



CANADA NICKEL
COMPANY



Stantec

Crawford Nickel Project Impact Statement

Chapter 17 Assessment of Potential Effects on Fish and Fish
Habitat



Prepared for:
Canada Nickel Company

Prepared by:
Stantec Consulting Ltd.

September 30, 2024

Table of Contents

17	Assessment of Potential Effects on Fish and Fish Habitat.....	17.1
17.1	Scope of Assessment	17.2
17.1.1	Regulatory and Policy Setting	17.2
17.1.2	The Influence of Consultation and Engagement on the Assessment	17.6
17.1.3	Potential Effects, Pathways and Measurable Parameters	17.10
17.1.1	Boundaries	17.13
17.1.4	Residual Effects Characterization	17.15
17.1.5	Significance Definition	17.17
17.2	Existing Conditions for Fish and Fish Habitat	17.18
17.2.1	Methods.....	17.18
17.2.2	Overview.....	17.18
17.3	Project Interactions with Fish and Fish Habitat.....	17.20
17.4	Assessment of Residual Effects on Fish and Fish Habitat	17.26
17.4.1	Analytical Assessment Techniques.....	17.26
17.4.2	Change in Fish Habitat.....	17.28
17.4.3	Change in Fish Health, Growth, or Survival	17.42
17.4.4	Summary of Project Residual Effects.....	17.64
17.4.5	Significance of Adverse Federal Effects	17.65
17.5	Federal Lands	17.66
17.6	Prediction Confidence	17.67
17.6.1	Change in Fish Habitat.....	17.67
17.6.2	Change in Fish Health, Growth, or Survival	17.67
17.6.3	Additional Data Collection	17.68
17.7	Assumptions.....	17.69
17.8	Follow-up and Monitoring.....	17.70
17.9	References.....	17.70
17.10	Figures	17.77

List of Tables

Table 17.1	Summary of Key Information, Indigenous knowledge and Concerns for the Project Related to Fish and Fish Habitat	17.7
Table 17.2	Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat	17.10
Table 17.3	Characterization of Residual Effects on Fish and Fish Habitat	17.16
Table 17.4	Project Interactions with Fish and Fish Habitat	17.22
Table 17.5	Summary of Fish Habitat Potentially Affected by the Project Footprint in the North Driftwood River, West Buskegau River, and Jocko Creek Watersheds.....	17.35
Table 17.6	Summary of Habitat Units for focal fish species by life history stage and watershed for habitat potentially overprinted by Project Area	17.37
Table 17.7	Total summary Habitat Units for focal fish species by life history stage for habitat potentially overprinted by Project Area.....	17.38
Table 17.8	Mean Receiver and Predicted Parameter Concentrations During the Operations Phase in the North Driftwood River Watershed	17.56
Table 17.9	Project Residual Effects on Fish and Fish Habitat	17.65
Table 17.10	Additional Fish and Fish Habitat Data Collection Commitments.....	17.68

List of Figures

Figure 17.1 Local Study Area for the Fish and Fish Habitat VC..... 17.78
Figure 17.2 Regional Study Area for the Fish and Fish Habitat VC 17.79
Figure 17.3 Fish Habitat Overprinting Summary 17.80
Figure 17.4 Project Area Existing Watersheds and Subwatersheds..... 17.81
Figure 17.5 Location of Subwatersheds within the Hydrologic Model Boundary Used in Mass
Balance Analysis 17.82

Acronyms and Abbreviations

BML	biotic ligand model
CCME	Canadian Council of Ministers of the Environment
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWQG FAL	Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Long Term
DFO	Department of Fisheries and Ocean Canada
DL	detection limit
DO	dissolved oxygen
DOC	dissolved organic carbon
dwt	dry weight
ECCC	Environment and Climate Change Canada
EEM	Environmental Effects Monitoring
EPT	Ephemeroptera, Plecoptera, and Trichoptera
FDP	final discharge point
HADD	harmful alteration, disruption, or destruction
HEP	Habitat Evaluation Procedures
HSI	Habitat Suitability Indices
HU	habitat unit
IAAC	Impact Assessment of Canada
kilopascal	kPa
LSA	Local Study Area
MDMER	<i>Metal and Diamond Mining Effluent Regulation</i>

mg/L	Milligram per litre
mm/s	millimetre/second
MNR	Ministry of Natural Resources (formerly Ministry of Natural Resources and Forestry [MNR])
ONR	Ontario Northland Railway
PA	Project Area
PoPC	Parameter of Potential Concern
PPV	peak particle velocity
PWQO	Provincial Water Quality Objectives
RSA	Regional Study Area
SAR	Species at Risk
SARA	<i>Species at Risk Act</i>
SSP	Shared Socioeconomic Pathway
TIA	Tailings Impoundment Area
TIS Guidelines	Tailored Impact Statement Guidelines
TMF	Tailings Management Facility
TSS	total suspended solids
VC	Valued Component
WQG-FAL	Water Quality Guidelines for the Protection of Freshwater Aquatic Life

Glossary of Technical Terms

acute lethality testing	Scientific testing used to determine the lethal dose or concentration of a substance that causes death in a specific percentage of a test population within a short period of time.
allochthonous	Refers to substances, materials, or organisms that originate from outside a particular ecosystem or area and are introduced into it (e.g. twigs or leaves that get deposited into a stream).
barotrauma	Refers to the physical damage that fish experience due to rapid changes in pressure.
benthivorous	Descriptive term for an organism (e.g. fish) that primarily feeds on things that live in or on the bottom of an aquatic environment (e.g. white sucker).
bioaccumulation	The process by which certain substances, such as toxic chemicals, heavy metals, or pollutants, accumulate in an organisms' tissues over time at concentrations higher than those found in the surrounding environment.
bioavailability	Refers to the extent and rate at which a substance, such as a nutrient or contaminant is absorbed into a living organism's system and becomes available for biological activity or interaction.
biota	The total collection of living organisms within a particular region, habitat or ecosystem.
channelization	The process of modifying the natural course, shape, or flow of a river or stream, typically by straightening, deepening, widening or lining it with concrete or other materials.
confluence	The point where two or more rivers or streams merge into a single watercourse.
depositional	Refers to a section of stream or river typically with low gradient (slope) that is characterized by the accumulation of fine-grained sediments such as sand, silt, clay and organic material.

detritus	Organic material composed of decaying plant and animal matter, as well as associated microorganisms, that accumulate in aquatic and terrestrial ecosystems.
eDNA	Short form for environmental DNA, referring to genetic material (DNA) that is collected from environmental samples, such as water, rather than directly from an organism. eDNA samples from aquatic environments are used to detect the presence of fish species in specific locations.
eutrophying	Refers to any process that leads to eutrophication, which is the enrichment of a water body with nutrients particularly nitrogen and phosphorus.
fry	Refers to the early life stage of the fish that starts immediately after they hatch from eggs and ends once they have begun to actively feed on their own in the aquatic environment.
gonadosomatic index	A commonly used metric or measurement in fisheries biology that represents the relative size of a fish's gonads (reproductive organs) compared to its total body weight. The metric is used to assess the reproductive cycle, determine the time of spawning and assess the reproductive health of a given population of fish.
guild	Group of species that utilize the same kinds of resources or occupy the same types of habitats within a given community.
headwater	The source or uppermost part of a river or stream, typically located in the higher elevations of a watershed.
hepatosomatic index	A commonly used metric or measurement in fisheries biology that represents the relative size of a fish's liver compared to its total body weight. The metric is used as an indicator of the nutritional status, energy reserves, and overall health of the fish.
impoundment	Refers to water that has been collected and confined within a reservoir, lake or other water body, usually as the result of the construction of a dam or other barrier (e.g. beaver dam).

invertivorous	Descriptive term for an organism (e.g. fish) that primarily feeds on invertebrates, which are animals without a backbone, such as insects, worms, and mollusks.
low gradient	Refers to a section of river or stream that is characterized by a very gradual slope (e.g. very flat).
mainstem	The principal or primary channel of a river or stream, as opposed to its tributaries or branches.
naturalized	Refers to a habitat that was initially human made that has, over time come to mimic or provide the ecological function of a natural habitat.
piscivorous	Descriptive term for organism that primarily feeds on fish.
pour points	Refers to specific locations in a watershed where water from upstream areas converges and is discharged into a downstream waterbody, such as a river, lake or reservoir. A pour point is essentially the lowest point in a drainage area or catchment, where all the surface water from the surrounding area drains into a single outlet.
primary production	The process by which autotrophic (i.e. make their own food) organisms, such as phytoplankton, algae, and aquatic plants, convert inorganic carbon (usually carbon dioxide) into organic matter through photosynthesis.
Q ₁₀₀	The estimated discharge or flow rate that corresponds to a 100-year flood event.
riffle	Shallow section of a stream or river where the water flows swiftly over a rocky or gravelly substrate creating small waves or ripples on the surface.
recruitment	The process by which juvenile fish survive and grow to a size or age where they become part of the adult population. This stage is critical because it determines the future abundance of a fish population.
riparian	The interface or transitional zone between land and an aquatic habitat such as a lake, river or stream that is characterized by a distinct vegetation community.

scouring	The process by which flowing water removes and erodes sediment, soil or rock from the bed and banks of a river, stream or other water body typically during periods of high flow such as during floods or spring freshet.
speciation	Refers to the distribution of an element (e.g. copper) among different chemical forms or species in a particular aquatic environment. Species can vary in their oxidation state, molecular form, complexation with other substances, or physical state (e.g. dissolved vs. particulate).
Species at risk	Extirpated, endangered, or threatened species or a species of special concern
Species of special concern	A species that may become threatened or endangered because of a combination of biological characteristics and identified threats
taxa richness	A measure of the number of groups or categories (typically species) used as a metric or measurement of biodiversity and overall ecosystem health.
trophic	Refers to feeding relationships and energy transfer between different organisms in a given ecosystem. Often used to describe the various levels in a food chain or food web known as trophic levels which categorize organisms based on their primary source of nutrition.

17 Assessment of Potential Effects on Fish and Fish Habitat

Fish and fish habitat was selected as a Valued Component (VC) because fish and fish habitat, and the productivity of fisheries that they support, are valued by Indigenous nations, recreational anglers, and the public-at-large, and are protected in Canada by the *Fisheries Act* and in Ontario by the *Lakes and Rivers Improvement Act*. Fish and fish habitat provide cultural, economic, recreational, and aesthetic values to the people of Ontario. Fish and fish habitat also contribute to biodiversity and are indicators of aquatic ecosystem health. The Tailored Impact Statement Guidelines (TIS Guidelines; Appendix A.1 of the Impact Statement) require an assessment of the effects of the Project on fish and fish habitat, including aquatic Species at Risk (SAR) for these reasons.

The Crawford Nickel Project ('the Project') may affect fish and fish habitat because of potential changes to water quantity and quality, and habitat quantity and quality. These changes could affect fish community composition, population abundance, and individual fish health, growth, or survival directly due to overprinting or dewatering of watercourses and ponds, changes in stream flow, changes in water quality, or indirectly through effects to lower trophic communities upon which fish depend for food.

The Fish and Fish Habitat VC is linked to the following other VCs and Indigenous Interests:

- Atmospheric Environment (Chapter 12), whereby changes in water quality due to atmospheric deposition of dust and/or potentially acidifying or eutrophying emissions from the burning of fossil fuels.
- Acoustic Environment (Chapter 13), whereby changes in sound overpressures or peak particle velocities (PPV) from blasting may affect the health and survival of fish and fish eggs in waterbodies near the Open Pit.
- Surface Water (Chapter 15), whereby changes in surface water quality may affect fish health, growth, and survival and changes in surface water quantity may affect the availability and suitability of fish habitat upon which fish depend to spawn, rear, forage, migrate, and overwinter. Groundwater (Chapter 14) is linked to Surface Water, but not directly to Fish and Fish Habitat.
- Vegetation, Riparian and Wetland Environments (Chapter 16), whereby changes in riparian vegetation may affect bank stability, shade, and organic debris inputs that may affect the suitability of adjacent fish habitat for fish; changes in wetland habitat may affect water quality and quantity in fish habitats downstream or connected to these wetlands.
- Wildlife and Wildlife Habitat (Chapter 19), whereby changes in fish tissue metal concentrations in fish downstream of mine effluent discharge locations may affect the health, growth, or survival of wildlife that consume fish; changes in fish habitat may affect the abundance and distribution of wildlife that rely on aquatic habitats for all or part of their life histories (e.g., beaver).
- Health (Chapter 21), whereby changes in fish tissue metals concentrations in fish downstream of mine effluent discharge locations may affect the health of human consumers of fish.

- Social Conditions (Chapter 22), whereby changes in the abundance, distribution, or contamination levels may affect the use of fish by commercial or recreational fisheries.
- Indigenous Interests (Chapters 25-28), whereby changes in the abundance, distribution, or contamination levels in fish may affect fish harvesting by Indigenous nations for subsistence and cultural purposes.

17.1 Scope of Assessment

17.1.1 Regulatory and Policy Setting

17.1.1.1 Federal

17.1.1.1.1 Fisheries Act

The *Fisheries Act* defines ‘fish’ as all parts and life history stages of fish, crustaceans, and shellfish and ‘fish habitat’ as water frequented by fish and any other areas on which fish depend, directly or indirectly, to carry out their life processes, including spawning grounds, and nursery, rearing, food supply and migration areas.

The purpose of the *Fisheries Act* is to provide a framework for the “proper management and control of fisheries and the conservation and protection of fish and fish habitat, including by preventing pollution.” To do so, the *Fisheries Act* includes the following fish and fish habitat protection provisions:

- section 34(2) provides provisions for maintaining adequate flow and passage of fish
- section 34.4(1) prohibits any work, undertaking or activity, other than fishing, that results in the death of fish
- section 35(1) prohibits the carrying on of a work, undertaking or activity that results in the harmful alteration, disruption, or destruction (HADD) of fish habitat
- section 36(3) prohibits the deposit of deleterious substances of any type in water frequented by fish or in any place under any conditions where the deleterious substance or any other deleterious substance may enter such water

The *Fisheries Act* is administered by Fisheries and Oceans Canada (DFO) except for section 36 which is administered by Environment and Climate Change Canada (ECCC).

Section 34.1(1) of the *Fisheries Act* identifies the following factors that the Minister of Fisheries and Oceans Canada must consider when exercising his or her authority under the fish and fish habitat protection provisions of the *Fisheries Act* (e.g., issuance of authorizations or permits related to the death of fish or the HADD of fish habitat):

1. The contribution to the productivity of relevant fisheries by the fish or fish habitat that is likely to be affected.

2. Fisheries management objectives.
3. Whether there are measures and standards to avoid the death of fish or to mitigate the extent of their death or offset their death, or to avoid, mitigate or offset the HADD of fish habitat.
4. The cumulative effects of the carrying on of the work, undertaking, or activity in combination with other works, undertakings, or activities that have been or are being carried on, on fish and fish habitat.
5. Any fish habitat banks that may be affected.
6. Whether any measures or standards to offset the HADD of fish habitat give priority to the restoration of degraded fish habitat.
7. Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister.
8. Any other factor that the Minister considers relevant.

17.1.1.1.2 Fish and Fish Habitat Policy Statement

The Fish and Fish Habitat Protection Policy Statement (DFO 2019) provides guidance on how DFO interprets and implements the fish and fish habitat protection provisions in the *Fisheries Act*. The Policy describes how avoidance, mitigation, and offsetting form a hierarchy of measures to limit harmful impacts to fish and fish habitat, emphasizing that efforts should be made first to prevent (i.e., avoid) and then minimize (i.e., mitigate) harmful impacts to fish and fish habitat with offsetting being the last resort when death of fish or HADD of fish habitat cannot be entirely avoided.

The Policy applies to proponents of existing or proposed works, undertakings, or activities that may result in harmful impacts to fish or fish habitat, specifically the death of fish by means other than fishing or the HADD of fish habitat.

17.1.1.1.3 Policy of Applying Measures to Offset Harmful Impacts to Fish and Fish Habitat

The Policy for Applying Measures to Offset Harmful Impacts to Fish and Fish Habitat (DFO 2023a) provides guidance to proponents and to DFO staff on the use of offsetting measures to counterbalance harmful impacts to fish and fish habitat. It also provides guidance on the development of offsetting plans when seeking authorization under paragraph 34.4(2) for the death of fish and/or paragraph 35(2)(b) for the HADD of fish habitat or on the development of conservation project plans for habitat banks.

17.1.1.1.4 Metal and Diamond Mine Effluent Regulation

The *Metal and Diamond Mining Effluent Regulation* (MDMER), promulgated under the *Fisheries Act*, regulates the deposit of deleterious mine effluents, tailings, and waste rock into waters frequented by fish and is administered by ECCC, on behalf of DFO. The MDMER defines mine effluent as:

“(a) hydrometallurgical facility effluent, milling facility effluent, mine water effluent, tailings impoundment area effluent, treatment pond effluent or treatment facility effluent other than effluent from a sewage treatment facility; or (b) any seepage or surface runoff containing any deleterious substance that flows over, through or out of the site of a mine.”

The MDMER applies to metal and diamond mines with an effluent flow rate of greater than 50 cubic metres per day (m³/d) based on effluent deposited from all final discharge points of the mine. For these mines, the MDMER allows the discharge of mine effluent containing deleterious substances if:

1. The effluent is not acutely lethal.
2. The pH is equal to or greater than 6.0, but not greater than 9.5.
3. Concentrations of deleterious substances do not exceed concentration limits identified in Schedule 4 of the MDMER at the final discharge point(s).

Schedule 4 of the MDMER prescribes “end-of-pipe” discharge limits for arsenic, copper, cyanide, lead, nickel, zinc, total suspended solids (TSS), radium-226, and un-ionized ammonia in metal and diamond mine effluent in Canada. All mines and recognized closed mines subject to the MDMER are required to conduct water quality monitoring, acute lethality testing of final effluent, effluent characterization, and Environmental Effects Monitoring (EEM) in the downstream receiving environment in three-year cycles.

Deposition of mine effluent, tailings, and waste rock into waterbodies frequented by fish is prohibited by the *Fisheries Act* unless those waterbodies are designated as a Tailings Impoundment Area (TIA) by the Parliament of Canada and listed in Schedule 2 of the MDMER.

17.1.1.1.5 Species at Risk Act

The *Species at Risk Act* (SARA) provides protection, and mandates recovery strategies and action plans, for extirpated, endangered, or threatened species in Canada, while managing species of special concern to prevent further declines. DFO administers SARA for aquatic species listed on Schedule 1 of the SARA. Species at Risk (SAR) are added to Schedule 1, the official list of SAR, through a federal government process after receiving scientific information and recommendations from the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Each species is classified as extirpated, endangered, threatened, or special concern. Species listed on Schedule 1 of the SARA are subject to protection and recovery measures.

17.1.1.2 Provincial

17.1.1.2.1 Endangered Species Act

The *Endangered Species Act* is administered by the Ontario Ministry of the Environment, Conservation and Parks (MECP) and has provisions for the protection of provincially listed SAR.

17.1.1.2.2 Lakes and Rivers Improvement Act

The *Lakes and Rivers Improvement Act* provides the Ontario Ministry of Natural Resources (MNR) with the legislative authority to oversee the design, construction, operation, maintenance, and safety of dams and the construction, alteration, improvement, or repair of water control infrastructure in Ontario. Under the *Lakes and Rivers Improvement Act*, approval must be obtained from the MNR for:

- dams
- water crossings – bridges, culverts, and causeways
- river channels – channelization of rivers, including dredging, diverting, or enclosing a channel except for the installation or maintenance of a drain subject to the *Drainage Act*
- enclosures (e.g., pipe enclosures)
- buried pipelines and cables – installing cables and pipelines where they will hold back, forward or divert water
- municipal and other drains

One purpose of the *Lakes and Rivers Improvement Act* is to provide for the management, perpetuation, and use of the fish, wildlife, and other natural resources that depend on the lakes and rivers in Ontario (MNR 2011).

17.1.1.2.3 Fish and Wildlife Conservation Act

During the life of the Project, the Proponent will be required to collect fish for the purpose of monitoring potential adverse effects and to remove fish from in-water work areas. To collect these fish, authorization will be required from the Ontario MNR under section 39 of the *Fish and Wildlife Conservation Act* which states that the Minister may authorize a person to capture, kill, or possess wildlife for educational or scientific purposes (S.O. 1997).

17.1.1.2.4 Ontario Provincial Fish Strategy – Fish for the Future

The *Ontario Provincial Fish Strategy* (MNR 2015) provides guidance for managing fisheries resources in Ontario. It does so by identifying provincial long-term fisheries goals, shorter-term objectives, and the specific tactics that will be implemented to achieve these goals and objectives. The main purpose of the strategy is to improve the conservation and management of Ontario's fisheries resources and to promote, facilitate, and encourage fishing as an activity that contributes to the nutritional needs, and the social, cultural and economic wellbeing of individuals and communities in Ontario.

The Provincial Fish Strategy provides management direction to Ontario MNR staff and is intended to better position the ministry to respond to evolving environmental, economic, social, technological and policy challenges facing fisheries in Ontario.

17.1.2 The Influence of Consultation and Engagement on the Assessment

Canada Nickel Company (Canada Nickel) has engaged with potentially affected Indigenous nations, regulators, the public, and other stakeholders. Table 17.1 provides a summary of the topics, key information, including Indigenous knowledge, and concerns that Canada Nickel identified during engagement efforts that relate to fish and fish habitat, as well as a summary of the influence that the outcomes of this engagement had on the assessment.

Information and concerns on the topic of fish and fish habitat were raised during various engagement activities. Concerns were raised regarding spawning sites, fish health, contamination, and potential effects on fish consumption and culturally important species.

This information was considered when evaluating whether Canada Nickel's planned mitigation will effectively manage the identified potential interactions, or whether additional or refined mitigation is warranted. Specific concerns regarding fish and fish habitat raised during engagement for the Project and any additional specific mitigation measures added to address one or more of the concerns, are described in Table 17.1.

Table 17.1 Summary of Key Information, Indigenous knowledge and Concerns for the Project Related to Fish and Fish Habitat

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the Impact Statement
Fish Species of Cultural Importance	<ul style="list-style-type: none"> • Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation and Taykwa Tagamou Nation reported that numerous fish species are important sources of nutrition and facilitate the transmission of knowledge and practices related to fishing. Example species include, pickerel (walleye), perch, northern pike/jackfish, trout, whitefish, lingcod, lake trout, speckled trout, sturgeon, minnow and bass. Traditional species of importance also include bait fish, sauger, sea trout, mooneye, sheepshead, goldeye, splake, sucker (white and redhorse), brook trout, burbot, and catfish (channel and brown bullhead). • Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation, Taykwa Tagamou Nation and Métis Nation of Ontario – Region 3 reported that fishing is a key cultural component for traditional practices, sustenance, engaging with land, and cultural transmission. Fishing is identified as an important skill to teach the youth. Fishing occurs seasonally. • Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation and Taykwa Tagamou Nation expressed concern regarding the Project effects on Sturgeon due to effluent, disruption of natural water flows, and noise and vibrations from blasting. • Flying Post First Nation, Matachewan First Nation and Mattagami First Nation expressed concern regarding the presence of pickerel (walleye) within the LSA and requested the species be scoped in the Fish & Fish Habitat VC of the Impact Statement. • Flying Post First Nation, Matachewan First Nation and Mattagami First Nation expressed concern regarding construction and operation of crossings over Victoria Creek and potential impacts to fish. • Taykwa Tagamou Nation expressed concern regarding effects to water quantity and quality, impacts to fish and other aquatic species, as well as cultural practices and spiritual connections. • Flying Post First Nation expressed concern regarding contamination of local water sources in the Mattagami River, resulting in Flying Post First Nation ability to practice water related ceremonies and effects of consuming fish from the sources. • Flying Post First Nation, Matachewan First Nation and Mattagami First Nation, recommend all fish in all life cycle stages in the LSA and RSA need to be assessed. At minimum, species must also include perch, walleye, and baitfish. • Apitipi Anicinapek Nation recommended consideration of lake sturgeon as a potential valued component in the Impact Statement if the Project interacts with Jocko Creek. 	<ul style="list-style-type: none"> • Contributed to an understanding of existing conditions for fish. Particular focus was directed to understanding the existing conditions of five specific species including Lake Sturgeon and pickerel (walleye). • The construction and use of watercourse crossings is identified as a pathway of effect on fish and fish habitat. • Considered in the development of mitigation and management measures and supported scope of issues assessed. • The identification of fish of importance to Indigenous nations was carried forward for the fish and fish habitat assessment and informed the assessment on Indigenous interests in Chapters 25-28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). • Canada Nickel's responses to mitigation recommendations made by Indigenous nations are provided in Chapters 25-28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). 	<ul style="list-style-type: none"> • Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Sections 17.2, 17.4, 17.8, 17.9 • Chapters 25-28 (Assessment of Potential Effects on Indigenous Interests)
Fish Habitat and Spawning Sites	<ul style="list-style-type: none"> • Members of the public and other stakeholders expressed concern regarding: <ul style="list-style-type: none"> • the potential loss of fish habitat in tributaries, lakes, and ponds that support many different fish species, including those that are culturally important to Indigenous nations, or that support these culturally important fish species. • the potential negative effects of the proposed diversion channel and disruption of natural flow on fish migrations, fish populations, and habitat (including riparian habitat) used by fish, including lake sturgeon. • Potential effects of fish and fish habitat from the destruction of watercourses, flow reductions in watercourses downstream of the mine, and use of waterbodies for mine waste disposal • Need for fish population data that corresponds to habitat potentially affected by the Project • Potential effects on lake sturgeon, suckers, and spawning areas in the Mattagami River from construction and operation of the effluent discharge pipeline. • Assessment of alternative for mine waste disposal as it relates to effects on fish habitat • Potential effects of fugitive dust on fish • Need for detailed mapping and habitat characterization of each watercourse and waterbody potentially affected by the Project • Potential impacts to walleye spawning habitat in the North Driftwood River • Need for assessment of potential changes to flow regimes and its effect on fish that are dependent on flow for their life history • Need for standard and fish and fish habitat-specific mitigation measures and a strong support for a plan to offset unavoidable habitat losses. • Need for information on the current and historical distribution of lake sturgeon in the North Driftwood River and information on potential mitigation measures that may be needed to prevent impacts to lake sturgeon in the North Driftwood River. • Potential effects of fish relocations and methods used for fish relocations. 	<ul style="list-style-type: none"> • Contributed to an understanding of existing conditions for fish, fish habitat and spawning sites regarding changes to fish habitat. • Considered in the development of mitigation and management measures and supported scope of issues assessed. • Informed the assessment on Indigenous interests in Chapters 25-28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). • Canada Nickel's responses to mitigation recommendations made by Indigenous nations are provided in Chapters 25 -28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). • Potential effects of fish habitat loss in the PA and changes in habitat in watercourses downstream of the Project have been included in the assessment. Potential impacts to water quality from effluent release have also been assessed. • Potentially impacted habitat has been quantified based on fish species and habitat function as part of the assessment. Potential effects on focal species and their 	<ul style="list-style-type: none"> • Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Sections 17.2, 17.4.1, 17.9.2 • Chapters 25-28 (Assessment of Potential Effects on Indigenous Interests) • Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.3.1 • Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat) • Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) • Chapter 3 (Project Description) • Chapter 17 (Assessment of Potential Effects on Fish and

