI Five Nations multi-species rights-based sale fishery (AABM)	DFO		Prevents the largest fish in the population from being fished out before they can return to their spawning grounds.	
First Nations opportunities to harvest salmon for FSC purposes are provided through communal licences issued by DFO. Chinook retention throughout the year is permitted for FSC purposes.	Haida Gwaii FSC – PFMA 1 and 2	DFO	Due to low estimated encounter rates with Okanagan Chinook, additional restrictions are not anticipated to be necessary	Continued low estimated encounter rates with Okanagan Chinook	
First Nations opportunities to harvest salmon for FSC purposes are provided through communal licences issued by DFO.	North Coast FSC - PFMA 3 to 6	DFO	Due to low estimated encounter rates with Okanagan Chinook, additional restrictions	Continued low estimated encounter rates with Okanagan	

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
The majority of these fisheries occur in coastal and inland areas. Chinook retention throughout the year is permitted for FSC purposes.			are not anticipated to be necessary.	Chinook	
There are currently no directed fisheries for Okanagan Chinook through communal license. This will continue until Okanagan Chinook reach a harvestable level.	Okanagan FSC Fisheries All Gear Types.	DFO		No Okanagan Chinook directed fisheries	
As a condition of license, FSC fisheries are urged to return Chinook alive and unharmed to the water.	Okanagan FSC Fisheries All Gear Types.	DFO		Proper handling and release techniques of Chinook will minimize mortality.	
As a condition of license, Chinook must be released and 100% dockside validation of catch is required.	Okanagan Osoyoos lake Commercial for Sockeye (purse seine or troll)	DFO		No retention of Okanagan Chinook.	
ONA continues to educate community members on the efforts to rebuild Chinook.	Okanagan FSC Fisheries All Gear Types.	ONA		Knowledge of Chinook biology and presence in the area.	

Table 7.3 Recreational salmon fisheries.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Only barbless hooks may be used when fishing for salmon in British Columbia.	General regulations for recreational fisheries	DFO		Reduced risk of harm if caught and released.	Salmon physiology
Potential fishery adjustments will be considered based on updated information. Evaluation of exploitation rates will be conducted annually through the Integrated Fisheries Management Planning process for all fisheries under the Recreation Salmon Fisheries section of this table.	General regulations for recreational fisheries	DFO		Regulations can be varied to reduce encounters of Okanagan Chinook.	Based on the stock assessment and timing information.
DFO regulates recreational fishing for Pacific salmon in both tidal and non-tidal waters. All recreational fishers must possess a valid sport fishing license. Anglers wishing to retain salmon must have a valid salmon conservation stamp.	General regulations for recreational fisheries	DFO			
WCVI Areas 121, 123-127 seaward of the Boundary Line (1 nautical mile outside of the surfline) are Chinook non-retention from April 1 to July 14.	WCVI Recreational PFMA 121 to 127	DFO	Existing regulations to protect other BC stocks of concern also benefit co-migrating Okanagan Chinook. Exploitation rates in recreational	Window closure reduces risk of by-catch of Okanagan	Based on the stock assessment and timing information for Fraser

