CHAPTER EIGHT

Stream Habitat and Riparian Areas Analysis

This chapter documents the habitat analysis and summarizes potential measures to preserve and restore habitat conditions in the Nisqually River Basin planning area. Aquatic habitat problems were identified based on nearly 30 years of field data collection by scientists working for the Nisqually Tribe in partnership with scientists from federal, state, and local agencies. The Ecosystem Diagnosis and Treatment (EDT) model was used to analyze the field data, identify limiting factors, and determine habitat restoration and preservation needs and priorities.

Chapter 4 documents the extent of degraded riparian and aquatic habitat in the Nisqually River basin. *Table 4-16* includes a list of references that have been used to characterize stream health and aquatic habitat condition. Chapter 5 describes habitat problems identified during the field work and EDT development.

8.1 SUMMARY OF FIELD INVESTIGATIONS AND EDT MODEL DEVELOPMENT

Nisqually Tribe scientists, working in partnership with federal, state and local agencies, have conducted extensive field studies and habitat modeling in the Nisqually watershed since 1977. These studies are summarized in *Table 8-1*.

Development of the EDT model for the Nisqually Basin began in 1997. The model was developed by Mobrand Biometrics Inc. (MBI) based on the data listed above and technical assistance from scientists with the Nisqually Tribe, the Northwest Indian Fisheries Commission, Washington Department of Fish and Wildlife, and the National Marine Fisheries Service. The EDT model works by analyzing the best available habitat information for all salmon stream reaches in the basin, applying biological rules of how salmon are impacted by changes in habitat, and evaluating which changes have caused the greatest impacts to salmon population parameters. Model outputs for historical and current conditions were found to be consistent with actual salmon population data collected.

During the field work and analyses summarized in *Table 8-1*, a number of habitat problems were identified. These problems are summarized in Section 8.2 and described in detail for each stream in the basin in Section 8.3.

TABLE 8-1
Habitat Investigations and Analyses

Dates	Activities
1970s	Stream surveys conducted in the Nisqually River watershed
Late 1980s to mid 1990s	Stream surveys conducted in forested areas
1990s	Extensive water quality studies completed
1997-2001	EDT model developed for chinook
2000-present	EDT models updated with new habitat information
2000-present	Habitat studies completed
Post 2000	Fish passage barrier assessment conducted in conjunction with Pierce Conservation District
Post 2000	Riparian vegetation condition assessment conducted in conjunction with Pierce Conservation District
Post 2000	Mainstem Nisqually River off-channel habitat assessment conducted – led by South Puget Sound Salmon Enhancement Group
2001-present	EDT model developed for coho, chum, steelhead, and pink
2001-present	High temperature monitoring completed
2001-present	Yearly macroinvertebrate sampling completed
2002	Detailed habitat assessment of Ohop Creek conducted
2002-2007	Spawning distribution surveys completed

8.2 LIMITING FACTORS

In the Nisqually River Basin, EDT modeling and on-the-ground habitat analysis have been used to identify reach-specific watershed processes and habitat features that are affecting the survival of each species of salmon. Conditions that limit the ability of habitat to fully sustain populations of salmon are limiting factors. These factors typically include degraded estuarine areas, riparian corridors, stream channels, and wetlands, as well as fish passage barriers.

8.2.1 Limiting Watershed Processes

Many of the impaired watershed processes are affecting multiple species of salmon. The major limiting processes that are affecting salmon and trout in the Nisqually River Basin are listed below.

- Dikes have impaired estuarine processes, including tidal exchange, sediment transport, nutrient input (by reducing salt marsh vegetation quantity), food web (loss of estuarine habitat for invertebrates), and tidal channel forming processes.

- In the nearshore, shoreline hardening and fill, mainly associated with the railroad along the Puget Sound shoreline from the Nisqually estuary north to Pt. Defiance, have impaired

sediment and wood recruitment processes, prevented tidal exchange (especially in potential pocket estuaries blocked by hanging culverts), and reduced nutrient and prey species input from the lack of overhanging terrestrial shoreline vegetation.

- Unnatural channel confinement and bank hardening (dikes, riprap, levees, ditching) in some places on the mainstem Nisqually as well as some tributaries, including Ohop Creek, limit channel migration processes and the formation and maintenance of off-channel and instream habitat. These limiting processes also reduce the diversity of instream habitat types, and riparian and wetland function.

- Loss of riparian vegetation has resulted in impaired riparian function, loss of wood recruitment, reduced nutrient cycling, reduced water quality, and reduced instream habitat formation.

- Changes in sediment transport, both increases in fine sediment transport and loss of gravel inputs, have impacted instream habitat in some key tributaries such as Ohop Creek and the Mashel River.

8.2.2 Limiting Habitat Features

Many of the impaired habitat features identified through this work are affecting multiple species of salmon. The major limiting habitat features that are affecting salmon and trout in the Nisqually River Basin are listed below.

- Diking has resulted in a loss of estuarine habitat, particularly intertidal emergent marsh and tidal channel habitat.

- In the nearshore, shoreline hardening along the Puget Sound shoreline from the Nisqually estuary north to Pt. Defiance has altered beach slope and substrate, blocked potential pocket estuaries, and reduced forage fish spawning habitat.

- In the freshwater, unnatural channel confinement and bank hardening (dikes, riprap, levees, ditching) in places on the mainstem Nisqually and several tributaries, including Ohop Creek, have reduced habitat complexity and blocked access to or prevented the creation of side-channel and off-channel habitat.

- There is a lack of mature native riparian vegetation in some areas along the tributaries and the mainstem. This results in a severe lack of large wood in the stream channel, high water temperatures, and reduced food availability in tributaries such as Ohop Creek and the Mashel River.

- Many tributaries have had a decrease in habitat diversity caused by a loss of woody debris, impaired riparian function, and channel modification. In many areas there has been a decline

in the amount of pools, pool tailouts, and beaver pond habitat. This negatively affects fry and juveniles that rear in the creek, as well as adults holding in the creek before spawning, and adults seeking suitable spawning areas.

- In the key tributaries, the Mashel River and Ohop Creek, increased fine sediment load smothers incubating eggs, while increased scour and flashiness of flows cause eggs to be washed away. Unstable banks and mass wasting contribute to this increased sediment load.

- Increased summer peak temperatures are a problem in Ohop Creek and both high temperatures and decreased summer/ fall flow are a problem in the Mashel River.

8.3 RESULTS OF EDT ANALYSIS

The EDT model was used to assess riparian and aquatic habitat problems, as described above. The following sections describe the major reasons for loss of salmon productivity, as determined by the EDT model, on the Nisqually mainstem, Red Salmon Creek, Murray Creek, Brighton and Horn Creeks, Tanwax Creek, Kreger Creek, Ohop Creek, and the Mashel River. The primary focus is on salmon because it is the dominant native fish species in the lower Puget Sound basin and is widely regarded as a reliable indicator of overall stream health. Thus, habitat conditions that are favorable for salmon are expected to be favorable for other native species as well. Moreover, Puget Sound Chinook salmon has been listed as threatened and steelhead is under consideration for listing under the Endangered Species Act.

8.3.1 Nisqually Mainstem

Much of the Nisqually mainstem is still in very good condition, especially compared to most other lowland Puget Sound rivers in urbanizing areas. The mainstem of the river is still a very productive habitat for all species of salmon that are currently found in the Nisqually. However, there have been some losses of habitat due to alterations that have happened over the last century. The major types of losses are:

- Decline in habitat diversity
- Decline in channel stability
- Loss of key habitat, including pools, backwater pools, beaver ponds, riffles with small cobble and gravel substrate, and off-channel habitat
- Reduced food availability

Habitat quality varies throughout the Nisqually mainstem. Several reaches are considered some of the last best examples of what a natural free-flowing lowland Puget Sound river should look like. However, there are also locations where the river habitat has been degraded.

Some of the mainstem Nisqually salmon habitat degradation issues are common to many of the reaches. Channel stability while salmon and trout eggs incubate in the gravel has been reduced in certain places by simplification of the channel, disconnection of the channel from its floodplain, and lack of large wood that creates complex instream habitat. Large wood is at less than historical levels in some places along the river's mainstem due to localized losses of mature riparian trees and localized bank hardening that prevents large wood from being held by the river channel. The amount of wood in the river compared to historical levels varies by reach. In general, all the reaches except the Reservation Reaches have some loss of large wood from historical levels. Section 4.4.1 provides more information on the extent of loss. These changes have also reduced the habitat diversity available for spawners, fry, and rearing juveniles.

Modifications to the channel such as dikes, levees, and riprap bank armoring that confine the channel and prevent natural channel migration are extensive in the lower reach (between Interstate 5 and the railroad grade at river mile 4), the McKenna reaches (from the Highway 507 bridge in McKenna up to the diversion dam at river mile 26.2), and, to a lesser degree, in the Wilcox and Middle reaches (i.e., between the diversion dam and Ohop Creek).

