

MEMORANDUM

TO: Isabelle Deguise, Narrows Inlet Hydro Holding Corporation.
FROM: Leah Ballin MSFM, R.P.Bio., RPF and Deborah Lacroix M.Sc., R.P. Bio.
DATE: October 5, 2015
FILE: 1132-13

RE: Narrows Inlet Hydro Project: Northern Goshawk Habitat Suitability Modelling and Field Verification Including Nest Surveys Conducted to Satisfy Part of Condition #1 of the Project's Environmental Assessment Certificate.

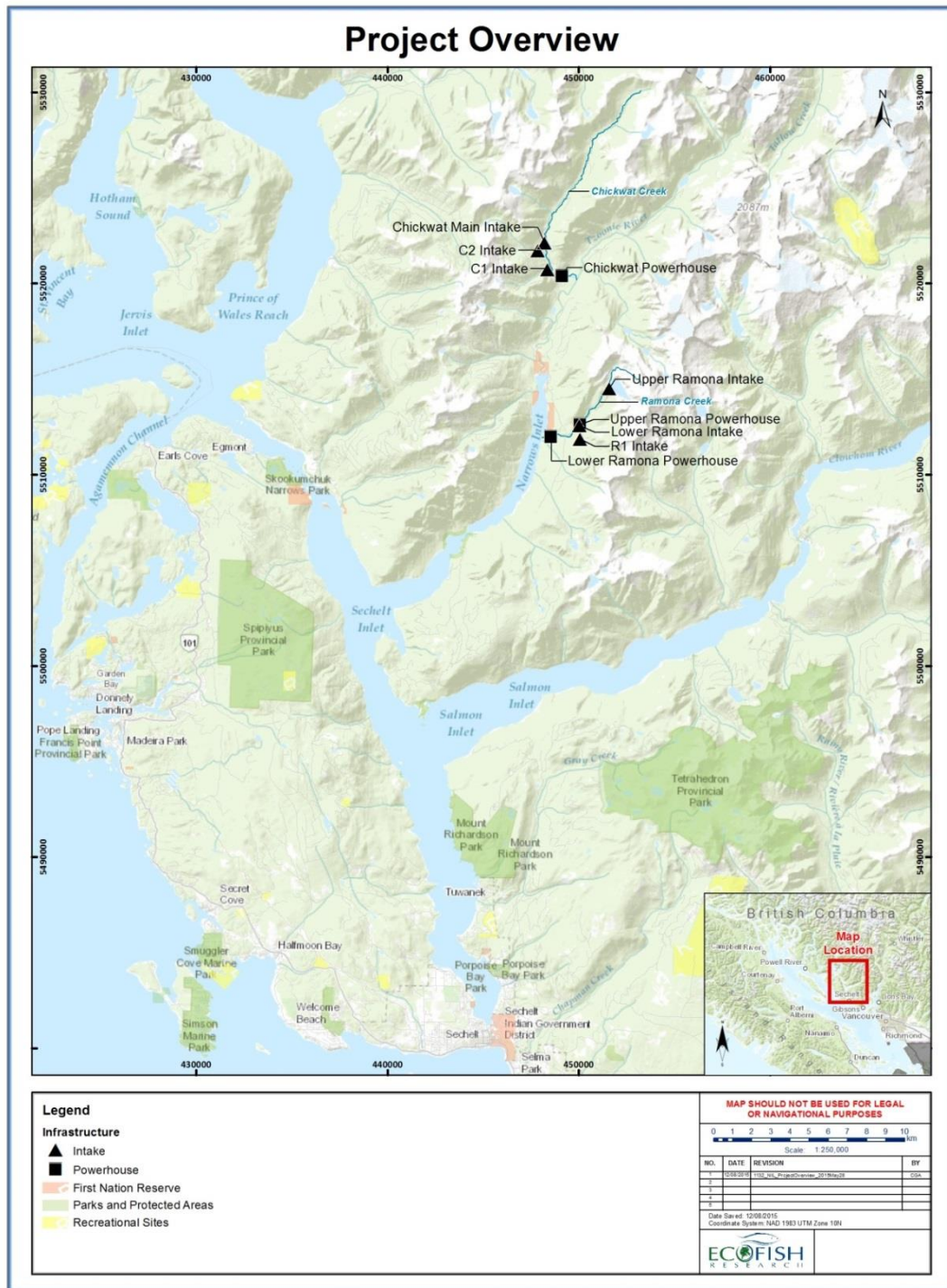
1. INTRODUCTION

The Narrows Inlet Hydro Project (the Project), located approximately 50 km north of Sechelt, British Columbia (BC), is comprised of three hydroelectric components (Chickwat Creek, Lower Ramona Creek and Upper Ramona Creek) and an associated transmission line which interconnects to the BC Hydro transmission line near Ruby Lake on the Sunshine Coast (Map 1). The Project was issued an Environmental Assessment Certificate (#E13-04) in 2013 (EAO 2014). The Project's legally binding Environmental Assessment Certificate (EAC) includes requirements and conditions set out in two appended schedules. Schedule B (Table of Conditions) sets out all of the commitments made to address concerns raised through the environmental assessment certificate application process.

The Project's Table of Conditions (TOC) lists 26 conditions which must be implemented as directed in the Schedule. Condition #1 of the TOC requires the following:

- (a) *Identify high suitability goshawk habitat by using habitat suitability models following Inventory Methods for Raptors (Resource Inventory Committee 2001) and by using a qualified professional;*
- (b) *Undertake goshawk nest surveys in all identified high quality habitat using a QP;*
- (c) *Maintain an area of undisturbed forest surrounding all active and alternate nest sites within an identified breeding area determined by the Ministry of Forests, Lands and Natural Resource Operations (FLNR); and*
- (d) *Implement suitable habitat replacement for any high suitability goshawk habitat that is proposed to be cleared, prior to undertaking clearing of or construction to the satisfaction of FLNR.*

Map 1. Overview map showing the Narrows Inlet Hydro Project including the Chickwat Creek, Lower Ramona Creek and Upper Ramona Creek components.



Northern Goshawk habitat suitability modelling was completed as a component of the application for an EAC (Robertson 2012) and again following submission of the environmental assessment to address regulator concerns (EAO *et al.* 2012, Graham/Wall 2015). However, no field verification of the model or Northern Goshawk surveys were conducted. Ecofish Research Ltd. (Ecofish) was retained by Narrows Inlet Hydro Holding Corp. (majority ownership held by BluEarth Renewables Inc.) to conduct Northern Goshawk (*Accipiter gentilis*) habitat suitability modelling and field surveys to address the requirements of Condition #1 of Schedule B of the Project's EAC (#E13-04; EAO 2014). The model was updated in consideration of both recent and future harvesting, current forest cover data (2014), and to be at a finer resolution that better represents the scale of the input data and is more useful in consideration of the size of the Project infrastructure. The modelling exercise, combined with field verification of high suitability nesting habitat by a Qualified Professional (QP), satisfies Condition 1a of the EAC. Northern Goshawk nest surveys were conducted in all identified high quality nesting habitat using a QP to satisfy Condition 1b. This information will be used to inform Conditions 1c and 1d.

2. BACKGROUND/OBJECTIVES

Northern Goshawk (subspecies *laingi*) is threatened in BC due to the conversion of mature and old-growth forests on which they depend, to young seral stages, resulting in habitat loss and fragmentation (MOE 2008). The Northern Goshawk (subspecies *laingi*) is listed as Threatened under Schedule 1 of the *Species at Risk Act* (2002) and is provincially red-listed. The Northern Goshawk (subspecies *laingi*) has also been legally categorized; under a ministerial Order (MWLAP 2004), as a Species at Risk under the Government Action Regulations of the *Forest and Range Practices Act* (2002). The Provincial Conservation Framework categorizes the species as Priority 1 under Goal 1 (contributing to global conservation efforts). Consequently, Northern Goshawk was identified as a Valued Component. The Project's EAC Application assessed potential Project effects on the species (Robertson 2012).

EAC Application

Northern Goshawk habitat suitability mapping was conducted as a component of the EAC Application (Application). The Application evaluated habitat loss, habitat change and change in behaviour. The effects of habitat loss and change were assessed by considering the amount of high and moderate value nesting habitat overlapping the proposed Project footprint. According to the original model results, high value habitat occurred in the Local Assessment Area (LAA) of the Chickwat Creek, Lower Ramona Creek and Upper Ramona Creek components and along the transmission line (Robertson 2012). No field verification of the modelled habitat suitability was conducted and only a few Northern Goshawk call-playback surveys were conducted (EAO *et al.* 2012, Robertson 2012). Call-playback surveys for Northern Goshawk were completed within potentially suitable habitat within the Project area in the summer of 2008, prior to acquiring habitat

suitability mapping. Upon cross-examination of call-playback site locations and modelling results, it was determined that most of the sixteen call-playback surveys were not located within or near (<500 m) modelled high or moderate suitability nesting habitat. Further, none of these surveys occurred within the Chickwat Creek LAA. Six call-playback surveys were conducted in the Ramona Creek LAA, five along the road to Ramona Creek in the Lower Ramona Creek LAA and one at Ramona Lake. In addition, four call-playback surveys were conducted along the road to Ramona Creek on the east side of Narrows Inlet, and five in the Ruby Lake area at the west end of the previously proposed transmission line alignment. No Northern Goshawks were detected in the Project area (Robertson 2012).

EAC Application Review

During the review of the Application, the working group noted that surveys of suitable habitat for Northern Goshawk were not completed. The Proponent and EAO agreed that these would be completed in the future to reflect the most updated Project design, particularly in respect to the specific infrastructure locations (EAO *et al.* 2012).

Interim Modelling

Updated habitat suitability modelling was completed by Graham/Wall Consulting Ltd. (2015) using mapping conducted by FLNR in 2009 following *Parameterization of the Northern Goshawk (Accipiter gentilis laingi) Habitat Model for Coastal British Columbia Nesting and Foraging Habitat Suitability Models and Territory Analysis Model: a Working Draft* (Mahon *et al.* 2008). The provincial mapping was developed with a 100 m x 100 m (1 ha) cell size. The updated maps displayed recent forest depletions and ranked these habitats as nil.

Objectives

The objectives of this memorandum are threefold. Firstly, to update the Northern Goshawk nesting habitat suitability model with the most updated model parameters (Mahon *et al.* 2012) using a finer scale of resolution than previous mapping, thus being more representative of the scale and size of the Project infrastructure. The updated model will also consider both recent and future harvesting and current forest cover data. Secondly, to field verify modelled high suitability nesting habitat within key areas within the Project area. Thirdly, to conduct Northern Goshawk nest searches and call-playback surveys for the species in strategic locations within the Project area.

3. METHODS

3.1. Habitat Suitability Modelling

The provincial Northern Goshawk nesting habitat suitability model was applied to the Project area (Map 2). The model was originally developed by Mahon *et al.* in 2008 and was later updated with additional species information in 2012 (Mahon *et al.* 2012). The model continues to be a working

draft that will evolve with improved knowledge of the species. This model builds upon the Inventory Methods for Raptors (RIC 2001) that is required to be followed in accordance with Condition 1a of the EAC. For the purpose of this assessment, the most current version of the model was applied to the Project area (Mahon *et al.* 2012).

The nesting habitat suitability model uses seven parameters (Table 1) and associated rating variables to rate habitat suitability from 0 to 1 (Table 2). All mapping queries were conducted using the most recent provincial Vegetation Resource Inventory (VRI) data current to 2014, and slope information converted to a 20 m x 20 m grid cell size digital elevation model (DEM), obtained from GeoBC (2015a) and GeoBase, respectively. This finer scale of resolution, compared to the previous Project models (100 m x 100 m) (Graham/Wall 2015) is more appropriate relative to the size of the infrastructure and the extent of the potential effect on high suitability nesting habitat.

The updated habitat suitability modelling also considered recent cutblocks, including modelling edge effects. The previous model overlaid cutblock data on the model output. Cutblock data was obtained from active forest cutblock (FTEN) data (GeoBC 2015b). In addition, consolidated cutblock data from the province was incorporated (MOF 2015).

ESRI ArcMap 10 was used to run the model.

The nesting habitat suitability model is based on the following Habitat Suitability Index (HSI) equation:

$$HSI = \text{mean}(\text{Stand Age}_r, \text{Stand Height}_r) \times \text{Distance from Edge}_r \\ \times \text{Forest Composition}_r \times \text{Elevation}_r \times \text{Slope}_r \times \text{BEC Variant}_r$$

where $_r$ = rating.

The resulting HSI was classified into four categories of habitat suitability (Table 2).

Table 1. Northern Goshawk habitat suitability model parameters.