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the Impact Statement
	<ul style="list-style-type: none"> Taykwa Tagamou Nation reported that many rivers, streams, and lakes in northeastern Ontario provide access to abundance of fish species. Apitipi Anicinapek Nation expressed concern regarding effects to sturgeon fishing in the Mattagami River and confluence of the Buskegau and Frederick House River. Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation and Taykwa Tagamou Nation identified several fish habitat features within and/or near the PA. Apitipi Anicinapek Nation, Flying Post First Nation, Matachewan First Nation, Mattagami First Nation, Taykwa Tagamou Nation and Métis Nation of Ontario – Region 3 expressed concern regarding effects to fish related to blasting in or near fish habitat, spawning sites, and impacts to fish through relocation. Flying Post First Nation, Matachewan First Nation and Mattagami First Nation expressed concern regarding impacts to pickerel (walleye), sturgeon and sucker spawning locations. Matachewan First Nation expressed concern regarding impacts to fish habitats and available food sources for fish (e.g., insects), especially due to the loss of water and waterways throughout the area due to Project activities. Métis Nation of Ontario – Region 3 expressed concern that changes to fish, fish habitat, fish predators and prey may have considerable impacts to Section 35 rights, including limiting Métis way of life. Métis Nation of Ontario – Region 3 recommended Canada Nickel consider improving sites along the Mattagami River (e.g., former sawmill at Smooth Rock Falls) or other main water systems, such as the Abitibi River, that are tied to historic and current Métis use (e.g., fur trade). Flying Post First Nation, Matachewan First Nation and Mattagami First Nation, recommended further information regarding methodology of fish relocation and the ability to participate in fish relocation programs. Additionally, the need for mitigation measures for effects from fish relocation, overprinting of tributaries to the North Driftwood River and West Buskegau River, changes in water levels and flows, effluent discharge, seepage, disposal of mine waste in waterbodies, and blasting in or near fish and fish habitat and spawning sites. Flying Post First Nation recommended the Groundhog River system and Bromley Lake (sturgeon spawning area) should be protected to support the survival of the species. 	<p>spawning areas have been assessed and appropriate mitigation proposed.</p> <ul style="list-style-type: none"> The fact that there will be effluent discharge pipe and no discharges to the Mattagami River is noted in the Impact Statement. Fish habitat mapping and characterization has been included as part of the baseline description associated with the Impact Statement. Potential impacts from flow regime changes on the fish in the LSA has been included in the Impact Statement. Options related to effluent release and treatment have been included in the assessment. Role of air-borne contaminants on fish habitat and fish health have been included in the assessment Potential impacts to walleye spawning habitat in the North Driftwood have been included in the assessment Mitigation measures, including ones specifically aimed at the offsetting of the unavoidable fish habitat losses have been included in the Impact Statement. The current and historical distribution of lake sturgeon in the North Driftwood and other sections of the LSA and RSA have been included in the Impact Statement. The commitment to develop a fish relocation plan if relocation is to be undertaken has been included in the Impact Statement. 	<p>Fish Habitat), Section 17.1.3.1.2</p> <ul style="list-style-type: none"> Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.2 Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) Chapter 3 (Project Description) Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.2.1 , 17.4.2.3.2 Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.3.1 Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.1.3 and Section 17.9 Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.5.4 Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.9

Topic	Key Information, Indigenous Knowledge, and Concerns	Influence on the Assessment	Where Information is Addressed in the Impact Statement
<p>Fish Health, Contamination, and Potential Effects on Consumption and Harvest</p>	<ul style="list-style-type: none"> Members of the public and other stakeholders expressed concern regarding the potential effect of bioaccumulating substances on fish health and community members who eat fish. Agencies asked which considerations informed what was selected for fish tissue analysis. Flying Post First Nation and Matachewan First Nation expressed concern regarding contamination of the local waterways from tailings and settling ponds, as well as machinery spills, accidents, general contamination, dam failures, or oil spills that would negatively affect waterways and consequently the fish and animals that community members consume. Mattagami First Nation expressed concern due to the loss of confidence in fish health from water quality concerns resulting in an avoidance of fishing areas. Matachewan First Nation expressed concern regarding diminished trust and confidence in the safety of consuming fish. Matachewan First Nation expressed concern regarding effects to the health of fish, stating that members have observed diseased fish due to contaminants introduced by other projects in the region. Mattagami First Nation reported that preserving access and confidence in lakes and rivers is vital to fishing practices and food security. 	<ul style="list-style-type: none"> Contributed to an understanding of existing conditions for fish consumption and harvest. In particular, the effects of contamination and the impact on fish health. Fish tissue samples were analyzed for a full suite of metals, including methyl mercury, and are consistent with water and sediment samples. It is noted that the WSP baseline does not provide result for the full suite of metals, however, this will be updated as part of the Impact Statement submission. Considered in the development of mitigation and management measures and supported scope of issues assessed. Additional mitigation measures for surface and groundwater effects are provided in Chapters 14 (Assessment of Potential Effects on Groundwater) and 15 (Assessment of Potential Effects on Surface Water) of the Impact Statement, and those for accidents and malfunctions are provided in Chapter 31 (Accidents and Malfunctions). Informed the assessment on Indigenous interests in Chapters 25-28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). Canada Nickel's responses to mitigation recommendations made by Indigenous nations are provided in Chapters 25-28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests). 	<ul style="list-style-type: none"> Chapter 14 (Assessment of Potential Effects on Groundwater) Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.1.3 Chapter 15 (Assessment of Potential Effects on Surface Water) Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Sections 17.2, 17.4.1, 17.9.2 Chapters 25-28 (Assessment of Potential Effects on Indigenous Interests) Chapter 31 (Accidents and Malfunctions)
<p>Surface water and groundwater interaction with Fish life cycles</p>	<ul style="list-style-type: none"> Members of the public asked for clarity on how fish life cycles and habitat use were addressed in the approach to baseline studies for surface water and groundwater. Members of the public asked if the type and resolution of the modelling approach is able to assess seasonal changes to fish and fish habitat as a result of surface water and groundwater effects. For example, areas fish rely on due to groundwater recharge. 	<ul style="list-style-type: none"> The spawning, foraging, migratory, and overwintering fish habitat were considered in baseline characterization. Potential effects arising from changes in surface water and groundwater have been included in the assessment. The surface water quantity and quality models incorporate results of the groundwater draw-down model and provide predicted changes in stream flow and water quality on a daily time steps at multiple nodes within and downstream of the Project footprint. These predictions can be used to assess potential seasonal changes in fish and fish habitat. 	<ul style="list-style-type: none"> Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.2 Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) Chapter 15 (Assessment of Potential Effects on Surface Water) Chapter 17 (Assessment of Potential Effects on Fish and Fish Habitat), Section 17.4.2

Where made available by Indigenous nations through engagement, information gathering, and voluntary information sharing, Indigenous knowledge has been considered and incorporated into the Impact Statement, as applicable. Refer to the Description of Engagement with Indigenous Peoples (Chapter 7 of the Impact Statement) for detailed methods regarding the incorporation of Indigenous knowledge to the Impact Statement.

17.1.3 Potential Effects, Pathways and Measurable Parameters

Table 17.2 summarizes the potential effects of the Project on fish and fish habitat, effect pathways, and measurable parameters. These potential effects and measurable parameters were selected based on professional judgement, understanding of the Project, recent environmental assessments for mining projects in Canada, and comments provided during engagement.

Table 17.2 Potential Effects, Effect Pathways and Measurable Parameters for Fish and Fish Habitat

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
Change in Fish Habitat ¹	Construction, operations, and decommissioning/closure of the Project has the potential to physically alter, disrupt, or destroy instream and/or riparian habitat, create barriers to fish passage, and/or alter stream flows, that may impair the ability of different fish species to conduct their different life stages (e.g., spawning).	<ul style="list-style-type: none"> Areal extent of altered fish habitat (m²), by habitat type and/or fish species life stage. Fish habitat quality as described in the Ontario Stream Assessment Protocol, including stream morphology (e.g., % riffle, % pool), substrate types (e.g., % detritus, % gravel), and % cover. Change in stream flow (m³/sec)
Change in Fish Health, Growth, or Survival	Construction, operations, and decommissioning/closure of the Project has the potential affect fish health, growth, or survival due to stranding of fish or fish eggs, death of fish or fish eggs due to sound over-pressures and PPV from blasting, trauma from physical impacts, changes in prey quantity or quality, or acute or chronic toxicological effects from changes in water quality or sediment quality.	<ul style="list-style-type: none"> Numbers of fish killed or stranded, by species and age class. Underwater sound pressure (kPa) and PPV (mm/second) Water quality parameters that influence fish health: water temperature (°C), pH (pH units), conductivity (µS/cm), and dissolved oxygen (DO) and total suspended solid (TSS) concentrations (mg/L) Water quality parameters that influence fish prey availability or contribute to eutrophication: phosphorus, nitrogen, dissolved organic carbon (DOC) and chlorophyll a (mg/L) concentrations. Fish community composition (% relative abundance of individual species, species presence/ absence) Fish population composition (average length, weight, age, length-frequency distribution, age-frequency distribution).

Potential Effect	Effect Pathway	Measurable Parameter(s) and Units of Measurement
		<ul style="list-style-type: none"> • Fish abundance (fish per unit effort by gear type). • Fish condition (length-weight relationship, condition factor). • Fish growth (length-at-age, weight-at-age). • Fish health (hepatosomatic index, gonadosomatic index). • Contaminant (e.g., metals) body burdens in fish tissue (mg/kg wet weight and ug/g dry weight).
<p>Note: 1. Fish habitat is defined in the <i>Fisheries Act</i> as “waters frequented by fish and any other areas on which fish depend directly or indirectly to carry out their life processes, including spawning grounds and nursery, rearing, food supply, and migration areas”.</p>		

For this assessment, all fish and fish habitat end-points for the above pathways of effects were condensed into two over-arching potential effects of the Project: 1) change in fish habitat, including the potential HADD of fish habitat and potential change in fish passage; and 2) change in fish health, growth, and survival, including potential effects of predicted changes in water quality. Change in fish habitat was included as a potential effect because:

- activities required for construction, operation, and decommissioning of the Project have the potential to cause a HADD of fish habitat, an activity prohibited by paragraph 35(1) of the *Fisheries Act* unless authorized by DFO
- changes in fish habitat may occur due to physical destruction of in-water and riparian habitat during construction of the mine infrastructure, and alteration of lake levels or stream flows due to changes in groundwater-surface water interactions, and/or diversion, extraction, or storage of surface water run-off
- changes to fish habitat have the potential to affect the ability of fish to conduct one or more life stages and, thereby, alter the annual recruitment and production of fish populations

Change in fish health, growth, or survival was included as a potential effect because:

- carrying out a work, undertaking or activity other than fishing, that results in the death of fish, by means other than fishing, is prohibited by paragraph 34.4(1) of the *Fisheries Act*
- changes in fish health, growth, and survival may occur due to changes in water quality or sediment quality due to release of mine effluent or contact water, mobilization of sediment, stranding of fish, effects from underwater noise due to blasting, increased fishing pressure, or changes to the composition, abundance, and distribution of periphyton, plankton, and benthic invertebrate communities that fish depend on for food

The assessment focuses on five fish species or species guilds. This is because the Local Study Area (LSA) is known to support up to 28 different fish species which is too many to reasonably assess potential effects to all, but also unnecessary given that many of these species, particularly the minnows, dace, and chubs, have similar life histories and habitat requirements. The five focal fish species were selected based on their unique life history or habitat requirements, their vulnerability to potential effects of the Project, their abundance and distribution in the Project Area (PA) and LSA, and their importance to people as recreational, commercial, or Indigenous fisheries.

Focusing the assessment on these five fish species or species guilds allowed the identification of potential interactions between the Project and the factors important to fish production in the LSA. Focusing on these five species also enabled identification of avoidance and mitigation measures that would reduce potential effects to most, if not all, fish species and their habitats. The focal fish species used in this assessment were:

- Lake sturgeon (*Acipenser fulvescens*): a large-bodied, benthivorous (benthic feeding) species that inhabits large rivers in the Regional Study Area (RSA). Lake sturgeon is a culturally important fish species for all potentially affected Indigenous nations, and the Southern Hudson Bay-James Bay populations (of which lake sturgeon in the RSA are a part) are listed on Schedule 1 of the SARA (special concern). Lake sturgeons are long-lived, late to mature, and require fast-flowing rapids for spawning and deep pools for rearing. Due to these traits, lake sturgeon populations are vulnerable to over-harvesting, habitat loss, habitat fragmentation, and alterations to the natural flow regime of rivers. Lake sturgeons were identified as a required valued component in the TIS Guidelines.
- Northern pike/jackfish (*Esox lucius*): a large-bodied, piscivorous (fish-eating) species that is widespread in the streams and lakes in the LSA and is the top predatory fish species in the LSA. Northern pike spawn in the spring in still or slow-moving water with aquatic vegetation or submerged terrestrial vegetation. Northern pike are an important recreational fish species and are harvested as country food by all potentially affected Indigenous nations.
- White sucker (*Catostomus commersoni*): a large-bodied, benthivorous species that are found in the mainstem and headwater lakes of the North Driftwood River and in the mainstem of the West Buskegau River and Jocko Creek. White suckers spawn in spring, typically in swift-flowing riffles with clean cobble and gravel, habitat that is vulnerable to changes in flow, but also along gravel shorelines in lakes. White suckers are an important recreational fish species and are harvested as country food by most of the potentially affected Indigenous nations. White suckers have a swim-bladder that is connected to their inner ears, making them sensitive to underwater noise (e.g., blasting).
- Walleye (*Sander vitreus*): a large-bodied, piscivorous (fish-eating) species that are found in the West Buskegau River and Mattagami River. Walleye spawn in spring after ice break-up in shallow shoreline areas and shoals in lakes and in riffles and dam faces in rivers with rocky substrate and good water circulation from currents or wave action. Walleyes are an important recreational fish species and are harvested as country food by all potentially affected Indigenous nations.

- Forage Species Guild: a group of five ecologically similar small-bodied species including brook stickleback (*Culaea inconstans*), northern pearl dace (*Margariscus nachtriebi*), northern redbelly dace (*Chrosomus eos*), fathead minnow (*Pimephales promelas*) and finescale dace (*Chrosomus neogaeus*) found throughout the PA and LSA in headwater ponds and streams with stagnant water or slow flow. These fishes are common prey items for large-bodied, piscivorous fish such as walleye, yellow perch, and northern pike. This guild of fishes typically spawns in late spring and generally feed on benthic invertebrates, plankton, or algae. Minnows (i.e., all the species except brook stickleback) possess a swim-bladder that is connected to their inner ears, making them sensitive to underwater noise (e.g., blasting). Forage fish are actively harvested by the commercial bait fishery.

17.1.1 Boundaries

17.1.3.1 Spatial Boundaries

17.1.3.1.1 Project Area

The PA encompasses the Project footprint and is the anticipated area of physical disturbance associated with construction, operations, and decommissioning and closure of the Project. The PA includes the physical footprints of the Open Pit, Tailings Management Facility (TMF), Stockpiles, Impoundment Facility, Processing Plant (i.e., Primary and Secondary Crushers, Process Plants, and concentrate load-out buildings), water management infrastructure (i.e., non-contact water diversion ditches, contact water collection ditches, ponds, and sumps), associated mine infrastructure (i.e., potable water supply, ancillary buildings, explosives magazine, fuel farm, site access and internal roads, and power supply and distribution).

The PA also includes a new rail spur to connect the mine to the existing Ontario Northland Railway (ONR) operated by Glencore for their Kidd Mine, and realignment of Highway 655 and the 500 kV transmission line operated by Hydro One to the west of the proposed mine infrastructure.

The PA for the Project is shown on Figure 3.1 (Chapter 3 of the Impact Statement [Project Description]) and includes all mine infrastructure and related linear developments. The PA straddles the headwater areas of the North Driftwood River, West Buskegau River, and Jocko Creek watersheds. Jocko Creek is a tributary of the Mattagami River.

17.1.3.1.2 Local Study Area

The LSA for the Fish and Fish Habitat VC encompasses the area in which Project-related direct and indirect effects may occur, can be predicted with a level of confidence that allows for assessment, and in which there is a reasonable expectation of public interest (Figure 17.1). The LSA includes:

- North Driftwood River watershed upstream from its confluence with Nesbitt Creek.
- West Buskegau River watershed upstream from its confluence with the Buskegau River.
- Jocko Creek upstream from its confluence with Kidd Creek.

This LSA was selected because:

- It includes the likely downstream extent of potential changes in stream flow and water quality in the North Driftwood River and West Buskegau River; effluent will be discharged to the North Driftwood River and West Buskegau River at two locations in each watershed and the PA footprint and water management infrastructure will intercept, divert, or overprint headwater streams and ponds in both watersheds.
- It includes the maximum extent of predicted groundwater table draw-down caused by development of the Open Pit.
- It includes the likely extent of potential deposition of mine-created dust and/or potentially acidifying and eutrophying air-borne emissions.
- The mine footprint, and associated water management infrastructure, will encroach into the headwater area of Jocko Creek; however, no effluent will be discharged to the Jocko Creek watershed.
- The downstream extents of the LSA in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds were defined by the confluences of the North Driftwood River, West Buskegau River, and Jocko Creek mainstems with the next downstream watercourse of similar or larger discharge.

The LSA does not include the Mattagami River because potential changes in stream flow are expected to be limited to the Jocko Creek watershed and because mine effluent will not be discharged to the Mattagami River or any of its tributaries.

17.1.3.1.3 Regional Study Area

The RSA for the Fish and Fish Habitat VC (Figure 17.2) was defined to:

- Encompass the area within which potential residual effects of the Project on fish and fish habitat may interact cumulatively with existing or potential residual effects to fish and fish habitat from past, present, or reasonably foreseeable future projects or activities.
- To provide regional context for the assessment of potential Project-specific residual effects to fish and fish habitat in the LSA.
- To include the likely migration range of fish species potentially affected by the Project and cumulatively affected by other past, present, or reasonably foreseeable future projects.

The RSA for the Project includes the PA and LSA and extends further to include:

- The North Driftwood River watershed downstream to its confluence with the Abitibi River.
- The Buskegau River watershed downstream to its confluence with the Frederick House River.

- The Jocko Creek watershed downstream to its confluence with the Mattagami River.
- The Mattagami River from Lower Sturgeon Falls Dam downstream to Yellow Falls Dam.

This RSA was selected because it:

- Extends downstream to, or includes, rivers known to support populations of lake sturgeon, a fish species listed on Schedule 1 of SARA, known to make spawning migrations >100 km, and identified as a culturally important fish species by all potentially affected Indigenous nations.
- Includes all past, present, or reasonably foreseeable projects that are known to, or have the potential to, cause residual effects to fish due to changes in stream flow, water quality, fish habitat, or fish passage.
- Includes the watershed areas within which fish populations potentially affected by the Project are likely to find habitat suitable to complete their entire life histories (e.g., spawning, overwintering).

17.1.3.2 Temporal Boundaries

The temporal boundary of the assessment includes all Project phases from the start of construction through to the end of closure. Based on the current Project schedule, the temporal boundaries for the Project are:

- Construction (Year -3 to Year -1)
- Operations
 - Operations phase 1 (Year 1 to Year 5): 60 kilotonnes per day (kt/d) milling capacity with ore extraction
 - Operations phase 2 (Year 5 to Year 30): 120 kt/d milling capacity with ore extraction
 - Operations phase 3 (Year 30 to Year 41): 120 kt/d milling capacity with no ore extraction
- Decommissioning and closure
 - Active closure (Year 41 to Year 46)
 - Passive closure (Year 46+)

17.1.4 Residual Effects Characterization

Descriptions and quantitative measures or qualitative definitions for the criteria used to characterize potential residual effects on fish and fish habitat are provided in Table 17.3.

Table 17.3 Characterization of Residual Effects on Fish and Fish Habitat

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Direction	The long-term trend of the residual effect.	<p>Positive – a residual effect that moves measurable parameters in a direction beneficial to fish and fish habitat relative to baseline.</p> <p>Adverse – a residual effect that moves measurable parameters in a direction detrimental to fish and fish habitat relative to baseline.</p> <p>Neutral – no net change in measurable parameters for fish and fish habitat relative to baseline.</p>
Magnitude	The amount of change in measurable parameters for the Fish and Fish Habitat VC relative to existing conditions.	<p>Change in Fish Habitat</p> <p>Negligible – following mitigation and/or offsetting, no measurable change in habitat area (m² or ha) and/or monthly flows (m³/sec) in a waterbody or watercourse.</p> <p>Low – following mitigation and/or offsetting, a measurable change in habitat area and/or monthly flows in a waterbody or watercourse but that is within the range of natural variability.</p> <p>Moderate – following mitigation and/or offsetting, a measurable change in habitat area and/or monthly flows (<10%) in a waterbody or watercourse that is greater than the range of natural variability, but that does not affect the ability of fish to use this habitat to carry out one or more of their life processes.</p> <p>High – following mitigation and/or offsetting, a measurable change in habitat area and/or monthly flows (>10%) in a waterbody or watercourse that is greater than the range of natural variability and large enough that fish can no longer rely on this habitat to carry out one or more of their life processes.</p> <hr/> <p>Change in Fish Health, Growth, or Survival</p> <p>Negligible – no measurable change in the abundance, structure, or health metrics of focal fish populations.</p> <p>Low – a measurable change in the abundance, structure, or health metrics of focal fish populations, but that is within the range of natural variability.</p> <p>Moderate – a measurable change in the abundance, structure, or health metrics of focal fish populations that is greater than the range of natural variability but not large enough to affect the productivity of focal fish populations.</p> <p>High – a measurable change in abundance, structure, or health metrics of focal fish populations that is greater than the range of natural variability and large enough to affect the productivity of focal fish populations.</p>
Geographic Extent	The geographic area in which a residual effect occurs.	<p>PA – residual effects are restricted to the PA.</p> <p>LSA – residual effects extend into the LSA.</p> <p>RSA – residual effects extend into the RSA.</p>

Characterization	Description	Quantitative Measure or Definition of Qualitative Categories
Timing ¹	Considers when the residual effect is expected to occur, where relevant to the VC.	<p>No sensitivity – effect does not occur during a critical life stage (e.g., fish spawning or migration period) or timing does not affect the VC.</p> <p>Moderate sensitivity – effect may occur at the start or end of a critical life stage (e.g., fish spawning or migration period).</p> <p>High sensitivity – effect occurs during a critical life stage (e.g., fish spawning period, migration).</p>
Duration	The time required until the measurable parameter or the VC returns to its existing condition, or the residual effect can no longer be measured or otherwise perceived.	<p>Short-term – the residual effect is restricted to less than two years or is shorter than one generation of the focal fish species.</p> <p>Medium-term – the residual effect extends through operation and decommissioning/closure or is greater than one but less than two generations of focal fish species.</p> <p>Long-term – the residual effect extends beyond the life of the project and is greater than two generations of focal fish species.</p>
Frequency	How often the residual effect occurs during the Project or specific Project phase.	<p>Single event – occurs only once.</p> <p>Multiple irregular event – occurs at no set schedule.</p> <p>Multiple regular event – occurs at regular intervals.</p> <p>Continuous – occurs continuously.</p>
Reversibility	Pertains to whether a measurable parameter or the VC can return to its existing condition after the Project activity ceases.	<p>Reversible – the residual effect is likely to be reversed after activity completion and reclamation.</p> <p>Irreversible – the residual effect is unlikely to be reversed after activity completion and reclamation.</p>
<p>Note:</p> <p>1. Timing depends on when critical life stages for various fish species occur, for how long, and what environmental variables contribute to the natural variability of this timing.</p>		

17.1.5 Significance Definition

The Impact Statement must characterize the extent of significance of any residual adverse federal effect, which includes residual adverse effects within federal jurisdiction and any adverse direct or incidental effects as defined in section 2 of the *Impact Assessment Act*. A change to fish and fish habitat, as defined in subsection 2(1) of the *Fisheries Act*, is identified as an effect within federal jurisdiction for which a determination of the extent of significance is required. As such, the extent to which residual adverse effects on fish and fish habitat are considered significant is presented in Section 17.4.5.

A residual adverse effect of high significance on fish and fish habitat is one that, following the application of avoidance and mitigation measures (including offsets), causes an alteration or destruction of fish habitat or a change in fish health, growth, or survival that is likely to cause a measurable reduction in the productivity, abundance, community composition, or population structure of focal fish populations within the RSA that threatens the long-term persistence or viability of an aquatic species at risk.

A residual adverse effect of moderate significance on fish and fish habitat is one that, following the application of avoidance and mitigation measures (including offsets), causes an alteration or destruction of fish habitat or a change in fish health, growth, or survival that is likely to cause a measurable reduction in the productivity, abundance, community composition, or population structure of focal fish populations within the RSA but does not threaten the long-term persistence or viability of an aquatic species at risk.

