

Prepared in cooperation with Seattle City Light

Applying Intrinsic Potential Models to Evaluate Salmon (*Oncorhynchus* spp.) Introduction into Main-Stem and Tributary Habitats Upstream from the Skagit River Hydroelectric Project, Northern Washington



Open-File Report 2023–1077

Cover. View of Ross Lake, Nohokomeen Glacier, and the Cascade Mountain Range from Desolation Peak, North Cascades National Park. Photograph taken August 28, 2020, by Jeffrey J. Duda, U.S. Geological Survey

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Conversion Factors

International System of Units to U.S. customary units

Multiply	By	To obtain
Length		
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
Area		
square meter (m ²)	0.0002471	acre
square meter (m ²)	10.76	square foot (ft ²)
square kilometer (km ²)	0.3861	square mile (mi ²)

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1983 (NAVD 83).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Abbreviations

CnH	Cooney and Holzer
DEM	digital elevation model
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
IP	intrinsic potential
LP	licensing participants
rkm	river kilometer
PS-TRT	Puget Sound Technical Recovery Team
USGS	U.S. Geological Survey

Applying Intrinsic Potential Models to Evaluate Salmon (*Oncorhynchus* spp.) Introduction into Main-Stem and Tributary Habitats Upstream from the Skagit River Hydroelectric Project, Northern Washington

By Jeffrey J. Duda and Jill M. Hardiman

Abstract

We assessed habitat suitability for salmonids across selected tributaries upstream from three hydroelectric dams on the upper Skagit River in Whatcom County, northern Washington. We used NetMap, a commercial toolset within the ArcMap geographic information system (GIS), to analyze stream attributes based upon a synthetic stream channel network derived from digital elevation models. The GIS-derived stream attributes—including gradient, bankfull width, valley width index, elevation, and stream flow—allowed us to examine the spatial distribution and relative quality of spawning and rearing habitat for salmonids based on existing intrinsic potential (IP) models. As a first step, we created maps of potential anadromous fish distribution by identifying potential migration barriers within the synthetic stream network. Next, we applied a suite of existing IP models for steelhead, coho, and Chinook salmon (*Oncorhynchus mykiss*, *O. kisutch*, and *O. tshawytscha*, respectively) to estimate low, medium, and high IP habitat for each species. Three different IP models were used for each species, based on species preference curves from populations from coastal Oregon, northern California, Alaska, and western Washington. We found that at least 25 tributaries that were greater than third order and contained habitat with the potential for anadromous fish, totaling about 470 river kilometers in 4,453 synthetic stream reaches averaging about 100 meters (m) in length. The IP of each of these reaches was calculated and placed into low, medium, and high IP categories. For Chinook salmon, the only stream with significantly (in other words, greater than 1 kilometer [km]) high IP reaches was the upper Skagit River upstream from Ross Lake reservoir in Canada, upstream from the third dam in the hydroelectric system. There were differences among the three models evaluated, with the model derived for the lower Skagit River showing more high and medium IP habitat than the other two models that were designed for the Columbia River Basin. For coho salmon, all three models showed similar results favoring medium IP over low and high IP habitat. Of the 3 species examined with existing IP models, steelhead had the most habitat rated as high IP with 19 targeted tributaries showing greater than 1 km of high intrinsic potential habitat.

Introduction

Seattle City Light (hereinafter City Light) is one of the Nation's largest municipally owned utilities in terms of the number of customers served. City Light owns and operates the Skagit River Hydroelectric Project in Whatcom County, northern Washington, which produces about 20 percent of the power supply for the City of Seattle. The operating license issued by the Federal Energy Regulatory Commission (FERC) for the three dams in the project expires in 2025 and the process is underway to renew the license. A component of this relicensing process is the implementation of an integrated study plan to provide additional information on a suite of topics related to recreation, fisheries, cultural resources, wildlife, and vegetation. Included in the Revised Study Plan submitted to FERC was an interrelated set of studies (FA07—Reservoir Tributary Habitat; Seattle City Light, 2023) to assess habitat, environmental conditions, and species interactions that affect the availability and production potential of habitat for native salmonids (*Oncorhynchus* spp.) in reservoirs and major tributaries associated with Ross, Diablo, and Gorge dams on the Skagit River.

The Skagit River Hydroelectric Project is in the upper Skagit River watershed ([fig. 1](#)) on the main stem of the Skagit River. The three hydroelectric dams and their reservoirs are located between river kilometer (rkm) 151 and 204 and work together through hydrological coordination to generate about 700 megawatts of power. Currently, the three hydroelectric dams block upstream and downstream migration of fish in the Skagit River. The dams and their reservoirs are contained within the Ross Lake National Recreation Area, which is administered by the National Park Service (NPS) as part of North Cascades National Park. The upstream-most 1.5 km section of the upper reservoir (Ross Lake) is in Canada and is contained within the Skagit Valley Provincial Park. Several major tributaries and about 50 km of the main stem of the Skagit River are located upstream from Ross Lake in Canada.

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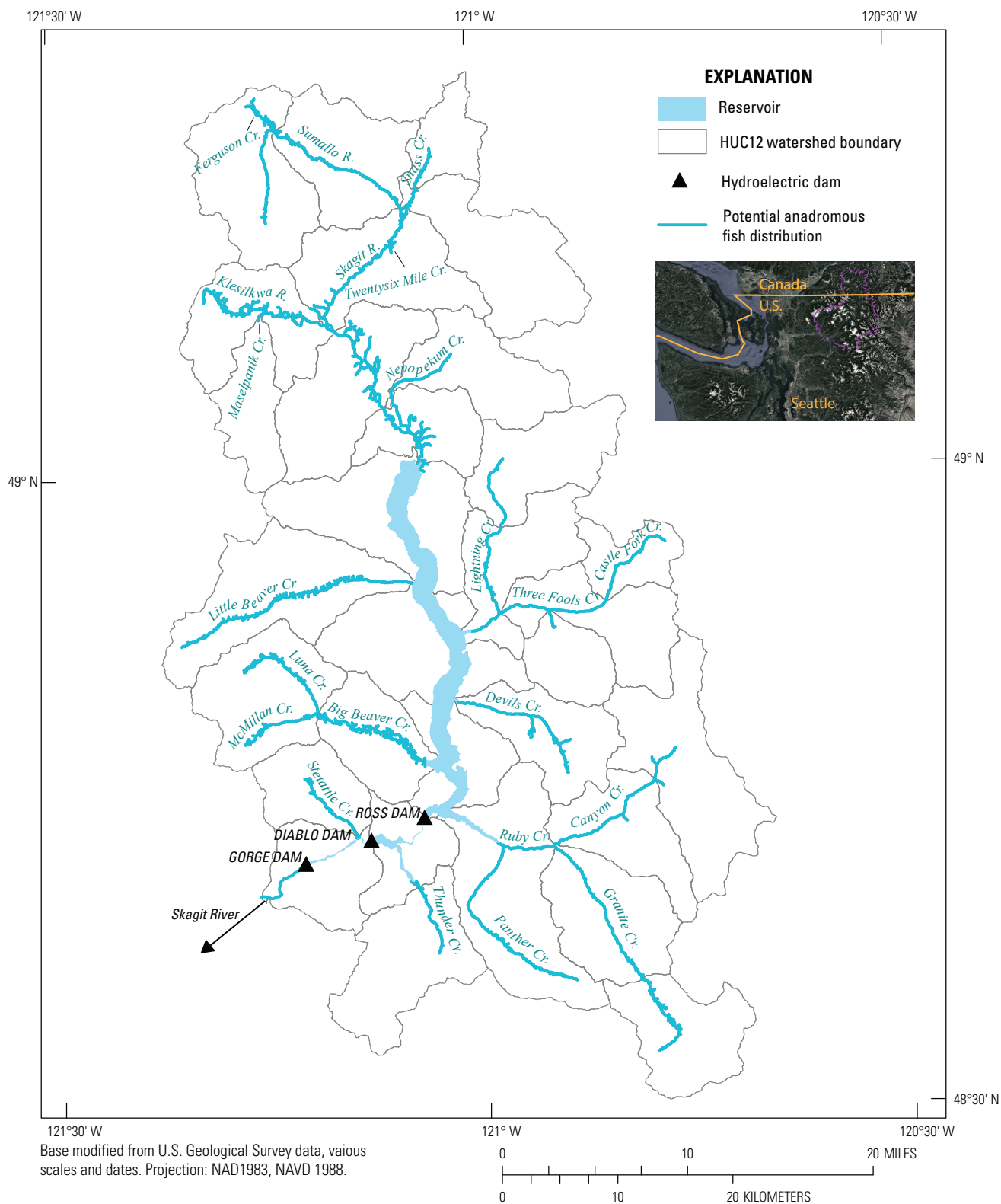


Figure 1. Upper Skagit River watershed showing targeted and non-targeted tributary habitat with potential accessibility for anadromous salmonids (*Oncorhynchus* spp.) upstream from three currently impassable dams, in Whatcom County, northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

Over the past several decades, City Light, NPS, and fisheries biologists from other agencies have gathered data on aquatic resources in the project reservoirs, including bull trout (*Salvelinus confluentus*) movement, fish species assemblages, sport fishing catches (creel surveys in Ross Lake, for example), water quality, and hydrodynamic modeling of the reservoirs. Although these efforts provide valuable baseline information, a comprehensive analysis of trophic interactions, environmental conditions, and the hydroelectric project operations that affect reservoir and tributary fish populations was identified by City Light to be a part of the Revised Study Plan for the relicensing application process. Such data could provide information necessary to evaluate the status of fish populations upstream from the dams, current effects that project operations have on these fish populations, and specific fishery monitoring and management activities into the future, if necessary, beyond the needs of the relicensing process.

To address this information need, a multi-element study was initiated by the U.S. Geological Survey's Western Fisheries Research Center in Seattle, Washington. The goal of the ongoing study was to identify and quantify factors that might limit recruitment or production of native adfluvial salmonids, which populate the reservoirs and associated tributaries upstream from the three main-stem dams on the Skagit River (Ross, Diablo, and Gorge dams). From 2018 to 2020, several related projects were underway. These projects focused on seasonal and size-structured food web interactions in the reservoirs, ontogenetic connections of adfluvial salmonids to tributary habitats, presence and geographic extent of native and non-native fishes in targeted reservoir tributaries in the basin, levels of hybridization among native and introduced species, and habitat suitability and bioenergetic growth potential of select tributaries. Food web interactions, distribution, and growth of native salmonids will ultimately be linked to environmental conditions, and these will be evaluated within the context of projected changes in climate or dam operations.

Subsequently, introduction of salmon or steelhead upstream from the dams was posed as a study topic by several parties to the relicensing project (licensing participants, hereinafter LPs). Because of the widespread installation of dams across the range of Pacific salmon, a significant percentage of historical spawning and rearing habitat for anadromous salmonids is inaccessible at locations where dams lack fish passage structures and block migratory fish access to historical spawning and rearing habitats upstream (Ward and Stanford, 1979; Waldman and Quinn, 2022). Where installation of fish passage structures such as fishways or fish ladders is not possible because of engineering or economic constraints, so called trap-and-haul operations have been used to (1) collect migrating adults and move them upstream (Clay and Eng, 2017) or downstream (Piper and others, 2020) past the dam, (2) collect migrating juveniles and move them past the dam (Johnson and others, 2005), or (3) move both adults and juveniles (referred to as two-way trap-and-haul; Lusardi and Moyle, 2017; Kock and others, 2021). Repatriating anadromous fish to formerly disconnected upstream areas could be useful in situations where habitat is limiting population growth in downstream areas while production potential exists upstream. It is also seen as a possible mitigation to future warming water temperatures in the face of climate change, given that colder temperature waters are expected to shift farther upstream under climate change scenarios (Naughton and others, 2018). To date, the efficacy of these approaches has seen mixed results (Lusardi and Moyle, 2017; Kock and others, 2021). Given the recent increase in projects to introduce or reintroduce anadromous salmonids upstream from passable barriers, it was determined that identifying the amount of suitable habitat in streams that could be used by Pacific salmon upstream from Gorge, Diablo, and Ross dams would be useful information to consider as part of the relicensing process.

Purpose and Scope

The purpose of this study was to (1) use watershed attributes estimated from synthetic stream networks derived from digital elevation models (DEMs) in a geographic information system (GIS) to identify the upstream limit of tributary habitat that could be accessed by introduced Pacific salmon and steelhead and (2) to use several existing intrinsic potential (IP) models for three species of anadromous salmonids (Chinook, coho, and steelhead [*Oncorhynchus tshawytscha*, *O. kisutch*, and *O. mykiss*, respectively]) to identify suitable habitat in tributaries and main-stem reaches upstream from the three Skagit River dams. Where IP models do not exist for a given species, use of results from other species could be used heuristically to infer the potential for a species' performance.

Methodology

We used a synthetic watershed approach (that is, a watershed with stream segments composed within a GIS based on DEM data; Benda and others, 2016) to assess the potential distribution of anadromous salmon in the Skagit River Basin upstream from the dams. NetMap (Terrainworks, 2023) is a commercial software system available as an add-on analysis toolkit for ArcGIS (ESRI, 2023) for use in watershed analyses (Benda and others, 2007). NetMap is an integrated set of numerical algorithms and base parameters that are used to create a synthetic stream network based on DEMs (Benda and others, 2007, 2011). Effectively, NetMap derives stream networks consisting of reaches ranging from 10 to 200 meters (m; average = 102 m \pm 12 m; number of reaches [n] = 133,808 reaches to represent the study area of the upper Skagit River Basin). Within each reach, geomorphic and hydrological characteristics are derived based upon the surrounding DEM-derived landscape (such as drainage area and elevation), flow accumulation, and channel delineation processing. Geomorphic and hydrological habitat variables for each reach are estimated throughout the channel network using modeled parameters and empirically based relationships available from published region-specific models related to valley geometry, river network structure and hydrology, climate, and channel elevation profiles (Benda and others, 2011). At the start of the project, an existing NetMap model for the upper Skagit River watershed up to the Canadian border was based on a 10-m DEM. Terrainworks extended the model into the remaining watershed in Canada using a 20-m DEM, which was the highest resolution publicly available DEM. Terrainworks merged the two DEMs together to create a seamless DEM that could be packaged into NetMap as a dataset for further analysis and estimates of fish distribution and IP modeling.

As part of the study plan review, LPs proposed a list of 21 streams with potential salmonid habitat that could potentially be used by introduced anadromous salmonids. On

the United States side of the border (table 1), these included Big Beaver Creek, Luna Creek, Little Beaver Creek, Canyon Creek, North Fork Canyon Creek, Granite Creek, Lightning Creek, Three Fools Creek, Castle Fork Creek, Ruby Creek, Cabinet Creek, and East Creek. Subsequent analyses and discussions with LPs added additional target tributaries, including a tributary to Gorge Lake reservoir (Stetattle Creek) and five tributaries to Ross Lake reservoir (Hozomeen Creek, Devils Creek, McMillan Creek, Panther Creek, and Slate Creek). In the Canadian part of the watershed upstream from the Ross Lake reservoir, the Skagit River main stem and several tributaries, including the Klesilkwa River, Sumallo River, Ferguson Creek, Nepopekum Creek, Maselpalik Creek, Snass Creek, Twentysix Mile Creek, and Marmotte Creek, were proposed for assessment (table 2).

As a first analysis step, we used the hydrographic representation of the upper Skagit River study area in NetMap to identify the upper extent of potential anadromous salmonid distribution in each tributary upstream from the dams. We did this by applying two criteria related to fish passage: changes to gradient that would limit anadromous fish passage, and the presence of natural waterfalls and other water surface drops that could serve as anadromous fish barriers. Definitions of both criteria were obtained from the anadromous fish passage assessment protocols for the State of Washington (Washington Department of Fish and Wildlife, 2019). The first criterion to assess the extent of potential habitat was a maximum of 20-percent gradient over a 160-m reach, which studies have shown to be impassable for upstream migrating salmonids (Washington Department of Fish and Wildlife, 2019). Although some studies have used lower gradient thresholds (such as, 16 percent over 300 m for Fraser River salmonids; Finn and others, 2021), we used the standard for upstream migration barriers as set by the State of Washington. The second criterion was waterfalls or geomorphic features with vertical drops greater than or equal to 3.7 m. We assessed such drops using the NetMap node-based stream layer, which represents the synthetic stream network at the grain of the DEM that is 10 m for reaches in the United States and 20 m for reaches in Canada. NetMap identifies a node drop value for a reach based on differences in elevation between adjacent nodes. Potential upstream distribution was stopped at nodes that equaled or exceeded 3.7 m. In most cases, because of elevation changes, several nodes would exceed the drop height threshold and be obvious areas of steep gradient and vertical waterfalls or cascades. We cross-referenced known barriers and waterfalls with the node drop values in NetMap as verification that the tool was accurately depicting known barriers. Because of the remote nature of the watershed and few existing on-the-ground surveys of potential barriers, most of the potential barriers stopping upstream anadromous fish distribution were identified only from the NetMap environment. However, there were a few cases where single or small clusters of adjacent nodes that exceeded the height threshold were surrounded by several hundred meters of habitat upstream and downstream from the impacted reach.

Table 1. Tributary and main-stem reaches upstream from Ross Lake reservoir identified by stakeholders as having accessible fish habitat that could potentially be used by introduced Pacific salmon and steelhead (*Oncorhynchus* spp.), with estimates of the amount and average percent gradient of the accessible sections, in northern Washington.

[km, kilometer; <, less than]

River/stream name	Reach description	Reach estimates	
		Length (km)	Gradient (percent)
Skagit River	Ross Lake to Klesilkwa	17.5	<1
	Klesilkwa to barrier falls near Snass Creek	17.1	<1
Klesilkwa River	Skagit River to Silverhope Divide	14.3	<1
	Silverhope Divide to end of third-order stream	3.7	10
Sumallo River	Skagit River to Ferguson Creek	16.6	<1
	Ferguson Creek to end of third-order stream	12.1	5
Ferguson Creek	Sumallo River to Highway 3	3.9	2
	Highway 3 to end of third-order stream	3.7	9
Nepopekum Creek	Skagit River to start of canyon	2.7	3
	Start of canyon to Poland Creek	9.3	5
Maselpanik Creek	Klesilkwa River to end of third-order stream	12.2	6
Snass Creek	Skagit River to Dry Lake	3.9	6
Twentysix Mile Creek	Skagit River to end of third-order stream	5.8	11
Marmotte Creek	Skagit River to end of third-order stream	4.3	12

Table 2. Ross Lake reservoir tributary reaches identified by stakeholders as having accessible fish habitat that could potentially be used by introduced Pacific salmon and steelhead (*Oncorhynchus* spp.), with estimates of the amount (in kilometers) and average percent gradient of the accessible sections, in northern Washington.

[km, kilometer; <, less than]

River/stream name	Reach description	Reach estimates	
		Length (km)	Gradient (percent)
Big Beaver Creek	Ross Lake to McMillan Creek	14.6	<1
Little Beaver Creek	Ross Lake to end of third-order stream	24.2	2
Ruby Creek	Ross Lake to confluence of Canyon and Granite Creeks	5.5	2
Canyon Creek	Ruby Creek to Slate Creek	11.9	2
	Slate Creek to barrier	4.2	7
North Fork Canyon Creek	Canyon Creek to barrier	1.0	7
Granite Creek	Ruby Creek to barrier	8.6	4
Lightning Creek	Ross Lake to Three Fools Creek	3.5	2
	Three Fools Creek to Freezeout Creek	8.8	2
	Freezeout Creek to Boundary Creek	6.3	4
Luna Creek	Big Beaver Creek to end of third-order stream	4.5	4
Three Fools Creek	Lightning Creek to Castle Fork Creek	10.1	4
Castle Fork Creek	Three Fools Creek to Rustle Creek	5.8	9
East Creek	Granite Creek to end of third-order stream	6.9	12
Cabinet Creek	Granite Creek to end of third-order stream	3.2	13

To be conservative with identifying potential barriers, in these cases we by-passed such “spurious nodes,” which had drops ranging from 3.7 to 8.8 m, and assumed that fish passage was possible. There were only a few such cases in Canyon Creek (one node), Castle Fork Creek (six nodes in three reaches), Devils Creek (eight nodes in four reaches), Granite Creek (three nodes in two reaches), Lightning Creek (two nodes in one reach), McMillan Creek (two nodes in one reach), Nepopekum Creek (eight nodes in five reaches), and Snass Creek (eight nodes in five reaches). Given the above two decision rules, we identified the potential areas of anadromous fish distribution within GIS for use in IP modeling (fig 1).

For the next step, we used several existing species-specific IP models to estimate the geomorphically based habitat suitability for Chinook, coho, and steelhead. The concept of IP was originally developed in the Pacific Northwest for use as a broad-scale assessment tool to estimate the potential for stream reaches to support salmonids based on species habitat preferences related to persistent landscape features that are not easily modified by human disturbances (Burnett and others, 2007; Sheer and others, 2009). Features, such as hydrology, gradient, and channel width, create the template upon which other transient features, like the presence of riffle and pool channel units and large woody debris, interact to create habitat that support salmonid populations. The influence of these landscape features creating the template are determined by the geomorphic context of landforms interacting with other habitat forming processes, such as hydrology and wood and sediment recruitment and retention, to create habitat conditions that are suitable for spawning and rearing of salmon (Benda and others, 2004; Burnett and others, 2007; Bidlack and others, 2014).

As detailed below, there were two approaches to calculate the IP depending on the model and species. The first approach was the original one described by Burnett and others (2007) where IP for each reach is calculated based upon species suitability curves for each of three habitat variables so that for each reach, habitat scores for the species would range from 1 (highest preference) to 0 (not suitable). An IP score based on the geometric mean from the three variables of interest (for example, gradient, valley confinement, and width) is calculated for each reach, ranging from 1 to 0. The

second approach was a categorically based one, where low, medium, and high IP values were assigned to each reach according to ranges of values for the 3 variables of interest. For example, reaches with a bankfull width between 3.8 and 25 m, a gradient from 0 to 0.5 percent, and a moderate valley width ratio would receive a relative IP score of “medium.” To compare model-derived IP scores and maps across species, we assigned reaches from numerically derived models as low (score less than or equal to 0.25), medium (greater than 0.25 or less than or equal to 0.75), and high (greater than 0.75) IP. All calculations were made in GIS using the NetMap tool applied to the fish distribution described above.

For each target species of salmonid (Chinook salmon, coho salmon, steelhead), we used three existing models to score the IP of each stream reach in the areas identified as having potential for introduced anadromous salmonids (fig. 1). For Chinook salmon, we used existing models from Connor and others (2015; hereinafter Connor model), Busch and others (2013; hereinafter Busch model), and Cooney and Holzer (2006; hereinafter Cooney and Holzer model) that were developed from populations in the interior Columbia River Basin, the lower Columbia River Basin, and the Skagit River downstream from the Skagit River Hydroelectric Project, respectively. The Connor model used elevation as a factor in place of bankfull width. For coho salmon, existing models by Burnett and others (2007; hereinafter Burnett model), Agrawal and others (2005; hereinafter Agrawal model), and Romey (Terrainworks, 2023; hereinafter Romey model) were based on species preference curves developed from populations from coastal Oregon, northern California, and Alaska, respectively. All three models used the same three physical habitat variables (percent gradient, mean annual flow, and valley width index; table 3), with differences among the models in the shape of the habitat suitability curves that assigned slightly different IP ranking scores to each attribute. For steelhead, we used the Burnett model, the Agrawal model, and the model from the Puget Sound Technical Recovery Team (Hard and others, 2015; hereinafter Puget Sound Technical Recovery Team model) based on populations in coastal Oregon, northern California, and Puget Sound, respectively.