Parameter	Comments	Reference	Parameter Rating			Data Source
Stand Age	Frequently used to assess structural maturity of a stand.	Mahon <i>et al.</i> 2008	Age	Rating		VRI
			0-30	0		
			30-95	$(\text{age}-30)*0.015385$		
			>95	1		
Stand Height	Frequently used to assess structural maturity of a stand.	Mahon <i>et al.</i> 2008	If leading species is	Rating		VRI
			0-12	0.3		
			Spruce 12-25	$(0.3 + (\text{PROJ_HT_1} - 12) * 0.05385)$		
			>25	1		
			Else 0-12	0.3		
			12-30	$(0.3 + (\text{PROJ_HT_1} - 12) * 0.03889)$		
			>30	1		
Distance From Forest Edge	Data from Vancouver Island and interior BC show strong avoidance of edges for nest	Smith and Sutherland 2008	Edge Distance	Anthropogenic	Natural	VRI
			0-100 m	0.4	0.6	
			100-200 m	0.8	0.9	
Forest Composition	Suitability of branching platforms for nests and subcanopy flyways are related to the form of different tree species	Mahon <i>et al.</i> 2008	Name	Leading Species	Secondary Species	Rating
			Hw Dominant	Hw	Any except Yc or Pl	1
			Cw pure	Cw > 80%	Any < 20%	0.45
			Cw dominant	Cw < 80%	Any except Yc or Pl	0.65
			B dominant	B, BA, BL	Any except Yc or Pl	0.8
			S dominant	S, SE	Any except Yc or Pl	1
			Fd dominant	Fd	Any except Yc or Pl	1
			Yc dominant	Yc	Any	0.4
			Yc secondary	Any	Yc	0.6
			Pl dominant	Pl	Any	0.5
			Pl secondary	Any	Pl	0.7
			Deciduous	Dr, Ac, At	Any deciduous	0.7
			Mixed forest	Dr, Ac, At	Any coniferous	0.9
Elevation	Local data indicates weak avoidance of higher elevations	Mahon <i>et al.</i> 2008	Elevation	Rating		DEM
			0-800	1		
			801-1300	$0.85 - ((\text{elev}-801)/1300-801)*(0.85-0.5))$		
			>1300	0.5		
Slope	Nest sites often on low-moderate slopes. Local data indicates most nest on slopes >60%	Mahon <i>et al.</i> 2008	Slope (%)	Rating		DEM
			0-60	1		
			60-100	0.7		
			>100	0.5		
BEC Variant	Apparent avoidance of higher elevation Mountain Hemlock and hypermaritime Coastal Western Hemlock zone; none of the ca. 100 nest areas occur in these variants	Mahon <i>et al.</i> 2008	BEC Variants	Rating		VRI
			Alpine tundra (all except parkland)	0.4		modified with revised
			Alpine parkland	0.4		BEC
			CWH (all except vh)	1		polygons
			ESSF (all except parkland)	0.7		(Blackwell 2011)
			ESSF parkland (all)	0.4		
			IDF (all)	1		
			MH (all)	0.8		

Table 2. Northern Goshawk habitat suitability index categories.

HSI Rating	Category	Interpretation	Description
0.00 – 0.25	Nil	Unsuitable	Condition fails to provide minimum requirements.
0.25 – 0.5	Low	Suitability Unknown	Condition of variable provides theoretical minimum requirements, but use by goshawks is unknown or rarely observed. Goshawks are not normally expected in forest with attributes in these conditions, but may do so if that is all that is available.
0.50 – 0.75	Moderate	Suitable	Suitability is lower than optimal conditions but exceeds minimum requirements. A small portion of use by goshawks is expected to occur in areas with variables in this condition.
0.75 – 1.0	High	Suitable	Conditions at or near optimal. Majority of use by goshawks is expected to occur in areas with variables in this condition.

3.1.1.Future Harvesting

The model considered, as a secondary process, areas with active Forest Licenses and provincially approved for future clearing. These areas have a high likelihood of being harvested within five years of approval which would decrease Northern Goshawk habitat suitability to nil and decrease the suitability of adjacent areas due to edge effects. Several stands within the Project area have approved Forestry Licenses(s). Active forest cutblock (FTEN) data (GeoBC 2015b) was used to determine the location and approval date of active Forest Licenses. Active Forest Licenses are approved and forestry activities may be taking place in the cutblocks (GeoBC 2015b). Forest Licenses must be replaced between 5 to 10 years into the term of the license to remain active (ABCFP 2014). Furthermore, cutblock boundary tape was observed throughout the Lower Ramona Creek and Upper Ramona Creek components indicating an intention to harvest.

The model was run with the assumption that these stands will be harvested in the near future and their stand age reduced to zero. The edge effects of the potential future cut blocks were also considered.

3.2. Habitat Suitability Field Verification

Habitat suitability models are an effective method of identifying Northern Goshawk habitat. The nesting model specifically is expected to be 82% accurate, thus field verification is recommended (Mahon *et al.* 2012).

Potential Northern Goshawk nesting habitat that was modelled as high suitability and that intersected or occurred near Project infrastructure was initially assessed in the field by a helicopter overflight, then from the ground by walking or driving through the area, and lastly on orthophotos. Field verification of modelled high suitability habitat evaluated the locations of all new proposed infrastructure, including powerhouses, penstocks, transmission lines, and all areas where widening road right-of-ways or new infrastructure may impact modelled high suitability nesting habitat. Field ranks were given to all assessment sites (polygons) and a rationale for rating modification recorded.

With the field data, polygons were delineated around the habitat assessment sites and the high value cells within assigned the field verified value. Field habitat suitability ratings were conservative in that if a site was considered on the low side of moderate it was assigned 'moderate', and if a rating was on the nil side of low, it was assigned 'low'.

3.2.1. Future Harvesting and Field Verification

Future harvesting was considered in combination with field verified habitat values to provide an overarching assessment of the future nesting habitat value with the assumption that these areas will be harvested in the near future.

3.3. Call Playback Surveys

Northern Goshawk call-playback surveys and nest searches were conducted following provincial standards (RIC 2001) to determine whether these areas are occupied. Even though no modelled high suitability habitat occurred in close proximity to proposed Project infrastructure, surveys were nevertheless conducted in field verified moderate and low suitability nesting habitats that were previously modelled as high suitability.

Ten survey stations were established within habitat suitability assessment sites, where stand age and forest composition characteristics were modelled as having high nesting suitability and that were near proposed Project infrastructure. Surveys were conducted during daylight hours from July 21 to July 22, 2015. At each site, observers used a FoxPro NX4 to broadcast a juvenile Northern Goshawk begging call. A study on Vancouver Island found a 75% detection rate when broadcasting the juvenile begging call from July 1 to August 31 (RIC 2001). After arriving on site, qualified observers first listened silently for two minutes then began broadcasting the appropriate call three times for 20 seconds, followed by 30 seconds of silence after each call. The megaphone was held at chest height and was rotated 120° between broadcasts. Observers remained on site to listen for responses for a minimum of ten minutes following the last broadcast. The start and end time of each survey was recorded. Observers also noted any difference in the number of songbirds calling before and after playing the Northern Goshawk recording, as singing songbirds will often become silent after a Northern Goshawk call is broadcast if there has been a Northern Goshawk in the area.

4. RESULTS

4.1. Habitat Suitability Modelling

Based on the provincial nesting model (Mahon *et al.* 2012), high value Northern Goshawk nesting habitat was identified in the vicinity of the Chickwat Creek component (Map 3), other ancillary components (Map 4), and the Lower Ramona Creek and Upper Ramona Creek components (Map 5). No high value habitat was identified along the transmission line (Map 6).

Similar to the application, little high suitability habitat was detected in the Chickwat Creek valley bottom due to historic logging. Most high suitability areas exist on steep slopes that are difficult to harvest, but also do not provide good cover for nests. Additionally, most modelled high suitability polygons are too small to support nesting habitat. In general, more high suitability habitat was identified in the updated model than was identified in the application (Robertson 2012) or in subsequent mapping (Graham/Wall 2015). This is likely due to the use of current forest cover data (forests have aged) and may also be related to a slight change in the stand age and height curves considered by the model, and also likely due to the scale in which the model was run.

4.1.1. Future Harvesting

The Northern Goshawk nesting habitat suitability model was then adjusted with the assumption that active Forest Licences are cut and the forest age equals zero. The amount of high suitability nesting habitat remained similar within the Chickwat Creek component (Map 7), the other ancillary components (Map 8) and the transmission line (interconnection) (note only low suitability habitats were down-rated to nil) (Map 10). In contrast, the amount of high suitability nesting habitat decreased for the Lower Ramona Creek and Upper Ramona Creek components (Map 9).

4.2. Habitat Suitability Field Verification

Northern Goshawks (subspecies *laingi*) preferentially nest in mature to old-growth forest with an open understory and high canopy cover (Greenwald *et al.* 2005). Characteristics of nesting areas chosen by Northern Goshawk include mature and old forests, closed canopies (>50%), and relatively large diameter trees (MOE 2008). Goshawks typically nest in trees on gentle slopes, usually less than 60% (Mahon *et al.* 2012). They typically nest over 200 m from hard edges and in stands that are >100 ha in size (McClaren and Pendergast 2003, cited in MOE 2008). Nesting areas typically include multiple nest trees. Most alternative nest trees (95%) are within 800 m of each other (McClaren 2010, pers. comm.), although they can be greater than 1 km apart. McClaren (2003, cited in MOE 2008) found that Northern Goshawks will use more than one nest area over successive years, thus not all nest areas are occupied annually. The Provincial Recovery Strategy defines the core-use area as the area providing multiple nest trees, roost trees, and prey plucking posts (MOE 2008). Radio-telemetry studies suggest that the total area for all of these features is approximately 100 ha to 200 ha in size (McClaren 2004).

All field-verified modelled high suitability Northern Goshawk nesting habitat was down-rated to moderate or low suitability at the Chickwat Creek component (Map 11), other ancillary components (Map 12), and at the Lower Ramona Creek and Upper Ramona Creek components (Map 13). No high value habitat was modelled along the transmission line, thus this habitat was only assessed at a high level (helicopter overflight); nevertheless, the ratings were not adjusted. Nesting habitat suitability values were down-rated primarily because the forest stands were young, and the trees did not have sufficiently large branches to support Northern Goshawk nests. On the remnant mature

veteran trees, large branches were either exposed above the main canopy or were on a steep slope and thus less suitable due to predation risk. Furthermore, the patch size of most modelled high suitability habitat polygons was too small to support a nesting area or territory as Northern Goshawks are not known to nest within 200 m from an edge (MOE 2008).

The Northern Goshawk habitat suitability models are under continuous development. During the last revision of the nesting model, it was determined that the model averaged 82% accuracy and overestimated suitability by 0.01-0.09 HSI units. Errors were primarily linked to erroneous forest cover (VRI) data (Mahon *et al.* 2012). An overestimate of suitability of this magnitude could erroneously increase suitability from moderate to high.

A detailed summary of the field verification results is provided below by Project component.

Chickwat Creek

Field verification of modelled high value Northern Goshawk nesting habitat surrounding the Chickwat Creek component infrastructure and ancillary components revealed that these habitats were clear cut logged, and left to naturally regenerate 70-80 years ago. This resulted in dense, even aged stands with little structure and a relatively open understory with no evident suitable nest locations.

The riparian areas adjacent to the Tzoonie River that were modelled as high value nesting habitat are occupied by middle-high bench floodplain forests that are dominated by Sitka spruce and decadent red alder with a thick understory. These areas were down-rated to low suitability because the canopy is too open to provide cover for nests, the deciduous trees are too old and fragile to provide nesting platforms, and the understory is too thick for foraging on the forest floor (Table 3: CHK-NOGO03, CHK-NOGO04, CHK-NOGO06, CHK-NOGO07, CHK-NOGO08, CHK-NOGO10) (Figure 1, Figure 2) (Map 11).

Figure 1. Low suitability riparian habitat observed at CHK-NOGO10 on July 22, 2015.



Figure 2. Low suitability riparian habitat along Tzoonie River observed during overflight on July 21, 2015.



The areas upslope of the riparian area that were modelled as high value nesting habitat are occupied by even aged, relatively densely stocked, approximately 70-80 year old western hemlock and western redcedar dominated forests. These areas were down-rated to moderate value because of the absence of observed suitable nesting branches. A few slightly larger mossy lower branches and mistletoe exist that are unlikely to be adequately large or strong enough to support a successful nest. Fine branches occupy the upper two thirds of tree trunks. The understory is relatively open with a ground cover dominated by sword fern, some salmonberry and step moss (Table 3: CHK-NOGO09, CHK-NOGO11, CHK-NOGO12, CHK-NOGO13, CHK-NOGO14, CHK-NOGO15, CHK-NOGO16) (Figure 3, Figure 4).