A residual adverse effect of negligible/low significance on fish and fish habitat is one that, following the application of avoidance and mitigation measures (including offsets), causes an alteration or destruction of fish habitat or a change in fish health, growth, or survival that is not likely to cause a measurable reduction in the productivity, abundance, community composition, or population structure of focal fish populations.

A change to aquatic species at risk, as defined in subsection 2(1) of the Species at Risk Act, is identified as an effect within federal jurisdiction for which a determination of significance is required. However, since residual adverse effects on Lake Sturgeon are not anticipated (see Section 17.2.2.1) as a result of the Project due to project changes that avoid discharge to the Mattagami River, the extent to which residual adverse effects on this species is not assessed. No other aquatic SAR occur within the RSA.

17.2 Existing Conditions for Fish and Fish Habitat

17.2.1 Methods

The determination of existing conditions for fish and fish habitat was based on a review of background information from publicly available data sources, relevant literature, feedback and engagement with stakeholders, government and Indigenous nations and field surveys. Refer to the Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) and the 2021-2023 Fish and Fish Habitat Baseline Report (Appendix B.8.2 of the Impact Statement) for detailed information on the existing condition methods.

17.2.2 Overview

An overview of the baseline conditions for fish and fish habitat is provided in Section 9.5 of Chapter 9 of the Impact Statement (Description of Existing Environment), which provides a summary of the Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement). The Fish and Fish Habitat Supplemental Baseline Report was prepared to summarize existing conditions (i.e., pre-mine) of fish habitat, fish community composition, sediment quality, lower trophic communities, and fish tissue contamination burdens in waterbodies and watercourses near the Project (Appendix B.8.1 of the Impact Statement). The Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement) summarizes information compiled from a desktop review of existing reports, provincial and federal datasets, Indigenous knowledge provided by potentially affected Indigenous nations, and a three-year field program conducted by WSP between 2021 and 2023 (Appendix B.8.2 of the Impact Statement [2021-2023 Fish and Fish Habitat Baseline]). The baseline information presented herein provides an overview of fish and fish habitat baseline conditions from those references.

The PA is located within the headwater areas of the North Driftwood River, West Buskegau River, and Jocko Creek watersheds. The North Driftwood River flows into the Abitibi River approximately 60 km downstream from the Project. The West Buskegau River flows into the Frederick House River approximately 47 km downstream of the Project. Jocko Creek is a tributary of the Mattagami River with its confluence upstream of the Lower Sturgeon Generating Station, due west of the Project.

Fish habitat in the mainstem channels of the North Driftwood River and West Buskegau River within the PA are generally wide (10 m to 20 m) with broad floodplains and fine substrates. The smaller streams draining to these mainstem channels are low gradient, low energy depositional environments with fine grained organic substrates. Beaver dams and ponds are frequent in these smaller, headwater tributaries. Small headwater lakes near the Project (i.e., Martin, Jerry, Mel, Sutherland, Davis) were created for the concrete needed for construction of the Lower Sturgeon Generating Station in the 1920s. These lakes have naturalized, and been colonized by fish, over the last century.

The fish communities in the North Driftwood River, West Buskegau River, and Mattagami River watersheds are represented by a mix of cool and cold-water fish species typical of northeastern Ontario. They include a variety of small-bodied (e.g., minnows) and large-bodied (e.g., northern pike) species. A total of 28 fish species were identified during baseline surveys (Appendix B.8.2 of the Impact Statement [2021-2023 Fish and Fish Habitat Baseline]). Common large-bodied fish species in streams include northern pike, white sucker, yellow perch, and burbot. Brook stickleback, fathead minnow, finescale dace, northern pearl dace, northern redbelly dace, and common shiner were the most common small-bodied fish species in the lakes and ponds.

The benthic invertebrate communities in the North Driftwood River and West Buskegau River watersheds show a taxa richness, diversity and density typical of those observed in northeastern Ontario. One or two species of chironomids (i.e., midge larvae) dominates the benthic invertebrate community in slow-flowing depositional habitats (i.e., beaver ponds and impounded headwater streams) with fine organic substrates, habitats that dominate the headwater areas of the North Driftwood River and West Buskegau River watersheds near the Project.

Fish tissue data shows naturally elevated concentrations of total mercury and methylmercury in northern pike, with exceedances of the provincial and federal guidelines for mercury and methylmercury for the protection of human health and wildlife consumers of aquatic biota, respectively. Elevated mercury concentrations in large-bodied fish have been observed elsewhere in northern Ontario and is not unique to the site (Pirkle et al. 2016; Fimreite and Reynolds 1973). Methylmercury concentrations in small-bodied fish samples from all three watersheds also exceeded the Canadian Council of Ministers of the Environment (CCME) guideline for the protection of wildlife consumers of aquatic biota (33 micrograms per kilogram [$\mu\text{g}/\text{kg}$] wet weight tissue [wwt]).

17.2.2.1 Aquatic Species at Risk: Lake Sturgeon

Lake sturgeon is the only aquatic species at risk in the vicinity of the Project. The Southern Hudson Bay-James Bay population unit, which includes populations known to inhabit the Mattagami River, Abitibi River, and Frederick House River within the RSA, are listed as Special Concern on Schedule 1 of SARA.

The potential for lake sturgeon habitat within the LSA was evaluated through a combination of field and desktop studies that are outlined in detail in the Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement). The conclusion that was reached is that there is no indication that lake sturgeon is present in either the Project area or the LSA. The locations where lake sturgeon have been confirmed to be present are all well over 50 kilometres downstream of the PA. eDNA samples collected from the North Driftwood River (one within the PA and one within the LSA outside of the PA) were negative for lake sturgeon, while samples collected during the same sampling period confirmed lake sturgeon presence in the Mattagami River.

For lake sturgeon to enter the LSA, they would need to migrate upstream from the Abitibi River along the North Driftwood River or upstream from the Fredrick House River along the WBR. The aerial survey undertaken in May 2024 (report appended to the Aquatic Baseline Report, Appendix B.8.1 of the Impact Statement) identified five barriers to upstream migration in the North Driftwood River. One of these barriers (a series of bedrock waterfalls) was identified as being ‘impassable without reservation’, meaning that lake sturgeon would not be able to pass upstream beyond this point, regardless of the flow conditions in the river. This barrier is 21.8km upstream of the North Driftwood River’s confluence with the Abitibi River and 63.3km downstream of the Project Area. The North Driftwood River can therefore be excluded as a possible avenue for lake sturgeon to enter the project area from downstream.

There are no barriers to upstream passage of Lake Sturgeon in the West Buskegau River or Buskegau River that would prevent Lake Sturgeon in the Frederick House River from migrating upstream into habitat near the Project area. There are three impediments to passage in the WBR, which at high or moderate flow may allow lake sturgeon access to upstream. Seven riffles in the WBR and Buskegau River between the Frederick House River confluence and the Project area were identified as having high potential for Lake Sturgeon spawning. All were in the Buskegau River within 16 km of the confluence with the Frederick House River (between 45.21 and 61.65 km downstream of the Project area).

Even though there are no barriers to upstream passage via the WBR, the likelihood of sturgeon using the habitat in the project area is considered low. This is because the habitat conditions in the Project area are not considered attractive to lake sturgeon, being slow moving, with silty, low-quality sediment.

Given the absence of passage in the North Driftwood River, the distance to suitable potential spawning habitat on the Buskegau River from the Project area, the negative eDNA results and the unsuitability of the habitat in the Project area, it is considered unlikely that lake sturgeon occur in the LSA or therefore would be impacted by the Project. It is not anticipated at this time that a SARA permit will be required.

17.3 Project Interactions with Fish and Fish Habitat

The physical activities required to construct, operate, and decommission and close the proposed Project are listed in Table 17.4. They include activities that require the removal of trees and shrubs, the excavation, removal, and deposition of topsoil and overburden material, the diversion and storage of surface water run-off, the draining and in-filling of watercourses and waterbodies, the drilling, blasting, transportation and processing of rock, the storage of tailings, ore, and waste rock, the release of air-borne contaminants, and the discharge of mine effluent. They also include construction and decommissioning of

stream crossings for a highway, internal site roads, a transmission line, and a railway line. These activities fall under the following “land-based” or “in-water” pathways of effects (DFO 2024a):

- excavation (land-based)
- grading (land-based)
- use of explosives (land-based)
- use of industrial equipment (land-based and in-water)
- vegetation clearing (land-based)
- change in timing, duration, and frequency of flow (in-water)
- fish passage issues (in-water)
- placement of material or structures in water (in-water)
- wastewater management (in-water)
- water extraction (in-water)

Without mitigation, on-land activities such as excavation and grading have the potential to introduce sediment into nearby watercourses and waterbodies. They also require the use of heavy machinery which poses risks to fish from accidental releases of contaminants such as oil, grease, and fuel, mortality of fish and fish eggs if the heavy machinery is working in fish-bearing waterbodies and introduction of aquatic invasive species. Vegetation clearing, particularly clearing of riparian vegetation adjacent to watercourses and waterbodies, has the potential to reduce bank stability, shade, and allochthonous inputs of invertebrates, leaf litter, and woody debris. This in turn has the potential to alter nutrient concentrations, sediment concentrations, water temperature, food supply, and habitat structure and cover for fish. However, these potential effects are not expected to occur in watercourses or waterbodies within the Project footprint because these watercourses and waterbodies will be destroyed during construction of the Project. Use of explosives for blasting in the Open Pit has the potential to result in the death of fish or fish eggs due to the promulgation of sound pressure waves through the rock into the water.

Without mitigation, activities involving the placement of materials in water have the potential to introduce sediment, alter fish passage, change habitat structure and cover for fish, and reduce the nutrients and food supply for the aquatic food web. Water extraction has the potential to result in the death of fish that are entrained in the intake and, if a large enough volume is extracted, alter the timing, duration, and frequency of stream flows. Alteration of the natural flow regime of streams due to water extraction, change in groundwater contributions to surface waterbodies, alteration of catchment areas, and/or diversion and storage of run-off has the potential to affect the timing and magnitude of spawning migrations, access to habitat, water depths and water velocities important for various fish life stages (e.g., spawning), downstream drift of invertebrates and fine and coarse organic matter, sediment transport, water temperature, and the quantity and quality of available habitat. Release of mine effluent (i.e., wastewater) has the potential to affect water temperatures, dissolved oxygen concentrations, and contaminants in the downstream receiving environment. This in turn has the potential to negatively affect fish and other aquatic organisms by causing chronic or acute toxicological effects, depending on the concentration of the contaminant introduced to the water, the duration of exposure, and their range of tolerance to the contaminant.

Table 17.4 identifies the Project components and activities that may interact with fish and fish habitat prior to implementation of mitigation measures. Potential interactions that may result in a change in fish habitat or the health, growth, or survival of fish are indicated by a check mark (✓) and are assessed in Section 17.4 in the context of pathways of effects, standard and project-specific mitigation measures, and potential residual effects (i.e., effects remaining after implementation of standard and Project-specific mitigation).

Table 17.4 Project Interactions with Fish and Fish Habitat

Physical Activities	Potential Effects	
	Change to fish habitat	Change to fish health, growth, or survival
Construction		
Mobilization of construction equipment and materials on site.	–	–
Vegetation clearing, including the removal and disposal of trees, brush, shrubs, and other foliage.	✓	✓
Stripping, including the removal of topsoil and other organic materials, as well as storing of some materials for use in reclamation.	✓	✓
Grading of overburden to be used as fill.	✓	✓
Handling and use of explosives, including blasting.	–	✓
Excavating and pre-stripping of mine rock from the Open Pit and surrounding area.	✓	✓
Development of the Impoundment Facility for storage of rock, clay, sand, and till.	✓	✓
Preparation of construction surfaces, including hauling reclaimed graded material and crushed mine rock to construction locations.	✓	✓

Crawford Nickel Project Impact Statement
Chapter 17 Assessment of Potential Effects on Fish and Fish Habitat
September 30, 2024

Physical Activities	Potential Effects	
	Change to fish habitat	Change to fish health, growth, or survival
Construction of water management systems to collect, manage, treat and discharge contact water from mine components to the receiving waterbodies via collection ponds, ditches, and water treatment plants.	✓	✓
Construction of minor water diversions around perimeter of the mine site to collect and divert flows.	✓	✓
Dewatering of natural waterbodies within the PA.	✓	✓
Waste management, including collection and temporary storage.	–	–
Construction of mine infrastructure, including crusher facilities, process plant and TMF, as well as the potable water well, and ancillary infrastructure (e.g., offices, workshop, fuel farm, magazine storage and explosives pad).	✓	–
Construction of internal haul roads and internal access roads, including water crossings.	✓	✓
Construction of power supply and distribution systems.	✓	✓
Construction of temporary Highway 655 by-pass and overpass.	✓	✓
Construction of the rail spur.	✓	✓
Vehicle operation within the PA.	–	–
Employment and expenditures ¹ .	–	✓
Operations (Mining and Processing)		
Construction of Project infrastructure, including the expansion of ore processing components.	✓	✓
Relocation and decommissioning of Highway 655 and associated infrastructure.	✓	✓
Relocation of 500 kV transmission line.	✓	✓
Construction of the North Driftwood Diversion Channel.	✓	✓
Handling and use of explosives including blasting.	–	✓
Ore extraction in the Main Zone and East Zone of the Open Pit, including drilling, loading and hauling of mine rock from the pits.	–	☐
Maintenance and management of mine rock stockpiles, overburden, and TMF.	–	✓
Ore processing, including conveyor, crushing, and processing activities with and between the stockpiles, crusher facilities and process plant.	–	✓
Operation of water management systems, including the collection, management, treatment, and discharge of contact water from mine components to the receiving waterbodies via collection ponds, ditches, and water treatment plants.	✓	✓

Physical Activities	Potential Effects	
	Change to fish habitat	Change to fish health, growth, or survival
Transportation of Ore via the rail spur line.	–	–
Waste management, including collection and temporary storage.	–	–
Vehicle operation within the PA.	–	–
Progressive reclamation of disturbed areas.	–	✓
Employment and expenditures ¹ .	–	✓
Decommissioning and Closure		
Pit flooding through the creation of channels from the collection ponds towards the Open Pit.	✓	✓
Water management, including groundwater and surface water.	✓	✓
Decommissioning, dismantling and/or disposal of buildings and mine infrastructure.	–	–
Removal of power lines and electrical equipment.	–	–
Decommissioning of potable water and sewage systems.	–	–
Vehicle operation within the PA.	–	–
Reclamation, including the placement of overburden, seeding and re-grading.	–	✓
Monitoring and maintenance.	✓	✓
Employment and expenditures ¹ .	–	✓
Notes: ✓ = Potential interaction – = No interaction ¹ Project employment and expenditures are generated by most Project activities and are the main drivers of many potential socio-economic effects. Rather than acknowledging this by placing a checkmark against each of these activities, 'employment and expenditures' is listed as a separate item under each phase of the Project.		

Activities during construction that will not interact with fish or fish habitat are:

- mobilization of construction equipment and materials on site
- waste management, including collection, temporary storage, and hauling of solid hazardous and non-hazardous waste to offsite facilities
- vehicle operation within the PA

None of these activities will interact with fish or fish habitat because they will occur on land, involve the use of vehicles on roads (not the construction of the roads), and will not result in any discharge of contaminants to water unless a result of an accident or malfunction.

Activities during operations that are not expected to interact with fish or fish habitat are:

- the transportation of ore to a process facility via the rail spur line
- waste management activities
- vehicle operation within the PA

None of these activities will interact with fish and fish habitat because they will occur on land and, except in the case of an accident or malfunction, will not occur near water, require water, or have the potential to produce run-off that may contaminate any fish-bearing or non-fish-bearing waterbody.

Activities associated with maintenance and management of mine rock stockpiles, overburden, and the TMF, ore processing, and progressive reclamation of disturbed areas during operations have the potential to affect fish health, growth, or survival due to their potential contribution of contaminants to the mine effluent. However, none of these activities will affect fish habitat because none of these activities require the alteration, disturbance, or destruction of any new fish habitat that has not already been disturbed during construction.

Activities that are not expected to interact with fish or fish habitat during decommissioning and closure are those involved in:

- the removal of mine infrastructure, powerlines, and potable water and sewage systems
- the operation of vehicles within the PA

None of these activities will interact with fish and fish habitat because they will occur on land. Further, these activities will not directly affect fish habitat and can be conducted without increasing erosion or sediment transport to fish-bearing watercourses. Reclamation activities will require placement and grading of topsoil. Therefore, while this activity has the potential to increase sediment loads and TSS concentrations in nearby fish-bearing watercourses, this is a potential effect to fish health, growth, and survival and not to fish habitat.

The employment and expenditure activity has the potential to interact with fish and fish habitat because of the potential for increased fishing pressure created by the presence of the workforce during all mine phases. This activity only has the potential to effect the health, growth, or survival of fish.

17.4 Assessment of Residual Effects on Fish and Fish Habitat

17.4.1 Analytical Assessment Techniques

17.4.1.1 Change in Fish Habitat

Potential effects of the Project on fish habitat were assessed quantitatively when numerical data such as geographic information system (GIS) data and model results were available, or qualitatively when numerical data was not available. Quantitative assessment methods included:

- GIS analysis of the PA overlain on habitat maps of fish-bearing and non-fish-bearing watercourses and waterbodies to delineate and calculate potential habitat losses under the mine footprint.
- Comparison of surface water model flow predictions to existing monthly and annual stream discharges in streams and rivers potentially affected by the Project. These comparisons were conducted for a climate scenario based on Shared Socioeconomic Pathway (SSP) 2-4.5 to depict the range of likely flow changes for years 2071 to 2100.
- Comparison of surface water model flow predictions to the federal Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada (DFO 2013a). Flow increases over 10% were further assessed by comparing predicted flood flows (100-year return period, 24-hour duration event; Q_{100}) to the baseline condition flood flow to assess potential flooding and erosion. Flow reductions over 10% were compared with environmental flows, which were adjusted to account for climate change.
- A Habitat Evaluation Procedures (HEP) approach was utilized where fish habitat quality was defined by Habitat Suitability Indices (HSI) to generate species specific HSI maps. The HEP methods are presented in the Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement).

Qualitative assessment methods were conducted using a weight-of-evidence approach. This entailed the use of professional judgement based on an understanding of the potential effect, the habitat preferences and life histories of potentially affected focal fish species in the LSA, and the likely effectiveness of mitigation measures, supported by scientific literature, grey literature, industry best management practices, and regulatory guidelines, as available.

17.4.1.2 Change in Fish Health, Growth, or Survival

Potential effects of the Project on fish health, growth, and survival were assessed quantitatively when model results were available, or qualitatively when model results were not available. Quantitative assessment methods included:

- Comparison of predicted concentrations of Parameters of Potential Concern (PoPCs) to provincial and/or federal water quality guidelines for the protection of freshwater aquatic life.

- Comparison of predicted air-borne particulate matter loadings into lakes, ponds, and streams within 1 km, 3 km, and 10 km of the PA to background TSS concentrations and to provincial and/or federal water quality guidelines for the protection of freshwater aquatic life.
- Comparison of predicted air-borne loadings of potentially acidifying emissions to the natural buffering capacity of lakes, ponds, and streams within 1 km, 3 km, and 10 km of the PA.
- Comparison of predicted air-borne loadings of potentially eutrophying emissions to the trophic status of lakes, ponds, and streams within 1 km, 3 km, and 10 km of the PA.

Predicted PoPCs identified in the Surface Water Resources Assessment (Appendix C.5 of the Impact Statement), were assessed for their potential effects on fish health, growth, and survival. This was because PoPCs were, by definition, the water quality parameters predicted to exceed provincial and/or federal water quality guidelines for the protection of freshwater aquatic life and be higher than baseline concentrations. Potential Project effects on fish and aquatic biota due to potential changes in nutrients concentrations (i.e., phosphorus or nitrogen) were also assessed.

Predicted PoPCs do not necessarily mean that adverse effects will occur in fish or aquatic biota. This is because guidelines are typically developed to protect the most sensitive species at a provincial or federal level (which may not be present at the site), and often incorporate uncertainty factors and include conditions that may not be relevant at a local or regional level. In addition, some guidelines do not incorporate the most recent science about the toxicity of a parameter to fish or aquatic biota. Therefore, PoPCs were used to flag parameters that required evaluation to determine whether adverse effects to fish and aquatic biota are likely to occur at the concentrations predicted by the water quality models. Methods to assess potential effects of PoPCs on fish health, growth, and survival were applied in the following order:

- Assess the appropriateness of the guideline to the aquatic biota and fish species present in the LSA.
- Evaluate co-occurrence of parameters that may influence the toxicity of the PoPCs (e.g., water hardness, temperature, pH) based on the scientific literature and the site-specific concentrations of these factors at the site.
- For PoPCs known to bioaccumulate (e.g., mercury and selenium), use available scientific literature on bioaccumulation in aquatic biota and fish species, or appropriate analogs, present in the LSA.
- Assess the potential acute and/or chronic toxicological effects of the PoPCs exceeding guidelines, focusing on effects to survival, reproduction, development, or growth that could have population-level effects.

Qualitative assessments were conducted using a weight-of-evidence approach for other potential Project interactions with fish health, growth, or survival. This entailed the use of professional judgement based on an understanding of the potential effect, the habitat preferences and life histories of potentially affected focal fish species in the LSA, and the likely effectiveness of mitigation measures, supported by scientific literature, grey literature, industry best management practices, and regulatory guidelines, as available.

The assessment of potential effects of the Project on fish health, growth, and survival was completed under future climate conditions for the Expected Case (i.e., average climate conditions/average groundwater quality/average geochemistry source terms/average baseline surface water quality). As described in the Surface Water Resources Assessment (Appendix C.5 of the Impact Statement), future climate conditions provide conservative model results. When required, baseline surface water quality parameters (e.g., hardness, pH, DOC concentrations) were used. Due to the high variability measured for these parameters, average watershed-specific average concentrations were considered more representative than 75th or 95th percentiles. As a result, average watershed specific concentrations of baseline water quality parameters were used in the assessment when needed.

The analytical assessment was completed by comparing predicted concentrations with applicable guidelines. Except for aluminum and zinc, potential effects of metals were assessed based on predicted total concentrations. Speciation in surface water influences metal toxicity, with dissolved metals being considered the most bioavailable and toxic fraction to aquatic organisms (Väänänen et al. 2018). Therefore, the use of total predicted metal concentrations, which are higher than dissolved concentrations because they include the dissolved and suspended fractions, to assess the fish health, growth and survival was considered conservative.

Canadian water quality guidelines for the protection of aquatic life used in this assessment are derived to protect the most sensitive species. For example, sensitive species can be determined using a species sensitive distribution (SSD) study. Fish species in the natural receiving environment may be more tolerant than the most sensitive species used in the guideline derivation. Therefore, the comparison to the guideline is considered conservative. In addition, the assessment assumes that a fish species would be exposed continuously to the highest predicted concentration (or predicted concentration above guideline). However, the home range of individual fish may be greater than the area for which the PoPC concentration was predicted above guideline and, therefore, the assessment is considered conservative.

17.4.2 Change in Fish Habitat

17.4.2.1 Project Pathways

Twenty-two different Project components or activities have the potential to affect fish habitat in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds: 14 activities during construction; five activities during operations; and three activities during closure and decommissioning. They include activities that require the removal of trees and shrubs, the excavation, removal, and deposition of topsoil and overburden material, the diversion and storage of surface water run-off, the draining and in-filling of watercourses and waterbodies, the storage of tailings, ore, and waste rock, and the construction and decommissioning of stream crossings. These activities fall under the following “land-based” or “in-water” pathways of effects (DFO 2024a):

- excavation (land-based activity)
- grading (land-based activity)
- vegetation clearing (land-based activity)
- change in timing, duration, and frequency of flow (in-water activity)

- fish passage issues (in-water activity)
- placement of material or structures in water (in-water activity)
- water extraction (in-water activity)

When taken together, these Project activities may affect fish habitat in the following ways:

- loss or alteration of habitat underneath mine infrastructure
- alteration of stream flows downstream of the Project due to diversion or storage of surface water run-off
- alteration of fish passage at new stream crossings

Potential effects of these Project activities on fish habitat, prior to mitigation, are described under these headings in the following Sections.

17.4.2.1.1 Alteration, Disruption, or Destruction of Fish Habitat

Alteration and loss of fish habitat will occur during the construction phase of the Project. Various Project activities including vegetation clearing, stripping, grading, excavation and the dewatering of waterbodies and watercourses within the PA are required to build various Project components including the Open Pit, TMF, rock and overburden impoundment areas. These activities will result in the loss of fish habitat within the Project footprint, the dewatering of fish habitat in tributaries downstream of the Project footprint, and the dewatering of fish habitat affected by water management infrastructure (Figure 17.3). Potentially affected fish is located primarily in the headwaters of the North Driftwood River and West Buskegau River watersheds with a smaller portion of potential affected habitat in the Jocko Creek watershed.

Alteration or loss of fish habitat may reduce the productivity in fish populations that use the habitat for some or all of their life history. A reduction or loss of wetted habitat area can lead to lower amounts of area suitable for fish occupancy, recruitment, growth and survival. Various scientific papers have established that fish population and carrying capacity are proportional to the size of the wetted area available to fish (Bradford et al. 2014).

Alteration or loss of fish habitat in riverine systems can also affect fish habitat downstream through changes in sediment transport, nutrients and food supply. Changes in sediment transport resulting from upstream habitat loss can alter the dynamic equilibrium of a river's channel morphology and the physical habitat it provides to fish and other aquatic biota (Montgomery 1996). The loss of vegetation, including instream and riparian vegetation, associated with habitat loss can also reduce nutrient, carbon and invertebrate inputs which can reduce the productivity of fish populations in downstream areas (Bradford et al. 2014).

The pathways of effects on fish habitat as it relates to the alteration, disruption or destruction of fish habitat are described by Project phase and activity in the following sections.

