Olympic Wildlife Area Fish Retrofit

Habitat Program
Salmonid Screening, Habitat Enhancement
and Restoration (SSHEAR) Division

Submitted by

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ABSTRACT

The Department of Fish and Wildlife manages over 840,000 acres, to preserve, protect and perpetuate the state's valuable fish and wildlife resources (RCW 75.08.012, RCW 77.04.055, RCW 77.12.010). In order to maximize accessibility to these lands and other areas for all citizens, several hundred Department of Fish and Wildlife Access Areas have been constructed. Due to the increasing interest of the agency and public in factors affecting fish resources, the Salmonid Screening, Habitat Enhancement and Restoration Division (SSHEAR) initiated an inventory of all fish passage structures (e.g culverts, dams, fishways, lake screens) and unscreened irrigation diversions on agency lands. Potential habitat gain was assessed for features identified as fish passage barriers.

A priority index for order of inventory was calculated for each wildlife area according to the ranking of four separate factors: the number of estimated fish passage problems, fish species status (potential ESA listings or at-risk SASSI stock status), species mobility (resident and/or anadromous fish species), and interest (high profile fish passage issues of public concern). Based on this prioritization, the Olympic Wildlife Area ranked second in priority for western Washington.

Fish passage barriers alone prevented access to 7,376 square meters and 808,990 square meters of spawning and summer rearing habitat, respectively. These barriers were prioritized based on proportion of potential passage improvement, annual adult equivalent production potential per square meter of habitat gain, species mobility, species condition, and a cost modifier. The unscreened water diversions were prioritized based on flow, species mobility, species condition and cost.

If the Olympic Wildlife Area and Region 6 Access Areas are an indication of the problems with fish passage structures and unscreened water diversions that exist on Department of Fish and Wildlife owned or managed land, there are many corrections that need to be made on the wildlife and access areas. For example, with the Olympic Wildlife Area and Rigion 6 Access Areas combined, 42% (25 of 60) of the culvert crossings, 100% of the dams (1) and 100% of the lake screen structures (1) are barriers to fish passage. Although 100% of the water diversions (2) are screened, it is doubtful there is a water right. To compliment the state salmonid recovery effort, the problem features should be corrected as soon as possible.

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INTRODUCTION

Over the past 59 years, the Washington Department of Fish and Wildlife (WDFW) has purchased approximately 840,000 acres of Wildlife Area sites, scattered throughout almost every county in the state. Due to the increasing interest in fish passage issues, the Habitat and Lands Services Program initiated an inventory of fish passage barriers and water diversions on all state owned and managed lands (Appendix I). The Salmonid Screening, Habitat Enhancement and Restoration Division was assigned this task. The purpose of the inventory is to document and prioritize for correction all fish passage problems including culverts, dams, lake screens and water diversions to ensure compliance with Washington State laws (Appendix II). All diversions from waters of the state should be screened to protect fish and all flow control and fish passage structures are to be constructed to provide unobstructed fish passage.

Salmonids of the Pacific Northwest have long been impacted by structures installed in streams incorrectly or with no regard to the salmonid life cycle. Every year thousands of juvenile salmonids are killed when they enter malfunctioning or unscreened water diversions, by mutilation from a pump turbine or being stranded in irrigation canals as the irrigation season comes to a conclusion. Culverts, dams, and abandoned lake outlet screens also have a very detrimental impact on salmonid populations. When these facilities result in a barrier to fish migration, spawning and rearing habitat become inaccessible. Even screened water diversions can be detrimental if design criteria are not rigidly followed. They can impinge salmonids, either killing them or carrying them into the diversion system.

Each year more of these structures become barriers to fish migration. Watersheds are continually being altered (e.g. development, logging, roads etc.) which substantially influences the hydraulic dynamics of the watershed. Culverts, fishways, lake outlet screens, and water diversions that were once designed for a defined annual flow, are now incapable of managing the increased flow. Culverts become velocity barriers and eventually scour huge plunge pools that in most circumstances result in large outfall drops. Even hydraulic drops less than one foot are a potential barrier to chum and juvenile salmonids. Recent studies have unveiled that these small hydraulic drops can limit juvenile production by rendering valuable rearing habitat unreachable.

In cooperation with other Habitat and Lands Services Program staff, SSHEAR staff designed a Wildlife Area Scheduling Index to organize the inventory. To establish the scheduling index of wildlife areas, a questionnaire was designed to collect information on the number of known fish passage problems, stock status, stock mobility, and high profile fish passage issues of public interest. This enabled SSHEAR staff to gain the knowledge and expertise of Wildlife Area and Access Area Managers. In December of 1997, the questionnaire was mailed to all Regional Lands Coordinators, Wildlife Area Managers and Access Area Managers. After the index was calculated for each area (Appendix III), they were stratified according to the time of year in which the inventory could be accomplished. Eastern areas will be scheduled in the spring and summer months and the western areas will be inventoried in the fall and winter months. The Olympic Wildlife Area ranked second in priority for western Washington.

SITE DESCRIPTION

The numerous units of the Olympic Wildlife Area are located throughout several counties of western Washington including; Clallam, Grays Harbor, Jefferson, Mason and Pacific (Figure 1). A total of fourteen different units (Chehalis, Dungeness, Elk River, Ferbrache, Hoxit, John's River, North River, Ocean Park, Olympic, Oyhut, Palix River, Smith Creek, Union, Wynoochee) comprise the 6,000 acre wildlife area. The majority of the units are within substantial flood plains. Due to ownership coverages not being up to date, some features may appear to be outside of WDFW property.

Chehalis

The Chehalis Unit is located on the flood plain of the Chehalis River approximately two miles southwest of Elma, Washington (Figure 2). The majority of the land is best characterized as open wetland, riparian shrub habitat, or meadow/field habitat. The habitats are interspersed and, allowing for an abundance of species including chinook, coho, chum and a variety of resident species (Chehalis Wildlife Area Management Plan, 1997).

The habitat surrounding the unit has been extensively modified by humans. A rock quarry is located on the northeast border and agricultural land surrounds much of the rest of the wildlife area. State Highway 12 borders the wildlife area on the north. The west is bordered by Hansen Creek and on the south by Vance Creek. The uncompleted WPSS nuclear power plant lies just two miles south of the unit (Chehalis Wildife Area Management Plan, 1997).

The Department of Fish and Wildlife acquired the wildlife unit in segments. In 1969 the smallest parcel was aquired from the Washington Department of Transportation (WDOT). It was previously used by WDOT as a rock quarry. This parcel is approximately 24 acres in size. The second segment acquired was purchases in 1986 from the Greenhead Duck Club. It is approximately 168 acres . The most recent segment was acquired from the Mouncer family in 1988 and is approximately 335 acres in size (Chehalis Wildlife Area Management Plan, 1997).

Dungeness

The Dungeness Unit is located approximately seven miles northwest of Sequim. The Strait of Juan de Fuca borders the north and agricultural land borders the south end of the unit. According to the agreement the land was to be utilized for farming and waterfowl hunting by the general public on the large pond located on the premises. Fishing is not an option since the pond is not stocked and has no fish bearing streams leading to or from it. Water enters the pond via irrigation ditches and roadside drainage.

On February 20th 1975, The department entered a management agreement on the 216.41 acre parcel of land with Clallam County Commissioners. The agreement commenced on April 1, 1975 and will expire in 2000, reverting back to Clallam County and Voices of America.

Elk River

The Elk River Unit is estuary land on the south side of Grays Harbor and is approximately three miles south of Westport on State Route 105 in Grays Harbor County (Figure 3). During construction of the Ocean Shores Airport, the City of Ocean Shores filled in approximately 40 acres of wetland. The 105 acre parcel was used as mitigation for the destruction of wetland habitat.

In August of 1983 mitigation funds were used to purchase the 57 acre parcel. After acquisition, WDFW returned the site to a functioning estuary by breaching the onsite dike system, creating excellent waterfowl habitat and some additional rearing for chinook. Roosevelt elk are also known to frequent the area during spring and summer.

Ferbrache

The Ferbrache Unit is located between the Chehalis River and Brady Loop Road approximately two and one half miles southeast of Montesanso (Figure 4). The first parcel, acquired in October of 1969, was the property of George and Patricia Murphy Ferbrache. The 90 acre parcel of farmland is approximately three-quarters of a mile along the Chehalis River, with a wooded slough running diagonally through the cleared farmland. A second 24.15 acre parcel was acquired in December of 1974 from Benjamin Wroth.

The Chehalis River also provides excellent fishing opportunities for several species of salmonids. The Wroth property itself has about 1000 feet of stream frontage and is known as a particularly good spot for bank fishing. The Ferbrache property has one slough area that rarely floods.

Much of the property and other valley farmlands flood during periods of high river levels, and heavy rainfall forms ponds in the marshy sloughs producing excellent off channel rearing habitat. These factors combined with the presence of waterfowl foods in the form of scrap grain and weed seed have always created good conditions for waterfowl hunting.

Hoxit

The Hoxit Unit is located on the east bank of the Chehalis River 35 miles southwest of Olympia or one and a half mile south of Porter (Figure 5). It was the first foreclosed farm in the nation deeded to a state under the Agricultural Credit Act of 1987. The Grays Harbor property transfer was a cooperative venture between the Interior Department's U.S. Fish and Wildlife Service, the Department of Agriculture's Farmers Home Administration, and the Washington Department of Wildife (WDFW).

The 85 acre parcel lies almost entirely within the Chehalis River floodplain and contains extensive wetland and marsh areas. Its river border contains several gravel bars used by chinook, coho and chum for spawning. It is primarily managed for waterfowl and wildlife habitat, fisheries, and wetland flood protection. Two streams enter the Hoxit Unit that would provide excellent coho and resident salmonids spawning habitat and chinook, coho, steelhead and resident salmonids rearing habitat, if they were accessible.

John's River

The John's River Unit is located ten miles southwest of Aberdeen on SR 105 in the community of Markam (Figure 6). In 1955 the Department of Game reviewed available lands in the area for acquisition. The John's River parcel was selected due to its unique habitat for large numbers of waterfowl and upland birds. Adjoining parcels were later acquired as they became available. The John's River Unit now totals 1500 acres.

A 6,864 foot retainer dike was rebuilt in order to enclose 60 acres of esturian marshlands on the south side of John's River. The primary purpose was to create an area where dryland cereal grain production could be implemented to attract water fowl. An old dike on the north side was also rebuilt, which enclosed 40 acres of esturian marshlands previously used for agricultural purposes, again for waterfowl. Another dike was rebuilt enclosing 80 acres of estuarian marshlands on the eastern segment of the departments ownership. These dikes significantly reduced the spawning and rearing habitat for chinook, chum, and coho. All of the dikes were originally built in the 1930's prior to the Department's acquisition (John's River Wildlife Area Management Plan, Draft 1995).

North River

The North River Unit is located at the north end of Willapa Bay, approximately twelve miles northwest of Raymond off SR 105 (Figure 7). The 145 acre property is accessible only by boat from a WDFW access site about 1.5 miles away at the mouth of Smith Creek. The area is a tidally influenced and just over a mile from Willapa Bay. It is one of the largest and most productive estuaries in the Pacific Flyway. It is classified as an internationally important site. The property was historically logged but now consists of lightly timbered marshlands and supports various salmonids, including; chinook, coho, chum, steelhead, sea-run cutthroat, and resident trout species.

Ocean Park

The Ocean Park Unit is located on Bismark Street and Peninsula Street in Ocean Park on the Long Beach Peninsula of southwest Washington. This unit was first established with the donation of 0.57 acres by Walter and Lydia Neth in December of 1992. The second donation of .92 acres was from Gerald and Katherine Murphy in August of 1984. The third donation of of two 50' by 100' lots were granted to the state by Rose Martin through the Citizens Wildlife Heritage Program.

The lots are part of the Long Beach peninsula wetlands. The land is used by a variety of game and nongame wildlife including migratory shorebirds, waterfowl, trumpeter swans, bear, deer and aquatic furbearers. No fish bearing streams are within the unit. These wetlands are impacted by ditching, draining and filling. It is the department's plan to obtain 72 of these lots through the donation process and thereby preserve the remaining habitat. The lots will be left in an "as is" condition requiring little or no management.

Olympic

The Olympic Unit lies in the southern foothills of the Olympic Mountains, approximately 15 miles north of Aberdeen in the Wishkah and Upper Wynoochee River Valleys (Figure 8). The Olympic Unit encompasses nearly 1500 noncontiguous acres. The majority of the lands surrounding the unit are owned by the Department of Natural Resources, Grays Harbor County and private timber companies (Olympic Wildlife Area Management Plan Draft, 1995).

Poor logging practices in the 1900's led to shortages of food supplies for elk. In return the elk converged onto the lowlands and caused significant damage to agricultural crops. In order to reduce the amount of game damage complaints and to avoid an either sex hunting season, the state purchased the higher elevation dairy farms and converted natural timber to agricultural areas in order to support the increasing elk populations (Olympic Wildlife Area Management Plan Draft, 1995) .

