NISQUALLY BASIN
Water Resource Inventory Area 11

The Nisqually River system is the principal drainage of this basin with McAllister Creek the only independent stream. There are 331 identified streams providing approximately 715 linear miles of river and tributaries plus the one independent stream within this drainage basin. These drainages provide suitable spawning and rearing area for anadromous and resident fishes, and each contributes to the ecological make-up of estuarine and marine habitats at their confluence with salt water. Although the marine environment of this basin represents a relatively small segment of Puget Sound, it nevertheless is very important for juvenile anadromous and marine species, and for the abundant shellfish populations thriving in the area.

The Nisqually River, with a total length of approximately 72 miles, heads in the high cascades just south of Mount Rainier. From its glacial origin, the river flows generally west 23 miles to Alder Lake. This reservoir, some 8 miles in length, is formed by the City of Tacoma's Alder Dam at river mile 41. One and one-half miles below Alder Dam is LaGrande Dam where upstream anadromous fish migration is blocked. Above Alder Lake the Nisqually River contains at least 30 miles of streambed considered suitable for fish use, but is now inaccessible to anadromous fish. Although the stream character is principally mountain type with numerous cascade and rapid sections, it does offer many good quality pool and riffle sections. In addition, numerous tributary streams above Alder Dam present potential for spawning and rearing of salmon and anadromous trout species.

Below the Alder-LaGrande installations, the Nisqually courses generally northwest, moving away from the typical mountain terrain and across an increasingly broader and flatter valley floor to its confluence with Puget Sound at Nisqually Reach. Through this section the river is bounded by mixed deciduous and coniferous forest, intermittent cleared farm land, and a few small towns. Much of this river course is through Fort Lewis Military Reservation. The river character consists of extensive, moderately deep riffles and long glides with occasional deep pools. Good quality spawning and rearing area exists throughout this stretch which is deemed highly suitable for use by both anadromous and resident fish species. At river mile 25 is a laddered diversion, the Yelm Power Canal water intake. Here water is removed and transported via a canal 14 miles downstream,

PHOTO 11-1. Nisqually River mouth forms the last major undeveloped delta in Puget Sound.

where it is returned to the river through a powerhouse.

Important accessible tributaries entering the Nisqually below Alder Dam include the Mashel River and the smaller Ohop, Tanawax, Horn, Yelm, and Muck creeks. With the exception of the Mashel River, which heads in the foothill slopes of the Cascade Mountains, each of these streams has principally flatland character, offering intermittent sections suitable for anadromous fish spawning. The Mashel presents considerable good quality spawning and rearing area despite its mostly mountain-type conditions. Each of the tributaries supports good to excellent populations of resident fish and substantial runs of anadromous species where accessible.

McAllister Creek, the basin's only independent drainage, enters Nisqually Reach just west of the Nisqually River. The majority of this stream's accessible area flows over the flatland of the lower Nisqually Valley with the upper 10 miles moving through moderately timbered slopes immediately above the valley floor. The stream contains intermittent sections of good quality spawning material and considerable rearing area.

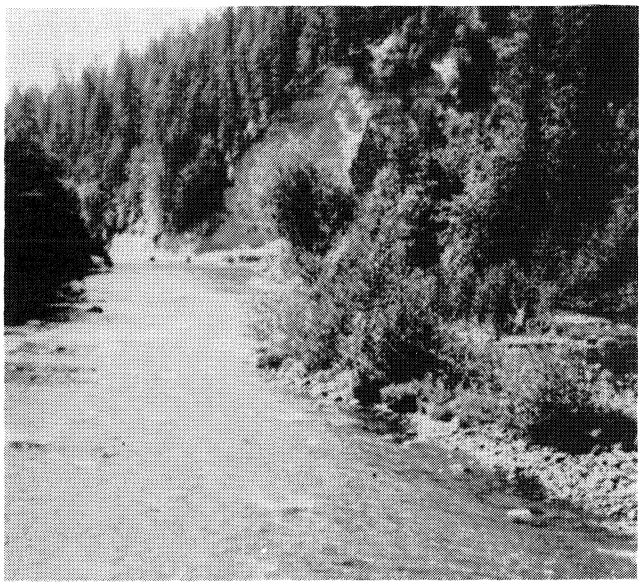


PHOTO 11-2. Nisqually River near Eatonville.

Fish Inventory and Distribution

Four of the Pacific salmon species utilize Nisqually basin drainages; chinook, coho, pink, and chum. As with many of the Puget Sound region's larger drainages the Nisqually maintains a relatively small run of sockeye; however, this run is virtually insignificant regarding commercial and sport interest.

The Nisqually River receives each of these salmon species and each of the anadromous game fish. These fish migrate, spawn, and rear in some 136 miles of stream including each of the accessible tributaries. McAllister Creek, offering an additional 5 miles of accessibility, is inhabited principally by coho and chum salmon, and by steelhead and searun cutthroat trout. On occasions some pink salmon have also been observed.

Chinook Salmon — Chinook salmon populating the Nisqually basin are generally considered to be the summer-fall segment, as differentiated from the spring chinook race. These fish spawn in various sections throughout the river's accessible length and in some portions of the larger tributaries, principally the Mashel River, and Ohop, Yelm, and Muck creeks. The occurrence of chinook spawning in other Nisqually tributaries or in McAllister Creek is considered minimal since these streams exhibit very low flows during the adult migration and spawning period.

PHOTO 11-3. Typical chinook spawning area in the Mashel River.

Juvenile chinook salmon utilize the entire accessible length of mainstem Nisqually for rearing, as well as each of the tributary streams populated by spawning adults. In addition, important rearing takes place within the estuarine and marine areas of the basin.

Adult chinook salmon have been recorded entering the Nisqually in early July with the run continuing well into October (Table 11-1). Limited survey records indicate that chinook spawning commences near mid to late September and is probably completed throughout the system by early November. Following incubation, that portion of emerging juveniles considered progeny of the fall chinook segment characteristically rears in the system for three months prior to seaward migration. Little is known regarding the early life history of the juvenile summer chinook, but it is quite possible that these rearing fish utilize the system for a longer period. In general the bulk of juvenile chinook out-migration occurs between mid-February and early June, even though some chinook smolts emigrate the system nearly year around.

Based principally on Indian catch statistics and spawning ground information, it is estimated that the chinook salmon escapement to this system has ranged from 300 to 3,500 fish from 1966 to 1971, averaging about 1,470 chinook annually.

Calculated catch to escapement ratios indicate that a seasonal escapement of approximately 1,500 chinook relates to a total commercial and sport fisheries catch of some 4,500 salmon.

Coho Salmon — Nearly every accessible stream draining the Nisqually basin is utilized by coho salmon. The tributaries of the mainstem Nisqually serve as the principal

spawning grounds. Some spawning occurs in the mainstem river, particularly in areas where divided channels create smaller courses containing spawning conditions more suitable for coho. Such areas are common below the Yelm Power Canal Diversion. Some of the more important tributaries receiving coho include the Mashel River, and Ohop, Tanwax, Horn, Yelm, and Muck creeks. McAllister Creek also maintains significant coho populations.

PHOTO 11-4. A majority of coho spawn and rear in the smaller tributary streams (Busywild Creek).

Juvenile coho rear throughout the accessible length of the Nisqually River and in each of the tributaries used by adults. In addition, important rearing also occurs in the basin's estuarine environment.

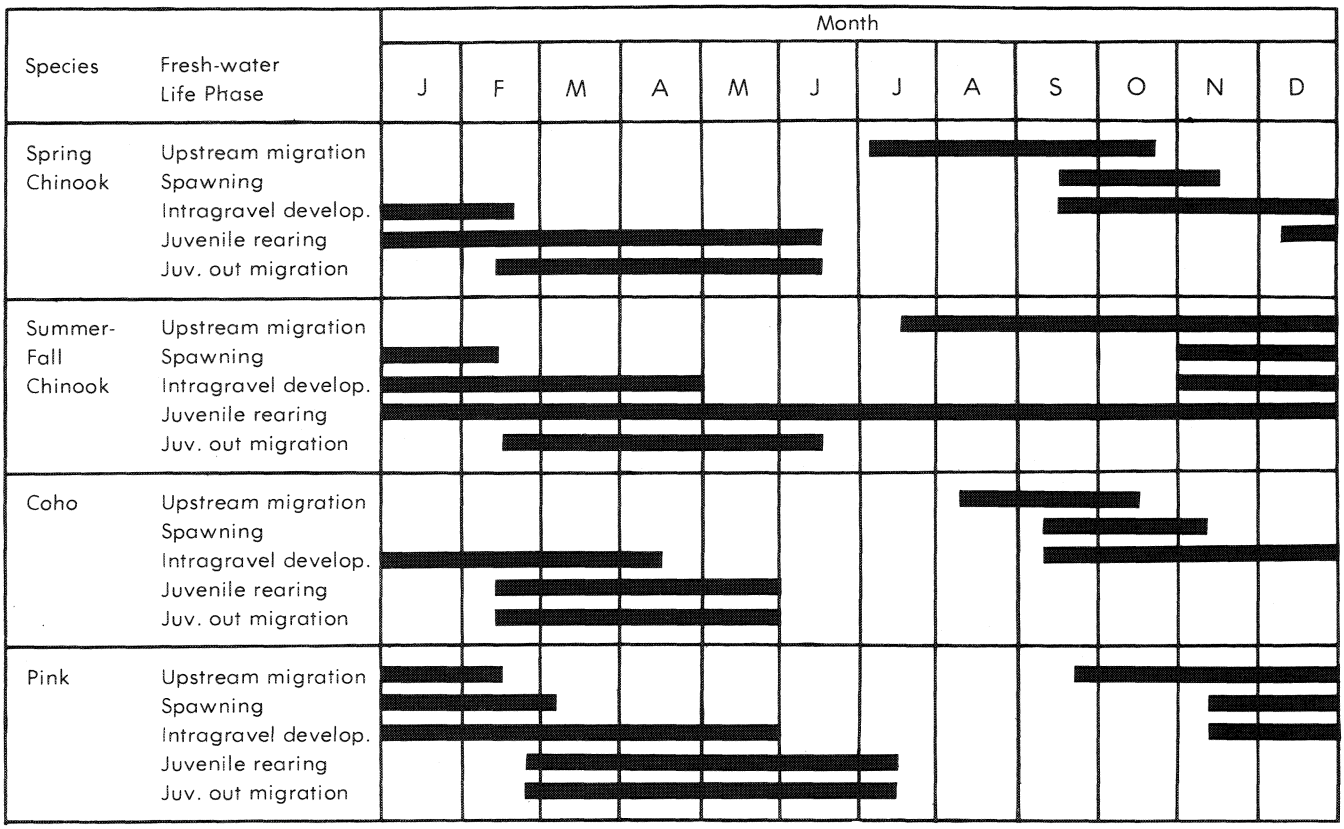
Adult coho have been recorded entering this system as early as July with the major run occurring in October. Spawning commences in some areas in mid-November and often extends through January. Following egg incubation and subsequent fry emergence, the juveniles characteristically remain within the river system more than a year, migrating seaward early in the spring of their second year of life. This migration occurs principally between late February and early June; however, some coho smolts may be found moving seaward nearly the year around. The timing of coho salmon migrations in McAllister Creek are believed to be about the same as those in the Nisqually.

Based principally on Indian catch records and on spawning ground surveys, it is estimated that annual coho escapements to the Nisqually basin have ranged from 1,300 to 9,000 fish for the period 1966 to 1971, averaging about 4,200 per year.

Calculated catch to escapement ratios indicate that a coho escapement of approximately 9,000 reflects a total commercial and sport fishery catch of about 36,000 fish.

Pink Salmon — Adult pink salmon, present in the odd-numbered years only, spawn principally in the mainstem Nisqually River. These fish utilize the broad shallow riffle areas, particularly where channel splitting creates more suitable spawning conditions for pinks. Adult pink salmon have also been recorded in the Mashel River and in Yelm Creek. Few pinks are known to utilize McAllister Creek.

Timing of salmon fresh-water life phases in Nisqually Basin WRIA 11



The mainstem Nisqually River provides important early rearing environmental characteristics necessary for successful migration of the pink salmon fry to salt water. Extensive early rearing also occurs in the estuarine waters of Nisqually Reach.

Adult pink salmon begin entering the Nisqually in early August with the run continuing well into October. Limited survey data indicates that spawning commences in early to mid-September and is generally completed by early November. Soon after the pink fry emerge from the gravel their seaward migration begins with this usually being completed by mid-June (Table 11-1).

Based mainly on Indian catch records and on spawning ground information, it is estimated that the pink salmon runs to the Nisqually system have ranged from 3,500 to 10,000 fish from 1965 to 1971 averaging about 6,125 per odd year escapement.

Calculations based on catch to escapement ratios indicate a spawning escapement of 10,000 fish relates to a commercial and sport fishery catch of up to 20,000 pink salmon.

Chum Salmon — Chum salmon are known to spawn extensively in the mainstem Nisqually below the Yelm Power Diversion and in Muck and Yelm creeks. The numbers of adult chum successfully negotiating the ladder system at the Yelm Diversion Barrier is presently unknown. Large numbers of chum have also been reported in McAllister Creek.

The young chum begin their seaward migration soon after emerging from the gravel, making the rearing quality of the mainstem Nisqually exceedingly important to their early fresh-water life. Also, the estuary waters of Nisqually Reach are extremely important to the early rearing of these young fry.