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
			fisheries will be evaluated on a regular annual basis to determine if impacts on Okanagan Chinook have changed.	Chinook.	Chinook which also provide some protection for Okanagan Chinook.
Minimum size limit of 45cm, a daily limit of two (2), and an annual limit of ten (10) Chinook.	WCVI Recreational PFMA 21, 23, 24, 25, 26 and 27, and 121 to 127	DFO	Due to low estimated encounter rates with Okanagan Chinook, additional restrictions are not anticipated to be necessary	Daily and annual limit reduces daily catches of Chinook, reducing Okanagan Chinook by-catch The general size restriction may reduce impacts on juvenile Okanagan Chinook.	
June 15, 2022 to July 31, 2022: 1 Chinook per day, August 1, 2022 to March 31, 2023: 2 Chinook per day	Haida Gwaii Recreational PFMA 1 and 2 (AABM)	DFO	Existing regulations to protect Skeena Chinook also benefit co-migrating Okanagan Chinook. Due to low estimated encounter rates with Okanagan Chinook, additional restrictions are not anticipated to be necessary	Daily and annual limit reduces daily catches of Chinook, reducing Okanagan Chinook by-catch.	Based on the stock assessment and timing information for Skeena Chinook.
June 15, 2022 to July 31, 2022: 0 Chinook per day. August 1, 2022 to August 31, 2022: 1 Chinook per day. September 1, 2022 to March 31, 2023: 2 Chinook per day.	North Coast Recreational PFMA 3 and 4 (ISBM)	DFO	Existing regulations to protect Skeena Chinook also benefit co-migrating Okanagan Chinook. Due to low estimated encounter rates with Okanagan Chinook, additional restrictions are not anticipated to be necessary	Daily and annual limit reduces daily catches of Chinook, reducing Okanagan Chinook by-catch.	Based on the stock assessment and timing information for Skeena Chinook.
No fishing for salmon in the southern Okanagan (Freshwater Region 8) except when there is a sufficient abundance of sockeye salmon in Osoyoos Lake.	Okanagan Recreational salmon fishing	DFO		No fishing for salmon will aid in improving Okanagan Chinook returns to the spawning grounds.	
The fishery requires single barbless hooks and there is mandatory release of Chinook in the license conditions.	Okanagan Recreational salmon fishing	DFO		Reduced risk of harm if caught and released.	
Operates a creel survey to monitor catches in the fishery that targets sockeye.	Okanagan Recreational salmon fishing	ONA			
Fisheries are closed on the Okanagan River in some areas from Apr 1 to June 30 and Oct 1 to Nov 15.	Okanagan Freshwater fisheries	Province of BC	The BC Freshwater Fishing Regulations specify regulations and restrictions for recreational fisheries in the Okanagan region (Region 8). Recreational fisheries for freshwater species may occur year-round in Osoyoos, Skaha and	No retention of Okanagan Chinook during these times.	
Barbless hooks are required on Osoyoos Lake from July 1 to Oct 31 and year-round in the Okanagan River. There is mandatory release of Chinook salmon.	Okanagan Freshwater fisheries	Province of BC		Reduced risk of harm if caught and released.	Salmon physiology

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
			Vaseux lakes.		
Further investigate opportunities to communicate with anglers and raise awareness of Chinook presence in the system and safe handling procedures in the event of bycatch while targeting other Freshwater species. Further investigate the feasibility of creel surveys on -Kalamalka, Okanagan and Skaha lakes.	Okanagan Freshwater fisheries	Province of BC	Due to low estimated encounter rates with Okanagan Chinook, closures are not anticipated to be necessary; however, investigate opportunities with the Province of BC for enhanced monitoring, enforcement, and outreach with anglers		

Table 7.4 Non-salmon commercial fisheries.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Pacific salmon and trout are prohibited species that may not be targeted or sold. All trawl trips are subject to mandatory at-sea electronic monitoring and 100% dockside validation of catch. To improve the accuracy of bycatch estimates by salmon species and obtain information on mortality by stock, an enhanced monitoring and sampling program is being implemented on a temporary basis for all Option A groundfish trawl vessels. Results will be used to evaluate fisheries mortality on Okanagan Chinook and other stocks if feasible to inform the development of management measures as appropriate. Coded-wire tags for Chinook salmon are sampled by the enhanced monitoring program since 2022. Prior to 2022, sampling for coded-wire tags were opportunistic and not representative. The enhanced monitoring program has a statistically-representative sampling design for Chinook coded-wire tags to enable the accurate estimation of indicator stock ERs on an annual basis. The enhanced monitoring program may inform the adaptive management of ERs on Okanagan Chinook as part of the overall management approach to reduce bycatch of Okanagan Chinook.	Pacific Region groundfish trawl	DFO	Okanagan Chinook migrate along the West Coast of Vancouver Island in the spring and early summer, therefore, there is the potential for overlap with groundfish trawl fisheries that are active in those areas and times.	Improved monitoring will provide a better understanding of the potential mortality of Okanagan Chinook from groundfish trawl bycatch.	

Objective 2. Habitat restoration efforts by communities and organizations are supported by DFO where ever possible

Activities within this category target threats related to habitat impacts due to transportation and service corridors (ranked high threat risk with medium causal certainty) and other ecosystem modifications (ranked medium threat risk with high causal certainty).