Figure 3. Moderate suitability 75 year old hemlock dominated forest observed at NOGO-CHK13 on July 22, 2015.

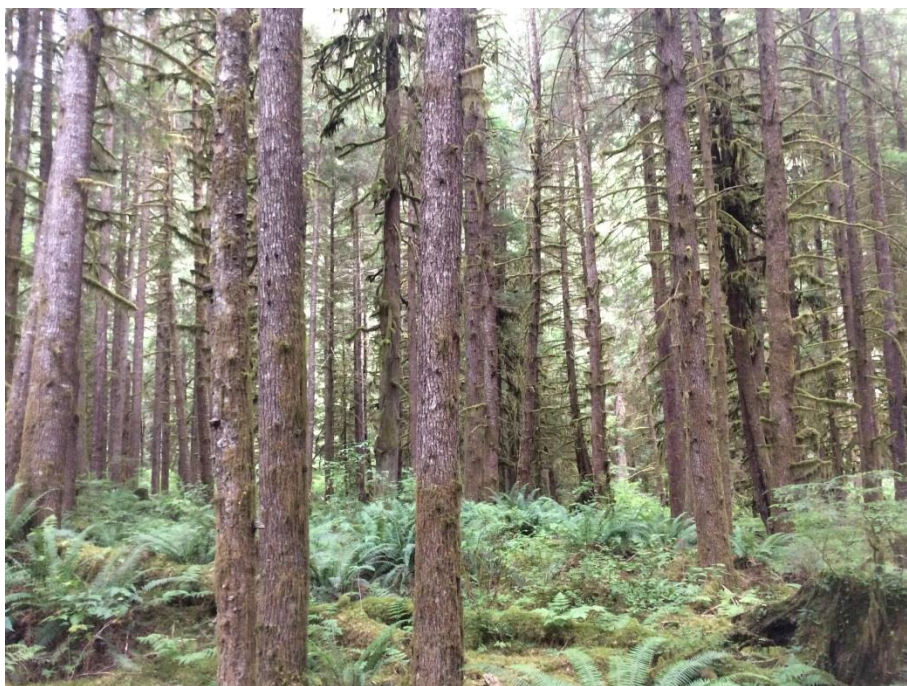


Figure 4. Looking from CHK-NOGO17 across the Tzoonie River to the proposed Chickwat powerhouse location on July 22, 2015.



The few smaller modelled high value patches of nesting habitat on the east side of the Tzoonie River above the riparian area were located on steep slopes. These patches were down-rated to moderate suitability because although they had large, mature trees, the branches were exposed due to the steep slope and the patches were surrounded by low suitability habitat and were too small to support multiple nests. Two of these areas are adjacent to riparian areas (Table 3: CHK-NOGO17, CHK-NOGO18) and two of them are further upslope (Table 3: CHK-NOGO19, CHK-NOGO20) (Figure 5).

Figure 5. Small patch of moderate suitability habitat observed at RAM-NOGO08 on July 22, 2015.



Ancillary components

The modelled high suitability habitat located at the interconnection near CHK-NOGO01 and CHK-NOGO02 consists of even-aged second-growth forest that has been recently selectively cut, which down-grades the habitat value to low (Map 12). The adjacent modelled high value habitat located at RAM-NOGO09 consists of an approximately 70 year old densely stocked western hemlock and western redcedar dominated stand. The habitat was down-rated to moderate due to the absence of branches large enough to support a nest and the unlikelihood of Northern Goshawk presence due to the young stand age and method of harvesting. Abundant fine branches line the majority of the length of the tree trunks (Figure 6). At RAM-NOGO08, the habitat was down-rated from high to moderate due to small patch size and the level of exposure of larger branches due to slope (Table 3).

Figure 6. Moderate-low suitability 70 year old even-aged stand observed at RAM-NOGO09 on July 22, 2015.



Lower Ramona Creek and Upper Ramona Creek

The forest stands surrounding the Lower Ramona Creek and Upper Ramona Creek components were selectively logged and then burnt, or burnt and not logged 80-100 years ago (Map 13). Recently, there has been a second wave of logging. The resulting forest is a patchwork of mixed age stands and recent shrub-dominated cutblocks. The mixed stands modelled as high nesting habitat value, consist of larger fire-scarred veteran trees and younger densely stocked trees. The understory is relatively open, and most of the larger branches that could potentially support a nest are situated above the main canopy, exposing them to high predation risk.

The modelled high suitability habitat that occurs near the proposed Lower Ramona Creek component powerhouse was down-rated to moderate value (RAM-NOGO02) (Figure 7). The forest is approximately 80 years old with an approximate tree height of 50 m. Douglas-fir and western redcedar dominate the stand, and fire scars exist on remnant approximately 100 year old trees. No suitable nesting branches were observed; however, they may be more prevalent downslope (Figure 8). The area below RAM-NOGO02 is on private land and was only viewed from the air and on orthophotos. Because this area of modelled high suitability will not be impacted by the construction of the powerhouse it was not more thoroughly assessed although it appears to be of moderate – high suitability. The adjacent patch of modelled high value habitat located at RAM-NOGO01

appeared to be of good quality from the air but the patch size was too small to support high value habitat, and thus was down-rated to moderate.

Figure 7. Moderate suitability habitat at RAM-NOGO02, the proposed Lower Ramona Creek component powerhouse location on July 21st, 2015.



Figure 8. Moderate and high suitability habitat located downslope of the proposed Lower Ramona Creek component powerhouse on private land which will be unaffected by construction, on July 21, 2015.



Modelled high suitability habitat in the vicinity of the R1 intake was down-rated to moderate. The stand age is approximately 50 years old with some large veteran trees with branches large enough to support a nest. However, these branches occur above the main canopy and would not provide the necessary protective cover for a nest. Logging and subsequent fire were the prevalent last large-scale land disturbance (RAM-NOGO03) (Figure 9). Habitat in the vicinity of the proposed Upper Ramona Creek component penstock and access road was similar to that near the R1 intake except for the main canopy appeared to be approximately 80 years old (RAM-NOGO04 and RAM-NOGO10) (Figure 10 and Figure 11). The canopy has a few gaps with a thick understory, and also densely stocked areas where small branches extend down the trees into the upper third of the canopy. Similar to R1, the large diameter branches that could support a nest are located above the main canopy offering potential nests little protection from predators.

Figure 9. Moderate suitability habitat at RAM-NOGO03 on July 31, 2015.



Figure 10. Canopy of moderate suitability habitat including one veteran tree located at RAM-NOGO04 on July 22, 2015.

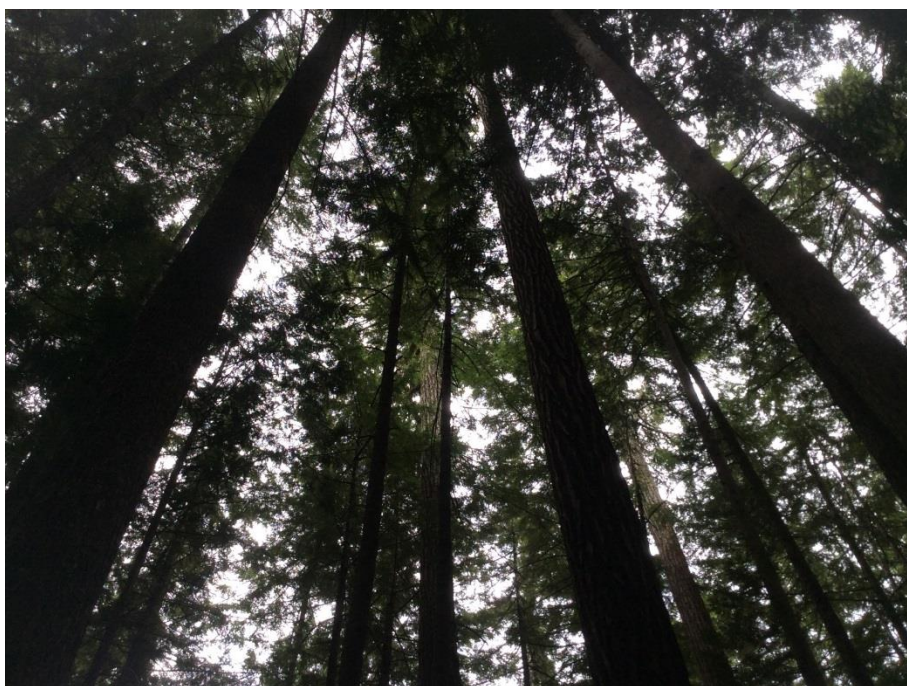


Figure 11. Aerial view of moderate suitability habitat observed at RAM-NOGO04 on July 21, 2015.



The area where the road to the Upper and Lower Ramona Creek Components intersects modelled high value habitat is composed of approximately 80 year old Douglas-fir dominated forest with a slope of approximately 30% (RAM-NOGO06 and RAM-NOGO07). RAM-NOGO05 is too small to support high value habitat and was down-rated to moderate (Table 3).

Interconnection

Consistent with the model, no high suitability Northern Goshawk nesting habitat was observed during the helicopter survey of the transmission line alignment from Ruby Lake to Skookumchuck Narrows, therefore no field verification took place.

Table 3. Summary of field verified Northern Goshawk nesting habitat suitability – Part 1 of 4.

Location	Site	Survey Type	Nesting Habitat Suitability Rank		Observation Platform	Comments
			Model	Field Verified		
Chickwat	CHK-NOGO03	Habitat Assessment	High	Low	Ground/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory.
	CHK-NOGO04	Habitat Assessment	High	Low	Ground/Heli/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory.
	CHK-NOGO05	Habitat Assessment	High	Moderate	Heli/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO06	Habitat Assessment	High	Low	Ground/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory.
	CHK-NOGO07	Habitat Assessment	High	Low	Ground/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory.
	CHK-NOGO08	Habitat Assessment	High	Low	Ground/Heli/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory.
	CHK-NOGO09	Call Playback and Habitat Assessment	High	Moderate	Ground/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO10	Call Playback and Habitat Assessment	High	Low	Ground/Orthophoto	Sitka spruce and red alder dominated mid-high bench floodplain forest with a dense understory downslope of the road. Upslope of the road the habitat approaches moderate habitat rating as the forest transitions to approximately 75 year old western hemlock dominated stand.
	CHK-NOGO11	Habitat Assessment	High	Moderate	Ground/Heli/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO12	Call Playback and Habitat Assessment	High	Moderate	Ground/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO13	Call Playback and Habitat Assessment	High	Moderate	Ground/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO14	Habitat Assessment	High	Moderate	Heli/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.

Table 3. Summary of field verified Northern Goshawk nesting habitat suitability – Part 2 of 4.

Location	Site	Survey Type	Nesting Habitat Suitability Rank		Observation Platform	Comments
			Model	Field Verified		
	CHK-NOGO15	Habitat Assessment	High	Moderate	Heli/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO16	Habitat Assessment	High	Moderate	Heli/Orthophoto	Second growth approximately 75 year old western hemlock, western redcedar forest.
	CHK-NOGO17	Call Playback and Habitat Assessment	High	Moderate	Ground/Heli/Orthophoto	Small patch of older trees occupies a narrow band of a steep slope. Below is a high bench Sitka spruce dominated floodplain forest. The habitat value is moderate because of the small patch size, thick underbrush, and few suitable nest trees. Too small to be goshawk habitat but provides a few larger branched trees.
	CHK-NOGO18	Habitat Assessment	High	Moderate	Heli/Orthophoto	Small patch of older trees occupies a narrow band of a steep slope. Below is a high bench Sitka spruce dominated floodplain forest. The habitat value is moderate because of the small patch size, thick underbrush, and few suitable nest trees. Too small to be goshawk habitat but provides a few larger branched trees.
	CHK-NOGO19	Habitat Assessment	High	Moderate	Heli/Orthophoto	Some larger trees but polygon too small, on steep slope.
	CHK-NOGO20	Habitat Assessment	High	Moderate	Heli/Orthophoto	Some larger trees but polygon too small, on steep slope.
Ancillary Components	CHK-NOGO01	Habitat Assessment	High	Low	Ground/Heli/Orthophoto	Recent selective cut of homogeneous western hemlock stand.
	CHK-NOGO02	Habitat Assessment	High	Low	Heli/Orthophoto	Recent selective cut of homogeneous western hemlock stand.
	RAM-NOGO08	Habitat Assessment	High	Moderate	Heli/Orthophoto	Small patch of older trees occupying a steep slope. Some large branches likely exist however they are exposed due to the slope. Much of the surrounding forest has been recently logged.
	RAM-NOGO09	Call Playback and Habitat Assessment	High	Moderate	Ground/Heli/Orthophoto	The surrounding forest is approximately 70 years old and is densely stocked with western hemlock and western redcedar with abundant fine branches.