These poor logging practices have also rendered many miles of salmonid habitat inaccessible. Several tributaries cross the unit which are intersected by logging roads before these tributaries meet with the Wishkah and Wynoochee Rivers. Chinook, chum, coho, steelhead, and resident trout presently use the lower reaches for spawning and rearing.

In the past farmers in the area have used large amounts of ammonium nitrate, ammonium sulphate and calcium nitrate to ameliorate milk production. However, the soil nutrients leached out with heavy rainfall and into nearby streams which is not beneficial for fish production (Olympic Wildlife Area Management Plan Draft, 1995).

Oyhut

The Oyhut Unit is located at the southern end of Ocean Shores Peninsula and bounded by the city of Ocean Shores. The 683 acre Oyhut unit is a unique salt water marsh with sand dunes on three sides and the north jetty of Grays Harbor on the other. The marsh is recognized as an ancestral gathering place for a variety of waterfowl and a principal resting spot for coastal migrating species. Even though the marsh is human-created, a large amount of wildlife species use the area, such as Dusky Canada goose, mallard, pintail, widgeon, teal, the endangered snowy plover, it also serves as a permanent habitat for approximately 87 other species of birds. Marine life such as shellfish, worms, insects and small fish are abundant in the inner tidal pools. The sea on the outer fringes is the home of large marine life such as sea perch, bass, flounder, and dungeness crab (Oyhut Recreation Area Master Development Plan).

Palix

The Palix Unit is located approximately five miles southwest of South Bend, just east of U.S. 101 (Figure 9). The 240 acre unit lies at the confluence of the north, middle, and south forks of the Palix River. The Palix River flows into Willapa Bay in Pacific County.

The first parcel of the Palix Unit was purchased in December of 1967. The property at that time was only 160 acres, which included the upper two-thirds of the Palix River Delta. In 1970, WDG (now WDFW) purchased an additional 80 acres which extended the unit southwest to highway 101. The 80 acre purchase increased public fishing access along the Palix River for coho, chum, chinook, steelhead, sea-run cutthroat, and resident rainbow.

The property was diked prior to purchase, but after several heavy winter storms the water has long since breached the dike, and the department decided to allow the area to return to a naturally functioning estuary. Suitable habitat was then provided for shorebirds, waterfowl, salmon, and many other types of fish and wildlife.

Smith Creek

The Smith Creek Unit is located at the north end of Willapa Bay, approximately 12 miles northwest of Raymond adjacent to State Route 105 (Figure 10). The property encompasses 460 acres at the mouth of Smith Creek and North River in Pacific County. It includes 136 acres of second class tidelands, 234 acres of saltwater marsh, and 90 acres of timbered uplands. The estuary is utilized by migratory shorebirds and waterfowl during the spring and fall migrations along the Pacific Flyway. The internal slough complex provides excellent overwintering habitat for all salmonid species including; chinook, coho, steelhead and sea-run cutthroat. The area is a popular salmon fishing access site.

Union River

The Union River Unit is located at the furthest inland extension of Hood Canal, less than a mile from Belfair in Mason County. In 1962, the Department of Game purchased a tract of land to create a fish and game preserve on the Union River delta. WDFW now owns 200 acres which is managed cooperatively with approximately another 200 acres held by the North Mason School District and a local land trust. The majority of the upper watershed is owned by the City of Bremerton for it's principal water supply. Ninety percent of the estuary is under protective ownership. Part of the estuary is also managed through a cooperative agreement with the Hood Canal Watershed Project Center (Theler Wetland Group) in Belfair.

Fish and wildlife recreational opportunities are abundant on the property. Chinook, coho, chum, and resident species are present as well as a sturgeon bank fishery on stocks that are believed to originate in several other larger rivers in the region. Though it is an excellent water fowl viewing area, only limited waterfowl hunting opportunities exist.

Wynoochee

The Wynoochee Unit lies in the foothills of the Olympic Mountains, approximately 20 miles north of Aberdeen in the Upper Wynoochee River Valley (Figure 11). As a result of inundation of 1,170 acres of habitat behind Wynoochee Dam, approximately 1,030 acres of land was acquired in fee and easements by the Corps of Engineers for wildlife mitigation. The Corps purchased 520 acres and acquired easements on an additional 510 acres for elk habitat. About 250 acres were designated to be farmed and managed primarily for elk by the Department of Game (now Fish and Wildlife) (Olympic Wildlife Area Management Plan Draft, 1995). In 1972 the 250 acres were cleared and seeded by the Corps of Engineers in cooperation with the Department of Wildlife. In 1974 and 1975 the Corps of Engineers contracted the Department of Wildlife to do the operation and maintenance of the range lands. In 1976 they obtained thier own equipment and farmed the area until 1985. From 1985 to 1987 they contracted with the Department of Wildlife again. Nineteen eighty-eight was the first year the lands were not farmed by Corps personnel or WDW. The Corps began the process of transferring operation and

maintenance of the project to the City of Aberdeen and from 1989 to 1992 a contract farmer was hired to farm the project which resulted in lack of adequate attention. In April of 1992 WDW signed the final agreement with the Cities of Aberdeen and Tacoma for management of the Wynoochee Wildlife Mitigation Lands (Olympic Wildlife Area Management Plan Draft, 1995).

Currently, the properties are managed for big game and for the various fish species as well, i.e. chinook, chum, coho steelhead and resident species. Correction of the fish passage barriers would make accessible a significant amount of habitat.

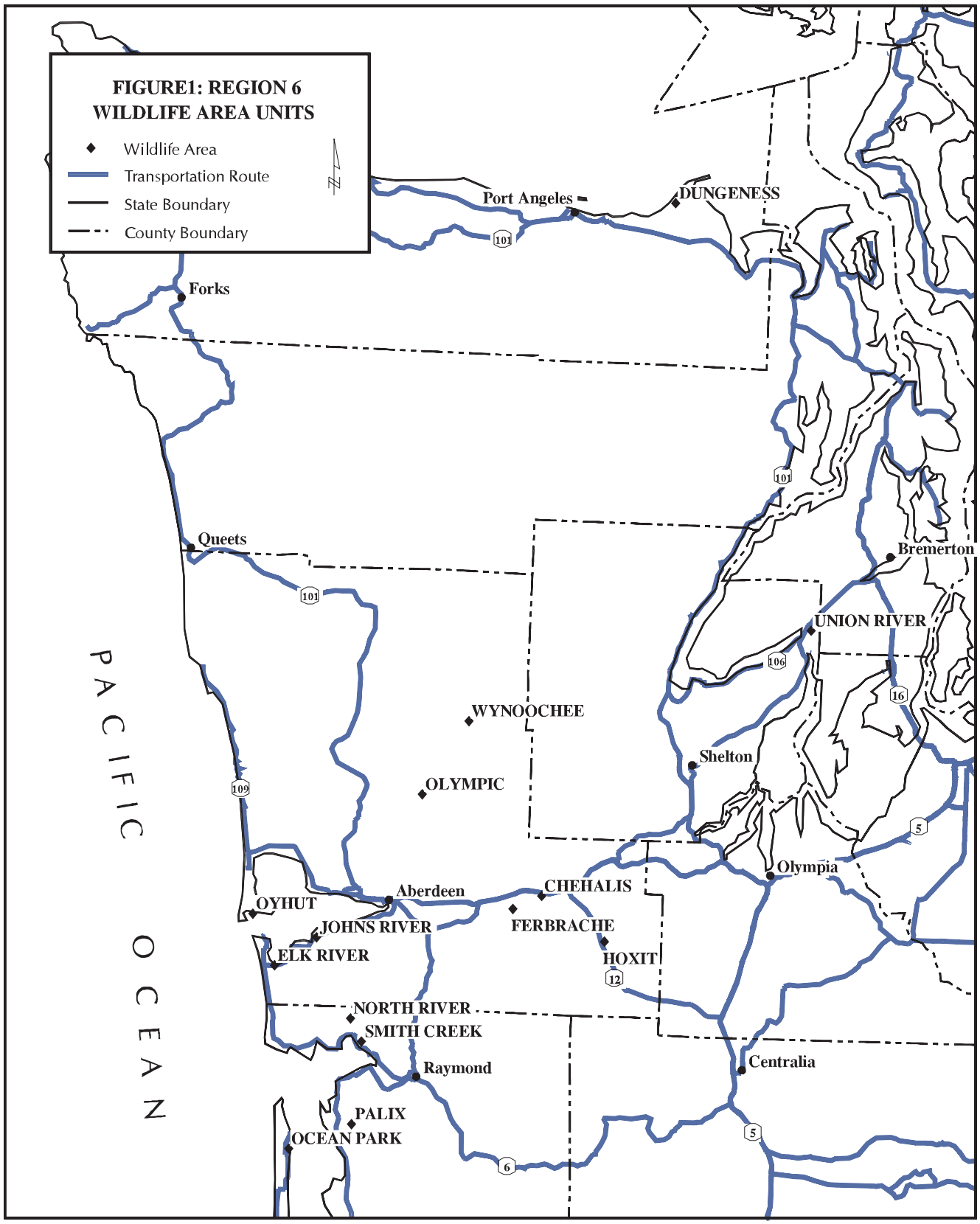
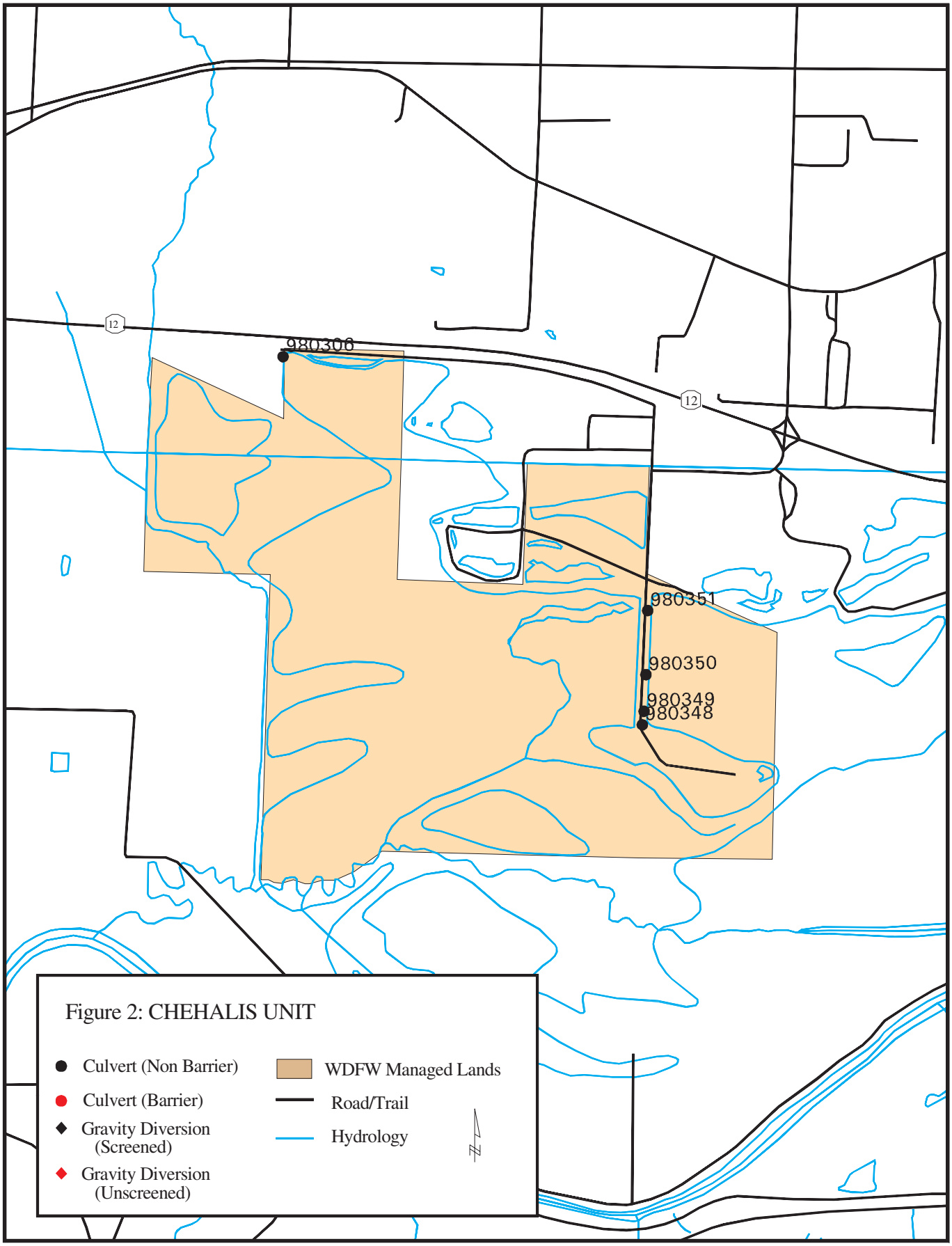