Table 7.5 **Habitat restoration and protection.**

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
The *Fisheries Act* prohibits the carrying on of works, undertakings, or activities, other than fishing, that result in the death of fish and/or the harmful alteration, disruption, or destruction of fish habitat.	Federal protection of fish habitat	Federal Government		Reduced mortality and enhanced migratory spawning habitat. Preservation of habitat.	
FFHPP reviews project submissions for potential impacts to fish and fish habitat, provides advice to proponents regarding compliance with the fish and fish habitat protection provisions of the *Fisheries Act*, and implements the process whereby proponents apply for Ministerial authorization under S. 34.4(2)(b) and/or 35(2)(b) of the *Fisheries Act*.	Federal review and tracking of projects near water	Fish and Fish Habitat Protection Program (FFHPP)	The FFHPP maintains regulatory oversight of non-fishing works, undertakings, and activities in and near fish habitat.	Reduced mortality and enhanced migratory habitat Preservation of habitat	
Potential contraventions of the fish and fish habitat protection provisions of the *Fisheries Act* (called 'occurrences') are triaged and assessed by Conservation & Protection and may be referred to FFHPP, depending on circumstances.	Occurrence Management	Conservation & Protection		Reduced mortality and enhanced migratory spawning habitat Preservation of habitat	
The general timing window for Chinook salmon is Jul 15 – Aug 31.	Timing windows for instream works	The Province of BC	Timing windows for instream works are provided to reduce the risk of impacts to fish and wildlife species and their habitats. Specific timing windows are in place for streams and lakes within the Okanagan Region, as well as a general timing window for any areas in which Chinook salmon are present.	Minimize the risk of impact to fish species and habitat. Reduce mortality of Chinook while they are present during in-stream rearing or fry out migration.	Migration, spawning, overwinter and rearing
Continued support for, and participation in, the Okanagan River Restoration Initiative (ORRI). Key restoration efforts to date include projects that reconnect and re-engage portions of the floodplain, re-meander sections of river, reconnect side channels, add spawning habitat, improve passage, and projects that add habitat complexity and diversity to the system.	Habitat restoration	ONA, the Province of BC, DFO and others	The Okanagan River Restoration Initiative (ORRI), a partnership between the ONA, the Province of BC, DFO and others which has conducted habitat restoration and monitoring in the Okanagan region since 2009, with the overall goal of improving the health of the river.	The ecological conditions of the restored areas are measurably improved. The restored areas are more self-sustaining, interconnected, and resilient to future impacts than pre-restoration conditions using natural fluvial and ecological processes. The restored areas provide long-term benefits to both nature and communities. Continued use of an adaptive management process that prioritizes learning, monitoring, and adjusting restoration practices based on Traditional Ecological Knowledge,	Consideration of survival bottlenecks from juvenile tracking studies, habitat quality, water temperatures, change in hydrology in response to climate change.
Continued participation in the Canadian Okanagan Basin Technical Working Group (COBTWG) and associated sub-committees.	Habitat restoration	DFO and COBTWG			
Continued participation in the Okanagan Fish-Water Management Tool (FWMT).	Habitat restoration	DFO and FWMT			
This rebuilding plan is in support of groups or organizations interested in supporting efforts for re-naturalization of channelized portions of the river via set-back dyke restoration, revegetation of riparian areas, and replacement of vertical drop structures with more natural riffle sequences as they have been identified as high priorities for mitigating habitat threats to Okanagan Chinook during the Risk Assessment Methodology for	Habitat restoration	ONA and DFO			

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Salmon (RAMS) workshop (DFO 2020) and PSC working group workshops.				western science, and lessons learned from ongoing or past projects.	
The ONA is supporting a visioning plan for the conservation and restoration of the Okanagan River. The project will include habitat mapping and surveys along main-stem and off-channel habitats, species composition surveys, and gathering of traditional ecological knowledge (TEK) to support planning.	Habitat restoration	ONA		Continued collaboration, engagement, fostering partnerships, and incorporating diverse perspectives to ensure the effectiveness and long-term success of the restoration efforts.	

Activities within this category are targeted primarily towards the threat of invasive non-native/alien species (ranked high threat risk with medium causal certainty).