Table 3. Summary of field verified Northern Goshawk nesting habitat suitability – Part 3 of 4.

Location	Site	Survey Type	Nesting Habitat Suitability		Observation Platform	Comments
			Model	Field Verified		
Ramona	RAM-NOGO01	Habitat Assessment	High	Moderate	Heli/Ground/Orthophoto	Habitat good but too small a patch size.
	RAM-NOGO02	Call Playback and Habitat Assessment	High	Moderate	Heli/Ground/Orthophoto	Habitat likely improves downslope of call-playback site to moderate-high on private land, and is low upslope of powerhouse footprint. The forest is approximately 80 years old, with an approximate tree height of 50 m. Douglas-fir and western redcedar dominate the stand. Fire scars exist on remnant trees. No good nesting branches are visible, however there may be some downslope, outside of the Project footprint that could support a goshawk nest. Habitat above powerhouse footprint is of low value.
	RAM-NOGO03	Call Playback and Habitat Assessment	High	Moderate	Heli/Ground/Orthophoto	Approximately 50 year old forest with large approximately 120-150 year old veteran trees forming a component of the stand, however the large branches are above the canopy. The last large scale stand disturbance appears to have been fire. This is a geologically active slope as evidenced by large and abundant colluvium.
	RAM-NOGO04	Call Playback and Habitat Assessment	High	Moderate	Heli/Ground/Orthophoto	Approximately 80 year old forest with large Douglas-fir and western redcedar veterans over 150 years old (maybe over 250 years). The canopy has some gaps with thick understory, and densely stocked areas where small branches extend down the trees into the upper third of the canopy. A few potential nest branches exist. Most branches are small except for the large branches on veteran trees which typically exist above the canopy. Fire scars and stumps give evidence of historic fire and logging.

Table 3. Summary of field verified Northern Goshawk nesting habitat suitability – Part 4 of 4.

Location	Site	Survey Type	Nesting Habitat Suitability Rank		Observation Platform	Comments
			Model	Field Verified		
Ramona continued	RAM-NOGO05	Habitat Assessment	High	Moderate	Heli/Orthophoto	Some larger trees but area of high value trees too small.
	RAM-NOGO06	Habitat Assessment	High	Moderate	Heli/Orthophoto	Low side of moderate, only a few large trees.
	RAM-NOGO07	Call Playback and Habitat Assessment	High	Low	Ground/Heli/Orthophoto	Low-moderate for nesting and foraging habitat. The branches are too small to support a nest, the canopy is moderately open, and the ground has a slope of approximately 30%.
	RAM-NOGO10	Habitat Assessment	High	Moderate	Heli/Orthophoto	Approximately 80 year old forest with large Douglas-fir and western redcedar veterans over 150 years old (maybe over 250 years). The canopy has some gaps with thick understory, and densely stocked areas where small branches extend down the trees into the upper third of the canopy. A few potential nest branches exist. Most branches are small except for the large branches on veteran trees which typically exist above the canopy. Fire scars and stumps give evidence of historic fire and logging.

4.2.1.Future Harvesting

The final Northern Goshawk nesting habitat suitability ratings for the Project area combine the current field verified ratings with the assumption that areas with active Forestry Licences are harvested. This final set of field verified habitat suitability ratings indicates that there is no high value Northern Goshawk nesting habitat that intersects the Chickwat Creek component (Map 14), ancillary components (Map 15), Lower Ramona Creek and Upper Ramona Creek components (Map 16), or the transmission line component (Map 10) of the Narrows Inlet Hydro Project.

4.3. Call-Playback Surveys

No Northern Goshawks were detected at any of the ten call-playback sites (Table 4, Map 11, Map 12, and Map 13). Although survey sites targeted locations with high suitability habitat that intersected Project infrastructure, habitat was evaluated in the field as low to moderate quality at all sites. No songbirds recorded at survey sites appeared to be bothered by the Northern Goshawk call broadcasts as would be expected if goshawks were frequently present. Furthermore, no signs of goshawks were observed in the Project area while walking through the forest, driving, or flying during habitat verification surveys. The absence of Northern Goshawk sightings or sign in the Project area is supported by Ecofish's wildlife observation records, the EAC Application (Robertson 2012), previous Northern Goshawk reports (Graham/Wall 2015) and provincial species occurrence data (CDC 2015).

Table 4. Location of call-playback surveys conducted on July 21 and 22, 2015 and Northern Goshawk response results.

Location	Survey Site	UTM Coordinates (Zone 10U)		Response
		Easting	Northing	
Chickwat	CHK-NOGO09	448718	5519074	No
	CHK-NOGO10	448983	5519341	No
	CHK-NOGO12	449188	5520109	No
	CHK-NOGO13	449146	5520404	No
	CHK-NOGO17	449849	5519824	No
Ancillary Components	RAM-NOGO09	448532	5517074	No
Ramona	RAM-NOGO02	448543	5511950	No
	RAM-NOGO03	450084	5511863	No
	RAM-NOGO04	450472	5513220	No
	RAM-NOGO07	448611	5513831	No

5. SUMMARY

Northern Goshawk nesting habitat suitability was modelled for the Narrows Inlet Hydro Project area using the most recent version of the provincial nesting habitat suitability model (Mahon *et al.* 2012). The updated model was completed at a finer scale and incorporated current forest cover data (GeoBC 2015a) to identify potentially high suitability goshawk nesting habitat. The model was applied to the Project area with and without integrating future harvesting areas with approved active Forest Licences (GeoBC 2015b).

Field verification of modelled high suitability Northern Goshawk habitat in the vicinity of proposed Project infrastructure by qualified professionals resulted in down-rating all verified areas to moderate or low nesting suitability. Forest stands in the Project area are typically too young to have the structure required by nesting Northern Goshawks and remnant patches of older forest are too small and discrete to support a Northern Goshawk territory, which includes multiple nest locations. Key observations that led to down-rating habitat suitability were the lack of large branches that could support a nest or thick riparian understories. The few large veteran trees that exist have large branches located above the main canopy where they are exposed to potential predators. Historic large-scale logging is the primary cause of the observed degraded habitat condition, paired with historic fires in the cases of the Lower Ramona Creek and Upper Ramona Creek components.

Northern Goshawk nest surveys were conducted simultaneous with habitat verification surveys. As no high suitability habitat was observed, call-playback surveys were conducted in moderate and low suitability habitats in the vicinity of proposed Project infrastructure. No Northern Goshawks responded to the call broadcasts and no sightings or signs were detected while walking, driving or flying around the Project area, which corroborates other reports that indicate no records of Northern Goshawks in the Project area (NIHP 2012, Graham/Wall 2015, CDC 2015, GeoBC 2015c).

Currently, no high suitability Northern Goshawk habitat is located in the vicinity of the proposed Narrows Inlet Hydro Project infrastructure, nor is there any indication that goshawks are present in the Project area. If significant changes are made to the location of any infrastructure, or if signs or sightings of Northern Goshawks occur in the future, the potential effects to the species should be re-assessed by a qualified professional.

The habitat suitability modelling, field verification and call playback surveys satisfy the commitments set out in Condition #1 a) and b) of Schedule B (Table of Conditions) of the Project's EAC. Condition #1c is not currently required, as no nests or nesting evidence were detected during field verification. However, if future nests or nesting evidence is detected during construction then appropriate protection will be afforded, as part of construction environmental management plan. The currently proposed Project footprint will not clear high suitability Northern Goshawk habitat based on field verification results and approved future forest harvesting. Thus, the results of this



study indicate no action is required for Condition #1d. If large changes in Project alignment are required that would result in the clearing of high suitability habitat then the EAC holder (i.e. Narrows Inlet Hydro Holding Corporation) would be required to engage in discussions with FLNR regarding habitat replacement.

If you have questions or require clarification on any information presented in this memorandum, please do not hesitate to contact the undersigned.

Yours truly,

Ecofish Research Ltd.

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Disclaimer:

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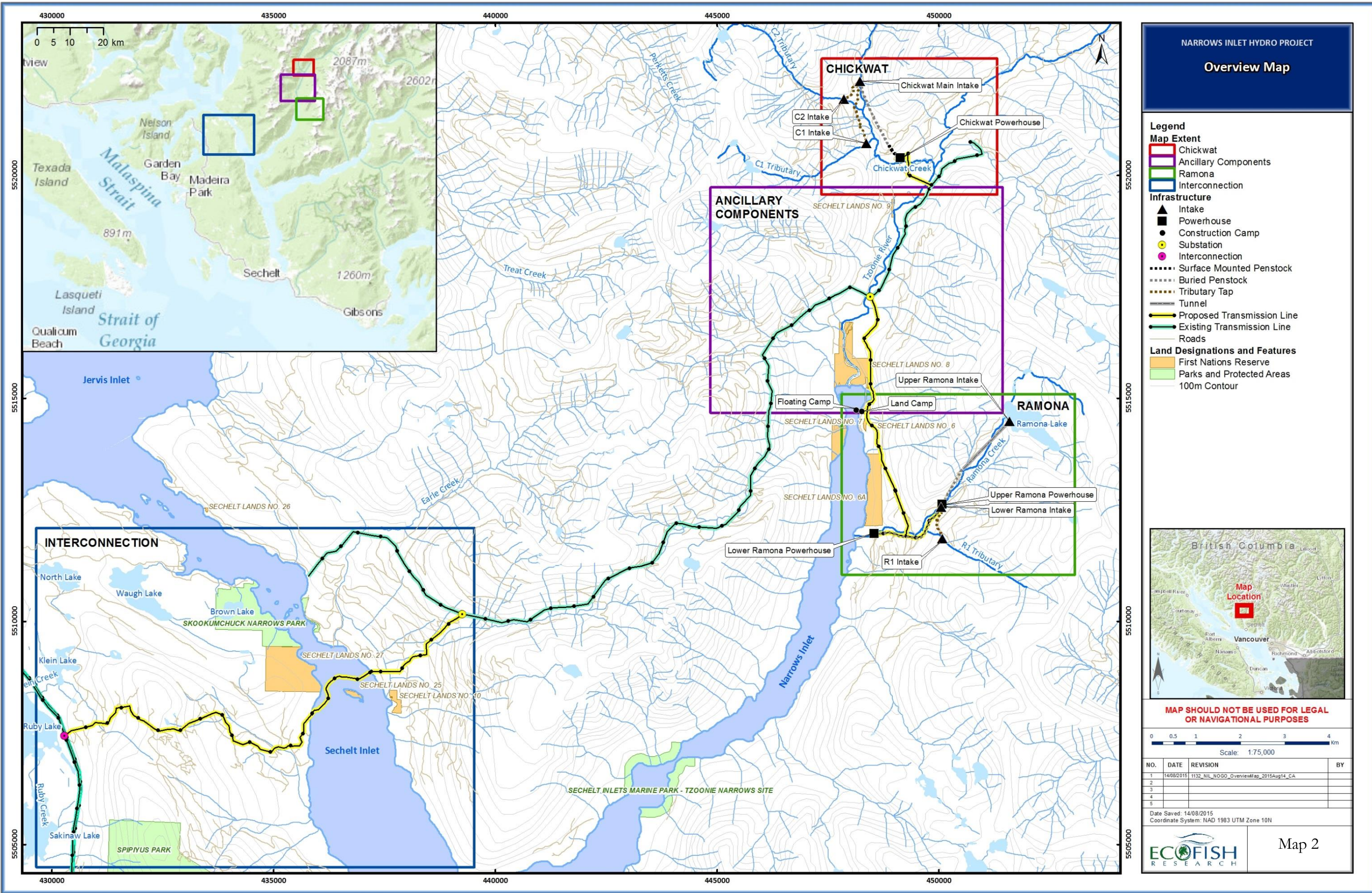
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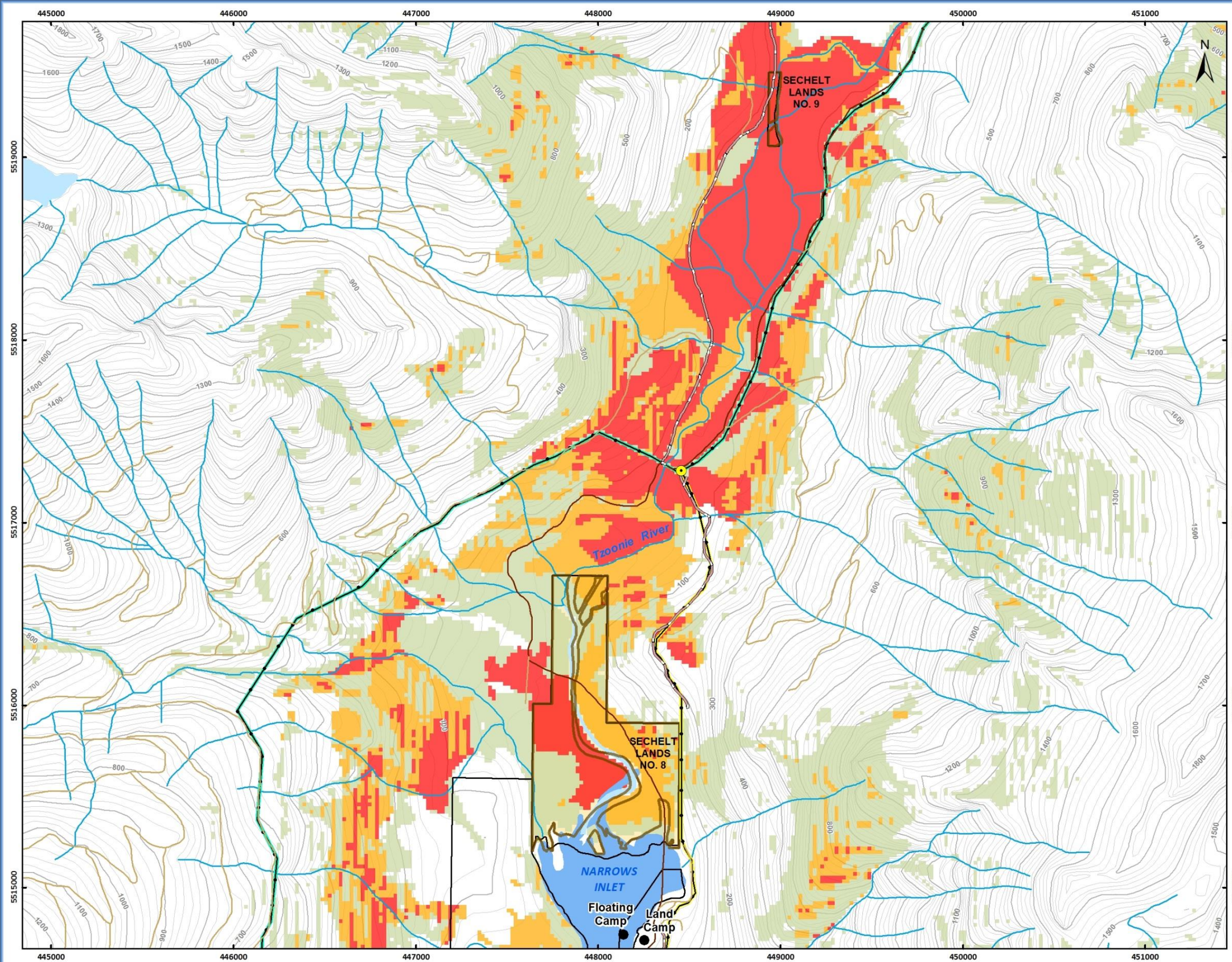