FIGURE1: REGION 6
WILDLIFE AREA UNITS
Wildlife Area
Transportation Route
State Boundary
County Boundary
Port Angeles
DUNGENESS
Forks
Queets
Bremerton
UNION RIVER
WYNOOCHEE
Shelton
OLYMPIC
Olympia
Aberdeen
CHEHALIS
OYHUT
JOHNS RIVER
FERBRACHE
ELK RIVER
HOXIT
NORTH RIVER
SMITH CREEK
Centralia
Raymond
PALIX
OCEAN PARK
PACIFIC OCEAN
101
109
106
16
5
12
6


12
980306
12
980351
980350
980349
980348
Figure 2: CHEHALIS UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
N

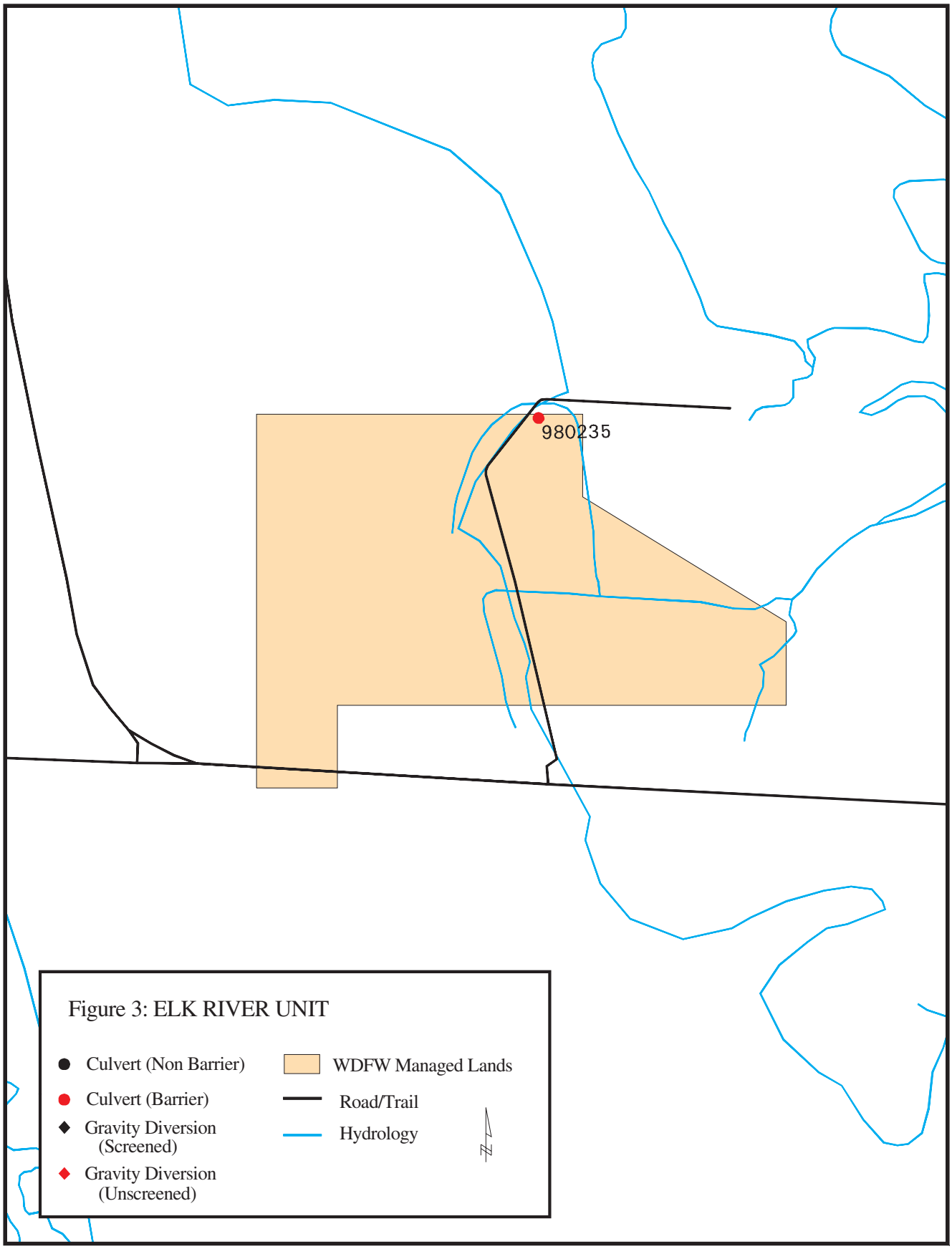

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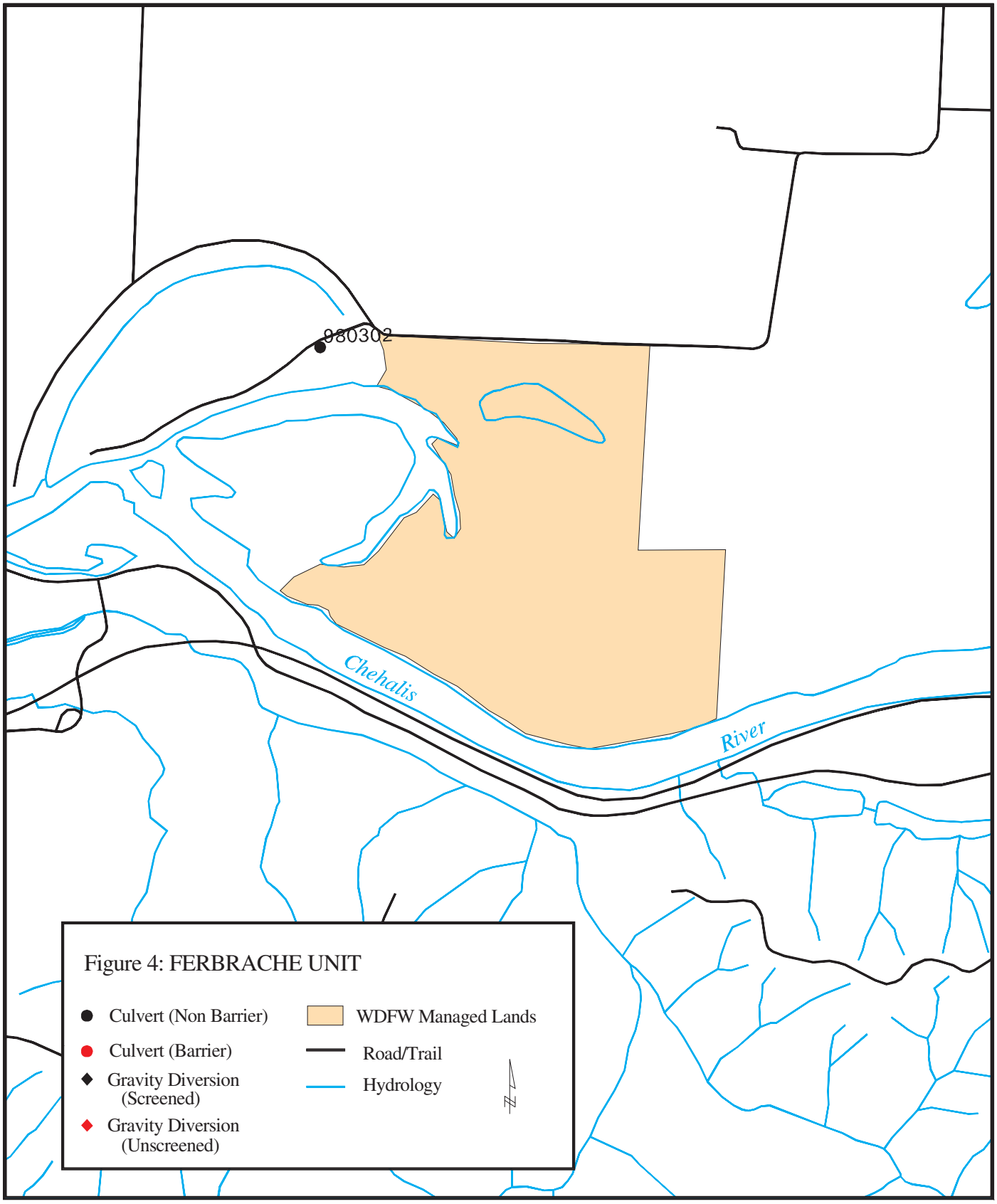
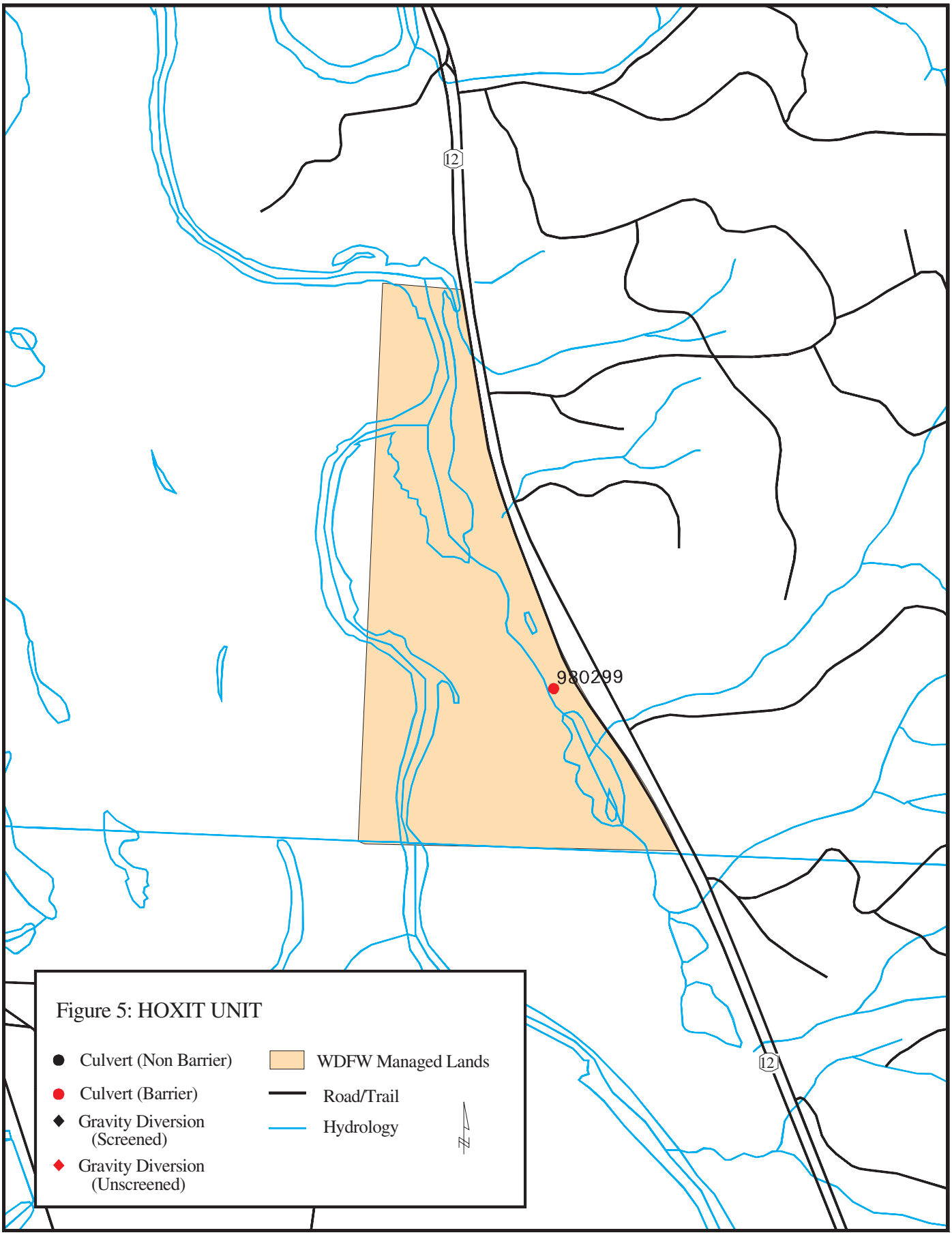
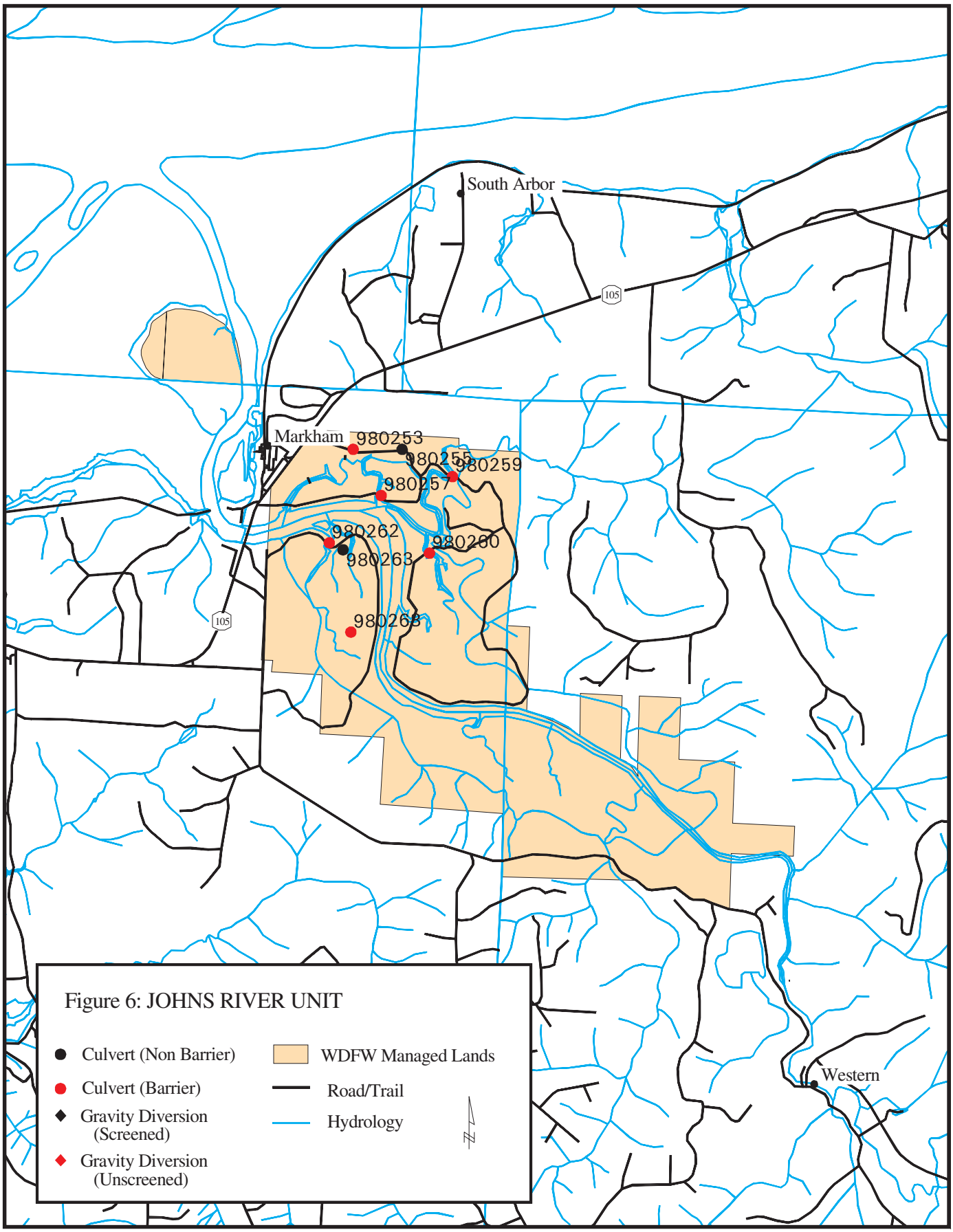
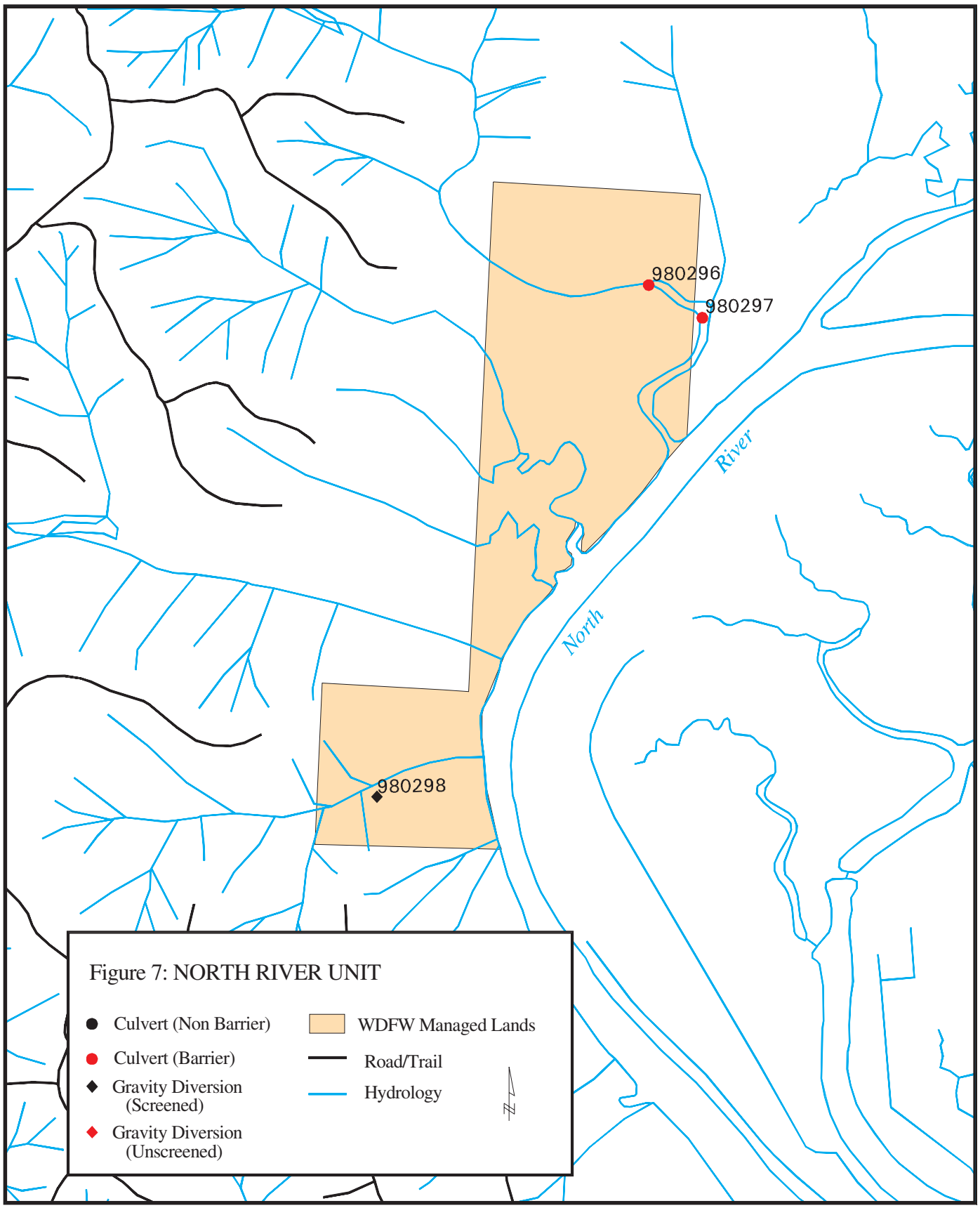
Figure 3: ELK RIVER UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
N