Table 7.6 High risk threat: invasive species and genes.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
The BC Freshwater Fishing Regulations describe the Provincial response to AIS, including the following measures: All waterbodies with new detections of AIS will be immediately closed to fishing for that species. Where feasible high-risk AIS will be eradicated from watersheds. Where eradication is not immediately feasible, measures to manage risk and prevent AIS spreading such as special regulations will be implemented. For a restricted list of lakes, AIS may be managed as a regulated fishery which could be terminated should risks of AIS increase. In the Okanagan region, fishing for AIS is allowed in Osoyoos Lake, Vaseux Lake, Skaha Lake, and the Okanagan River.	Fishing regulations for aquatic invasive species (AIS)	The Province of BC		The current policy and regulations are intended to mitigate the spread and impact of aquatic invasive species, while retaining angling opportunities at historical high use fisheries.	
A management plan for Eurasian watermilfoil in the Okanagan region is in place and includes rototilling of Kalamalka, Wood, Okanagan, Skaha, and Osoyoos lakes.	Eurasian milfoil control	Province of BC	Plans are underway for experimental removal of milfoil within a portion of Vaseux Lake. Removal of milfoil may lead to improvements of habitat quality for Okanagan Chinook within the lake.	Reduction in milfoil distribution and density	Eurasian watermilfoil removal can harm SARA-listed Rocky Mountain Ridged Mussel. Guidance on reproductive timing windows, location of known populations and mussel detection should be followed when planning and implementing milfoil removal
The BC Conservation Officer Service operates watercraft inspection stations from the spring to fall to prevent the spread of AIS in BC waters, especially zebra and quagga mussels. There is a permanent inspection station located	AIS species surveys and watercraft inspections	BC Conservation Officer	Many species of AIS have been established in the Okanagan system for decades; AIS surveys are not	Continuation of current mussel inspection program.	Predatory species, timing and locations of predation.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
in Osoyoos and a roving inspection crew located in Penticton.		Service	conducted regularly in the Okanagan region.	Improved understanding of the predation risk posed by AIS to juvenile Chinook. Provide baseline information to guide possible AIS suppression programs.	Feasibility assessment for investigating AIS stock parameters and risk.
The Pacific Salmon Commission (PSC) Working Group on Okanagan Chinook is developing a cross-border detection and response plan for Northern pike in the Okanagan River. eDNA monitoring for pike presence in Osoyoos Lake is employed as a screening tool for detecting Northern pike spread to the Okanagan.	Northern pike detection and response planning	PSC	Northern pike has been detected in the Columbia River near the confluence with the Okanogan River and would be a significant threat if established in the Okanagan watershed.	Early detection and eradication of Northern Pike into the Okanagan drainages.	

Activities within this category are targeted primarily towards threats related to dams and water management/use (ranked high threat risk with high causal certainty) and pollutants (ranked medium threat risk with medium causal certainty).

Table 7.7 High risk threat: natural system modification.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
The system is managed in consideration of needs for flood control, water supply, fisheries, aquatic and riparian values, and tourism.	Okanagan lake regulation system	Province of BC	Lake levels and river flows in the Okanagan watershed are managed as part of the Okanagan Lake Regulation System, which includes Okanagan, Skaha, and McIntyre dams and the Canadian portion of the Okanagan River.	Appropriate water levels for Chinook survival.	
The Fish Water Management Tool is used to manage flows to meet the biological requirements of salmon.	Okanagan lake regulation system	FWMT	Fish Water Management Tool sub models are specific to Sockeye Salmon life stages in the Okanagan River and shore spawning kokanee life stages in Okanagan Lake but would positively support Okanagan Chinook as well.	Appropriate water levels for Chinook survival.	
The long-term monitoring network collects, analyses and publishes water quality information supporting the health of aquatic ecosystems The BC Lake Stewardship and Monitoring Program collects and maintains a database of lake water quality data to understand long-term trends. The Canada-BC Water Quality Monitoring Program, delivered by Environment and Climate Change Canada (ECCC) in partnership with the Ministry of Environment and Climate Change Strategy (MoE) has established: • a long-term monitoring network that collects water samples every two weeks or every month. Benthic macroinvertebrate samples are collected every three years.	Water quality monitoring	The BC Ministry of Environment in partnership with the BC Lake Stewardship Society	The Canada-BC Water Quality Monitoring Program strives to track current natural water quality conditions, determine trends in water quality over time and detect emerging threats to water quality in British Columbia.	The data supports the development of evidence-based guidelines and objectives and decision makers in managing Canada's freshwater resources.	Parameters monitored include nutrients, metals, physical parameters, bacteria, major ions and analysis of benthic macroinvertebrate community composition.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
• a temperature monitoring network that collects hourly temperature in a number of rivers two water quality monitoring buoys that provide real-time continuous temperature and dissolved oxygen data at various depths in Osoyoos Lake.					
Limited passage of anadromous salmon is being permitted at this time as part of a phased approach for reintroduction into Okanagan Lake. Adjustments to the fish ladder are required for it to work under the full range of flows. Further investigate the potential for overshot gates or alternative flow release strategies (such as having more gates open) on Skaha Dam to avoid harm to juvenile Chinook salmon during their outmigration. Okanagan Lake Dam planning has commenced for a bypass channel on the east side of the dam to provide an alternative route of passage to migrating salmon.	Salmon passage at dams on the Okanagan River	Province of BC and ONA	Salmonid passage at McIntyre Dam was re-established in 2009, allowing fish access above Vaseux Lake. The fish ladder on Skaha Lake Dam was activated in 2014, allowing fish access above Skaha Lake up to the Okanagan Lake Dam. Fish passage at Okanagan Lake Dam was established in 2022 with the reactivation of the fish ladder.	Full access to spawning and rearing habitats between the north end of Okanagan Lake to the Canada-US border.	Salmon Physiology