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NARROWS INLET HYDRO PROJECT
**Ancillary Components - Northern
Goshawk Modelled Suitable
Nesting Habitat**

- Legend**
NOGO Habitat Suitability
Modelled
High (0.75 - 1.0)
Moderate (0.5 - 0.75)
Low (0.25 - 0.5)
Nil (0 - 0.25)
- Infrastructure**
Construction Camp
Substation
Existing Transmission Line
Proposed Transmission Line
- Road Status, Status During Construction**
Active, Active
Deactivated, Deactivated
Deactivated, Active
- Land Designations and Features**
First Nations Reserve
Tantalis - Surveyed Parcels
Index Contour (100 m)
Intermediate Contour (20 m)



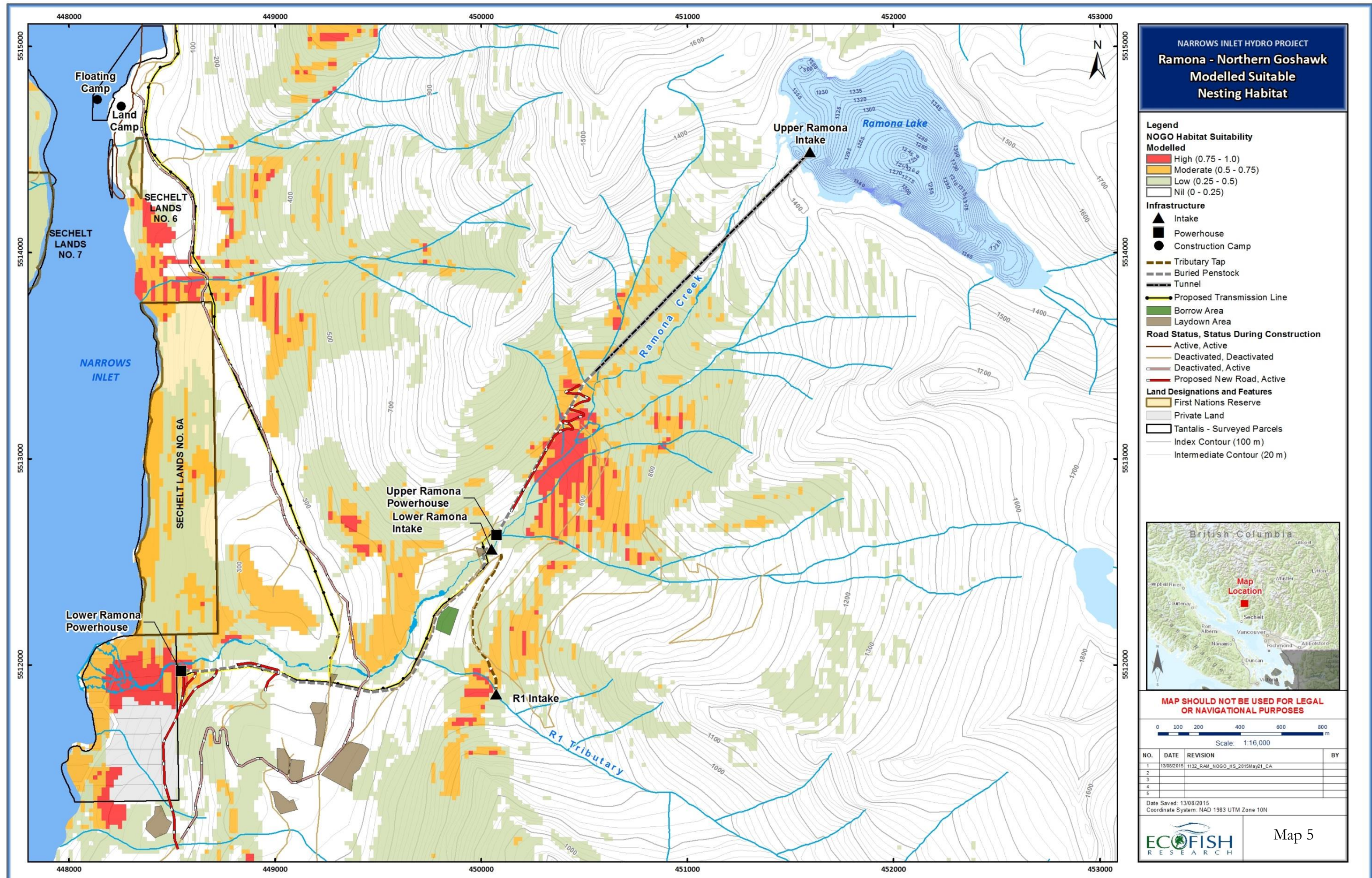
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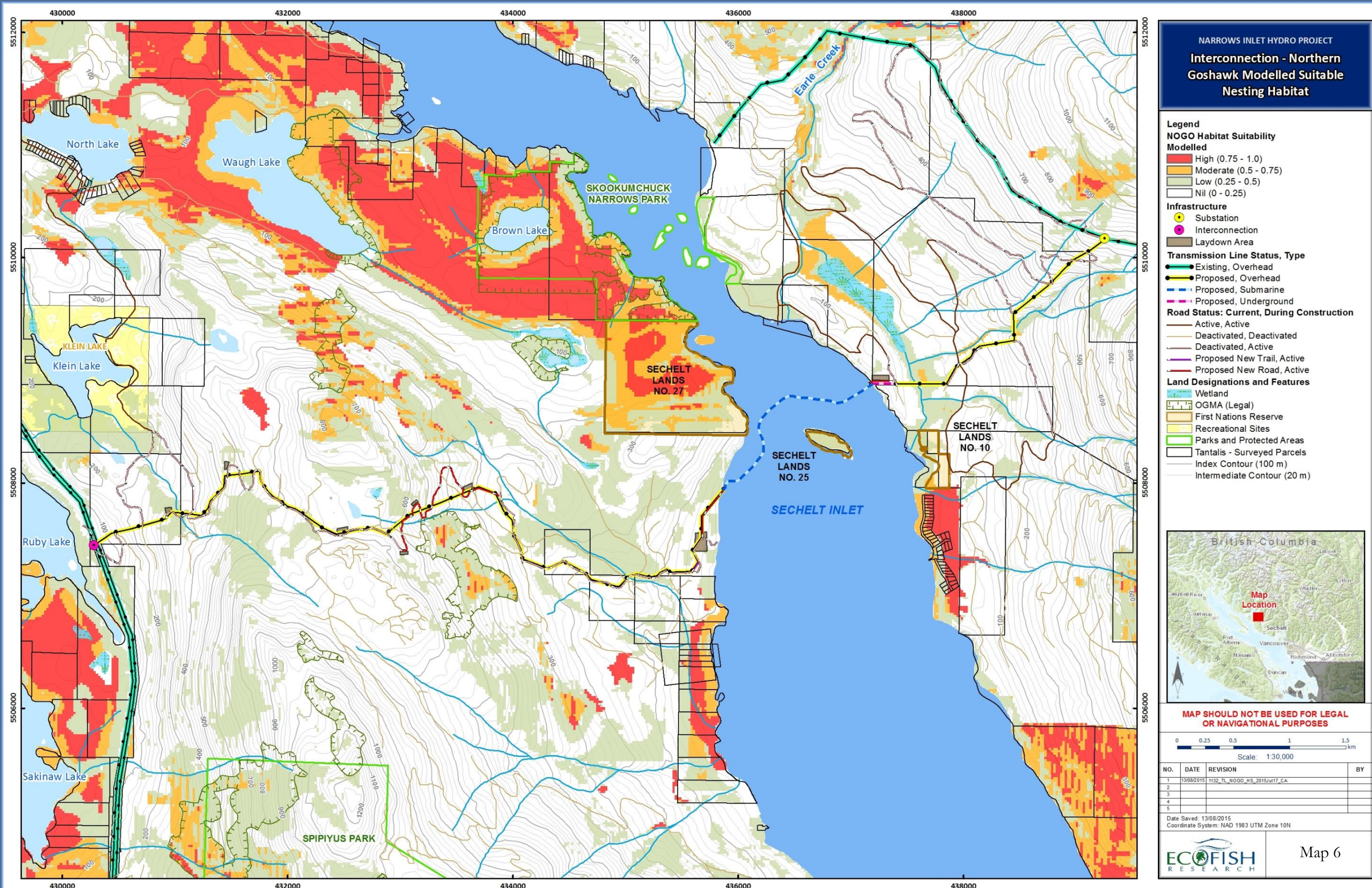