980302
Chehalis
River
Figure 4: FERBRACHE UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
N


12
980299
12
Figure 5: HOXIT UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology


South Arbor
105
Markham
980253
980255
980259
980257
980262
980260
980263
980268
105
Western
Figure 6: JOHNS RIVER UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology


980296
980297
980298
North
River
Figure 7: NORTH RIVER UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology

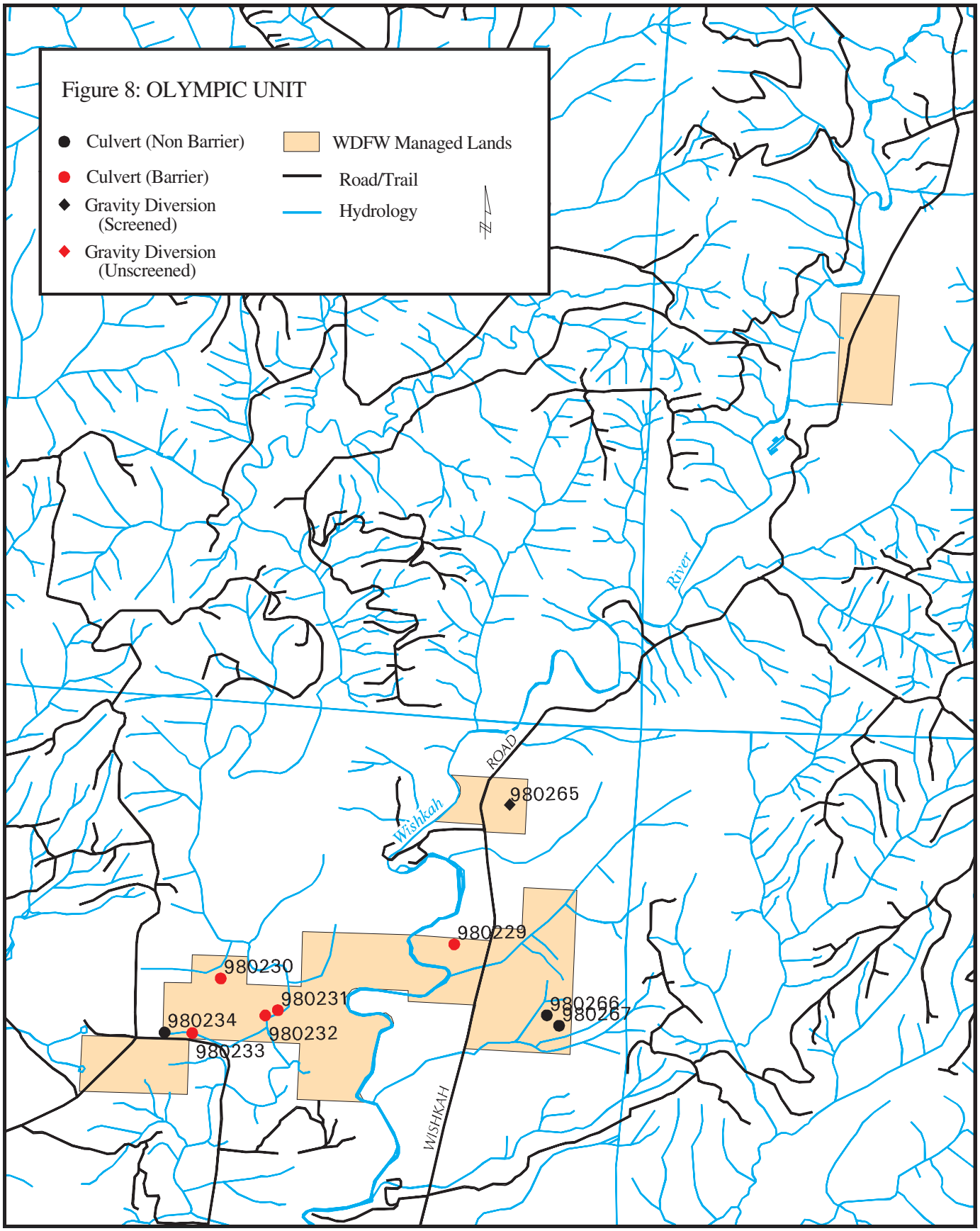


Figure 8: OLYMPIC UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
N
River
ROAD
Wishkah
WISHKAH
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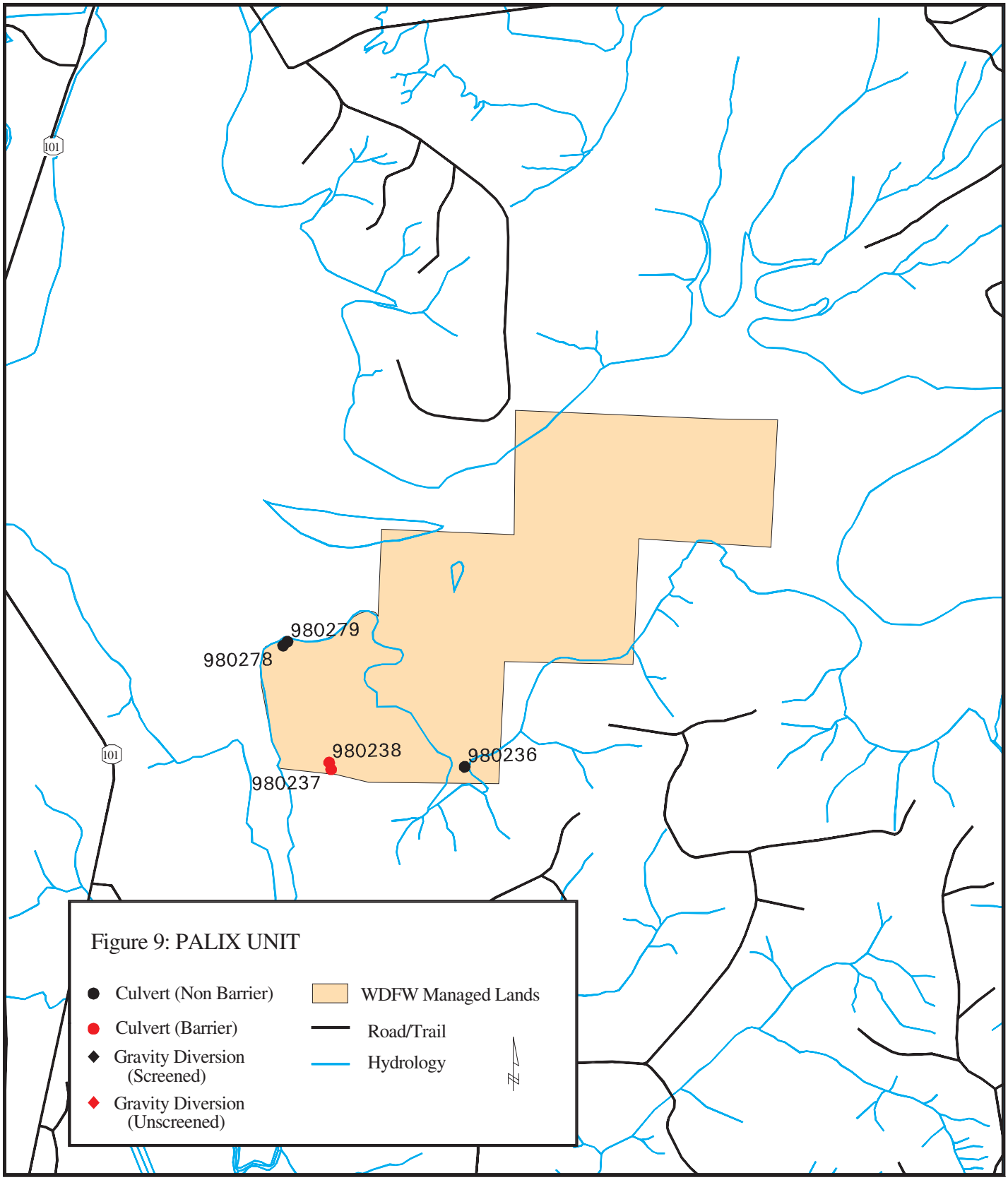
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Figure 9: PALIX UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
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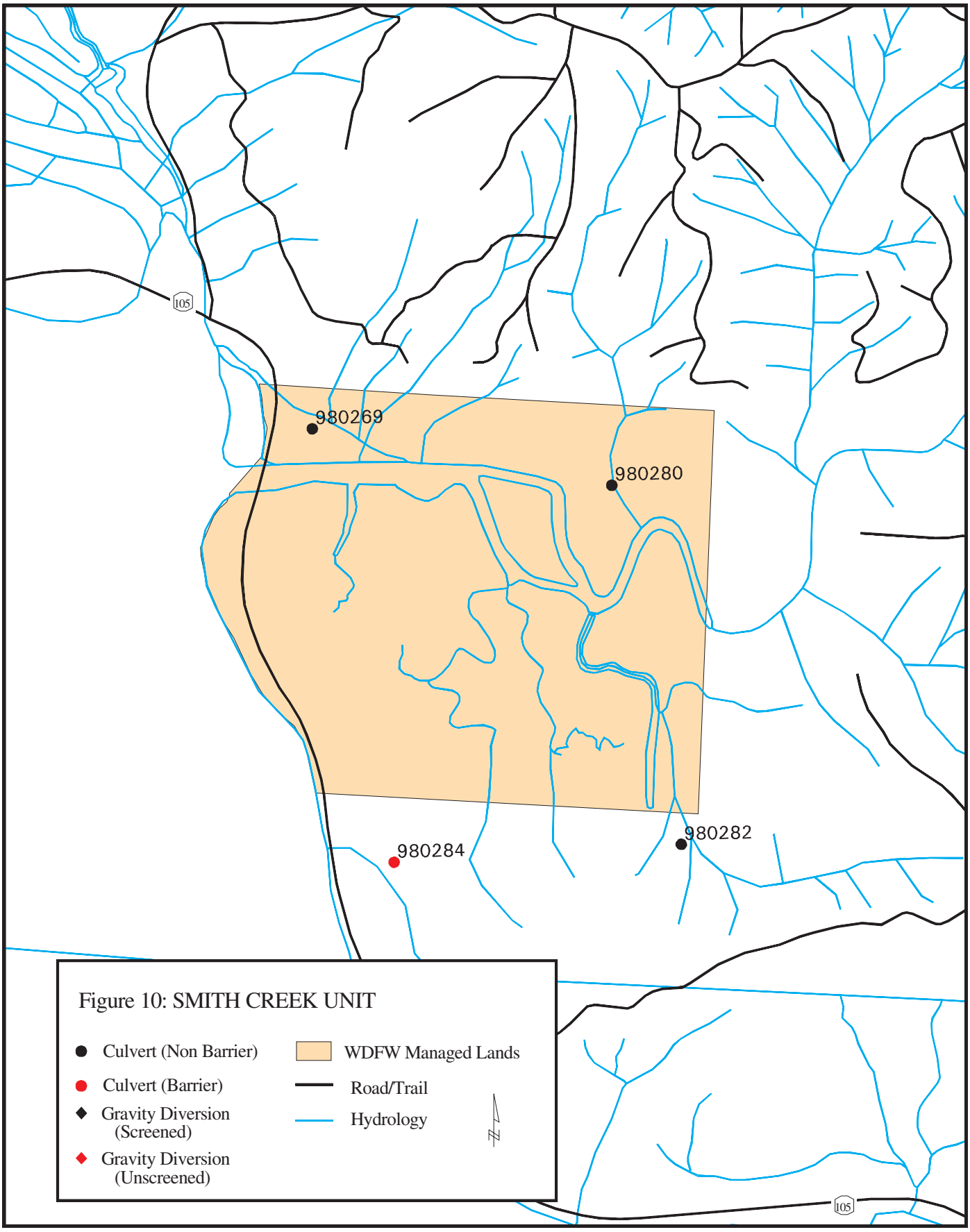
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980282
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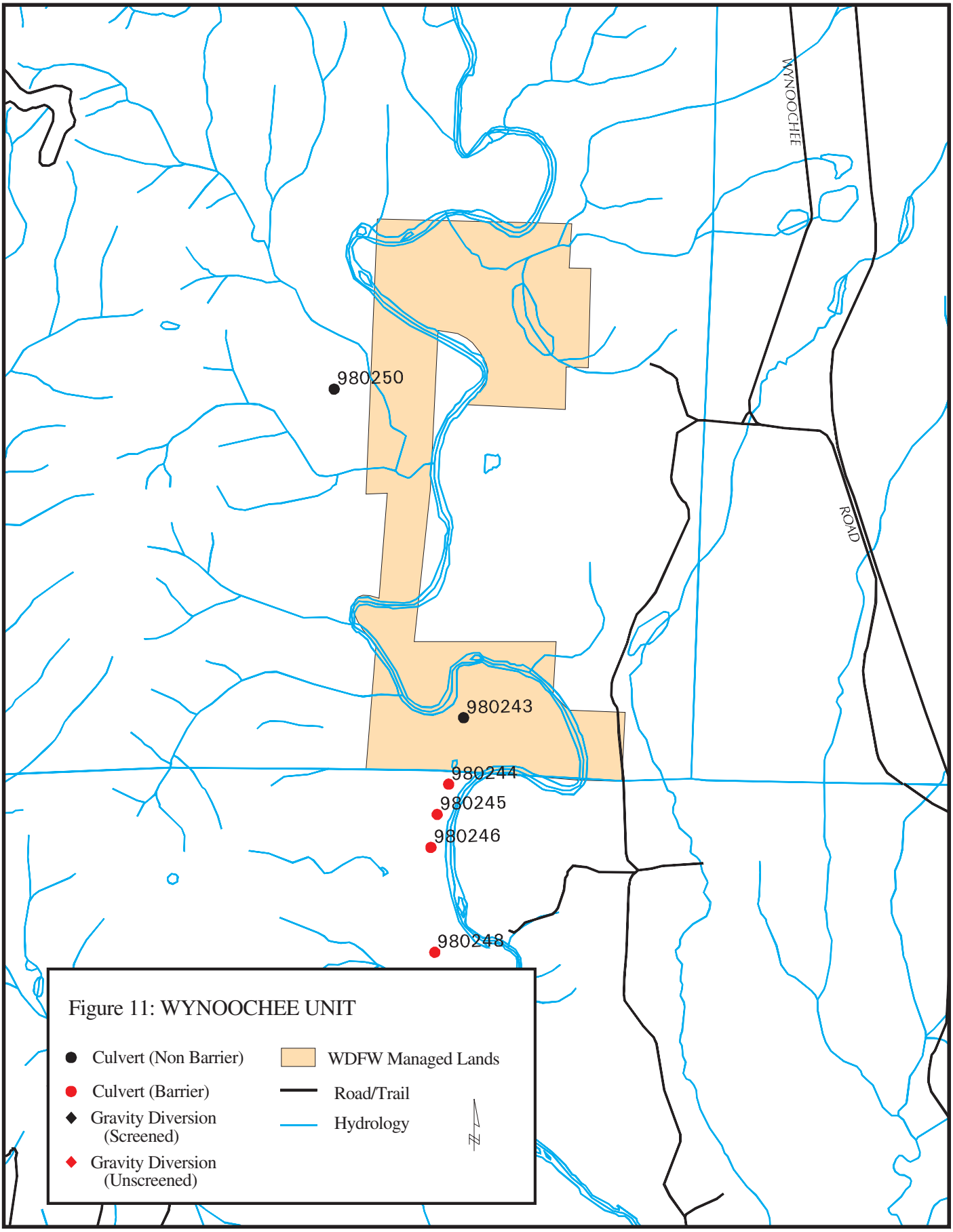
Figure 10: SMITH CREEK UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology
N


WYNOOCHEE
ROAD
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980246
980248
Figure 11: WYNOOCHEE UNIT
Culvert (Non Barrier)
Culvert (Barrier)
Gravity Diversion (Screened)
Gravity Diversion (Unscreened)
WDFW Managed Lands
Road/Trail
Hydrology

METHODS

Feature Location

Features were located using several techniques: the Wildlife Area Manager guided the inventory crew to each culvert, dam, fishway and water diversion known to them, maps were created by overlaying the Department of Natural Resources hydrology and transportation GIS layers with the use of Arc Info software to identify potential crossings, the field crew then drove all roads and walked each drainage to locate any additional features.

Feature Evaluation

Once a feature was located, the evaluation began with recording the site information. Using a Trimble Pro XR GPS Receiver equipped with a TDC2 data logger or the Trimble GeoExplorer II, latitude and longitude were recorded for mapping purposes. All positional data were differentially corrected using Trimble's Pfinder software and base files obtained from the Thurston County community base station. All streams were located and, if possible, identified by name and/or Water Resource Inventory Area (WRIA) using U.S.G.S quadrangle maps (1:24000), a DeLorme Atlas of Washington State (DeLorme Mapping 1992), The Thomas Guide (Thomas Bros. Maps 1989), and the Catalog of Washington Streams and Salmon Utilization (Williams et al. 1975). Fish species presence was determined using the Washington State Salmon and Steelhead Stock Inventory (WDF et. al.1992), the Washington Department of Fish and Wildlife Salmonid Stock Inventory Bull Trout and Dolly Varden Appendix (1997), the Wildlife Area Manager, and the Regional Fish Biologist.

Culverts were evaluated for fish bearing status and passablitly per the Fish Passage Barrier Assessment and Prioritization Manual (WDFW, 1999).

The water diversions that were encountered were evaluated for screening needs or if screened, if they met current screening requirements (Appendix IV). The data collected for gravity diversions and pump diversions, revolved around the cost and feasibility of screening (i.e. flow, size, access) (Appendix V). If a dam or lake outlet structure (e.g. lake level control or lake screen) was a barrier to fish passage, we recorded all feature specifications: the crest length, which is defined as the total horizontal distance measured along the axis of the dam at the elevation of the top of the dam between abutments or ends of the dam; dam height, which is defined as the vertical distance between the lowest point of the dam crest and the streambed elevation (Department of Ecology, 1994); and other data (Appendix V). The passability with all these features varies with flows, tidal influence, and species. All of these factors and more have to be taken into account. A complete description of all the attributes and values are described in Appendix V.

Feature dimensions were measured in English units, utilizing a Mound City stadia rod (Model 43623). Slope measurements were calculated using a laser from Laser Tech Inc. (Model Impulse 200) mounted on a Bogen Manfrotto monopod (Model 3218). Velocity readings were calculated using a Marsh-McBirney, Inc. FLO-MATE (Model 2000). Positional data were downloaded from the TDC2 data logger and GeoExplorer II to a personal computer and converted to ASCII files via Trimbles Pfinder Software and later imported into Paradox for management.

Habitat Assessments, Data Analysis, and Barrier Prioritization

Habitat assessments, data analysis and barrier prioritization were completed per the Fish Passage Barrier Assessment and Prioritization Manual (Washington Department of Fish and Wildlife, 1999). Potential habitat gain was calculated utilizing the Expanded Threshold Determination (ETD) methodology.