Table 3. Comparison of intrinsic potential model parameters used for Pacific salmon and steelhead (*Oncorhynchus* spp.) intrinsic potential models.

Model ¹	Variables				
	Gradient	Bankfull	Valley width index	Elevation	Streamflow
Chinook					
Connor	Yes	Yes	No	Yes	No
Cooney and Holzer ¹	Yes	Yes	Yes	No	No
Busch	Yes	Yes	Yes	No	No
Coho					
Agrawal	Yes	No	Yes	No	Yes
Romey	Yes	No	Yes	No	Yes
Burnett	Yes	No	Yes	No	Yes
Steelhead					
Burnett	Yes	No	Yes	No	Yes
Agrawal	Yes	No	Yes	No	Yes
Puget Sound Technical Recovery Team ²	Yes	Yes	No	No	No

¹Named models include Connor model (Connor and others, 2015), Cooney and Holzer model (Cooney and Holzer, 2006), Busch model (Busch and others 2013), Agrawal model (Agrawal and others, 2005), Romey model (Terrainworks, 2023), Burnett model (Burnett and others, 2007), and Puget Sound Technical Recovery Team model (Hard and others, 2015).

²Categorical based IP scoring (none, low, medium, or high for Cooney and Holzer model; low, medium, or high for Puget Sound Technical Recovery Team model) based on combined ranges of parameter values.

Results and Interpretations

Potential Fish Distribution Upstream from the Skagit River Hydroelectric Project Dams

Of the 27 proposed targeted streams, 25 of them were included in the final analysis based on potential fish distribution. Two proposed streams, East and Cabinet Creeks, were identified to have several reach nodes exceeding the fish passage thresholds within about 200 m or less from the confluence with their respective tributaries and were not considered for further analysis. Based upon gradient threshold and waterfall drop values for the remaining 25 target streams, we identified 4,453 stream reaches totaling an estimated length of 470 rkm of potential fish habitat for migratory fish species (fig. 1). The average length of reaches was 105 m (standard deviation; SD \pm 13.8 m, range 9–227) and the median stream order of these reaches being was 4. These included 2,838 reaches within 25 target streams (tables 1 and 2 plus an additional four streams) totaling 306 km with a median stream order of 5. There were 1,615 reaches totaling 164 km that were found in other accessible tributaries that were often smaller (median stream order was 2) named or unnamed tributaries to the targeted streams (hereinafter referred to as non-targeted streams or non-targeted reaches). The targeted tributary and

main-stem Skagit River reaches identified were larger streams, and the other non-targeted reaches were smaller and generally shorter reaches of accessible habitat.

Chinook Salmon Intrinsic Potential Model Results

There were similarities and differences among the results for the three Chinook salmon IP models (fig. 2). The Chinook salmon IP model proposed by Connor and others (2015; Connor model), which was parameterized based on other Skagit River Basin populations downstream from the Skagit River Hydroelectric Project, was different from the Busch model (Busch and others, 2013) and the Cooney and Holzer model (Cooney and Holzer, 2006) developed for Chinook salmon populations in the Columbia River Basin. All three models used gradient and stream bankfull width habitat preference curves, whereas the Connor IP model replaced valley width ratio used by the other two models with elevation as the third parameter (table 3). In total, the Connor model rated more reaches as having high IP habitat than the other two models. Summaries of habitat parameter values and the number of reaches scored as low, medium, and high IP sections are provided for main-stem and tributary habitat in the United States (table 4) and Canada (table 5).

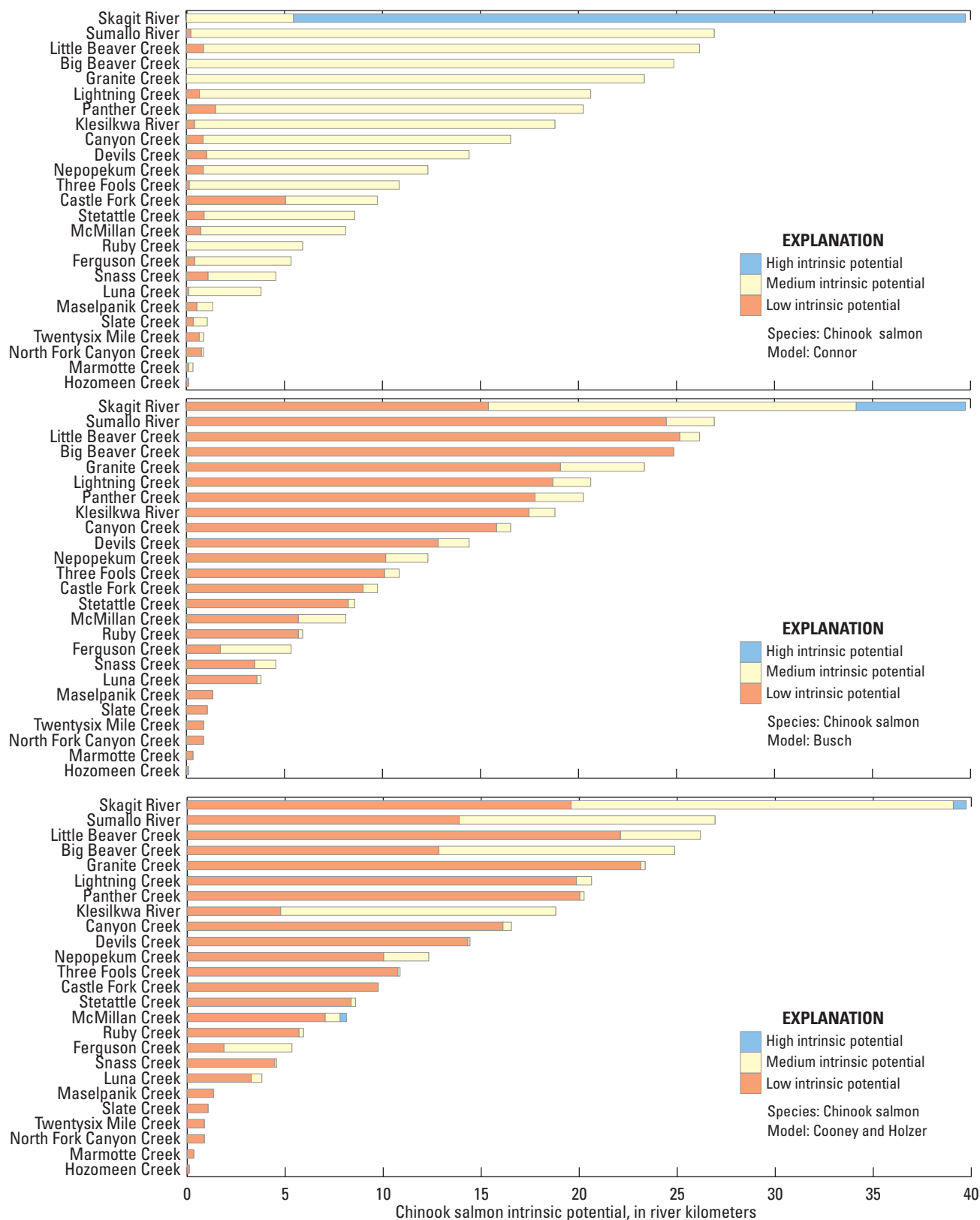


Figure 2. Length of high, medium, and low intrinsic potential habitat for Chinook salmon (*Oncorhynchus tshawytscha*) based on three different models for target tributaries upstream from the three upper Skagit River dams, in northern Washington.

Table 4. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Big Beaver Creek	Connor	0	High	NA	NA	NA	NA
Big Beaver Creek	Busch	0	High	NA	NA	NA	NA
Big Beaver Creek	CnH	0	High	NA	NA	NA	NA
Big Beaver Creek	Connor	230	Medium	1.3 (\pm 2.1)	0.6 (\pm 0.3)	14.1 (\pm 2.7)	4.4 (\pm 1.5)
Big Beaver Creek	Busch	0	Medium	NA	NA	NA	NA
Big Beaver Creek	CnH	113	Medium	0.1 (\pm 0.1)	0.5 (\pm 0.1)	15.7 (\pm 1.5)	5.5 (\pm 0.8)
Big Beaver Creek	Connor	0	Low	NA	NA	NA	NA
Big Beaver Creek	Busch	230	Low	1.3 (\pm 2.1)	0.6 (\pm 0.3)	14.1 (\pm 2.7)	4.4 (\pm 1.5)
Big Beaver Creek	CnH	117	Low	2.4 (\pm 2.5)	0.7 (\pm 0.3)	12.5 (\pm 2.7)	3.5 (\pm 1.4)
Little Beaver Creek	Connor	0	High	NA	NA	NA	NA
Little Beaver Creek	Busch	0	High	NA	NA	NA	NA
Little Beaver Creek	CnH	0	High	NA	NA	NA	NA
Little Beaver Creek	Connor	231	Medium	1.8 (\pm 1.4)	0.7 (\pm 0.2)	12.1 (\pm 2.5)	3.2 (\pm 1.4)
Little Beaver Creek	Busch	9	Medium	2.1 (\pm 1.0)	1.0 (\pm 0.0)	8.3 (\pm 1.6)	1.4 (\pm 0.7)
Little Beaver Creek	CnH	37	Medium	0.2 (\pm 0.2)	0.6 (\pm 0.1)	13.8 (\pm 1.0)	4.1 (\pm 0.7)
Little Beaver Creek	Connor	8	Low	8.6 (\pm 1.1)	0.9 (\pm 0.3)	8.7 (\pm 3.9)	1.8 (\pm 1.9)
Little Beaver Creek	Busch	230	Low	2.1 (\pm 1.9)	0.7 (\pm 0.2)	12.1 (\pm 2.6)	3.2 (\pm 1.4)
Little Beaver Creek	CnH	202	Low	2.4 (\pm 1.8)	0.7 (\pm 0.2)	11.6 (\pm 2.7)	3.0 (\pm 1.5)
Ruby Creek	Connor	0	High	NA	NA	NA	NA
Ruby Creek	Busch	0	High	NA	NA	NA	NA
Ruby Creek	CnH	0	High	NA	NA	NA	NA
Ruby Creek	Connor	59	Medium	1.5 (\pm 0.5)	0.5 (\pm 0.2)	19.9 (\pm 1.4)	9.2 (\pm 1.4)
Ruby Creek	Busch	2	Medium	1.4 (\pm 0.3)	1.2 (\pm 0.2)	19.8 (\pm 0.2)	9.0 (\pm 0.2)
Ruby Creek	CnH	2	Medium	0.1 (\pm 0.1)	0.3 (\pm 0.1)	22.2 (\pm 0.1)	11.6 (\pm 0.1)
Ruby Creek	Connor	0	Low	NA	NA	NA	NA
Ruby Creek	Busch	57	Low	1.5 (\pm 0.5)	0.4 (\pm 0.1)	19.9 (\pm 1.4)	9.2 (\pm 1.5)
Ruby Creek	CnH	57	Low	1.6 (\pm 0.4)	0.5 (\pm 0.2)	19.8 (\pm 1.3)	9.1 (\pm 1.4)
Canyon Creek	Connor	0	High	NA	NA	NA	NA
Canyon Creek	Busch	0	High	NA	NA	NA	NA
Canyon Creek	CnH	0	High	NA	NA	NA	NA
Canyon Creek	Connor	148	Medium	2.8 (\pm 1.6)	0.8 (\pm 0.4)	12.0 (\pm 2.4)	3.1 (\pm 1.2)
Canyon Creek	Busch	7	Medium	2.2 (\pm 0.6)	1.1 (\pm 0.0)	10.6 (\pm 2.3)	2.4 (\pm 1.2)
Canyon Creek	CnH	4	Medium	0.1 (\pm 0.1)	0.7 (\pm 0.0)	12.4 (\pm 1.0)	3.2 (\pm 0.6)
Canyon Creek	Connor	8	Low	8.3 (\pm 0.4)	1.9 (\pm 0.6)	6.5 (\pm 0.1)	0.8 (\pm 0.0)
Canyon Creek	Busch	149	Low	3.2 (\pm 2.0)	0.8 (\pm 0.5)	11.8 (\pm 2.7)	3.1 (\pm 1.3)
Canyon Creek	CnH	152	Low	3.2 (\pm 2.0)	0.8 (\pm 0.5)	11.7 (\pm 2.7)	3.0 (\pm 1.3)
North Fork Canyon Creek	Connor	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Busch	0	High	NA	NA	NA	NA

Table 4. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
North Fork Canyon Creek	CnH	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Connor	1	Medium	6.4 (NA)	1.0 (NA)	6.4 (NA)	0.7 (NA)
North Fork Canyon Creek	Busch	0	Medium	NA	NA	NA	NA
North Fork Canyon Creek	CnH	0	Medium	NA	NA	NA	NA
North Fork Canyon Creek	Connor	7	Low	9.4 (\pm 1.5)	1.6 (\pm 0.4)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
North Fork Canyon Creek	Busch	8	Low	9.0 (\pm 1.8)	1.5 (\pm 0.5)	6.4 (\pm 0.0)	0.7 (\pm 0.0)
North Fork Canyon Creek	CnH	8	Low	9.0 (\pm 1.8)	1.5 (\pm 0.5)	6.4 (\pm 0.0)	0.7 (\pm 0.0)
Granite Creek	Connor	0	High	NA	NA	NA	NA
Granite Creek	Busch	0	High	NA	NA	NA	NA
Granite Creek	CnH	0	High	NA	NA	NA	NA
Granite Creek	Connor	215	Medium	2.9 (\pm 1.5)	0.8 (\pm 0.3)	10.5 (\pm 1.7)	2.3 (\pm 0.8)
Granite Creek	Busch	39	Medium	1.8 (\pm 0.7)	1.3 (\pm 0.4)	9.1 (\pm 1.2)	1.6 (\pm 0.5)
Granite Creek	CnH	2	Medium	0.4 (\pm 0.0)	0.9 (\pm 0.2)	8.9 (\pm 0.2)	1.5 (\pm 0.1)
Granite Creek	Connor	0	Low	NA	NA	NA	NA
Granite Creek	Busch	176	Low	3.1 (\pm 1.5)	0.7 (\pm 0.2)	10.9 (\pm 1.6)	2.5 (\pm 0.8)
Granite Creek	CnH	213	Low	2.9 (\pm 1.5)	0.8 (\pm 0.3)	10.6 (\pm 1.7)	2.3 (\pm 0.8)
Lightning Creek	Connor	0	High	NA	NA	NA	NA
Lightning Creek	Busch	0	High	NA	NA	NA	NA
Lightning Creek	CnH	0	High	NA	NA	NA	NA
Lightning Creek	Connor	190	Medium	2.8 (\pm 1.7)	0.8 (\pm 0.4)	11.3 (\pm 2.8)	2.8 (\pm 1.7)
Lightning Creek	Busch	18	Medium	1.5 (\pm 1.4)	1.5 (\pm 0.7)	8.7 (\pm 1.6)	1.5 (\pm 0.7)
Lightning Creek	CnH	7	Medium	0.0 (\pm 0.0)	1.4 (\pm 0.6)	7.6 (\pm 0.4)	1.1 (\pm 0.1)
Lightning Creek	Connor	6	Low	8.6 (\pm 1.1)	1.3 (\pm 0.2)	7.7 (\pm 0.5)	1.1 (\pm 0.2)
Lightning Creek	Busch	178	Low	3.2 (\pm 1.9)	0.8 (\pm 0.3)	11.5 (\pm 2.9)	2.9 (\pm 1.7)
Lightning Creek	CnH	189	Low	3.1 (\pm 1.9)	0.8 (\pm 0.4)	11.3 (\pm 2.8)	2.8 (\pm 1.7)
Luna Creek	Connor	0	High	NA	NA	NA	NA
Luna Creek	Busch	0	High	NA	NA	NA	NA
Luna Creek	CnH	0	High	NA	NA	NA	NA
Luna Creek	Connor	34	Medium	2.4 (\pm 1.9)	0.8 (\pm 0.1)	8.9 (\pm 0.3)	1.5 (\pm 0.1)
Luna Creek	Busch	2	Medium	2.6 (\pm 0.5)	1.0 (\pm 0.0)	8.6 (\pm 0.1)	1.4 (\pm 0.0)
Luna Creek	CnH	5	Medium	0.2 (\pm 0.2)	0.8 (\pm 0.1)	9.1 (\pm 0.2)	1.6 (\pm 0.1)
Luna Creek	Connor	1	Low	7.7 (NA)	0.9 (NA)	8.1 (NA)	1.2 (NA)
Luna Creek	Busch	33	Low	2.5 (\pm 2.1)	0.8 (\pm 0.1)	8.9 (\pm 0.3)	1.5 (\pm 0.1)
Luna Creek	CnH	30	Low	2.9 (\pm 2.0)	0.9 (\pm 0.1)	8.9 (\pm 0.3)	1.5 (\pm 0.1)

Table 4. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Three Fools Creek	Connor	0	High	NA	NA	NA	NA
Three Fools Creek	Busch	0	High	NA	NA	NA	NA
Three Fools Creek	CnH	0	High	NA	NA	NA	NA
Three Fools Creek	Connor	102	Medium	3.7 (\pm 1.6)	0.9 (\pm 0.4)	10.6 (\pm 1.5)	2.3 (\pm 0.7)
Three Fools Creek	Busch	7	Medium	2.5 (\pm 1.0)	1.2 (\pm 0.2)	9.9 (\pm 2.1)	2.1 (\pm 0.9)
Three Fools Creek	CnH	1	Medium	0.2 (NA)	0.9 (NA)	9.9 (NA)	1.9 (NA)
Three Fools Creek	Connor	3	Low	9.7 (\pm 3.8)	1.0 (\pm 0.6)	9.8 (\pm 4.3)	2.2 (\pm 1.6)
Three Fools Creek	Busch	98	Low	4.0 (\pm 2.0)	0.9 (\pm 0.4)	10.6 (\pm 1.0)	2.3 (\pm 0.7)
Three Fools Creek	CnH	104	Low	3.9 (\pm 1.9)	0.9 (\pm 0.4)	10.6 (\pm 1.6)	2.3 (\pm 0.7)
Castle Fork Creek	Connor	0	High	NA	NA	NA	NA
Castle Fork Creek	Busch	0	High	NA	NA	NA	NA
Castle Fork Creek	CnH	0	High	NA	NA	NA	NA
Castle Fork Creek	Connor	44	Medium	4.8 (\pm 1.6)	1.9 (\pm 1.0)	5.7 (\pm 1.1)	0.6 (\pm 0.2)
Castle Fork Creek	Busch	7	Medium	2.1 (\pm 0.4)	1.7 (\pm 0.5)	6.3 (\pm 0.2)	0.7 (\pm 0.0)
Castle Fork Creek	CnH	0	Medium	NA	NA	NA	NA
Castle Fork Creek	Connor	47	Low	9.3 (\pm 2.1)	2.3 (\pm 0.6)	4.0 (\pm 1.3)	0.3 (\pm 0.2)
Castle Fork Creek	Busch	84	Low	7.6 (\pm 2.6)	2.1 (\pm 0.9)	4.7 (\pm 1.4)	0.4 (\pm 0.3)
Castle Fork Creek	CnH	91	Low	7.1 (\pm 2.9)	2.1 (\pm 0.9)	4.8 (\pm 1.4)	0.4 (\pm 0.3)
Panther Creek	Connor	0	High	NA	NA	NA	NA
Panther Creek	Busch	0	High	NA	NA	NA	NA
Panther Creek	CnH	0	High	NA	NA	NA	NA
Panther Creek	Connor	176	Medium	4.1 (\pm 1.8)	1.2 (\pm 0.9)	8.5 (\pm 2.2)	1.5 (\pm 0.8)
Panther Creek	Busch	23	Medium	2.7 (\pm 0.5)	1.6 (\pm 0.6)	8.1 (\pm 1.2)	1.3 (\pm 0.4)
Panther Creek	CnH	2	Medium	0.2 (\pm 0.2)	0.9 (\pm 0.0)	9.0 (\pm 0.0)	1.6 (\pm 0.0)
Panther Creek	Connor	14	Low	7.9 (\pm 0.7)	1.4 (\pm 0.7)	6.9 (\pm 2.1)	1.0 (\pm 0.7)
Panther Creek	Busch	167	Low	4.6 (\pm 2.0)	1.2 (\pm 0.9)	8.5 (\pm 2.3)	1.5 (\pm 0.8)
Panther Creek	CnH	188	Low	4.4 (\pm 1.9)	1.2 (\pm 0.9)	8.4 (\pm 2.2)	1.5 (\pm 0.8)
Devils Creek	Connor	0	High	NA	NA	NA	NA
Devils Creek	Busch	0	High	NA	NA	NA	NA
Devils Creek	CnH	0	High	NA	NA	NA	NA
Devils Creek	Connor	126	Medium	4.4 (\pm 1.2)	1.2 (\pm 0.5)	7.5 (\pm 1.4)	1.1 (\pm 0.4)
Devils Creek	Busch	15	Medium	2.6 (\pm 0.2)	1.3 (\pm 0.1)	7.0 (\pm 0.2)	0.9 (\pm 0.1)
Devils Creek	CnH	1	Medium	0.3 (NA)	0.8 (NA)	9.0 (NA)	1.6 (NA)
Devils Creek	Connor	10	Low	8.5 (\pm 1.1)	1.4 (\pm 0.6)	6.9 (\pm 2.7)	1.0 (\pm 0.7)
Devils Creek	Busch	121	Low	5.0 (\pm 1.5)	1.3 (\pm 0.5)	7.5 (\pm 1.6)	1.1 (\pm 0.4)
Devils Creek	CnH	135	Low	4.7 (\pm 1.6)	1.3 (\pm 0.5)	7.4 (\pm 1.6)	1.1 (\pm 0.4)
Stetattle Creek	Connor	0	High	NA	NA	NA	NA
Stetattle Creek	Busch	0	High	NA	NA	NA	NA
Stetattle Creek	CnH	0	High	NA	NA	NA	NA
Stetattle Creek	Connor	72	Medium	4.0 (\pm 1.9)	1.2 (\pm 1.5)	9.8 (\pm 2.3)	2.0 (\pm 0.8)