These channel modifications have also led to reduced habitat diversity. These changes and simplifications of the channel, along with the lack of large wood in the river, have a negative effect on the way changes in river flow affect fry, juveniles, and prespawners because there are fewer places for the fish to find refuge from high flows. Food availability for juvenile salmon and trout that rear in the river is estimated to be reduced compared to historic conditions. This is due to both a reduced amount of streamside vegetation providing nutrients and to a reduced amount of salmon returning (compared to historic runs) that provide fewer salmon carcasses as a nutrient source.

Changes in the amount of key habitat needed for salmon and trout (compared to presumed historical conditions) have also been detrimental in the Nisqually. These changes include a reduction in the amount of pool habitat available, especially in the McKenna reaches (from the SR Highway 507 bridge in McKenna up to the diversion dam at river mile 26.2) and small reductions in the amount of backwater pool, beaver pond, and small cobble and gravel riffle habitats. There have been extreme reductions in the amount of off-channel habitat available compared to historic conditions between Murray Creek and Horn Creek (Nisqually reaches Whitewater 3.3 and McKenna 4.1), and moderate reductions between Lackamas and Toboton Creeks (Nisqually Wilcox 5.2), and between Powell and Kreger Creeks (Nisqually Middle 6.2).

Relatively high summer and early fall water temperatures in the river downstream of the Centralia diversion (river mile 26.2) reduce survival of rearing juveniles as well as impact migrating and spawning adults in the river. Mainstem temperatures should be further investigated and their possible impacts better understood. Fish passage rates at the Centralia Diversion Dam's fish ladder should be investigated to determine whether impaired upstream migration is a serious concern.

There have not been any formal quantitative studies on the sediment budget and transport cycle in the Nisqually River. As noted in Section 4.4.1, sediment flow from the upper Nisqually is disrupted by the Tacoma's Nisqually Hydroelectric Project. The current understanding of the sediment budget and spawning substrate condition of the Nisqually River is based on professional judgment from qualitative assessments.

It is believed that sediment important to salmonids in the mainstem of the river has changed little compared to historic conditions. The amount of fine sediment has probably decreased and bed load gravels and cobbles have probably become coarser in a few selected reaches, but overall the condition of the sediment has probably not changed much.

Preservation value is high throughout the mainstem Nisqually River, with potential benefits to protecting abundance, productivity, and diversity of salmon and trout populations. Restoration value in the Nisqually mainstem is also high (especially in the estuary and lower reach below the railroad at river mile 4, in the McKenna reaches between McKenna and the Centralia Diversion Dam, and in some other areas (between the Centralia powerhouse at river mile 12.7 and Kreger Creek at river mile 34).

Restoration would be expected to lead to substantial improvements, especially in salmon and trout abundance but also in the productivity and diversity of the populations.

8.3.2 Red Salmon Creek

Major reasons for loss of salmon productivity on Red Salmon Creek include:

- Reduced habitat diversity
- Reduced in channel stability
- Loss of pool and beaver pond habitat

The habitat in Red Salmon Creek is in fairly good condition, but there have been some changes to the historic channel such as loss of streamside vegetation, loss of instream wood, and restriction of channel migration in some areas. These factors have led to reduced habitat diversity, which is detrimental to all the life stages of salmon that use the creek. These factors have also led to reduced channel stability, which reduces the survival of juveniles that rear in the creek. These rearing juveniles are also impacted by small losses in the amount of pool and beaver pond habitat types in the creek compared to what was presumably available historically, the pools and beaver ponds having been replaced by other, less valuable habitat types.

8.3.3 Murray Creek

Major reasons for loss of salmon productivity in Murray Creek include:

- Decline in habitat diversity
- Decline in channel stability
- High sediment load
- High water temperature in summer
- Loss of pool habitat
- Lower than historic summer low flows

Disconnection of the channel from its floodplain, lack of streamside vegetation, and a low availability of wood in the creek channel compared to historic conditions are problems in Murray Creek that have led to a decline in habitat diversity. This has a negative effect on fry, juveniles that rear in the creek, and adults returning to spawn. These changes, along with the ditching of portions of the upper Murray reach and an increase in the amount of bed scour, have also led to a decline in channel stability in most sections of the creek. Poor channel stability reduces the survival of incubating eggs and of fry and juveniles that rear in the creek. The disconnection of the channel from its floodplain and lack of large wood in the stream channel also lead to poor habitat diversity that provides fewer adequate habitats for rearing juveniles to hold in during summer low flows.

Based on nearby land use patterns, Murray Creek is presumed to have high levels of fine sediment. This is a concern because the sediment can reduce survival by smothering incubating eggs and can also negatively affect salmon and trout fry. The decrease in the amount of pool habitat available in the upper Murray reach (from the railroad crossing at river mile 0.4 to the headwaters) compared to what was presumably available historically decreases the survival rates of juveniles that rear in the creek and adults that hold in the creek before spawning. Several culverts in the system are partial barriers that limit the available spawning and rearing habitat for salmon and trout in the creek. There has also been a decline in food availability for juveniles that rear in the creek due to a lack of streamside vegetation providing nutrient input, presumed lower benthos production in the upper parts of the creek, and the fact that fewer salmon return to spawn (providing fewer carcasses with marine-derived nutrients). Summer flows have not been studied but are presumed to be lower than they were historically due to agricultural and residential water use. This would have a negative impact on survival of juvenile salmon and trout rearing in the creek.

The section between the unnamed lake near the Denman marsh and Highway 507 is extensively utilized by chum salmon in years with high chum returns and years with plentiful flow. This section is highly impacted by unrestricted livestock grazing, which has eroded the banks and promoted the growth of invasive grasses.

8.3.4 Brighton and Horn Creek

Major reasons for loss of salmon productivity in Brighton and Horn Creeks include:

- Fish passage barriers
- Decline in channel stability
- Decline in habitat diversity
- High water temperature in summer
- Loss of pool habitat
- Lower than historic summer low flows

The lower Brighton reach (below Harts Lake Loop Road) is primarily good habitat, although it has some minor problems with loss of streamside vegetation, reduced availability of large instream wood, and reduced numbers of salmon carcasses to provide nutrients compared to historic conditions. The wetlands at the mouth of Brighton Creek are a valuable refuge area for juvenile salmonids (both juveniles that were hatched in the creek and juveniles hatched in other places in the Nisqually River Basin that migrate in from the river). These wetlands and the stream channel at the mouth are in healthy condition except for extensive reed canary grass that dominates the emergent wetland and the riparian vegetation.

The upper Brighton reach is much more degraded than the lower reach, having significant problems with fish access and multiple habitat impacts. At and above Harts Lake Loop Road, numerous culverts block or impede access for juvenile and adult salmon. There are other habitat issues upstream of the barriers as well. Poor channel stability (related to the lack of woody debris, lack of streamside vegetation, some disconnection of the channel from its floodplain), and a high level of fine sediment lead to poor survival for salmon and trout eggs incubating in the gravel. Other problems in upper Brighton Creek above fish barriers include poor habitat diversity, a loss of pool habitat compared to presumed historic conditions, and loss of nutrients provided by returning salmon. The lack of streamside shade in these areas has likely led to increased water temperatures throughout Brighton Creek, which in turn are thought to reduce survival of juvenile salmon and trout that rear in the lower part of the creek in the summer (and would rear in these upper areas if access was restored).

Summer low flows in Brighton Creek have not been studied, but are presumed to be somewhat lower than they were historically due to agricultural and residential use. The impact of these lower flows would be reduced survival of juvenile salmon and trout rearing in the creek (currently only below the barrier at Harts Lake Loop Road).

Problems for salmon in Horn Creek are similar to those in upper Brighton Creek. Like Brighton, Horn Creek has a wetland complex near its mouth in the Nisqually floodplain that is an important refuge area for juvenile salmonids. However, there are also some habitat impacts from alterations of Horn Creek. The wetlands at the mouths of Horn and Harts creeks are

substantially affected by man-made flood control structures associated with bank hardening and the Centralia diversion dam on the mainstem of the Nisqually River. These structures prevent the mainstem from freely migrating and flooding into those areas, processes which are important for maintaining habitat functions. The wetlands at the mouths of the creeks that are in the Nisqually River floodplain are slowly filling up with silts and invasive reed canary grass. These would be periodically flushed out by the river under a normal flooding regime.

Disconnection of the channel from its floodplain, loss of streamside vegetation and the amount of fallen trees in the stream, and unnatural ditching and diking of the channel in lower Horn Creek have led to poor habitat diversity and poor channel stability throughout Horn Creek. In Harts Creek, a tributary of Horn Creek, disconnection of the channel from its floodplain, loss of streamside vegetation and large logs in the stream, and unnatural ditching and diking of the channel are extreme, leading to poor habitat diversity, poor channel stability, and poor salmon survival. The numerous impassable or partially passable culverts in Horn Creek are a major problem.