In watersheds that provide habitat for resident species only, the habitat gain could either be the upstream or downstream habitat. For instance, if a barriers falls exists 500 linear meters downstream of the project site, and there is greater than 500 linear meters of useable habitat upstream, the downstream habitat would be considered the priority habitat, since upon correction of the human-made barrier, the smaller piece of habitat is connected to the larger piece of habitat. The smaller piece of habitat is used to estimate the potential production gain from barrier removal. This approach acknowledges a 'biological interchange" between the upstream and downstream areas, where the net benefit is expressed by the smaller area. In another example, if there is a known falls five miles downstream on the mainstem that prevents anadromous access, and there is <5 miles of habitat upstream, the upstream habitat would be used to prioritize for barrier resolution.

Screening Priority Index

The Screening Priority Index (SPI) model is a hybrid of the original quadratic formula used in prioritizing fish passage barriers. The SPI was created to consolidate the many factors of water diversions into a manageable framework for developing a prioritized lists of projects. The SPI for each unscreened or ineffectively screened diversion is calculated as follows:

$$SPI = \sum_{all\,species} \sqrt[4]{(DF)(M)(D)(C)}$$

Where:

SPI = Priority Index

- Relative project benefit considering cost.

- The SPI is actually the sum ($\sum_{\text{all species}}$)of individual SPI values, one of which is calculated for each species present in a stream (e.g., SPI_{coho} is added to SPI_{chum} to obtain $SPI_{\text{all species}}$).

DF = Design Flow

- The legal water right for which the headgate and water diversion canal were originally constructed or current maximum use, whichever is less (measured in gallons per minute).

- Design flow is used as an estimate of potential fished saved (i.e. more flow is related to more fish).

M = Mobility Modifier

- Accounts for benefits to each fish stock for increased mobility (access to habitat being evaluated); gives greater weight to projects that increase productivity of species that are highly mobile and subject to geographically diverse recreational and commercial fisheries by providing access to habitat currently limiting productivity.

- 2 = Highly mobile stock subject to geographically diverse recreational and commercial fisheries (anadromous species)

- 1 = Moderately mobile stock subject to local recreational fisheries (resident species)

D = Species Condition Modifier

- Representation of status of species present; gives greater weight to less healthy species as listed in the Washington State Salmon and Steelhead Stock Inventory (SASSI) report, (WDF, et. al., 1992). In the absence of a SASSI assignment, stock condition should be estimated using the best available information.

  3 = Condition of species considered critical.

  2 = Condition of species considered depressed or stock of concern.

  1 = species not meeting the conditions for 2 or 3.

C = Cost Modifier

- Representation of projected cost of project; gives greater weight to less costly projects.

  3 = incremental funds needed ≤ $1,000...

  2 = incremental funds needed >$1,000 and ≤$5,000...

  1 = incremental funds needed >$5,000...

RESULTS

Inventory

On the Olympic Wildlife Area a total of 62 features were evaluated. There are 60 culvert crossings and two gravity diversions. Forty-four culverts and both diversions are considered to be in fish bearing streams. Twenty-five culverts were identified as potential barriers, nine are total barriers and 16 are partial barriers. Both water diversions meet current screening criteria.

The inventory and physical habitat surveys for the 25 barrier culverts covered approximately 46 kilometers of stream. Twenty of the sites affect both anadromous and resident salmonids while five sites affect resident salmonids only. Habitat surveys revealed 12 of the 25 barrier culverts have sufficient habitat gain to warrant repair. They are located on the Elk River, Hoxit, Johns River, North River, Olympic, Palix, Smith Creek and Wynoochee units. The total spawning and rearing habitat made inaccessible due to barriers within the Olympic Wildlife Area are 7,376 and 808,990 square meters respectively. Table 1 lists the number of features at each Wildlife Area Unit. Table 2 lists the site identification number, Wildlife Area, unit, stream, tributary to, feature type and repair status of each feature located in fish bearing waters. Figures 2-10 show the fish bearing features located within each Wildlife Area Unit.

Table 1. Numbers of fish passage features (culverts, dams, fishways, lake outlet screens) and fish screening features (water diversions) evaluated at each Olympic Wildlife Area Unit. Fishways and lake outlet screens are assumed to be in fish bearing waters. Fishways and lake outlet screens are assumed to be in fish bearing waters.

Wildlife Area Unit	Culverts			Dams			Fishways		Lk Outlet Screens		Water Diversions		
	Total	Fish Bearing	Barriers	Total	Fish Bearing	Barriers	Total	Barriers	Total	Barriers	Total	Fish Bearing	Unscreened
Chehalis	8	5	0	0	0	0	0	0	0	0	0	0	0
Dungeness	1	0	0	0	0	0	0	0	0	0	0	0	0
Elk River	1	1	1	0	0	0	0	0	0	0	0	0	0
Ferbrache	1	1	0	0	0	0	0	0	0	0	0	0	0
Hoxit	1	1	1	0	0	0	0	0	0	0	0	0	0
John' River	13	8	6	0	0	0	0	0	0	0	0	0	0
North River	2	2	2	0	0	0	0	0	0	0	1	1	0
Ocean Park	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic	10	8	5	0	0	0	0	0	0	0	1	1	0
Oyhut	0	0	0	0	0	0	0	0	0	0	0	0	0
Palix River	5	5	2	0	0	0	0	0	0	0	0	0	0
Smith Creek	6	4	1	0	0	0	0	0	0	0	0	0	0
Union	0	0	0	0	0	0	0	0	0	0	0	0	0
Wynoochee	12	9	7	0	0	0	0	0	0	0	0	0	0
TOTALS	**60**	**44**	**25**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**2**	**0**

Table 2. The location, type and repair status of features within the Olympic Wildlife Area in fish bearing waters. Repair status indicates whether the site has no significant habitat gain (NG), the site requires repair (RR) or if the site does not require repair (OK).

Site ID	Unit Name	Stream	Tributary to	Feature Type	Repair Status
980351	Chehalis	Unnamed	Unnamed	Culvert	OK
980350	Chehalis	Unnamed	Unnamed	Culvert	OK
980306	Chehalis	Unnamed	Unnamed	Culvert	OK
980348	Chehalis	Unnamed	Unnamed	Culvert	OK
980349	Chehalis	Unnamed	Unnamed	Culvert	OK
980235	Elk River	Unnamed	Grays Harbor	Culvert	RR
980302	Ferbrache	Moon Sl	Chehalis R	Culvert	OK
980299	Hoxit	Unnamed	Chehalis R	Culvert	RR
980263	John's River	Unnamed	John's R	Culvert	OK
980268	John's River	Unnamed	John's R	Culvert	NG
980257	John's River	Unnamed	John's R	Culvert	RR
980262	John's River	Unnamed	John's R	Culvert	RR
980255	John's River	Unnamed	John's R	Culvert	OK
980253	John's River	Unnamed	John's R	Culvert	RR
980260	John's River	Unnamed	John's R	Culvert	RR
980259	John's River	Beaver Cr	John's R	Culvert	RR
980296	North River	Unnamed	North R	Culvert	NG
980297	North River	Unnamed	North R	Culvert	NG
980298	North River	Unnamed	North R	Gravity Diversion	OK
980267	Olympic	Unnamed	Unammed	Culvert	OK
980230	Olympic	Unnamed	WF Wishkaw R	Culvert	NG
980233	Olympic	Unnamed	WF Wishkaw R	Culvert	RR
980265	Olympic	Unnamed	Unnamed	Gravity Diversion	OK
980229	Olympic	Unnamed	Wishkaw R	Culvert	NG
980231	Olympic	Unnamed	WF Wishkaw R	Culvert	NG
980266	Olympic	Unnamed	Unnamed	Culvert	OK
980232	Olympic	Unnamed	WF Wishkaw R	Culvert	NG

Table 2 cont. The location, type and repair status of features within the Olympic Wildlife Area in fish bearing waters. Repair status indicates whether the site has no significant habitat gain (NG), the site requires repair (RR) or if the site does not require repair (OK).

Site ID	Unit Name	Stream	Tributary to	Feature Type	Repair Status
980234	Olympic	Unnamed	WF Wishkaw R	Culvert	OK
980278	Palix River	Unnamed	Palix R	Culvert	OK
980236	Palix River	Unnamed	Palix R	Culvert	OK
980238	Palix River	Unnamed	Palix R	Culvert	NG
980279	Palix River	Unnamed	Palix R	Culvert	OK
980237	Palix River	Unnamed	Palix R	Culvert	NG
980269	Smith Creek	Unnamed	Smith R	Culvert	OK
980284	Smith Creek	Unnamed	Smith R	Culvert	RR
980282	Smith Creek	Unnamed	Unnamed	Culvert	OK
980280	Smith Creek	Unnamed	Smith R	Culvert	OK
980243	Wynoochee	Unnamed	Wynoochee R	Culvert	OK
980245	Wynoochee	Unnamed	Wynoochee R	Culvert	NG
980248	Wynoochee	Unnamed	Wynoochee R	Culvert	RR
980244	Wynoochee	Unnamed	Wynoochee R	Culvert	RR
980250	Wynoochee	Unnamed	Wynoochee	Culvert	OK
980246	Wynoochee	Unnamed	Wynoochee R	Culvert	NG
980242	Wynoochee	Unnamed	Wynoochee R	Culvert	NG
980241	Wynoochee	Unnamed	Wynoochee R	Culvert	NG
980240	Wynoochee	Unnamed	Wynoochee R	Culvert	RR

Prioritization

Prioritization for each barrier was also completed per the Fish Passage Barrier Assessment and Prioritization Manual (WDFW, 1999). Table 3 lists the fish passage barriers requiring repair within the Olympic Wildlife Area. Barriers are sorted by unit and total PI, listing tributary to, barrier type, potential spawning and rearing habitat gain, estimated passability, number of additional human-made barriers within the drainage (including non-WDFW ownership), priority index, recommended correction and cost. These values are only intended as a guide to prioritizing projects. Other factors can and need to be considered when selecting projects. For example, the PI values do not reflect the possibility of additional human-made barriers. The true habitat gain can only be realized if all other human-made barriers within the drainage are repaired.

The PI should be regarded as a dynamic index as it can change as new information becomes available and inputs are refined.

DISCUSSION / RECOMMENDATIONS

The fact that most the Olympic Wildlife Area Units are within a flood plain, were logged and cleared in the early 1900's and then purchased by Washington Department of Fish and Wildlife primarily to provide waterfowl habitat and public recreation area, can make characterization and prioritization of correction to fish passage barriers and screening issues very complex. Before most of the barrier corrections on Olympic Wildlife Area Units can be initiated, the agency must establish what the Wildlife Area management priorities are, waterfowl, fish or both. Several of the features inventoried are barriers because their primary function is to control the water level for waterfowl nesting habitat. If this is to remain constant, then means other than removal must be addressed. The ideal theory is to protect and preserve fish, wildlife, and their habitat.

Chehalis

The Chehalis Unit has no culverts or other features that were considered to be a problem with fish passage (Sites 980306, 980348, 980349, 980350, 980351).

Dungeness

The Dungeness Unit has one culvert that is considered to be non-fish bearing and no action is warranted at site 980239.

Elk River

The total potential rearing area made inaccessible due to barrier features on the Elk River Unit is 2,520 square meters. This unit contains one partial barrier consisting of two culverts with tide gates (Site 980235)(Photo 1). They are two separate crossings, but one Site ID was assigned due to the drainage in front and behind the dike is one system. Redesigning the tide gates would provide improved fish passage and allow access to the additional rearing habitat for chinook and possibly sea-run cutthroat. Cost is estimated at $50,000.

Ferbrache

The Ferbrache Unit contains two culverts at one crossing (Site 980302), which was considered not to be a barrier to fish passage. No correction is warranted.

Hoxit

The potential spawning and rearing habitat on the Hoxit Unit is 3,430 and 10,614 square meters, respectively. A culvert/standpipe combination creates a barrier to fish passage (Site 980299, Photo 2 & 3). The standpipe was installed so higher water levels could be maintained during the water fowl migration. This creates a total barrier to potential spawning area and to the excellent rearing habitat further upstream on the system. The additional spawning and rearing would benefit chinook, coho, steelhead and resident salmonids. Because water levels are of particular importance for waterfowl and providing fish passage is required by law, a formal fishway would need to be constructed. Cost is estimated at $100,000.

Johns River

Once all the dikes were constructed at the John's River Unit, it significantly reduced the rearing habitat in the estuary. The culverts with tidegates and standpipe combinations created immediate fish passage barriers. The huge standpipe at site 980257 was constructed to increase waterfowl nesting area, which it has done remarkably well. But, at the same time created a total fish passage barrier. Reinstating fish passage would allow access to 224 square meters of spawning habitat and 256,024 square meters of rearing habitat for coho, chinook, steelhead and resident salmonids. In order to maintain the function of waterfowl habitat and still provide for fish passage a formal juvenile and adult fishway would be warranted. Cost is estimated at $250,000. In order to realize total potential habitat gain, the culvert at site 980253 which is upstream of site 980257, would need to be replaced simultaneously. It would be an easy repair due to gravel surfacing and little road fill. The cost is estimated at $10,000.