Construction

Construction of the processing plants, TMF, stockpiles, impoundment facilities, water management infrastructure (i.e., diversion channels, collection ponds, collection ditches, and effluent discharge locations), associated buildings within the PA, and access and site roads during the first three years of the Project will involve various activities, such as vegetation clearing, stripping, grading of overburden and excavation, and water management that will result in the permanent loss of fish habitat within the North Driftwood River, West Buskegau River and Jocko Creek watersheds. These habitat losses may negatively affect the productivity of local fish populations by reducing the amount of available habitat for various life stages (e.g., spawning, rearing, overwintering) and altering sediment transport, nutrients and/or food supply to fish habitat downstream of the PA.

Operations

Construction of the North Driftwood Diversion Channel during the operations will involve vegetation clearing, stripping, grading of overburden and excavation, and dewatering of fish habitat in the mainstem and tributaries of the North Driftwood River within the PA. The North Driftwood Diversion Channel is a non-contact water diversion channel that will convey flow from Martin Lake to the west of the Project footprint before rejoining the North Driftwood River downstream of the PA.

Loss of fish habitat associated with the North Driftwood Diversion Channel may negatively affect the productivity of local fish populations by reducing the amount of available habitat for various life stages (i.e. spawning, rearing, overwintering) as well as reducing sediment transport, nutrients and/or food supply to areas of fish habitat downstream of the PA.

Realignment of Highway 655 will involve vegetation clearing, stripping, and grading of overburden that has the potential to affect fish habitat within a portion of the North Driftwood River watershed. Realignment of Highway 655 will also require construction of stream crossings that have the potential to alter upstream or downstream fish passage.

Decommissioning and Closure

No Project activities during the decommissioning and closure phase of the Project are anticipated to result in loss of fish habitat not already impacted by activities occurring during construction or operation phases.

17.4.2.1.2 Alteration of Stream Flows

The Project has the potential to alter stream flows in the North Driftwood River, West Buskegau River, and Jocko Creek downstream of the PA during construction, operations, and decommissioning and closure phases. Project activities that may affect stream flows include construction and operation of water storage infrastructure (e.g., sumps, collection ponds, collection ditches), dewatering of natural watercourses and waterbodies within the PA, and construction and operation of water diversion channels.

Alteration of the natural flow regime has the potential to affect the timing and magnitude of spawning migrations, alter the timing of access to habitat, alter the amount of available wetted habitat, and alter the hydraulic variables (i.e., water depth, water velocity) important to various fish life stages (e.g., spawning adults). For example, reductions in stream flows in the summer (i.e., low flow conditions) may decrease habitat availability and increase barriers to fish passage. Alternatively, increases in stream flows in the winter (i.e., high flow conditions) can cause scouring, bank erosion, and increased sediment suspension which may reduce primary production and nutrient loading in watersheds (Clarke et al. 2008).

White suckers and walleye that use habitat potentially affected by changes in flows may be more than other fish species because white suckers and walleye spawn in swift-flowing riffles (Appendix B.8.1 of the Impact Statement [Fish and Fish Habitat Supplemental Baseline Report]); habitats are vulnerable to changes in stream flows (Clarke et al. 2008).

Construction

The construction of mine infrastructure, and water management infrastructure will alter approximately 64% of the North Driftwood River watershed and 18% of the West Buskegau River watershed. Construction of the TMF has the potential to alter a portion of the Jocko Creek watershed.

During construction, the water management infrastructure, including collection ditches, sumps, and ponds, will be constructed to collect, manage, treat and discharge contact water from mine components to the North Driftwood River and West Buskegau River. The Project is anticipated to have up to four final discharge points for treated effluent: two into the North Driftwood River and two into the West Buskegau River.

At the north end of the Impoundment Facility, a combination of perimeter berms and ditching will redirect non-contact water (i.e., surface runoff and water draining from existing watercourses) into the West Buskegau River watershed. At the southern extent of the TMF, a diversion ditch will intercept and redirect non-contact water from the south and east side of the TMF to the North Driftwood River watershed. A diversion channel will be constructed to replace a portion of the North Driftwood River main channel.

Construction of internal haul roads and access roads have the potential to alter stream flows at water crossings. A series of ditches, culverts and bridges will be installed where Project components will intersect with existing watercourses. The type and dimensions of these structures are to be determined.

Operations

Construction activities associated with the realignment of Highway 655, including the installation of culverts to convey flows beneath the new highway, will occur during the operations phase of the Project. No alteration of stream flows is anticipated because of the relocation of the 500 kV transmission line.

Construction of the North Driftwood Diversion Channel will result in the diversion of flows from the North Driftwood River mainstem around the PA. The channel will convey non-contact water from Martin Lake around mine infrastructure parallel to the realigned portion of Highway 655 before reconnecting with the North Driftwood River downstream of the PA. Additionally, a diversion dam will be constructed to cut off

the existing outlet of Martin Lake to prevent flows from entering the PA. The effect of the North Driftwood Diversion Channel will be the dewatering of habitat in the North Driftwood River mainstem within the PA.

Flows in the North Driftwood River and West Buskegau River may be affected by storage of surface water run-off captured in the collection ditches, ponds, and sumps for use in the processing plants, truck washes, dust suppression, and TMF. The primary source of potential water losses to both rivers from the Project are in the tailings deposited in the TMF.

Decommissioning and Closure

During decommissioning and closure, the Open Pit will be filled with water from direct precipitation, local run-off, and gravity-fed contact water from the site, as well as groundwater (groundwater pumping within the pit will cease at the end of operations), until a pit lake is formed.

The Open Pit is predicted to fill to the spillway elevation approximately 118 years after operations (Year 159), at which point the pit lake will drain to the North Driftwood River and West Buskegau River. The overflow spillways to the North Driftwood River and West Buskegau River will be sized proportionally to the catchment area of each watershed to the extent possible.

17.4.2.1.3 Alteration of Fish Passage

The realigned Highway 655 and proposed new rail spur will cross watercourses frequented by fish. Approximately 26 km of Highway 655 will be realigned to the west of the mine to divert Highway 655 traffic around the mine site. Once realigned, portions of the existing section of Highway 655 will be decommissioned. A new 25 km rail spur will be built to connect to the existing spur to the south. A series of ditches, culverts and/or bridges will be installed to convey water along and beneath the highway and the new rail spur. Major watercourse crossings, such as Jocko Creek and North Driftwood River, are expected to have free span structures (i.e., open-bottom culverts, bridges) like those beneath the existing Highway 655, while smaller tributaries are expected to have closed-bottom culverts (size and dimensions to be determined).

During construction, temporary access roads will require crossings of existing watercourses frequented by fish until flow in these watercourses has been dewatered or diverted. Permanent access roads will also require crossings but these crossings will be over water management infrastructure and not fish-bearing habitat.

Construction of stream crossings along the realigned Highway 655, new rail spur, and temporary access roads have the potential to create barriers or impediments to fish passage if not properly designed or constructed. Any change in upstream or downstream fish passage has the potential to restrict the timing, number, or ability of fish to access habitat, including habitat critical for their survival (e.g., overwintering), growth (e.g., foraging, rearing), or reproduction (e.g., spawning), and to redistribute within the watershed as habitat and/or foraging conditions change.

Knowledge of the swimming capabilities of a fish species play a critical part in assessing the effects of potential barriers on fish passage (Wang 2008). Physiology, size, morphology, and life stage influence the swimming abilities of fish (Koehn and Crook 2013). Juvenile and small-bodied fish possess weaker swimming abilities than adult and large-bodied fish (Domenici 2001; Rodgers et al. 2014) as larger fish have more muscle to propel them through the water (Tillinger and Stein 1996). Fish communities in the North Driftwood River and West Buskegau River watersheds include a variety of small-bodied (e.g., minnows) and large-bodied (e.g., northern pike) species and life stages (Appendix B.8.1 of the Impact Statement [Fish and Fish Habitat Supplemental Baseline Report]). It is anticipated that small-bodied species (e.g., brook stickleback, finescale dace) and early life stages (e.g., fry and juveniles) in these watersheds will be more susceptible to potential adverse effects of stream crossings required for the Project.

17.4.2.2 Mitigation Measures

Mitigation measures to avoid or reduce potential effects to fish habitat were selected based on provincial and federal regulations and policies, on best management practices and guidelines, and relevant peer-reviewed literature. Reference to the following documents were made in identifying appropriate mitigation measures for this Project:

- Measures to Protect Fish and Fish Habitat (DFO 2023b)
- Code of practice: Clear span bridges (DFO 2023c)
- Code of practice: Temporary fords (DFO 2023d)
- Code of practice: Beaver dam breaching and removal (DFO 2023e)
- Interim code of practice: Temporary cofferdams and diversion channels (DFO 2020b)
- Ontario's Environmental Guidelines for Access Roads and Water Crossings (MNRF 1990)
- Ontario's Provincial Fish Strategy – Fish for the Future (MNRF 2015)

The Project followed a hierarchical approach to reduce changes in fish habitat as outlined by DFO's Fish and Fish Habitat Protection Policy Statement (DFO 2019). This hierarchy involved implementing avoidance measures that eliminated potential change in fish habitat in space or time before applying mitigation measures to reduce any remaining effects.

Mitigation measures designed to avoid or reduce potential changes in fish habitat caused by the Project are:

- reducing the Project footprint in the West Buskegau River and Jocko Creek watersheds to the extent possible
- avoiding placement of mine infrastructure in the West Buskegau River mainstem to the east and the headwater lakes of the North Driftwood River watershed (i.e., Martin, Gerry, Jack, Mel, Sutherland, Davis lakes) to the west of the PA
- constructing mine infrastructure in a progressive manner to delay alteration of fish habitat, to the extent practical

- progressively backfilling portions of the mined-out pit with tailings during operations to reduce the footprint of the TMF at surface
- constructing the North Driftwood River Diversion Channel to divert run-off in the North Driftwood River watershed around the PA and to reduce potential flow reductions in the North Driftwood River downstream of the PA
- applying natural channel design principles into the design of the North Driftwood River Diversion Channel using the existing North Driftwood River as a template
- maintaining riparian buffers around fish-bearing watercourses and waterbodies within the PA to the extent possible
- installing open-bottom structures (i.e., clear-span bridges or open-bottom culverts) with abutments above the ordinary high-water mark at stream crossings of permanent fish-bearing mainstem channels
- installing appropriately sized closed-bottom culverts at crossings of ephemeral streams or permanent fish-bearing or non-fish-bearing tributaries of mainstem channels
- developing a Site-Wide Water Management Plan (Appendix J of the Impact Statement) for the Project. This Plan will include measures to:
 - divert clean, non-contact water around the Project site so that it reports to its natural watershed, to the extent possible
 - capture run-off in collection ponds during construction (reducing potential for contamination of watercourses) to provide start-up water for the Processing Plant
 - use contact water from the Open Pit and water decanted from the TMF as source water for use in the Processing Plant
 - recycle water between the Processing Plant and the water collection ponds
- developing a Construction Environmental Protection Plan for the Project. This plan will include measures to:
 - isolate instream work areas and implement erosion prevention and sediment control measures suitable for the local site and flow conditions
 - maintain downstream flow, as required, when conducting in-water construction activities
 - maintain riparian buffers around fish-bearing watercourses and waterbodies near construction activities to the extent possible
- developing a Fish Habitat Offsetting Plan to counterbalance all unavoidable losses of fish habitat in the North Driftwood River, West Buskegau River and Jocko Creek watersheds. A Conceptual Fish Habitat Offsetting Plan (Appendix M of the Impact Statement) has been developed with input from Indigenous nations, agency staff, provincial fisheries managers, and local stakeholders. This conceptual plan provides a suite of “in-kind” and “out-of-kind” options that are likely to form the basis for the final Fish Habitat Offsetting Plan that Canada Nickel will include as part of the Project’s paragraph 35(2)(b) *Fisheries Act* Authorization application to DFO.

17.4.2.3 Project Residual Effects

17.4.2.3.1 Alteration, Disruption, or Destruction of Fish Habitat

17.4.2.3.1.1 Spatial Area

The Project is anticipated to result in the unavoidable HADD of approximately 147 ha of fish habitat (Table 17.5). Most (70%) of this habitat will be in the North Driftwood River watershed with smaller areas of affected habitat in the West Buskegau River watershed (29%) and Jocko Creek watershed (< 1%). Maps depicting the location of potentially affected habitat are presented in Figure 17.3 and the Fish and Fish Habitat Supplemental Baseline Report (Appendix B.8.1 of the Impact Statement).

Table 17.5 Summary of Fish Habitat Potentially Affected by the Project Footprint in the North Driftwood River, West Buskegau River, and Jocko Creek Watersheds

Watershed	Habitat Type	Total Spatial Area (ha)
North Driftwood River	Mainstem ¹	14.96
	Headwater tributary ²	21.42
	Headwater pond ³	66.32
West Buskegau River	Mainstem ¹	0.36
	Headwater tributary ²	10.08
	Headwater pond ³	34.02
Jocko Creek	Headwater tributary ²	0.15
Total		147.31
Notes:		
1. includes channels with stream orders of 4		
2. includes tributaries with stream orders 1 to 3		
3. includes ponds and beaver dam impoundments		

In the North Driftwood River watershed, potentially affected fish habitat includes approximately 8 km of the North Driftwood River mainstem channel. However, most (92%) of the potentially affected fish habitat in the North Driftwood River watershed is headwater tributaries and headwater ponds. None of the habitat in the headwater lakes in the North Driftwood River watershed (i.e., Martin, Jerry, Jack, Sutherland, Mel, and Davis lakes) will be affected the Project.

In the West Buskegau River watershed, potentially affected fish habitat is almost entirely (99%) located in small, unnamed tributaries and headwater ponds that drain into the West Buskegau River mainstem from the west. A small portion (<1%) of habitat in the West Buskegau River mainstem will be affected by the two effluent discharge pipes.

In the Jocko Creek watershed, approximately 0.15 ha of habitat in the Jocko Creek watershed will be potentially affected by the installation of water management infrastructure. All this potentially affected fish habitat is in small, headwater tributaries.

Habitat losses in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds will occur in phases. Construction activities will account for losses associated with mine infrastructure, such as water management systems and initial ore stockpile and rock impoundments. As mining operations progress, fish habitat will be progressively impacted.

17.4.2.3.1.2 Habitat Units

A quantitative assessment of the relative value of the fish habitat to be affected by the Project was carried utilizing an HEP approach (U.S. FWS 1980). Results are presented in dimensionless Habitat Unit (HUs) because they are a product of the spatial area of different affected habitat types and qualitative rating of the suitability of those different habitat types for different fish species and life stages.

A summary of HUs for northern pike, walleye, white sucker and the forage fish guild for different life history stages, by watershed, is provided in Table 17.6. A summary of the total HUs for the different northern pike, walleye, white sucker and the forage fish life history stages is presented in Table 17.7. Lake sturgeon were not included in either table because, based baseline sampling conducted between 2021 and 2023 and subsequent surveys, including eDNA surveys, conducted in May 2024 (Appendix B.8.1 of the Impact Statement [Fish and Fish Habitat Supplemental Baseline Report]), none of the habitat affected by the Project is used by lake sturgeon; lake sturgeon inhabit large rivers with deep, swift flowing water for all of their life cycle stages (Peterson et al. 2006), not the small, shallow, slow-flowing streams that will be affected by the Project footprint.

Habitat losses in the North Driftwood River watershed are expected to affect forage fish to a greater degree than northern pike or white sucker (Table 17.6). This is because most of the affected habitat in the North Driftwood River watershed is comprised of headwater streams and beaver ponds. Loss of forage fish habitat in the upper North Driftwood River watershed has the potential negatively affect populations of predatory fish species such as northern pike and yellow perch residing in the North Driftwood River downstream of the PA. This is because forage fish are important prey items for these larger predatory species. However, the species in the forage fish guild are regionally abundant and the habitat on which they rely (i.e., headwater streams, beaver ponds) are common.

Habitat losses in the North Driftwood River mainstem will affect white sucker and northern pike spawning, rearing, foraging, and overwintering habitat.

A conservative approach was adopted during the quantification of habitat units in the potentially affected fish habitat. This is because abundance data collected during baseline studies indicated that northern pike and white sucker are uncommon in the headwater tributaries and ponds that comprise most of the affected habitat. However, habitat units for both species were calculated for these habitat types because these species may utilize these habitats for some, or all their life stages based on their habitat suitability indices.

Walleye were not captured in the North Driftwood River during baseline studies conducted between 2021 and 2023 (Appendix B.8.2 of the Impact Statement) and walleye were not captured during the spring spawning survey conducted in May 2024. The absence of walleye from the North Driftwood River fish catch may be due to the paucity of fast-flowing riffles suitable for walleye spawning, deep pools suitable

for walleye rearing, foraging and overwintering, and the presence of a barrier to upstream fish migration between the North Driftwood River and the Abitibi River located approximately 25 km upstream from their confluence. For these reasons, habitat units for walleye were not calculated for the affected habitat in the North Driftwood River watershed.

Habitat losses in the West Buskegau River watershed are anticipated to affect forage fish species to a greater degree than northern pike, walleye or white sucker (Table 17.6). This is because nearly all the overprinted habitat in the West Buskegau River watershed is comprised of headwater streams and beaver ponds. Walleye were captured in mainstem reaches of the West Buskegau River during the spring of 2024 (Appendix B.8.1 of the Impact Statement [Fish and Fish Habitat Supplemental Baseline Report]) but have not been captured in the small headwater tributaries that will be affected by Project infrastructure.

Habitat losses in the Jocko Creek watershed will only affect forage fish habitat and white sucker habitat because the affected habitat is comprised exclusively of headwater streams and beaver ponds.

Table 17.6 Summary of Habitat Units for focal fish species by life history stage and watershed for habitat potentially overprinted by Project Area

Watershed	Species/Habitat Type	Habitat Units (HU)	
North Driftwood River	Northern pike spawning/rearing	10.6	379.9
	Northern pike adult/migration	13.3	
	Northern pike overwintering	8.4	
	White sucker spawning/rearing	14.8	
	White sucker adult/migration	47.6	
	White sucker overwintering	28.0	
	Walleye spawning/rearing	4.1	
	Walleye adult/migration	4.1	
	Walleye overwintering	4.1	
	Forage fish guild spawning/rearing	88.0	
	Forage fish guild adult/migration	90.2	
	Forage fish guild overwintering	66.6	
West Buskegau River	Northern pike spawning/rearing	~0.0	134.0
	Northern pike adult/migration	~0.0	
	Northern pike overwintering	~0.0	
	White sucker spawning/rearing	5.2	
	White sucker adult/migration	10.9	
	White sucker overwintering	8.3	
	Walleye spawning/rearing	~0.0	
	Walleye adult/migration	~0.0	
	Walleye overwintering	~0.0	

Watershed	Species/Habitat Type	Habitat Units (HU)	
	Forage fish guild spawning/rearing	41.0	
	Forage fish guild adult/migration	41.0	
	Forage fish guild overwintering	27.5	
Jocko Creek	White sucker spawning/rearing	0.048	4.7
	White sucker adult/migration	0.4	
	White sucker overwintering	0.3	
	Forage fish guild spawning/rearing	1.5	
	Forage fish guild adult/migration	1.5	
	Forage fish guild overwintering	1.0	

Table 17.7 Total summary Habitat Units for focal fish species by life history stage for habitat potentially overprinted by Project Area

Species/Habitat Type	Total Habitat Units (HU)	
Northern pike spawning/rearing	10.6	32.4
Northern pike adult/migration	13.3	
Northern pike overwintering	8.4	
White sucker spawning/rearing	20.1	115.6
White sucker adult/migration	58.8	
White sucker overwintering	36.7	
Walleye spawning/rearing	4.1	12.3
Walleye adult/migration	4.1	
Walleye overwintering	4.1	
Forage fish guild spawning/rearing	130.5	358.4
Forage fish guild adult/migration	132.7	
Forage fish guild overwintering	95.2	
*Note: Calculations have been rounded to the nearest decimal place. Any non-zero values less than 0.04 HUs are represented in the table as ~0.0.		

Mitigation of potential effects on the habitat of culturally significant species such as lake sturgeon, walleye, northern pike and white sucker was accomplished, in part, during preliminary design and multiple accounts assessment when the Project footprint in the West Buskegau River and Jocko Creek watersheds was strategically reduced. Nevertheless, the habitat losses in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds summarized in the tables above are unavoidable.

Canada Nickel has developed a conceptual fish habitat offsetting plan that includes “in-kind” habitat creation in the North Driftwood River Diversion Channel and various “out-of-kind” habitat creation, enhancement, and restoration opportunities. While the amount of “in-kind” habitat creation that is possible in the North Driftwood River Diversion Channel has yet to be determined, it is likely to include mainstem and off-channel habitats similar to those affected in the North Driftwood River watershed. These habitats are expected to benefit the fish populations most directly affected by the habitat losses within the PA because the North Driftwood River Diversion Channel will be hydraulically connected to the North Driftwood River immediately downstream of the PA. Whatever combination of “out-of-kind” options are included in the final fish habitat offsetting plan will likely benefit the same fish species affected by the Project, but not necessarily the same populations.

17.4.2.3.2 Alteration of Stream Flows

Pre-mine flows were used as the baseline against which Project-related changes to stream flows during the construction, operations, and decommissioning and closure phases were compared. To assess potential alteration of stream flows, an existing climate baseline was used for Years -1 to 17 while a climate normal based on emissions scenario SSP2-4.5 was used for Years 23 to pit full (Year 46+) to account for the extended mine life and globally driven changes in climate, as recommended by Canadian Standards Association (2019). Relative to the present period climate normal, the SSP2-4.5 scenario applied a 14% increase in total annual precipitation and seasonal temperature increases of +5.3°C, +3.9°C, +3.7°C, +3.6°C for winter, spring, summer, and autumn seasons, respectively. Water quantity assessment methods are further discussed in Chapter 15 of the Impact Statement (Assessment of Potential Effects on Surface Water).

For Years -1 to 17, spring freshet flows were predicted to occur between April to May. Hydrological models for Years 23 to 46+ predicted that the spring freshet would occur between February to March. These predicted seasonal variations in the climate change adjusted baseline were not a Project-related effect.

Walleye and white sucker were chosen as the focal fish species to assess the potential residual effects of potential change in stream flows because:

- Walleye and white suckers are important recreational fish species and are harvested as country food by all potentially affected Indigenous nations.
- Walleye and white suckers spawn in spring in swift-flowing riffles with clean, rocky substrates and good water circulation. Riffles are the stream habitat type with hydraulic characteristics most sensitive to changes in stream flow.

North Driftwood River

During construction (Year -3 to Year -1), flow reductions in the North Driftwood River were not predicted to exceed 10% of baseline in sub-watershed ND1, the sub-watershed extending from the downstream of the PA to the confluence with Nesbitt Creek (Figure 17.4). Daily flow increases greater than 10% from baseline were predicted during low flow conditions but an increase in the Q₁₀₀ flow was not predicted.

During operations (Year 1 to 41), flow increases greater than 10% of baseline were predicted in sub-watershed ND1. The maximum predicted flow rate during operations was 31.72 m³/s using the climate adjusted dataset. An increase in the Q₁₀₀ flow from baseline conditions was not predicted for sub-watershed ND1 meaning there would be no increase to scour and erosion potential in the channel. Flow increases in sub-watershed ND1 during operations were primarily associated with the low flow period.

During operations phase 2 (i.e., Year 17), flow reductions greater than 10% than baseline were predicted during the spring freshet (i.e., April to May) when walleye and white suckers spawn. However, the predicted flow reductions were not greater than the environmental flow thresholds in any months.

During decommissioning and closure (Year 41+), flow reductions greater than 10% were not predicted in sub-watershed ND1. However, daily flow increases greater than 10% of baseline flows were predicted with a maximum flow rate of 43.98 m³/s using the climate adjusted dataset. An increase to the Q₁₀₀ from baseline conditions was not predicted for ND1 for this Project phase.

Predicted changes in stream flows in the North Driftwood River watershed are expected to have moderate effects on walleye and white sucker populations because:

- 15 riffle habitats were observed in the North Driftwood River mainstem that had potential to provide spawning habitat for walleye and/or white sucker (see Appendix C of the Fish and Fish Habitat Supplemental Baseline Report [Appendix B.8.1 of the Impact Statement]).
- Flow reductions greater than 10% during spring freshet may reduce water depths and water velocities in these riffles. However, predicted flow reductions did not fall below environmental flow values and changes in the suitability of these riffles for walleye and white sucker spawning were, therefore, not expected.
- Predicted flow increases greater than 10% were not associated with an increased Q₁₀₀ flood flow rate and, therefore, were unlikely to substantially alter channel morphology in the North Driftwood River downstream of the PA

West Buskegau River

During construction (Year -3 to Year -1), flow reductions greater than 10% were not predicted in the sub-watershed WB1 of the West Buskegau River, the sub-watershed between the confluences of the Buskegau River with the West Buskegau River and the Buskegau River with Reaume Creek (Figure 17.4). However, flow increases greater than 10% were predicted in sub-watershed WB1 during the low flow period. These predicted flow increases were at or below the environmental flow threshold. An increase to the Q₁₀₀ flow from baseline conditions was not predicted in sub-watershed WB-1.

During operations (Year 1 to 41), flow reductions greater than 10% from baseline were not predicted in sub-watershed WB1 for the existing or climate change adjusted baseline flows. However, flow increases greater than 10% were predicted, with a maximum predicted flow rate of 3.75 m³/s for the climate adjusted dataset. The days with flows higher than the 10% threshold were typically associated with low flow conditions that were at or below the environmental flow threshold. An increase to the Q₁₀₀ flow value

from baseline conditions was not predicted for WB1 during this Project phase, meaning the potential for increased scour and erosion of the channel was low.

During decommissioning and closure, flow changes greater than 10% from the climate change adjusted baseline values were not predicted in sub-watershed WB1 of the West Buskegau River watershed.

Predicted flow increases greater than 10% in the West Buskegau River watershed are not expected to have measurable effect on walleye and white sucker population because predicted flow increases greater than 10% were typically associated with low flow conditions and not associated with an increased Q₁₀₀ flood flow rate.

Jocko Creek

A portion of the TMF and its associated water management infrastructure will be located within the Jocko Creek watershed. This infrastructure will alter the amount of run-off entering Jocko Creek from its upstream watershed area.