Adult chum salmon have been reported entering the Nisqually as early as mid-August with the bulk of the run occurring in November and December. Spawning begins in early November and continues in some areas until mid to late February. Soon after emergence from the gravel the juvenile chum begin seaward migration, generally completing their early fresh-water life phase by late June. The timing of chum salmon migrations in McAllister Creek is believed to be about the same as that in the Nisqually.

Based principally on Indian catch statistics and on limited spawning ground information, it is estimated that chum salmon escapements to the Nisqually subregion have ranged from about 9,500 to 30,000 for the period 1966 to 1971, averaging about 16,500 per year.

Salmon Production

The natural production from the native stocks of salmon in the Nisqually basin provides over 75,000 salmon annually to various sport and commercial fisheries in Washington. In an average year approximately 29,200 adult salmon return to spawn in the Nisqually drainage (Table 11-2).

A six year base period, 1966 through 1971, has been selected for the presentation of all salmon production figures. This span of years is also used for both naturally and artificially produced fish, as well as escapement and harvest figures.

Although the Washington Department of Fisheries maintains no hatcheries or artificial propagation facilities within the Nisqually basin, natural salmon production is supplemented by the planting of stock obtained at hatcheries located in other areas. In general both chinook and coho juveniles are planted annually, principally from the Puyallup basin hatchery. Between 1966 and 1971 a total of 3,493,000 chinook, and 2,785,000 coho juveniles were planted in the Nisqually system. Hatchery plants of chinook and coho have been made only on years when poor escapements were observed.

Preliminary information from commercial and sport catch statistics indicates that the present salmon stocking program contributes approximately 3,500 chinook and 18,600 coho to these fisheries annually.

TABLE 11-2. Salmon Escapement Level for the Nisqually Basin WRIA 11.

	1966-1971 Escapements [1]	
Species	*Range*	*Average*
Chinook	300— 3,500	1,500
Coho	1,300— 9,000	4,200
Pink	3,500—10,000	7,000
Chum	9,500—30,000	16,500

Natural Escapement Potential	
Chinook	1,500
Coho	6,500
Pink	10,000
Chum	15,000

[1] *Includes natural plus artificial combined escapements.*

Harvest

Salmon produced or reared within the Nisqually basin contribute to U.S. and Canadian, Pacific Ocean sport and commercial fisheries, and to the sport and commercial fisheries existing through the Strait of Juan de Fuca and Puget Sound. Some sport harvest also occurs within the Nisqually River proper. The estimated total annual contribution (all species) to these various fisheries has, in recent years, averaged nearly 52,000 salmon.

The basin's marine waters are closed to commercial salmon fishing. The Nisqually Indian fishery, operating in the lower mainstem Nisqually River, catches and markets salmon through recognized fish dealers. In recent years 1966 -71 this fishery has harvested as many as 25,000 salmon in a single season.

The question of Indian fishing rights has been contested for many years and adjudication now in progress may cause significant alterations in both fishing patterns and distribution of catch.

Sport angling for salmon is very popular in the basin's marine waters with fishermen utilizing the area from the mouth of the Nisqually River northwest toward Johnson Point and north to Anderson Island. Relatively large numbers of immature fish find excellent feeding grounds within these waters the year around. This fact combined with good

returns of adult salmon through the area to southern Puget Sound streams, relatively good access for fishermen, and fishing areas that are semi-protected from winds and rough water all tend to make this basin's salt-water sport fishery a very popular year-round activity. The angling sites are among the most popular in southern Puget Sound where, in 1971, over 150,000 angler trips were recorded.

Freshwater salmon angling is allowed in the mainstem Nisqually River. Here the river is open downstream from State Highway 507 (McKenna Bridge) to the mouth, a distance of 21 miles. Only jack salmon [1] may be possessed in these waters during the season which extends from July through mid-November. Average reported catch of salmon for the 1966 through 1971 seasons was 80 fish with most of these being jack chinook or coho. The 24-inch maximum size limit permits the harvest of small pink salmon on odd-numbered years as occurred in 1967 when 1,436 salmon were harvested.

Limiting Factors

Limiting factors refer to conditions that lead to a complete loss or reduction of the environment's fish producing potential, excluding harvest or exploitation. They include only those conditions presently considered alterable.

Within the Nisqually basin major limiting factors include low summer flows, unstable streamflows, physical barriers, and profile changes in some tributaries.

Stream flow — Fish production in nearly all of the basin's smaller streams suffer to some extent from low summer flows. Unfortunately for most of these streams, there is little potential for actual low flow augmentation. In the mainstem Nisqually River, low flow conditions are aggravated by restricted water releases from Alder Dam during summer months and by the diversion of water into the Centralia Power Canal above Yelm. These two projects are not coordinated with fish needs and the result is extremely low flow conditions in the main river. The two major tributaries to the Nisqually below Alder Dam, Muck Creek and the Mashel River, both experience annual low flow problems. Portions of Muck Creek, because of its location in a glacial outwash plain, are actually dry for a month or more each year. The natural summer low flow problem in the Mashel River has been increased by extensive logging in the basin.

Flooding has only a limited effect on the fish producing environment in the mainstem Nisqually River. The influence of Alder Lake has changed the run-off pattern to the point that most damaging floods have been curtailed. The Mashel, however, experiences flooding problems because of the rapid run-off of water from heavily logged areas. This in turn causes rapid movement of bed materials and the stability of the stream is affected.

Physical barriers — The City of Tacoma's Alder and LaGrande Dam complex located above river mile 42.5 blocks over 30 additional miles of upper Nisqually River watershed suitable for use by anadromous fishes. No fish passage facilities are operated at this facility. Flow releases during periods of low flow from the LaGrande Dam require the outflow shall not be less than the inflow into the upper reservoir, but these flows are not coordinated with the water

[1] *Not less than 10 inches nor more than 24 inches in length.*

PHOTO 11-5. Centralia diversion dam.

diversion by the Centralia Power Canal which claims 1,050 cfs. Actual diversion amounts to 720 cfs by the City of Centralia at their diversion dam at R.M. 26.2, which dries up 13.8 miles of river channel for fish use. In 1955 an agreement between the City of Centralia and the Department of Fisheries provided for 120 cfs through this section of river

PHOTO 11-6. Numerous migration barriers occur in the upper Nisqually drainage (Little Mashel River).

for fish passage. When the flow at Centralia's diversion dam falls below 840 cfs then fish flows are subsequently reduced.

Waterfall-cascade type barriers occur on numerous tributaries in the mountainous upper sections of the basin. Elimination of these barriers, in most cases, would not open significant areas for anadromous fish production. However, there are several which have considerable production area above the block. These include blocks on the Mashel River and its upper tributaries.

Water quality — A potential water quality problem exists in the mountainous forest lands of the upper Nisqually and Mashel river watersheds. Here new techniques of pest and foliage control associated with forestry may involve use of aerial chemical spraying, a method extremely difficult to effectively regulate. Glacial "flour" or silt occurs in heavy concentrations in the Nisqually River and several tributaries from late spring to early fall. Nonseasonal siltation occurs between November and March due to reservoir flushing operations from Alder Dam. Glacial silt is detrimental to anadromous fish production through the reduction of egg and fry survivals and production of fish food organisms.

Only the smaller low land drainages, such as McAllister, Muck, and Yelm creeks, experience warm temperatures which may be limiting to fish production. Cold temperatures in the upper watersheds near the stream origins tend to limit fish populations, principally on the upper Mashel River and its tributaries.

Limited spawning and rearing area — Spawning area in the Nisqually basin is limited mainly by physical blocks, profile changes, and by actual destruction of suitable streambed by construction and/or erosion control projects. The loss of gravel associated with profile changes in the Mashel River is a serious problem which reduces available spawning area for adult salmon. Construction has as yet had only a limited effect on the environment, but it is expected to become an increasing problem as population and industrial expansion continues.

PHOTO 11-7. Elimination of stream bank cover is a serious limiting factor.

Rearing area is naturally limited by the low summer flows prevalent in this basin. Also, considerable potential rearing area is lost because of its location upstream of artificial and natural physical barriers.

Watershed development — Logging is, and will probably continue to be, the most significant development factor in the upper watersheds of the basin. Extensive programs of clear-cutting and clearcut section logging occur over the upper watersheds of the Mashel River and the mainstem Nisqually.

In the lower stream areas of the basin, extensive land areas are within the Fort Lewis Army Reservation. In addition to this, a large portion of land on the southwest bank makes up the Nisqually Indian Reservation. These two land reserves will retard land development along the lower reaches of the river, preserving fish production habitat.

PHOTO 11-8. The lower river area is largely undeveloped.

NISQUALLY BASIN WRIA 11
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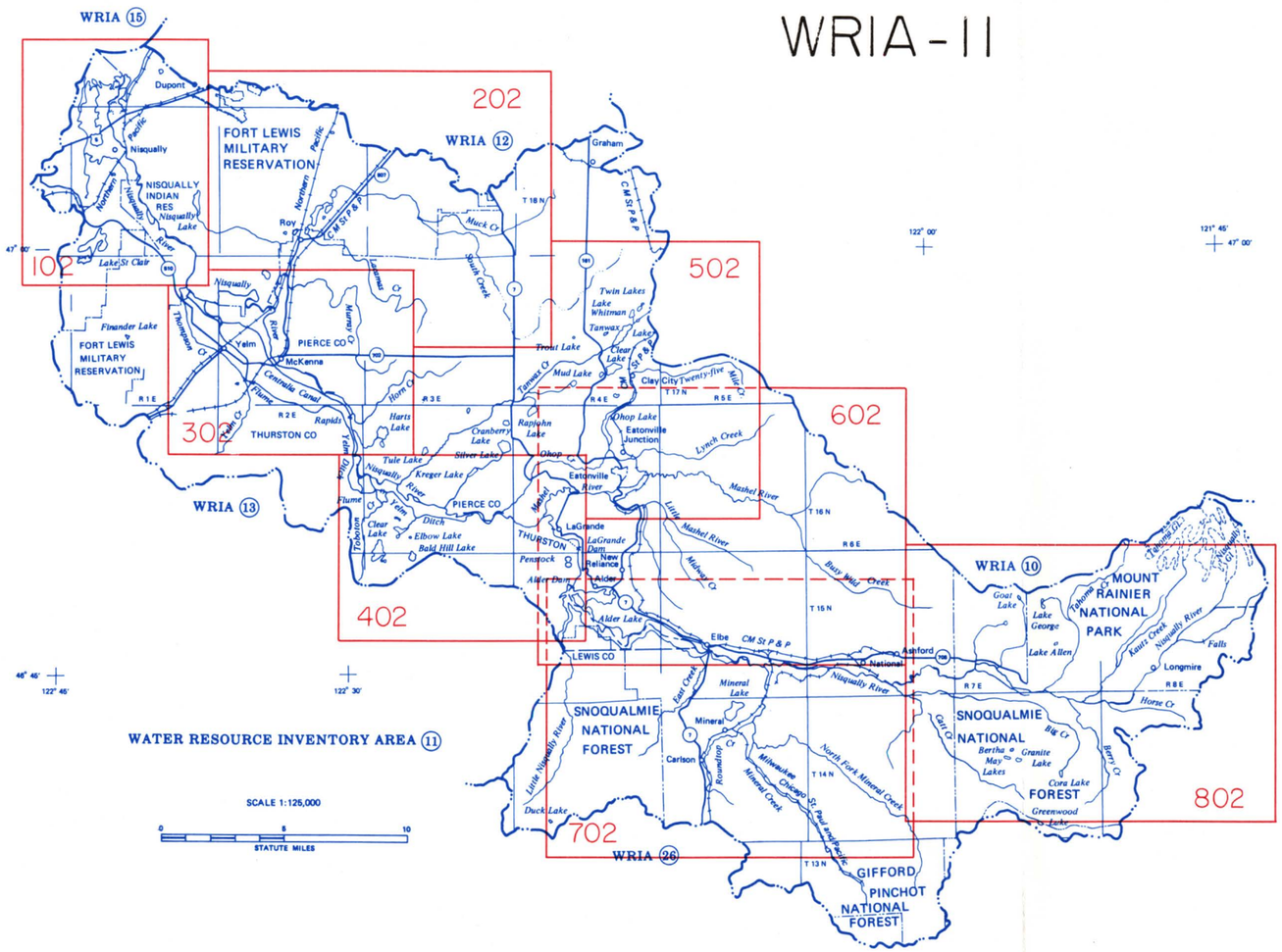
NISQUALLY RIVER BASIN

WRIA-11



NISQUALLY RIVER
Lower Mainstem

The Nisqually River forms the boundary between Pierce and Thurston counties. The section described here includes the lower 10.6 miles from its mouth to Muck Creek. Tributaries total 12.65 miles, but most of this lies within several drainage ditch systems as well as stream side channels. Three small nearby independent drainages are also described, with a combined total of 26.6 miles, which again includes several drainage ditches.

Stream Description

The lower three miles of the Nisqually River is surrounded by a broad, flat delta with salt marsh and swampy conditions prevailing. Between mile 3.0 and 6.0 the stream is bordered on its right bank by a bluff, and on the left bank by a lowland valley that slowly narrows progressing upstream. From mile 6.0 to the mouth of Muck Creek, the river meanders between the bluffs that confine the valley. Development has been moderately light, consisting of residences and farms. The river is bordered on its south bank by the Nisqually Indian Reservation from approximately mile 3.7 to the upper end of this stream reach. The Fort Lewis military reservation borders the Nisqually on its north bank throughout this section above Interstate Highway 5 at mile 2.4. While much of Fort Lewis is well developed and is heavily utilized for military exercises, a protective buffer has been left undisturbed along the river banks. Watershed cover in undeveloped areas includes mixed second growth timber.