The culverts on Beaver Creek (Site 980259, Photos 4 & 5), a tributary to John's River, were originally built with tide gates. Over time, the natural corrosion affects of salt water caused the gates to become inoperable and they were eventually removed. Removing the tide gates took care of part of the fish passage problem, but it did not make the crossing 100% passable. The culverts are still substantially undersized for the velocity of flow caused by tidal fluctuations that occur close to the bay. In order to provide complete passability at all times, the culverts would need to be removed. This would allow for chinook, chum, coho steelhead and resident salmonids to access the additional 1,459 square meters of spawning and 41,886 square meters of rearing habitat upstream of this site. If the crossing is absolutely necessary for access to certain areas of the property, a large squashpipe could be used. Cost is estimated at $100,000

At site 980260 (Photos 6,7, & 8) standpipes were installed on the upstream end of the culverts to maintain high water levels for waterfowl habitat. Not only did the standpipes create a total barrier, but the tidegates on the downstream end also constitute a partial barrier. If the high water levels are to be maintained and juvenile chinook and sea-run cutthroat are to be allowed access to 470,340 square meters of vital rearing habitat, then a juvenile fishway would need to be constructed. Cost is estimated at $250,000.

The other crossing on the John's River Unit is also a standpipe/tidegate/culvert crossing (Site 980262, Photos 9 & 10). This crossing is scheduled to be removed and a new one constructed at a new location. This will put the crossing in line with the natural stream channel and therefore hopefully reduce the erosion of the dike. The new crossing will be designed to allow juvenile chinook and sea-run cutthroat access to the additional 1,800 square meters of excellent rearing habitat. Cost is estimated at $150,000. The total potential spawning and rearing habitat on the John's River Unit is approximately 1,683 and 770,050 square meters, respectively

North River

The only two culverts inventoried on the North River Unit were old sluice boxes constructed during a period of intense logging. They were located on very small sloughs and therefore do not require repair due to limited habitat gain. The other feature located on WDFW property was the small gravity diversion (Site 980298) utilized for a houseboat water supply. The diversion was sufficiently screened, but is most likely unauthorized. Water rights should be obtained or the diversion removed.

Ocean Park

The Ocean Park Unit was originally planned to be developed. Land owners recognized the importance of these last remaining second class dunes and donated the property to WDFW to preserve and to protect. Since this unit is primarily dune habitat, no stream systems cross the property and therefore no crossings, dams or diversions were encountered.

Olympic

The Olympic Unit, covering over 1500 acres, contains numerous stream systems that cross WDFW property. Of the nine fish bearing culverts inventoried, only one crossing warrants repair. The road crossing at site 980233 (Photo 11) has very little fill and the culvert is relatively small in size. Setting in a larger culvert at the correct elevations would provide for increased resident fish migration to and from the 139 square meters of spawning and 313 square meters of rearing habitat. The cost for site 980233 is estimated at $10,000.

Oyhut

The Oyhut unit is a unique salt water intrusion with sand dunes on three sides and the north jetty of Grays Harbor on the other. Most of the property is marsh/wetland habitat and no roads cross it, no culverts, dams, diversions, fishways or lake outlet screens were found at this unit.

Palix

The Palix Unit was diked and two culverts were installed for access to and from the dike. After several heavy winter storms the dike breached. The Department decided to allow the area to return to a naturally functioning estuary. There were three culverts located on the dike itself. Two culverts (Sites 980278 & 980279) are presently not barriers to fish passage, but should be removed. The entire dike at Site 980236 has eroded away and is no longer a crossing. The only two crossings that were considered to be barriers (Sites 980237 & 980238) have no significant habitat gain upstream and therefore do not require repair.

Smith Creek

The Smith Creek Unit is diked for agricultural purposes but also contains 90 acres of upland timber that had been logged in the past. On the portion of land that was previously logged, one culvert was inventoried that was judged to be a fish passage barrier, Site 980284)(Photo 12). Correction of this fish passage barrier would allow access for chinook, chum, coho and steelhead to an additional 35 square meters of spawning and 258 square meters of rearing habitat. The crossing is no longer used and could be remedied by removal. Cost would be relatively low, approximately $5,000, due to the small amount of fill. All other fish bearing sites on the Smith Creek Unit were considered 100% passable.

Union River

The Union River Unit was purchased by the Department of Game strictly for the purpose of making a fish and game preserve on the Union River delta. No culverts, dams, diversions, fishways or lake outlet screens were located on this unit.

Wynoochee

The Wynoochee Unit is reserved mitigation property for construction of the Wynoochee dam. During the logging process to create elk habitat, eight culverts were installed that became fish passage barriers. Only three crossings (Sites 980240, 980244, 980248) proved to have significant habitat upstream. The culvert at site 980240 (Photo 13) is severely undersized and therefore a velocity problem. Correction of this site alone would allow access to another 1,375 meters of rearing habitat for chinook, coho, steelhead and resident salmonids. Culverts at sites 980244 (Photo 14) and 980248 have been recently installed for access to a logging operation. Not only were they installed incorrectly, but they are undersized. The correction of site 980248 would allow access to an additional 2,089 square meters of spawning and 23,860 square meters of rearing habitat for chinook, coho, steelhead and resident species. In order to realize total potential habitat gain, the culvert at site 980244 which is upstream of site 980248, would need to be replaced simultaneously. A combined cost is estimated at $30,000 for all three culverts. Fortunately, all three road crossings were built with very little road fill. Replacement and resetting at proper elevations would provide fish passage to valuable spawning and rearing habitat. The Wynoochee unit potential habitat gain is 2,089 square meters of spawning habitat and 25,235 square meters of rearing habitat.

Table 3. Fish passage barriers requiring repair within the Olympic Wildlife Area. Barriers are sorted by unit and total PI, listing tributary to, barrier type, potential spawning and rearing habitat gain, estimated passability, number of additional human-made barriers within the drainage (including non-WDFW ownership), priority index, recommended correction and estimated cost. Species benefitting from repair are indicated by a PI value.

Site ID	Stream/Tributary to	Barrier Type	% Passable	Habitat Gain (m^2)		Additional Barriers		Priority Index								Recommended Correction	Estimated Cost
				Spawning	Rearing	Upstream	Downstream	Total	CK	CO	CH	SH	CT	DB	RB		
Elk River																	
980235	Unnamed/Grays Harbor	culvert	33	0	2,520	0	0	7.07	3.14				3.93			Replacement	$50,000
Hoxit																	
980299	Unnamed/Chehalis R	culvert	0	3,430	10,614	5	0	29.45	4.58	6.09	5.18	2.94	5.23	2.31	3.14	Fishway	$100,000
John's River																	
980257	Unnamed/John's R	culvert	0	224	256,024	3	0	55.95	11.02	14.65		6.63	11.58	5.11	6.95	Fishway	$250,000
980259	Beaver Cr/John's R	culvert	33	1,459	41,886	0	0	37.75	6.34	8.43	5.56	3.82	6.67	2.94	4.00	Replacement	$100,000
980253	Unnamed/John's R	culvert	67	224	15,691	1	1	27.75	4.16	5.52		2.5	4.37	1.62	2.62	Replacement	$10,000
980260	Unnamed/John's R	culvert	0	0	470,340	0	0	26.31	12.83				13.49			Fishway	$250,000
980262	Unnamed/John's R	culvert	33	0	1,800	0	0	6.5	2.89				3.61			Replacement	$150,000
Olympic																	
980233	Unnamed/WF Wishkaw	culvert	0	139	313	0	1	4.74					2.40	0.89	1.44	Replacement	$10,000
Smith Creek																	
980284	Unnamed/Smith Creek	culvert	0	35	258	0	0	7.19		2.67		1.21	2.07		1.24	Removal	$5,000
Wynoochee																	
980244	Unnamed/Wynoochee R	culvert	0	0	8,580	0	1	23.59	4.71	6.27		2.84	4.96	1.84	2.97	Replacement	$10,000
980248	Unnamed/Wynoochee R	culvert	67	2,089	23,860	1	0	23.17	4.52	6.01		2.73	4.85	2.14	2.91	Replacement	$10,000
980240	Unnamed/Wynoochee R	culvert	33	0	1,375	0	0	15.16	2.99	3.97		1.8	3.14	1.38	1.88	Replacement	$10,000
																TOTAL	**$955,000**

CK = chinook, **CO** = coho, **CH** = chum, **SH** = steelhead, **CT** = cutthroat, **DB** = Dolley Varden/bull, **RB** = rainbow.

REFERENCES

Bates, Ken M., G. Johnson and T. Lehr, J. Lenzi, and P. Powers. 1995. Fish Passage Progress Performance Report for the Biennium 1993 - 1995. Washington Department of Fish and Wildlife. Olympia. 40 pp.

Bates, Ken M., B. Benson, T. Burns, S. Cierebiej, L. Cowan, J. Lenzi, P. Powers, P. Sekulich, P. Wagner, 1997. Fish Passage Program, Department of Transportation Inventory, Final Report. Washington Department of Fish and Wildlife and Washington Department of Transportation. Olympia. 58 pp.

Benson, Brian, E. Gower, L. Cowan, G. Johnson, J. Lenzi, 1997. Thurston County Barrier Culvert Inventory. Washington Department of Fish and Wildlife. Olympia. 21 pp.

State of Washington, Department of Game, Master Development Plan for Oyhut Wildlife Recreation Area, 21 pp.33333

The Thomas Guide, 1990. Thomas Brothers Maps.

Washington Atlas & Gazetteer, 1992. DeLorme Mapping.

Washington Department of Ecology, 1994. Inventory of Dams in the State of Washington. Olympia. 150 pp.

Washington Department of Fish and Wildlife, Wildlife Area Division, Chehalis Wildlife Area Management Plan, Working Draft Summary, 1995. 12 pp.

Washington Department of Fish and Wildlife, Wildlife Area Division, John's River Wildlife Area Management Plan, 1995. 39 pp.

Washington Department of Fish and Wildlife, Wildlife Area Division, Olympic Wildlife Area Management Plan, 1995. 40 pp.

Washington Department of Fish and Wildlife, Salmonid Screening, Habitat Enhancement and Restoration Division, Fish Passage Barrier Assessment and Prioritization Manual, 1999. 57 pp.

Washington Department of Fisheries, Washington Department of Wildlife and Western Washington Treaty Indian Tribes, 1993. 1992 Washington State Salmon and Steelhead Stock Inventory. Olympia. 212 pp.

Washington Department of Fish and Wildlife. 1997. Salmonid Stock Inventory Bull Trout and Dolly Varden Appendix. Olympia. 435

Williams, R.W., R.M. Laramie, and J.J. Ames. 1975. A catalog of Washington Streams and salmon utilization. Vol. 1 - Puget Sound. Washington Department of Fisheries. Olympia. 974 pp.

APPENDIX I

Memorandum of Project Initiation

STATE OF WASHINGTON
DEPARTMENT OF FISH & WILDLIFE
LANDS AND RESTORATION SERVICES PROGRAM

DATE: 7/11/97

TO: Betty Buckley
Larry Peck

FROM: Elyse Kane

SUBJECT: Fish Passage Barriers and Screens at State Facilities and on State Lands

The inventory, prioritization and correction of man-made barriers to fish passage and of unscreened facilities is a major endeavor that must be embraced by our programs. Several laws and the recently adopted agency policy require that we do so. Considerable effort has been placed by the Lands and Restoration Services Program on identifying and resolving problem culverts and diversions owned by other jurisdictions and private entities. Unfortunately, there exist a number of barriers and unscreened facilities at WDFW hatcheries, on agency owned lands, and at lake outlet screens and structures maintained by the Engineering Division.

For those barriers associated with State hatcheries, SSHEAR has completed an inventory and prioritized the barriers for correction. A report of our findings is attached. Please note that there are priorities for correction assigned to each of the hatchery facilities, but there still remain immediate questions regarding the resolution of these barriers: 1) pathogen issues, 2) operational procedures at each hatchery, and 3) other issues that may arise from the Wild Salmonid Policy. In addition, Ken Bates has worked directly with the Hatcheries Program to inventory screening problems.

For those barriers and unscreened water diversions associated with WDFW lands, we are just beginning to formulate a program to inventory and prioritize for correction those problems pursuant to the ongoing budget discussions. For lake outlet screens and structures, it is my understanding that Ken Nolan is compiling an inventory meant to address their future use and required maintenance or correction.

Within the next few weeks I would like to discuss the aforementioned issues in order to develop a plan for consolidating the results of these inventories, addressing the associated questions, and budgeting for maintenance or correction of man made problems at our facilities and on our lands. In light of what we expect from outside jurisdictions and private entities, I'm sure you can appreciate the sensitivity of this subject for our agency and the need to expedite the needed corrections. Please respond at your earliest convenience.