Flow reductions greater than 10% from the baseline were not predicted in sub-watershed JS-DS in the Jocko Creek watershed during any mine phase. Similarly, flow increases greater than 10% were not predicted in sub-watershed JS_DS during construction and decommissioning and closure phases. However, flow increases greater than 10% were predicted in sub-watershed JS_DS during operations phase 2 and were associated with increased groundwater seepage from the TMF. An increase to the Q₁₀₀ from baseline conditions was not predicted for JS_DS for this project phase.

Predicted flow increases greater than 10% in the Jocko Creek watershed are not expected to have measurable effects on walleye and white sucker populations because:

- Predicted flow increases greater than 10% were not associated with an increased Q₁₀₀ flood flow rate meaning there would be no increase to scour or erosion potential in the channel.
- Predicted flow increases greater than 10% were associated with a maximum flow rate of less than 0.9 m³/s, which would be considered a low flow condition.

17.4.2.3.3 Alteration of Fish Passage

The Project has the potential to alter fish passage through the construction of watercourse crossings for access and haul roads, Highway 655 realignment, and the new rail spur, as well as through the construction of water diversions associated with the water management infrastructure. The forage fish guild was chosen as the focal fish group to assess potential effects of altered fish passage because:

- The forage fish guild (i.e., brook stickleback, fathead minnow, finescale dace, northern pearl dace, and northern redbelly dace) were the most common fish species captured in the North Driftwood River and West Buskegau River watersheds during the aquatic baseline surveys (Appendix B.8.1 of the Impact Statement [Fish and Fish Habitat Supplemental Baseline Report]).

- Small-bodied fish possess weaker swimming abilities than larger fish (Domenici 2001; Rodgers et al. 2014) and, therefore, are more susceptible to the alteration of fish passage created by the Project.

Alteration of fish passage is not anticipated to occur due to the construction of stream crossings associated with access and haul roads, the realignment of Highway 655 and any other linear component required for the Project. This is because:

- Watercourse crossings will be designed in accordance with applicable standards and regulatory requirements, including the Ontario's "Environmental Guidelines for Access Roads and Water Crossings" (MNRF 1990) and DFO's "Clear-span Bridges" Code of Practice (DFO 2023c), as applicable.
- New culverts will be sized to convey the peak flows and will utilize open-bottom structures where practical to maintain fish habitat values and fish passage at all flows.
- Construction activities will follow the best practices outlined in the Environmental Protection Plan (EPP), including DFO's "Measures to Protect Fish and Fish Habitat" (DFO 2023b).
- The North Driftwood Diversion Channel will be designed to allow unobstructed fish passage along its entire length.

17.4.3 Change in Fish Health, Growth, or Survival

17.4.3.1 Project Pathways

Twenty-eight different Project components or activities have the potential to affect fish health, growth, or survival in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds: 15 activities during construction; nine activities during operations; and four activities during decommissioning and closure. They include activities that require the removal of trees and shrubs, the excavation, removal, and deposition of top-soil and overburden material, the diversion and storage of surface water run-off, the draining and in-filling in of watercourses and waterbodies, the drilling, blasting, transportation and processing of rock, the storage of tailings, ore, and waste rock, the construction of stream crossings for linear developments (e.g., realignment of Highway 655), the release of air-borne contaminants, and the discharge of mine effluent. These activities fall under the following "land-based" or "in-water" pathways of effects (DFO 2024a):

- excavation (land-based activity)
- grading (land-based activity)
- use of explosives (land-based activity)
- use of industrial equipment (land-based and in-water activity)
- vegetation clearing (land-based activity)
- placement of material or structures in water (in-water activity)
- wastewater management (in-water activity)

Potential effects of these Project activities, prior to mitigation, are described under these headings in the Sections below.

17.4.3.1.1 Increase in Total Suspended Solid Concentrations

Increases in TSS created by Project activities or components may occur during all phases of the Project. Increases in the concentration of suspended solids in the receiving environment may result from the disturbance and re-suspension of bed material during in-water construction, through land disturbance (e.g., grading, vegetation clearing), or dust deposition generated from blasting in the pit, crushing of rock in the processing plant, and/or road traffic.

Exposure to increased TSS can affect the health of fish and lower trophic organisms, with effects ranging from minor physiological stress to mortality (Coen 1995; Berli et al. 2014). The nature and extent of adverse effects to fish and other aquatic biota are influenced by the concentration of TSS, particle size, and length of exposure (Bash et al. 2001; Kjelland et al. 2015; Fondriest Environmental Inc. 2014). If TSS concentrations are elevated for an extended period, TSS can result in adverse effects on fish and other aquatic organisms including gill abrasion, feeding impairment, and avoidance of impacted areas (Newcomb 1994; Kjelland et al. 2015; Bash et al. 2001; Miner and Stein 1996). Increased TSS can also result in diminished water clarity and light attenuation, slowing growth rates and decreasing abundance of photosynthetic organisms (periphyton in streams, phytoplankton in lakes, and aquatic vegetation in both), organisms that form the basis of the aquatic food-web and provide habitat for some fish species like northern pike (Kjelland et al. 2015).

Suspended sediments may also affect fish and aquatic organisms when they settle out of suspension by physically covering the substrates and filling in the interstitial spaces between substrate particles. This can cause the death of fish eggs by smothering the eggs and preventing the exchange of gases (e.g., dissolved oxygen, carbon dioxide) between the fish membrane and the water column. This can also cause infilling of interstitial spaces between substrates where benthic invertebrates and algae live and grow. If the rate and/or level of sediment deposition is sufficient, it may cover attached algae (i.e., periphyton) and aquatic vegetation, slowing or completely impairing photosynthesis. This can reduce the food availability for benthic invertebrates and, subsequently, for fish that depend on benthic invertebrates or algae for food. Infilling of interstitial spaces with sediment may cause potential shifts in benthic communities and decreased feeding rates (Newcombe 1994; Kjelland et al. 2015; Bash et al. 2001) and may be detrimental to the use of impacted habitat for spawning, rearing, and foraging by fish (Bash et al. 2001; Muck 2010).

Suspended sediment loads generated in the headwaters of the Jocko Creek, North Driftwood River, and West Buskegau River watersheds are conveyed to the downstream environment primarily in spring when flows are highest but also during lower flow months during the rest of the year. During the baseline surveys, TSS from the three watersheds ranged from below the detection limit (0.67 mg/L) to 80 mg/L in watercourses and from below the detection limit to 27.3 mg/L in waterbodies (Appendix B.6 of the Impact Statement [Surface Water Resources Baseline Report]). The 75th percentile for TSS in Jocko Creek, North Driftwood River and West Buskegau River watersheds were 6.4, 5.7, and 7.7 mg/L, respectively. Seasonally elevated TSS is a natural occurrence within the LSA, as TSS was observed to be slightly

higher in the winter months in watercourses and in the late fall for waterbodies (Appendix B.6 of the Impact Statement [Surface Water Resources Baseline Report]). Seasonally elevated TSS in these watersheds indicate that fish species present within these watersheds are tolerant to fluctuations in TSS concentrations.

In recognition of the potentially harmful effects of increased TSS, the CCME Water Quality Guidelines for the Protection of Freshwater Aquatic Life (WQG-FAL) stipulate that an increase in TSS for short-term exposure (i.e., 24 hours or less) should not exceed 25 mg/L over background concentrations and for longer term exposures (i.e., 24 hours to 30 days) should not exceed 5 mg/L over background concentrations during clear flow (CCME 2024). For high flows, maximum TSS increases should not exceed 25 mg/L from background levels when background levels are between 25 to 250 mg/L and not increase more than 10% of background levels when background levels are greater than 250 mg/L (CCME 2024).

17.4.3.1.1.1 Construction

Project activities and components that require in-water construction have the potential to directly increase TSS levels by disturbing and suspending sediment. Specifically, activities associated with the installation of water management infrastructure, including construction of collection ponds, diversion channels for contact and non-contact water, and watercourse crossings for the access and haul roads, and linear developments (e.g., new rail spur) may disturb sediments and have the potential to increase TSS concentrations. Site preparations and land-based activities (e.g., site clearing, excavation, grading) also have the potential to increase TSS in the receiving environment through erosion and site runoff.

17.4.3.1.1.2 Operations

During operations, increases in TSS may occur due to construction and operation of the North Driftwood Diversion Channel and operation of water management infrastructure such as the collection and diversion ditches, collection ponds, and discharge of contact water from mine components to the receiving environment. Similarly, any construction activities planned to occur during operations (i.e., realignment of Highway 655) present similar opportunities for increasing TSS concentrations as described above. Discharge of effluent into the North Driftwood River and West Buskegau River also has the potential to result in an increase in TSS in the receiving environment. Changes in natural erosion and sedimentation conditions in the North Driftwood River and West Buskegau River may also occur during operations due to alterations to their natural flow regimes downstream of the PA.

17.4.3.1.1.3 Decommissioning and Closure

During decommissioning and closure, dismantling and removing infrastructure near water may temporarily increase TSS concentrations in streams downstream of the PA. The decommissioning and closure phase will focus on reclamation, establishing physical, chemical and biological stability at the site and to meet desired end land functions and uses. Pit lake discharge is not expected to be a substantial source of TSS because sediment is expected to settle in the bottom of the pit over the many years required to fill the pit.

17.4.3.1.2 Change in Water Quality

Changes in water quality in the downstream receiving environment because of Project activities or components may occur during all phases of the Project. Changes in water quality in the North Driftwood River and West Buskegau River may result from the discharge of mine effluent while changes in water quality in the North Driftwood River, West Buskegau River, and Jocko Creek may occur due to deposition of air-borne contaminants from burning fossil fuels.

Discharge of the mine effluent may introduce contaminants (e.g., total or dissolved metals) absent from the surface water prior to the start of the Project or increase its concentration above the effect threshold concentration of an aquatic species such that it may negatively affect the health, growth, and survival of individuals that are part of the populations in the downstream receiving environment.

Contaminants that bioaccumulate (i.e., mercury, selenium, arsenic) have the potential to increase in individual organisms as they age and grow and to increase in higher trophic level organisms such as predatory fish. At high enough concentrations, these contaminants can become toxic to the aquatic organisms exposed to the effluent causing adverse effects to their growth, survival, and reproduction. High concentrations of bioaccumulating contaminants in fish can pose health risks to wildlife and humans that consume fish as parts of their diet. For this reason, the CCME and Health Canada have developed tissue quality guidelines for fish for the protection of wildlife consumers of fish and human consumers of fish, respectively.

17.4.3.1.3 Change in Water Temperature

Project activities and components during all Project phases, such as vegetation clearing, pumping and storage of contact water, discharge of treated effluent, and other activities associated with the water management system and site preparations, have the potential to alter the temperature regime of downstream receiving environment.

Changes to water temperature could occur through the mixing of treated effluent with ambient waters downstream or through changes in environmental conditions or processes that mediate physiochemical characteristics of surface water. For example, disturbance or loss of riparian vegetation (Broadmeadow and Nisbet 2004; DeWalle 2010), increases in nutrient concentrations (Wetzel 2001), and changes to surface water levels and flows (Caissie 2006) can be factors affecting the temperature regime of freshwater environments.

Water temperature influences the rate of chemical and biological processes that occur in freshwater streams and lakes. This includes photosynthesis in algae communities, bacterial decomposition of organic matter, and reduction/oxidation reactions in bottom sediments. Fish and other aquatic biota are ectotherms whose internal temperatures match those of the water they reside in. Each species has a range of preferred and tolerable temperatures within which they have evolved to grow and reproduce. Changes in water temperatures that exceed these temperatures ranges can result in lower growth rates, lower reproduction success, or mortality if water temperatures exceed these ranges for long enough or if fish cannot move to areas with more favourable temperatures for that species.

17.4.3.1.4 Production of Underwater Noise

Project activities have the potential to produce underwater noise through drilling and blasting during construction and operations. Blasting produces high-velocity spherical shock waves as well as introducing high-intensity noise into the aquatic environment through the air and vibrations in the substrate that can affect fish species and their habitats (DFO 2006; Popper et al. 2014). Injury or mortality to fish can occur due to shock waves (e.g., instantaneous pressure change) created by explosive detonations, which can rupture internal organs and damage swim bladders. Particle velocities caused by detonation of explosives can also cause injury or death of fish eggs or larval fish. In finfish, the primary site of damage is the swim bladder but rupture or haemorrhaging to internal organs (i.e., kidney, liver, spleen, and sinus venosus) may also occur.

The water volume affected by the pressure wave produced from blasting is complex and is a function of the depth of the explosion, the water depth, and substrate type (Popper et al. 2014, Faulkner *et al* 2006). There are two areas within the affected water volume that pose the highest risk to fish. The first is the immediate vicinity of the explosion where the compressive forces of the shock wave produced from the blast dominate. The second is a more distant area where negative pressure from the overshoot of the gas bubble created from the blast and the reflection of the shock wave from the water surface which can cause cavitation and negative pressures low enough to cause injuries to the swim bladders and other barotraumas, including mortality (Popper et al. 2014). The range of potential effects on fish from blasting include physical injuries and mortality, temporary or permanent hearing loss, changes in behaviour, and mechanical shock to developing embryos.

The effects of underwater noise from blasting on aquatic life are dependent on many factors including the life history and physiological characteristics of fish species. Fish species most susceptible to injury from blasting are species with swim bladders that function with hearing (e.g., suckers, cyprinids). There is evidence that little to no damage occurs to fish without swim bladders except at very short ranges from in-water blasting (Goertner et al. 1994; Stephenson et al. 2010; Halvorsen et al. 2012).

Body shape and size of fish can influence the degree of injury. Fish that have laterally compressed bodies have a greater surface area to receive shock waves than cylindrically shaped fish. Smaller fish may also be more susceptible than larger fish, making early life stages and juveniles more vulnerable (Yelverton et al. 1975).

DFO has developed the Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998), which includes two thresholds to protect fish and fish eggs from the use of confined or unconfined explosives: a 100 kPa peak overpressure threshold to prevent the death of fish and a 13 mm/second PPV to prevent the death of fish eggs. However, DFO now recommends a 50 kPa overpressure threshold based on more recent data from monitoring of seismic exploration in the Mackenzie Delta in 2002 (Cott and Hanna 2005).

17.4.3.1.4.1 Construction

Blasting activities may occur near fish-bearing watercourses and waterbodies during construction of the Open Pit and other areas where bedrock may be at or near the surface (e.g., TMF dams, plant site). Based on the current blasting plan, blasting activities are not anticipated to start until the second year of construction. Blasting during construction has the greatest potential for underwater noise for fish as the upper most pit shell is the largest, shallowest, and therefore closest area of the pit to fish-bearing watercourses and waterbodies.

17.4.3.1.4.2 Operations

During operations, mining activities will include the development of the Open Pit and extraction of ore. The Open Pit will be excavated by drilling and blasting successive benches and removing the broken rock using a combination of electric shovels and front-end loaders. Blasts will be planned and implemented to optimize the number of explosives used.

Blasting in the Open Pit during operations is expected to occur at a rate of once per day, with a limited duration of one to two minutes. Pre-split holes will be 114 mm in diameter to a depth of 15 m. As operations progresses, different benches will continue down deeper into the pit and the set-back distance to fish-bearing streams and ponds on the surface will increase as a result.

17.4.3.1.5 Impingement and Entrainment of Fish

The Project will require construction of water diversions, dewatering of natural watercourses and waterbodies, and operation of water management systems. These Project activities and components will require the use of temporary water intakes and pumps to dewater from or divert water around fish-bearing habitat. Freshwater for the processing plant will be from recycled from contact water in the collection ponds near the TMF while potable water will be supplied by groundwater sourced from water wells located west of the processing plant; neither of these water supplies will require water intakes or fish screens.

Use of water intakes has the potential to impinge or entrain fish that could result in fish mortalities. Impingement occurs when a fish becomes trapped against the intake screen and the fish is unable to free itself. Entrainment occurs when a fish is drawn through the screen completely into the intake.

The effects of impingement and entrainment are influenced by the location and flow rate of the intake (Fedorenko 1991). Survival from impingement is species- and life stage-specific, with physiological features playing a key role (Hogan 2015). Planktonic species are particularly vulnerable to impingement and entrainment due to their limited ability to swim against the intake current (Fedorenko 1991). Whether an organism becomes impinged or entrained depends on the size of the intake screen compared to the size of the organism, the flow rate through the intake screen, and the swimming capability of the fish.

To minimize potential harm to fish, DFO has an interim code of practice: end-of-pipe fish protection screens for small water intakes in freshwater (DFO 2020a). The guideline provides guidance on the design, installation and maintenance of small end-of-pipe water intake fish screens to prevent impingement and entrainment of fish. This code of practice is for small-scale water intakes, where water intakes are up to 0.150 m³/s and no aquatic SAR are present in the affected area.

17.4.3.1.6 Death of Fish or Fish Eggs from Stranding or Physical Injury

Project activities during the construction and operations phases have the potential to increase the risk of death of fish or fish eggs from stranding or physical injury. These potential effects are expected to be localized to the streams or ponds within the PA need to be dewatered prior to construction of mine infrastructure and in areas where in-water construction below the high-water mark needs to be conducted, including construction of the water management system, and watercourse crossings for the access and haul roads, the realignment of Highway 655 and the new rail spur.

Dewatering of watercourses and waterbodies within the Project footprint is required for construction of the Open Pit, East and West Stockpiles, TMF, and the Impoundment Facility. These areas will be dewatered by constructing non-contact water diversion ditches and contact water collection ditches and ponds which will dewater the streams and ponds within the PA by gravity or excavated sumps. Fish present in the streams and ponds within the Project footprint will be at risk of stranding, burial, or physical injury during these dewatering activities. Sessile or slow-moving species and larvae and fish eggs of all species are at greater risk of injury from these activities than adult fish due to their inability to move away from these activities.

17.4.3.1.7 Introduction of Aquatic Invasive Species and Disease

Potential change in fish health, growth and survival due to the introduction of aquatic invasive species and disease may occur during construction, operations, and closure and decommissioning phases of the Project when equipment and machinery are brought on-site from other locations. If this equipment and machinery are contaminated with sediment or with fragments, eggs, spores, rhizomes, seeds, or individuals of aquatic invasive species or diseases prior to their arrival on-site, and if this equipment or machinery is then introduced to streams or ponds within the PA, these aquatic invasive species or disease may become established in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds to the detriment of native algae, invertebrate, and fish populations.

Large amounts of dirt and plant material can accumulate in the tread and machinery of construction equipment if not properly cleaned and decontaminated between work areas. Additionally, construction of water diversions can connect waterbodies and watercourses, which can allow aquatic invasive species to move into new areas (DFO 2024b).

Aquatic invasive species can grow quickly once introduced as they often do not have natural predators in their new environment. As a result, invasive species can reduce biodiversity and habitat quality, outcompete and harm endanger native species (DFO 2024b), introduce pathogens and parasites (Kiruba-Sankar et al. 2018), decrease water quality, reduce nutrient transportation, and increase eutrophication (Soka University 2024).

17.4.3.1.8 Increased Fishing Pressure

Construction of new access roads to previously inaccessible areas during construction, operations, and decommissioning and closure of the Project and introduction of the workforce to the area has the potential to increase fishing pressure on local fish populations. Although not all Project workers will be anglers, it is anticipated that some proportion of the workforce will be, and this influx of anglers has the potential to increase fishing pressure in fish-bearing watercourses within the LSA.

A series of internal haul roads and access roads have been proposed to facilitate access to various Project components. In addition, the Project will require the realignment of Highway 655, which will be shifted to the west of the mine, and the construction of a temporary bypass. Currently, the areas in proximity to the Project are connected by the Camp 40 Road, Lower Sturgeon Dam Road, and numerous resource/recreational roads managed by MNR. These roads currently provide access to reaches of the North Driftwood River, West Buskegau River, and Jocko Creek, and are likely to be used by recreational and Indigenous anglers for fishing (MNR 2023).

17.4.3.1.9 Change in Aquatic Invertebrate Communities

Benthic habitats with depositional sediment account for most of the habitat in the LSA, with riffle areas being limited. Low species diversity, dominance of chironomids, and the low occurrence of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa are characteristics common to the benthic invertebrate communities in this habitat. This type of benthic invertebrate community is less sensitive to changes in habitat and water quality than a benthic invertebrate community dominated by EPT taxa.

The benthic invertebrate community within the Project footprint will be lost when the streams and ponds within the PA are dewatered or diverted during construction of mine infrastructure and the progressive expansion of the mine during operations. This loss will lead to elimination of benthic invertebrate biomass in the PA and a lowering of overall benthic invertebrate biomass within the LSA.

Benthic invertebrate communities downstream of the PA may be impacted by changes in water quality, sediment quality, and/or changes in flow. Physio-chemical variables related to temperature, sediment particle size and water chemistry are known to have a considerable effect on benthic invertebrate community composition (Faith and Norris, 1989). Changes in water quality in the North Driftwood River and West Buskegau River may occur due to discharge of treated mine effluent. Any change in water quality or sediment quality in these two rivers downstream of the PA has the potential to reduce species diversity, with an increased dominance of pollution-tolerant taxa such as chironomids and oligochaetes (Canfield et al. 1994), and/or benthic invertebrate abundance.

Any change in the magnitude, timing, or duration of flows in the North Driftwood River, West Buskegau River and Jocko Creek caused by construction and operation of mine infrastructure and water management infrastructure (e.g., sumps, collection ponds, ditches) and/or filling of the open pit during closure and decommissioning has the potential to alter the abundance, diversity, composition, and rate of downstream drift of benthic invertebrates downstream of the PA. Species that occupy shallower, faster-flowing habitats (e.g., riffles) would be more susceptible to changes in flow than species that occupy deeper, slower-flowing habitats (e.g., runs, pools). While the majority of habitat in the North Driftwood

River, West Buskegau River, and Jocko Creek mainstems is comprised of deep, slow-flowing depositional habitat, shallow, rocky riffles are present.

17.4.3.2 Mitigation Measures

Mitigation measures to avoid or reduce potential effects to fish health, growth, or survival were selected based on provincial and federal regulations and policies, on best management practices and guidelines, and relevant peer-reviewed literature. Mitigation measures to avoid or reduce potential effects on fish health, growth, or survival considered the following sources:

- Measures to Protect Fish and Fish Habitat (DFO 2023b)
- Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater (DFO 2020a)
- Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters (Wright and Hopky 1998)
- Land Development Guidelines for the Protection of Aquatic Habitat (Chilibeck et al 1992)
- Ontario's Invasive Species Strategic Plan (MNR 2012)
- Ontario's Provincial Fish Strategy – Fish for the Future (MNR 2015)
- Ontario Provincial Water Quality Objectives (PWQOs) (MOEE 1994)
- CCME WQG-FAL (CCME 2024)

The Project followed a hierarchical approach to reduce changes in fish health, growth, or survival as outlined by DFO's Fish and Fish Habitat Protection Policy Statement (DFO 2019). This hierarchy involved implementing avoidance measures that eliminated potential change in fish health, growth, or survival in space or time before applying mitigation measures to reduce any remaining effects. The following mitigation measures have been incorporated into the design of the Project or are proposed to avoid or reduce Project-related effects on fish health, growth and survival:

- limiting the construction footprint (i.e., Project Area) to the extent possible to limit the number of sub-watersheds overprinted by the Project Area and to avoid larger watercourse (e.g. the West Buskegau River) and lakes (e.g. Martin Lake)
- constructing the North Driftwood River Diversion Channel "in the dry" to accommodate construction, stabilization, and vegetation growth within the new channel prior to diverting flows from the North Driftwood River
- prohibiting maintenance or refueling of machinery within 30 m of a fish-bearing watercourse or waterbody
- conducting any in-water construction activities outside of the restricted activity periods defined by DFO (DFO 2013c), as follows, unless otherwise approved by DFO or MNR:
 - April 1 to June 20, for spring spawning in northeastern Ontario with walleye and northern pike present

- September 1 to June 15 for fall and winter spawning fish in northeastern Ontario
- Designing water intakes to reduce disturbance of the stream or lake bed and fitting all intakes with screens that comply with the Department of Fisheries and Ocean's (DFO's) end-of-pipe fish screen requirements
- isolating and dewatering any work areas within watercourses or waterbodies
- progressively reclaiming mine infrastructure to reduce erosion and sediment loading to streams
- maintaining downstream flow when conducting in-water construction activities
- conducting fish salvages prior to dewatering by a qualified aquatic biologist and releasing captured fish to areas within the same watercourse, outside of the work area, where suitable habitat exists, or in accordance with appropriate permits
- requiring machinery, vehicles, and equipment to be clean and in good working order prior to coming to site
- implementing a no-fishing policy in watercourses and waterbodies within or adjacent to the Project Area by all Project personnel while on-shift
- installing and maintaining appropriate temporary erosion and sediment control measures during construction in accordance with an Erosion and Sediment Control Plan (ESCP)
- progressively reclaiming mine infrastructure to reduce erosion and sediment loading to streams
- developing and implementing a Site-Wide Water Management Plan (Appendix J of the Impact Statement) for the Project. This Plan will include the following mitigation measures:
 - divert clean, non-contact water around the Project site so that it reports to its natural watershed (including the North Driftwood River), to the extent possible
 - capture run-off in collection ponds during construction to provide start-up water for the Processing Plant
 - use contact water from the Open Pit and other areas of the active mine as source water for use in the Processing Plant
 - recycle water between the Processing Plant and the water collection ponds
 - install water treatment plants at the collection pond outlets to provide treatment of contact water prior to its release to the surrounding environment
- developing and implementing a Construction Environmental Protection Plan which will describe the steps that will be taken to limit environmental impacts during mine construction.
- developing and implementing an Air Quality Management Plan which will describe the management efforts to be taken to manage the effects of the Project on ambient air quality in accordance with provincial regulatory requirements.
- developing and implementing an Erosion and Sediment Control Plan which will describe the measures and best management practices to be implemented to protect the environment through reduction of site erosion and protection of nearby watercourses and/or waterbodies from sedimentation.