The Nisqually River flows in a generally northwesterly direction throughout this reach. Its gradient is shallow in the lower two miles, but becomes moderate above this point. There is tidal influence to approximately R.M. 4.0. The entire section is composed of riffle areas separated by pools, with substrate predominantly medium and coarse gravel. Much of the Nisqually River is of glacial origin and the stream bottom is covered by a thin coating of silt at most times. Discharge as measured near McKenna, a substantial distance upstream at mile 31.6, has averaged 1,819 cfs over 25 years. There is major flow regulation at Alder Reservoir and at the La Grande Hydraulic Plant. The flow of sediment to downstream areas is also regulated by Alder Reservoir. Glacial material flows off Mount Rainier and settles within the reservoir and is not released until drawn down during the following winter.

Tributaries within this section are few, small, and of little importance. Independent drainages include McAllister Creek, Eaton Creek, and an unnamed stream that enters Nisqually Flats just north of the mainstem river. The latter drainage is known locally as Mounts Creek. McAllister Creek originates in McAllister Springs and flows 5.5 miles to enter the tide flats south of the Nisqually River. It has extremely shallow gradient throughout its entire length except at its immediate headwaters. Tidal influence also extends through much of the stream area. Substrate is sand and mud with some gravel in the uppermost section. Two spring areas enter from the left bank along McAllister Creek and provides some additional gravel area. The terrain is mostly farmland or swampy habitat, and stream bank vegetation is dense. Medicine Creek, its principal tributary and site of the territorial government's treaty with the Indian nation, drains lowland area within the Nisqually Valley. It has shallow gradient throughout its length and serves as a drainage area within the valley floor with no fisheries value. Eaton Creek is the inlet to Lake St. Clair. This lake has no outlet, but water from this system is assumed to be the source of McAllister Springs. The unnamed tributary (Mounts Creek) contains several gravel stretches in its upper reaches before entering the Nisqually Flats, where the remaining stream is marshy.

Salmon Utilization

The Nisqually River produces large runs of chinook, chum, pink, and coho salmon. This lower section provides suitable spawning area, above approximately R.M. 3, that is utilized by chinook, chum, and pink salmon. Spawning also occurs in several side channels and sloughs. The entire section provides transportation water for all species. Chum salmon is the major species utilizing McAllister Creek; however, chinook, coho, pink, and even sockeye are frequently seen here. Mounts Creek has an important chum run, considering its small size, and it is believed to also produce coho. The desired escapement level in the Nisqually River system is 2,000 fall chinook, 2,330 coho, 30,000 chum and 10,000 pink.

Limiting Factors

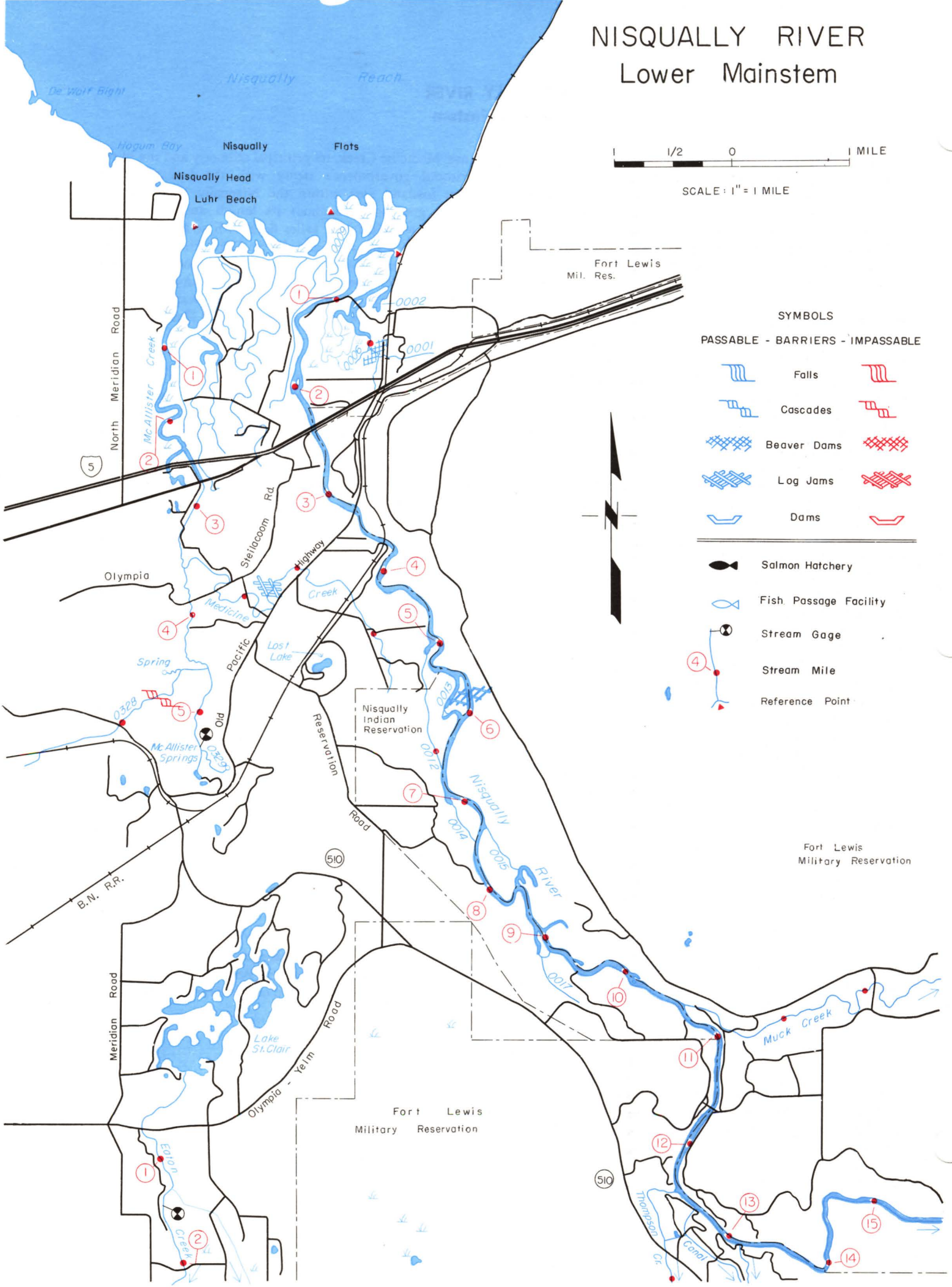
There are few apparent factors limiting salmon production within this area. The natural silt load carried by the stream as well as the artificial regulation of flows have direct impact; however, these have not been evaluated. The shallow gradient within McAllister Creek which limits the amount of spawning material available, could also be considered a natural limiting factor.

Beneficial Developments

Numerous plants of fall chinook and coho have been made into the Nisqually River system, and future development of rearing facilities is anticipated near the mouth of Muck Creek.

Habitat Needs

Normal stream habitat management, through application of the hydraulics code, is the principal requirement to maintain the natural production of this river section.


NISQUALLY RIVER
Lower Mainstem
De Wolf Bight
Nisqually Reach
Hogum Bay
Nisqually Flats
Nisqually Head
Luhr Beach
1/2
0
1 MILE
SCALE: 1" = 1 MILE
Fort Lewis
Mil. Res.
North Meridian Road
McAllister Creek
Steilacoom Rd.
Highway
Olympia
Medicine Creek
Lost Lake
Pacific
Spring
Old
McAllister Springs
B.N. R.R.
Nisqually Indian Reservation
Reservation Road
Nisqually River
Meridian Road
Lake St. Clair
Olympia - Yelm Road
Eaton Creek
Fort Lewis
Military Reservation
Muck Creek
Thompson Cr.
Canal
SYMBOLS
PASSABLE - BARRIERS - IMPASSABLE
Falls
Cascades
Beaver Dams
Log Jams
Dams
Salmon Hatchery
Fish Passage Facility
Stream Gage
Stream Mile
Reference Point

NISQUALLY RIVER—LOWER MAINSTEM
Nisqually Basin—WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0001	Unnamed	Sec33,T19,R1E	1.5	—	(Coho), Chum
0008	Nisqually River	Sec29,T19N,R1E	78.5	—	Chin., Coho, Pink Chum, Sockeye
0010	Drainage Ditch	LB-0.95	~ 7.25	—	None
0012	Unnamed Side Channel	LB-4.95	1.2	—	Coho, (Chum)
0018	Muck Creek	RB-10.6	20.85	92.0	Coho, Chum
	(See Nisqually 203)				
0041	Thompson Creek	LB-12.4	3.0	—	(Coho)
	(Cont. Nisqually 303)				
0324	McAllister Creek	Sec31,T19N,R1E	5.5	—	Coho, Chum
0325	Drainage Ditch	RB-0.4	~ 6.2	—	Unknown
0327	Medicine Creek	RB-3.55	3.5	—	(Chin.), Coho, (Chum)
0328	Unnamed	LB-4.6	1.95	—	Coho, Chum
	McAllister Springs	Outlet-5.5	—	—	
0330	Eaton Creek	Sec6,T17N,R1E	2.85	—	None
0331	Drainage Ditch	RB-1.3	~ 2.3	—	None

MUCK CREEK DRAINAGE

Muck Creek is a moderately large tributary of the lower Nisqually River, entering on the right bank at mile 10.6. Its mainstem length is 20.85 miles and it has 7 tributaries totaling 50.35 miles. Most of the tributary mileage is in Lacamas Creek and South Creek. This watershed is located in southern Pierce County.

Stream Description

The headwaters and upper reaches of Muck Creek lie in a broad prairie several miles south of the City of Puyallup. The stream flows westerly through the town of Roy, with most of the lower 7 miles within the Fort Lewis military reservation. The prairie, or level surrounding land mass, continues throughout much of its length with exception of the lower few miles of watershed. The drainage has been moderately well developed, with rural residential homes, farms, and pastureland. Undeveloped portions are comprised of second growth coniferous and deciduous timber. The highest density of settlement within the watershed is near Roy. Development within the U.S. Army reservation at Fort Lewis is also important, since the area surrounding Muck Creek is heavily used for training maneuvers and target ranges, including heavy artillery.

Gradient in much of the stream is shallow, with intermittent moderate sections throughout its length. The steepest section is the lower 2 to 3 miles of stream, where it finally leaves the prairie and cuts a valley through the bluff bordering the mainstem Nisqually River. As a result of the gradient, the stream is characterized by numerous pools and a relatively deep stream channel, separated by occasional riffles. There are a number of marshy areas distributed along the drainage. Tributary streams exhibit these same characteristics. Substrate is regulated by the gradient, with gravel or sandy-muddy areas predominating. Only an occasional section has sufficiently steep gradient where rubble or coarse materials prevail. Within the lower 3 miles the gradient gradually becomes moderate to steep. Here the quality of gravel first improves with the reduction of sandy substrate, then begins to deteriorate as the streambed becomes mostly rubble and coarse material. The favorable gradient and gravel return again in the lower 0.5 mile of stream.

Stream bank coverage is varied, ranging from open farmland and marshes where where the stream is totally exposed, to dense trees and brush that form a complete canopy over the creek. In general the vegetation is intermittent in the upper watershed, favorable through much of Fort Lewis, and excellent in the lower 2 miles.

The streamflow pattern in Muck Creek is the primary factor regulating fish usage of the stream. In spite of its large drainage area (92.0 square miles) Muck Creek has intermittent flow within large portions of the mainstem and tributaries. A U.S.G.S. stream gage at Roy shows the average flow over 16 years has been dry during a portion of every year. These data indicate that there is some regulation in lakes above the station, and some domestic diversion. Much of the upper watershed has year-round flow, as well as the lowermost sections.

Salmon Utilization

Chum salmon comprise the largest population of anadromous fish produced in the Nisqually River system, and Muck Creek stocks are an extremely important segment of this run. Stream flows in Muck Creek preclude entry and spawning of fish until after mid-December. The chum run normally enters in late December and January and spawning extends throughout February. Important areas within the stream include an unnamed tributary (Exeter Springs) at mile 2.3, an unnamed tributary (Halverson Marsh) at mile 5.55, an unnamed tributary (Johnson Creek) at mile 9.3, and mainstem sections that contain suitable gravel. Coho also spawn and rear in upper watershed areas of year-round flow. Some coho spawn in the mainstem or tributary intermittent flow areas, and rearing of their progeny is presumably in the lower Nisqually River.