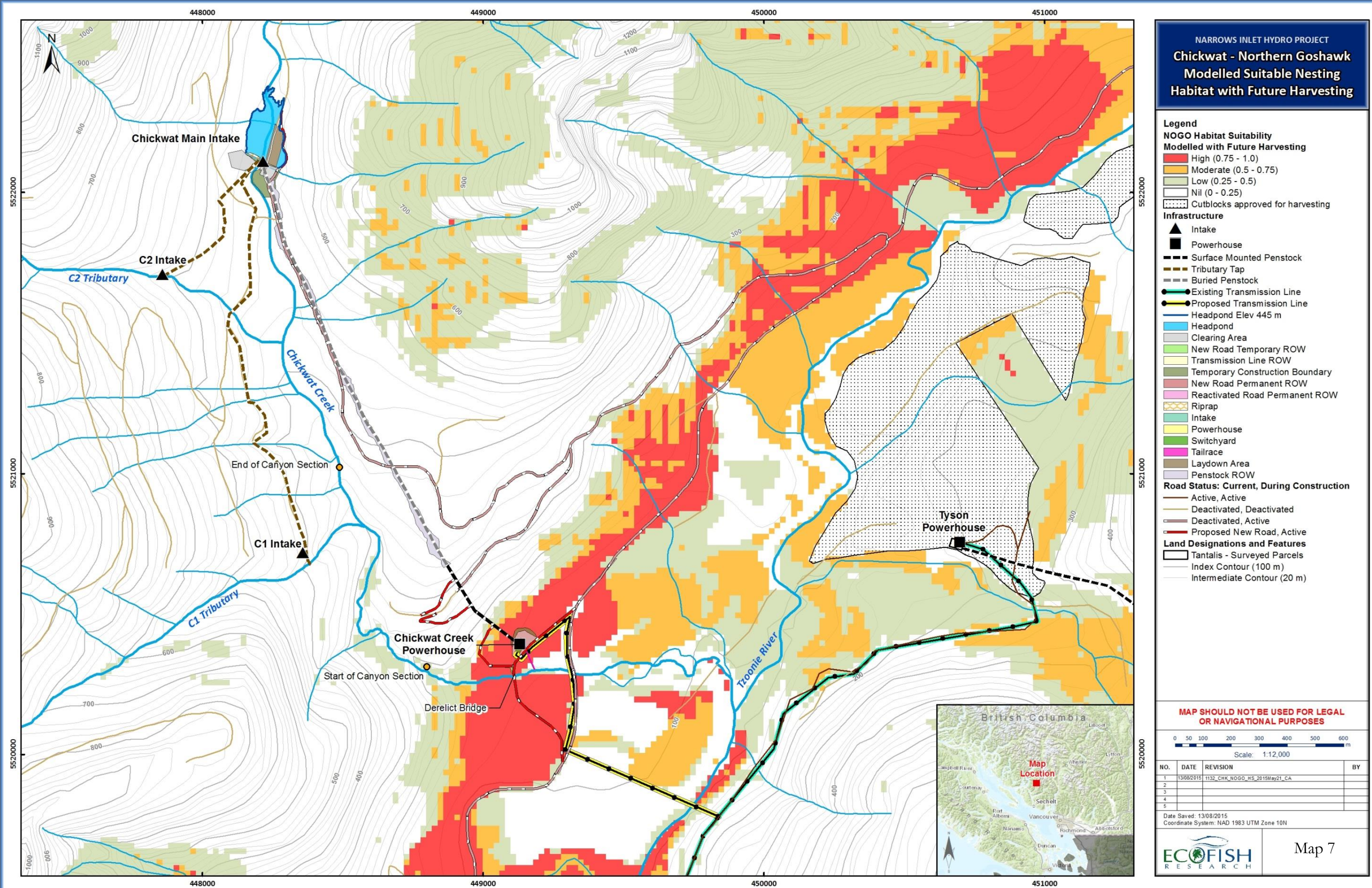
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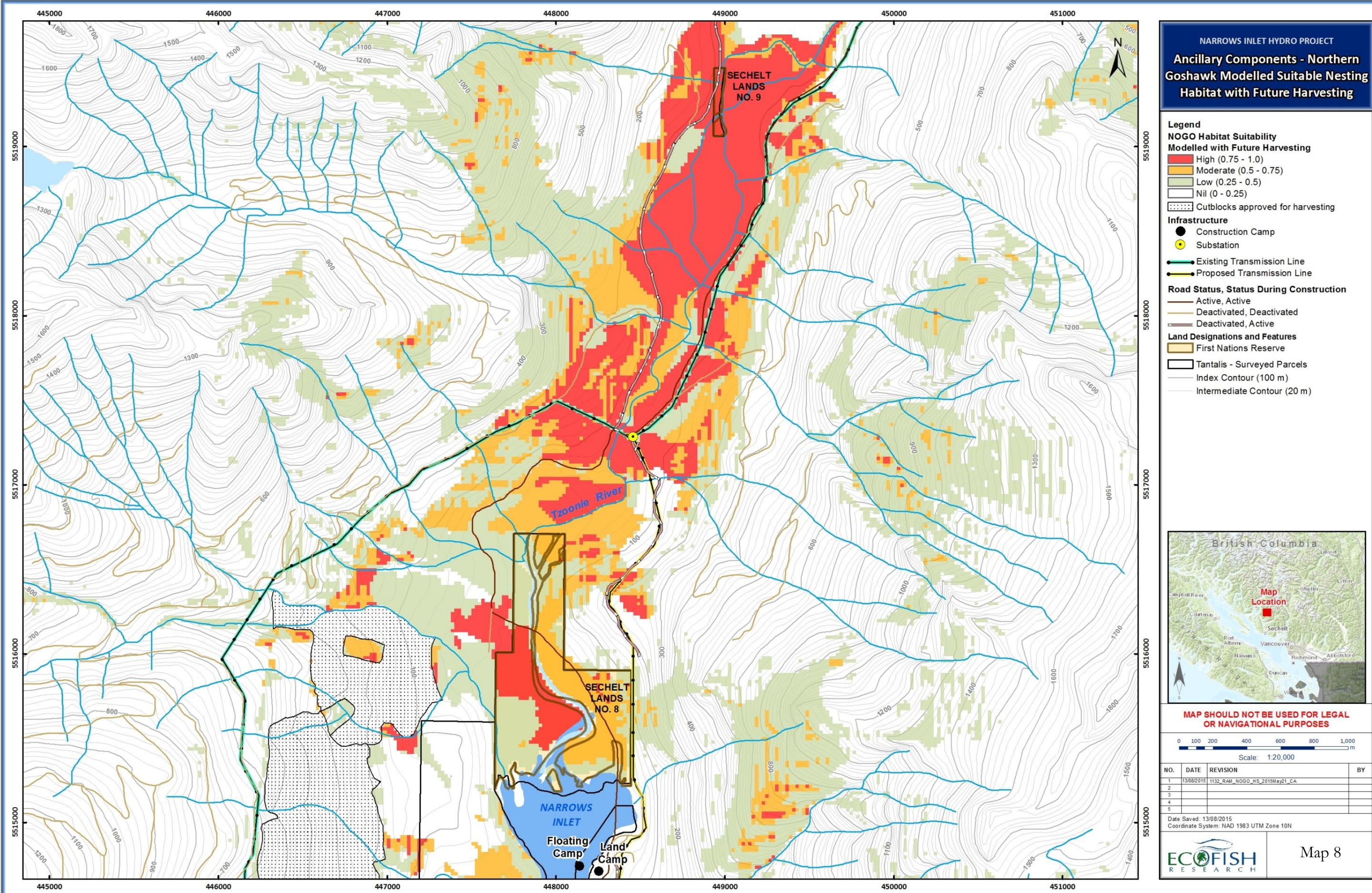
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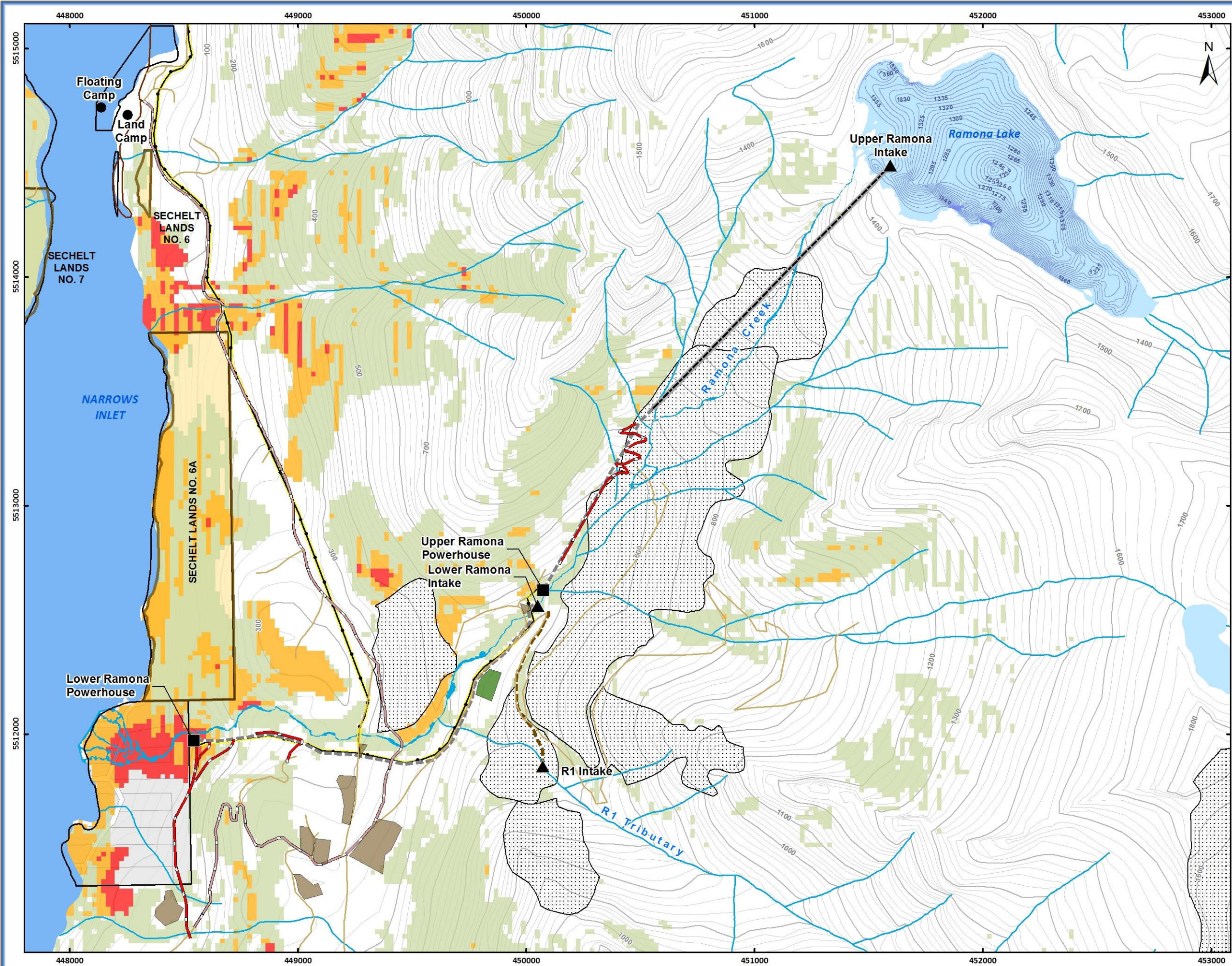
Map 4











NARROWS INLET HYDRO PROJECT
**Ramona - Northern Goshawk
Modelled Suitable Nesting
Habitat with Future Harvesting**

- Legend**
- NOGO Habitat Suitability**
Modelled with Future Harvesting
- High (0.75 - 1.0)
 - Moderate (0.5 - 0.75)
 - Low (0.25 - 0.5)
 - Nil (0 - 0.25)
 - Cutblocks approved for harvesting
- Infrastructure**
- Intake
 - Powerhouse
 - Construction Camp
 - Tributary Tap
 - Buried Penstock
 - Tunnel
 - Proposed Transmission Line
 - Borrow Area
 - Laydown Area
- Road Status, Status During Construction**
- Active, Active
 - Deactivated, Deactivated
 - Deactivated, Active
 - Proposed New Road, Active
- Land Designations and Features**
- First Nations Reserve
 - Private Land
 - Tantalis - Surveyed Parcels
 - Index Contour (100 m)
 - Intermediate Contour (20 m)