- developing and implementing a Vegetation Management Plan which will describe the mitigation approaches for reducing effects on vegetation (including riparian vegetation) and include an Invasive Species Management Plan.
- developing and implementing a Waste Management Plan that will include procedures for the handling and storage of chemical and hazardous materials.
- developing and implementing a Spill Prevention and Contingency Plan which will describe the means (internal corporate procedures) by which the spill contingency plan is activated and steps to be taken to report, contain, clean up and dispose of contaminants following a spill, including appropriate contacts for responding to spills.
- developing an Explosives Management Plan which will describe the safe use and storage of explosives at the Project site. This plan will include consideration of the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright and Hopky 1998).

17.4.3.3 Project Residual Effects

17.4.3.3.1 Increase in Total Suspended Solid Concentrations

Increased TSS concentrations due to Project activities may occur during all Project phases. Potential residual effects are discussed by Project phase below. The forage fish guild was chosen as the focal fish group to describe the potential residual effects of an increase in TSS and turbidity on fish health, growth, or survival because:

- The forage fish species are found throughout the PA and LSA where potential increases in TSS concentrations are anticipated to be greatest from Project activities and components.
- Brook sticklebacks are relatively intolerant of activities that increase TSS concentrations because they locate their prey by sight and engage in displays during breeding (Tompkins and Gee 1983; Winn 1960; Reisman and Cade 1967). A reduction or elimination of local populations have been observed from increased TSS because of degradation or loss of habitat for all purposes (e.g., spawning, rearing) and mortality of all life stages (Stewart et al. 2007).

17.4.3.3.1.1 Construction

The main Project activities and components that may result in sediment release to waterbodies and watercourses are in-water constructions activities associated with the water management infrastructure, including the diversion channels, ditches, and ponds, watercourse crossings for the access and haul roads and linear developments, as well as runoff from land-based site preparations (e.g., vegetation clearing, grading, excavation, construction of infrastructure).

Erosion and sediment control measures will be implemented for various earthwork and construction activities, including clearing, stripping, and grubbing of vegetation; excavation and storage of overburden; preparation of surfaces in the Process Plant area; ditch construction; haul road construction; and dewatering of pit excavations to reduce environmental effects. The erosion and sediment control mitigation measures will be outlined in a Project-specific Erosion and Sediment Control Plan (Chapter 34

of the Impact Statement [Follow-up Programs]). The Project footprint, including riparian vegetation clearing, will be limited to the smallest practical amount required to reduce exposed soils. Vegetation clearing limits will be marked in advance and only designated areas will be cleared to limit erosion potential. Erosion and sediment control measures would be inspected regularly to verify that control practices are functioning as intended.

For in-water construction activities within a fish-bearing watercourse or waterbody, a fish salvage would be completed to remove fish from the affected area prior to activities that would create increases in TSS above guidelines in the receiving environment. A fish salvage will reduce the number of fish potentially exposed to increased TSS concentrations. In addition, where possible, in-water construction activities within a fish-bearing watercourse or waterbody would occur outside of the DFO restricted activity timing windows, which are: April 1 to June 20 for spring spawning in northeastern Ontario with walleye and northern pike present; and September 1 to June 15 for fall/winter spawning fish in northeastern Ontario (DFO 2013c).

Once constructed, the water management system will allow for clean, non-contact water to be directed around the Project through diversion channels. Surface water runoff that comes into contact with disturbed areas will be managed prior to being released to the surrounding environment. Runoff from disturbed areas will be collected in gravity ditches and conveyed to ponds.

Collection ponds have been designed with adequate residence time to treat the expected TSS loads resulting from a 1:10 annual exceedance probability flood, attenuate flows up to the 1:100 year storm event with diversion of flows to the Open Pit that are above the 1:10 year storm event, and to release flows to the environment resulting from a 1:200 year storm event. Details regarding the proposed pond sizes and expected TSS treatment potential are provided in the Site-Wide Water Management Plan (Appendix J of the Impact Assessment). Each pond will be equipped with a treatment plant so that discharge meets environmental criteria for TSS prior to discharging to the North Driftwood River and West Buskegau River.

The collection ditches will be hydroseeded or vegetated with native species to resist erosion. Additional erosion and sediment control practices, inclusive of deploying rock or straw check dams and silt fencing will be employed as required. The inlet and outlet locations of collection ponds, areas where higher water velocity is anticipated, will be lined with stone. The sidewalls of the collection ponds will be stabilized with coir matting cover until vegetation establishes, if needed.

Elevated TSS concentrations are not anticipated to occur due to construction of stream crossings associated with internal haul and access roads, the realignment of Highway 655, and any other linear component required for construction and operation of the Project. This is because:

- Watercourse crossings will be designed in accordance with applicable standards and regulatory requirements, including the Ontario's "Environmental Guidelines for Access Roads and Water Crossings" (OMNF 1990) and DFO's "Clear-span Bridges" Code of Practice (DFO 2023c), as applicable.
- Equipment will be operated from land, except for fording.

- If fording is required, mitigation measures in DFO's Temporary Fords Code of Practice (DFO 2023d) will be implemented with one piece of equipment crossing the stream once (over and back) to support construction, if required.
- Equipment for construction of watercourse crossings will be clean and in good working order.
- Construction activities will follow the Erosion and Sediment Control Plan (Chapter 34 of the Impact Statement [Follow-up Programs]) to prevent the mobilization of sediment into the receiving environment.

With implementation of mitigation measures and best management practices to reduce the potential introduction of sediment to downstream watercourses, TSS concentrations are not expected to exceed the CCME WQG-FAL for TSS concentration (CCME 2024) during construction. Therefore, it is anticipated that the residual effect to forage fish health, growth, and survival due to increases in TSS from construction of the Project is expected to be low in magnitude, confined to the LSA, have no sensitive timing, short-term in duration, occur across multiple irregular events, and be reversible.

17.4.3.3.1.2 Operations

During operations, potential sources of elevated TSS concentrations include discharge of effluent into the North Driftwood River and West Buskegau River, construction and operation of the North Driftwood Diversion Channel, and natural erosion due to altered site runoff conditions.

The Site-Wide Water Management Plan will be implemented during operations to divert clean, non-contact water around the Project and separate contact water for treatment before discharge into the North Driftwood River and West Buskegau River. Non-contact water will be managed separately from contact water to reduce TSS from site runoff entering watercourses and waterbodies, as well as maintain natural flows to the extent possible.

Contact water from runoff, precipitation events, and groundwater inflows will be collected using ditches and sumps. The ditches and sumps will be constructed around Project infrastructure and will direct water into a system of collection and sedimentation ponds for management. As described in above, the collection ponds have been designed and sized to reduce TSS concentrations in the mine effluent discharge. In addition, water treatment plants in line with the collection pond outlets will provide additional treatment of contact water prior to its release to the surrounding environment. These treatment plants will have a capacity to treat up to approximately 28,000 m³/day. Treated effluent from these ponds and treatment plants will be discharged to the North Driftwood River and West Buskegau River only if it meets Schedule 4 MDMER effluent guidelines (i.e., 15 m/L maximum monthly mean concentration and 30 mg/L maximum daily concentration).

Erosion and sediment control measures will also be applied throughout operations. These mitigation measures and management practices will be outlined in the ESCP. As part of the reclamation process, mine infrastructure and disturbed areas would be progressively reclaimed and revegetated to reduce erosion and sediment loading to streams. An example of this will be the naturalization of the TMF Northeast Collection Pond following rehabilitation of the TMF and vegetation establishment. The TMF

Northeast Collection Pond naturalization will include vegetation plantings and construction of a spillway overflow.

The potential effects to the health, growth and survival of forage fish as a result of increased TSS concentrations are rated as low in magnitude because the Project will comply with federal and provincial regulatory requirements for TSS before discharging effluent to the North Driftwood River and West Buskegau River. Residual effects will be reversible, occur as multiple irregular events and be limited to the LSA, specifically downstream of the effluent discharge locations in the North Driftwood River and West Buskegau River. As discharge of treated effluent will occur year-round, there is high sensitivity associated with the residual effects on forage fish (i.e., occur during critical life stages, such as spawning period).

17.4.3.3.1.3 Decommissioning and Closure

Decommissioning of Project infrastructure may result in the temporary mobilization of sediments in the receiving environment (e.g., the removal of water management infrastructure). Erosion and sediment control measures will be implemented for decommissioning activities. In addition, the decommissioning and closure phase will focus on reclaiming and stabilizing the site, thus reducing erosion and sedimentation potential. Monitoring and maintenance will continue until the physical and chemical characteristics of the site are deemed acceptable and can be closed out in accordance with the MDMER. Therefore, potential increases in TSS during the decommissioning and closure phase are anticipated to have a negligible effect on forage fish health, growth, or survival.

17.4.3.3.2 Change in Water Quality

17.4.3.3.2.1 North Driftwood River

Surface water quality in the North Driftwood River watershed was predicted by modelling at several stations in relation to final discharge point (FDP). As reported in Table 17.8, three PoPCs were predicted at the following stations at the North Driftwood River watershed for the operations phase:

- Nitrite (as N), with a long-term water quality guideline for the protection of aquatic life of 60 µg/L (CCREM 1987), is predicted to reach 61 µg/L at FDP-TMF-SP (Full Mixing), the station at the new outlet of Martin Lake into the North Driftwood River Diversion Channel where the effluent is fully mixed with non-contact water (Figure 17.5)
- Nitrate (as N), with a long-term water quality guideline for the protection of aquatic life of 3,000 µg/L (CCME 2012), is predicted to reach 3,615 µg/L at FDP-TMF-SP (Full Mixing), 3,494 µg/L at FDP-SP-02 (Full Mixing) the station in the North Driftwood River Diversion Channel adjacent to the rock impoundment where the effluent is fully mixed with non-contact water, and 3,106 µg/L at the ND 11 Pour point, the station in the North Driftwood River Diversion Channel just upstream of its confluence with the North Driftwood River mainstem (Figure 17.5).

- Total copper, with a long-term water quality guideline for the protection of aquatic life of 2 µg/L (CCME 1999), is predicted to reach concentrations ranging from 2.63 to 3.59 µg/L at stations 0.03 (i.e., FDP-TMF-SP) to 19.93 km (i.e., ND5 Pour point) downstream of the furthest upstream FDP.

Each of these PoPCs are assessed below for its potential to cause lethal or sub-lethal effects to fish and aquatic biota in these lakes.

Table 17.8 Mean Receiver and Predicted Parameter Concentrations During the Operations Phase in the North Driftwood River Watershed

Model Node		Parameter		
		Nitrite (as N)	Nitrate (as N)	Copper (Total)
Guideline	Source	CCME CWQG-FAL	CCME CWQG-FAL	CCME CWQG-FAL
	Value	60	3,000	2.0 ^C
Unit		µg/L	µg/L	µg/L
Mean Receiver		10	20	1.2
FDP-TMF-SP (Full Mixing)		61	3,615	3.59
FDP-SP-02 (Full Mixing)		58	3,494	3.54
ND11 Pour point		53	3,106	3.27
ND8 Pour point		47	2,667	2.97
ND7 Pour point		45	2,520	2.87
ND6 Pour point		40	2,159	2.63
ND5 Pour point		40	2,159	2.63
ND3 Pour point		24	1,028	2
ND1 Pour point ^A		20	761	2
NDR-A - Upstream of Calder Creek Confluence		18	597	2
NDR-B - Upstream of Sheriff Creek Confluence		17	553	2
NDR-C - Upstream of Abitibi Confluence		16	443	1
NDR-D - Downstream of Abitibi Confluence		10	35	1
Notes: CCME CWQG-FAL - Canadian Environmental Quality Guidelines, Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Long Term A Hydrologic model limit B CWQG = 5 µg/L if pH < 6.5, CWQG = 100 µg/L if pH ≥ 6.5 C When the water hardness is 0 to < 82 mg/L, the CWQG is 2 µg/L. Based on the baseline average hardness of 62.9 mg/L, CWQG is 2 ug/L. Bold Predicted concentrations during operations phase exceeds the guideline. Parameter is considered a PoPC. <i>Italic Predicted</i> concentrations during operations phase exceeds the guideline but are blow the concentrations in the mean receiver.				

Potential Effects due to Nitrite

The maximum predicted concentration of nitrite (as N) of 61 µg/L is slightly (1.02 times) higher than the Canadian Water Quality Guidelines for the Protection of Aquatic Life - Freshwater Aquatics Long Term (CWQG-FAL) guideline. The guideline exceedance was predicted at a single location (FDP-TMF-SP Full Mixing) during operations. Nitrite concentrations during operations were predicted to decrease at downstream stations from 58 to 10 µg/L and all concentrations during closure and decommissioning were predicted to be below the guideline.

The CWQG FAL was determined in 1987 (CCREM 1987). More recently, the British Columbia Ministry of Environment established nitrite guidelines based on chloride concentrations (BC MOE 2009). Although nitrite is toxic to aquatic organisms, chloride is known to lower nitrite toxicity as chloride and nitrite compete for the same binding site in aquatic organisms (CCME 2012). For example, a decrease in nitrite toxicity was observed in fish, crayfish, amphipod and planarian due to an increase of chloride concentration in water (Kroupova et al. 2018). While current chloride concentrations in the North Driftwood River watershed are below 3 mg/L, chloride concentrations at the FDP-TMF-SP (Full Mixing) were predicted to increase to 13 mg/L. The predicted nitrite concentration would be below the BC nitrite guideline of 6,000 µg/L for a chloride concentration greater than 10 mg/L (BC MOE 2009).

Considering the more recent guidelines and research describing the relationship between nitrite toxicity and chloride concentration, it is likely that the CCME CWQG for the protection of aquatic life (1987) is conservative for the North Driftwood River watershed. In addition, given the low magnitude of the nitrite exceedance, and the lower predicted concentrations downstream and during the closure phase, effects on the health growth, or survival of fish and other aquatic biota, such as plankton and benthic invertebrates and their contributions to primary and secondary productivity of the North Driftwood River watershed are not expected due to predicted nitrite concentrations during operation and closure and decommissioning phases.

Potential Effects due to Nitrate

Nitrate (as N) concentrations were predicted to exceed the CWQG FAL of 3 mg/L at three stations during operations: FDP-TMF-SP (Full Mixing), FDP-SP-02 (Full Mixing), and ND11 Pour point, all locations within the North Driftwood River Diversion Channel (Figure 17.5). Predicted nitrate concentrations at these stations ranged from 3.1 to 3.6 mg/L. All concentrations during closure were predicted below the guideline. Therefore, the maximum magnitude exceedance of the nitrate guideline occurs during operation and is 1.2 times higher than the guideline.

The CCME guideline for nitrate is based on a species sensitivity distribution study (CCME 2012). The species sensitivity distribution identified lake trout (*Salvelinus namaycush*) as the most sensitive species to long term nitrate toxicity. However, lake trout and other salmonids are not present in the North Driftwood River watershed. Invertebrates such as the water flea (*Ceriodaphnia dubia*) and amphipod (*Hyalella azteca*) were sensitive to nitrate with endpoint concentrations ranging from 50 to 57 mg/L of nitrate ion NO₃ (i.e., 11 to 13 mg/L of nitrate as N), which is approximately four times higher than the maximum predicted concentration. The Topeka shiner (*Notropis topeka*) was the least sensitive organism to nitrate in the species sensitivity distribution study (CCME 2012) while another study found that juvenile

pikeperch (*Sander lucioperca*) may be tolerant of nitrate concentrations up to 350 mg/L of nitrate (as N) (Schram et al. 2014). This data suggest that minnows and walleye (*Sander vitreus*) may be similarly tolerant to nitrate.

More recent research has demonstrated that water hardness reduces nitrate toxicity in aquatic organisms. Decrease in nitrate toxicity with increased hardness was observed in fish, amphipods, water fleas, and midges (Baker et al. 2017). The lake trout toxicity test on which the guideline was based was performed in softer water (hardness of 10 to 16 mg/L) than occurs in the North Driftwood River (baseline average hardness of 62.9 mg/L). Therefore, the water hardness in North Driftwood River is expected to reduce potential nitrate toxicity.

While the nitrate concentration is predicted to exceed the guideline during operations, the occurrences are limited to three stations, they are low in magnitude, the most sensitive fish is absent from the watershed, and the CCME guideline is likely conservative based on more recent research considering the interaction of nitrate and water hardness. For these reasons, adverse effects on the health, growth, or survival of fish and other aquatic biota, such as plankton and benthic invertebrates and their contributions to primary and secondary productivity, in the North Driftwood River watershed are not expected due to predicted nitrate concentrations during operation and closure and decommissioning phases.

Potential Effects due to Copper

Total copper concentrations are predicted to exceed the CWQG FAL of 2 µg/L at seven stations during operations, based on a hardness in the receiving environment between 0 and 82 mg/L (average hardness in the North Driftwood River was 62.9 mg/L (Appendix B.6 of the Impact Statement [Surface Water Resources Baseline Report]): FDP-TMF-SP (Full Mixing), FDP-SP-02 (Full Mixing), and ND11 in the North Driftwood River Diversion Channel and ND8, ND7, ND6, and ND5 Pour points in the North Driftwood River downstream of the diversion channel. Predicted copper concentrations ranged from 2.63 to 3.59 µg/L. Therefore, the maximum magnitude exceedance is predicted to be 1.8 times higher than the guideline. All concentrations during closure and decommissioning were predicted to be below the guideline.

Copper is present in several forms in surface waters with the free copper ions (Cu^{2+}) being the most bioavailable and potentially toxic form for aquatic organisms. Therefore, total copper concentrations are not directly related to toxicological effects in aquatic organisms (ECCC 2021). Copper speciation in surface water is influenced by general water chemistry. The CWQG FAL (1987) is based on water hardness. However, more recent guidelines (ECCC 2021, BC MOECCS 2019) were derived from the Biological Ligand Model (BLM) taking into consideration hardness, pH and DOC. Based on a hardness of 60 mg/L, pH of 7.3, and DOC 20 mg/L, the chronic water quality guideline protective of freshwater organisms is 4.8 µg/L (BC MOECCS 2019). Baseline average water chemistry parameters for the North Driftwood River watershed were hardness of 62.9 mg/L, pH of 7.3 and DOC of 26.5 mg/L. Therefore, the BLM-generated copper guideline for the North Driftwood River greater than the maximum predicted copper concentration of 3.59 µg/L; the CWQG FAL of 2 µg/L based only on hardness is likely conservative. For these reasons, potential adverse residual effects on the health, growth, or survival of fish and other aquatic biota, such as plankton and benthic invertebrates and their contributions to primary

and secondary productivity, in the North Driftwood River watershed are not expected due to predicted copper concentrations during operation and closure and decommissioning phases.

17.4.3.3.2.2 West Buskegau River

Surface water quality was predicted by modelling at several stations in relation to FDPs in the West Buskegau River. During operations, all predicted concentrations were below current baseline concentrations and, therefore, not considered PoPCs. All predicted concentrations during decommissioning and closure were below guidelines.

17.4.3.3.2.3 Jocko Creek

Surface water quality was predicted by modelling at three sub-watershed pour points in the Jocko Creek watershed. Jocko Creek will not receive direct discharge from the Project. Instead, potential changes in water quality in Jocko Creek are related to changes in groundwater inputs.

Total copper concentrations, with a long-term water quality guideline for the protection of aquatic life of 2 µg/L (CCME 1999) based on a hardness in the receiving environment between 0 and 82 mg/L (average hardness in Jocko Creek of 47.1 mg/L (Appendix B.6 of the Impact Statement [Surface Water Resources Baseline Report]) were predicted to reach a maximum concentration of 2.3 µg/L at each sub-watershed pour points in Jocko Creek for the Expected Case (i.e., average climate conditions/average groundwater quality/average geochemistry source terms/average baseline surface water quality) during the operations and closure and decommissioning phases under future climate conditions. Therefore, the maximum magnitude exceedance of the total copper guideline is predicted to be 1.15 times higher than the guideline.

Based the BLM and a hardness of 50 mg/L, pH of 6.9, and DOC 20 mg/L, the chronic copper guideline protective of freshwater organisms is 2.4 µg/L (BC MOECCS 2019). The baseline average water chemistry parameters for the Jocko Creek watershed were a hardness of 47.1 mg/L, pH of 6.9 and DOC of 24.2 mg/L. Therefore, BLM-generated copper guideline is greater than the maximum predicted copper concentration of 2.3 µg/L in Jocko Creek. Therefore, the CWQG FAL of 2 µg/L based on hardness only may be conservative. For these reasons, potential adverse residual effects on the health, growth, or survival of fish and other aquatic biota, such as plankton and benthic invertebrates and their contributions to primary and secondary productivity, in the Jocko Creek watershed are not expected due to predicted copper concentrations during operation and closure and decommissioning phases.

17.4.3.3.2.4 Deposition of Airborne Contaminants

The deposition of airborne contaminants and their potential to lead to eutrophication and/or acidification of receiving waterbodies is assessed in detail in the Surface Water VC chapter (Chapter 15 of the IS). Based on the analysis therein, potential adverse residual effects on the health, growth or survival of fish and other aquatic biota due to eutrophication and acidification from the deposition of airborne contaminants are predicted to be minimal.

17.4.3.3.3 Change in Water Temperature

Water temperatures in the North Driftwood River and West Buskegau Rivers have the potential to be altered by effluent discharged from the sediment ponds. The ponds will have bottom draw pump intakes that draw water from 1 m to 3 m below the pond surface; this water will then be conveyed to the treatment plants prior to discharge to the rivers. Bottom draw pump intakes located below permanent pool elevations >1 m can reduce discharge temperatures by several degrees Celsius (MOE 2003; SWAMP 2005, TRCA 2013) if ponds become thermally stratified during summer.

The sediment ponds and treatment plants designed for the Project are designed to release storm events over multiple days to the receivers (Site-Wide Water Management Plan; Appendix J of the Impact Statement). With a multi-day release, ponds will discharge 24 hours a day; effluent discharged at night would be cooler than effluent discharged during the day, the magnitude of which would depend on the difference between ambient air temperatures and temperature of the water in the ponds. The treatment plants will not alter water temperature of the effluent prior to discharge to the receivers. For these reasons, water temperatures of the effluent are not expected to alter water temperatures in the receivers (i.e., North Driftwood River, West Buskegau River).

17.4.3.3.4 Production of Underwater Noise

Production of underwater noise because of Project activities is anticipated to occur from drilling and blasting in the Open Pit during construction and operation phases. Fish species known to be present near the Project have varying sensitivities to underwater noise; white suckers and the forage fish guild species have the greatest sensitivity to underwater noise compared to other focal fish species. This is because they have swim bladders that are mechanically connected to the inner ear by structures called Weberian apparatus (Popper and Hawkins 2018). The Weberian apparatus enhances auditory sensitivity (i.e., wide frequency range and low hearing threshold) by conducting pressure changes produced by externally originating sound waves from the swim bladder to the ear.

Blasting will follow the mitigation measures and best management practices outlined in the Explosives Management Plan. All Project blasting would occur on land and not take place within fish-bearing waterbodies or watercourses. Applicable DFO-recommended measures to avoid causing harm to fish from the use of explosives near fish-bearing waters would be followed (Wright and Hopky 1998; DFO 2023b).

Set-back distances required to meet DFO's 50 kPa overpressure threshold and the 13 mm/sec PPV threshold for the protection of fish and fish eggs were calculated for the charge sizes to be used in the Open Pit during mine construction and operations (i.e., 150 to 250 kg), conservatively assuming that the substrates between the pit and the closest fish-bearing waterbody will be bedrock. Using the formula in Wright and Hopky (1998), the minimum setback distances between the Open Pit and the nearest fish-bearing waterbody were 92 m for the 50 kPa threshold and 215 m for the PPV threshold. These minimum set-back distances are substantially smaller than the minimum distances between the closest location in the upper bench of the Open Pit to the West Buskegau River (710 m), Martin Lake (1,900 m), Gerry Lake (2,200 m), and the North Driftwood River Diversion Channel (2,300 m). Therefore, residual effects on the

health, growth, or survival of white suckers and forage fish due to blasting in the Open Pit are not expected to occur during construction or operation phases of the Project.

17.4.3.3.5 Impingement and Entrainment of Fish

The Project will not require any permanent freshwater intakes during construction, operations, or closure and decommissioning. Any temporary water intakes required for dewatering activities or other purposes will have intake screens designed and installed in accordance with DFO's *Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater* (DFO 2020a). Screens would be sized for the weakest swimming life stage of the weakest swimming fish species present in the affected area (i.e., juvenile burbot). With this mitigation, the number of fish becoming impingement or entrained in the pumps is expected to be low and the potential residual effects to focal fish species are expected to be negligible.

17.4.3.3.6 Death of Fish due to Stranding or Physical Injury

The forage fish guild was chosen as the focal fish species to assess the potential residual effects of death of fish due to stranding or physical injury on fish health growth or survival because:

- The forage fish guild (i.e., brook stickleback, fathead minnow, finescale dace, northern pearl face, and northern redbelly dace) were the most common fish caught in the North Driftwood River and West Buskegau River watershed during the aquatic baseline surveys (Appendix B.8 of the Impact Statement [Fish Baseline Reports]).
- The small-bodied species spend all life stages within the affected areas (e.g., spawning, rearing, overwintering), and would therefore have the greatest potential for all life stages to be susceptible to injury or mortality during in-water construction, including those at greatest risk of injury or mortality (i.e., fish eggs and larvae).

Fish salvages will be completed prior to any in-water construction or dewatering activities within the Project footprint. Fish salvages will relocate individuals away from impacted areas to limit the likelihood of injury or mortality. It is anticipated that some individuals (e.g., buried eggs, larvae) may not be salvaged and may be affected by Project activities despite mitigation. Therefore, where possible, dewatering and in-water construction activities within fish-bearing watercourse or waterbody would occur outside of the DFO restricted activity timing windows: April 1 to June 20 for spring spawning in northeastern Ontario with walleye and northern pike present and September 1 to June 15 for fall/winter spawning fish in northeastern Ontario (DFO 2013c). Limiting dewatering and in-water construction work during sensitive times will reduce potential interactions between Project activities and important biological activities/life stages occurring within these periods.