Table 4. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Stetattle Creek	Busch	4	Medium	1.3 (\pm 1.1)	1.2 (\pm 0.2)	10.6 (\pm 0.9)	2.3 (\pm 0.4)
Stetattle Creek	CnH	2	Medium	0.2 (\pm 0.0)	1.0 (\pm 0.1)	10.3 (\pm 0.0)	2.1 (\pm 0.0)
Stetattle Creek	Connor	8	Low	8.7 (\pm 2.4)	1.0 (\pm 0.1)	11.2 (\pm 0.6)	2.5 (\pm 0.3)
Stetattle Creek	Busch	76	Low	4.6 (\pm 2.4)	1.2 (\pm 1.5)	9.9 (\pm 2.2)	2.1 (\pm 0.8)
Stetattle Creek	CnH	78	Low	4.5 (\pm 2.4)	1.2 (\pm 1.5)	9.9 (\pm 2.2)	2.1 (\pm 0.8)
McMillan Creek	Connor	0	High	NA	NA	NA	NA
McMillan Creek	Busch	0	High	NA	NA	NA	NA
McMillan Creek	CnH	0	High	0.7 (\pm 0.6)	26.3 (\pm 7.7)	6.9 (\pm 0.0)	0.9 (\pm 0.0)
McMillan Creek	Connor	68	Medium	3.1 (\pm 1.8)	3.7 (\pm 7.3)	8.2 (\pm 1.0)	1.3 (\pm 0.3)
McMillan Creek	Busch	22	Medium	1.7 (\pm 1.3)	5.6 (\pm 9.3)	8.0 (\pm 1.0)	1.2 (\pm 0.3)
McMillan Creek	CnH	7	Medium	0.2 (\pm 0.2)	1.1 (\pm 0.2)	7.7 (\pm 0.5)	1.1 (\pm 0.2)
McMillan Creek	Connor	7	Low	9.5 (\pm 2.4)	2.1 (\pm 1.4)	7.5 (\pm 1.9)	1.1 (\pm 0.6)
McMillan Creek	Busch	53	Low	4.6 (\pm 2.6)	2.7 (\pm 5.6)	8.2 (\pm 1.1)	1.3 (\pm 0.4)
McMillan Creek	CnH	65	Low	4.2 (\pm 2.5)	2.8 (\pm 5.3)	8.2 (\pm 1.1)	1.3 (\pm 0.4)
Slate Creek	Connor	0	High	NA	NA	NA	NA
Slate Creek	Busch	0	High	NA	NA	NA	NA
Slate Creek	CnH	0	High	NA	NA	NA	NA
Slate Creek	Connor	7	Medium	5.7 (\pm 0.8)	1.1 (\pm 0.2)	8.6 (\pm 0.1)	1.4 (\pm 0.0)
Slate Creek	Busch	0	Medium	NA	NA	NA	NA
Slate Creek	CnH	0	Medium	NA	NA	NA	NA
Slate Creek	Connor	4	Low	8.2 (\pm 0.9)	1.3 (\pm 0.3)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	Busch	11	Low	6.6 (\pm 1.5)	1.2 (\pm 0.2)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	CnH	11	Low	6.6 (\pm 1.5)	1.2 (\pm 0.2)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Hozomeen Creek	Connor	0	High	NA	NA	NA	NA
Hozomeen Creek	Busch	0	High	NA	NA	NA	NA
Hozomeen Creek	CnH	0	High	NA	NA	NA	NA
Hozomeen Creek	Connor	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Busch	0	Medium	NA	NA	NA	NA
Hozomeen Creek	CnH	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Connor	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	Busch	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	CnH	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)

Table 5. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Skagit River	Connor	314	High	0.5 (\pm 0.7)	3.2 (\pm 10.5)	23.3 (\pm 2.6)	13.2 (\pm 3.1)
Skagit River	Busch	51	High	0.3 (\pm 0.4)	12.8 (\pm 24.0)	25.0 (\pm 2.3)	15.4 (\pm 3.0)
Skagit River	CnH	6	High	0.2 (\pm 0.2)	4.8 (\pm 1.3)	21.3 (\pm 3.3)	11.0 (\pm 3.6)
Skagit River	Connor	46	Medium	0.6 (\pm 0.5)	1.1 (\pm 0.8)	18.0 (\pm 2.4)	7.5 (\pm 2.1)
Skagit River	Busch	170	Medium	0.5 (\pm 0.7)	1.6 (\pm 0.6)	22.4 (\pm 3.2)	12.3 (\pm 3.5)
Skagit River	CnH	178	Medium	0.1 (\pm 0.2)	4.0 (\pm 13.6)	22.7 (\pm 2.7)	12.5 (\pm 3.1)
Skagit River	Connor	0	Low	NA	NA	NA	NA
Skagit River	Busch	139	Low	0.6 (\pm 0.8)	0.8 (\pm 0.2)	21.9 (\pm 2.9)	11.6 (\pm 3.2)
Skagit River	CnH	176	Low	0.9 (\pm 0.8)	1.7 (\pm 2.9)	22.5 (\pm 3.5)	12.4 (\pm 3.9)
Klesilkwa River	Connor	0	High	NA	NA	NA	NA
Klesilkwa River	Busch	0	High	NA	NA	NA	NA
Klesilkwa River	CnH	0	High	NA	NA	NA	NA
Klesilkwa River	Connor	166	Medium	0.5 (\pm 1.1)	0.7 (\pm 0.2)	11.0 (\pm 2.7)	2.6 (\pm 1.3)
Klesilkwa River	Busch	12	Medium	0.4 (\pm 0.7)	1.1 (\pm 0.0)	7.9 (\pm 0.5)	1.2 (\pm 0.2)
Klesilkwa River	CnH	127	Medium	0.1 (\pm 0.1)	0.7 (\pm 0.2)	11.2 (\pm 2.6)	2.8 (\pm 1.3)
Klesilkwa River	Connor	4	Low	10.5 (\pm 1.9)	1.2 (\pm 0.0)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Klesilkwa River	Busch	158	Low	0.8 (\pm 2.0)	0.7 (\pm 0.2)	11.1 (\pm 2.7)	2.7 (\pm 1.3)
Klesilkwa River	CnH	43	Low	2.7 (\pm 3.0)	0.8 (\pm 0.2)	9.7 (\pm 2.8)	2.1 (\pm 1.4)
Sumallo River	Connor	0	High	NA	NA	NA	NA
Sumallo River	Busch	0	High	NA	NA	NA	NA
Sumallo River	CnH	0	High	NA	NA	NA	NA
Sumallo River	Connor	245	Medium	1.3 (\pm 1.6)	0.7 (\pm 0.2)	11.0 (\pm 2.7)	2.7 (\pm 1.2)
Sumallo River	Busch	23	Medium	2.0 (\pm 0.8)	1.2 (\pm 0.1)	6.8 (\pm 0.5)	0.8 (\pm 0.2)
Sumallo River	CnH	118	Medium	0.1 (\pm 0.1)	0.6 (\pm 0.1)	12.7 (\pm 1.3)	3.4 (\pm 0.8)
Sumallo River	Connor	2	Low	7.5 (\pm 0.1)	1.4 (\pm 0.1)	5.4 (\pm 0.0)	0.5 (\pm 0.0)
Sumallo River	Busch	224	Low	1.3 (\pm 1.8)	0.7 (\pm 0.2)	11.4 (\pm 2.4)	2.8 (\pm 1.2)
Sumallo River	CnH	129	Low	2.6 (\pm 1.6)	0.9 (\pm 0.3)	9.4 (\pm 2.6)	1.9 (\pm 1.2)
Ferguson Creek	Connor	0	High	NA	NA	NA	NA
Ferguson Creek	Busch	0	High	NA	NA	NA	NA
Ferguson Creek	CnH	0	High	NA	NA	NA	NA
Ferguson Creek	Connor	45	Medium	0.6 (\pm 1.2)	1.3 (\pm 0.2)	5.6 (\pm 0.6)	0.6 (\pm 0.1)
Ferguson Creek	Busch	33	Medium	0.2 (\pm 0.4)	1.3 (\pm 0.2)	5.9 (\pm 0.5)	0.6 (\pm 0.1)
Ferguson Creek	CnH	32	Medium	0.0 (\pm 0.1)	1.3 (\pm 0.2)	5.7 (\pm 0.5)	0.6 (\pm 0.1)
Ferguson Creek	Connor	4	Low	7.5 (\pm 0.6)	1.6 (\pm 0.1)	4.6 (\pm 0.0)	0.4 (\pm 0.0)
Ferguson Creek	Busch	16	Low	3.2 (\pm 3.0)	1.5 (\pm 0.3)	4.9 (\pm 0.5)	0.4 (\pm 0.2)
Ferguson Creek	CnH	17	Low	3.3 (\pm 2.8)	1.5 (\pm 0.3)	5.3 (\pm 0.9)	0.5 (\pm 0.2)
Nepopekum Creek	Connor	0	High	NA	NA	NA	NA
Nepopekum Creek	Busch	0	High	NA	NA	NA	NA
Nepopekum Creek	CnH	0	High	NA	NA	NA	NA
Nepopekum Creek	Connor	107	Medium	2.6 (\pm 2.0)	0.9 (\pm 0.1)	8.7 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Busch	20	Medium	1.5 (\pm 1.0)	1.1 (\pm 0.1)	8.8 (\pm 0.2)	1.5 (\pm 0.1)

Table 5. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, or low intrinsic potential (IP) rank for Chinook salmon (*Oncorhynchus tshawytscha*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. CnH, Cooney and Holzer model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Nepopekum Creek	CnH	22	Medium	0.1 (\pm 0.1)	0.9 (\pm 0.1)	8.9 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Connor	8	Low	9.0 (\pm 1.4)	0.9 (\pm 0.1)	8.5 (\pm 0.2)	1.4 (\pm 0.1)
Nepopekum Creek	Busch	95	Low	3.3 (\pm 2.7)	0.9 (\pm 0.1)	8.7 (\pm 0.3)	1.5 (\pm 0.1)
Nepopekum Creek	CnH	93	Low	3.7 (\pm 2.4)	0.9 (\pm 0.1)	8.7 (\pm 0.2)	1.4 (\pm 0.1)
Maselpalik Creek	Connor	0	High	NA	NA	NA	NA
Maselpalik Creek	Busch	0	High	NA	NA	NA	NA
Maselpalik Creek	CnH	0	High	NA	NA	NA	NA
Maselpalik Creek	Connor	7	Medium	2.7 (\pm 1.7)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Busch	0	Medium	NA	NA	NA	NA
Maselpalik Creek	CnH	0	Medium	NA	NA	NA	NA
Maselpalik Creek	Connor	5	Low	8.5 (\pm 1.2)	0.7 (\pm 0.2)	10.5 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Busch	12	Low	5.1 (\pm 3.3)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	CnH	12	Low	5.1 (\pm 3.3)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Snass Creek	Connor	0	High	NA	NA	NA	NA
Snass Creek	Busch	0	High	NA	NA	NA	NA
Snass Creek	CnH	0	High	NA	NA	NA	NA
Snass Creek	Connor	32	Medium	3.7 (\pm 1.9)	1.3 (\pm 0.3)	6.6 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	Busch	10	Medium	1.6 (\pm 0.8)	1.3 (\pm 0.2)	6.7 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	CnH	1	Medium	0.2 (NA)	1.6 (NA)	5.1 (NA)	0.5 (NA)
Snass Creek	Connor	11	Low	9.6 (\pm 1.6)	1.0 (\pm 0.2)	6.9 (\pm 0.9)	0.9 (\pm 0.2)
Snass Creek	Busch	33	Low	6.4 (\pm 2.8)	1.2 (\pm 0.3)	6.7 (\pm 0.9)	0.8 (\pm 0.2)
Snass Creek	CnH	42	Low	5.4 (\pm 3.1)	1.2 (\pm 0.3)	6.8 (\pm 0.8)	0.8 (\pm 0.2)
Twentysix Mile Creek	Connor	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Busch	0	High	NA	NA	NA	NA
Twentysix Mile Creek	CnH	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Connor	2	Medium	5.5 (\pm 0.2)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Busch	0	Medium	NA	NA	NA	NA
Twentysix Mile Creek	CnH	0	Medium	NA	NA	NA	NA
Twentysix Mile Creek	Connor	6	Low	11.6 (\pm 1.4)	1.2 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Busch	8	Low	10.1 (\pm 3.1)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	CnH	8	Low	10.1 (\pm 3.1)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Marmotte Creek	Connor	0	High	NA	NA	NA	NA
Marmotte Creek	Busch	0	High	NA	NA	NA	NA
Marmotte Creek	CnH	0	High	NA	NA	NA	NA
Marmotte Creek	Connor	2	Medium	6.4 (\pm 0.8)	1.6 (\pm 0.4)	4.8 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	Busch	0	Medium	NA	NA	NA	NA
Marmotte Creek	CnH	0	Medium	NA	NA	NA	NA
Marmotte Creek	Connor	1	Low	8.6 (NA)	1.7 (NA)	4.7 (NA)	0.4 (NA)
Marmotte Creek	Busch	3	Low	7.1 (\pm 1.4)	1.6 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	CnH	3	Low	7.1 (\pm 1.4)	1.6 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)

Chinook Salmon Intrinsic Potential Based on the Connor Model

The Connor model identified 165 low (17.3 km), 2,355 medium (253.6 km), and 314 high (34.3 km) IP reaches across all 25 targeted streams for Chinook salmon (fig. 2), with an additional 852 (86.1 km) low and 763 medium (78.2 km) IP reaches from non-targeted streams (fig. 3). The reaches that scored a high IP (that is, modeled IP scores ≥ 0.75) for Chinook salmon were found in 34.3 km of reaches in the Skagit River main stem upstream from the Ross Lake reservoir in Canada (fig. 4). Most of the other targeted tributaries were dominated by medium IP habitat (scores greater than 0.25 and less than or equal to 0.75; fig. 4). Across all targeted reaches, 5.1 percent was rated as having low (less than 0.25) intrinsic potential habitat. After the main-stem Skagit River, which had about 40 km of main-stem habitat rated as high or medium IP, 11 different targeted tributaries had greater than 10 km of medium-rated IP habitat (fig. 2). Those tributaries with medium IP amounts greater than 10 km were the Sumallo River (26.7 km), Little Beaver Creek (25.3 km), Big Beaver Creek (24.9 km), Granite Creek (23.3 km), Lightning Creek (20.0 km), Panther Creek (18.8 km), Klesilkwa River (18.4 km), Canyon Creek (15.7 km), Devil's Creek (13.3 km), Nepopekum Creek (11.4 km), and Three Fools Creek (10.7 km). An additional seven tributaries contained at least 1 km of medium IP habitat.

Across all reaches with low IP habitat, 59.8 percent were scored as having zero IP. In non-targeted tributary reaches, there was no high IP habitat identified, with 78.2 km of medium IP habitat and 86.1 km of low IP habitat identified from non-targeted tributaries (fig. 3).

Chinook Salmon Intrinsic Potential Based on the Busch Model

The Busch model identified 2,360 low (253.6 km), 423 medium (46.0 km), and 51 high (5.6 km) intrinsic potential reaches within the 25 targeted streams for Chinook salmon (fig. 2), with an additional 25 medium (2.8 km) and 1,590 (161.5 km) low intrinsic potential reaches identified from non-targeted reaches (fig. 3). The only high intrinsic potential reaches for Chinook salmon, totaling 5.6 km, were found in the main-stem Skagit River (fig. 5) upstream from the Ross Lake reservoir in Canada. The other 24 targeted streams, except Ferguson Creek (fig. 2), and non-targeted streams (fig. 3) had most of the habitat identified as low intrinsic potential, a total of 253.9 km. Of the 46.0 km of reaches scored with medium intrinsic potential, the Skagit River (18.8 km), Granite Creek (4.3 km), and Ferguson Creek (3.6 km) had greater than 3 km of habitat, with the other 23 reaches ranging from 0 to 2.4 km. There was only 10 km of non-target tributary reaches identified as medium or low non-zero intrinsic potential (fig. 3). Of the low intrinsic potential habitat across all reaches, 90.4 percent scored as having 0 intrinsic potential (with the other 9.6 percent having scores greater than 0 and less than 0.25).

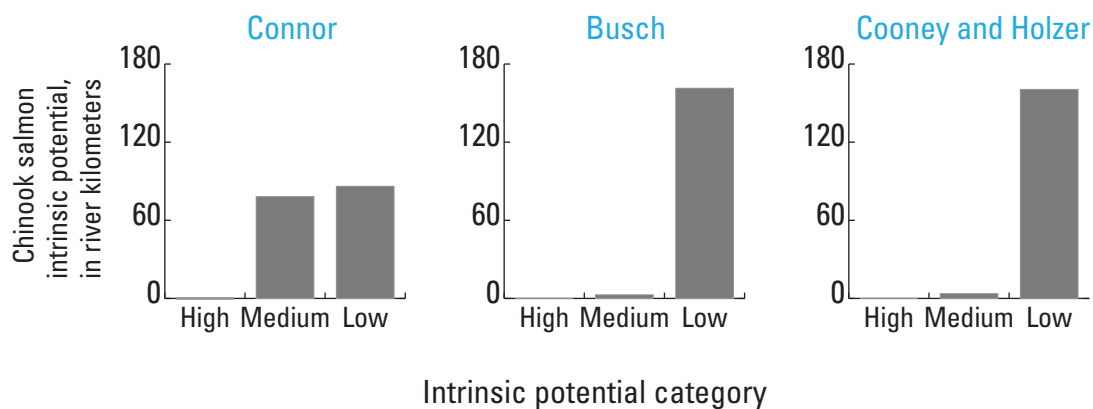


Figure 3. Length of high, medium, and low intrinsic potential habitat for Chinook salmon (*Oncorhynchus tshawytscha*) based on three different models for non-target tributaries upstream from the three upper Skagit River dams, in northern Washington.

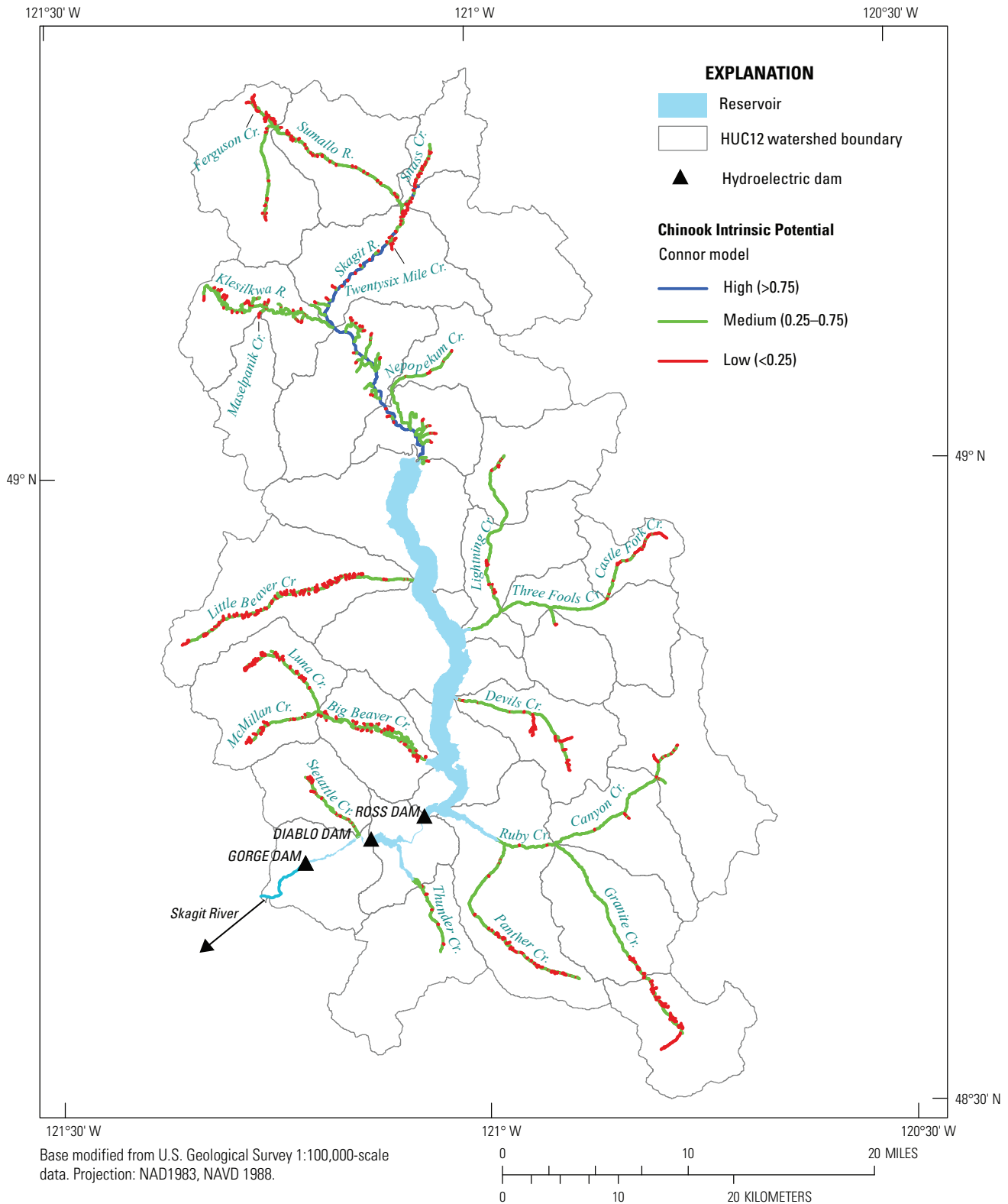


Figure 4. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for Chinook salmon (*Oncorhynchus tshawytscha*) derived from the Connor intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

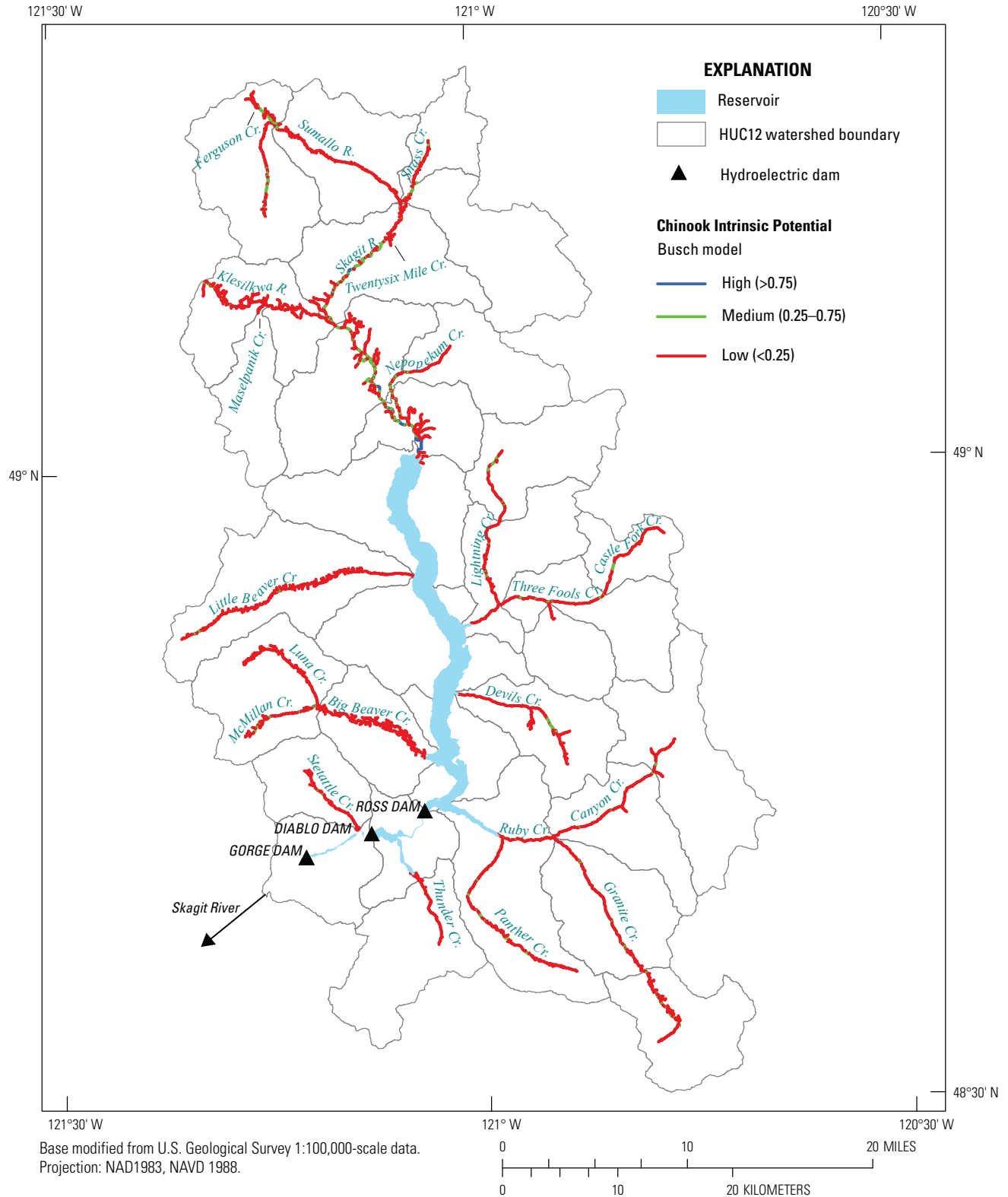


Figure 5. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for Chinook salmon (*Oncorhynchus tshawytscha*) derived from the Busch intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

Chinook Salmon Intrinsic Potential Based on the Cooney and Holzer Model

The Cooney and Holzer model identified 2,164 low (232.0 km), 661 medium (72.2 km), and 9 high (1.0 km) intrinsic potential reaches within the 25 targeted streams for Chinook salmon (fig. 2), with an additional 35 medium (3.7 km) and 1,580 (160.5 km) low intrinsic potential reaches identified from non-targeted reaches (fig. 3). Of the three IP models, this model scored the lowest amount of high intrinsic potential habitat (totaling 1.0 km) for Chinook salmon, with 661 m found in the main-stem Skagit River and 339 m in McMillan Creek (figs. 5 and 6). There were seven targeted streams with greater than 1 km of medium intrinsic potential habitat for Chinook salmon, including the main-stem Skagit River (19.5 km), Klesilkwa River (14.0), Sumallo River (13.0 km), Big Beaver Creek (12.0 km), Little Beaver Creek (4.1 km), Ferguson Creek (3.5 km), and Nepopekum Creek (2.3). Across all 25 streams, 232.0 km of the reaches were rated as having low intrinsic potential (fig. 2). For non-targeted tributaries, there were no high intrinsic potential reaches, 3.7 km of medium intrinsic potential reaches, and 160.5 km of low intrinsic potential reaches (fig. 3). Across all reaches rated as having low intrinsic potential, 59.8 percent had IP scores of zero.