Objective 3. Okanagan Chinook is supported through the Pacific Salmon Treaty Updated Negotiations in time 2029 agreement

Table 7.8 General regulations and activities.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
The PSC Okanagan working group is undertaking work to inform the development of the Annex IV agreement.	Pacific Salmon Treaty: Annex IV Chapter 1 - Transboundary rivers	DFO	For Okanagan Chinook and other Southern Transboundary salmon, Annex IV states that the Parties shall consult and develop an arrangement for consultation and setting escapement targets, with the intentions to: a) Ensure effective conservation of the stocks; b) Facilitate future enhancement of the stocks as jointly approved by the Parties; c) Avoid interference with United States management programs on the salmon stocks existing in the non-transboundary tributaries and the main stem of the Columbia River.	Initial objectives under PST work will help set the stage for discussion on a possible long-term arrangement under PST. The PSC Okanagan working group is undertaking work to inform the development of this agreement (see above bullet). Canada will use the Rebuilding Plan as one of the tools to support discussions by the Pacific Salmon Commission, Okanagan Work Group.	N/A

Objective 4. Okanagan Chinook is highlighted as a stock of concern in the Integrated Fisheries Management Plan

Table 7.9 General fisheries management.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Okanagan Chinook is managed as a stock of concern in the IFMP, with Canadian fisheries managed in a precautionary manner meaning no directed fisheries in Canada target Okanagan Chinook.. Updates to the IFMP will be made during the annual planning process.	Fisheries Planning and Objectives	DFO	Reference points and removal rate references consistent with the precautionary approach have not yet been defined for this SMU. As an interim approach until further information is available, Canadian fisheries will continue to be managed in a precautionary manner to allow as many fish as possible to reach spawning grounds and support rebuilding. Currently, there are no directed fisheries in Canada targeting this stock and Canadian fishery mortalities are limited to low levels of bycatch and incidental mortality (approx. <3% for 2019 to 2021 or approx.7.4% average, ranging from 0.6 to 12.9% from 2008-2021) (Table 1). Further review of the exploitation rate objectives will occur during the two year review of the rebuilding plan as needed. If the management measures that were put in place for Fraser Chinook were to be reduced a re-evaluation would be conducted and management measures changed as needed to support Okanagan Chinook.	Minimal Okanagan Chinook mortality	Spawning escapement, exploitation rates, habitat changes, environmental conditions with emphasis on temperature.

Objective 5. Maintaining and where possible improving sampling standards and coordination between Okanagan Nation Alliance, other supporting bodies and DFO

Table 7.10 Scientific research and monitoring.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
ONA and DFO to collaboratively would together to confirm monitoring protocols/practices and develop a communication plan surrounding the monitoring and sampling work	Okanagan Nation Alliance and DFO Coordination	DFO and ONA		Improve communication and understanding of monitoring and sampling efforts	
The ONA conducts sampling of Chinook and sockeye salmon in the Okanagan region. Juvenile survey methods may include fyke nets, rotary screw traps, acoustic trawl surveys, beach seining, or other methods such as telemetry. Adult sampling may include enumeration surveys and deadpitch.	Okanagan Scientific sampling			Improved information on juvenile behaviour and survival; adult migration timing, distribution, abundance and population parameters	