Injury or mortality of fish are not anticipated to occur due to construction of stream crossings associated with internal haul and access roads, the realignment of Highway 655, and any other linear components required for construction and operations of the Project. This is because:

- clear-span watercourse crossings (i.e., bridges or open-bottom culverts) will be designed and constructed above the ordinary high-water mark of watercourses following the mitigation measures described in DFO's "Clear-span Bridges" Code of Practice.
- Equipment will be operated from land, except for fording.
- If fording is required, mitigation measures in DFO's Temporary Fords Code of Practice (DFO 2023d) will be implemented with one piece of equipment crossing the stream once (over and back) to support construction, if required.
- Equipment for construction of watercourse crossings will be clean and in good working order.

With the implementation of mitigation measures, potential residual effects on the health, growth, or survival of forage fish due to stranding or physical injury is expected to be low in magnitude. The geographical extent of residual effects will be limited to the PA. Any residual effects would be short-term, would occur as multiple irregular events, and would not have sensitive timing effects as in-water works will be completed outside the restricted timing windows. The consequences of death of fish or fish eggs from stranding or physical injury is expected to be permanent at an individual level but reversible at the population level.

17.4.3.3.7 Introduction of Aquatic Invasive Species and Disease

The introduction of aquatic invasive species and disease during construction and decommissioning of Project components and infrastructure is not anticipated to occur with the implementation of mitigation measures and best management practices, including:

- Develop and implement a Vegetation Management Plan, which outlines mitigation measures and procedures to manage invasive species. The Plan will include provincial and federal guidelines, including Ontario's "Invasive Species Strategic Plan" (MNRF 2012) and DFO's "Measures to Protect Fish and Fish Habitat" (DFO 2023b).
- Only clean machinery, vehicles and equipment will be used, any equipment arriving at site in a dirty condition will be clean and re-inspected prior to use. Cleaning equipment before use around watercourses will help to remove hydrocarbons, aquatic invasive species, and pathogens potentially present on the equipment.
- No instream works are anticipated at fish-bearing watercourse crossings, as clear-span watercourse crossings (i.e., bridges or open-bottom culverts) will be designed and constructed above the ordinary high-water mark of watercourses following the mitigation measures described in DFO's "Clear-span Bridges" Code of Practice (DFO 2023c) for permanent crossings.

By implementing the above mitigation measures, the risk of introducing aquatic invasive species and disease to the North Driftwood River, West Buskegau River, and Jocko Creek watersheds is low. However, the consequences of potential introduction of aquatic invasive species and disease to the local ecosystem are large. Therefore, Canada Nickel will work with Indigenous nations and provincial agencies to develop an Aquatic Invasive Species and Disease Management Plan that will include best industry

practices that can be incorporated into all aspects of construction, operations, and closure and decommissioning activities, monitored for compliance and effectiveness, and regularly updated as required.

17.4.3.3.8 Increased Fishing Pressure

The adverse residual effects related to increased fishing pressure during construction and decommissioning of Project components is expected to be negligible with the implementation of mitigation measures described in Section 17.4.3.2. Implementing and adhering to a no-fishing policy by Project personnel is expected to be effective in reducing fish mortality due to fishing. Accommodations or camp facilities are not proposed for the Project. Therefore, it is anticipated that workers, who are commuting from surrounding communities and residences, will have limited opportunities to participate in angling activities near the Project. No angling will be permitted within the PA and no fishing by Project personnel will be permitted near the PA while on shift.

During decommissioning and closure, disturbed areas including access and haul roads that are no longer required for future reclamation or monitoring purposes will be decommissioned and scarified which will restrict access to fish-bearing watercourses and waterbodies in and around the PA. By implementing relevant mitigation measures, residual effects on focal fish species health, growth, or survival are expected to be negligible.

17.4.3.3.9 Change in Aquatic Invertebrate Community

Aquatic invertebrate habitat within the LSA is dominated by slow-flowing depositional habitat, habitat that is dominated by chironomids and oligochaetes. This habitat and these organisms are relatively insensitive to changes in flow and water quality compared to fast-flowing erosional habitat dominated by EPT taxa.

Predicted changes in flow during all phases of the Project are not anticipated to substantially change the hydraulic characteristics or wetted areas of the depositional habitat available to invertebrates in the North Driftwood River, West Buskegau River, or Jocko Creek watersheds. Similarly, predicted changes in water quality are not expected to substantially alter the density, diversity, or dominance structure of the benthic invertebrate communities in these watersheds downstream of the PA.

Loss of fish habitat in the headwaters of the North Driftwood River and West Buskegau River watersheds will reduce the total benthic invertebrate community biomass in these two watersheds. Over time, this will likely reduce the amount of benthic invertebrate drift available for fish downstream of the PA. This effect is unavoidable. However, in the North Driftwood River watershed, some of this lost biomass is expected to be offset once a benthic invertebrate community becomes established in the North Driftwood River Diversion Channel. Colonization of this channel is expected to be relatively quick once the channel has stabilized and a riparian community has established because the headwaters of the diversion channel will be Martin Lake, a natural source of benthic invertebrates. Reduction of benthic invertebrate biomass and drift in the West Buskegau River is expected to be lower than in the North Driftwood River because only small, headwater tributaries to the west of the mainstem channel will be affected and benthic invertebrate drift from Prosser Lake and other headwater areas will be unaffected by the Project.

Potential residual effects on the health, growth, or survival of focal fish species in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds due to potential changes in the abundance, diversity, and dominance structure of benthic invertebrates are expected to be moderate, limited to the LSA, occur for the duration of the Project, and be irreversible.

17.4.4 Summary of Project Residual Effects

Table 17.9 summarizes Project residual effects on fish and fish habitat. Changes in fish habitat in the LSA will be moderate in magnitude following implementation of offsetting measures required to counterbalance the unavoidable habitat alterations or losses within the PA. The magnitude of the residual effect on fish habitat to fish populations in the North Driftwood River watershed will be reduced following implementation of the fish habitat offsets within the North Driftwood River Diversion Channel. Changes to fish habitat will occur progressively during construction and operations, will be continuous and long-term. Changes to fish habitat within the PA will be irreversible while change to fish habitat due to changes in stream flow will be reversible once the open pit has filled and is draining to the North Driftwood River and West Buskegau River.

Changes in fish health, growth and survival are expected to be driven by the potential effects of changes in water quality due to effluent discharge and changes to the aquatic invertebrate community associated with the loss of headwater habitat, changes in water quality and changes in stream flow. Together, these effects are expected to result in changes in fish health, growth, and survival that are moderate in magnitude, long term, continuous, and extend to the LSA. The residual effect on fish health, growth and survival is considered reversible, as effluent discharge will cease at the end of the Project and water quality and water quantity are expected to return to near baseline conditions post-closure.

Canada Nickel recognizes that Indigenous nations are best positioned to identify their priorities and interests, and to share their views, in their own words, regarding their preferred conditions or thresholds for the exercise or practice of rights (IAAC 2023). As available, descriptions of nation-specific thresholds identified for the Fish and Fish Habitat VC that informed this assessment are provided in Chapters 25 to 28 of the Impact Statement (Assessment of Potential Effects on Indigenous Interests).

Table 17.9 Project Residual Effects on Fish and Fish Habitat

Residual Effect	Residual Effects Characterization							
	Project Phase	Direction	Magnitude	Geographic Extent	Timing	Duration	Frequency	Reversibility
Change in Fish Habitat	C, O, D	A	M	LSA	MS	LT	C	IR
Change in Fish Health, Growth, or Survival	C, O, D	A	M	LSA	MS	LT	C	R
<p>KEY</p> <p>See Table 17.4 for detailed definitions.</p> <p>Project Phase C: Construction O: Operation D: Decommissioning</p> <p>Direction: P: Positive A: Adverse N: Neutral</p> <p>Magnitude: N: Negligible L: Low M: Moderate H: High</p> <p>Geographic Extent: PA: Project Area LSA: Local Study Area RSA: Regional Study Area</p> <p>Timing NS: No sensitivity MS: Moderate sensitivity HS: High sensitivity</p> <p>Duration: ST: Short-term MT: Medium-term LT: Long-term</p> <p>N/A: Not applicable</p> <p>Frequency: S: Single event IR: Irregular event R: Regular event C: Continuous</p> <p>Reversibility: R: Reversible I: Irreversible</p>								

17.4.5 Significance of Adverse Federal Effects

Change in Fish Habitat

The alteration or loss of fish habitat caused by construction and operation of the Project is expected to result in a moderate magnitude effect for the fish populations in the North Driftwood River watershed. This is because the Project will result in the loss of all headwater streams, ponds, and mainstem channel within the PA. This loss will negatively affect the forage fish populations that rely on this habitat for all their life stages and will negatively affect the northern pike, white sucker, and walleye populations that reside in this habitat or rely on the contributions of flow, nutrients, organic debris, invertebrates, and sediment that these headwater areas provide in the North Driftwood River mainstem downstream of the PA. However, the magnitude and corresponding significance of the alteration or loss of fish habitat in the North Driftwood River is moderate because: 1) the offsetting measures that Canada Nickel will implement will counterbalance these unavoidable habitat effects, including offsets in the North Driftwood River

Diversion Channel that will benefit fish populations in the North Driftwood River watershed; and 2) none of the potentially affected habitat is used by lake sturgeon, the only aquatic species at risk near the Project.

Canada Nickel will require a paragraph 35(2)(b) *Fisheries Act* authorization from DFO prior to construction of the Project, an authorization that will require Canada Nickel to design and implement habitat restoration, enhancement, or creation that counterbalance the harmful habitat impacts, including the time lags and uncertainties associated with the habitat offsets. There are a suite of technical feasible and biologically relevant fish habitat offsets available in the LSA and RSA that will provide benefits to the fish populations directly affected by the Project and to fish populations valued by Indigenous nations, recreational anglers, and other stakeholders, including offsets that will benefit lake sturgeon. As such, the significance of potential changes in fish habitat caused by the Project are expected to be moderate when these offsets are constructed and functioning as intended.

The effects of changes in flow are expected to be more noticeable in the riffle habitat than in run and pool habitats. The amount of riffle habitat in the LSA is low owing to the relatively low gradient of the stream and rivers affected by the Project. The greater impact of these flow changes occur during low-flow periods, not during the spring freshet when most fish species in the North Driftwood River and West Buskegau River spawn. The geographic extent of the effect of predicted flow changes on fish habitat is restricted to the LSA and is expected to occur continuously once Project activities are initiated. The effect of changes in flow on fish habitat will be reversible once mining is complete, the pit has filled with water, and run-off from the pit is released to the North Driftwood River and West Buskegau River in approximately the same proportions as their affected watershed areas. The significance of potential changes in flow on fish habitat in the North Driftwood River, West Buskegau River, and Jocko Creek is therefore moderate.

Change in Fish Health, Growth, or Survival

Adverse effects to fish health, growth and survival are expected to occur within the LSA downstream of the Project. These effects will result from changes in water quality and possible reduction in aquatic invertebrate abundance. The magnitude is considered to be moderate. The effects are anticipated to be long term and continuous, as there will be ongoing effluent discharge for the duration of the Project. The effect on fish health, growth and survival is considered reversible, as effluent discharge will cease at the end of the Project and water quality would be expected to return to conditions close to baseline after the Project ends.

As such, with the mitigation measures described above, Project residual effects to fish health, growth and survival are predicted to be of moderate significance.

17.5 Federal Lands

There are no federal lands within the LSA or RSA. The closest federal lands are the Taykwa Tagamou Nation Reserve lands located approximately 37 km away (straight line) from the PA (14 km southeast of Cochrane). Therefore, no additional mitigation measures beyond those identified are required for federal lands.

17.6 Prediction Confidence

17.6.1 Change in Fish Habitat

Confidence in the predicted effects of the Project on fish habitat is moderate. This is because habitat losses under the Project footprint were calculated using high resolution aerial imagery and a GIS-based model that identified all first and second order streams within the PA (i.e., streams that are not present on the 1:10,000 scale provincial data layer) and the distribution of different fish species using the habitat within the PA was conservatively based on their known habitat preferences and not only their presence in the fish catch. Understanding of the fish community in the North Driftwood River, West Buskegau River, and Jocko Creek watersheds was based on multi-season sampling conducted in 2021, 2022, and 2023. However, additional studies were initiated in 2024 (see Section 17.6.3) to fill identified data gaps. In lieu of these newer data, conservative assumptions were made regarding fish utilization of various habitat types.

Potential changes in fish habitat due to predicted changes in flow were based on comparison to the thresholds identified in DFO's "Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada" (DFO 2013) and an environmental flow threshold based on the Tessman method. Both methods are "standard-setting" approaches based on comparison of predicted stream discharge to baseline stream discharge. However, neither method predicts the hydraulic variables that are important to fish (i.e., water depth, water velocity). Therefore, the effect on fish of predicted changes in stream flows greater than these thresholds cannot be predicted with certainty.

Confidence in the predicted changes in fish passage is high because the mitigation measures that will be used to reduce barriers or impediments to fish passage at new stream crossings are well-known, industry standard techniques.

17.6.2 Change in Fish Health, Growth, or Survival

Confidence in the predicted effects of the Project on fish health, growth and survival is high. This is because the Project has committed to treatment of mine effluent that will meet provincial and federal effluent standards and because predicted changes in water quality were based on quantitative models that incorporated predicted changes in groundwater, surface water quantity and surface water quality (including predicted loadings from geochemical source terms) using actual baseline data and industry-standard modeling programs to predict water quality in the North Driftwood River, West Buskegau River, and Jocko Creek during all mine phases. Uncertainties related to the calibration or input data used for the models upon which the Fish and Fish Habitat VC assessment were based were assumed to be documented and similar to models conducted for other recent mines in Canada.

Predicted changes in the aquatic invertebrate community are made with moderate confidence, in the absence of detailed hydraulic modelling that would more accurately predict the extent of potential changes in wetted areas.

17.6.3 Additional Data Collection

Canada Nickel continues to undertake field surveys to refine its understanding of baseline conditions. Once available, results from these surveys will be used to further guide Project design and fish habitat offsetting requirements. Canada Nickel is committed to the data collection activities listed in Table 17.10.

Table 17.10 Additional Fish and Fish Habitat Data Collection Commitments

Commitment	Objective
Hydraulic Habitat Modeling in North Driftwood River & West Buskegau River	This task will allow quantification of potential effects on fish habitat associated with areas of the North Driftwood River and West Buskegau River downstream of the PA where flow reductions >10% are predicted.
Spring 2024 Fish Habitat Assessment	This task will assess fish habitat in previously sampled locations as well as newly proposed locations for watercourses and ponds to bring the overall sampling coverage to approximately 10% of available habitat in the PA. This task will assess fish habitat in previously sampled watercourses and ponds as well as newly selected 4 th and 5 th order watercourse to allow for assessment of potential effects on downstream fish populations
Spring 2024 Fish Community Assessment	This task will be conducted concurrently with fish habitat assessment and will assess fish community in previously sampled locations as well as newly proposed locations for watercourses and ponds to bring the overall sampling coverage to approximately 10% of available habitat in the PA. This task item will be conducted concurrently with fish habitat assessment and will assess fish community in previously sampled watercourses and ponds as well as newly selected 4 th and 5 th order watercourse to allow for assessment of potential effects on downstream fish populations.
Spring 2024 eDNA sampling	This task will test for the presence of lake sturgeon in various locations within and downstream of the PA.
Temperature Logger Installations	This task will help characterize fish habitat conditions in various locations upstream, near and downstream of the PA.
Summer 2024 Lake Habitat Assessments	This task will involve habitat assessment work in Martin Lake, Gerry Lake, Reaume Lake, Unnamed Lake and Return Lake to further establish baseline conditions both on site and in reference locations.
Summer 2024 Lake Fish Community Assessments	This task will involve fish community assessment work in Martin Lake, Gerry Lake, Reaume Lake, Unnamed Lake and Return Lake to further establish baseline conditions both on site and in reference locations.
Fish Tissue Collection 2024	This task will require the collection and analysis of addition fish tissue samples from various locations to ensure adequate sample sizes for future analysis.
Fall 2025 Benthic Invertebrate Sampling Program	This task will involve benthic tissue and community sampling from various locations to support long term monitoring programs.

17.7 Assumptions

For the purposes of the assessment of effects on fish and fish habitat, a number of assumptions were made. Key assumptions are summarized below:

- It was assumed that there is adequate available space and opportunity for the successful implementation of fish habitat offsetting by a combination of habitat creation and complementary offsetting to satisfy DFO requirements. This has led to the exclusion of the overprinted habitat from residual effects assessment of habitat loss.
- It was assumed that the benthic invertebrate and fish communities were similar within LSA watercourses and waterbodies that had similar physical characteristics to the watercourses and waterbodies within the PA.
- Assessments and conclusions regarding changes in fish health, growth and survival were based on modeling as described in the sections above. Assumptions underlying these models ultimately affect the assessments. Uncertainties related to the calibration or input data used for the models upon which the Fish and Fish Habitat VC assessment were based were assumed to be documented and similar to models conducted for other recent mines in Canada
- It was assumed that predicted flow changes would not result in dewatering of watercourses in the LSA downstream of the PA. This assumption was made in the absence of hydraulic modelling in these watercourses.
- Conservative assumptions on the distribution of different fish species using the habitat within the PA were based on their known habitat preferences and not only their presence in the fish community sampling. These assumptions were made in the absence of surveys being conducted in all the areas under consideration.
- The assessment of fish health, growth, and survival was completed under the assumptions of the future climate conditions for the Expected Case (i.e., average climate conditions/average groundwater quality/average geochemistry source terms/average baseline surface water quality). As mentioned above, assumptions underlying these models ultimately affect the assessments.
- Due to the high variability of baseline surface water quality parameters (e.g., hardness, pH, DOC concentrations), the average watershed specific concentrations of baseline water quality parameters were assumed more representative than the 75th or the 95th percentiles.
- It was assumed that the assessment of potential effects of metals based on predicted total concentrations was conservative since the dissolved fraction (included along other fractions in the total concentration) is considered the most bioavailable and toxic fraction to aquatic organisms (Väänänen et al. 2018).

- It was assumed that the use of the applicable water quality guidelines is conservative to protect fish species present within the LSA considering that guidelines are derived based on the most sensitive species and that fish species in the natural receiving environment may be more tolerant than the most sensitive species used in the guideline derivation.
- It was assumed that a fish species would be exposed continuously to the highest predicted concentration (or predicted concentration above guideline). However, the home range of individual fish may be greater than the area for which the PoPC concentration was predicted above guideline and, therefore, the assessment is considered conservative.

17.8 Follow-up and Monitoring

Canada Nickel will implement follow-up and monitoring programs to verify the accuracy of effects and to evaluate the effectiveness of mitigation measures, the results of which will be used to identify and implement adaptive management measures, as appropriate. As it relates to fish and fish habitat, follow-up and monitoring measures will be implemented to monitor offsetting habitats, water quality (see Chapter 15 of the Impact Statement), stream flows, benthic invertebrate communities, sediment quality, fish health and population metrics, and fish tissue contaminant concentrations. Environmental effects monitoring in accordance with Schedule 5 of the MDMER will be conducted when there is discharge or seepage of mine water to the aquatic environment (i.e., effluent characterization, water quality monitoring, sub-lethal toxicity testing). Monitoring will include reference sites and “impact sites” downstream of the discharge point(s) to enable a Before-After-Control-Impact analysis of data. Chapter 34 of the Impact Statement includes additional details on follow-up and monitoring programs proposed by Canada Nickel.

17.9 References

- Ausenco (Ausenco Engineering Canada ULC). 2023. Crawford Nickel Sulphide Project NI 43-101 Technical Report and Feasibility Study. Available at: https://canadanickel.com/wp-content/uploads/2023/11/Crawford-NI-43-101-FINAL-REPORT_Nov24_R2.pdf. Accessed November 2023.
- Baker, J.A., G. Gilron, B.A. Chalmers, and J.R. Elphick. 2017. Evaluation of the effect of water type on the toxicity of nitrate to aquatic organisms. *Chemosphere*. 168:435-440.
- Bash, J., C. Berman and S. Bolton. 2001. Effects of Turbidity and Suspended Solids on Salmonids. Technical Report Prepared for Washington State Transportation Commission, Seattle, Washington.
- BC MOE. 2009. Water Quality Guidelines for Nitrogen (Nitrate, Nitrite, and Ammonia). Overview Report Update.
- BC MOECCS. 2019. Copper Water Quality Guideline for the Protection of Freshwater Aquatic Life. Technical report. Water Quality Guideline Series, WQG-03-1. Prov. B.C., Victoria B.C.

- Berli, B. I., Gilbert, M. J., Ralph, A. L., Tiernery, K.B., and Burkhardt-Holm, P. 2014. Acute exposure to a common suspended sediment affects the swimming performance and physiology of juvenile salmonids. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology*. 176: 1-10.
- Bradford, M.J., R.G. Randall, K.S. Smokorowski, B.E. Keatley and K.D. Clarke. 2014. A framework for assessing fisheries productivity for the Fisheries Protection Program. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/067. v + 25 p.
- Broadmeadow, S., and Nisbet, T. R. 2004. The effects of riparian forest management on the freshwater environment: a literature review of best management practice. *Hydrology and Earth System Sciences*. 8: 286-305.
- Caissie, D. 2006. The thermal regime of rivers: a review. *Freshwater Biology*. 51: 1389-1406.
- Canadian Standards Association. 2019. Technical Guide: Development, interpretation, and use of rainfall intensity-duration-frequency (IDF) information: Guideline for Canadian water resources practitioners.
- Canfield, T.J., N.E. Kemble, W.G. Brumbaugh, F.J. Dwyer, C.G. Ingersoll and J.F. Fairchild. 1994. Use of benthic invertebrate community structure and the sediment quality triad to evaluate metal-contaminated sediment in the Upper Clark Fork River, Montana. *Env. Toxicol. Chem.* 13:1999-2012.
- CCME (Canadian Council of Ministers of the Environment). 2024. Water Quality Guidelines for the Protection of Aquatic Life: Freshwater and Marine. Available at: <https://ccme.ca/en/summary-table>. Accessed July 2024.
- CCME. 2012. Canadian Water Quality Guidelines for the Protection of Aquatic Life. Nitrate Ion.
- CCME. 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life, 1999 and updates. CCREM. 1987. Canadian Water Quality Guidelines. Prepared by the Task Force on Water Quality Guidelines.
- CCREM (Canadian Council of Resource and Environment Ministers). 1987. Canadian water quality guidelines for the protection of aquatic life. Ottawa, ON.
- Chilibeck, B., Chislett, G., and Norris, G. 1992. Land development guidelines for the protection of aquatic habitat. Department of Fisheries and Oceans Canada, Ministry of Environment, Lands and Parks, Integrated Management Branch.
- Clarke, K. D., T. C. Pratt, R. G. Randall, D. A. Scruton, and K. E. Smokorowski. 2008. Validation of the Flow Management Pathway: Effects of Altered Flow on Fish Habitat and Fishes Downstream from a Hydropower Dam. *Can. Tech. Rep. Fish. Aquat. Sci* 2784: vi + 111 p.
- Cott, P.A., Johnston, T.A., Gunn, J.M., and Higgs, D.M. 2013. Hearing Sensitivity of the Burbot. *Transaction of the American Fisheries Society*. 142(6): 1699-1704.

Coen, L. D. 1995. A review of the potential impacts of mechanical harvesting on subtidal and intertidal shellfish resources. South Carolina Division of Natural Resources, Marine Resources Research Institute, James Island, South Carolina, pp. 46.

COSEWIC (Committee on the Status of Endangered Wildlife in Canada). 2017. Assessment and Status Report on the Lake Sturgeon (*Acipenser fulvescens*) in Canada: Western Hudson Bay, Saskatchewan-Nelson River, Southern Hudson Bay-James Bay, and Great Lake-Upper St. Lawrence River populations.

DeWalle, D. R. 2010. Modeling stream shade: riparian buffer height and density as important as buffer width. *Journal of the American Water Resources Association*. 46: 323-333.

DFO (Fisheries and Oceans Canada). 1991. Land Development Guidelines for the Protection of Aquatic Habitat. Available at: <https://okcp.ca/images/resources/land-use-planning/dfo-land-development-guidelines-for-protection-of-aquatic-habitat-2009.pdf>. Accessed July 2024.

DFO. 2006. Whites Point Quarry and Marine Terminal Proposed Blasting Protocol Communication. Available at: <https://acee-ceaa.gc.ca/B4777C6B-docs/WP-1394.pdf>. Accessed March 2024.

DFO. 2013a. Framework for Assessing the Ecological Flow Requirements to Support Fisheries in Canada. *Can. Sci. Adv. Secr. Sci, Adv, Rep.* 2013/017

DFO. 2013b. A science-based framework for assessing the response of fisheries productivity to state of species or habitats. *Can. Sci. Adv. Secr. Sci, Adv, Rep.* 2013/067.

DFO. 2013c. Ontario Restricted Activity Timing Windows for the Protection of Fish and Fish Habitat. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/timing-periodes/on-eng.html>. Accessed July 2024.

DFO. 2019. Fish and Fish Habitat Protection Policy Statement. August 2019. Ottawa, ON. 35 p

DFO. 2020a. Interim code of practice: End-of-pipe fish protection screens for small water intakes in freshwater. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/codes/screen-ecran-eng.html>. Accessed July 2024.

DFO. 2020b. Interim code of practice: temporary cofferdams and diversion channels. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/codes/cofferdams-batardeaux-eng.html>. Accessed July 2024.

DFO. 2023a. Policy for Applying Measures to Offset Harmful Impacts to Fish and Fish Habitat. Draft for Discussion. May 2023. Ottawa, ON. 35 p.

DFO. 2023b. Measures to protect fish and fish habitat. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/measures-mesures-eng.html>. Accessed July 2024.

DFO. 2023c. Code of practice: Clear span bridges. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/codes/clear-span-bridges-ponts-portee-libre-eng.html>. Accessed July 2024.