Coho Salmon Intrinsic Potential Model Results

The estimates of IP for coho salmon upstream from the Skagit River Hydroelectric Project dams were similar across the three models. The Burnett model (Burnett and others, 2007), Agrawal model (Agrawal and others, 2005), and Romey model (Terrainworks, 2023) were all based on the same three parameters (gradient, bankfull width, and valley width index), but each model differed in the shape of the habitat preference curves and the IP weights assigned to the curves. All three models showed that most of the habitat upstream was classified as having medium IP habitat for coho salmon. For the 25 target streams, the main difference among the models was the higher amount of low IP reaches identified by the Burnett model and the greater number of streams having high IP by the Romey model. Summaries of habitat parameter values and the number of reaches scored as low, medium, and high IP sections are provided for main-stem and tributary habitat in the United States (table 6) and Canada (table 7).

Coho Salmon Intrinsic Potential Based on the Burnett Model

The Burnett model identified 551 low (58.4 km), 2,258 medium (244.0 km), and 25 high (2.8 km) IP reaches across all 25 targeted streams (fig. 7), with additional 998 low (100.0 km), 611 medium (63.7 km), and 6 high (0.6 km) IP reaches identified from non-targeted reaches (fig. 8). The only high IP habitat identified for coho salmon by the Burnett model was 2.4 km in the main-stem Skagit River upstream from the

Ross Lake reservoir and 339 m in McMillan Creek (fig. 9). Of the 25 target streams, 19 had greater than 1 km of medium IP habitat available, totaling 243.2 km. The other six streams were dominated by (Maselpanik Creek and Slate Creek) or had all (Twentysix Mile, North Fork Canyon, Marmotte, and Hozomeen Creeks) low IP for coho salmon. In the non-targeted reaches, most of the habitat was modeled to have low (100.0) or medium (63.7) IP for coho salmon, with only 634 m of habitat identified from unnamed tributary reaches (fig. 8).

Coho Salmon Intrinsic Potential Based on the Agrawal Model

Results from the Agrawal model were similar to those found with the Burnett model (fig. 7). The Agrawal model identified 115 low (118.0 km), 2,693 medium (290.5 km), and 26 high (2.4 km) IP reaches within the 25 targeted streams for coho salmon, with an additional 816 low (80.6 km), 790 medium (82.7 km), and 9 high (0.98 km) IP reaches identified from non-targeted reaches. The main difference between the Burnett and Agrawal models was some high intrinsic potential habitat identified in Stetattle Creek (<100 m) by the Agrawal model (fig. 10), which was classified as having medium intrinsic potential by the Burnett model. The amounts of high intrinsic potential habitat found in the main-stem Skagit River (2.4 km) and McMillan Creek (339.4 m) were identical in amount and the identified reaches in the two models. The main difference between the two models was the greater number of reaches classified as having medium intrinsic potential habitat by the Agrawal model (290.5 km), with the difference due to the lesser amount of low intrinsic potential habitat scores for this model compared with the Burnett model. A similar pattern was seen in the non-targeted streams, with more medium intrinsic potential habitat identified by the Agrawal model compared to the Burnett model (82.7 km versus 63.6 km), with the difference due to less total low intrinsic potential habitat (80.6 km versus 100 km; fig. 8).

Coho Salmon Intrinsic Potential Based on the Romey Model

Of the three coho salmon IP models, a larger amount of high intrinsic potential habitat was identified by the Romey model (fig. 7). This model identified 219 low (22.8 km), 2,564 medium (276.8 km), and 51 high (5.5 km) IP reaches in the 25 targeted streams, and 655 (64.8 km) low, 620 (64.7 km) medium, and 340 (34.7 km) high IP reaches identified from non-targeted reaches. A total of five streams (Skagit River, McMillan Creek, Panther Creek, Stetattle Creek, and Castle Fork Creek) had 5.5 km of high intrinsic potential habitat (fig. 11), with an additional 34.7 km identified in non-targeted tributaries (fig. 8). As seen in the other two intrinsic potential models for coho, most of the total accessible reaches in targeted streams were classified as having medium intrinsic potential (276.8 km).

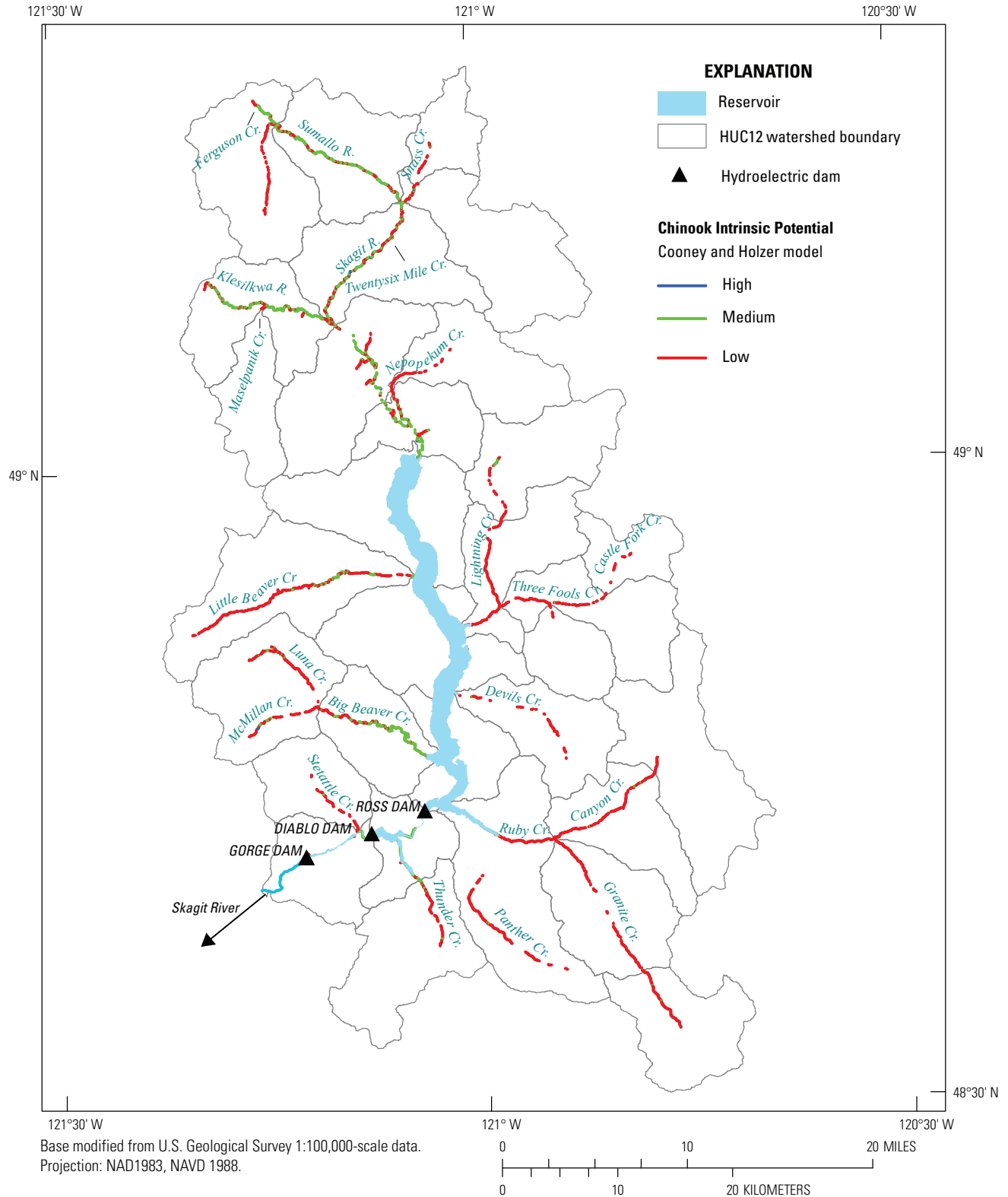


Figure 6. High, medium, and low intrinsic potential scores for Chinook salmon (*Oncorhynchus tshawytscha*) derived from the Cooney and Holzer intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

Table 6. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for coho salmon (*Oncorhynchus kisutch*).

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Big Beaver Creek	Burnett	0	High	NA	NA	NA	NA
Big Beaver Creek	Agrawal	0	High	NA	NA	NA	NA
Big Beaver Creek	Romey	0	High	NA	NA	NA	NA
Big Beaver Creek	Burnett	209	Medium	0.9 (± 1.1)	0.6 (± 0.3)	14.1 (± 2.7)	4.5 (± 1.5)
Big Beaver Creek	Agrawal	216	Medium	1.1 (± 1.4)	0.6 (± 0.3)	14.0 (± 2.7)	4.4 (± 1.5)
Big Beaver Creek	Romey	215	Medium	1.0 (± 1.4)	0.6 (± 0.3)	14.0 (± 2.7)	4.4 (± 1.5)
Big Beaver Creek	Burnett	21	Low	5.0 (± 4.5)	0.6 (± 0.1)	13.8 (± 2.1)	4.2 (± 1.4)
Big Beaver Creek	Agrawal	14	Low	4.6 (± 5.5)	0.5 (± 0.1)	14.5 (± 2.2)	4.6 (± 1.5)
Big Beaver Creek	Romey	15	Low	4.8 (± 5.4)	0.6 (± 0.1)	14.3 (± 2.2)	4.5 (± 1.5)
Little Beaver Creek	Burnett	0	High	NA	NA	NA	NA
Little Beaver Creek	Agrawal	0	High	NA	NA	NA	NA
Little Beaver Creek	Romey	0	High	NA	NA	NA	NA
Little Beaver Creek	Burnett	217	Medium	1.6 (± 1.0)	0.7 (± 0.2)	12.1 (± 2.4)	3.2 (± 1.3)
Little Beaver Creek	Agrawal	234	Medium	1.9 (± 1.5)	0.7 (± 0.2)	12.1 (± 2.6)	3.2 (± 1.4)
Little Beaver Creek	Romey	230	Medium	1.8 (± 1.4)	0.7 (± 0.2)	12.0 (± 2.5)	3.2 (± 1.4)
Little Beaver Creek	Burnett	22	Low	6.6 (± 1.7)	0.8 (± 0.3)	10.2 (± 3.9)	2.5 (± 2.0)
Little Beaver Creek	Agrawal	5	Low	9.1 (± 1.0)	1.1 (± 0.1)	6.6 (± 0.1)	0.8 (± 0.0)
Little Beaver Creek	Romey	9	Low	8.4 (± 1.2)	0.9 (± 0.3)	9.5 (± 4.3)	2.2 (± 2.1)
Ruby Creek	Burnett	0	High	NA	NA	NA	NA
Ruby Creek	Agrawal	0	High	NA	NA	NA	NA
Ruby Creek	Romey	0	High	NA	NA	NA	NA
Ruby Creek	Burnett	59	Medium	1.5 (± 0.5)	0.5 (± 0.2)	19.9 (± 1.4)	9.2 (± 1.4)
Ruby Creek	Agrawal	59	Medium	1.5 (± 0.5)	0.5 (± 0.2)	19.9 (± 1.4)	9.2 (± 1.4)
Ruby Creek	Romey	59	Medium	1.5 (± 0.5)	0.5 (± 0.2)	19.9 (± 1.4)	9.2 (± 1.4)
Ruby Creek	Burnett	0	Low	NA	NA	NA	NA
Ruby Creek	Agrawal	0	Low	NA	NA	NA	NA
Ruby Creek	Romey	0	Low	NA	NA	NA	NA
Canyon Creek	Burnett	0	High	NA	NA	NA	NA
Canyon Creek	Agrawal	0	High	NA	NA	NA	NA
Canyon Creek	Romey	0	High	NA	NA	NA	NA
Canyon Creek	Burnett	130	Medium	2.4 (± 1.1)	0.7 (± 0.2)	12.5 (± 2.0)	3.3 (± 1.0)
Canyon Creek	Agrawal	152	Medium	3.0 (± 1.8)	0.8 (± 0.4)	11.9 (± 2.6)	3.1 (± 1.2)
Canyon Creek	Romey	144	Medium	2.7 (± 1.5)	0.7 (± 0.4)	12.1 (± 2.4)	3.2 (± 1.2)
Canyon Creek	Burnett	26	Low	6.8 (± 1.2)	1.5 (± 0.8)	8.1 (± 2.7)	1.4 (± 1.2)
Canyon Creek	Agrawal	4	Low	8.6 (± 0.2)	2.3 (± 0.7)	6.5 (± 0.1)	0.8 (± 0.0)
Canyon Creek	Romey	12	Low	7.9 (± 0.7)	1.6 (± 0.7)	7.6 (± 2.4)	1.2 (± 1.0)
North Fork Canyon Creek	Burnett	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Agrawal	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Romey	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Burnett	0	Medium	NA	NA	NA	NA
North Fork Canyon Creek	Agrawal	3	Medium	7.2 (± 0.9)	1.2 (± 0.3)	6.4 (± 0.0)	0.7 (± 0.0)

Table 6. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in United States by high, medium, or low intrinsic potential (IP) rank for coho salmon (*Oncorhynchus kisutch*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
North Fork Canyon Creek	Romey	1	Medium	6.4 (NA)	1.0 (NA)	6.4 (NA)	0.7 (NA)
North Fork Canyon Creek	Burnett	8	Low	9.0 (± 1.8)	1.5 (± 0.5)	6.4 (± 0.0)	0.7 (± 0.0)
North Fork Canyon Creek	Agrawal	5	Low	10.1 (± 1.0)	1.7 (± 0.5)	6.3 (± 0.0)	0.7 (± 0.0)
North Fork Canyon Creek	Romey	7	Low	9.4 (± 1.5)	1.6 (± 0.4)	6.3 (± 0.0)	0.7 (± 0.0)
Granite Creek	Burnett	0	High	NA	NA	NA	NA
Granite Creek	Agrawal	0	High	NA	NA	NA	NA
Granite Creek	Romey	0	High	NA	NA	NA	NA
Granite Creek	Burnett	184	Medium	2.4 (± 1.0)	0.9 (± 0.3)	10.5 (± 1.8)	2.3 (± 0.9)
Granite Creek	Agrawal	215	Medium	2.9 (± 1.5)	0.8 (± 0.3)	10.5 (± 1.7)	2.3 (± 0.8)
Granite Creek	Romey	213	Medium	2.8 (± 1.4)	0.8 (± 0.3)	10.5 (± 1.7)	2.3 (± 0.8)
Granite Creek	Burnett	31	Low	5.7 (± 0.7)	0.7 (± 0.2)	11.0 (± 0.7)	2.5 (± 0.4)
Granite Creek	Agrawal	0	Low				
Granite Creek	Romey	2	Low	7.8 (± 0.4)	0.6 (± 0.1)	10.7 (± 0.5)	2.3 (± 0.2)
Lightning Creek	Burnett	0	High	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)
Lightning Creek	Agrawal	0	High	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)
Lightning Creek	Romey	0	High	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)	0.0 (± 0.0)
Lightning Creek	Burnett	159	Medium	2.3 (± 1.2)	0.8 (± 0.4)	11.6 (± 2.9)	3.0 (± 1.7)
Lightning Creek	Agrawal	193	Medium	2.9 (± 1.8)	0.8 (± 0.4)	11.3 (± 2.9)	2.8 (± 1.7)
Lightning Creek	Romey	188	Medium	2.8 (± 1.6)	0.8 (± 0.4)	11.3 (± 2.9)	2.8 (± 1.7)
Lightning Creek	Burnett	37	Low	6.1 (± 1.4)	1.0 (± 0.4)	9.4 (± 2.1)	1.8 (± 1.2)
Lightning Creek	Agrawal	3	Low	9.5 (± 0.6)	1.2 (± 0.3)	7.9 (± 0.6)	1.2 (± 0.2)
Lightning Creek	Romey	8	Low	8.3 (± 1.0)	1.1 (± 0.3)	8.5 (± 1.6)	1.4 (± 0.6)
Luna Creek	Burnett	0	High	NA	NA	NA	NA
Luna Creek	Agrawal	0	High	NA	NA	NA	NA
Luna Creek	Romey	0	High	NA	NA	NA	NA
Luna Creek	Burnett	29	Medium	1.8 (± 1.4)	0.8 (± 0.1)	9.0 (± 0.3)	1.6 (± 0.1)
Luna Creek	Agrawal	35	Medium	2.5 (± 2.1)	0.9 (± 0.1)	8.9 (± 0.3)	1.5 (± 0.1)
Luna Creek	Romey	34	Medium	2.4 (± 1.9)	0.8 (± 0.1)	8.9 (± 0.3)	1.5 (± 0.1)
Luna Creek	Burnett	6	Low	6.0 (± 0.8)	0.9 (± 0.2)	8.6 (± 0.4)	1.4 (± 0.2)
Luna Creek	Agrawal	0	Low				
Luna Creek	Romey	1	Low	7.5 (NA)	0.9 (NA)	8.1 (NA)	1.2 (NA)
Three Fools Creek	Burnett	0	High	NA	NA	NA	NA
Three Fools Creek	Agrawal	0	High	NA	NA	NA	NA
Three Fools Creek	Romey	0	High	NA	NA	NA	NA
Three Fools Creek	Burnett	83	Medium	3.1 (± 1.0)	0.9 (± 0.3)	10.6 (± 1.5)	2.3 (± 0.7)
Three Fools Creek	Agrawal	102	Medium	3.7 (± 1.5)	0.9 (± 0.4)	10.6 (± 1.5)	2.3 (± 0.7)
Three Fools Creek	Romey	95	Medium	3.4 (± 1.2)	0.9 (± 0.4)	10.5 (± 1.5)	2.3 (± 0.7)
Three Fools Creek	Burnett	22	Low	6.7 (± 2.2)	0.9 (± 0.6)	10.5 (± 2.0)	2.3 (± 0.8)
Three Fools Creek	Agrawal	3	Low	10.7 (± 2.9)	1.0 (± 0.6)	9.8 (± 4.2)	2.2 (± 1.5)
Three Fools Creek	Romey	10	Low	8.5 (± 2.1)	0.8 (± 0.3)	11.1 (± 2.3)	2.6 (± 0.9)
Castle Fork Creek	Burnett	0	High	NA	NA	NA	NA