Limiting Factors

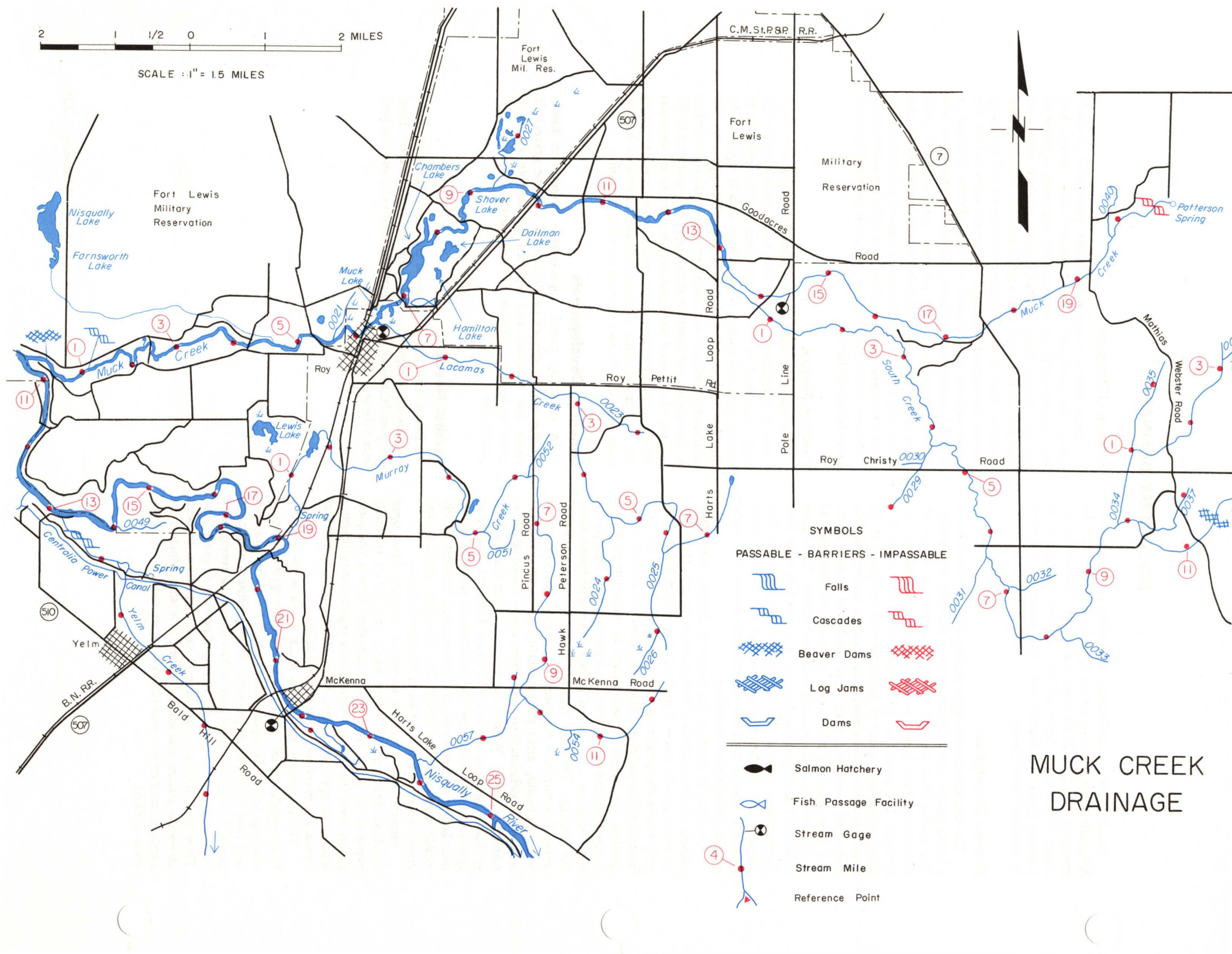
The major limiting factor to salmon production in Muck Creek is intermittent stream flow. Coho production in this large watershed is severely restricted by the depletion of rearing area, and timing of all salmon runs is regulated by the flow regime. Muck Creek is accessible only after the middle of December, and flows generally begin their decline in late spring and continue throughout the summer and fall months. Man-caused problems include many small reservoirs constructed within the stream channels to store water during the dry season, many without hydraulic approvals. In past years these have formed barriers for adult migration.

Beneficial Developments

A spawning gravel improvement project on Exeter Springs was completed in 1972. Sand and fine gravel substrate was removed and replaced by suitable spawning gravel material to increase the area suitable for salmon reproduction.

Habitat Needs

Due to the critical nature of the streamflow during dry months, consumptive uses of water should be denied. There are possibilities of future spawning area enhancement projects to benefit chum salmon.


2 1 1/2 0 1 2 MILES
SCALE : 1" = 1.5 MILES
Fort Lewis Mil. Res.
C.M.St.P.&P. R.R.
Fort Lewis Military Reservation
Fort Lewis Military Reservation
Nisqually Lake
Farnsworth Lake
Chambers Lake
Shaver Lake
Dailman Lake
Muck Lake
Hamilton Lake
Lacamas Creek
Lewis Lake
Murray Creek
Spring Creek
Pincus Creek
Peterson Road
Hawk Creek
Harts Lake
Harts Loop Road
Goodacres Road
Roy Pettit Road
Roy Christy Road
Pole Line Road
Lake Road
Roy
McKenna
McKenna Road
Yelm
Yelm Creek
Centralia Power Canal
Spring
Bald Hill Road
B.N.R.R.
Nisqually River
Patterson Spring
Mathias Creek
Webster Road
South Creek
Muck Creek
0021
0023
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0049
0051
0052
0054
SYMBOLS
PASSABLE - BARRIERS - IMPASSABLE
Falls
Cascades
Beaver Dams
Log Jams
Dams
Salmon Hatchery
Fish Passage Facility
Stream Gage
Stream Mile
Reference Point
MUCK CREEK DRAINAGE

MUCK CREEK DRAINAGE
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				Chin., Coho, Pink, Chum, Sockeye
0018	Muck Creek	RB-10.6	20.85	92.0	Coho, Chum
0020	Diversion Ditch	RB-4.5	~ 3.4	—	Unknown
	Muck Lake	Outlet-6.35	—	—	
0022	Lacamas Creek	LB-6.36	7.7	15.7	Coho, Chum
0023	Unnamed	RB-2.9	1.1	—	(Coho), (Chum)
0024	Unnamed	LB-4.6	1.85	—	(Coho), (Chum)
0025	Unnamed	LB-6.3	1.3	—	(Coho), (Chum)
	Unnamed Lake	Outlet-7.7	—	—	
	Chambers Lake	Outlet-6.85	—	—	
	Shaver Lake	Outlet-8.75	—	—	
0027	Unnamed (Johnson Cr)	RB-9.3	1.2	—	(Coho), Chum
	Unnamed Lake	Outlet-0.7	—	—	
	Unnamed Lake	Outlet-1.2	—	—	
0028	South Creek	LB-13.35	16.9	—	(Coho), (Chum)
0029	Unnamed	LB-4.3	1.0	—	Unknown
0034	Unnamed	RB-9.8	3.35	—	(Coho)
0035	Unnamed	RB-1.0	1.3	—	Unknown
0036	Unnamed	LB-3.15	2.25	—	Unknown
0037	Unnamed	RB-10.1	1.1	—	Unknown
0038	Unnamed	RB-12.8	1.0	—	Unknown
0039	Unnamed	LB-13.1	1.5	—	Unknown

NISQUALLY RIVER
Yelm Area

This section covers the Nisqually River from the vicinity of Thompson Creek, northwest of Yelm, upstream nearly 16 miles to a point just southeast of Harts Lake. Nine tributaries add approximately 46 stream miles along this reach. Here, the river serves as the Pierce-Thurston county boundary. Much of the north bank area downstream from McKenna is within Fort Lewis Military Reservation. Principal access is via the Yelm-McKenna Highways, and various county, military, or private roads. A principal feature of this reach is the Centralia power facility consisting of a diversion dam R.M. 26.2), a canal essentially paralleling the Nisqually's left bank, and penstocks and power plant on the Nisqually (R.M. 12.7) just upstream from Thompson Creek.

Stream Description

From the Harts Lake vicinity the Nisqually flows generally in a northwest direction through this reach, with considerable winding stream course beginning near the Burlington Northern Railroad crossing, northeast of Yelm. Principal tributaries include Horn, Murray, Yelm, and Thompson creeks.

Through the majority of this reach the river is contained within a somewhat shallow, narrow, fairly steep-sloped valley, bordered on each side by mostly flat prairie terrain. Stream-side cover ranges from moderate to dense, consisting of mixed deciduous and conifer growth. Surrounding hillsides above the diversion dam maintain relatively dense forest cover, some heavily logged areas. Downstream more cleared land is encountered, this mostly in agricultural use. Principal community developments are Yelm and McKenna, with scattered rural residences.

Over the reach's upper 2-3 miles, to just below Horn Creek (R.M. 25.8), the Nisqually exhibits a moderate gradient, with relatively good pool-riffle character. There are a number of channel-split stretches, the stream ranging 15 to over 40 yards during normal fall flows. The bottom is mostly rubble and gravel with some boulder-strewn sections. Banks are mainly rubble beaches, some natural earth cuts. Stream-side cover is mostly dense, mixed deciduous and conifer growth.

Over the remaining 13-14 miles the relatively stable channel is, for the most part, restricted by the narrowing valley condition, the stream rangpng from 20 to over 45 yards in width, and presenting a mainly fast riffle-glide stream character, with some fair sized pools and a few rapids. The bottom is predominantly boulder and rubble with some gravel riffles; mostly patch gravel strips. Riffle formation increases downstream from Yelm Creek (R.M. 13.1). Most banks are sharply sloped, either earth or rock cuts. There are relatively few beach areas, these generally on the inside of large sweeping turns. Cover is moderate to dense, mixed deciduous and conifer trees.

Most tributaries offer moderate gradient stream courses, with good pool-riffle conditions, and mainly gravel bottom, at least along their lower stretches. Tributary cover generally consists of fairly thick deciduous growth.

Salmon Utilization

This river section provides transport, spawning, and rearing habitat for all 5 species of Pacific salmon. Chinook, pink, chum, and a small run of sockeye tend to use the main river, while coho and some pink and chum spawn in the accessible tributaries. Sockeye spawning appears to be confined to the stream area immediately below the diversion dam. Juvenile salmon rearing takes place throughout the accessible waters with coho maintaining year around habitation.

Limiting Factors

The cold glacial character of the Nisqually presents some production limitation. Occasionally severe flow reductions, or sharp fluctuations affect the 13.5 miles of river between the Centralia power diversion and powerhouse, inhibiting adult transportation or impacting spawning and/or rearing fish.

Beneficial Developments

The Centralia power diversion is equipped with a ladder, transporting adult fish to upstream areas, and fish screens, preventing juvenile fish from entering the canal. There are a number of springs along the lower reaches which could serve future production stations.

Habitat Needs

In addition to maintaining stream habitat conditions in their near natural state, there is a need to carefully coordinate river flow control, this involving the upriver City of Tacoma facilities and the Centralia power diversion operation.

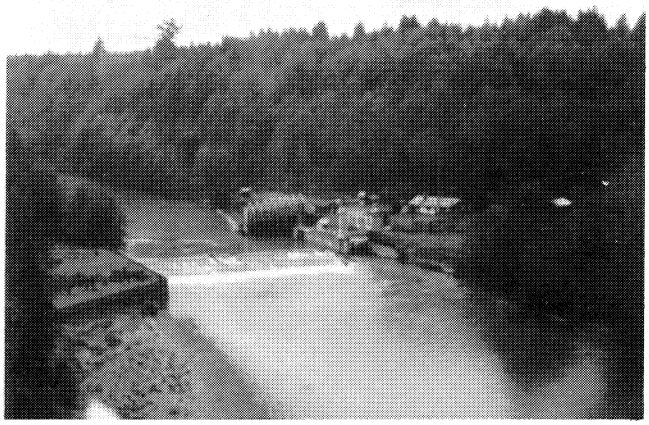
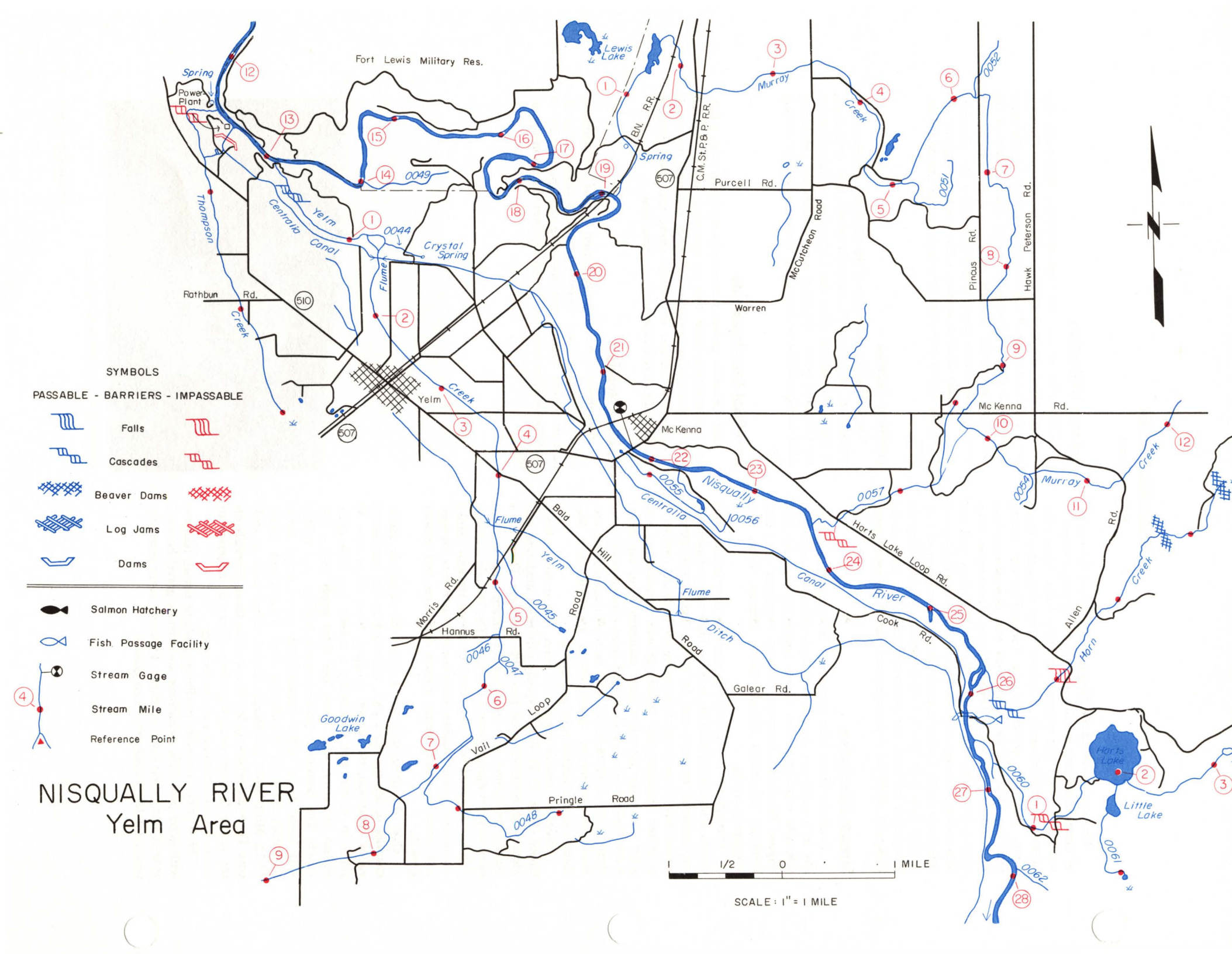


PHOTO 11-9. Centralia power diversion.