Table 7.11 Stock assessment and monitoring activities.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Under the renewed PST, the possible use of Okanagan Chinook as an indicator stock is being explored by the PSC Okanagan Chinook working group. Escapement programs on both sides of the border are being reviewed to inform the recommendation regarding development of an indicator stock.	Pacific Salmon Treaty escapement and exploitation rate monitoring	PST	The PSC regularly reports on escapements and stock exploitation rates in Canada and the US through the Upper Columbia CWT program; exploitation rate estimates are produced annually.	Additional information from the existing work will provide information on fishery removals. Management measures can be adjusted based on the updated information.	
The ONA is developing a PIT tag mark-recapture program to meet the Chinook Technical Committee data standards for escapement indicators and improve the accuracy of spawner abundance estimates.	Spawner enumeration	ONA	The ONA conducts enumeration surveys of Okanagan Summer Chinook spawners along the natural and semi-natural reaches of the Okanagan River and Penticton Channel from late September to early November. The Area-Under-the-Curve method is used to determine an index of abundance based on the survey areas, but this index likely underestimates total escapement to the watershed. Biological sampling and passive integrated transponder (PIT) tag recovery also occurs on any encountered Chinook.	Annually updated estimate of abundance index (AUC-based) and total abundance estimate (PIT mark-recapture). Information on biological characteristics from carcass samples (e.g. hatchery contribution, age, sex ratio, spawning success, lengths).	
The ONA is planning PIT and acoustic tagging studies to assess survival bottlenecks and habitat usage of juveniles for 2021-2023 with funding support from DFO's Indigenous Habitat Participation Program (IHPP).	Juvenile monitoring	ONA, IHPP, and DFO		Information on reach-specific juvenile survival to guide restoration actions and further studies.	

Objective 6. Enhancement Objective

Activities within this category relate to hatchery enhancement and its role in recovery.

Table 7.12 Enhancement activities.

Management Measures	Activity or Application Fishery	Implemented by	Context (optional)	Expected Outcome	Biology or Environmental Conditions Considered
Natural spawners are collected by the ONA for hatchery broodstock for the Kł cp'əlk' stim' hatchery when available. Given the available spawners for broodstock within the Canadian section of the Okanagan are very low, ONA is currently getting eyed eggs from the Okanagan Chinook program at Chief Joseph hatchery in Washington state. The eggs are transported to the Kł cp'əlk' stim' hatchery in Penticton and reared until they are released into the Canadian Section of the Okanagan River.	Broodstock collection	ONA	A license to access wild aquatic resources for aquaculture purposes is granted on an annual basis from the introductions and transfer committee (ITC). In recent years, the ITC has approved ONA requests to collect 40 adult Chinook from the Okanagan River and Penticton Channel for broodstock purposes.	Collection of broodstock in the Canadian Okanagan River will enhance fish that are locally adapted to the conditions in Canada and reduce the recovery timeframe for Okanagan Chinook.	The projected abundance of summer Chinook returning to the Canadian Okanagan River is considered when planning for broodstock collection
Manage the enhancement program in 3 phases based on spawner abundance and objectives: Conservation phase when spawners <1,000 to increase abundance, an integrated-transition phase when spawners are in the 1,000-5,399 range to increase fitness and local adaptation, and an integrated-wild phase when spawners exceed 5,400 for a viable population that supports fisheries. Genetically-based targets for enhanced contributions of Canadian Okanagan Chinook would have the following guidelines for the Proportion of Hatchery-Origin Spawners (pHOS_effective) and the Proportionate Natural Influence (PNI) that correspond to the Conservation phase (pHOS_eff $\geq$ 0.5, PNI = no target), Integrated-transition phase (pHOS_eff $\leq$ 0.5, PNI: 0.5 – 0.72) and Integrated-wild phase (pHOS_eff $\leq$ 0.28, PNI $\geq$ 0.72). The PSC Okanagan Work Group is developing recommendations on a bilateral supplementation program that may use brood stock from the US component of the population to enhance production in the Canadian watershed. The PSC will ultimately recommend whether to implement a bilateral supplementation program to help restore Chinook in Canada.	Hatchery enhancement	ONA	The ONA operate an enhancement program for Okanagan Chinook at the Kł cp'əlk' stim' hatchery in Penticton. The goal of the hatchery program is to increase Chinook abundance, conserve the genetics of Okanagan summer Chinook and expand their spatial distribution. Small numbers of hatchery-reared Chinook have been released into the okanagan River since June 2017. The hatchery program itself is a staged process in which the initially high level of hatchery production decreases throughout the process of population recovery to ultimately achieve PNI and pHOSeff values consistent with the population designation and objectives. This conservation hatchery program is conducted for persistence and recovery of a populations imperiled by low abundance and threats to productivity, and it is undertaken as part of a broader recovery program in which the factors leading to low abundance are being addressed.	Increased survival of eggs to fry at the hatchery and rebuilding of the population abundance. Hatchery released fry are expected to home back to their release location as adults and contribute toward rebuilding of the population abundance in Canada. Tagging of the hatchery smolts will enable better quality spawner estimates to be developed via new methods, and it will lead to increased knowledge of the survival of Okanagan Chinook as they migrate to and return from the ocean.	The presence of hatchery-origin salmon poses risks to the fitness and genetic diversity of wild fish spawning in the natural environment and therefore has implications for the conservation of wild salmon. Canadian enhancement programs have been developed as 'integrated' populations in which natural- and hatchery-origin salmon spawn in both the hatchery and wild environments, with the gene flow between the two spawning components slowing the process of domestication (adaptation to the hatchery rather than the wild environment) than would occur in a segregated hatchery system. The *PNI* and associated metrics developed by the U.S. Hatchery Scientific Review Group (HSRG) have been assessed by DFO as appropriate metrics to evaluate, classify and monitor levels of hatchery influence and genetic risk to the natural adaptive state in Canadian integrated Chinook Salmon hatchery populations.