Table 6. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in United States by high, medium, or low intrinsic potential (IP) rank for coho salmon (*Oncorhynchus kisutch*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Castle Fork Creek	Agrawal	0	High	NA	NA	NA	NA
Castle Fork Creek	Romey	0	High	NA	NA	NA	NA
Castle Fork Creek	Burnett	16	Medium	3.1 (\pm 1.1)	2.0 (\pm 1.2)	5.8 (\pm 0.9)	0.6 (\pm 0.2)
Castle Fork Creek	Agrawal	64	Medium	5.7 (\pm 1.8)	1.9 (\pm 0.9)	5.3 (\pm 1.2)	0.5 (\pm 0.2)
Castle Fork Creek	Romey	43	Medium	4.9 (\pm 1.6)	1.7 (\pm 0.8)	5.7 (\pm 1.1)	0.6 (\pm 0.2)
Castle Fork Creek	Burnett	75	Low	8.0 (\pm 2.4)	2.1 (\pm 0.8)	4.6 (\pm 1.4)	0.4 (\pm 0.3)
Castle Fork Creek	Agrawal	27	Low	10.6 (\pm 0.9)	2.5 (\pm 0.7)	3.5 (\pm 1.1)	0.2 (\pm 0.1)
Castle Fork Creek	Romey	47	Low	9.3 (\pm 2.1)	2.3 (\pm 0.6)	4.0 (\pm 1.2)	0.3 (\pm 0.2)
Panther Creek	Burnett	0	High	NA	NA	NA	NA
Panther Creek	Agrawal	0	High	NA	NA	NA	NA
Panther Creek	Romey	0	High	NA	NA	NA	NA
Panther Creek	Burnett	115	Medium	3.0 (\pm 1.0)	1.3 (\pm 1.0)	8.3 (\pm 1.7)	1.4 (\pm 0.6)
Panther Creek	Agrawal	184	Medium	4.2 (\pm 1.8)	1.3 (\pm 0.9)	8.4 (\pm 2.2)	1.5 (\pm 0.8)
Panther Creek	Romey	160	Medium	3.8 (\pm 1.5)	1.1 (\pm 0.4)	8.5 (\pm 2.1)	1.5 (\pm 0.7)
Panther Creek	Burnett	75	Low	6.4 (\pm 1.2)	1.2 (\pm 0.5)	8.6 (\pm 2.9)	1.6 (\pm 1.0)
Panther Creek	Agrawal	6	Low	8.8 (\pm 0.4)	0.9 (\pm 0.3)	9.1 (\pm 2.4)	1.7 (\pm 1.0)
Panther Creek	Romey	26	Low	7.8 (\pm 0.7)	1.2 (\pm 0.6)	8.5 (\pm 2.8)	1.6 (\pm 1.0)
Devils Creek	Burnett	0	High	NA	NA	NA	NA
Devils Creek	Agrawal	0	High	NA	NA	NA	NA
Devils Creek	Romey	0	High	NA	NA	NA	NA
Devils Creek	Burnett	71	Medium	3.5 (\pm 0.9)	1.4 (\pm 0.5)	7.1 (\pm 1.4)	1.0 (\pm 0.4)
Devils Creek	Agrawal	131	Medium	4.5 (\pm 1.4)	1.3 (\pm 0.5)	7.4 (\pm 1.5)	1.1 (\pm 0.4)
Devils Creek	Romey	126	Medium	4.4 (\pm 1.2)	1.2 (\pm 0.5)	7.5 (\pm 1.4)	1.1 (\pm 0.4)
Devils Creek	Burnett	65	Low	6.0 (\pm 0.3)	1.2 (\pm 0.4)	7.8 (\pm 1.6)	1.2 (\pm 0.4)
Devils Creek	Agrawal	5	Low	9.5 (\pm 0.4)	1.4 (\pm 0.7)	6.9 (\pm 2.9)	1.0 (\pm 0.8)
Devils Creek	Romey	10	Low	8.5 (\pm 1.1)	1.4 (\pm 0.6)	6.9 (\pm 2.7)	1.0 (\pm 0.7)
Stetattle Creek	Burnett	0	High	NA	NA	NA	NA
Stetattle Creek	Agrawal	0	High	NA	NA	NA	NA
Stetattle Creek	Romey	0	High	NA	NA	NA	NA
Stetattle Creek	Burnett	44	Medium	2.7 (\pm 1.2)	1.3 (\pm 1.9)	10.4 (\pm 2.3)	2.3 (\pm 0.7)
Stetattle Creek	Agrawal	76	Medium	4.2 (\pm 2.1)	1.1 (\pm 1.3)	10.0 (\pm 2.0)	2.1 (\pm 0.7)
Stetattle Creek	Romey	66	Medium	3.8 (\pm 1.9)	0.9 (\pm 0.2)	10.2 (\pm 1.6)	2.1 (\pm 0.7)
Stetattle Creek	Burnett	36	Low	6.6 (\pm 1.6)	1.0 (\pm 0.2)	9.5 (\pm 1.9)	1.8 (\pm 0.8)
Stetattle Creek	Agrawal	3	Low	10.7 (\pm 3.3)	1.1 (\pm 0.0)	11.4 (\pm 0.5)	2.7 (\pm 0.2)
Stetattle Creek	Romey	11	Low	8.2 (\pm 2.2)	1.0 (\pm 0.1)	10.7 (\pm 1.5)	2.4 (\pm 0.6)
McMillan Creek	Burnett	0	High	NA	NA	NA	NA
McMillan Creek	Agrawal	0	High	NA	NA	NA	NA
McMillan Creek	Romey	0	High	NA	NA	NA	NA
McMillan Creek	Burnett	52	Medium	2.6 (\pm 1.3)	2.9 (\pm 5.9)	8.3 (\pm 0.9)	1.3 (\pm 0.3)
McMillan Creek	Agrawal	67	Medium	3.3 (\pm 1.8)	2.6 (\pm 5.3)	8.3 (\pm 0.9)	1.3 (\pm 0.3)
McMillan Creek	Romey	58	Medium	3.1 (\pm 1.7)	1.8 (\pm 4.7)	8.4 (\pm 0.9)	1.4 (\pm 0.3)

Table 6. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in United States by high, medium, or low intrinsic potential (IP) rank for coho salmon (*Oncorhynchus kisutch*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
McMillan Creek	Burnett	20	Low	7.1 (\pm 2.4)	2.0 (\pm 1.9)	7.9 (\pm 1.5)	1.2 (\pm 0.4)
McMillan Creek	Agrawal	5	Low	10.7 (\pm 1.8)	2.8 (\pm 1.2)	7.0 (\pm 2.1)	1.0 (\pm 0.6)
McMillan Creek	Romey	8	Low	9.4 (\pm 2.2)	2.1 (\pm 1.3)	7.8 (\pm 1.9)	1.2 (\pm 0.6)
Slate Creek	Burnett	0	High	NA	NA	NA	NA
Slate Creek	Agrawal	0	High	NA	NA	NA	NA
Slate Creek	Romey	0	High	NA	NA	NA	NA
Slate Creek	Burnett	1	Medium	4.6 (NA)	0.8 (NA)	8.5 (NA)	1.4 (NA)
Slate Creek	Agrawal	9	Medium	6.1 (\pm 1.1)	1.1 (\pm 0.3)	8.6 (\pm 0.1)	1.4 (\pm 0.0)
Slate Creek	Romey	6	Medium	5.5 (\pm 0.6)	1.1 (\pm 0.2)	8.6 (\pm 0.1)	1.4 (\pm 0.0)
Slate Creek	Burnett	10	Low	6.9 (\pm 1.4)	1.2 (\pm 0.2)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	Agrawal	2	Low	8.9 (\pm 0.7)	1.3 (\pm 0.1)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	Romey	5	Low	8.0 (\pm 1.0)	1.3 (\pm 0.3)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Hozomeen Creek	Burnett	0	High	NA	NA	NA	NA
Hozomeen Creek	Agrawal	0	High	NA	NA	NA	NA
Hozomeen Creek	Romey	0	High	NA	NA	NA	NA
Hozomeen Creek	Burnett	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Agrawal	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Romey	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Burnett	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	Agrawal	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	Romey	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)

Table 7. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, or low intrinsic potential rank (IP) for coho salmon (*Oncorhynchus kisutch*).

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Skagit River	Burnett	22	High	0.3 (\pm 0.5)	24.6 (\pm 33.5)	26.4 (\pm 1.1)	17.3 (\pm 1.5)
Skagit River	Agrawal	22	High	0.3 (\pm 0.5)	24.6 (\pm 33.5)	26.4.0 (\pm 1.1)	17.3 (\pm 1.5)
Skagit River	Romey	34	High	0.4 (\pm 0.5)	9.4 (\pm 7.8)	24.9 (\pm 3.2)	15.5 (\pm 3.8)
Skagit River	Burnett	336	Medium	0.5 (\pm 0.6)	1.5 (\pm 1.0)	22.4 (\pm 3.0)	12.2 (\pm 3.4)
Skagit River	Agrawal	338	Medium	0.5 (\pm 0.7)	1.5 (\pm 1.0)	22.3 (\pm 3.0)	12.1 (\pm 3.4)
Skagit River	Romey	326	Medium	0.5 (\pm 0.7)	2.2 (\pm 9.8)	22.3 (\pm 3.0)	12.1 (\pm 3.4)
Skagit River	Burnett	2	Low	4.8 (\pm 0.0)	2.3 (\pm 0.7)	14.5 (\pm 0.7)	4.6 (\pm 0.5)
Skagit River	Agrawal	0	Low	NA	NA	NA	NA
Skagit River	Romey	0	Low	NA	NA	NA	NA
Klesilkwa River	Burnett	0	High	NA	NA	NA	NA
Klesilkwa River	Agrawal	0	High	NA	NA	NA	NA
Klesilkwa River	Romey	0	High	NA	NA	NA	NA
Klesilkwa River	Burnett	162	Medium	0.4 (\pm 0.7)	0.7 (\pm 0.2)	11.0 (\pm 2.7)	2.7 (\pm 1.3)
Klesilkwa River	Agrawal	166	Medium	0.5 (\pm 1.1)	0.7 (\pm 0.2)	11.0 (\pm 2.7)	2.6 (\pm 1.3)
Klesilkwa River	Romey	165	Medium	0.5 (\pm 1.0)	0.7 (\pm 0.2)	11.0 (\pm 2.6)	2.6 (\pm 1.3)
Klesilkwa River	Burnett	8	Low	8.3 (\pm 2.7)	1.1 (\pm 0.1)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Klesilkwa River	Agrawal	4	Low	10.5 (\pm 1.9)	1.2 (\pm 0.0)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Klesilkwa River	Romey	5	Low	9.8 (\pm 2.3)	1.1 (\pm 0.0)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Sumallo River	Burnett	0	High	NA	NA	NA	NA
Sumallo River	Agrawal	0	High	NA	NA	NA	NA
Sumallo River	Romey	0	High	NA	NA	NA	NA
Sumallo River	Burnett	232	Medium	1.1 (\pm 1.4)	0.7 (\pm 0.2)	11.2 (\pm 2.6)	2.7 (\pm 1.2)
Sumallo River	Agrawal	246	Medium	1.4 (\pm 1.7)	0.7 (\pm 0.2)	11.0 (\pm 2.7)	2.6 (\pm 1.3)
Sumallo River	Romey	243	Medium	1.3 (\pm 1.6)	0.7 (\pm 0.2)	11.1 (\pm 2.6)	2.7 (\pm 1.2)
Sumallo River	Burnett	15	Low	5.4 (\pm 1.7)	1.0 (\pm 0.2)	7.6 (\pm 1.5)	1.1 (\pm 0.5)
Sumallo River	Agrawal	1	Low	0.2 (NA)	0.7 (NA)	9.8 (\pm NA)	1.9 (\pm NA)
Sumallo River	Romey	4	Low	5.5 (\pm 3.6)	1.2 (\pm 0.3)	6.5 (\pm 2.2)	0.9 (\pm 0.7)
Ferguson Creek	Burnett	0	High	NA	NA	NA	NA
Ferguson Creek	Agrawal	0	High	NA	NA	NA	NA
Ferguson Creek	Romey	0	High	NA	NA	NA	NA
Ferguson Creek	Burnett	43	Medium	0.5 (\pm 0.9)	1.3 (\pm 0.2)	5.6 (\pm 0.6)	0.6 (\pm 0.1)
Ferguson Creek	Agrawal	47	Medium	1.0 (\pm 2.0)	1.4 (\pm 0.2)	5.6 (\pm 0.7)	0.5 (\pm 0.1)
Ferguson Creek	Romey	44	Medium	0.6 (\pm 1.2)	1.3 (\pm 0.2)	5.6 (\pm 0.6)	0.6 (\pm 0.1)
Ferguson Creek	Burnett	6	Low	6.0 (\pm 3.0)	1.5 (\pm 0.2)	4.9 (\pm 0.5)	0.4 (\pm 0.1)
Ferguson Creek	Agrawal	2	Low	4.2 (\pm 5.8)	1.4 (\pm 0.2)	5.3 (\pm 1.0)	0.5 (\pm 0.2)
Ferguson Creek	Romey	5	Low	6.0 (\pm 3.3)	1.5 (\pm 0.2)	4.9 (\pm 0.6)	0.4 (\pm 0.1)
Nepopekum Creek	Burnett	0	High	NA	NA	NA	NA
Nepopekum Creek	Agrawal	0	High	NA	NA	NA	NA
Nepopekum Creek	Romey	0	High	NA	NA	NA	NA
Nepopekum Creek	Burnett	89	Medium	1.9 (\pm 1.5)	0.9 (\pm 0.1)	8.8 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Agrawal	109	Medium	2.7 (\pm 2.1)	0.9 (\pm 0.1)	8.7 (\pm 0.3)	1.5 (\pm 0.1)

Table 7. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, or low intrinsic potential rank (IP) for coho salmon (*Oncorhynchus kisutch*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Nepopekum Creek	Romey	107	Medium	2.6 (\pm 2.0)	0.9 (\pm 0.1)	8.7 (\pm 0.2)	1.5 (\pm 0.0)
Nepopekum Creek	Burnett	26	Low	6.8 (\pm 1.7)	0.9 (\pm 0.1)	8.5 (\pm 0.2)	1.4 (\pm 0.1)
Nepopekum Creek	Agrawal	6	Low	9.4 (\pm 1.2)	0.8 (\pm 0.1)	8.5 (\pm 0.1)	1.4 (\pm 0.0)
Nepopekum Creek	Romey	8	Low	9.0 (\pm 1.4)	0.9 (\pm 0.1)	8.5 (\pm 0.2)	1.4 (\pm 0.1)
Maselpanik Creek	Burnett	0	High	NA	NA	NA	NA
Maselpanik Creek	Agrawal	0	High	NA	NA	NA	NA
Maselpanik Creek	Romey	0	High	NA	NA	NA	NA
Maselpanik Creek	Burnett	6	Medium	2.1 (\pm 0.9)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpanik Creek	Agrawal	9	Medium	3.7 (\pm 2.5)	0.7 (\pm 0.1)	10.4 (\pm 0.1)	2.2 (\pm 0.1)
Maselpanik Creek	Romey	7	Medium	2.7 (\pm 1.7)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpanik Creek	Burnett	6	Low	8.0 (\pm 1.5)	0.7 (\pm 0.2)	10.5 (\pm 0.2)	2.2 (\pm 0.1)
Maselpanik Creek	Agrawal	3	Low	9.3 (\pm 0.6)	0.8 (\pm 0.2)	10.0 (\pm 0.3)	2.2 (\pm 0.1)
Maselpanik Creek	Romey	5	Low	8.5 (\pm 1.2)	0.7 (\pm 0.2)	10.5 (\pm 0.2)	2.2 (\pm 0.1)
Snass Creek	Burnett	0	High	NA	NA	NA	NA
Snass Creek	Agrawal	0	High	NA	NA	NA	NA
Snass Creek	Romey	0	High	NA	NA	NA	NA
Snass Creek	Burnett	21	Medium	2.6 (\pm 1.4)	1.3 (\pm 0.2)	6.6 (\pm 0.9)	0.8 (\pm 0.2)
Snass Creek	Agrawal	34	Medium	4.0 (\pm 2.1)	1.3 (\pm 0.3)	6.6 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	Romey	31	Medium	3.6 (\pm 1.9)	1.3 (\pm 0.3)	6.6 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	Burnett	22	Low	7.7 (\pm 2.3)	1.2 (\pm 0.3)	6.8 (\pm 0.8)	0.9 (\pm 0.2)
Snass Creek	Agrawal	9	Low	10.1 (\pm 1.3)	1.0 (\pm 0.2)	7.1 (\pm 0.08)	0.9 (\pm 0.2)
Snass Creek	Romey	12	Low	9.4 (\pm 0.7)	1.0 (\pm 0.2)	6.9 (\pm 0.9)	0.9 (\pm 0.2)
Twentysix Mile Creek	Burnett	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Agrawal	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Romey	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Burnett	0	Medium	NA	NA	NA	NA
Twentysix Mile Creek	Agrawal	2	Medium	5.5 (\pm 0.2)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Romey	2	Medium	5.5 (\pm 0.2)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Burnett	8	Low	10.1 (\pm 3.1)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Agrawal	6	Low	11.6 (\pm 1.4)	1.2 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Romey	6	Low	11.6 (\pm 1.4)	1.2 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Marmotte Creek	Burnett	0	High	NA	NA	NA	NA
Marmotte Creek	Agrawal	0	High	NA	NA	NA	NA
Marmotte Creek	Romey	0	High	NA	NA	NA	NA
Marmotte Creek	Burnett	0	Medium	NA	NA	NA	NA
Marmotte Creek	Agrawal	2	Medium	6.4 (\pm 0.8)	1.6 (\pm 0.4)	4.8 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	Romey	1	Medium	5.9 (NA)	1.9 (NA)	4.8 (NA)	0.4 (NA)
Marmotte Creek	Burnett	3	Low	7.1 (\pm 1.4)	1.6 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	Agrawal	1	Low	8.6 (NA)	1.7 (NA)	4.7 (NA)	0.4 (NA)
Marmotte Creek	Romey	2	Low	7.8 (\pm 1.2)	1.5 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)

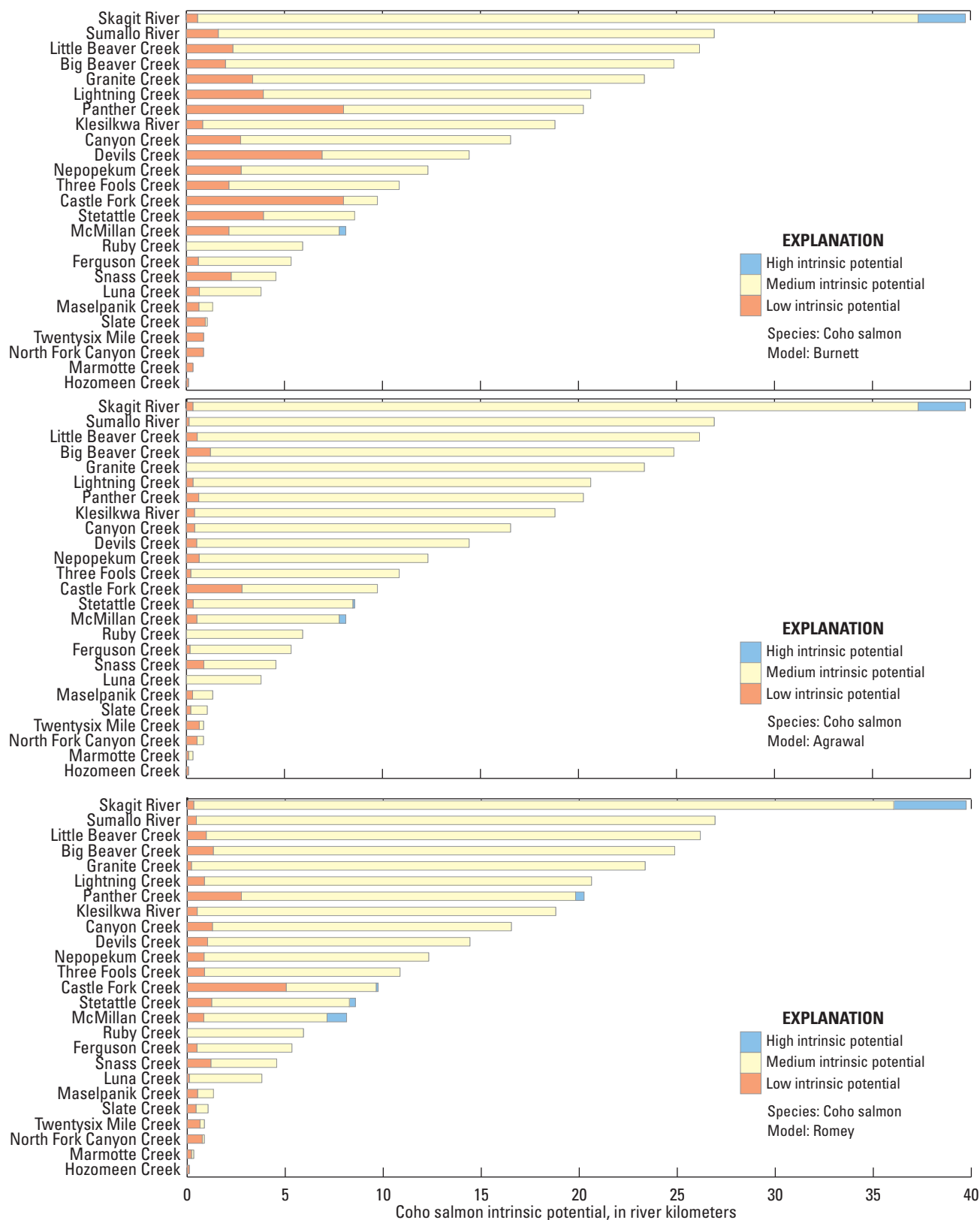


Figure 7. Length in kilometers of high, medium, or low habitat intrinsic potential for coho salmon (*Oncorhynchus kisutch*) based on three different models for target tributaries upstream from the three upper Skagit River dams, in northern Washington.

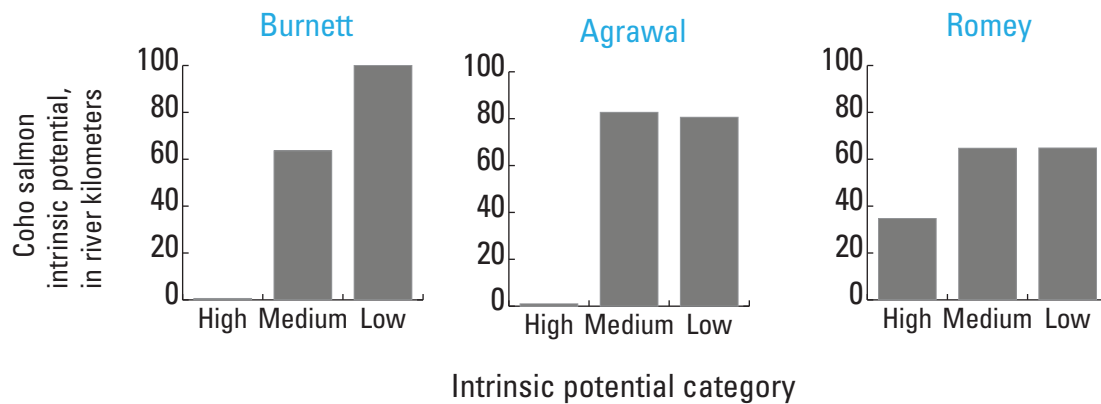


Figure 8. Length in kilometers of high, medium, or low habitat intrinsic potential for coho salmon (*Oncorhynchus kisutch*) based on three different models for non-target tributaries upstream from the three upper Skagit River dams, in northern Washington.