NISQUALLY RIVER
Yelm Area

NISQUALLY RIVER — YELM AREA
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				Chin., Coho, Pink Chum, Sockeye
0041	Thompson Creek	LB-12.4	3.0	—	(Coho)
0043	Yelm Creek	LB-13.1	9.05	—	Coho, Chum
0048	Unnamed	RB-6.6	2.0	—	Unknown
0050	Murray Creek	RB-19.1	12.25	—	(Coho), (Chum)
	Unnamed Lake	Outlet-1.3	—	—	
0055	Unnamed	LB-22.3	1.35	—	(Coho), (Chum)
0057	Unnamed	RB-23.6	2.0	—	Coho, (Chum)
0059	Horn Creek	RB-25.8	5.85	—	(Coho), (Chum)
0060	Unnamed	RB-26.5	3.6	—	Coho, (Chum)
	Harts Lake	Outlet-1.8	—	—	
0061	Unnamed	LB-2.0	1.0	—	None
	Unnamed Lake	Outlet-3.1	—	—	

(Cont. Nisqually 403)

NISQUALLY RIVER
La Grande Area

This section covers 16 miles of Nisqually River, from just below Lacamas Creek, southeast of McKenna, upstream to Alder Dam, just south of Eatonville in southern Pierce County. Twelve tributaries add more than 30 miles, these excluding the Tanwax-Ohop creeks (Nisqually 500), and Mashel River (Nisqually 600). Principal access is via the Mount Rainier National Park Highway and private logging roads southwest of Eatonville.

Stream Description

From City of Tacoma's Alder Dam (R.M. 44.2) the Nisqually cuts north and west more than 4 miles through a very narrow, steep-walled canyon, emerging near the Mashel River (R.M. 39.6). From here it winds west-northwest more than 11 miles over a much broader valley floor, having moderate to dense stands of mixed deciduous and conifer cover. The more gently sloping sidehills maintain mostly thick conifer forest, with some extensively logged slopes in various stages of reforestation. Development is sparse along this river section with principally timber and some limited agriculture land use. The only community developments are Eatonville and La Grande. Principal tributaries other than those mentioned include Powell, Taboton, and Lacamas creeks.

From Alder Dam the Nisqually drops into its narrow canyon about 1.5 miles above La Grande Dam. Below this lower City of Tacoma impoundment the narrowly confined river presents numerous cascades and rapids, this condition continuing downstream nearly to the Mashel River.

Below the Mashel the river maintains a moderate gradient through the remainder of the reach. he channel appears mostly stable with a few areas of channel splitting. Fall flows would cover the channel ranging 15 to over 40 yards in width, probably averaging 25-30 yards. Numerous long, broad riffles and glides exist, with some large, deep pools. The bottom is mostly rubble and gravel composition, just a few boulder-strewn stretches. Stream banks appear mostly stable, natural earth cuts or gently sloping rubble-gravel beaches. Stream-side cover is moderate to dense, mostly deciduous trees and underbrush, and some mixed conifers. A few divergent side channels along this stretch add considerably to the main river habitat.

In addition to Tanwax and Ohop creeks, and the Mashel River, Powell, Taboton, and Lacamas creeks also offer fairly extensive moderate gradient stream conditions. They produce some fairly good pool-riffle area, having mainly gravel and rubble bottoms. Their banks maintain relatively good cover, principally deciduous trees and underbrush. Other smaller tributaries generally have limited access, usually with intermittent flow patterns.

Salmon Utilization

This river segment provides transport, plus spawning and rearing habitat for chinook, coho, pink, and chum salmon. Most coho spawning occurs within the tributaries, the other species using mainly the mainstem river and larger tributaries. Juvenile salmon rear throughout these accessible waters with coho having year around habitation.

Limiting Factors

The cold glacial character of the river, plus c.. .ain flow fluctuation patterns associated with power peaki.g operations are the principal factors limiting salmon production in this section. Buildup of debris and/or beaver dams in tributaries periodically reduces their use potential. Poaching of adult salmon has at times been a problem in the lower Mashel drainage, mainly near confluence with the Nisqually.

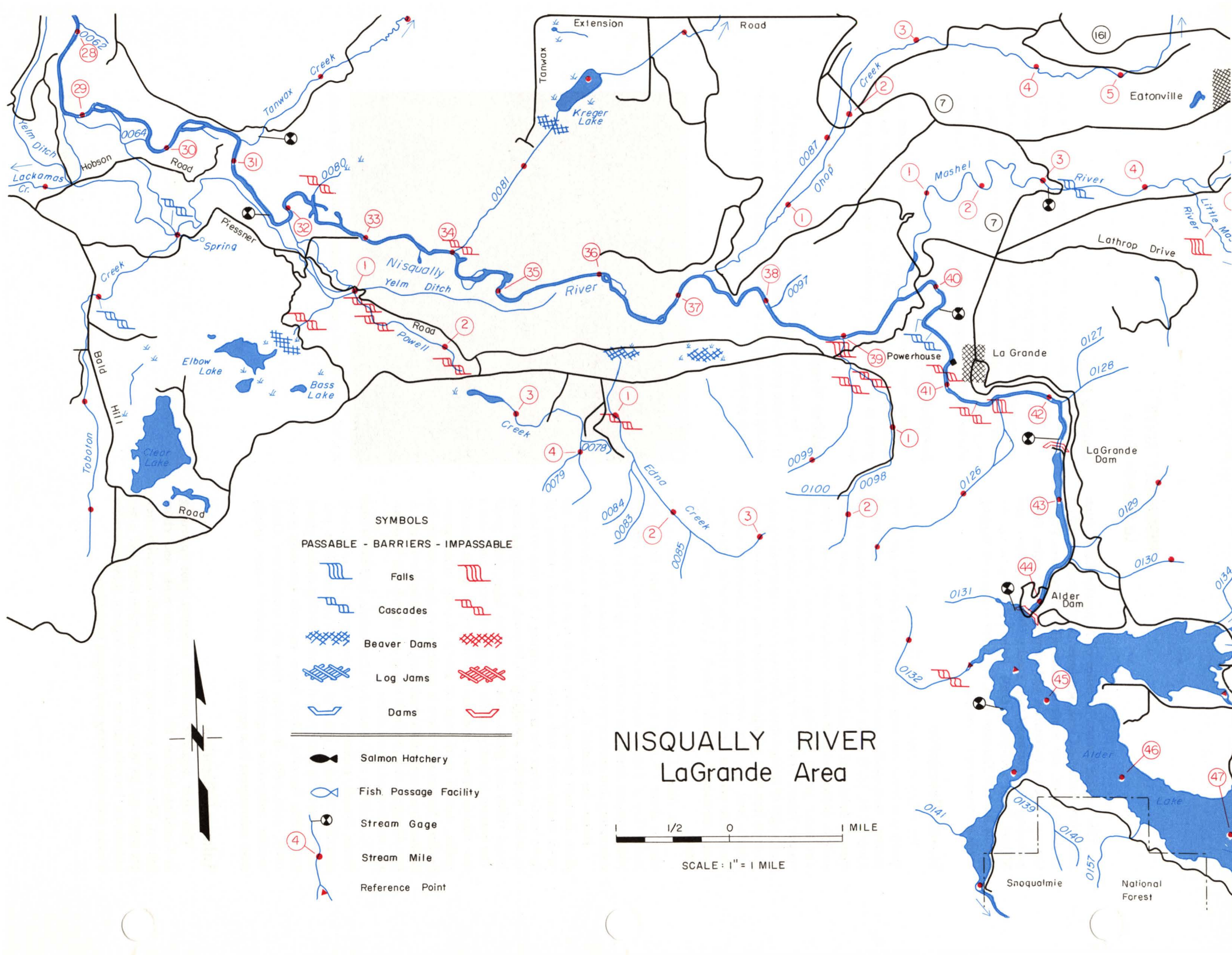
Beneficial Developments

Other than periodic stream maintenance projects and occasional planting of hatchery fish there have been no programs in this section to specifically benefit salmon production.

Habitat Needs

The principal requirements to maintain production habitat include preserving existing stream-side cover and maintaining stream and streambed conditions in as near a natural state as possible.

PHOTO 11-10. Typical section of Nisqually River below La Grande.


Extension
Road
Tanwax
Creek
Kreger Lake
Eatonville
Yelm Ditch
Lackamas Cr.
Hobson
Road
0062
0064
0080
0081
0087
Ohop
Creek
Mashel
River
Little Mashel River
Lathrop Drive
Pressner
Spring
Creek
Nisqually
Yelm Ditch
River
Powell
Road
Elbow Lake
Bass Lake
Bald Hill
Toboton
Clear Lake
Road
Creek
0078
0079
Edna
Creek
0083
0084
0085
0097
0098
0099
0100
Powerhouse
La Grande
0126
0127
0128
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0130
0131
0132
0134
LaGrande Dam
Alder Dam
Alder
Lake
0139
0140
0141
0157
Snoqualmie
National Forest
SYMBOLS
PASSABLE - BARRIERS - IMPASSABLE
Falls
Cascades
Beaver Dams
Log Jams
Dams
Salmon Hatchery
Fish Passage Facility
Stream Gage
Stream Mile
Reference Point
NISQUALLY RIVER
LaGrande Area
1/2
0
1 MILE
SCALE: 1" = 1 MILE

NISQUALLY RIVER — LA GRANDE AREA
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				Chin., Coho, Pink, Chum, Sockeye
0063	Lackamas Creek	LB-28.8	3.0	—	Coho, (Chum)
0064	Unnamed Side Channel	LB-29.4	0.5		Coho, (Pink) (Chum)
0065	Taboton Creek	LB-0.3	4.4	—	Coho, (Chum)
0067	Tanwax Creek	RB-30.8	13.3	—	Coho, Chum
	(See Nisqually 503)				
0076	Powell Creek	LB-31.9	4.55	—	Coho, (Chum)
	Unnamed Lake	Outlet-2.5	—	—	
0081	Unnamed	RB-34.05	3.6	—	Unknown
0082	Edna Creek [1]	LB-36.45	3.1	—	Unknown
0086	Ohop Creek	RB-37.3	11.9	—	Chin., Coho, Pink, (Chum)
	(See Nisqually 503)				
0098	Unnamed	LB-39.0	2.4	—	Unknown
0099	Unnamed	LB-0.3	1.2	—	None
0101	Mashel River	RB-39.6	20.5	—	Chin., Coho, Pink, (Chum)
	(See Nisqually 603)				
0126	Unnamed	LB-41.55	2.1	—	None
0129	Unnamed	RB-43.4	1.2	—	None
0130	Unnamed	RB-43.5	1.1	—	None
	(Cont. Nisqually 703)				

[1] *Edna Creek has no permanent connection with Nisqually River.*

TANWAX-OHOP DRAINAGE

This section covers the Nisqually River tributaries, Tanwax and Ohop creeks. The location is just west of Eatonville in southern Pierce County. Access routes are via the Mount Rainier National Park Highway, the Harts Lake Loop Road, and the Kapowsin-Eatonville Highway. Ohop Creek is nearly 12 miles in length, with 5 tributaries adding another 32 linear stream miles. Tanwax Creek is over 13 miles long, and has 7 short tributaries adding a little over 7 linear miles.

Stream Description

Both Tanwax and Ohop creeks flow in a southwest direction through shallow valleys within predominantly low rolling hill terrain. Ohop enters the north bank of the Nisqually at R.M. 37.3, and Tanwax at R.M. 30.8. Ohop's principal tributaries are Twenty-five Mile and Lynch creeks. One of the more significant features of each basin is their lakes; Ohop Lake, Tanwax Lake, plus at least eight smaller lakes on Tanwax Creek. Relatively dense residential development has occurred around the larger lakes with scattered rural dwellings along some sections of the creeks. Eatonville is the only large community in this area. Land use is principally forestry and agriculture, with considerable recreation on the lakes.

Ohop Creek presents a moderate to gentle gradient throughout most of its 12-mile length, with Ohop Lake occupying 2.3 miles in the upper drainage. Much of the area above the lake is bog with slough-like pool or glide character, and mainly a sand-gravel bottom. Below the lake the creek exhibits relatively good pool-riffle stream balance over the remainder of its length, except for the lower half-mile where it becomes a slow, relatively deep channel. Fall stream widths below the lake range near 4 to 7 yards. The bottom is mostly gravel with some rubble stretches, and a few slower areas having considerable quantities of sand. The channel is mostly confined by low earth banks and some narrow gravel-rubble beaches. Cover ranges from sparse to dense, with deciduous strips or thickets separated by expanses of cleared pastureland. Ohop's tributaries, Twenty-five Mile Creek (R.M. 9.9) and Lynch Creek (R.M. 6.1), contain considerable moderate gradients with fair to good pool-riffle conditions. Their bottoms are mainly of gravel and rubble composition. Each has a barrier cascade or falls about two miles above the confluence with Ohop Creek.