Other habitat issues in Horn and Harts Creeks include the effects of increased summer peak water temperature (due to lack of shade) on eggs, fry, and juveniles in the creek (especially steelhead), and the effects of low summer flows, which are presumed to be lower than they were historically. The impact of these lower summer low flows on rearing juveniles in the creek is made worse by the lack of streamside vegetation and instream wood and declines in available pool habitat (i.e., deep places in which fish hold). Based on the land use patterns in the Horn Creek subbasin, it is presumed that levels of fine sediment in the creek have increased compared to historic conditions. This is a concern because the increased fine sediment can smother incubating eggs. A reduction in nutrient inputs to the creek due to loss of streamside vegetation and the fact that fewer salmon return to the creek now compared to historically (resulting in fewer salmon carcasses with marine derived nutrients) results in low food availability for fry and juveniles that rear in the creek. There has been a small decline in the amount of pool habitat in Horn Creek and in the amount of beaver pond habitat in upper Horn Creek compared to presumed historical conditions. These changes in available habitat types are detrimental to fry, juveniles, and spawning adults.

Many wetlands in the upper Horn and upper Brighton reaches have been altered. In Horn Creek below 8th Avenue South and above Harts Lake Loop Road, there is a 1-mile-long section that has been straightened, ditched, and cleared of riparian vegetation. This has reduced available key habitat and the ability of this wetland to positively influence downstream habitat by lessening summer low flow problems and reducing sedimentation issues. Many wetlands in the headwater areas of Brighton and Horn Creeks have been greatly influenced by the surrounding agriculture.

8.3.5 Tanwax Creek

Major reasons for loss of salmon productivity in Tanwax Creek include:

- High fine sediment load
- Reduced summer low flows (compared to historic conditions)
- High water temperature in summer
- Loss of habitat diversity
- Lower channel stability
- Reduced food availability

Summer low flows are presumed to be lower and intermittent flows are presumed to be more frequent in Tanwax Creek than they were historically due to water withdrawals, channelization of the creek, and alteration of wetlands that have occurred mostly in the upper part of the sub-basin and have reduced water storage. This reduces the survival of juvenile salmon and trout that rear in the creek. Peak flows are also presumed to be somewhat higher than they were historically due to development of the subbasin. This can lead to increased scouring of eggs in the gravel and can be a problem for salmon and trout fry emerging from the gravel.

The reduced amount of large wood in the creek and the loss of streamside and overhanging vegetation have had numerous impacts. The lack of riparian vegetation available to provide shade has likely led to higher peak summer water temperatures throughout the subbasin, especially in Tanwax Lake and the middle and upper Tanwax reaches, reducing the productivity of juvenile coho and steelhead that rear in the creek. The loss of streamside vegetation is also associated with reduced nutrient input to the creek, reduced opportunities for fish concealment, and reduced shade, which helps prevent the growth of non-native reed canary grass.

Tanwax Creek and its tributaries (especially in Rapjohn Creek and in the upper Tanwax reach) have poor stream channel stability due to the lack of woody debris and streamside vegetation, the changes to the channel such as ditching that have occurred in areas throughout the creek and its tributaries (except in the lower Tanwax reach), and the increased bed scour that is presumed to occur due to this channelization. This reduced channel stability lowers the survival of salmon and trout eggs, fry, and juveniles. The lack of wood, the channel incision, and the lack of streamside vegetation have also reduced the diversity of habitat available in the creek, which reduces productivity of spawners, pre-spawners, and rearing juveniles throughout the creek. Fine sediment loads in the creek (both turbidity and fine sediment present in the substrate) are presumably elevated compared to historic conditions, based on the amount of disturbance in the subbasin from agriculture, forestry, and residences. This is expected to reduce the survival of eggs incubating in the gravel by smothering them and is also a problem for fry and juvenile steelhead that rear in the creek.

Changes in the composition of habitat types available in the creek have been detrimental to all life stages of salmon that use the creek. Compared to presumed historic conditions, there has been a loss of pool habitat and an increase in glide habitat throughout the creek and its tributaries. There has also been a decline in small cobble riffles for spawning in Tanwax Creek between the mouth and the lake. Some reaches show large losses in the amount of beaver dam pools, backwater pools, and off-channel habitat available compared to historic conditions. These changes are associated with the channel modifications and loss of riparian vegetation that have occurred in the subbasin.

Other issues in Tanwax Creek include the presence of introduced species (especially in the lake and upper tributaries) and the presumed increased predation associated with them, lack of food due to the lower numbers of salmon returning, lack of streamside vegetation, lowered dissolved oxygen in Mud Creek, and flow impacts from water withdrawals.

8.3.6 Kreger Creek

Major reasons for loss of salmon productivity in Kreger Creek include:

- Decline in channel stability
- Decline in habitat diversity
- Increased fine sediment load
- High water temperature in summer
- Loss of valuable habitat types such as pools and beaver ponds

Habitat condition in the lower 0.6 mile of Kreger Creek is very healthy compared to the upper parts of the creek, with minor problems of increased fine sediment load and lack of large instream wood to create channel complexity and stability.

The habitat in the upper Kreger reach is much more degraded. The channel is disconnected from its floodplain and lacks streamside vegetation and instream wood. This, along with modifications and simplifications of the creek's channel such as ditching, reduces habitat diversity and channel stability. Loss of important beaver pond, backwater pool, and small cobble riffle habitat types reduces survival of multiple life stages of salmon and trout in the creek. High water temperatures are a concern between Kreger Lake and the mouth of the creek (where data have been collected) and are presumed to be an issue throughout the creek. Summer flows have not been studied, but are presumed to be lower than they were historically due to agricultural and residential water use. These changes in water temperature and flow have a negative impact on survival of juvenile salmon and trout that rear in the creek. Lack of food for salmon, due to low numbers of carcasses from returning salmon and lack of streamside vegetation providing nutrients, is a problem throughout the creek. Increased predation on juvenile coho and steelhead due to the presence of non-native, introduced fish also reduces survival, especially in Silver Lake.

8.3.7 Ohop Creek

Major reasons for loss of salmon productivity in Ohop Creek include:

- Channel confinement modifications (ditching and channelizing)
- Decline in amount of key habitat and in habitat diversity (loss of large wood and streamside vegetation, loss of pool and riffle habitat)
- Reduced channel stability
- Increased summer stream temperatures
- Predation by non-native fish
- Increased fine sediment levels
- Reduced food availability

High sediment load and low channel stability during egg incubation and rearing are major problems in Ohop Creek between the mouth and the lake. This is caused by a lack of streamside vegetation, by channel incision, by the reduction in the amount of wood in the creek, and by the increased bed scour that is presumed to now occur as a result of the channelization of the creek. The lack of habitat diversity (which is also related to the lack of streamside vegetation, in-stream large wood, and the extensive channelization and ditching of the creek) also reduces the productivity of salmon and trout that spawn and rear in the creek.

Along with the changes to the creek such as ditching, straightening, and the loss of large wood in the creek, the types of habitat available in the creek have changed compared to what is presumed to have been present historically. The creek now has less pool habitat, and in some areas it also has less riffle, beaver pond, and off channel habitat areas. These changes negatively affect survival at numerous life stages of the salmon and trout in the creek. Other issues in the creek include predation from non-native fish, increased water temperatures (due to loss of streamside vegetation for shade), increased nutrient loads in and below Ohop Lake, and reduced food availability due to loss of streamside vegetation and reductions in the numbers of salmon that return to spawn compared to historic times.

In Twenty-Five Mile Creek (a tributary to Ohop Creek), reduced amounts of streamside vegetation and wood in the stream have led to poor channel stability during egg incubation and rearing and to poor habitat diversity, both of which have reduced the survival of coho salmon. Other concerns in Twenty-Five Mile Creek include a high sediment load that can smother incubating eggs and a somewhat altered flow regime (presumably based on land use) that has high flows that are higher than they were historically. These have led to increased bed scour and reduced survival during egg incubation, and low flows that are lower than they were historically, reducing survival of juvenile salmon and trout that rear in the creek.

8.3.8 Lynch Creek

In Lynch Creek, major problems affecting salmon survival include the high sediment load (presumed, based on nearby sampling), reduced channel stability and habitat diversity (due to some reduction in the amount of instream wood and simplification of the channel and its disconnection from the floodplain in some areas), and a loss of pool habitat compared to presumed historic conditions. In addition, accentuated high flows and increased 'flashiness' of flow (i.e., quicker in-stream flow responses to rainfall events and higher peak flows) compared to presumed historic conditions in Lynch Creek reduce survival of salmon and trout in the creek.