6 Socio-Economic Analysis

As described in the Rebuilding Plan Guidance, this section describes the socio-economic impacts associated directly with the incremental measures outlined in the rebuilding plan (i.e. those measures that do not exist under the baseline). There is a range of other values related to the species, such as First Nations cultural, social, economic, health, governance and other values, which are discussed in the Introduction and Context section of the rebuilding plan that are not reflected in this section.

The proposed fisheries management measures under the rebuilding plan do not include changes for commercial and recreational sectors, or for First Nations fisheries as beneficial measures to Okanagan Chinook are already in-place. As such, there are no incremental management changes, and therefore no incremental impacts to these fisheries. However, the rebuilding plan outlines incremental opportunities for monitoring, research, outreach, and habitat restoration activities. Costs are unknown at this time due to the exploratory nature of these opportunities, but are expected to be borne by the government or its partners.

Incremental socio-economic benefits associated with the rebuilding plan could accrue if the above non-fisheries related actions will lead to population recovery or increased abundance. The proposed rebuilding plan actions could result in an enhanced public profile of Okanagan Chinook, increased awareness of conservation of the species, and improved information to fill knowledge gaps.

7 Method to Track Progress to Achieve the Objectives

Performance metrics provide DFO with a means to assess the progress of the rebuilding plan towards the plan’s objectives. For each objective, table 3 below outlines how and when progress will be measured.

Table 8. Summary of the performance metrics and frequency of measurement associated with each objective in this rebuilding plan.

Objective	How it will be measured	Timeline
Main Objective: The interim goal for this rebuilding plan is for the population to exceed its LRP with a high level of confidence (1,000 natural origin spawners and positive percent change in spawner numbers over three generations)	Review of spawning escapement information annually through DFO stock assessment.	Collected annually and will be reviewed during two year review
DFO manages Canadian fisheries to allow as many Okanagan Chinook to pass through fisheries to the spawning grounds as possible;	Review of Canadian exploitation rates and analysis of annual escapement rates for positive growth through DFO stock assessment and two year review process.	Every two years
	Confirmation that if fisheries management measure reductions were being considered, an evaluation of the impacts to Okanagan Chinook was completed through the Integrated Fisheries Management Planning Process.	As and when needed
	Pacific Region groundfish trawl management: Evaluation to be completed of the enhanced monitoring program that informs the adaptive management of Exploitation Rates on Okanagan Chinook as part of the overall management approach to reduce bycatch of Okanagan Chinook through the two year review process.	2025
Habitat restoration efforts by communities and organizations are supported by DFO wherever possible.	Number of projects supported by DFO and reporting on progress/new projects underway through the two year review process.	Every two years
Okanagan Chinook continue to be explored as a Canadian Columbia River indicator stock under the Pacific Salmon Treaty	Okanagan Chinook working group continues under Chapter 3 of the Pacific Salmon Treaty after negotiations are complete in 2029. Progress from this working group will be shared during the two year review when possible.	Ongoing and 2029
Okanagan Chinook is highlighted as a stock of concern in the Integrated Fisheries Management Plan	Integrated Fisheries Management Plan will be reviewed during two year review to confirm change has be incorporated into the plan. Management performance reviews for the stock will be conducted as information becomes available.	2 years
Maintaining and where possible improving sampling	Agreed upon sampling standards and approach for communication will be reported through the two year	Every 2 years

standards and coordination between Okanagan Nation Alliance, other supporting bodies, and DFO	review. Improvements may include: • Programs such as juvenile survey methods which may include fyke nets, rotary screw traps, acoustic trawl surveys, beach seining, or other methods such as telemetry and juvenile tagging programs to monitor survival. • Adult sampling may include enumeration surveys and deadpitch.	
DFO supports Okanagan Nation Alliance's hatchery supplementation program through funding and expertise wherever possible	Review of DFO contributions and gaps of the hatchery supplementation program will be reviewed during the 2 year review Reporting on brood stock collections in Canada, egg transfers from US sources, sampling and monitoring of the spawners to assess the numbers and origins of hatchery-origin spawners that return to Canada will be reviewed during the 2 year review.	Every 2 years

8 Periodic Review of the Rebuilding Plan

The rebuilding plan will be reviewed every 2 years to determine whether progress towards the plan's objectives, including the rebuilding target, is being made and whether revisions to the rebuilding plan are necessary in order to achieve those objectives. The two year timeframe was chosen to make sure that the plan is on track and that no issues are left for a long period of time without a team working through them.