Tanwax Creek exhibits a moderate to gentle gradient throughout most of its length. Below Tanwax Lake it is largely a pool-glide type stream, with intermittent short riffles. The channel is generally confined by low earth banks, with fall widths ranging 3-5 yards in the lower stretches. Its bottom is mostly sand and small gravel, with only a few stretches having any larger material. Stream-side cover is mostly dense, mixed deciduous and coniferous trees, with some extensive clear-cut sections. Most of the short tributaries to Tanwax Ceek have intermittent flows, and their gentle gradients consist mostly of sand and gravel bottoms. Stream-side cover along these smaller tributaries is generally thick, mainly deciduous trees and underbrush.

Salmon Utilization

In Ohop Creek chinook, coho, pink and possibly some chum salmon ascend as far as Ohop Lake. Twenty-five Mile Creek and Lynch Creek receive some chinook and large numbers of coho. Relatively extensive rearing habitat is provided for year-round use by coho.

In Tanwax Creek, coho and some chum salmon utilize the lower stretches, with a few coho ascending nearly to Tanwax Lake when conditions are favorable.

Limiting Factors

In each of these drainages low summer flows tend to limit the available rearing habitat. Occasional buildup of debris or formation of beaver dams is at times a problem, particularly in Tanwax Creek. Extensive cover removal also impacts some stream sections.

Beneficial Developments

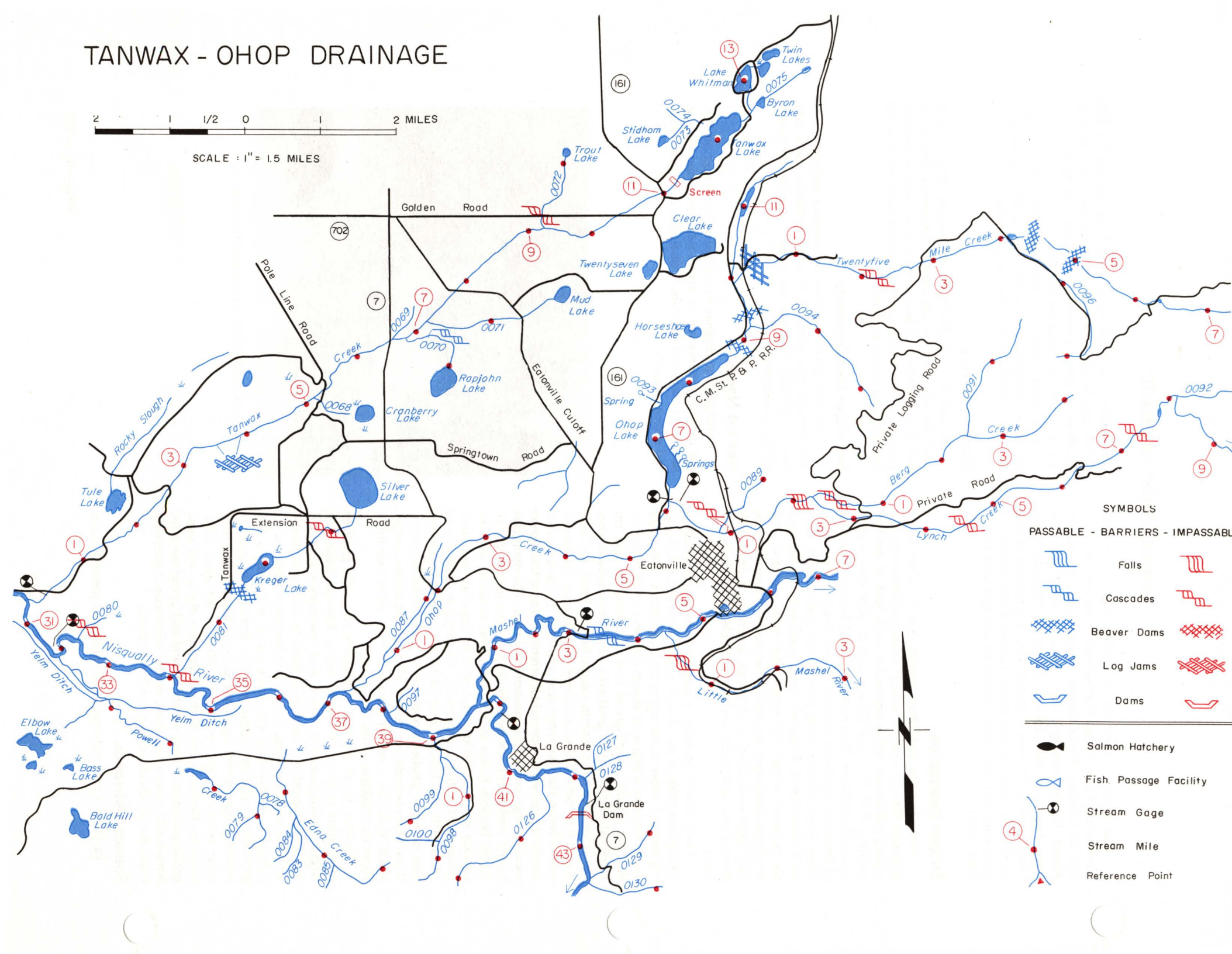
Other than periodic stream maintenance such as beaver dam removal, plus planting of juvenile salmon, there have been no projects in these drainages to specifically benefit salmon production.

Habitat Needs

Principal requirements to maintain the production habitat include preservation of stream-side cover, and maintenance of stream and streambed conditions in as near a natural state as possible.

PHOTO 11-11. Mashel River 0.25 mile above mouth.

TANWAX - OHOP DRAINAGE



TANWAX-OHOP DRAINAGE
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				Chin., Coho, Pink, Chum, Sockeye
0067	Tanwax Creek	RB-30.8	13.3	—	Coho, Chum
0070	Unnamed	LB-6.8	1.05	—	Unknown
0071	Unnamed	LB-7.2	1.9	—	(Coho)
0072	Unnamed	RB-9.2	1.1	—	Unknown
	Tanwax Lake	Outlet-11.3	—	—	
	Lake Whitman	Outlet-12.85	—	—	
	Twin Lake	Outlet-13.3	—	—	
0076	Powell Creek	LB-31.9	4.55	—	Coho, (Chum)
	(See Nisqually 403)				
0081	Unnamed	RB-34.05	3.6	—	Unknown
0082	Edna Creek	LB-36.45	3.1	—	Unknown
	(See Nisqually 403)				
0086	Ohop Creek	RB-37.3	11.9	43.6	Chin., Coho, Pink, (Chum)
0087	Unnamed	RB-0.7	1.85	—	(Coho)
0088	Lynch Creek	LB-6.1	10.2	—	Chin., Coho
0089	Unnamed	RB-0.85	1.0	—	Unknown
0090	Berg Creek	RB-2.3	4.1	—	None
0091	Unnamed	RB-2.5	1.7	—	None
	Ohop Lake	Outlet-6.3	—	—	
0094	Unnamed	LB-9.2	2.3	—	Coho
0095	Twenty-Five Mi. Cr.	LB-9.9	7.5	—	Coho
0096	Unnamed	LB-4.01	2.1	—	None
	Unnamed Lake	Outlet-4.05	—	—	
	Unnamed Lake	Outlet-10.85	—	—	
0098	Unnamed	LB-39.0	2.4	—	Unknown
0099	Unnamed	LB-0.3	1.2	—	None
0101	Mashel River	RB-39.6	20.5	—	Chin., Coho, Pink, (Chum)
	(See Nisqually 603)				
0126	Unnamed	LB-41.55	2.1	—	None
0129	Unnamed	RB-43.4	1.2	—	None
0130	Unnamed	RB-43.5	1.1	—	None
	(Cont. Nisqually 703)				

MASHEL RIVER DRAINAGE

This section includes the entire Mashel River drainage with over 20 miles of mainstem plus seven tributaries providing another 67 linear stream miles. The majority of this drainage is located east of Eatonville in southern Pierce County. Access is via the Mount Rainier National Park Highway, and various county and private roads out of Eatonville.

Stream Description

From mountain slopes about ten miles east of Eatonville, the Mashel winds its way more than 20 miles west and southwest to enter the Nisqually River (R.M. 39.6) northwest of La Grande. Principal tributaries are Busy Wild and Beaver creeks in the upper drainage, and the Little Mashel River in the lower reaches.

Through the majority of its drainage the Mashel cuts through a shallow, relatively narrow, steep-sloped, forested valley. A number of short, canyon-ravine stretches are encountered. Only in the Eatonville vicinity does the valley broaden to any extent, and this extends for only about a mile. Cover is mainly mixed deciduous and coniferous growth over the upper drainage, and predominantly deciduous trees and brush below. Principal land use is timber production with some agriculture and recreation. Development is sparse with a few scattered rural residences, generally downstream from the town of Eatonville.

From its headwaters downstream about six miles to Busy Wild Creek (R.M. 14.5) the Mashel has a fairly steep gradient, with a few falls, and numerous cascades. These are interspersed with some fast riffles and a few pools. In its narrowly confined channel the bottom is largely boulder and rubble, some bedrock, and only occasional gravel-rubble riffles. Its banks are fairly steep-sided earth or rock cuts, maintaining little cover and much of this upper area has been clear-cut.

Below Busy Wild Creek for approximately 9 miles, the river's gradient is moderately steep. The channel remains quite confined, with fall season flows covering 6 to 12 yards. It is mostly a fast riffle stretch with some cascades and a few relatively large pools. Stream-side cover is dense deciduous trees and underbrush.

In the two miles below Eatonville, the river has a moderate gradient with relatively good pool-riffle stream conditions. The channel is fairly stable with some braiding. Fall season flows range from 8 to 15 yards in width. Here, the bottom is predominantly rubble and gravel, with a few scattered boulders. The banks are low earth cuts or gravel-rubble side beaches. Cover consists of moderate stands or strips of mostly deciduous growth.

Through the lower 4 miles, the Mashel cuts through a narrow, shallow valley, with alternating moderate to moderately steep gradients. The confined channel width ranges from 6 to 12 yards during the fall. The bottom is composed mostly of rubble and gravel, with some bedrock and a few boulder-strewn sections. This area contains fast riffle-type character with occasional good quality pool-riffle stretches, particularly over the lower half-mile. Stream banks are usually natural earth or rock cuts, and a few relatively narrow rubble-gravel beaches. Cover is mainly thick deciduous growth.

Busy Wild Creek has a moderate gradient for nearly 5 miles, with relatively good pool-riffle balance and predominantly gravel-rubble bottom. Its cover is moderate growths of deciduous and low coniferous trees. Beaver Creek and the

In the two miles below Eatonville, the river has a moderate gradient with relatively good pool-riffle stream conditions. Ohe channel is fairly stable with some braiding. Fall season flows range from 8 to 15 yards in width. Here, the bottom is predominantly rubble and gravel, with a few scattered boulders. The banks are low earth cuts or gravel-rubble side beaches. Cover consists of moderate stands or strips of mostly deciduous growth.

Through the lower 4 miles, the Mashel cuts through a narrow, shallow valley, with alternating moderate to moderately steep gradients. The confined channel width ranges from 6 to 12 yards during the fall. The bottom is composed mostly of rubble and gravel, with some bedrock and a few boulder-strewn sections. This area contains fast riffle-type character with occasional good quality pool-riffle stretches, particularly over the lower half-mile. Stream banks are usually natural earth or rock cuts, and a few relatively narrow rubble-gravel beaches. Cover is mainly thick deciduous growth.

Busy Wild Creek has a moderate gradient for nearly 5 miles, with relatively good pool-riffle balance and predominantly gravel-rubble bottom. Its cover is moderate growths of deciduous and low coniferous trees. Beaver Creek and the Little Mashel River each have falls very near their mouths. The areas above the falls contain moderate gradient stream character for most of their upper stream courses. Most smaller tributaries to the Mashel exhibit steeper mountain-type stream character over much of their lengths, with little access or favorable salmon habitat.

Salmon Utilization

The accessible reaches of the Mashel drainage are utilized primarily by chinook and coho, with pink extending to the Eatonville vicinity. Chum are confined primarily to lower river stretches. Chinook spawn principally in the main river with coho extending into accessible tributaries. Juvenile salmon rearing takes place throughout the accessible stream reaches, with coho having year around habitation.

Limiting Factors

The canyon above Eatonville creates fish passage delays, particularly during low flow periods. This is sometimes compounded by the buildup of logging debris in the stream. Also, flash flooding and unusually heavy siltation are considered problems. Poaching is sometimes prevalent in the lower half-mile.