8.3.9 Mashel River

Major reasons for loss of salmon productivity in the Mashel River include:

- Decline in habitat diversity, pool habitat, and habitat suitable for spawning
- Decline in channel stability and increased scour of streambed material
- Unnatural channel narrowing from bank hardening and dikes
- High sediment load in the water from increased soil erosion
- High water temperature in summer
- Accentuated high and low flows

Throughout the Mashel watershed, simplification of the channel, disconnection of the channel from its floodplain, and the lack of available large trees (to fall in the creek and create complex habitat and cover) have reduced the diversity of the habitat available in the stream compared to what was available historically. This is a problem for all salmon species, including coho and steelhead that rear in the river, as well as fry and adult spawners of all species.

In the Mashel-Eatonville reach (between the Little Mashel River and Boxcar Canyon), habitat diversity is especially low due to changes to the natural channel confinement, such as rip rap used to confine the river into a narrow channel. High levels of fine sediment, channel bed scour, and lowered channel stability are a problem for salmon and trout eggs incubating in the Mashel River and its tributaries. The fine sediment settles into the gravel and can smother the eggs, while scouring of the channel can remove eggs from the gravel and increase bank erosion and fine sediment input.

The accentuated flow patterns present in the system, with higher high flows and lower summer flows than they presumably were historically, have a negative effect on salmon during multiple life stages, especially fry colonization, juvenile rearing, and pre-spawner holding life stages. Changes in the types of habitat available compared to presumed historic conditions present problems as well. A decline in the amount of pool habitat is a problem, especially for rearing coho and for adult salmon that hold in the river before spawning. Small declines in the amount

of pool tailout and small cobble riffle habitat available are a problem for adults seeking suitable areas to spawn.

Other problems in the Mashel subbasin include a lack of food (from decaying salmon carcasses or overhanging vegetation, both of which were historically more abundant) and increased summer temperatures (related to a loss of vegetation providing shade), which have a negative effect on juvenile salmon that rear in the creek year round.

8.3.10 EDT Analysis Summary

The results from the EDT analysis, by reach, are presented in *Table 8-2*. The EDT analysis provided two types of results: 1) a prioritization of stream reaches for both preservation and restoration, and 2) scores for a series of habitat attributes indicating the level of impact problems have had on the survival of fish species. The EDT results for coho salmon were used because coho distribution covers the largest area in the basin and includes multiple life stages. Other species needs are covered within habitat attributes that are beneficial for coho. In other words, coho are in more places and at more times than other species. By addressing the habitat issues identified in the coho EDT model, other salmonid species habitat issues will also be addressed.

TABLE 8-2
Habitat Investigations and Analyses

KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
BRI-01	Brighton Cr-1_a	High	Medium						●	●						●			●
BRI-03	Brighton Cr-1_b	High	Medium	●				●	●	●						●			●
BRI-05	Brighton Cr-1_c	High	Medium							●									●
BRI-08	Brighton Cr-1_d	High	Medium	●				●	●	●	●					●			●
BRI-13	Brighton Cr-1_e	High	Medium																
HRN-01	Horn Cr-1	High	Medium	●				●	●	●						●	●		●
HRN-03	Horn Cr-2_a	High	Medium	●		●		●	●	●					●	●			●
HRN-06	Horn Cr-2_b	High	Medium	●		●		●	●	●					●	●			●
HRN-10	Horn Cr-2_c	High	Medium	●				●	●	●						●			●
HRT-01	Harts Creek-1_a	High	Medium	●				●	●	●	●					●			●

TABLE 8-2
Habitat Investigations and Analyses

KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
HRT-02	Harts Creek-1_b	High	Medium	●		●		●	●	●	●					●	●		●
HRT-06	Harts Creek-1_c	High	Medium	●				●	●	●						●			●
HRT-08	Harts Creek-1_d	High	Medium	●				●	●	●	●					●			●
KRG-01	Kreger Cr-1	Medium	Medium						●	●						●			●
KRG-02	Kreger Cr-2	Medium	Medium	●				●	●	●	●					●	●		●
KRG-03	Kreger Lake	Medium	Medium							●									●
KRG-06	Kreger Cr-3	Medium	Medium	●				●	●	●						●			●
KRG-10	Silver Lake	Medium	Medium																
LMR-01	Little Mashel R	High	Medium	●				●	●	●						●			●
LYN-01	Lynch Cr	High	High	●				●	●	●						●			●
MAL-01	Lower Mashel-A_A	Highest	Highest	●				●	●	●						●	●		●
MAL-03	Lower Mashel-A_B	Highest	Highest	●				●	●	●						●	●		●

TABLE 8-2
Habitat Investigations and Analyses

KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
MAL-04	Lower Mashel-B	Highest	Highest	●		●		●	●	●	●					●	●		●
MAM-01	Middle Mashel R-1	Highest	High	●				●	●	●						●	●		●
MAM-03	Middle Mashel R-2	Highest	High	●				●	●	●						●	●		●
MAM-04	Beaver Cr-1	High	Medium						●	●						●			●
MAM-05	Beaver Cr-2	High	Medium	●				●	●	●						●	●		●
MAU-01	Upper Mashel R	High	High	●				●	●	●						●			●
MAU-02	Busy Wild Cr-1	High	Medium	●		●		●	●	●						●	●		●
MAU-03	Busy Wild Cr-2	High	Medium	●				●	●	●						●	●		●
MUR-01	Murray Cr-1	Medium	Medium	●						●						●			●
MUR-02	Murray Cr-2_a	Medium	Medium	●				●	●	●						●	●		●
MUR-06	Murray Cr-2_b_A	Medium	Medium	●				●	●	●						●	●		●
MUR-14	Murray Cr-2_b_B	Medium	Medium	●				●	●	●						●	●		●

TABLE 8-2
Habitat Investigations and Analyses

KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
MUR-19	Murray Cr-3_a	Medium	Medium	●				●	●	●						●			●
MUR-21	Murray Cr-3_b	Medium	Medium	●				●	●	●						●			●
NIS-02	Nisqually2a-LowerReach	Highest	High	●				●	●	●	●			●		●			●
NIS-04	Nisqually2B.1-LowerReach	Low	Highest	●				●	●		●			●	●		●		
NIS-05	Nisqually2B.2-LowerReach	Low	Highest	●				●	●					●	●		●		
NIS-06	Nisqually2B.3-LowerReach	Low	Highest	●					●					●	●		●		
NIS-07	Nisqually2B.4-LowerReach	Low	Highest	●				●	●						●		●		
NIS-08	Nisqually3.1-Wwater	High	Highest	●				●	●	●						●	●		●
NIS-09	Nisqually3.2-Wwater	High	Highest	●				●	●	●							●		●
NIS-10	Nisqually3.3-Wwater	High	Highest	●				●	●	●							●		●
NIS-12	Nisqually4.1-Mckenna	Highest	Highest	●				●	●	●	●			●	●		●		●
NIS-13	Nisqually4.2-Mckenna	Highest	Highest	●				●	●	●	●						●		●

TABLE 8-2
Habitat Investigations and Analyses

KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
NIS-15	Nisqually5.1-Wilcox	Medium	Highest	●				●	●	●									●
NIS-17	Nisqually5.2-Wilcox	Medium	Highest	●				●	●	●									●
NIS-18	Nisqually5.3-Wilcox	Medium	Highest	●				●	●	●									●
NIS-19	Nisqually6.1-MiddleReach	Medium	Highest	●				●	●	●									●
NIS-20	Nisqually6.2-MiddleReach	Medium	Highest	●				●	●	●									●
NIS-21	Nisqually6.3-MiddleReach	Medium	Highest	●				●	●	●									●
NIS-22	Nisqually7A-UpperReach	Low	Highest	●				●	●	●									●
NIS-23	Nisqually7B-UpperReach	Low	Highest	●						●									●
OHL-01	Ohop Cr-1	Highest	Medium	●				●	●	●	●		●	●		●	●		●
OHU-01	Ohop Cr-2	Highest	Medium					●		●					●	●			●
OHU-03	Ohop Lake	High	High			●		●	●	●					●				●
OHU-16	Twentyfive Mile Cr	High	High	●				●	●	●						●			●