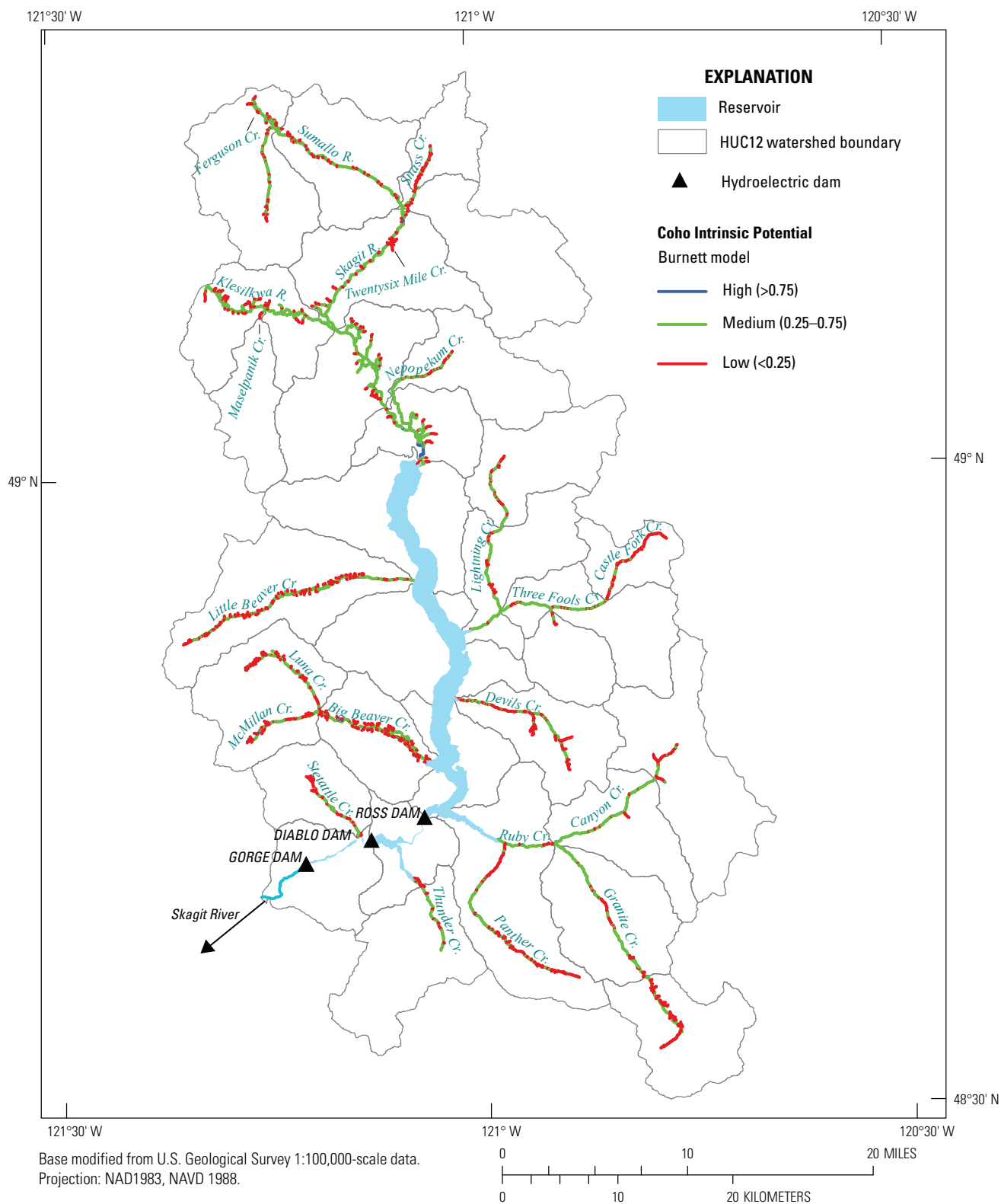


Figure 9. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for coho salmon (*Oncorhynchus kisutch*) derived from the Burnett intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

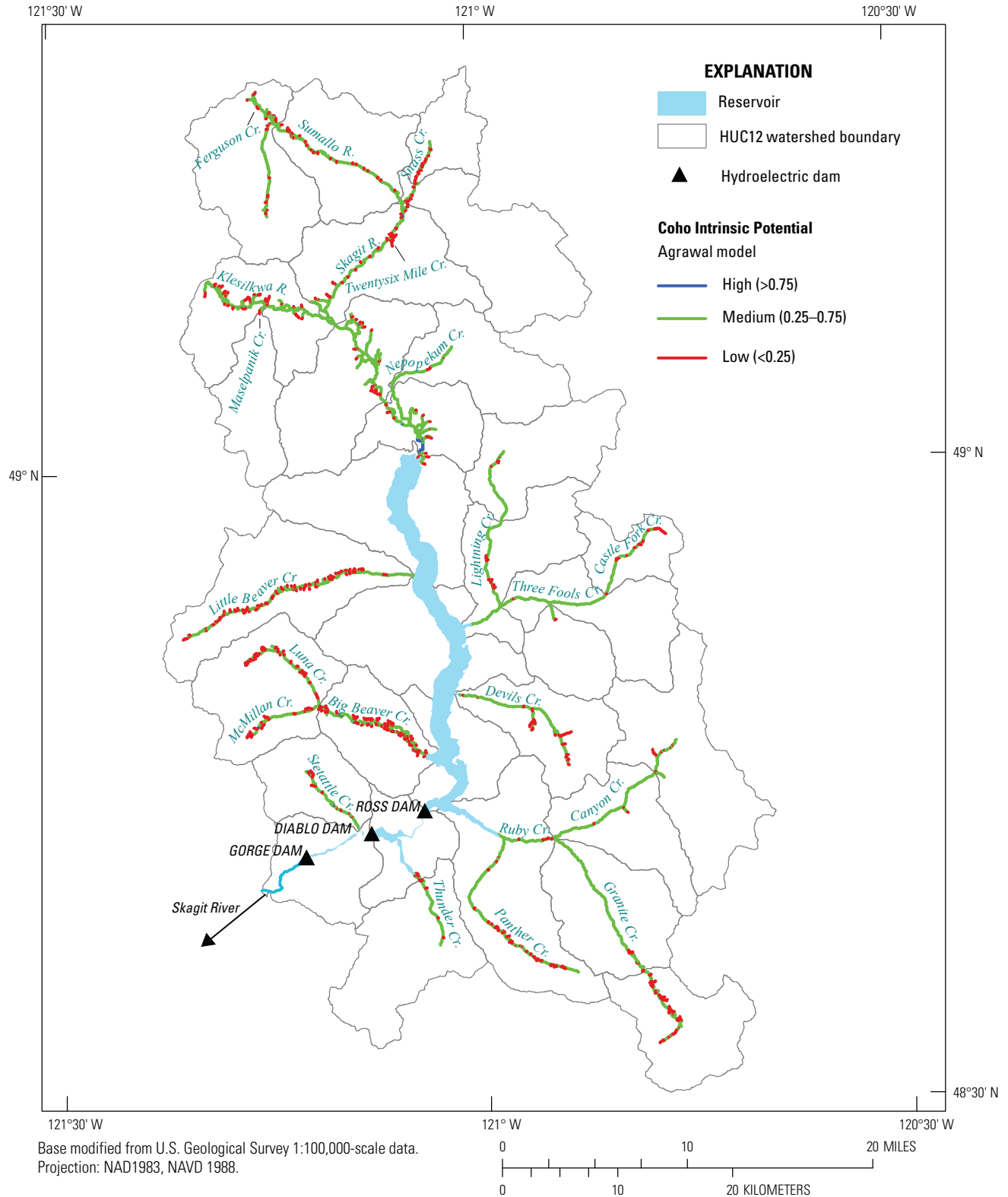


Figure 10. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for coho salmon (*Oncorhynchus kisutch*) derived from the Agrawal intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

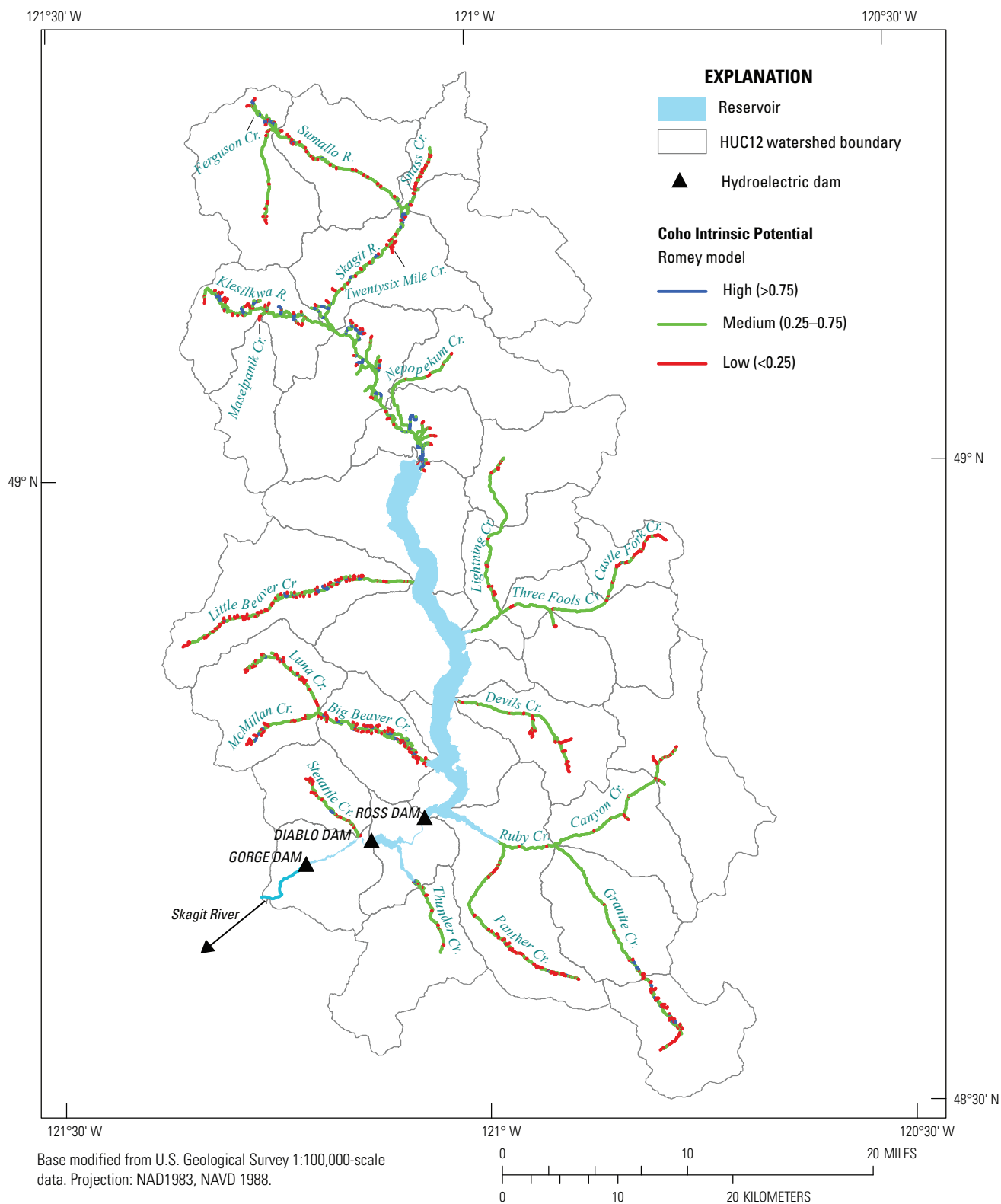


Figure 11. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for coho salmon (*Oncorhynchus kisutch*) derived from the Romey intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

Steelhead Intrinsic Potential Model Results

The IP estimates for steelhead upstream from the Skagit River Hydroelectric Project dams were similar across the three models (fig. 12). The Agrawal and Burnett models were calculated using the same three parameters (gradient, bankfull width, and valley width index) but with different weights assigned to the habitat preference curves, whereas the Puget Sound Technical Recovery Team model was based on combinations of gradient and bankfull width assigned as low, medium, and high IP. In general, steelhead showed greater amounts of high IP of the three species examined. The three models differed in the amount of high IP in the Skagit River main stem and the total amount of low IP habitat: the Puget Sound TRT model estimated greater amounts of these habitats than the other two models. Summaries of habitat parameter values and the number of reaches scored as low, medium, and high IP sections are provided for main-stem and tributary habitat in the United States (table 8) and Canada (table 9).

Steelhead Intrinsic Potential Based on the Puget Sound Technical Recovery Team Model

The Puget Sound Technical Recovery Team model identified 880 low (94.4 km), 573 medium (62.1 km), and 1382 high (149.0 km) IP reaches for steelhead across all 25 targeted streams (fig. 12), with additional 919 low (92.6 km), 428 medium (44.2 km), and 268 high (27.5 km) IP reaches identified from non-target reaches (fig. 13). Most of the high IP steelhead habitat was found in tributaries (145.6 km), with fewer high IP steelhead reaches (totaling 3.3 km) found in the main-stem Skagit River (fig. 14). There were 19 targeted tributaries with greater than 1 km of high IP habitat, all targeted streams except Slate Creek, Twentysix Mile Creek, North Fork Canyon Creek, Maselpalik Creek, Marmotte Creek, and Hozomeen Creek (with five of these six having only low IP habitat for steelhead).

Steelhead Intrinsic Potential Based on the Agrawal Model

The Agrawal model identified 28 low (2.5 km), 842 medium (92.3 km), and 1964 high (210.4 km) intrinsic potential reaches for steelhead across all 25 targeted streams (fig. 12), with additional 326 low (30.9 km), 970 medium (99.5 km), and 319 high (33.8 km) IP reaches identified from non-target reaches (fig. 13). As seen in the Puget Sound TRT steelhead model IP results, most of the high IP habitat was found in tributaries (195.5 km) compared with the 14.9 km in the main-stem Skagit River (fig. 15). There were 19 targeted streams that had greater than 1 km of high IP habitat, with 5 of the 6 remaining targeted streams having 329–952 m of high IP habitat. Of the non-targeted streams with names, Thunder Creek (6.8 km) and Cinnamon Creek (1.8 km) had greater than 1 km of high IP habitat, in addition to 22.7 km of high IP habitat found in unnamed streams.

Steelhead Intrinsic Potential Based on the Burnett Model

The Burnett model identified 205 low (21.3 km), 658 medium (71.4 km), and 1971 high (212.5 km) IP reaches for steelhead across all 25 targeted streams (fig. 12), with an additional 858 low (84.9 km), 387 medium (40.2 km), and 370 high (39.2 km) IP reaches identified from non-target reaches (fig. 13). As seen with the other two steelhead IP models, most of the high IP habitat was found in tributaries (186.1 km) compared with the 26.4 km of high IP habitats in the main-stem Skagit River (fig. 16). There were 19 targeted streams that had greater than 1 km of high IP habitat, with 3 of the 6 having 111–703 m of high IP habitat, in addition to 28.9 km of high IP habitat found in unnamed streams.

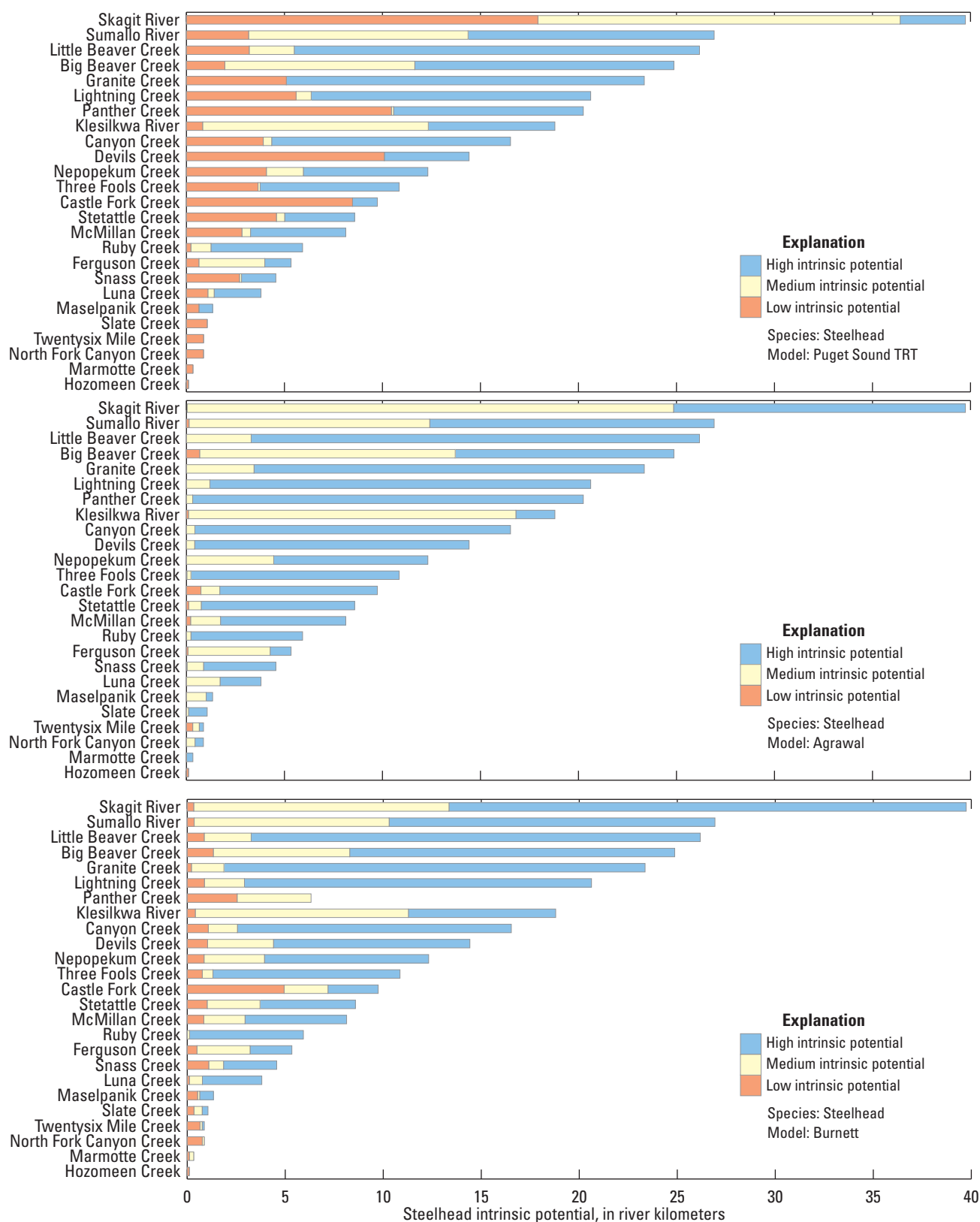


Figure 12. Length in kilometers of high, medium, and low habitat intrinsic potential for steelhead (*Oncorhynchus mykiss*) based on three different models for target tributaries upstream from the three upper Skagit River dams, in northern Washington.

Table 8. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for steelhead (*Oncorhynchus mykiss*).

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Big Beaver Creek	PS_TRT	120	High	1.3 (\pm 1.0)	0.7 (\pm 0.3)	12.8 (\pm 3.0)	3.7 (\pm 1.5)
Big Beaver Creek	Agrawal	102	High	1.9 (\pm 1.7)	0.6 (\pm 0.1)	13.2 (\pm 2.1)	3.8 (\pm 1.3)
Big Beaver Creek	Burnett	150	High	1.3 (\pm 1.2)	0.6 (\pm 0.3)	13.3 (\pm 2.9)	4.0 (\pm 1.5)
Big Beaver Creek	PS_TRT	92	Medium	0.1 (\pm 0.1)	0.5 (\pm 0.0)	16.0 (\pm 0.5)	5.6 (\pm 0.4)
Big Beaver Creek	Agrawal	119	Medium	0.8 (\pm 2.1)	0.6 (\pm 0.3)	14.7 (\pm 3.0)	4.9 (\pm 1.5)
Big Beaver Creek	Burnett	65	Medium	0.4 (\pm 1.5)	0.5 (\pm 0.1)	15.8 (\pm 1.1)	5.5 (\pm 0.8)
Big Beaver Creek	PS_TRT	18	Low	7.0 (\pm 2.9)	0.6 (\pm 0.1)	12.4 (\pm 0.9)	3.3 (\pm 0.6)
Big Beaver Creek	Agrawal	9	Low	1.4 (\pm 4.1)	0.5 (\pm 0.1)	15.7 (\pm 1.5)	5.5 (\pm 1.1)
Big Beaver Creek	Burnett	15	Low	4.8 (\pm 5.4)	0.6 (\pm 0.1)	14.3 (\pm 2.2)	4.5 (\pm 1.5)
Little Beaver Creek	PS_TRT	189	High	1.7 (\pm 0.8)	0.7 (\pm 0.2)	12.0 (\pm 2.4)	3.1 (\pm 1.3)
Little Beaver Creek	Agrawal	209	High	2.3 (\pm 1.7)	0.7 (\pm 0.2)	11.7 (\pm 2.7)	3.0 (\pm 1.5)
Little Beaver Creek	Burnett	209	High	1.8 (\pm 1.1)	0.7 (\pm 0.2)	11.9 (\pm 2.5)	3.1 (\pm 1.4)
Little Beaver Creek	PS_TRT	21	Medium	0.1 (\pm 0.1)	0.6 (\pm 0.1)	13.9 (\pm 0.9)	4.2 (\pm 0.6)
Little Beaver Creek	Agrawal	30	Medium	0.5 (\pm 1.9)	0.6 (\pm 0.1)	13.5 (\pm 1.6)	4.0 (\pm 0.9)
Little Beaver Creek	Burnett	22	Medium	1.9 (\pm 2.9)	0.6 (\pm 0.2)	13.4 (\pm 2.7)	4.0 (\pm 1.4)
Little Beaver Creek	PS_TRT	29	Low	6.1 (\pm 1.8)	0.8 (\pm 0.3)	10.4 (\pm 3.8)	2.6 (\pm 1.9)
Little Beaver Creek	Agrawal	0	Low	NA	NA	NA	NA
Little Beaver Creek	Burnett	8	Low	8.6 (\pm 1.1)	0.9 (\pm 0.3)	8.7 (\pm 3.9)	1.8 (\pm 1.9)
Ruby Creek	PS_TRT	43	High	1.5 (\pm 0.3)	0.5 (\pm 0.2)	19.1 (\pm 0.4)	8.4 (\pm 0.4)
Ruby Creek	Agrawal	57	High	1.6 (\pm 0.4)	0.5 (\pm 0.2)	19.8 (\pm 1.3)	9.1 (\pm 1.4)
Ruby Creek	Burnett	58	High	1.5 (\pm 0.4)	0.5 (\pm 0.2)	19.8 (\pm 1.3)	9.1 (\pm 1.4)
Ruby Creek	PS_TRT	14	Medium	1.7 (\pm 0.6)	0.4 (\pm 0.1)	21.8 (\pm 1.0)	11.3 (\pm 1.1)
Ruby Creek	Agrawal	2	Medium	0.1 (\pm 0.1)	0.3 (\pm 0.1)	22.2 (\pm 0.1)	11.6 (\pm 0.1)
Ruby Creek	Burnett	1	Medium	0.0 (NA)	0.3 (NA)	22.2 (NA)	11.7 (NA)
Ruby Creek	PS_TRT	2	Low	0.1 (\pm 0.1)	0.3 (\pm 0.1)	22.2 (\pm 0.1)	11.6 (\pm 0.1)
Ruby Creek	Agrawal	0	Low	NA	NA	NA	NA
Ruby Creek	Burnett	0	Low	NA	NA	NA	NA
Canyon Creek	PS_TRT	115	High	2.3 (\pm 0.8)	0.7 (\pm 0.2)	12.6 (\pm 1.8)	3.4 (\pm 1.0)
Canyon Creek	Agrawal	152	High	3.2 (\pm 2.0)	0.8 (\pm 0.5)	11.7 (\pm 2.7)	3.0 (\pm 1.3)
Canyon Creek	Burnett	132	High	2.5 (\pm 1.1)	0.7 (\pm 0.3)	12.4 (\pm 2.1)	3.3 (\pm 1.1)
Canyon Creek	PS_TRT	4	Medium	0.1 (\pm 0.1)	0.7 (\pm 0.0)	12.4 (\pm 1.0)	3.2 (\pm 0.6)
Canyon Creek	Agrawal	4	Medium	0.1 (\pm 0.1)	0.7 (\pm 0.0)	12.4 (\pm 1.0)	3.2 (\pm 0.6)
Canyon Creek	Burnett	14	Medium	5.4 (\pm 2.3)	1.3 (\pm 0.8)	8.4 (\pm 2.8)	1.5 (\pm 1.2)
Canyon Creek	PS_TRT	37	Low	6.1 (\pm 1.5)	1.3 (\pm 0.8)	8.9 (\pm 3.2)	1.8 (\pm 1.4)
Canyon Creek	Agrawal	0	Low	NA	NA	NA	NA
Canyon Creek	Burnett	10	Low	8.1 (\pm 0.6)	1.7 (\pm 0.8)	7.7 (\pm 2.6)	1.3 (\pm 1.1)
North Fork Canyon Creek	PS_TRT	0	High	NA	NA	NA	NA
North Fork Canyon Creek	Agrawal	4	High	7.6 (\pm 1.1)	1.4 (\pm 0.4)	6.4 (\pm 0.0)	0.7 (\pm 0.0)
North Fork Canyon Creek	Burnett	0	High	NA	NA	NA	NA
North Fork Canyon Creek	PS_TRT	0	Medium	NA	NA	NA	NA
North Fork Canyon Creek	Agrawal	4	Medium	10.5 (\pm 0.7)	1.6 (\pm 0.6)	6.3 (\pm 0.0)	0.7 (\pm 0.0)