Additional reviews may also be conducted outside the schedule stated above due to exceptional circumstances. For Okanagan Chinook, exceptional circumstances are defined as:

- An unforeseen event has occurred that may impact the purpose of the rebuilding plan
- Stock status has drastically changed before the next scheduled review
- Any other circumstance that warrants a review of the rebuilding plan

The review will be based on the data gathered using the metrics identified in the Method to Track Progress to Achieving the Objectives section of this plan. It will assess the progress of the implementation of management measures and evidence of their effectiveness, as well as the status of the stock and recent trends. In addition, the review will include opportunities for consultation with stakeholders on their views of the stock's progress towards rebuilding.

The review process will generate a brief report that evaluates progress towards each management objective against their timelines with accompanying evidence and states whether adjustments to the rebuilding plan were determined to be necessary to achieve the objectives. These reports will be appended to the rebuilding plan once completed.. Where progress towards an objective is not being made, modifications to the plan may be considered. This process will involve stakeholder consultations.

Stock rebuilding is not always a slow and steady, or even predictable process. Stocks may fluctuate and/or persist at low levels for years until conditions promote surplus production, resulting in rapid growth of the population. Thus lack of progress towards rebuilding may not be an indication that the rebuilding plan's objectives or management measures are insufficient or ineffective.

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10 Appendix 1: WSP Rapid Status Summary for OKANAGAN CHINOOK Stock Management Unit

CU No#	CU name	Populations
CK-01	**Okanagan_1.x**	**Okanagan River** (Pop ID 48442)

Data: Rapid status assessment for most SBC Ck CUs currently use time series generated using the approach from Brown et al. (2020), but DFO area staff provided an alternative data set for Okanagan Chinook. Annual estimates of natural origin spawners, starting in 2006, were developed by the Okanagan Nation Alliance (ONA) based on an area-under-the-curve (AUC) expansion of visual survey observations.

Future work: A test survey using PIT mark-recapture in 2020 produced an estimate roughly 3 times larger than the AUC estimate for that year (200 vs. 73 spawners). Additional mark-recapture surveys are planned, and in a few years a recalibrated time series is anticipated. Until then, rapid status assessments will use the current estimates.

WSP rapid statuses: Using a detailed decision tree that interprets how four standard WSP status metric interact to give an overall status (Appendix A: Table A2, Figure A1). This decision tree was selected among candidate trees, because it best approximates the rationale and status designations developed during expert workshops held from 2012 to 2014 (DFO In Prep; Pestal et al. 2023; Pestal et al. In Prep). For more information, refer to Appendix A.

CU #	CU Name	WSP Rapid Status	WSP Rapid Status Details
CK-01	Okanagan_1.x	**RED, HIGH CONFIDENCE**	The current year's WSP rapid status (2022) is *Red* with *High* confidence. The current generational average is well below 1,500 spawners, the lower benchmark for the *absolute abundance* metric (Node 3) (Figured 1-2 & Appendix A: Table A2, Figure A1). This *Red* status has been consistent throughout the time series from 2009 to 2022 (Figure 1). The 2012 WSP rapid status of *Red* matches the WSP integrated status (DFO 2016). Although not used to assess status for this CU, given the low absolute abundances, the *percent change* (short-term trends) for this CU has been increasing over the time series (Figure 1).

SMU LRP status

There is one CU in this SMU and that CU in the **Red** status zone, placing this SMU **below the LRP**. Rapid status for this CU is clearly *Red* with *High* confidence. The current generational average is well below the lower threshold for the *absolute abundance* metric of 1,500 (the absolute abundance metric benchmark is 1,000, with a buffer of 500 in the algorithm to account for how experts in past WSP integrated status assessments assessed status: Pestal et al. 2023; DFO 2024). This is the case, even if future PIT tagging studies confirm that the actual spawner abundance is about three times larger than the current AUC estimate.

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