TABLE 8-2
Habitat Investigations and Analyses

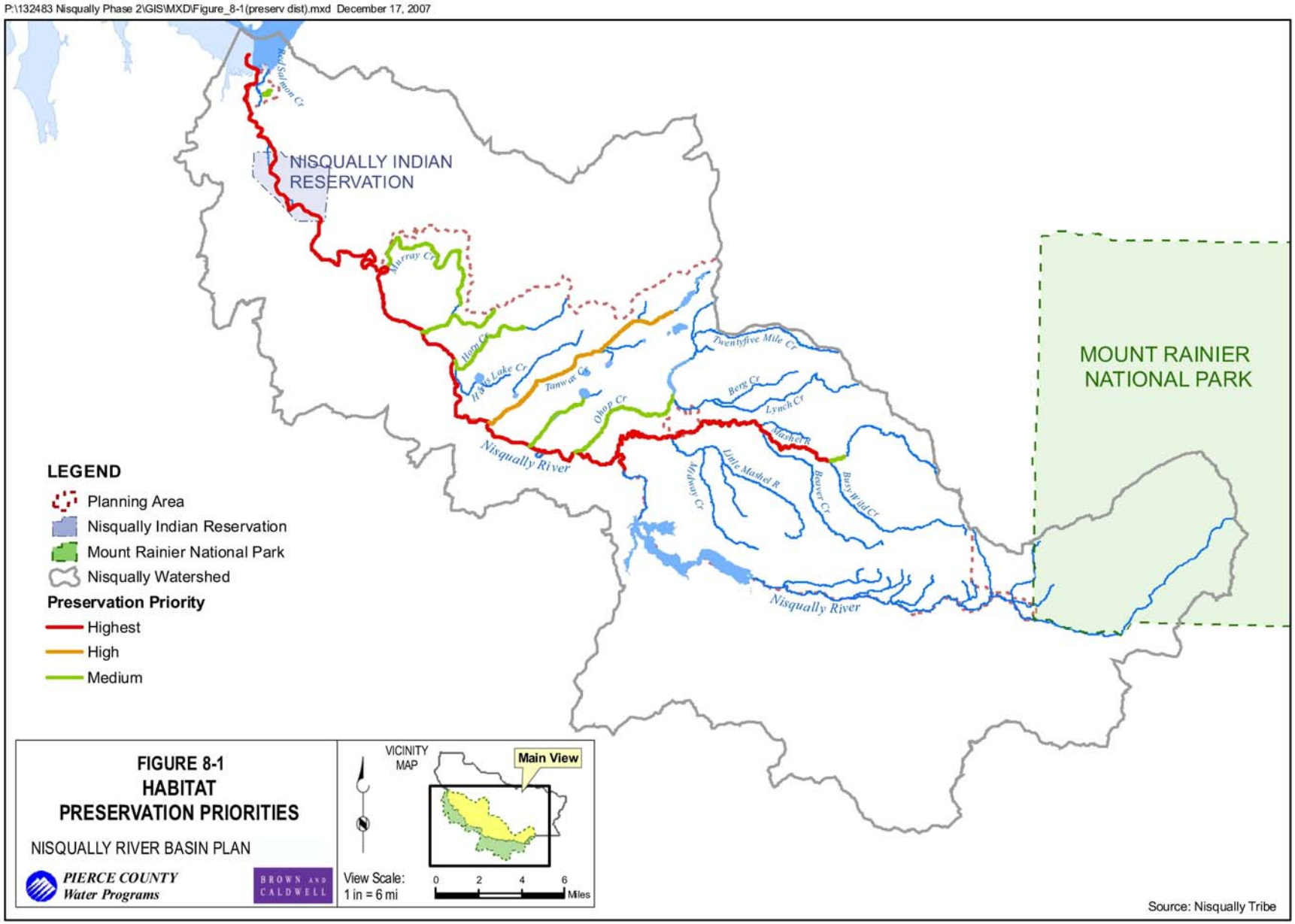
KEY: ● - Heavy negative impact on survival of species, ● - Moderate negative impact on survival of species, ● - Mild negative impact on survival of species.

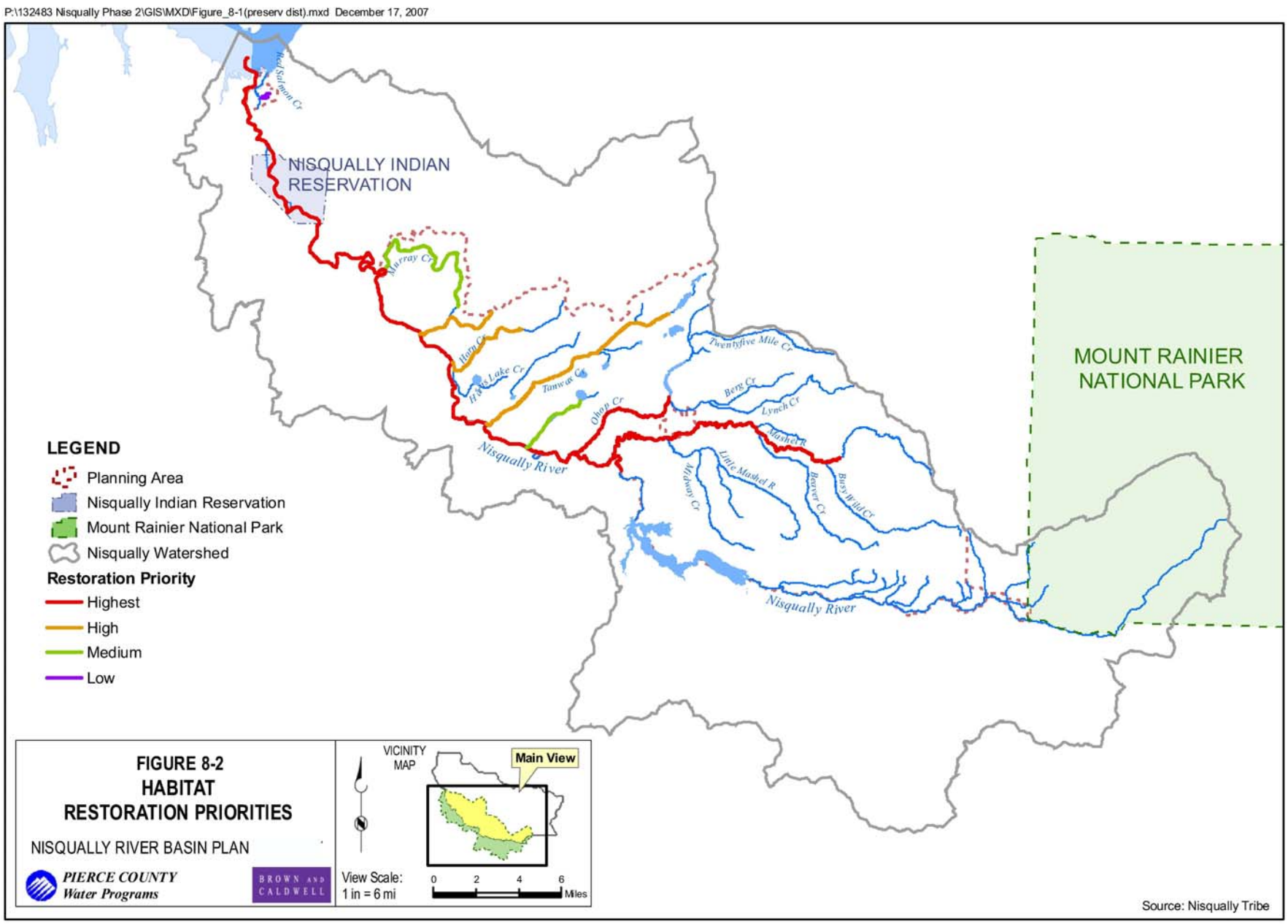
Problem ID	Location	Restoration	Preservation	Channel Stability	Chemicals	Competition (with hatch)	Competition (other species)	Flow	Flood	Habitat Diversity	Harassment/ Poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment Load	Temperature	Withdrawals	Key Habitat Quality
OHU-17	Trib0094	Low	Medium																
RED-04	Red Salmon Creek	Low	Medium	●				●		●									●
TWL-01	Tanwax Cr-1	High	High	●				●	●	●						●	●		●
TWL-02	Tanwax Cr-2	High	High	●				●	●	●						●	●		●
TWL-03	Cranberry	Low	Medium							●									●
TWU-01	Tanwax Cr-3_a	High	High	●				●	●	●	●					●	●		●
TWU-02	Rapjohn	Low	Medium	●				●	●	●						●			●
TWU-03	Mud	Low	Medium	●				●	●	●						●			●
TWU-07	Tanwax Cr-3_b	High	High	●		●		●	●	●	●					●	●		●
TWU-12	Trout Creek	Low	Medium																
TWU-22	Tanwax Lake	High	High	●		●		●	●	●	●				●	●	●		●
TWU-29	Tanwax Upper Tributaries	Low	Medium	●		●	●	●	●	●					●	●			●

The reach rankings were used to develop a restoration and preservation priority for each reach. The reach priorities for each species were reviewed by Tribal biologists to develop a multi-species priority for each reach as well as the overall stream. The multi-species priorities for each stream are provided in *Table 8-3* and shown on *Figures 8-1* and *8-2*.