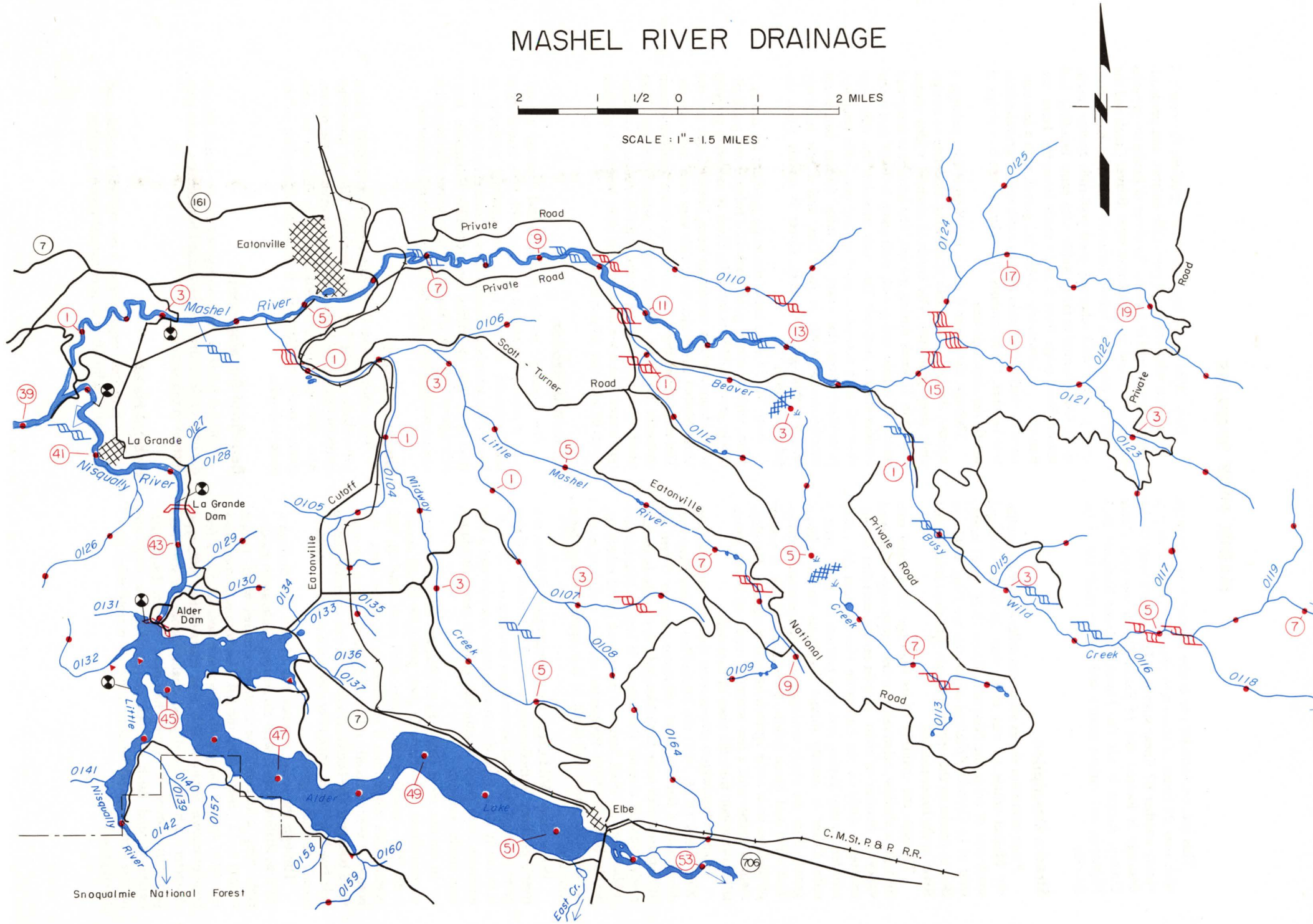
Beneficial Developments

Log jam removal and planting of hatchery-reared fish are the only projects that are performed benefiting salmon production in this section.

Habitat Needs

The principal requirement is to maintain stream and streambed conditions in as near natural state as possible.

MASHEL RIVER DRAINAGE



MASHEL RIVER DRAINAGE
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				
0101	Mashel River	RB-39.6	20.5	83.5	Chin., Coho, Pink, (Chum)
0102	Little Mashel R.	LB-4.35	9.2	—	Coho
0103	Midway Creek	LB-2.1	5.6	7.24	None
0104	Unnamed	LB-1.2	2.4	—	None
0106	Unnamed	RB-2.8	1.3	—	None
0107	Unnamed	LB-3.6	4.7	—	None
0108	Unnamed	LB-2.9	1.1	—	None
0109	Unnamed	LB-8.6	1.0	—	None
0110	Unnamed	RB-10.1	3.75	—	Unknown
0111	Beaver Creek	LB-10.4	8.3	—	(Coho)
0112	Unnamed	LB-0.95	2.35	—	None
0114	Busy Wild Creek	LB-14.5	7.8	—	(Chin.), (Coho)
0115	Unnamed	RB-2.9	1.3	—	Unknown
0117	Unnamed	RB-5.1	1.15	—	None
0118	Unnamed	LB-5.45	2.7	—	None
0119	Unnamed	RB-6.4	1.4	—	None
0121	Unnamed	LB-15.6	4.75	—	None
0123	Unnamed	LB-2.7	1.4	—	None
0124	Unnamed	RB-16.4	1.7	—	None
0125	Unnamed	RB-16.85	1.9	—	None

NISQUALLY RIVER
Alder Lake

This section covers the Nisqually River from Alder Dam upstream to the vicinity of National, approximately 15 river miles. Thirteen tributaries provide nearly 119 linear stream miles. It is located a few miles southeast of Eatonville with access via the Mount Rainier National Park Highway. Here, the river marks the Pierce-Lewis county boundary. Only the Little Nisqually River, a principal tributary, is within national forest land.

Stream Description

From the vicinity of National (R.M. 59.0) the Nisqually winds to the west about 7.5 miles to Alder Lake at Elbe. This lake is the major power and flood control reservoir operated by the City of Tacoma. From Elbe the lake runs generally northwest another 7.5 miles to Alder Dam. Principal tributaries include Mineral and East creeks, plus the Little Nisqually River.

The valley floor is relatively broad through this section, rising gradually away from the river to the steeper mountain side slopes. The bottomland has moderately dense deciduous cover with mixed conifers, while the steeper side slopes have mainly deciduous forest. Considerable logged off slopes are evident in various stages of reforestation. Principal developments consist of the communities of Ashford, National, Mineral, and Elbe, each with a few scattered outlying residences. The major activity is logging, with some agriculture and limited recreational use.

The Nisqually contains a moderate gradient over this reach. Although the channel is relatively stable, it transforms into a number of channel-split sections. Stream widths during fall months range from 8 to over 25 yards, averaging 12 yards. It is mainly a riffle-type stream, with a few swift areas and some pools. The bottom is mostly rubble and gravel with a few boulder-strewn areas. The banks are relatively low earth cut or gently sloping gravel-rubble side beaches. There are just a few stretches artifically contoured by bank protection projects. Stream-side cover ranges from moderate to dense stands of mostly deciduous trees and underbrush, with some coniferous timber.

Mineral Creek offers extensive moderate gradient stream course. This stream drains from the relatively low mountains southeast of Mineral, and is characterized by good quality pool-riffle habitat, a gravel-rubble bottom and good to excellent cover. Agricultural land borders much of its lower reaches, with extensive logging over the higher headwater slopes. East Creek, although smaller than Mineral Creek, offers similar habitat conditions. The Little Nisqually River, draining the steeper, heavily forested mountain slopes, shows more typical mountain stream characteristics, with numerous cascades and small falls, separated by relatively short pool-riffle stretches, where the bottom is mostly of larger rock material, with some gravel and rubble areas. Most of the smaller tributaries exhibit fairly steep mountain stream character over much of their lengths, providing little access or use by anadromous fish.

Salmon Utilization

There is no salmon utilization in the Nisqually drainage above La Grande, approximately R.M. 41.0, with two impassable dams located a short distance upstream.

Limiting Factors

The cold glacial character of the river presents a natural limitation on the stream's production capabilities. Potential habitat problems exist with cover removal, especially on smaller tributaries, as well as streambed alterations associated with gravel removal, bank protection, or channelization projects.

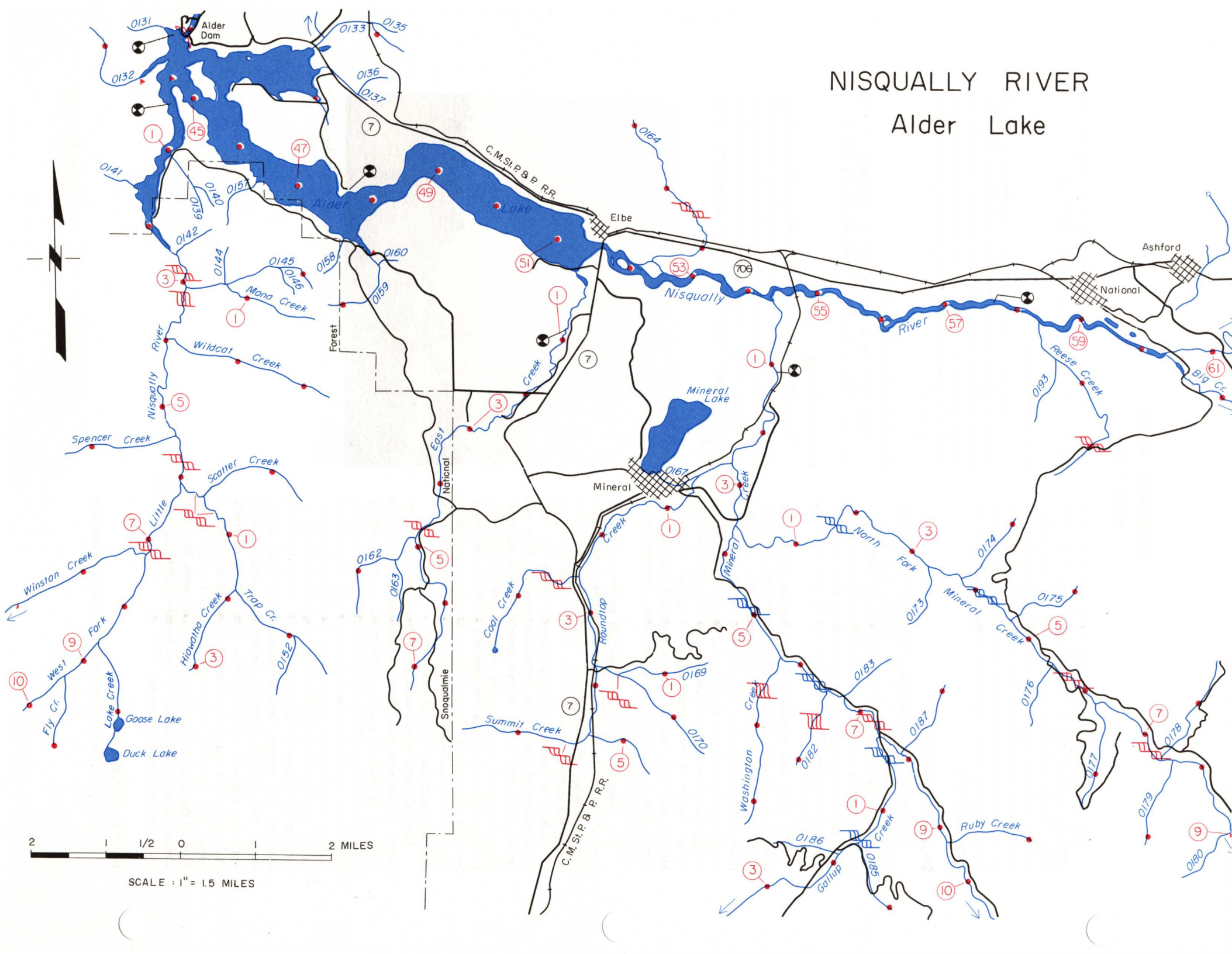
Beneficial Developments

There have been no projects or programs in this drainage section to specifically benefit salmon production.

Habitat Needs

The principal requirement to maintain existing habitat production capabilities involves maintaining stream-side cover and stream and streambed conditions in as near a natural state as possible. Some restrictions should be considered regarding gravel removal operations immediately above Alder Lake.

PHOTO 11-12. Confluence of Nisqually River with Alder Lake at Elbe.