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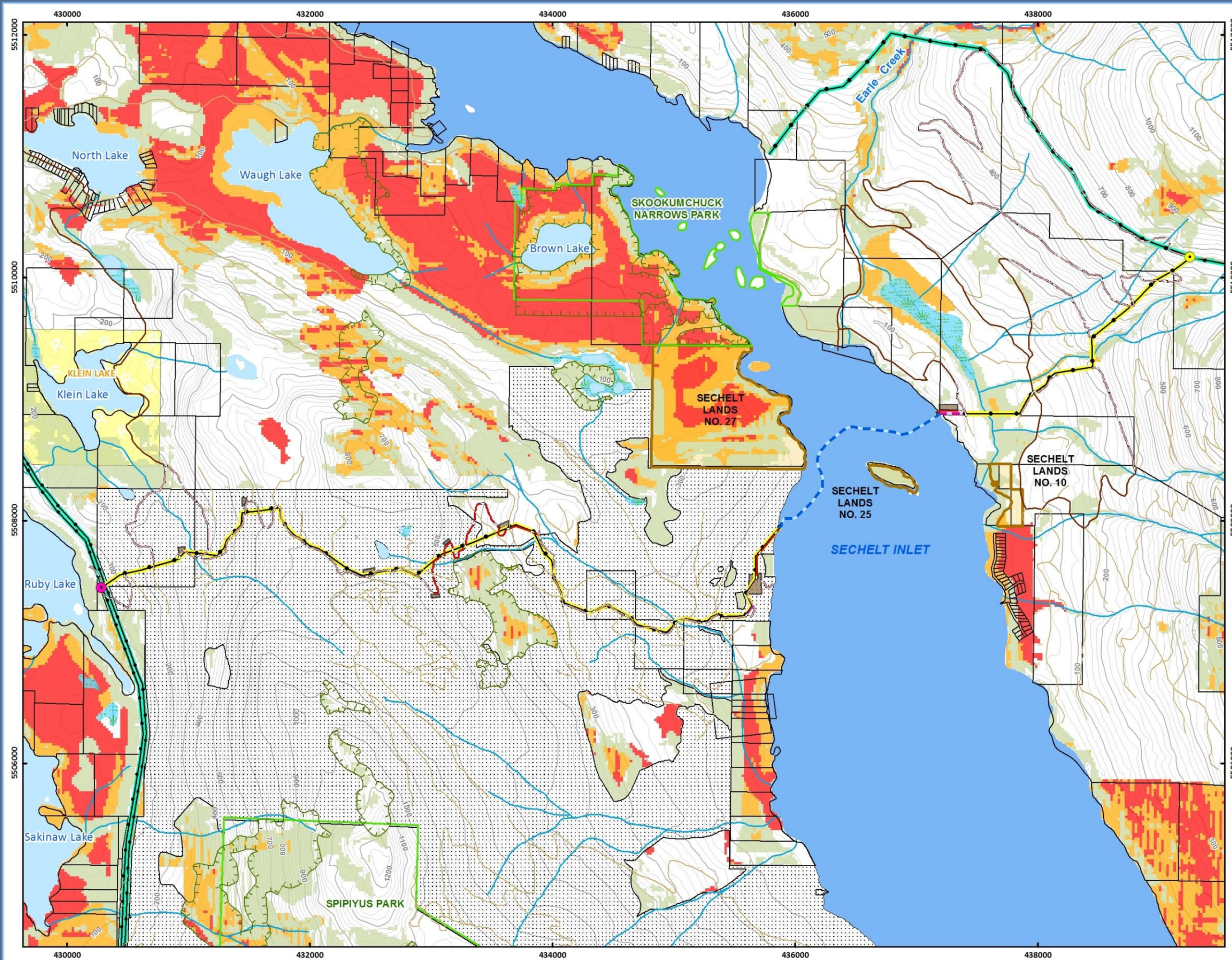
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Map 9



NARROWS INLET HYDRO PROJECT
Interconnection - Northern Goshawk
Modelled Suitable Nesting
Habitat with Future Harvesting

- Legend**
- NOGO Habitat Suitability**
Modelled with Future Harvesting
- High (0.75 - 1.0)
 - Moderate (0.5 - 0.75)
 - Low (0.25 - 0.5)
 - Nil (0 - 0.25)
 - Cutblocks approved for harvesting
- Infrastructure**
- Substation
 - Interconnection
 - Laydown Area
- Transmission Line Status, Type**
- Existing, Overhead
 - Proposed, Overhead
 - Proposed, Submarine
 - Proposed, Underground
- Road Status: Current, During Construction**
- Active, Active
 - Deactivated, Deactivated
 - Deactivated, Active
 - Proposed New Trail, Active
 - Proposed New Road, Active
- Land Designations and Features**
- Wetland
 - OGMA (Legal)
 - First Nations Reserve
 - Recreational Sites
 - Parks and Protected Areas
 - Tantalis - Surveyed Parcels
 - Index Contour (100 m)
 - Intermediate Contour (20 m)



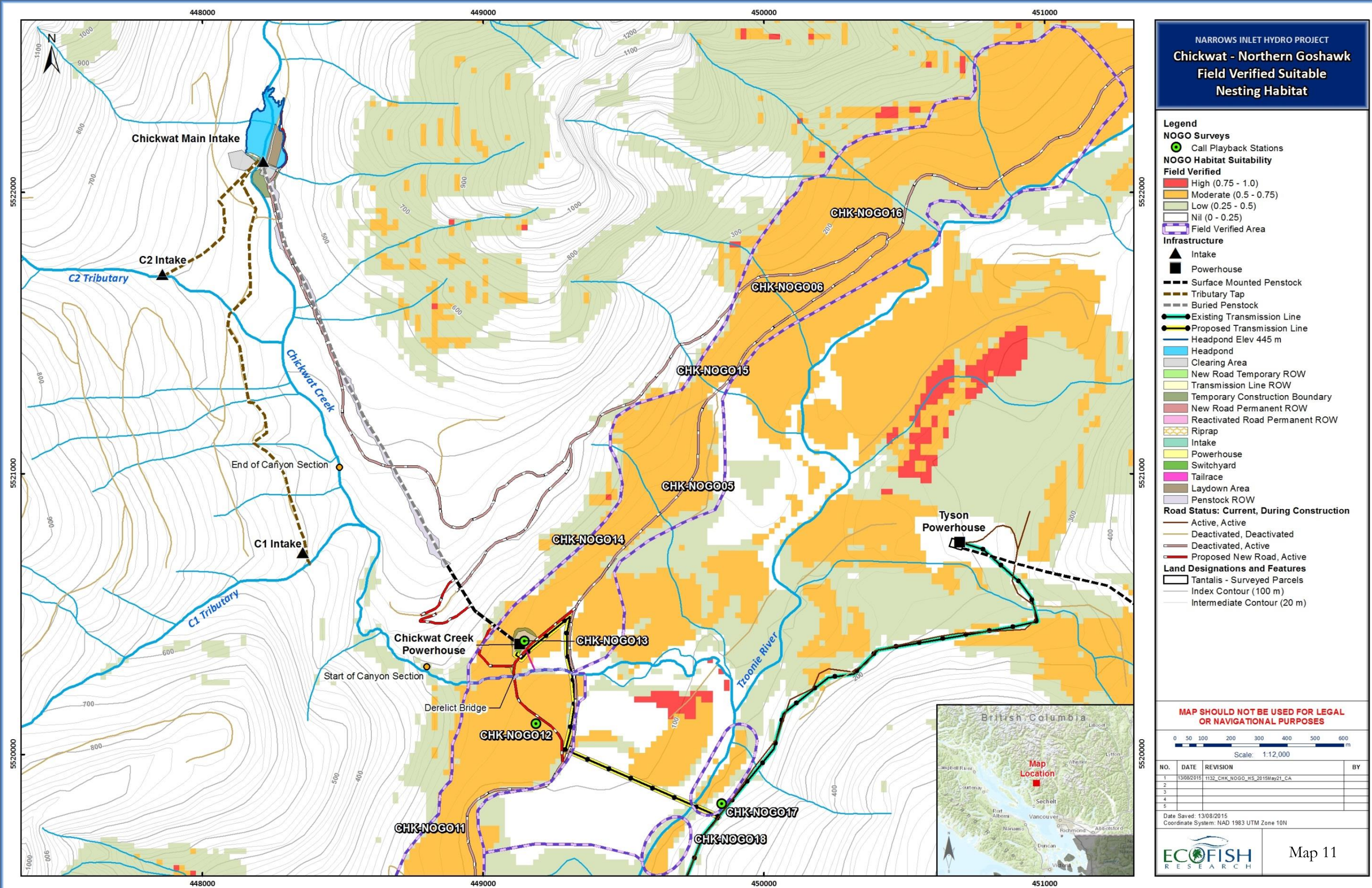
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Map 10



NARROWS INLET HYDRO PROJECT
Chickwat - Northern Goshawk
Field Verified Suitable
Nesting Habitat

- Legend**
- NOGO Surveys**
- Call Playback Stations
- NOGO Habitat Suitability**
- Field Verified**
- High (0.75 - 1.0)
 - Moderate (0.5 - 0.75)
 - Low (0.25 - 0.5)
 - Nil (0 - 0.25)
 - Field Verified Area
- Infrastructure**
- Intake
 - Powerhouse
 - Surface Mounted Penstock
 - Tributary Tap
 - Buried Penstock
 - Existing Transmission Line
 - Proposed Transmission Line
 - Headpond Elev 445 m
 - Headpond
 - Clearing Area
 - New Road Temporary ROW
 - Transmission Line ROW
 - Temporary Construction Boundary
 - New Road Permanent ROW
 - Reactivated Road Permanent ROW
 - Riprap
 - Intake
 - Powerhouse
 - Switchyard
 - Tailrace
 - Laydown Area
 - Penstock ROW
- Road Status: Current, During Construction**
- Active, Active
 - Deactivated, Deactivated
 - Deactivated, Active
 - Proposed New Road, Active
- Land Designations and Features**
- Tantalis - Surveyed Parcels
 - Index Contour (100 m)
 - Intermediate Contour (20 m)