TABLE 8-3
EDT Habitat Condition Assessment Rankings

Water Course	Multi-Species Priority	
	Restoration Priority	Preservation Priority
Nisqually River and Estuary	Highest	Highest
Red Salmon Creek	Low	Medium
Brighton Creek and Horn Creek	High	Medium
Murray Creek	Medium	Medium
Tanwax Creek	High	High
Kreger Creek	Medium	Medium
Ohop Creek	Highest	Highest
Mashel River	Highest	Highest


P:\132483 Nisqually Phase 2\GIS\MXD\Figure_8-1(preserv dist).mxd December 17, 2007
NISQUALLY INDIAN RESERVATION
MOUNT RAINIER NATIONAL PARK
Red Salmon Cr
Murray Cr
Horn Cr
Hiawatha Lake Cr
Tanwax Cr
Ohop Cr
Twentyfive Mile Cr
Berry Cr
Lynch Cr
Mashel R
Little Mashel R
Alder Cr
Beaver Cr
Busywild Cr
Nisqually River
Nisqually River
LEGEND
Planning Area
Nisqually Indian Reservation
Mount Rainier National Park
Nisqually Watershed
Preservation Priority
Highest
High
Medium
FIGURE 8-1
HABITAT
PRESERVATION PRIORITIES
NISQUALLY RIVER BASIN PLAN
PIERCE COUNTY
Water Programs
BROWN AND CALDWELL
VICINITY MAP
Main View
View Scale:
1 in = 6 mi
0 2 4 6
Miles
Source: Nisqually Tribe


P:\132483 Nisqually Phase 2\GIS\MXD\Figure_8-1(preserv dist).mxd December 17, 2007
NISQUALLY INDIAN RESERVATION
MOUNT RAINIER NATIONAL PARK
Red Salmon Cr
Murray Cr
Horn Cr
Hicks Lake Cr
Tanwax Cr
Ohop Cr
Twentyfive Mile Cr
Berg Cr
Lynch Cr
Mashel R
Little Mashel R
Alder Cr
Beaver Cr
Busy Wild Cr
Nisqually River
Nisqually River
LEGEND
Planning Area
Nisqually Indian Reservation
Mount Rainier National Park
Nisqually Watershed
Restoration Priority
Highest
High
Medium
Low
FIGURE 8-2
HABITAT
RESTORATION PRIORITIES
NISQUALLY RIVER BASIN PLAN
PIERCE COUNTY
Water Programs
BROWN AND CALDWELL
VICINITY MAP
Main View
View Scale:
1 in = 6 mi
0 2 4 6
Miles
Source: Nisqually Tribe

The Nisqually estuary and Puget Sound nearshore areas are of highest importance for protection and restoration because all Nisqually salmon species migrate through (or rear in) these areas. The habitat analyses for Nisqually salmon and trout indicate that these should be highest priority areas. Model results combined with an understanding of the relative value of estuary habitat suggest that restoration of the estuary habitat will result in significant increases in the productivity and abundance of multiple species of Nisqually salmon.

The mainstem Nisqually is used by all salmon species for spawning and some species for rearing, but it is also functions as a migration corridor for all species. Fry or juveniles use the Nisqually to migrate downstream, and adults use it to migrate upstream. Because of the high level of use by all salmon species, high quality habitat in the mainstem is important. High quality habitat includes healthy riparian function, availability of woody debris, and natural channel confinement to improve habitat diversity, channel stability, and flow patterns. Many locations on the mainstem are still in very good condition and are a high priority for protection. Approximately 70 percent of the riparian area along the river that is used by salmon is in protected ownership. The mainstem reaches most in need of overall restoration are the lower reach and the McKenna reaches. There are more targeted restoration needs in other mainstem reaches where there is localized habitat degradation.

The two most important tributaries for protection and restoration are the Mashel River and Ohop Creek. Further protection is important along these tributaries where habitat is still intact or in danger of being degraded. In addition, salmon and trout will benefit from restoration of habitat diversity and key habitat in the degraded reaches of these two streams.

The geographic priorities discussed above, in combination with the priority actions for specific stocks, are provided below. (See also the Nisqually Chinook Recovery Plan [NCRT, 2001] and the 2005 – 2007 Nisqually Salmon Habitat Workplan.)

1. Protect habitat in the Nisqually estuary, South Sound nearshore, and the mainstem Nisqually.

2. Restore degraded habitat in the Nisqually estuary. (Key projects are already underway to implement this action.)

3. Restore degraded habitat in the South Sound nearshore. (A plan is currently being developed to implement this action.)

4. Protect and restore the Mashel River. Restoration of habitat in the Lower Mashel and Middle Mashel reaches near Eatonville is of particular importance. (Key projects are already underway to implement this action.)

5. Protect and restore Lower Ohop Creek.

6. Restore Nisqually mainstem habitat in the lower and McKenna reaches.

7. Restore habitat in localized degraded areas along the Nisqually mainstem, other than the lower and McKenna reaches.

8.4 POTENTIAL SOLUTIONS

This section describes how habitat problems identified in the Nisqually River basin will be addressed. Recommendations were developed to address the following:

- Problems identified during fieldwork
- Preservation of high priority habitat reaches
- Restoration of high priority reaches by addressing the major reasons for loss of salmon productivity.

The aquatic habitat problems have multiple causes that will require a range of solutions, from non-structural programmatic actions to structural measures. The capital improvement program (CIP) projects developed to address habitat problems include:

- Removing fish passage barriers
- Wetland, instream, and riparian habitat restoration
- Revegetation projects
- Wetland, channel migration zone, and floodplain preservation through property acquisition

Removing fish passage barriers consists primarily of replacing existing culverts with large embedded or bottomless culverts. The Pierce Conservation District culvert survey identified numerous culverts as partial or complete fish passage barriers. Some of these culverts need to be assessed to confirm they are barriers and to collect data to develop replacement projects. Additional studies are described in Section 8.4.5.

Restoring the Nisqually estuary mainly entails the removal of dikes that prevent the saltwater from inundating former tidal lands. The Nisqually Tribe, the US Fish and Wildlife Service, and Ducks Unlimited are implementing major restoration projects in the Nisqually estuary. Restoring the nearshore may involve actions such as removal of bank hardening structures and replacing hanging culverts with larger bottomless culverts or bridges to allow the reconnection of pocket estuaries. Since actions required to restore habitat in the nearshore have not been identified, a comprehensive assessment of the shoreline habitat is being conducted by the South Puget Sound Salmon Enhancement Group with assistance from the Tribe.

Projects on the Mashel River include restoration of mature riparian vegetation; softening, reduction, or removal of bank-hardening structures to allow more channel migration; and

addition of large wood in the channel. The South Sound Salmon Enhancement Group, the Nisqually Tribe, the Nisqually Land Trust, and the Pierce Stream Team are now implementing many of these actions on the Mashel. The Town of Eatonville has assisted with habitat projects in its jurisdiction. On Ohop Creek, the Nisqually Tribe, the Pierce Conservation District, the Natural Resources Conservation Service, and the USFWS have completed a comprehensive habitat assessment to develop restoration options was completed. The assessment called for moving the creek channel (which is currently a man-made ditch) to its original floodplain, adding large wood to the newly constructed meandering stream channel, and restoring riparian vegetation and the surrounding connected wetlands. The South Puget Sound Salmon Enhancement Group is the sponsor for the Ohop restoration work.

Programmatic solutions can benefit existing aquatic habitat and prevent future degradation. For instance, programs can preserve high quality habitat areas, provide maintenance of areas being restored, and monitor water quality, erosion, channel incision, and other measures of the health of natural systems.

Table 8-4 summarizes the actions recommended to address aquatic habitat problems, including 21 CIP projects, 8 programmatic measures, and 16 studies to fill information gaps. Proposed programmatic measures and CIP projects are described in greater detail in Chapter 9; *Figures 9-1* through *9-8* show CIP project locations. Proposed studies to fill information gaps are described in Section 8.4.5.

8.4.1 Problems Resolved or Not Addressed in the Basin Plan

During Basin Plan development, it was found that two of the habitat problems are already being addressed by Nisqually Tribe projects. Fourteen habitat problems were found to be outside the authority of the Pierce County Public Works and Utilities. These problems were included in the original list because they were reported to the County. Also, based on further investigation, two problems require no action.

8.4.2 Maintenance and Enforcement Issues

No problems were identified as maintenance or enforcement issues.

8.4.3 Capital Improvement Program Projects

Twenty-one CIP projects were developed to address the aquatic habitat problems. The projects include removing dikes; creating a dam bypass channel; riparian, wetland, and instream restoration and preservation; and projects to improve fish passage. The projects are listed in *Table 8-4*. Chapter 9 describes each of the projects and *Figures 9-1* through *9-8* show the habitat project locations.

8.4.4 Potential Programmatic Measures

Eight programmatic measures are recommended that will serve to improve aquatic habitat and address problems as summarized in *Table 8-4*. These consist of:

1. **PRG00-06**, Develop and Implement an Education, Outreach, and Technical Assistance Program

2. **PRG00-15**, Develop and Implement a Lake Water Quality Management Program

3. **PRG00-16**, Develop and Implement Countywide Vegetation Management

4. **PRG11-02**, Nutrient Enhancement using Salmon Carcasses

5. **PRG11-03**, Enhance Nisqually River Council Capacity

8.4.5 Problems Requiring More Detailed Data or Analysis

Sixteen studies are recommended to fill information gaps, as listed below.