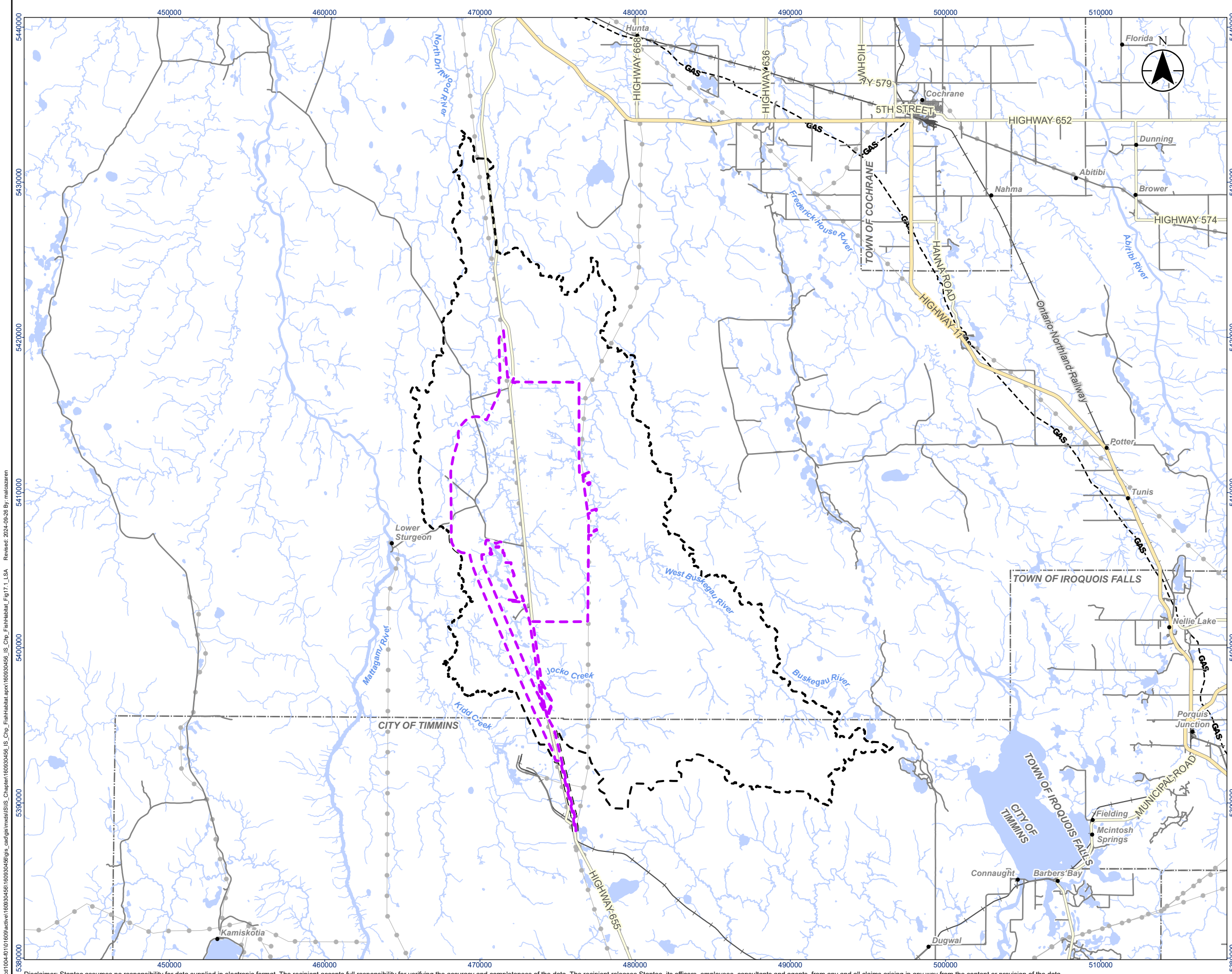
- DFO. 2023d. Code of practice: Temporary fords. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/codes/temporary-fords-traversees-temporaires-eng.html>. Accessed July 2024.
- DFO. 2023e. Code of practice: Beaver dam breaching and removal. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/codes/beaver-dam-barrage-castor-eng.html>. Accessed July 2024.
- DFO. 2024a. Pathways of Effects. Available at: <https://www.dfo-mpo.gc.ca/pnw-ppe/pathways-sequences/index-eng.html>. Accessed April 2024.
- DFO. 2024b. About aquatic invasive species. Available at: <https://www.dfo-mpo.gc.ca/species-especies/ais-eae/about-sur/index-eng.html>. Accessed July 2024.
- Domenici, P. 2001. The scaling of locomotor performance in predator–prey encounters: from fish to killer whales. *Comparative Biochemistry and Physiology. A. Comparative Physiology* 131, 169–182.
- ECCC. 2021. Canadian Environmental Protection Act, 1999. Federal Environmental Quality Guidelines. Copper. April 2021.
- Faith, D.P. and R.H Norris. 1989. Correlation of environmental variables with patterns of distribution and abundance of common and rare freshwater macro invertebrates. *Biol. Conserv.*, 50, 77-98.
- Faulkner, S. G., Tonn, W. M., Welz, M. W., and Schmitt, D. R. 2006. Effects of Explosives on Incubating Lake Trout Eggs in the Canadian Arctic. *North American Journal of Fisheries Management*. 26: 833-842.
- Fedorenko, A.Y. 1991. Guidelines for Minimizing Entrainment and Impingement of Aquatic Organisms at Marine Intakes in British Columbia. Canadian Manuscript Report of Fisheries and Aquatic Sciences. 2098. 86 pp.
- Fimreite, N., and Reynolds, L.M. 1973. Mercury contamination of fish in Northwestern Ontario. *The Journal of Wildlife Management*, 37(1): 62-68.
- Fondriest Environmental Inc. 2014. Turbidity, Total Suspended Solids & Water Clarity. Available at: <https://www.fondriest.com/environmental-measurements/parameters/water-quality/turbidity-total-suspended-solids-water-clarity/>. Accessed July 2024.
- Goertner, J. F., Wiley, M. L., Young, G. A., and McDonald, W.W. 1994. Effects of underwater explosions on fish without swimbladders, NSWC TR 88-114. Naval Surface Warfare Center, Silver Springs, MD.
- Halvorsen, M.B., Casper, B.M., Woodley, C.M., Carlson, T.J., Popper, A.N. 2012. Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. *PLoS ONE* 7(6): e38968.
- Hogan, T.W. 2015. Impingement and Entrainment at SWRO Desalination Facility Intakes, In: *Selected Topics of Computational and Experimental Fluid Mechanics*. Selected Topics of Computational and Experimental Fluid Mechanics, pp. 57–78.

- IAAC (Impact Assessment Agency of Canada). 2023. Guidance: Describing Effects and Characterizing Extent of Significance. Available at: <https://www.canada.ca/en/impact-assessment-agency/services/policy-guidance/practitioners-guide-impact-assessment-act/guidance-describing-effects-characterizing-extent-significance.html#toc7>. Accessed January 2024.
- Kjelland, M.E., C.M. Woodley, T.M. Swannack et al., 2015. A Review of the Potential Effects of Suspended Sediment on Fishes: Potential Dredging-Related Physiological, Behavioural, and Transgenerational Implications. *Environ Syst Decis* 35, 334–350.
- Kiruba-Sankar, R., Praveen Raj, J., Saravanan, K., Lohith Kumar, K., Raymond Jani Ange, J., Velmurugan, A., and Dam Roy, S. 2018. Chapter 9 - Invasive Species in Freshwater Ecosystems – Threats to Ecosystem Services. *Biodiversity and Climate Change Adaptation in Tropical Islands*, 257-296.
- Koehn, J.D. and Crook, D.A. 2013. Movements and Migration, In, *Ecology of Australian Freshwater Fishes*, Humphries, P and Walker, K. (eds), pp 105-129, CSIRO Publishing, Victoria, Australia.
- Kroupová Kocour, H., O. Valentová, Z. Svobodová, P. Šauer, and J. Máchová. 2018. Toxic effects of nitrite on freshwater organisms: a review. *Rev Aquacult*, 10: 525-542. <https://doi.org/10.1111/raq.12184>
- Kroupova, H., Valentova, O., Svobodova, Z., Sauer, P. and Machova, J. 2018. Toxic effects of nitrate on freshwater organisms: A review. *Reviews in Aquaculture*, 10(3) 525-542.
- Miner, J.G. and R.A. Stein. 1996. Detection of Predators and Habitat Choice by Small Bluegills: Effects of Turbidity and Alternative Prey. *Transactions of the American Fisheries Society*. 125: 97-103.
- MNRF (Ontario Ministry of Natural Resources and Forestry). 2023. MNRF Road Segments [Data set]. Province of Ontario. Available at: <https://geohub.lio.gov.on.ca/datasets/lio::mnrf-road-segments/explore?location=48.833059%2C-81.314590%2C11.00>. Access July 2024.
- MNRF (Ministry of Natural Resources and Forestry). 1990. Environmental Guidelines for Access Roads and Water Crossings. Available at: <https://www.ontario.ca/page/environmental-guidelines-access-roads-and-water-crossings>. Accessed April 2024.
- MNRF. 2011. *Lakes and Rivers Improvement Act* Administrative Guide. Ontario Ministry of Natural Resources, Great Lakes Salmonid Unit. August 2011.
- MNRF. 2012. Invasive Species Strategic Plan (2012). Available at: <https://www.ontario.ca/page/invasive-species-strategic-plan-2012>. Accessed July 2024.
- MNRF. 2015. Ontario's Provincial Fish Strategy – Fish for the Future. Available at: <https://www.ontario.ca/page/ontarios-provincial-fish-strategy>. Accessed April 2024.

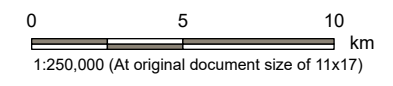
- MOEE (Ministry of the Environment and Energy). 1994. Water management: policies, guidelines, provincial water quality objectives. Appendix A: Provincial Water Quality Objectives. Accessed from: <https://www.ontario.ca/page/water-management-policies-guidelines-provincial-water-quality-objectives#section-7>. Accessed July 2024.
- Montgomery, D.R. 1996. Process Domains and the River Continuum. *Journal of the American Water Resources Association*, vol. 32, no. 2 pp. 217-238.
- Muck, J. 2010. Biological Effects of Sediment on Bull Trout and Their Habitat – Guidance for Evaluating Effects. Fish and Wildlife Service, Lacey, p 57.
- Newcombe, C.P. 1994. Suspended Sediments in Aquatic Ecosystems: III Effects as A Function of Concentration and Durations of Exposure. Habitat Protection Branch. British Columbia Ministry of Environment, Lands and Parks. Victoria, British Columbia, Canada. 298 pages.
- Peterson, D.L., Vecsei, P., and Jennings, C.A. 2006. Ecology and biology of the lake sturgeon: a synthesis of current knowledge of a threatened North American Acipenseridae. *Rev. Fish. Biol. Fisheries*, 17:59-76.
- Pirkle, C. M., Muckle, G., and Lemire, M. 2016. Managing mercury exposure in northern Canadian communities. *Canadian Medical Association Journal*, 188(14): 1015-1023.
- Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Lokkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G., and Tavolga, W.N. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer's Brief in Oceanography.
- Popper, A.N., Hawkins, A.D. 2018. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. *Journal of Fish Biology*. 94: 692-713.
- Reisman, H.M., and Cade, T.J. 1967. Physiological and behavioral aspects of reproduction in the brook stickleback, *Culaea inconstans*. *Am. Midl. Nat.* 77: 257-295.
- Rodgers, E, M., Cramp, R, L., Gordos, M., Weier, A., Fairfall, S., Riches, M. and Franklin, C. E. 2014. Facilitating upstream passage of small-bodied fishes: linking the thermal dependence of swimming ability to culvert design. *Marine and Freshwater Research*, 65 8: 710-719.
- Schram, E., J.A.C. Roques, T. van Kuijk, W. Abbink, J. van de Heul, P. de Vries, S. Bierman, H. van de Vis, and G. Flik. 2014. The impact of elevated water ammonia and nitrate concentrations on physiology, growth and feed intake of pikeperch (*Sander lucioperca*), *Aquaculture*, 420–421:95-104.
- Soka University. 2024. Effects of Invasive Species on Water Quality in Freshwater Ecosystems. Available at: <https://www.soka.edu/about/20th-anniversary-anthology/creative-coexistence-nature-humanity/effects-invasive-species>. Accessed July 2024.

- Stephenson, J.R., Gingerich, A.J., Brown, R.S. 2010. Assessing barotrauma in neutrally and negatively buoyant juvenile salmonids exposed to simulated hydro-turbine passage using a mobile aquatic barotrauma laboratory. *Fisheries Res*, 106:271–278.
- Stewart, D.B., Reist, J.D., Carmichael, T.J., Sawatzky, C.D., and Mochnacz, N.J. 2007. Fish life history and habitat use in the Northwest Territories: brook stickleback (*Culaea inconstans*). *Can. Manuscr. Rep. Fish. Aquat. Sci.* 2799: vi + 30 p.
- SWAMP (Stormwater Assessment Monitoring and Performance) Program. 2005. Synthesis of Monitoring Studies Conducted under the Stormwater Assessment Monitoring and Performance Program. Toronto and Region Conservation Authority.
- Tillinger, T.N. and O.R. Stein. 1996. Fish Passage Through Culverts in Montana: A Preliminary Investigation. Federal Highway Administration FHWA/MT/96/8117-2.
- Tompkins, A.M., and Gee, J.H. 1983. Foraging behavior of brook stickleback, *Culaea inconstans* (Kirtland): optimization of time, space, and diet. *Can. J. Zool.* 61: 2482-2490.
- TRCA (Toronto and Region Conservation Authority). 2013. Evaluation of an Innovative Technique for Augmenting Stream Baseflows and Mitigating the Thermal Impacts of Stormwater Ponds.
- U.S. FWS (U.S. Fish and Wildlife Service). 1980. Habitat evaluation procedures (HEP). USDI Fish and Wildlife Service. Division of Ecological Services. ESM 102.
- Väänänen, K., M.T. Leppänen, X. Chen, J. Akkanen. 2018. Metal bioavailability in ecological risk assessment of freshwater ecosystems: From science to environmental management. *Ecotoxicology and Environmental Safety.* 147: 430-446.
- Wang, R.Y. 2008. Aspects of Design and Monitoring of Nature-Like Fish Passes and Bottom ramps, PhD Thesis, Technical University of Munich. eds) *Dynamics of Lotic Systems*. Science Publishers, Ann Arbor, pp 29–42
- Wetzel, R.G. 2001. *Limnology*. 3rd Edition. Elsevier Science Academic Press, New York. 1,006 pp.
- Winn, H.E. 1960. Biology of the brook stickleback *Eucalia inconstans* (Kirtland). *Am. Midl. Nat.* 63: 424-438.
- Wright, D.G. and G.E. Hopky. 1998. Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters. Canadian Technical Report of Fisheries and Aquatic Sciences 2107. Available at: <https://publications.gc.ca/collections/Collection/Fs97-6-2107E.pdf>. Accessed July 2024.
- Yelverton, J.T., Richmond, D.R., Hicks, W., Saunders, H., and Fletcher, E.R. 1975. The relationship between fish size and their response to underwater blast. Lovelace Foundation for Medical Education and Research Topical Report, DNA 3677T, Albuquerque, NM. Prepared for the Defense Nuclear Agency.

17.10 Figures



- Legend**
- Project Area
 - Local Study Area
- Base Features**
- Expressway / Highway
 - Major Road
 - Minor Road
 - Railway
 - Existing Transmission Line
 - Submerged Communication Line
 - GAS- Natural Gas Pipeline
 - Watercourse
 - Municipal Boundary - Lower Tier
 - Waterbody



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.

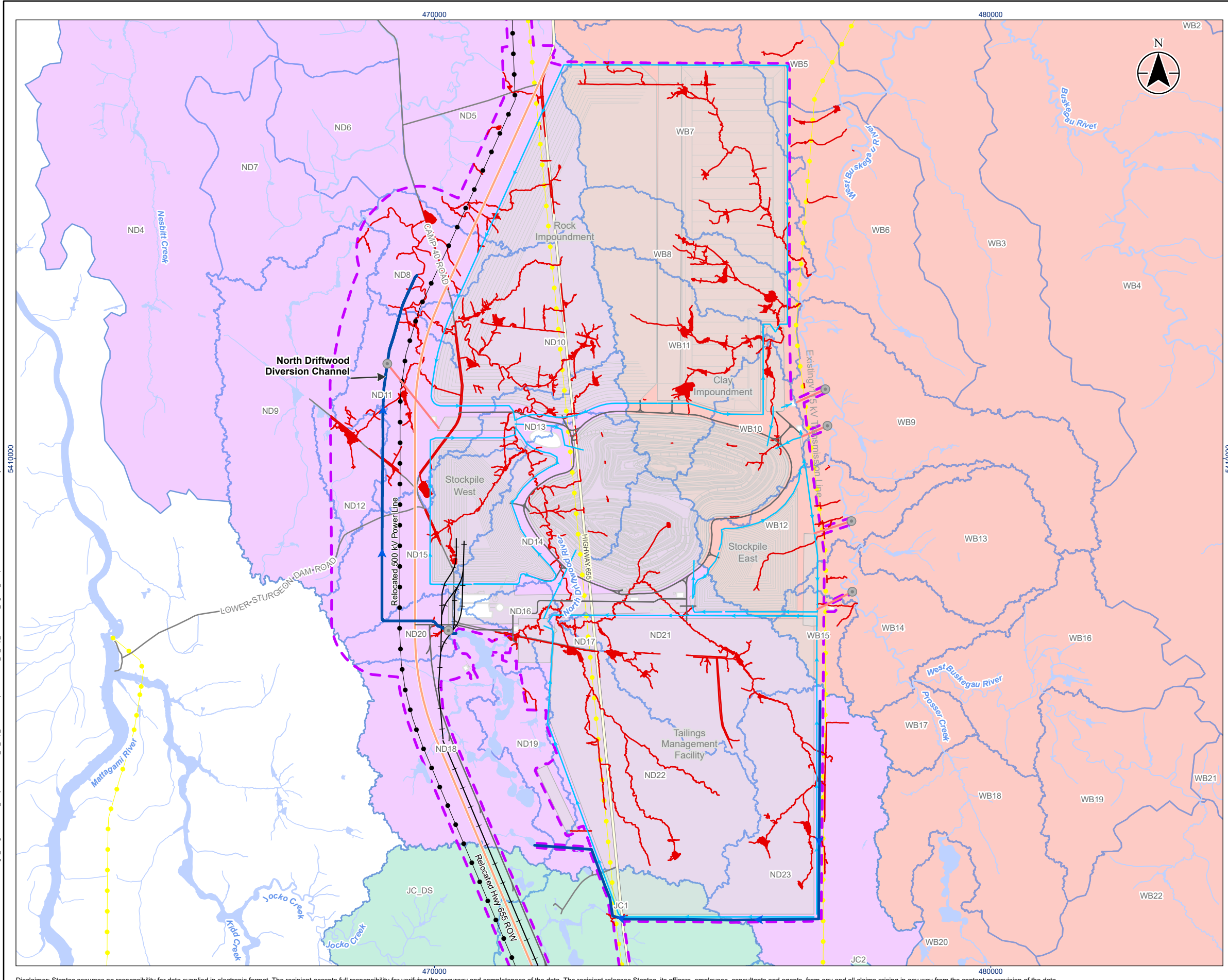


Project Location: Timmins, Ontario
 Prepared by: malcazaren on 2024-09-26
 160930456 REVA

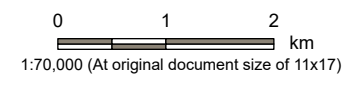
Client/Project:
 Canada Nickel Company (CNC)
 Crawford Nickel Project

Figure No.
17.1
 Title
Local Study Area

V:\1004-1010\160930456\160930456\GIS_Cadging\mxd\160930456_IS_Chp_FishHabitat_Fig17_LSA_Reviewed: 2024-09-26 By: malcazaren



- Legend**
- Project Area:** Dashed purple line
 - Habitat to be Overprinted:** Red fill
 - Sub Watershed:** Light blue outline
 - Jocko Creek Watershed:** Green fill
 - North Driftwood River Watershed:** Light purple fill
 - West Buskegau River Watershed:** Light orange fill
 - Base Features:**
 - Major Road: Grey line
 - Minor Road: Thin grey line
 - Existing Transmission Line: Yellow line with dots
 - Watercourse: Blue line
 - Waterbody: Blue fill
 - Proposed Project Components: Grey fill
 - Ancillary Infrastructure:**
 - Relocated Hwy 655: Orange line
 - Rail Spur Line: Black line with cross-ticks
 - Transmission Line: Black line with dots
 - Proposed Project Components:**
 - Discharge Route: Red line
 - Non-Contact Water Channel: Blue arrow
 - Contact Water Channel: Light blue line
 - Site Road: Thin grey line



- Notes**
- Coordinate System: NAD 1983 UTM Zone 17N
 - Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.
 - Orthomagey: ..

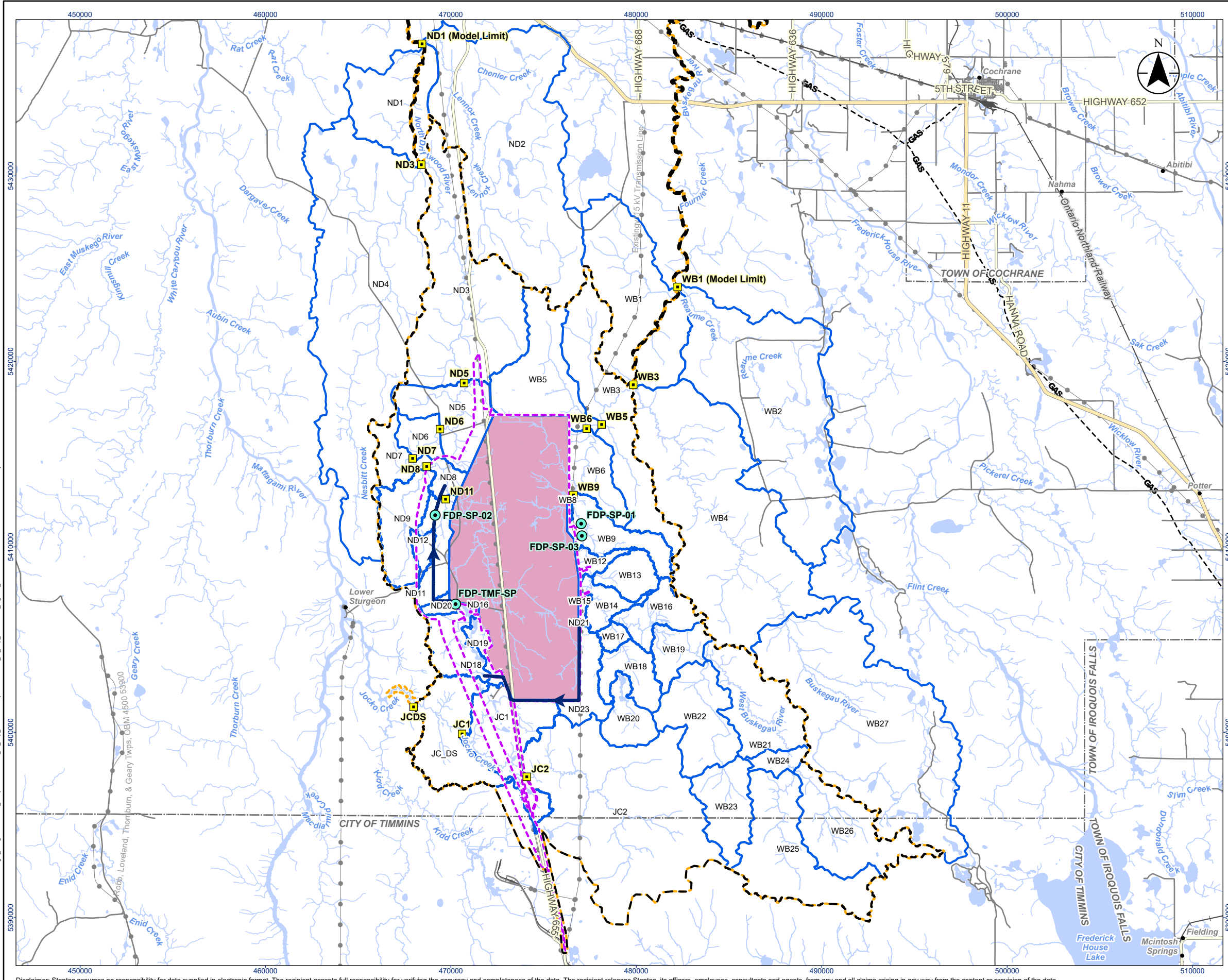


Project Location: Timmins, Ontario
 160930456 REVA
 Prepared by malcazaren on 2024-09-26

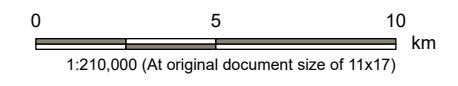
Client/Project: Canada Nickel Company (CNC)
 Crawford Nickel Project

Figure No.: **17.3**
 Title: **Fish Habitat Overprinting Summary**

V:\1004-10\160930456\160930456\gis_cad\gis\mxd\160930456_IS_Chp_FishHabitat_Fig17.3_OverprintedHabitat_Revisee_2024-09-26_By_malcazaren_5410000



- Legend**
- Project Area
 - Local Study Area
 - Regional Study Area
 - Base Features**
 - Expressway / Highway
 - Major Road
 - Minor Road
 - Railway
 - Existing Transmission Line
 - GAS- Natural Gas Pipeline
 - Watercourse
 - Municipal Boundary - Lower Tier
 - Waterbody
 - Non-Contact Diversion Channel
 - Existing Condition Subwatershed
 - Subwatershed Reports to Mine Water Management System
 - Discharge Location
 - Subwatershed Outlet



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2023.



Project Location: Timmins, Ontario
 Prepared by: malcazaren on 2024-09-26
 160930456 REVA

Client/Project: Canada Nickel Company (CNC) Crawford Nickel Project

Figure No. **17.5**

Title: **Location of Subwatersheds within the Hydrologic Model Boundary Used in Mass Balance Analysis**