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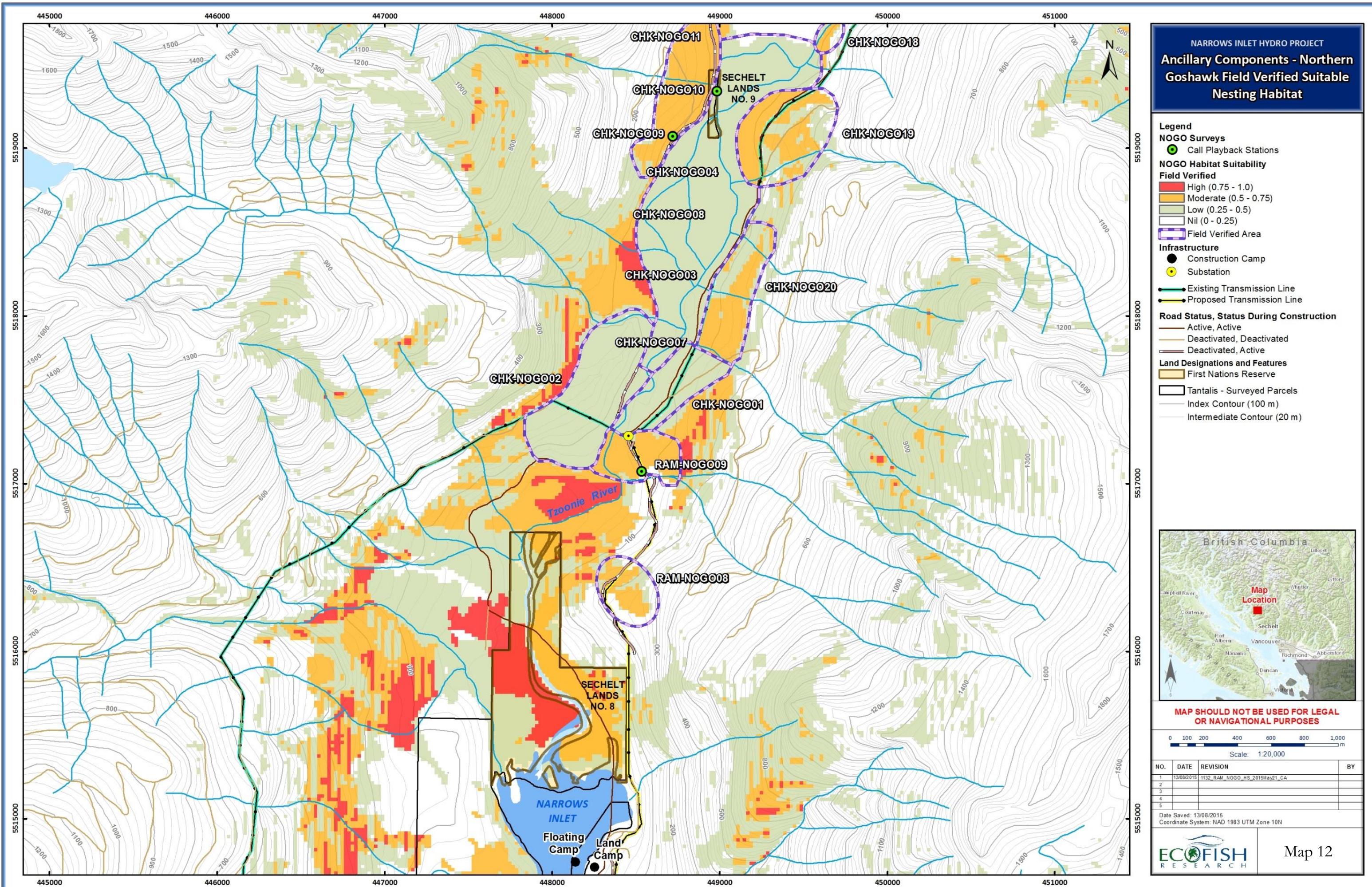
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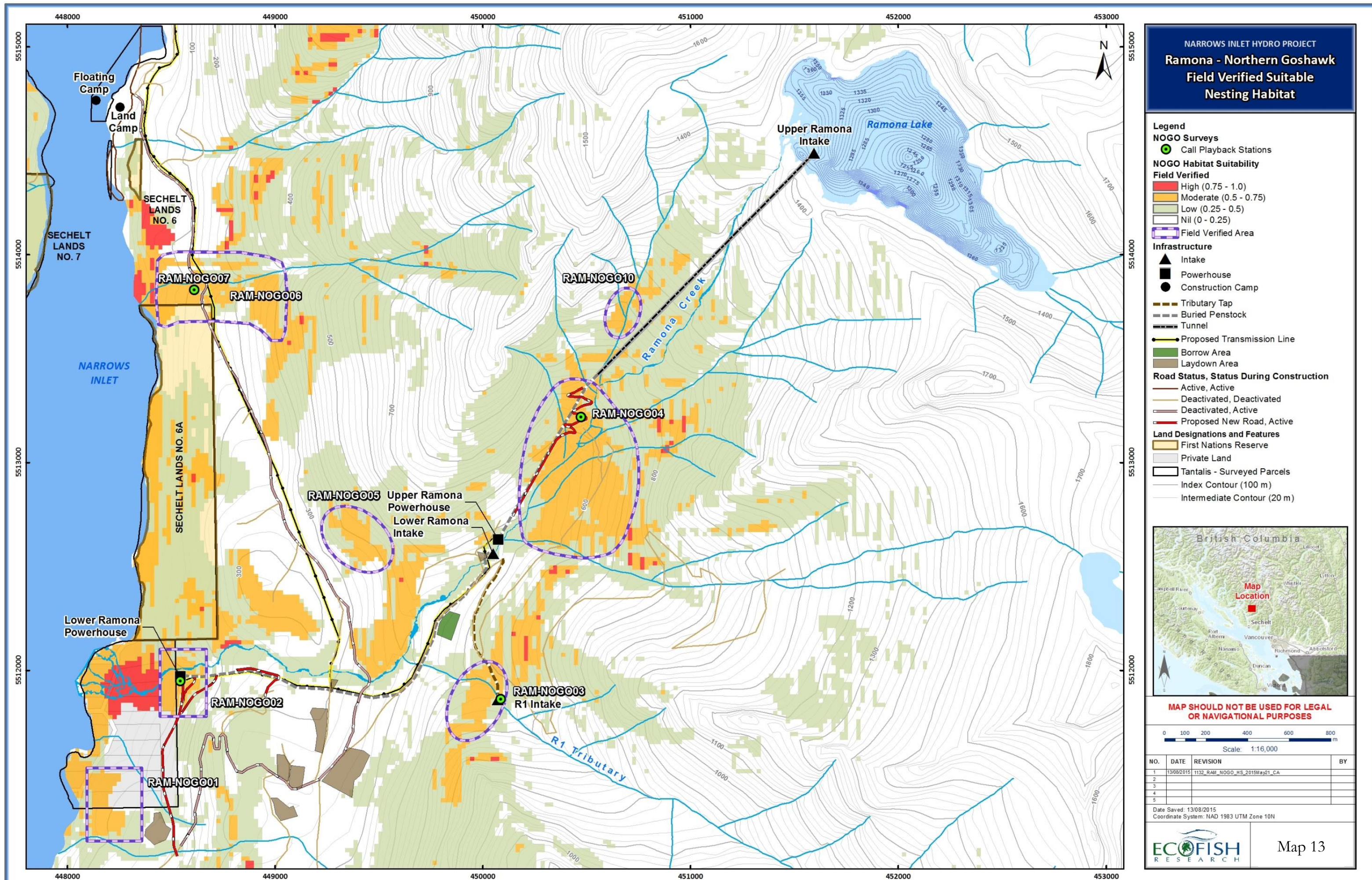
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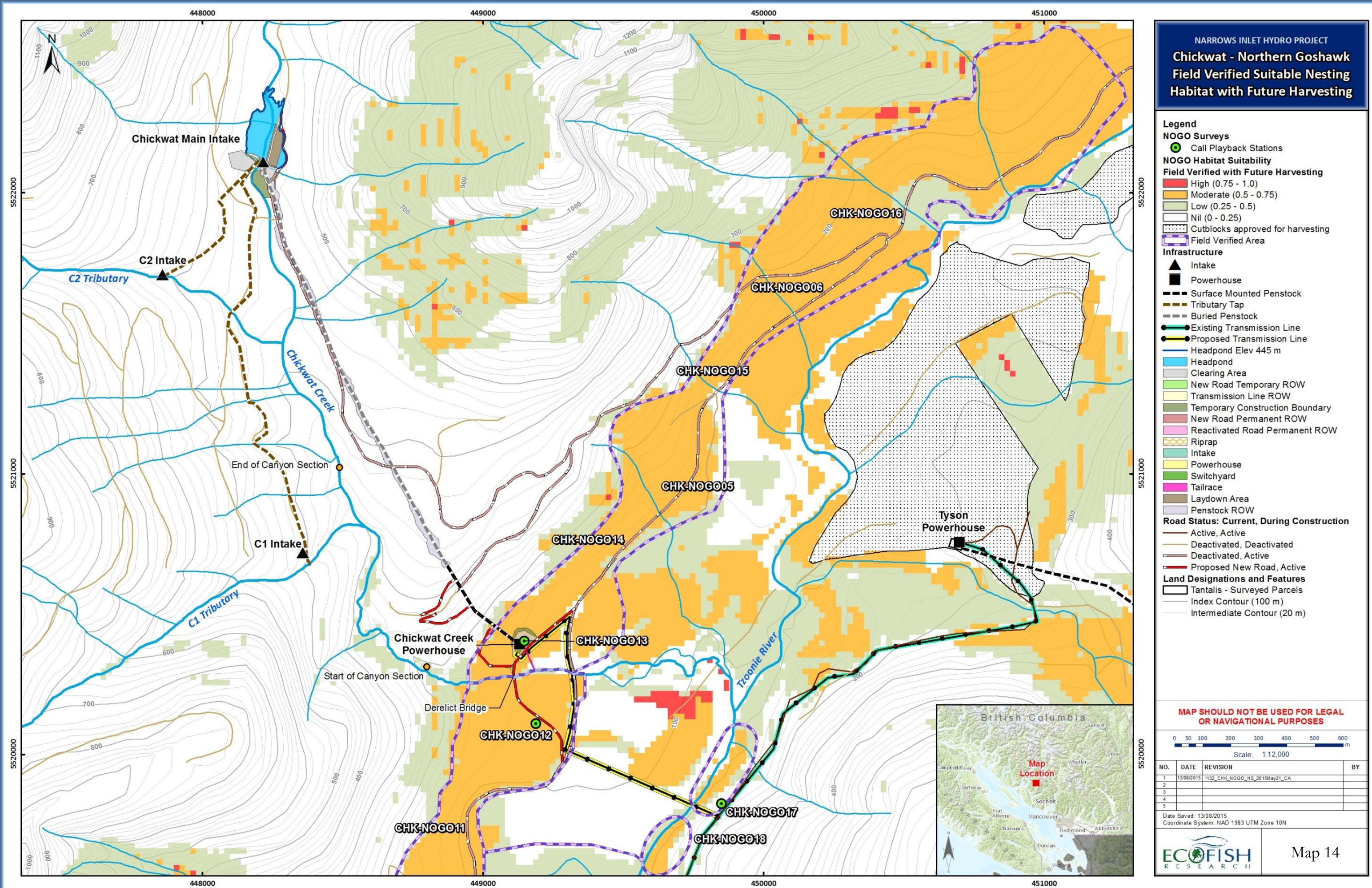
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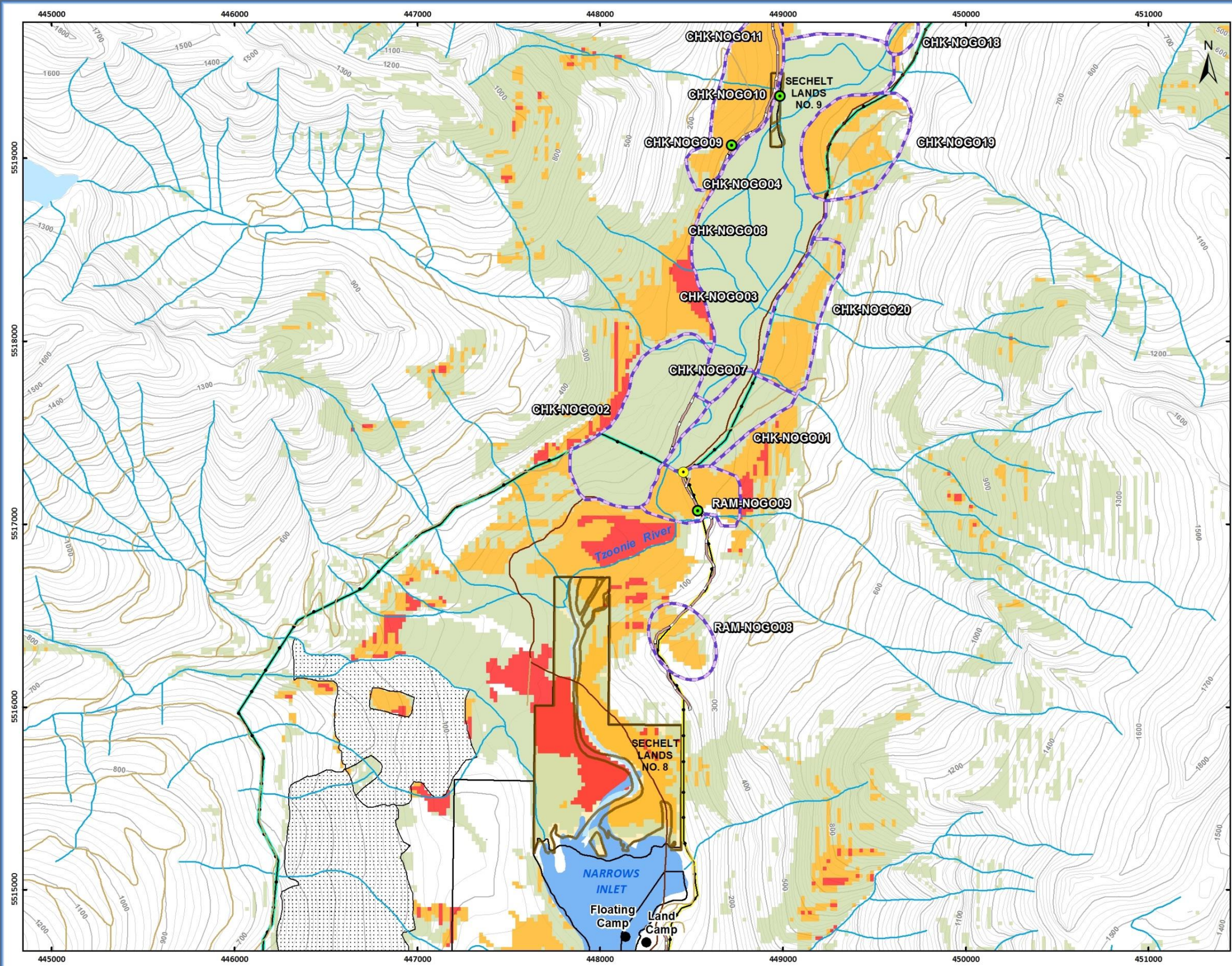
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Map 11









NARROWS INLET HYDRO PROJECT

**Ancillary Components - Northern
Goshawk Field Verified Suitable
Nesting Habitat with Future Harvesting**

- Legend**
- NOGO Surveys**
- Call Playback Stations
- NOGO Habitat Suitability**
- Field Verified with Future Harvesting**
- High (0.75 - 1.0)
 - Moderate (0.5 - 0.75)
 - Low (0.25 - 0.5)
 - Nil (0 - 0.25)
- Cutblocks approved for harvesting
 - Field Verified Area
- Infrastructure**
- Construction Camp
 - Substation
 - Existing Transmission Line
 - Proposed Transmission Line
- Road Status, Status During Construction**
- Active, Active
 - Deactivated, Deactivated
 - Deactivated, Active
- Land Designations and Features**
- First Nations Reserve
 - Tantalis - Surveyed Parcels
 - Index Contour (100 m)
 - Intermediate Contour (20 m)



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Map 15