1. **ST11-BRI-ST01,** Brighton Creek Barrier Removal Assessment (62nd Ave. S.)

2. **ST11-HRN-ST01,** Horn Creek Barrier Removal Assessment (368th St. S.)

3. **ST11-HRT-ST01,** Harts Creek / Harts Lake Habitat Assessment

4. **ST11-MUR-ST01,** Murray Creek Restoration Assessment

5. **ST11-MUR-ST02,** Murray, Brighton and Horn Creek Wetlands Restoration Assessment

6. **ST11-MUR-ST03,** Murray Creek Barrier Removal Assessment (48th Ave. S., RM 6.2)

7. **ST11-MUR-ST04,** Murray Creek Barrier Removal Assessment (pipeline crossing, RM 7.2)

8. **ST11-NIS-ST01,** Mainstem Nisqually LWD Assessment and Restoration Plan

9. **ST11-TWL-ST01,** Cranberry and Rapjohn Lakes Assessment

10. **ST11-TWL-ST02,** Lower Tanwax Sediment Reduction Assessment

11. **ST11-TWU-ST01,** Tanwax Valley Restoration Assessment

12. **ST11-TWU-ST02,** Eatonville Cutoff Road Culvert Replacement Assessment (Mud Creek)

13. **ST11-TWU-ST03,** Eatonville Cutoff Road Culvert Replacement Assessment (Tanwax Creek)

14. **ST11-TWU-ST04,** Trout Creek at 352nd Street East Culvert Replacement Assessment

15. **ST14-OHU-ST01,** Clay City Sediment Reduction Assessment

16. **ST20-LMR-ST01,** Lower Mashel Restoration Assessment

Section 9.3.4 contains descriptions and cost estimates for each of the recommended studies.

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
BRI-01	EDT Reach Brighton Cr-1_a	Riparian/aquatic habitat assessment reach with High restoration and Medium protection priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
BRI-02	Brighton Creek crossing of Harts Lake Loop Rd approx. 500 m upstream of confluence with Nisqually R.	Culvert was classified as a fish barrier due to its elevation above the channel bottom.	X			Brighton Creek Culvert Replacement (CIP11-BRI-FP01).
BRI-03	EDT Reach Brighton Cr-1_b	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
BRI-04	Brighton Creek crossing of 66th Ave S approx. 550 m south of 360th St S	Culvert was classified as a fish barrier (Pierce Conservation District culvert survey).				Problem is outside the County's jurisdiction. It is located on private property.
BRI-05	EDT Reach Brighton Cr-1_c	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
BRI-07	Brighton Creek crossing of 62nd Ave S approx. 400 m south of 360th St S	Culvert was classified as a fish barrier (EDT analysis).			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Brighton Creek Barrier Removal Assessment (ST11-BRI-ST01).
BRI-08	EDT Reach Brighton Cr-1_d	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
BRI-13	EDT Reach Brighton Cr-1_e	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
BRI-15	2410 SR 702 S	Culvert was classified as a fish barrier (Pierce Conservation District culvert survey and EDT analysis).				Problem is outside the County's jurisdiction. It will be referred to WSDOT.
HRN-01	EDT Reach Horn Cr-1	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
HRN-03	EDT Reach Horn Cr-2_a	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
HRN-05	Horn Creek crossing of 368th Ave S	Culvert was classified as a fish barrier (Pierce Conservation District culvert survey and EDT analysis).			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Horn Creek Barrier Removal Assessment (ST11-HRN-ST01).
HRN-06	EDT Reach Horn Cr-2_b	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
HRN-10	EDT Reach Horn Cr-2_c	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
HRT-01	EDT Reach Harts Creek-1_a	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Harts Creek/Harts Lake Habitat Assessment (ST11-HRT-ST01).
HRT-02	EDT Reach Harts Creek-1_b	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Harts Creek/Harts Lake Habitat Assessment (ST11-HRT-ST01).
HRT-03	Hart's Creek west of Wilcox Dairy	Harts Lake drains to the Nisqually River through a man-made channel which provides low habitat value.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Harts Creek/Harts Lake Habitat Assessment (ST11-HRT-ST01).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
HRT-06	EDT Reach Harts Creek-1_c	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Harts Creek/Harts Lake Habitat Assessment (ST11-HRT-ST01).
HRT-07	Hart's Creek west of Wilcox Dairy	Culvert was classified as a fish barrier (Pierce Conservation District culvert survey and EDT analysis).				Problem is outside the County's jurisdiction. It is located on a private road.
HRT-08	EDT Reach Harts Creek-1_d	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Harts Creek/Harts Lake Habitat Assessment (ST11-HRT-ST01).
KRG-01	EDT Reach Kreger Cr-1	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
KRG-02	EDT Reach Kreger Cr-2	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
KRG-03	EDT Reach Kreger Lake	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.		X		Develop and Implement a Lake Water Quality Management Program (PRG00-15).
KRG-06	EDT Reach Kreger Cr-3	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
KRG-10	EDT Reach Silver Lake	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.		X		Develop and Implement a Lake Water Quality Management Program (PRG00-15).
LGR-01	Stream crossing SR7 approx 200 meters north of 497th St E	Culvert requires repair for fish passage.				There is no recommended action since there is a natural fish passage barrier downstream of this culvert.
LMR-01	EDT Reach Little Mashel R	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Lower Mashel Restoration Assessment (ST20-LMR-01).
LYN-01	EDT Reach Lynch Cr	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG00-06).
MAL-01	EDT Reach Lower Mashel-A_A	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X			Mashel Small Properties Acquisition (CIP20-MAL-AC03), Mashel Eatonville Reach Instream Restoration Phase II (CIP20-MAL-RST01), Mashel Eatonville Reach Riparian Revegetation (CIP20-MAL-VC01).
MAL-03	EDT Reach Lower Mashel-A_B	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X			Mashel River Property Acquisition (CIP20-MAL-AC01), Mashel Shoreline Buffer Acquisition (-AC02), Mashel Small Properties Acquisition (-AC03), Mashel Eatonville Reach Instream Restoration Phase II (-RST01), Mashel Eatonville Reach Riparian Revegetation (-VC01).
MAL-04	EDT Reach Lower Mashel-B	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X			Mashel Small Properties Acquisition (CIP20-MAL-AC03), Mashel Eatonville Reach Instream Restoration Phase II (CIP20-MAL-RST01), Mashel Eatonville Reach Riparian Revegetation (CIP20-MAL-VC01).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
MAM-01	EDT Reach Middle Mashel R-1	Riparian/aquatic habitat assessment reach with Highest restoration and High preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAM-03	EDT Reach Middle Mashel R-2	Riparian/aquatic habitat assessment reach with Highest restoration and High preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAM-04	EDT Reach Beaver Cr-1	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAM-05	EDT Reach Beaver Cr-2	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAU-01	EDT Reach Upper Mashel R	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAU-02	EDT Reach Busy Wild Cr-1	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.
MAU-03	EDT Reach Busy Wild Cr-2	Riparian/aquatic habitat assessment reach with High restoration and Medium preservation priorities.				Reach is located on designated forest land and is outside the County's jurisdiction.