NISQUALLY RIVER
Alder Lake
Alder Dam
Alder Lake
C.M.St.P.&P. R.R.
Elbe
Ashford
National
Nisqually River
Mona Creek
Wildcat Creek
Spencer Creek
Scatter Creek
Little Nisqually River
Forest
Mineral Lake
Mineral
East Creek
Mineral Creek
North Fork Mineral Creek
Reese Creek
Big Cr.
Winston Creek
West Fork Fly Cr.
Lake Creek
Goose Lake
Duck Lake
Hiawatha Creek
Trap Cr.
Snoqualmie
Coal Creek
Roundup Creek
Summit Creek
Washington Creek
Gallup Creek
Ruby Creek
2 1 1/2 0 1 2 MILES
SCALE : 1" = 1.5 MILES

NISQUALLY RIVER — ALDER LAKE
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				Chin., Coho, Pink, Chum, Sockeye
	Alder Lake	Outlet-44.15	—	—	
0132	Unnamed	LS-44.4	1.3	—	None
0133	Unnamed	RS-44.41	1.4	—	None
0138	Ltl. Nisqually R.	LS-44.6	10.05	—	None
0143	Mona Creek	RB-3.1	1.9	—	None
0145	Unnamed	RB-0.65	1.2	—	None
0147	Wildcat Creek	RB-4.0	2.4	—	None
0148	Spencer Creek	LB-5.5	1.4	—	None
0149	Hiawatha Creek	RB-6.1	3.1	7.64	None
0150	Scatter Creek	RB-0.4	1.8	—	None
0151	Trap Creek	RB-1.8	1.95	—	None
0153	Winston Creek	LB-7.25	2.1	—	None
	Ltl. Nisq. R. cont. as W.F. Ltl. Nisq. R.	@ mi. 7.26	—	—	
0154	Lake Creek	RB-8.6	1.5	—	None
0155	Fly Creek	RB-9.3	1.0	—	None
0159	Unnamed	LS-47.7	1.15	—	None
0161	East Creek	LS-51.3	7.4	13.3	None
	Unnamed Lake	Outlet-0.02	—	—	
0162	Unnamed	LB-4.9	1.6	—	None
0164	Unnamed	RB-52.05	3.1	—	None
0165	Mineral Creek	LB-54.3	13.9	76.3	None
0166	Roundtop Creek	LB-2.7	5.5	—	None
0168	Coal Creek	LB-2.55	1.7	—	None
0169	Unnamed	RB-3.71	1.4	—	None
0170	Unnamed	LB-0.3	1.5	—	None
0171	Summit Creek	LB-4.55	1.6	—	None
0172	N. Fk. Mineral Cr.	RB-3.6	9.6	26.9	None
0174	Unnamed	RB-3.8	1.1	—	None
0175	Unnamed	RB-4.65	1.1	—	None
0177	Unnamed	LB-6.2	1.4	—	None
0178	Unnamed	RB-7.5	1.5	—	None
0179	Unnamed	LB-7.7	1.1	—	None
0181	Washington Creek	LB-5.7	2.3	—	None
0182	Unnamed	LB-6.6	1.1	—	None

NISQUALLY RIVER — ALDER LAKE
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0184	Gallup Creek	LB-7.5	4.2	—	None
0185	Unnamed	RB-1.5	1.0	—	None
0187	Unnamed	RB-7.9	1.1	—	None
0188	Ruby Creek	RB-9.25	1.1	—	None
0189	Unnamed	RB-11.05	1.1	—	None
0190	Unnamed	RB-11.2	1.5	—	None
0191	Unnamed	RB-11.4	2.0	—	None
0192	Reese Creek	LB-58.4	2.6	—	None
	(Cont. Nisqually 803)				

NISQUALLY RIVER
Headwaters

This section covers the entire upper Nisqually River drainage, including over 19 river miles, with some 18 tributaries adding another 180 stream miles. The area is located southeast of Eatonville, the river serving as the Pierce-Lewis county boundary. Principal access is via the Mount Rainier National Park Highway. The majority of this section is within either national forest or national park boundaries.

Stream Description

From the Nisqually Glacier the river flows southwest about 5 miles, then winds generally west over 13 miles to the vicinity of National. Principal tributaries include Kautz, Berry, Tahoma, and Big creeks.

The drainage's upper 5 miles presents a very narrow, steep-sloped, densely forested valley, some slopes rising sharply to over 6,000 feet. Over the remaining 14 miles the valley floor broadens considerably, holding mixed conifer-deciduous cover, the steeper valley side slopes still with dense conifer forest. Development is limited to recreation facilities inside park boundaries, while below there are widely scattered residences and the small communities of Ashford and National. Principal activities in this section include logging and recreation.

Over the upper 5 miles the river gradient is mostly steep, the narrowly confined channel presenting a number of falls, many cascades and rapids. The bottom is mostly large rocks, boulders, and rubble, with a few patch gravel areas. Stream banks are mostly large rock material, with side cover relatively dense.

The reaches' lower 14 miles offers mostly moderate gradient. The quite stable channel exhibits some splitting. Fall widths range generally from 8 to over 20 yards. The stream presents mostly fast riffles and glides, few pools. The bottom is mostly rubble and gravel, a few boulder-strewn sections. Stream banks alternate between relatively low earth cuts and gently sloping rubble-gravel side beaches. There are a few diked or riprapped sections along this lower stretch. Cover is moderate to dense, mixed deciduous and conifer growth.

Most tributaries exhibit steep mountain stream characteristics over the majority of their lengths, producing mainly falls, cascades, and rapids, mainly large rock or boulder stream bottoms. Big Creek (R.M. 60.3) offers fairly extensive moderate gradient habitat with good pool-riffle conditions, the bottom over much of the stream is predominantly rubble and gravel mixture. Most tributaries are provided with dense cover, usually deciduous trees and underbrush, some conifer timber.

Salmon Utilization

There is no salmon utilization within this section of Nisqually River drainage. The upper limit of accessibility is approximately R.M. 41 near La Grande, with two impassable dams located a short distance upstream.

Limiting Factors

The cold glacial character and increasingly steep gradient conditions are the chief natural limiting factors to fish production. Potential habitat problems exist with stream-side cover removal, particularly on the smaller tributaries, and streambed alterations associated with gravel removal, bank protection, or channelization projects.

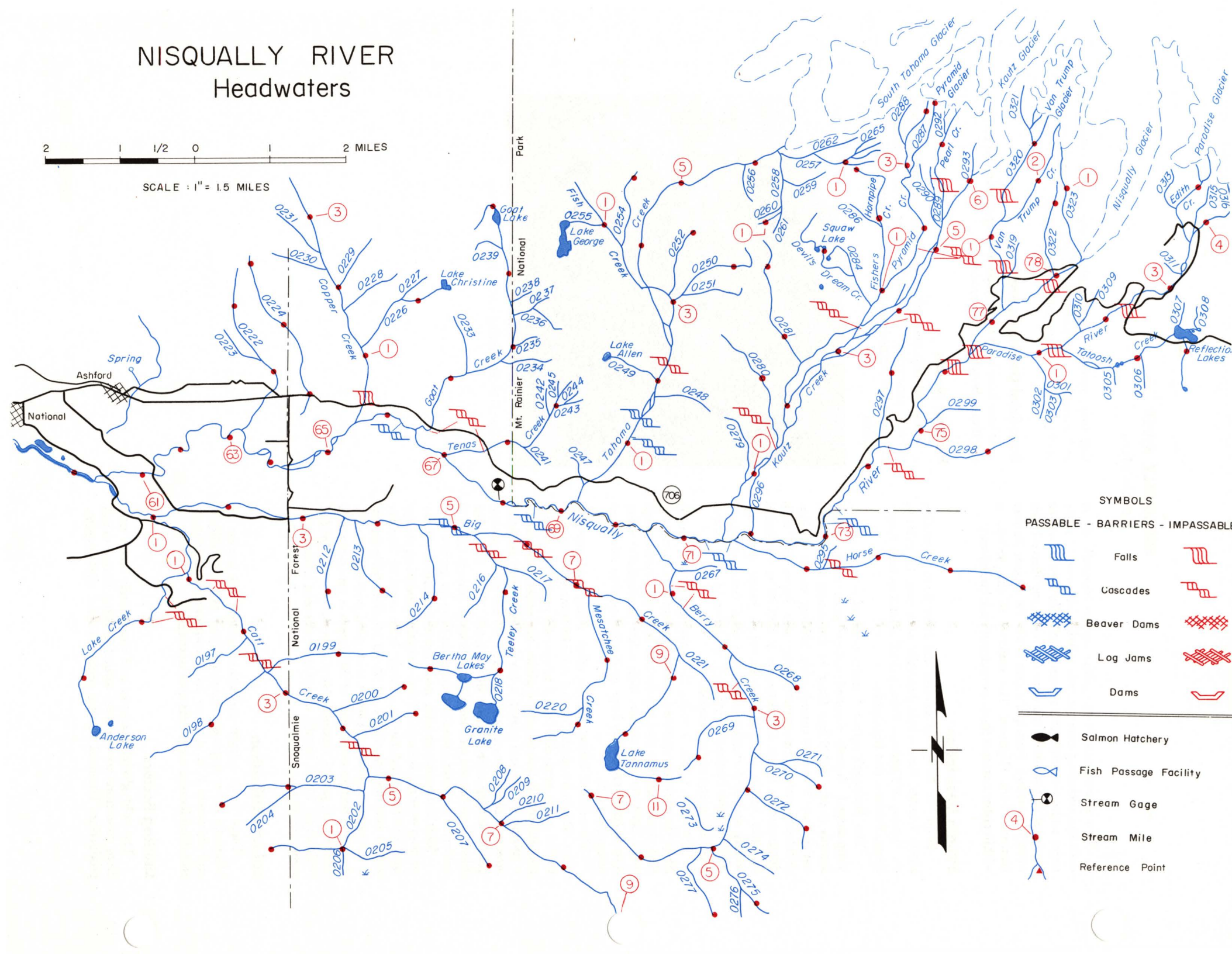
Beneficial Developments

There have been no projects or programs in this reach to specifically benefit salmon production.

Habitat Needs

Principal requirements to maintain production habitat include preserving stream-side cover and maintaining stream and streambed conditions in as near a natural state as possible.

PHOTO 11-13. Fluctuating runoffs over broad plains.


NISQUALLY RIVER
Headwaters
2 1 1/2 0 1 2 MILES
SCALE : 1" = 1.5 MILES
Park
National
Mt. Rainier
Forest
National
Snoqualmie
Ashford
Spring
Goat Lake
Lake Christine
Lake George
Fish Creek
Copper Creek
Goat Creek
Mt. Rainier Creek
Tenas Creek
Lake Allen
Tahoma Creek
Kautz Creek
Nisqually River
Big Creek
Lake Creek
Colt Creek
Bertha May Lakes
Teeley Creek
Granite Lake
Anderson Lake
Mesatchee Creek
Lake Tannamus
Berry Creek
Horse Creek
Squaw Lake
Devil's Dream Cr.
Fisher's Pyramid Cr.
Hornpipe Cr.
Pearl Cr.
Van Trump Creek
Trump Cr.
Nisqually Glacier
Edith Cr.
Paradise River
Taloosh Creek
Reflection Lakes
South Tahoma Glacier
Pyramid Glacier
Kautz Glacier
Van Trump Glacier
Paradise Glacier
706
SYMBOLS
PASSABLE - BARRIERS - IMPASSABLE
Falls
Cascades
Beaver Dams
Log Jams
Dams
Salmon Hatchery
Fish Passage Facility
Stream Gage
Stream Mile
Reference Point

NISQUALLY RIVER — HEADWATERS
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0008	Nisqually River				None
0194	Big Creek	LB-60.3	11.6	—	None
	Unnamed Lake	Outlet-0.21	—	—	
0195	Catt Creek	LB-1.0	9.3	—	None
0196	Lake Creek	LB-0.95	2.7	—	None
0198	Unnamed	LB-2.6	1.9	—	None
0199	Unnamed	RB-2.65	1.75	—	None
0200	Unnamed	RB-3.8	1.0	—	None
0201	Unnamed	RB-4.2	1.0	—	None
0202	Unnamed	LB-4.8	2.0	—	None
0203	Unnamed	LB-0.2	2.0	—	None
0207	Unnamed	LB-6.0	1.0	—	None
0212	Unnamed	LB-3.55	1.25	—	None
0213	Unnamed	LB-3.7	1.25	—	None
0214	Unnamed	LB-4.6	1.75	—	None
0215	Teeley Creek	LB-5.3	3.3	—	None
	Bertha May Lks.	Outlet-2.4	—	—	
0219	Mesatchee Creek	LB-7.2	2.6	—	None
	Lake Tannamus	Outlet-10.1	—	—	
0222	Unnamed	RB-63.25	2.5	—	None
0224	Unnamed	RB-64.45	3.1	—	None
0225	Copper Creek	RB-65.5	3.5	—	None
0226	Unnamed	LB-1.1	1.5	—	None
	Lake Christine	Outlet-1.5	—	—	
0332	Goat Creek	RB-66.45	4.4	—	None
	Goat Lake	Outlet-3.65	—	—	
0240	Tenas Creek	RB-67.0	2.2	—	None
0246	Tahoma Creek	RB-69.3	6.5	—	None
0250	Unnamed	LB-3.0	1.3	—	None
0252	Unnamed	RB-3.1	1.0	—	None
0253	Fish Creek	RB-3.5	1.5	—	None
0254	Unnamed	LB-0.7	1.1	—	None
0257	Unnamed	LB-6.3	1.5	—	None
0258	Unnamed	LB-0.1	1.1	—	None
0266	Berry Creek	LB-70.4	7.1	—	None
0268	Unnamed	RB-2.25	1.0	—	None

NISQUALLY RIVER — HEADWATERS
Nisqually Basin — WRIA 11

Stream Number	Stream Name	Location Of Mouth	Length	Drainage Area	Salmon Use
0269	Unnamed	LB-3.1	1.3	—	None
0270	Unnamed	RB-3.5	1.0	—	None
0272	Unnamed	RB-4.0	1.25	—	None
0275	Unnamed	RB-5.0	1.2	—	None
0277	Unnamed	RB-5.2	1.0	—	None
0278	Kautz Creek	RB-71.6	6.6	—	None
0280	Unnamed	RB-1.5	1.7	—	None
0281	Unnamed	RB-2.0	2.4	—	None
0282	Pyramid Creek	RB-3.0	4.1	—	None
0283	Devils Dream Cr.	RB-0.7	1.75	—	None
	Squaw Lake	Outlet-1.2	—	—	
0285	Fishers Hornpipe Creek	RB-1.0	2.0	—	None
0287	Unnamed	LB-2.95	1.0	—	None
0291	Pearl Creek	RB-5.4	1.4	—	None
0294	Horse Creek	LB-71.8	4.1	—	None
0297	Unnamed	RB-74.3	1.5	—	None
0298	Unnamed	LB-74.8	1.4	—	None
0300	Paradise River	LB-76.4	4.9	—	None
0304	Tatoosh Creek	LB-1.2	2.5	—	None
	Reflection Lake	Outlet-1.7	—	—	
0312	Edith Creek	RB-3.6	1.5	—	None
0318	Van Trump Creek	RB-77.2	2.8	—	None
0320	Unnamed	RB-1.25	1.3	—	None
0322	Unnamed	RB-78.0	1.3	—	None
0323	Unnamed	RB-78.45	1.65	—	None