Table 8. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for steelhead (*Oncorhynchus mykiss*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
North Fork Canyon Creek	Burnett	1	Medium	6.4 (NA)	1.0 (NA)	6.4 (NA)	0.7 (NA)
North Fork Canyon Creek	PS_TRT	8	Low	9.0 (\pm 1.8)	1.5 (\pm 0.5)	6.4 (\pm 0.0)	0.7 (\pm 0.0)
North Fork Canyon Creek	Agrawal	0	Low	NA	NA	NA	NA
North Fork Canyon Creek	Burnett	7	Low	9.4 (\pm 1.5)	1.6 (\pm 0.4)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Granite Creek	PS_TRT	168	High	2.2 (\pm 0.8)	0.9 (\pm 0.3)	10.4 (\pm 1.8)	2.3 (\pm 0.9)
Granite Creek	Agrawal	184	High	3.1 (\pm 1.5)	0.8 (\pm 0.3)	10.8 (\pm 1.7)	2.4 (\pm 0.8)
Granite Creek	Burnett	198	High	2.6 (\pm 1.2)	0.9 (\pm 0.3)	10.5 (\pm 1.8)	2.3 (\pm 0.8)
Granite Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Granite Creek	Agrawal	31	Medium	1.6 (\pm 0.5)	1.1 (\pm 0.4)	9.1 (\pm 0.6)	1.6 (\pm 0.2)
Granite Creek	Burnett	15	Medium	5.9 (\pm 0.4)	0.6 (\pm 0.1)	11.2 (\pm 0.6)	2.5 (\pm 0.3)
Granite Creek	PS_TRT	47	Low	5.2 (\pm 0.9)	0.7 (\pm 0.2)	10.9 (\pm 1.0)	2.4 (\pm 0.4)
Granite Creek	Agrawal	0	Low	NA	NA	NA	NA
Granite Creek	Burnett	2	Low	7.8 (\pm 0.4)	0.6 (\pm 0.1)	10.7 (\pm 0.5)	2.3 (\pm 0.2)
Lightning Creek	PS_TRT	136	High	2.2 (\pm 0.9)	0.7 (\pm 0.4)	12.1 (\pm 2.7)	3.2 (\pm 1.7)
Lightning Creek	Agrawal	185	High	3.1 (\pm 1.8)	0.8 (\pm 0.4)	11.4 (\pm 2.9)	2.9 (\pm 1.7)
Lightning Creek	Burnett	169	High	2.7 (\pm 1.3)	0.8 (\pm 0.4)	11.6 (\pm 2.8)	3.0 (\pm 1.7)
Lightning Creek	PS_TRT	7	Medium	0.0 (\pm 0.0)	1.4 (\pm 0.6)	7.6 (\pm 0.4)	1.1 (\pm 0.1)
Lightning Creek	Agrawal	11	Medium	1.4 (\pm 3.0)	1.2 (\pm 0.6)	8.7 (\pm 1.7)	1.5 (\pm 0.7)
Lightning Creek	Burnett	19	Medium	3.9 (\pm 3.1)	1.0 (\pm 0.5)	8.9 (\pm 2.2)	1.7 (\pm 1.2)
Lightning Creek	PS_TRT	53	Low	5.6 (\pm 1.4)	1.0 (\pm 0.4)	9.4 (\pm 2.1)	1.9 (\pm 1.2)
Lightning Creek	Agrawal	0	Low	NA	NA	NA	NA
Lightning Creek	Burnett	8	Low	8.3 (\pm 1.0)	1.1 (\pm 0.3)	8.5 (\pm 1.6)	1.4 (\pm 0.6)
Luna Creek	PS_TRT	22	High	1.6 (\pm 1.0)	0.8 (\pm 0.1)	9.0 (\pm 0.3)	1.6 (\pm 0.1)
Luna Creek	Agrawal	19	High	3.5 (\pm 2.0)	0.9 (\pm 0.1)	8.7 (\pm 0.3)	1.5 (\pm 0.1)
Luna Creek	Burnett	28	High	2.0 (\pm 1.5)	0.8 (\pm 0.1)	9.0 (\pm 0.3)	1.6 (\pm 0.1)
Luna Creek	PS_TRT	3	Medium	0.1 (\pm 0.1)	0.9 (\pm 0.1)	9.0 (\pm 0.1)	1.6 (\pm 0.0)
Luna Creek	Agrawal	16	Medium	1.3 (\pm 1.5)	0.8 (\pm 0.1)	9.1 (\pm 0.3)	1.6 (\pm 0.1)
Luna Creek	Burnett	6	Medium	3.8 (\pm 3.0)	0.9 (\pm 0.1)	8.1 (\pm 0.4)	1.5 (\pm 0.2)
Luna Creek	PS_TRT	10	Low	5.3 (\pm 1.1)	0.9 (\pm 0.1)	8.6 (\pm 0.4)	1.4 (\pm 0.1)
Luna Creek	Agrawal	0	Low	NA	NA	NA	NA
Luna Creek	Burnett	1	Low	7.5 (NA)	0.9 (NA)	8.1 (NA)	1.2 (NA)
Three Fools Creek	PS_TRT	68	High	2.9 (\pm 0.8)	0.8 (\pm 0.2)	10.8 (\pm 1.4)	2.4 (\pm 0.6)
Three Fools Creek	Agrawal	102	High	3.7 (\pm 1.6)	0.9 (\pm 0.4)	10.6 (\pm 1.5)	2.3 (\pm 0.7)
Three Fools Creek	Burnett	91	High	3.3 (\pm 1.1)	0.9 (\pm 0.4)	10.5 (\pm 1.5)	2.3 (\pm 0.7)
Three Fools Creek	PS_TRT	1	Medium	0.2 (NA)	0.9 (NA)	9.9 (NA)	1.9 (NA)
Three Fools Creek	Agrawal	2	Medium	4.9 (\pm 6.6)	0.8 (\pm 0.1)	11.0 (\pm 1.6)	2.5 (\pm 0.8)
Three Fools Creek	Burnett	5	Medium	6.1 (\pm 0.7)	0.8 (\pm 0.2)	10.4 (\pm 1.0)	2.2 (\pm 0.5)
Three Fools Creek	PS_TRT	36	Low	5.8 (\pm 2.0)	1.0 (\pm 0.6)	10.1 (\pm 1.9)	2.1 (\pm 0.8)
Three Fools Creek	Agrawal	1	Low	14.0 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Three Fools Creek	Burnett	9	Low	8.6 (\pm 2.1)	0.8 (\pm 0.3)	11.0 (\pm 2.4)	2.6 (\pm 0.9)
Castle Fork Creek	PS_TRT	12	High	2.6 (\pm 0.8)	2.1 (\pm 1.4)	5.9 (\pm 0.7)	0.6 (\pm 0.1)

Table 8. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for steelhead (*Oncorhynchus mykiss*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Castle Fork Creek	Agrawal	75	High	6.2 (\pm 2.1)	2.0 (\pm 0.9)	5.1 (\pm 1.3)	0.5 (\pm 0.2)
Castle Fork Creek	Burnett	24	High	3.7 (\pm 1.3)	1.8 (\pm 1.0)	6.0 (\pm 0.8)	0.6 (\pm 0.2)
Castle Fork Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Castle Fork Creek	Agrawal	9	Medium	10.5 (\pm 0.6)	2.5 (\pm 0.4)	3.9 (\pm 0.1)	0.2 (\pm 0.1)
Castle Fork Creek	Burnett	21	Medium	6.2 (\pm 0.5)	2.0 (\pm 1.1)	5.1 (\pm 1.3)	0.5 (\pm 0.2)
Castle Fork Creek	PS_TRT	79	Low	7.8 (\pm 2.5)	2.1 (\pm 0.8)	4.6 (\pm 1.5)	0.4 (\pm 0.3)
Castle Fork Creek	Agrawal	7	Low	13.3 (\pm 1.4)	2.6 (\pm 0.7)	3.1 (\pm 1.0)	0.2 (\pm 0.1)
Castle Fork Creek	Burnett	46	Low	9.4 (\pm 2.1)	2.3 (\pm 0.7)	4.0 (\pm 1.3)	0.3 (\pm 0.2)
Panther Creek	PS_TRT	91	High	2.7 (\pm 0.8)	1.1 (\pm 0.5)	8.6 (\pm 1.3)	1.5 (\pm 0.4)
Panther Creek	Agrawal	187	High	4.3 (\pm 1.9)	1.2 (\pm 0.9)	8.4 (\pm 2.2)	1.5 (\pm 0.8)
Panther Creek	Burnett	131	High	3.3 (\pm 1.2)	1.2 (\pm 0.8)	8.4 (\pm 1.9)	1.4 (\pm 0.6)
Panther Creek	PS_TRT	1	Medium	0.1 (NA)	0.9 (NA)	9.0 (NA)	1.6 (NA)
Panther Creek	Agrawal	3	Medium	6.1 (\pm 3.0)	1.2 (\pm 0.4)	6.9 (\pm 3.9)	1.1 (\pm 1.3)
Panther Creek	Burnett	35	Medium	5.9 (\pm 0.5)	1.4 (\pm 1.2)	8.3 (\pm 3.0)	1.6 (\pm 1.0)
Panther Creek	PS_TRT	98	Low	5.9 (\pm 1.3)	1.4 (\pm 1.1)	8.2 (\pm 2.9)	1.5 (\pm 1.0)
Panther Creek	Agrawal	0	Low	NA	NA	NA	NA
Panther Creek	Burnett	24	Low	7.9 (\pm 0.7)	1.2 (\pm 0.6)	8.8 (\pm 2.7)	1.7 (\pm 1.0)
Devils Creek	PS_TRT	41	High	3.0 (\pm 0.7)	1.2 (\pm 0.4)	7.3 (\pm 1.3)	1.0 (\pm 0.4)
Devils Creek	Agrawal	132	High	4.6 (\pm 1.4)	1.3 (\pm 0.5)	7.4 (\pm 1.5)	1.1 (\pm 0.4)
Devils Creek	Burnett	94	High	3.9 (\pm 1.0)	1.3 (\pm 0.5)	7.3 (\pm 1.4)	1.0 (\pm 0.4)
Devils Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Devils Creek	Agrawal	4	Medium	7.4 (\pm 4.7)	1.2 (\pm 0.7)	7.7 (\pm 2.7)	1.2 (\pm 0.7)
Devils Creek	Burnett	32	Medium	5.9 (\pm 0.4)	1.1 (\pm 0.4)	8.0 (\pm 1.4)	1.2 (\pm 0.4)
Devils Creek	PS_TRT	95	Low	5.5 (\pm 1.3)	1.3 (\pm 0.5)	7.5 (\pm 1.7)	1.1 (\pm 0.4)
Devils Creek	Agrawal	0	Low	NA	NA	NA	NA
Devils Creek	Burnett	10	Low	8.5 (\pm 1.1)	1.4 (\pm 0.6)	6.9 (\pm 2.7)	1.0 (\pm 0.7)
Stetattle Creek	PS_TRT	34	High	2.5 (\pm 1.0)	0.8 (\pm 0.2)	11.1 (\pm 0.7)	2.5 (\pm 0.3)
Stetattle Creek	Agrawal	73	High	4.4 (\pm 2.1)	0.9 (\pm 0.2)	10.2 (\pm 1.6)	2.2 (\pm 0.7)
Stetattle Creek	Burnett	46	High	2.8 (\pm 1.3)	1.0 (\pm 1.0)	10.7 (\pm 1.5)	2.3 (\pm 0.5)
Stetattle Creek	PS_TRT	4	Medium	1.7 (\pm 1.7)	4.3 (\pm 3.7)	6.3 (\pm 4.6)	1.1 (\pm 1.2)
Stetattle Creek	Agrawal	6	Medium	2.6 (\pm 1.9)	4.6 (\pm 4.2)	6.2 (\pm 4.3)	1.1 (\pm 1.1)
Stetattle Creek	Burnett	25	Medium	6.0 (\pm 0.8)	1.7 (\pm 2.2)	8.2 (\pm 2.5)	1.4 (\pm 0.8)
Stetattle Creek	PS_TRT	42	Low	6.3 (\pm 1.7)	1.2 (\pm 1.4)	9.4 (\pm 2.1)	1.8 (\pm 0.8)
Stetattle Creek	Agrawal	1	Low	14.4 (NA)	1.1 (NA)	11.6 (NA)	2.8 (NA)
Stetattle Creek	Burnett	9	Low	8.5 (\pm 2.3)	1.0 (\pm 0.1)	11.2 (\pm 0.6)	2.6 (\pm 0.3)
McMillan Creek	PS_TRT	45	High	2.5 (\pm 1.1)	3.1 (\pm 6.6)	8.3 (\pm 0.9)	1.3 (\pm 0.3)
McMillan Creek	Agrawal	59	High	3.9 (\pm 1.9)	3.9 (\pm 7.5)	8.3 (\pm 1.0)	1.3 (\pm 0.3)
McMillan Creek	Burnett	48	High	2.7 (\pm 1.3)	1.1 (\pm 0.8)	8.5 (\pm 0.8)	1.4 (\pm 0.3)
McMillan Creek	PS_TRT	4	Medium	0.1 (\pm 0.1)	5.1 (\pm 8.4)	7.7 (\pm 0.6)	1.1 (\pm 0.2)
McMillan Creek	Agrawal	14	Medium	2.0 (\pm 3.0)	2.6 (\pm 4.5)	7.6 (\pm 1.0)	1.1 (\pm 0.3)
McMillan Creek	Burnett	19	Medium	3.8 (\pm 2.3)	10.4 (\pm 11.5)	7.4 (\pm 0.9)	1.0 (\pm 0.3)

Table 8. Reach average values of gradient, valley width index (ratio), bankfull width, and mean annual flow for targeted upper Skagit River streams in the United States by high, medium, or low intrinsic potential (IP) rank for steelhead (*Oncorhynchus mykiss*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
McMillan Creek	PS_TRT	26	Low	6.5 (\pm 2.4)	4.1 (\pm 7.6)	7.8 (\pm 1.3)	1.2 (\pm 0.4)
McMillan Creek	Agrawal	2	Low	12.4 (\pm 0.5)	2.6 (\pm 0.7)	5.5 (\pm 0.0)	0.5 (\pm 0.0)
McMillan Creek	Burnett	8	Low	9.4 (\pm 2.2)	2.1 (\pm 1.3)	7.8 (\pm 1.9)	1.2 (\pm 0.6)
Slate Creek	PS_TRT	0	High	NA	NA	NA	NA
Slate Creek	Agrawal	10	High	6.4 (\pm 1.2)	1.2 (\pm 0.3)	8.6 (\pm 0.1)	1.4 (\pm 0.0)
Slate Creek	Burnett	3	High	5.0 (\pm 0.4)	1.0 (\pm 0.2)	8.5 (\pm 0.1)	1.4 (\pm 0.0)
Slate Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Slate Creek	Agrawal	1	Medium	9.4 (NA)	1.2 (NA)	8.6 (NA)	1.4 (NA)
Slate Creek	Burnett	4	Medium	6.3 (\pm 0.4)	1.1 (\pm 0.1)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	PS_TRT	11	Low	6.6 (\pm 1.5)	1.2 (\pm 0.2)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Slate Creek	Agrawal	0	Low	NA	NA	NA	NA
Slate Creek	Burnett	4	Low	8.2 (\pm 0.9)	1.3 (\pm 0.3)	8.6 (\pm 0.0)	1.4 (\pm 0.0)
Hozomeen Creek	PS_TRT	0	High	NA	NA	NA	NA
Hozomeen Creek	Agrawal	0	High	NA	NA	NA	NA
Hozomeen Creek	Burnett	0	High	NA	NA	NA	NA
Hozomeen Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Agrawal	0	Medium	NA	NA	NA	NA
Hozomeen Creek	Burnett	0	Medium	NA	NA	NA	NA
Hozomeen Creek	PS_TRT	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	Agrawal	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)
Hozomeen Creek	Burnett	1	Low	12.8 (NA)	1.7 (NA)	4.9 (NA)	0.4 (NA)

Table 9. Reach average values of gradient, valley width index, bankfull width (ratio), and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, and low intrinsic potential rank (IP) for steelhead (*Oncorhynchus mykiss*).

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Skagit River	PS_TRT	30	High	1.4 (\pm 0.9)	1.4 (\pm 0.8)	16.8 (\pm 2.4)	6.4 (\pm 2.0)
Skagit River	Agrawal	135	High	1.0 (\pm 0.9)	1.5 (\pm 1.0)	21.0 (\pm 3.3)	10.7 (\pm 3.5)
Skagit River	Burnett	239	High	0.7 (\pm 0.7)	1.5 (\pm 1.0)	22.0 (\pm 3.1)	11.8 (\pm 3.4)
Skagit River	PS_TRT	167	Medium	0.7 (\pm 0.6)	2.8 (\pm 12.8)	22.4 (\pm 2.6)	12.1 (\pm 3.1)
Skagit River	Agrawal	225	Medium	0.2 (\pm 0.4)	3.7 (\pm 12.4)	23.5 (\pm 2.6)	13.5 (\pm 3.1)
Skagit River	Burnett	121	Medium	0.1 (\pm 0.2)	5.6 (\pm 16.6)	23.7 (\pm 2.8)	13.8 (\pm 3.4)
Skagit River	PS_TRT	163	Low	0.1 (\pm 0.5)	3.3 (\pm 6.9)	23.9 (\pm 2.3)	13.9 (\pm 2.9)
Skagit River	Agrawal	0	Low	NA	NA	NA	NA
Skagit River	Burnett	0	Low	NA	NA	NA	NA
Klesilkwa River	PS_TRT	58	High	1.0 (\pm 0.9)	0.8 (\pm 0.2)	9.8 (\pm 2.5)	2.1 (\pm 1.3)
Klesilkwa River	Agrawal	19	High	0.9 (\pm 0.9)	0.7 (\pm 0.2)	11.9 (\pm 3.0)	3.1 (\pm 1.5)
Klesilkwa River	Burnett	68	High	0.9 (\pm 1.0)	0.8 (\pm 0.2)	9.9 (\pm 2.6)	2.1 (\pm 1.3)
Klesilkwa River	PS_TRT	104	Medium	0.0 (\pm 0.0)	0.7 (\pm 0.2)	11.7 (\pm 2.5)	3.0 (\pm 1.3)
Klesilkwa River	Agrawal	150	Medium	0.6 (\pm 1.7)	0.8 (\pm 0.2)	10.8 (\pm 2.7)	2.5 (\pm 1.3)
Klesilkwa River	Burnett	98	Medium	0.2 (\pm 1.1)	0.7 (\pm 0.2)	11.7 (\pm 2.6)	3.0 (\pm 1.3)
Klesilkwa River	PS_TRT	8	Low	8.3 (\pm 2.7)	1.1 (\pm 0.1)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Klesilkwa River	Agrawal	1	Low	12.9 (NA)	1.1 (NA)	7.2 (NA)	1.0 (NA)
Klesilkwa River	Burnett	4	Low	10.5 (\pm 1.9)	1.2 (\pm 0.0)	7.3 (\pm 0.0)	1.0 (\pm 0.0)
Sumallo River	PS_TRT	116	High	1.7 (\pm 1.1)	0.8 (\pm 0.2)	10.2 (\pm 2.7)	2.3 (\pm 1.2)
Sumallo River	Agrawal	135	High	2.4 (\pm 1.7)	0.8 (\pm 0.3)	9.8 (\pm 2.8)	2.1 (\pm 1.3)
Sumallo River	Burnett	154	High	1.9 (\pm 1.5)	0.8 (\pm 0.2)	10.2 (\pm 2.7)	2.3 (\pm 1.2)
Sumallo River	PS_TRT	101	Medium	0.0 (\pm 0.1)	0.6 (\pm 0.1)	12.9 (\pm 1.2)	3.5 (\pm 0.7)
Sumallo River	Agrawal	111	Medium	0.2 (\pm 0.6)	0.6 (\pm 0.1)	12.5 (\pm 1.6)	3.3 (\pm 0.9)
Sumallo River	Burnett	90	Medium	0.3 (\pm 1.4)	0.6 (\pm 0.1)	12.5 (\pm 1.7)	3.4 (\pm 0.9)
Sumallo River	PS_TRT	30	Low	5.0 (\pm 1.0)	1.0 (\pm 0.2)	7.8 (\pm 1.3)	1.2 (\pm 0.4)
Sumallo River	Agrawal	1	Low	0.2 (NA)	0.7 (NA)	9.8 (NA)	1.9 (NA)
Sumallo River	Burnett	3	Low	5.1 (\pm 4.2)	1.1 (\pm 0.4)	6.9 (\pm 2.5)	1.0 (\pm 0.8)
Ferguson Creek	PS_TRT	12	High	1.3 (\pm 0.7)	1.4 (\pm 0.3)	5.7 (\pm 0.9)	0.6 (\pm 0.2)
Ferguson Creek	Agrawal	10	High	4.6 (\pm 3.0)	1.6 (\pm 0.3)	4.9 (\pm 0.6)	0.4 (\pm 0.1)
Ferguson Creek	Burnett	19	High	1.1 (\pm 1.2)	1.4 (\pm 0.3)	5.7 (\pm 0.9)	0.6 (\pm 0.2)
Ferguson Creek	PS_TRT	31	Medium	0.0 (\pm 0.1)	1.3 (\pm 0.2)	5.7 (\pm 0.5)	0.6 (\pm 0.1)
Ferguson Creek	Agrawal	38	Medium	0.3 (\pm 0.5)	1.3 (\pm 0.2)	5.7 (\pm 0.6)	0.6 (\pm 0.1)
Ferguson Creek	Burnett	25	Medium	0.2 (\pm 1.1)	1.3 (\pm 0.2)	5.6 (\pm 0.4)	0.5 (\pm 0.1)
Ferguson Creek	PS_TRT	6	Low	6.7 (\pm 1.4)	1.6 (\pm 0.1)	4.6 (\pm 0.0)	0.4 (\pm 0.0)
Ferguson Creek	Agrawal	1	Low	0.1 (NA)	1.2 (NA)	6.0 (NA)	0.6 (NA)
Ferguson Creek	Burnett	5	Low	6.0 (\pm 3.3)	1.5 (\pm 0.2)	4.9 (\pm 0.6)	0.4 (\pm 0.1)
Nepopekum Creek	PS_TRT	59	High	2.0 (\pm 1.0)	1.0 (\pm 0.1)	8.8 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Agrawal	73	High	3.9 (\pm 2.0)	0.9 (\pm 0.1)	8.6 (\pm 0.2)	1.4 (\pm 0.1)