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
MUR-01	EDT Reach Murray Cr-1	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01), Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
MUR-02	EDT Reach Murray Cr-2_a	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01), Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
MUR-03	Culvert under railroad tracks approximately 600 meters upstream of confluence with Nisqually River	Culvert was classified as fish barrier. Also, culvert is damaged.				Problem is outside the County's jurisdiction. It will be referred to BNSF railroad. Culvert passability and replacement options, however, will be addressed as part of the Murray Creek Restoration Assessment (St11-MUR-ST01).
MUR-05	Murray Creek crossing of Chehalis Railroad, approximately 40 meters east of Hwy 507	Culvert under Chehalis Railroad was classified as a fish barrier (Pierce Conservation District culvert survey and EDT analysis).				Problem is outside the County's jurisdiction. It will be referred to Chehalis Railroad.
MUR-06	EDT Reach Murray Cr-2_b_A	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01), Murray, Brighton and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
MUR-11	Murray Creek crossing of Hinkleman Road approximately 600 meters east 72nd Avenue S	Culvert was classified as a fish barrier (EDT analysis).				Pierce Conservation District data indicate this culvert is not a barrier to fish passage.
MUR-14	EDT Reach Murray Cr-2_b_B	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01) and Murray, Brighton, and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
MUR-19	EDT Reach Murray Cr-3_a	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01) and Murray, Brighton, and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02).
MUR-20	Approximately 300 meters north of 31117 48th Avenue S	Culvert was classified as a fish barrier (Pierce Conservation District culvert survey).			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray Creek Barrier Removal Assessment (ST11-MUR-ST03).
MUR-21	EDT Reach Murray Cr-3_b	Riparian/aquatic habitat assessment reach with Medium restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Murray Creek Restoration Assessment (ST11-MUR-ST01) and Murray, Brighton, and Horn Creek Wetlands Restoration Assessment (ST11-MUR-ST02)
MUR-22	Murray Creek crossing under pipeline between 40th Ave S and 48th Ave S	Culvert was classified as fish barrier due to steep slopes (Pierce Conservation District culvert survey). Also, culvert is damaged.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Murray Creek Barrier Removal Assessment (ST11-MUR-ST04).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
NIS-01	EDT Reach Nisqually1-Estuary	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-02	EDT Reach Nisqually2a-LowerReach	Riparian/aquatic habitat assessment reach with Highest restoration and High preservation priorities.	X	X	X	Red Salmon Slough Estuary Restoration Phase III (CIP08-RED-RST01), Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-04	EDT Reach Nisqually2B.1-LowerReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-05	EDT Reach Nisqually2B.2-LowerReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
NIS-06	EDT Reach Nisqually2B.3-LowerReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-07	EDT Reach Nisqually2B.4-LowerReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-08	EDT Reach Nisqually3.1-Whitewater	Riparian/aquatic habitat assessment reach with High restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-09	EDT Reach Nisqually3.2-Whitewater	Riparian/aquatic habitat assessment reach with High restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-10	EDT Reach Nisqually3.3-Whitewater	Riparian/aquatic habitat assessment reach with High restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
NIS-12	EDT Reach Nisqually4.1-Mckenna	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-13	EDT Reach Nisqually4.2-Mckenna	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Nisqually Wilcox Side-Channel (-RST01), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following studies are recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01) and Murray, Brighton, and Horn Creek Wetland restoration Assessment (ST11-MUR-ST02).
NIS-14	Nisqually River, approximately 700 m south of Horn Creek confluence	Centralia Diversion inhibits passage of some fish and is identified as an obstruction in EDT analysis.				Problem is outside the County's jurisdiction. It will be referred to Centralia City Light.
NIS-15	EDT Reach Nisqually5.1-Wilcox	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Nisqually Wilcox Side-Channel (-RST01), Wilcox Flats Off-Channel Restoration (-RST02), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
NIS-17	EDT Reach Nisqually5.2-Wilcox	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Wilcox Flats Off-Channel Restoration (-RST02), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-18	EDT Reach Nisqually5.3-Wilcox	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Wilcox Flats Off-Channel Restoration (-RST02), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-19	EDT Reach Nisqually6.1-MiddleReach	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-20	EDT Reach Nisqually6.2-MiddleReach	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
NIS-21	EDT Reach Nisqually6.3-MiddleReach	Riparian/aquatic habitat assessment reach with Medium restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-22	EDT Reach Nisqually7A-UpperReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
NIS-23	EDT Reach Nisqually7B-UpperReach	Riparian/aquatic habitat assessment reach with Low restoration and Highest preservation priorities.	X	X	X	Nisqually Mainstem Acquisitions (CIP11-NIS-AC01, -AC02, -AC03), Mainstem Off-Channel Restoration (-RST03), Nisqually Salmon Carcass Nutrient Enhancement (PRG11-02), Countywide Vegetation Management (PRG00-16). Information gaps also exist and the following study is recommended: Mainstem Nisqually LWD Assessment and Restoration Plan (ST11-NIS-ST01).
OHL-01	EDT Reach Ohop Cr-1	Riparian/aquatic habitat assessment reach with Highest restoration and Medium preservation priorities.	X	X	X	Ohop Creek Acquisitions (CIP14-OHL-AC01, -AC02, -AC03), Lower Ohop Valley Restoration Phases 1 (CIP14-OHL-RST01), 2 (-RST02), and 3 (-RST03).
OHU-01	EDT Reach Ohop Cr-2	Riparian/aquatic habitat assessment reach with Highest restoration and Medium preservation priorities.		X		Develop and Implement a Program to Enhance Degraded Riparian Habitat and Water Quality (PRG00-05).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
OHU-03	EDT Reach Ohop Lake	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.		X		Develop and Implement a Lake Water Quality Management Program (PRG00-15).
OHU-12	Ohop Lake	No more frogs due to ditch cleaning. Clearing/logging near stream.		X		Develop and Implement a Lake Water Quality Management Program (PRG00-15).
OHU-14	Ohop Lake shoreline near 38509 Orville Rd E	Loss of native vegetation along shoreline.		X		Develop and Implement a Lake Water Quality Management Program (PRG00-15).
OHU-16	EDT Reach Twentyfive Mile Cr	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.	X		X	Part of the problem is addressed by project: Upper Ohop Shoreline Protection (CIP14-OHU-AC01 and -AC02). More data or analyses are required to address aspects of the problem. The following study is recommended: Clay City Sediment Reduction Assessment (ST14-OHU-ST01).
OHU-17	EDT Reach Trib0094	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.	X			Upper Ohop Shoreline Protection (CIP14-OHU-AC01 and -AC02).
OHU-18	Misc. tributary crossing of railroad tracks approximately 1 mile south of Clay City Rd	Culvert was classified as fish barrier. Also, culvert is damaged.				Problem is outside the County's jurisdiction. It will be referred to the railroad.
RED-03	EDT Reach Nearshore	Riparian/aquatic habitat assessment reach with Highest restoration and Highest preservation priorities.				The Nisqually Tribe is addressing this problem with their Nisqually Estuary restoration.
RED-04	EDT Reach Red Salmon Creek	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.				The Nisqually Tribe is working on a restoration project that addresses this problem.

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
TWL-01	EDT Reach Tanwax Cr-1	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.	X		X	Part of the problem is addressed by projects: Lower Tanwax Riparian Enhancement (CIP11-TWL-RST01), Tanwax Creek Wetland Protection Phases 1 and 2 (CIP11-TWU-AC01 and -AC02). The following study is recommended to fill information gaps on the problem: Lower Tanwax Sediment Reduction Assessment (ST11-TWl-ST02).
TWL-02	EDT Reach Tanwax Cr-2	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.	X		X	Part of the problem is addressed by projects: Lower Tanwax Riparian Enhancement (CIP11-TWL-RST01), Tanwax Creek Wetland Protection Phases 1 and 2 (CIP11-TWU-AC01 and -AC02). The following study is recommended to fill information gaps on the problem: Lower Tanwax Sediment Reduction Assessment (ST11-TWl-ST02).
TWL-03	EDT Reach Cranberry	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Cranberry and Rapjohn Lakes Assessment (ST11-TWL-ST01).
TWU-01	EDT Reach Tanwax Cr-3_a	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Tanwax Valley Restoration Assessment (ST11-TWU-ST01).
TWU-02	EDT Reach Rapjohn	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
TWU-03	EDT Reach Mud	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST02).

TABLE 8-4
Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
TWU-06	Tanwax Creek crossing of Eatonville Cutoff E	Culvert was classified as a partial fish barrier (EDT analysis).	X		X	Part of the problem is addressed by project: Tanwax Creek Wetland Protection (CIP11-TWU-AC01). More data or analyses are required to address other aspects of the problem. The following study is recommended: Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST03).
TWU-07	EDT Reach Tanwax Cr-3_b	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.			X	More data or analyses are required to address this problem. The following studies are recommended to fill the data gap: Tanwax Valley Restoration Assessment (ST11-TWU-ST01), Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST03).
TWU-10	Mud Creek crossing of Eatonville Cutoff E (approx. 170 m south of 372nd St E)	Culvert was classified as a partial fish barrier (Pierce Conservation District culvert survey).			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST02).
TWU-12	EDT Reach Trout Creek	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.		X		Develop and Implement an Education, Outreach, and Technical Assistance Program (PRG11-06), Enhance Nisqually River Council Capacity (PRG11-03).
TWU-13	352 St E crossing of creek leading to Trout Lake	Culvert was classified as a fish barrier due to steep slope and outfall drop height (Pierce Conservation District culvert survey).			X	More data or analyses are required to address this problem. The following study is recommended to fill the data gap: Trout Creek at 352nd Street East Culvert Replacement Assessment (ST11-TWU-ST04).
TWU-22	EDT Reach Tanwax Lake	Riparian/aquatic habitat assessment reach with High restoration and High preservation priorities.	X		X	Part of the problem is addressed by project: Tanwax Creek Wetland Protection Phases 1 and 2 (CIP11-TWU-AC01 and -AC02). More data or analyses are required to address other aspects of the problem. The following study is recommended: Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST03).

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Habitat Problem Recommendations

Problem ID	Location	Description	Recommendations			
			CIP	Programmatic Measure	Study	Description
TWU-29	EDT Reach Tanwax Upper Tributaries	Riparian/aquatic habitat assessment reach with Low restoration and Medium preservation priorities.	X		X	Part of the problem is addressed by project: Tanwax Creek Wetland Protection Phases 1 and 2 (CIP11-TWU-AC01 and -AC02). More data or analyses are required to address other aspects of the problem. The following study is recommended: Eatonville Cutoff Road Culvert Replacement Assessment (ST11-TWU-ST03).