Table 9. Reach average values of gradient, valley width index, bankfull width (ratio), and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, and low intrinsic potential rank (IP) for steelhead (*Oncorhynchus mykiss*).—Continued

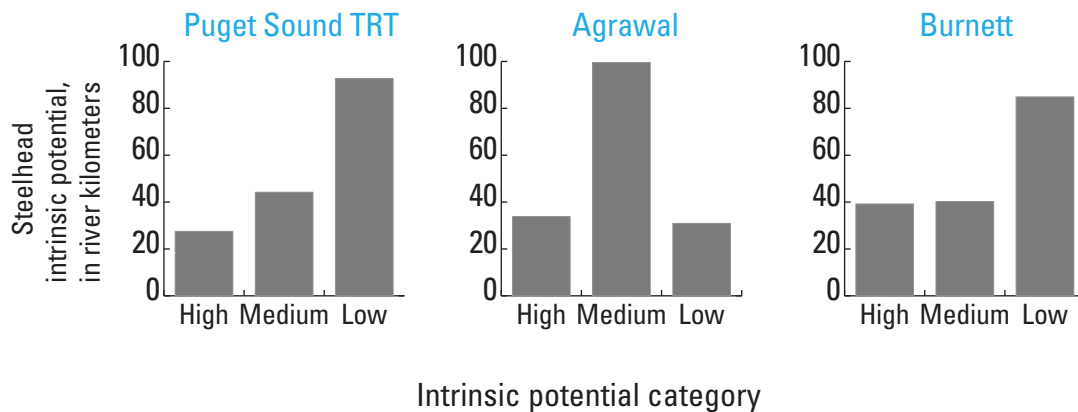
[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Nepopekum Creek	Burnett	78	High	2.4 (\pm 1.4)	0.9 (\pm 0.1)	8.8 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	PS_TRT	18	Medium	0.0 (\pm 0.1)	0.9 (\pm 0.1)	8.9 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Agrawal	42	Medium	1.4 (\pm 2.7)	0.9 (\pm 0.1)	8.9 (\pm 0.2)	1.5 (\pm 0.1)
Nepopekum Creek	Burnett	29	Medium	3.0 (\pm 3.1)	0.9 (\pm 0.1)	8.7 (\pm 0.3)	1.5 (\pm 0.1)
Nepopekum Creek	PS_TRT	38	Low	6.0 (\pm 1.9)	0.9 (\pm 0.1)	8.5 (\pm 0.2)	1.4 (\pm 0.1)
Nepopekum Creek	Agrawal	0	Low	NA	NA	NA	NA
Nepopekum Creek	Burnett	8	Low	9.0 (\pm 1.4)	0.9 (\pm 0.1)	8.5 (\pm 0.2)	1.4 (\pm 0.1)
Maselpalik Creek	PS_TRT	6	High	2.1 (\pm 0.9)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Agrawal	3	High	7.1 (\pm 3.5)	0.8 (\pm 0.2)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Burnett	6	High	2.1 (\pm 0.9)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Maselpalik Creek	Agrawal	9	Medium	4.4 (\pm 3.1)	0.7 (\pm 0.1)	10.4 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Burnett	1	Medium	6.0 (NA)	0.7 (NA)	10.3 (NA)	2.1 (NA)
Maselpalik Creek	PS_TRT	6	Low	8.0 (\pm 1.5)	0.7 (\pm 0.2)	10.5 (\pm 0.2)	2.2 (\pm 0.1)
Maselpalik Creek	Agrawal	0	Low	NA	NA	NA	NA
Maselpalik Creek	Burnett	5	Low	8.5 (\pm 1.2)	0.7 (\pm 0.2)	10.5 (\pm 0.2)	2.2 (\pm 0.1)
Snass Creek	PS_TRT	16	High	2.3 (\pm 1.1)	1.3 (\pm 0.2)	6.7 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	Agrawal	34	High	4.4 (\pm 2.4)	1.2 (\pm 0.3)	6.7 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	Burnett	25	High	3.0 (\pm 1.6)	1.3 (\pm 0.3)	6.7 (\pm 0.8)	0.8 (\pm 0.2)
Snass Creek	PS_TRT	1	Medium	0.2 (NA)	1.6 (NA)	5.1 (NA)	0.5 (NA)
Snass Creek	Agrawal	8	Medium	7.9 (\pm 4.1)	1.1 (\pm 0.2)	6.8 (\pm 1.0)	0.8 (\pm 0.2)
Snass Creek	Burnett	7	Medium	6.3 (\pm 0.5)	1.2 (\pm 0.3)	6.5 (\pm 0.9)	0.8 (\pm 0.2)
Snass Creek	PS_TRT	26	Low	7.2 (\pm 2.4)	1.2 (\pm 0.3)	6.8 (\pm 0.8)	0.9 (\pm 0.2)
Snass Creek	Agrawal	1	Low	12.0 (NA)	0.9 (NA)	7.2 (NA)	0.9 (NA)
Snass Creek	Burnett	11	Low	9.6 (\pm 1.6)	1.0 (\pm 0.2)	6.9 (\pm 0.9)	0.9 (\pm 0.2)
Twentysix Mile Creek	PS_TRT	0	High	NA	NA	NA	NA
Twentysix Mile Creek	Agrawal	2	High	5.5 (\pm 0.2)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Burnett	1	High	5.3 (NA)	0.9 (NA)	6.3 (NA)	0.7 (NA)
Twentysix Mile Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Twentysix Mile Creek	Agrawal	3	Medium	10.5 (NA)	1.1 (NA)	6.3 (NA)	0.7 (NA)
Twentysix Mile Creek	Burnett	1	Medium	5.6 (\pm 0.0)	1.2 (\pm 0.0)	6.3 (\pm 0.0)	0.7 (\pm 0.0)

Table 9. Reach average values of gradient, valley width index, bankfull width (ratio), and mean annual flow for targeted upper Skagit River streams in Canada by high, medium, and low intrinsic potential rank (IP) for steelhead (*Oncorhynchus mykiss*).—Continued

[Plus or minus (\pm) standard deviations are shown in parentheses. PS_TRT, Puget Sound Technical Recovery Team model; NA, no reaches were identified for a given stream, model, and intrinsic potential category; m, meter; m³/s, cubic meter per second]

Stream	Model	Number of reaches	IP rank	Percent gradient	Valley width ratio	Bankfull width (m)	Mean annual flow (m ³ /s)
Twentysix Mile Creek	PS_TRT	8	Low	10.1 (\pm 3.1)	1.1 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Agrawal	3	Low	12.7 (\pm 0.5)	1.2 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Twentysix Mile Creek	Burnett	6	Low	11.6 (\pm 1.4)	1.2 (\pm 0.2)	6.3 (\pm 0.0)	0.7 (\pm 0.0)
Marmotte Creek	PS_TRT	0	High	NA	NA	NA	NA
Marmotte Creek	Agrawal	3	High	7.1 (\pm 1.4)	1.6 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	Burnett	0	High	NA	NA	NA	NA
Marmotte Creek	PS_TRT	0	Medium	NA	NA	NA	NA
Marmotte Creek	Agrawal	0	Medium	NA	NA	NA	NA
Marmotte Creek	Burnett	2	Medium	6.4 (\pm 0.8)	0.6 (\pm 0.4)	4.8 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	PS_TRT	3	Low	7.1 (\pm 1.4)	1.6 (\pm 0.3)	4.7 (\pm 0.0)	0.4 (\pm 0.0)
Marmotte Creek	Agrawal	0	Low	NA	NA	NA	NA
Marmotte Creek	Burnett	1	Low	8.6 (NA)	1.7 (NA)	4.7 (NA)	0.4 (NA)

**Figure 13.** Length in kilometers of high, medium, and low habitat intrinsic potential for steelhead (*Oncorhynchus mykiss*) based on three different models for non-target tributaries upstream from the three upper Skagit River dams, in northern Washington.

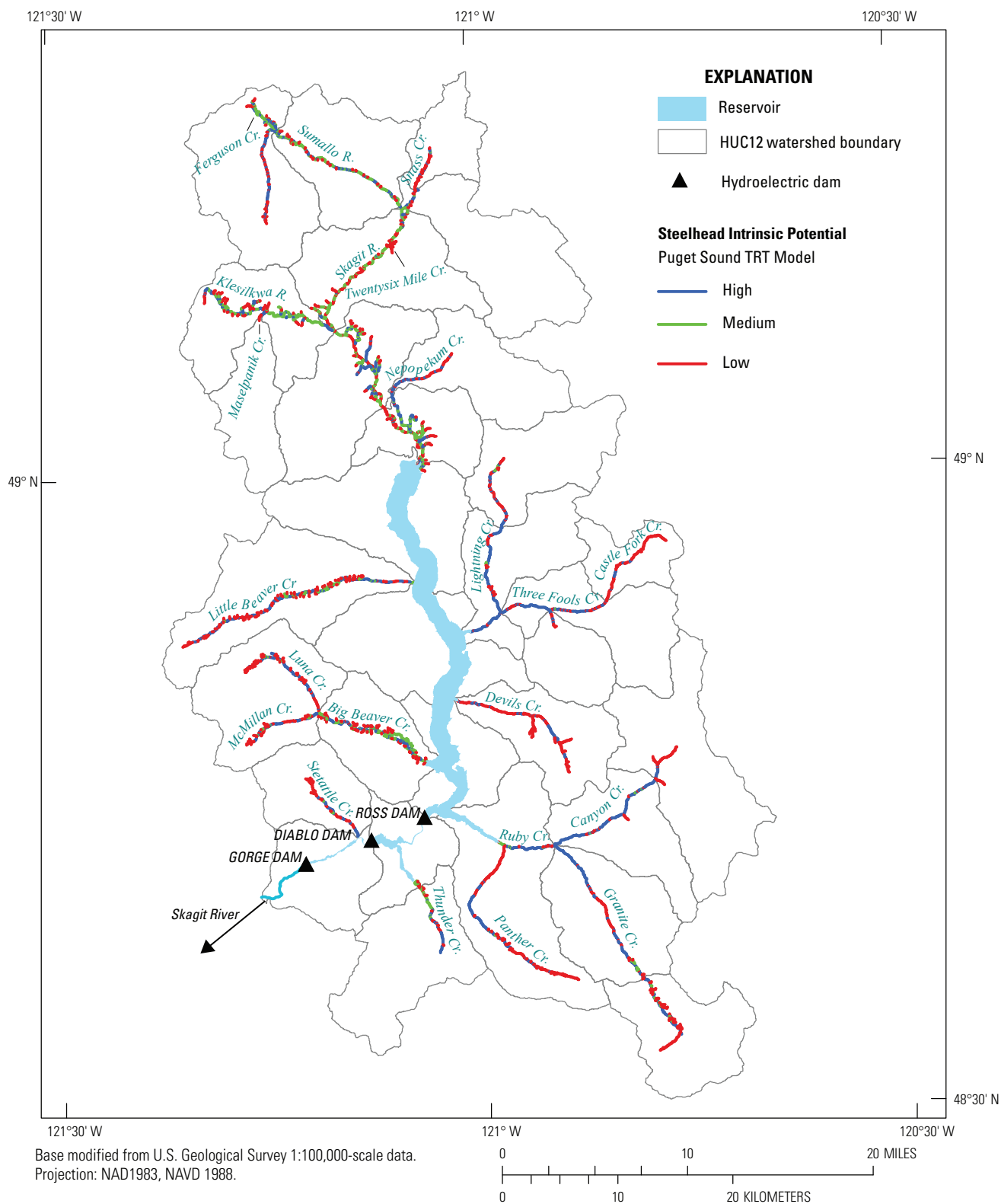


Figure 14. High, medium, and low intrinsic potential scores for steelhead (*Oncorhynchus mykiss*) derived from the Puget Sound Technical Recovery Team intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

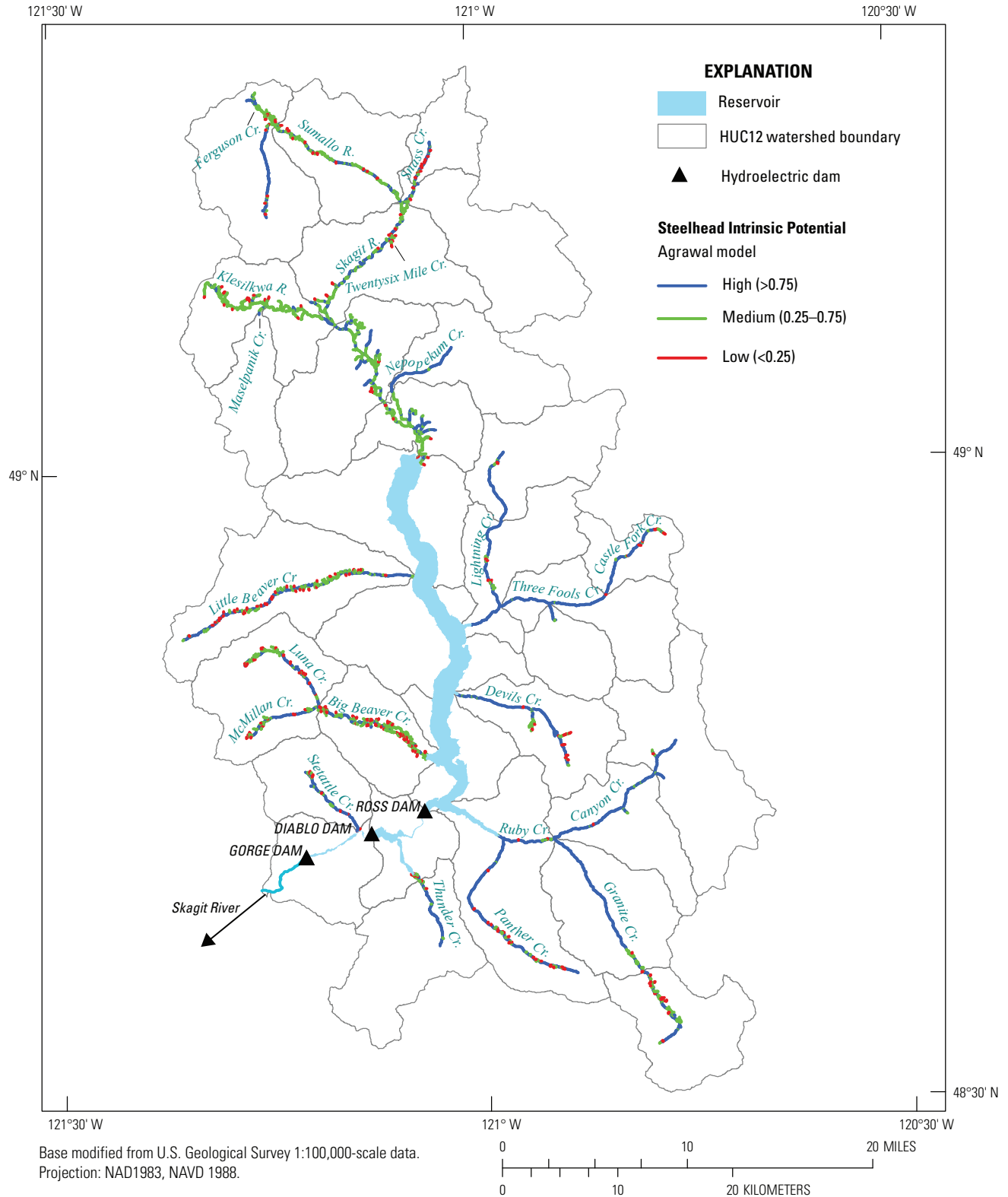


Figure 15. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for steelhead (*Oncorhynchus mykiss*) derived from the Agrawal intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

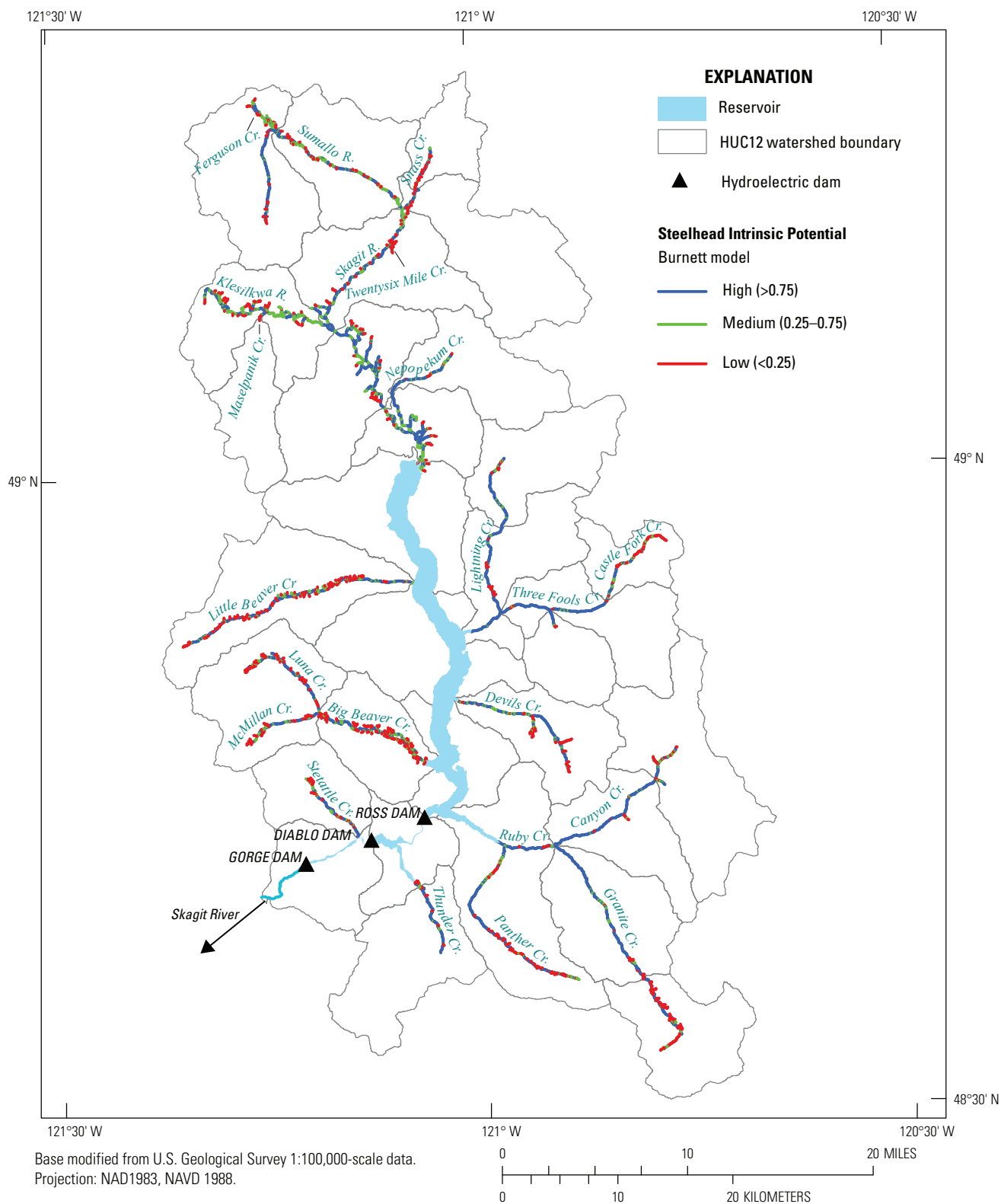


Figure 16. High (greater than [$>$] 0.75), medium (0.25–0.75), and low (less than [$<$] 0.25) intrinsic potential scores for steelhead (*Oncorhynchus mykiss*) derived from the Burnett intrinsic potential model applied to tributary and main-stem habitat upstream from the Skagit River Hydroelectric Project dams, in northern Washington. USGS Hydrological Unit Code (HUC) is a classification hierarchy to delimit watershed boundaries in successively smaller hydrologic units. HUC12 indicates boundaries of local sub-watershed scale that represents tributary systems.

Summary

We used intrinsic potential (IP) models to evaluate the potential habitat for anadromous salmonids upstream from three impassable dams in the upper Skagit River in Whatcom County, northern Washington. This was based on a two-step process within a synthetic geographic information system-based representation of the upper Skagit River Basin derived from 10-meter (m; on United States side of the international border) or 20-m (on the Canadian side) digital elevation models. The first step was estimating the upper extent of potential anadromous fish distribution within select tributaries. We used existing fish passage criteria from the State of Washington (Washington Department of Fish and Wildlife, 2019) based on waterfall height and stream gradient to filter continuous reaches of stream habitat from the confluence of tributary with a reservoir in the upper Skagit River to the first likely upstream barrier, thus defining the likely upstream extent of fish upstream migration. The length estimates derived from the resulting maps were similar to assessments of targeted streams compiled by stakeholders to the Federal Energy Regulatory Commission relicensing process. The second step was to apply existing IP models for target species (coho, Chinook, steelhead [*Oncorhynchus kisutch*, *O. tshawytscha*, *O. mykiss*, respectively]). Intrinsic potential models are general models that were created to estimate habitat potential based on generalized and broad-scale patterns of each species. Our use of three different IP models for each species was an attempt to obtain a consensus view of the amount and quality of habitat available in select tributaries that would be likely for anadromous fish to move into should an introduction program be initiated. With habitat preference curves derived from different populations and regions, the IP models showed similarities and differences in the amount of habitat in each IP category. For coho and steelhead, IP models with habitat suitability curves derived for Skagit River Chinook (Connor and others, 2015) or Puget Sound steelhead behaved differently than the other IP models based on other regions. This is an important point to consider when comparing the differences among the IP models for these species. When applied to the same “end of fish distribution” maps describing potential tributary habitat in the upper Skagit River watershed, the IP models found that the most high IP habitat existed for steelhead, whereas coho and Chinook IP models found that most stream sections were rated as having medium or low IP. These assessments, when coupled with other habitat models to estimate juvenile rearing capacity (for example, Cramer and Ackerman, 2009; Cooper and others 2020; Ramos and Ward, 2022) and bioenergetic growth potential (Weber and others, 2014; Thompson and Beauchamp, 2016) are a useful first step in evaluating the feasibility of potential anadromous salmonid introduction programs.

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