Attachment

cc: Bern Shanks
Ken Bates
Paul Sekulich
Rocky Beach

APPENDIX II

RCW 75.10.110
RCW 75.20.040
RCW 75.20.060
RCW 75.20.061
RCW 75.20.100
RCW 77.12.425
RCW 77.16.160
RCW 77.16.210
RCW 77.16.220
RCW 77.21.010

RCW 75.10.110 General penalties for violations--Seizure and forfeiture. (1) Unless otherwise provided for in this title, a person who violates this title or rules of the department is guilty of a gross misdemeanor, and upon a conviction thereof shall be subject to the penalties under RCW 9.92.020. Food fish or shellfish involved in the violation shall be forfeited to the state. The court may forfeit seized articles involved in the violation.

(2) The commission may specify by rule, when not inconsistent with applicable statutes, that violation of a specific rule is an infraction under chapter 7.84 RCW. [1996 c 267 º 10; 1990 c 144 º 6; 1987 c 380 º 16; 1983 1st ex.s. c 46 º 42; 1979 ex.s. c 99º 1; 1955 c 12 º 75.08.260. Prior: 1949 c 112 º 75; Rem. Supp. 1949 º 5780-601. Formerly RCW 75.08.260.]

RCW 75.20.040 Fish guards required on diversion devices--Penalties, remedies for failure. A diversion device used for conducting water from a lake, river, or stream for any purpose shall be equipped with a fish guard approved by the director to prevent the passage of fish into the diversion device. The fish guard shall be maintained at all times when water is taken into the diversion device. The fish guards shall be installed at places and times prescribed by the director upon thirty days' notice to the owner of the diversion device. It is unlawful for the owner of a diversion device to fail to comply with this section.

Each day the diversion device is not equipped with an approved fish guard is a separate offense. If within thirty days after notice to equip a diversion device the owner fails to do so, the director may take possession of the diversion device and close the device until it is properly equipped. Expenses incurred by the department constitute the value of a lien upon the diversion device and upon the real and personal property of the owner. Notice of the lien shall be filed and recorded in the office of the county auditor of the county in which the action is taken. [1983 1st ex.s. c 46 º 70; 1955 c 12 º 75.20.040. Prior: 1949 c 112 º 45; Rem. Supp. 1949 º 5780-319.]

RCW 75.20.060 Fishways required in dams, obstructions, - Penalties, remedies for failure. A dam or other obstruction across or in a stream shall be provided with a durable and efficient fishway approved by the director. Plans and specifications shall be provided to the department prior to the director's approval. The fishway shall be maintained in an effective condition and continuously supplied with sufficient water to freely pass fish. It is unlawful for the owner, manager, agent, or person in charge of the dam or obstruction to fail to comply with this section. If a person fails to construct and maintain a fishway or to remove the dam or obstruction in a manner satisfactory to the director, then within thirty days after written notice to comply has been served upon the owner, his agent, or the person in charge, the director may construct a fishway or remove the dam or obstruction. Expenses incurred by the department constitute the value of a lien upon the dam and upon the personal property of the person owning the dam. Notice of the lien shall be filed and recorded in the office of the county auditor of the county in which the dam or obstruction is situated. The lien may be foreclosed in an action brought in the name of the state.

If, within thirty days after notice to construct a fishway or remove a dam or obstruction, the owner, his agent, or the person in charge fails to do so , the dam or obstruction is a public nuisance and the director may take possession of the dam or obstruction and destroy it. No liability shall attach for the destruction. (1983 1st ex.s. c 46 § 72; 1955 c 12 § 75.20.060. Prior: 1949 c 112 § 47; Rem. Supp. 1949 § 5780-321.)

RCW 75.20.061 Director may modify inadequate fishways and fish guards. If the director determines that a fishway or fish guard described in RCW 75.20.040 and 75.20.060 and in existence on September 1, 1963, is inadequate, in addition to other authority granted in this

chapter, the director may remove, relocate, reconstruct, or modify the device, without cost to the owner. The director shall not materially modify the amount of flow of water through the device. After the department has completed the improvements, the fishways and fish guards shall be operated and maintained at the expense of the owner in accordance with RCW 75.20.040 and 75.20.060. (1983 1st ex.s. c 46 § 73; 1963 c 153 § 1.)

RCW 75.20.100 Hydraulic projects or other work--Plans and specifications--Permits--Approval--Criminal penalty--Emergencies. (1) In the event that any person or government agency desires to construct any form of hydraulic project or perform other work that will use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state, such person or government agency shall, before commencing construction or work thereon and to ensure the proper protection of fish life, secure the approval of the department as to the adequacy of the means proposed for the protection of fish life. This approval shall not be unreasonably withheld.

(2)(a) Except as provided in RCW 75.20.1001, the department shall grant or deny approval of a standard permit within forty-five calendar days of the receipt of a complete application and notice of compliance with any applicable requirements of the state environmental policy act, made in the manner prescribed in this section. (b) The applicant may document receipt of application by filing in person or by registered mail. A complete application for approval shall contain general plans for the overall project,complete plans and specifications of the proposed construction or work within the mean higher high water line in salt water or within the ordinary high water line in fresh water, and complete plans and specifications for the proper protection of fish life. (c) The forty-five day requirement shall be suspended if: (i) After ten working days of receipt of the application, the applicant remains unavailable or unable to arrange for a timely field evaluation of the proposed project; (ii) The site is physically inaccessible for inspection; or (iii) The applicant requests delay. Immediately upon determination that the forty-five day period is suspended, the department shall notify the applicant in writing of the reasons for the delay. (d) For purposes of this section, "standard permit" means a written permit issued by the department when the conditions under subsections (3) and (6)(b) of this section are not met.

(3)(a) The department may issue an expedited written permit in those instances where normal permit processing would result in significant hardship for the applicant or unacceptable damage to the environment. In cases of imminent danger, the department shall issue an expedited written permit, upon request, for work to repair existing structures, move obstructions, restore banks, protect property, or protect fish resources. Expedited permit requests require a complete written application as provided in subsection (2)(b) of this section and shall be issued within fifteen calendar days of the receipt of a complete written application. Approval of an expedited permit is valid for up to sixty days from the date of issuance. (b) For the purposes of this subsection, "imminent danger"means a threat by weather, water flow, or other natural conditions that is likely to occur within sixty days of a request for a permit application. (c) The department may not require the provisions of the state environmental policy act, chapter 43.21C RCW, to be met as a condition of issuing a permit under this subsection. (d) The department or the county legislative authority may determine if an imminent danger exists. The county legislative authority shall notify the department, in writing, if it determines that an imminent danger exists.

(4) Approval of a standard permit is valid for a period of up to five years from date of issuance. The permittee must demonstrate substantial progress on construction of that portion of the project relating to the approval within two years of the date of issuance. If the department denies approval, the department shall provide the applicant, in writing, a statement of the specific reasons why and how the proposed project would adversely affect fish life. Protection of fish life shall be the only ground upon which approval may be denied or conditioned. Chapter 34.05 RCW applies to any denial of project approval, conditional approval, or requirements for project modification upon which approval may be contingent.

(5) If any person or government agency commences construction on any hydraulic works or projects subject to this section without first having obtained approval of the department as to the adequacy of the means proposed for the protection of fish life, or if any person or government agency fails to follow or carry out any of the requirements or conditions as are made a part of such approval, the person or director of the agency is guilty of a gross misdemeanor. If any such person or government agency is convicted of violating any of the provisions of this section and continues construction on any such works or projects without fully complying with the provisions hereof, such works or projects are hereby declared a public nuisance and shall be subject to abatement as such.

(6)(a) In case of an emergency arising from weather or stream flow conditions or other natural conditions, the department, through its authorized representatives, shall issue immediately, upon request, oral approval for removing any obstructions, repairing existing structures, restoring stream banks, or to protect property threatened by the stream or a change in the stream flow without the necessity of obtaining a written approval prior to commencing work. Conditions of an oral approval to protect fish life shall be established by the department and reduced to writing within thirty days and complied with as provided for in this section. Oral approval shall be granted immediately, upon request, for a stream crossing during an emergency situation. (b) For purposes of this section and RCW 75.20.103, "emergency" means an immediate threat to life, the public, property, or of environmental degradation. (c) The department or the county legislative authority may declare and continue an emergency when one or more of the criteria under (b) of this subsection are met. The county legislative authority shall immediately notify the department if it declares an emergency under this subsection.

(7) The department shall, at the request of a county, develop five-year maintenance approval agreements, consistent with comprehensive flood control management plans adopted under the authority of RCW 86.12.200, or other watershed plan approved by a county legislative authority, to allow for work on public and private property for bank stabilization, bridge repair, removal of sand bars and debris, channel maintenance, and other flood damage repair and reduction activity under agreed-upon conditions and times without obtaining permits for specific projects.

(8) This section shall not apply to the construction of any form of hydraulic project or other work which diverts water for agricultural irrigation or stock watering purposes authorized under or recognized as being valid by the state's water codes, or when such hydraulic project or other work is associated with streambank stabilization to protect farm and agricultural land as defined in RCW 84.34.020. These irrigation or stock watering diversion and streambank stabilization projects shall be governed by RCW 75.20.103. A landscape management plan approved by the department and the department of natural resources under RCW 76.09.350(2), shall serve as a hydraulic project approval for the life of the plan if fish are selected as one of the public resources for coverage under such a plan.

(9) For the purposes of this section and RCW 75.20.103, "bed" means the land below the ordinary high water lines of state waters. This definition does not include irrigation ditches, canals, storm water run-off devices, or other artificial watercourses except where they exist in a natural watercourse that has been altered by man.

(10) The phrase "to construct any form of hydraulic project or perform other work" does not include the act of driving across an established ford. Driving across streams or on wetted stream beds at areas other than established fords requires approval. Work within the ordinary high water line of state waters to construct or repair a ford or crossing requires approval. [1997 c 385 º 1; 1997 c 290 º 4; 1993 sp.s. c 2 º 30; 1991 c 322 º 30; 1988 c 272 º 1; 1988 c 36 º 33; 1986 c 173 º 1; 1983 1st ex.s. c 46 º 75; 1975 1st ex.s. c 29 º 1; 1967 c 48 º 1; 1955 c 12 º 75.20.100. Prior: 1949 c 112 º 49; Rem. Supp. 1949 º 5780-323.]

RCW 77.12.425 Director may modify inadequate fishways and protective devices. The director may authorize removal, relocation, reconstruction, or other modification of an inadequate fishway or fish protective device required by RCW 77.16.210 and 77.16.220 which device was in existence on September 1, 1963, without cost to the owner for materials and labor. The modification may not materially alter the amount of water flowing through the fishway or fish protective device. Following modification, the fishway or fish protective device shall be maintained at the expense of the person or governmental agency owning the obstruction or water diversion device. (1980 c 78 § 90; 1963 c 152 § 1. Formerly RCW 77.16.221.)

RCW 77.16.160 Damaging or interfering with fish ladders, guards, screens, etc. It is unlawful to damage or interfere with a fish ladder, guard, screen, stop, protective device, bypass, or trap operated by the department. [1980 c 78 º 84; 1955 c 36 º 77.16.160. Prior: 1947 c 275 º 55; Rem. Supp. 1947 º 5992-64.]

RCW 77.16.210 Fishways to be provide and maintained. Persons or government agencies managing, controlling, or owning a dam or other obstruction across a river or stream shall construct, maintain, and repair durable fishways and fish protective devices that allow the free passage of game fish around the obstruction. The fishways and fish protective devices shall be provided with sufficient water to insure the free passage of fish. (1980 c 78 § 88; 1955 c 36 § 77.16.020. Prior: 1947 c 275 § 60; Rem. Supp. 1947 § 5992-69.)

RCW 77.16.220 Diversion of water--Screen, bypass required. It is unlawful to divert water from a lake, river, or stream containing game fish unless the water diversion device is equipped at or near its intake with a fish guard or screen to prevent the passage of game fish into the device and, if necessary, with a means of returning game fish from immediately in front of the fish guard or screen to the waters of origin. A person who is *now otherwise lawfully diverting water from a lake, river or stream shall not be deemed guilty of a violation of this section.

Plans for the fish guard, screen, and bypass shall be approved by the director prior to construction. The installation shall be approved by the director prior to the diversion of water. The director may close a water diversion device operated in violation of this section and keep it closed until it is properly equipped with a fish guard, screen, or bypass. [1980 c 78 º 89; 1955 c 36 º 77.16.220. Prior: 1947 c 275 º 61; Rem. Supp. 1947 º 5992-70.]

RCW 77.21.010 Penalties--Confiscated articles and devices, disposal--Placing traps on private property--Jurisdiction of courts. (1) A person violating RCW 77.16.040, 77.16.050, 77.16.060, 77.16.080, 77.16.210, 77.16.220, 77.16.310, 77.16.320, or 77.32.211, or committing a violation of RCW 77.16.020 or 77.16.120 involving 77.16.210, 77.16.220, 77.16.310, 77.16.320, 77.16.340, or 77.32.211, or committing a violation of RCW 77.16.020 or 77.16.120 involving big game or an endangered species is guilty of a gross misdemeanor and shall be punished by a fine of not less than two hundred fifty dollars and not more than one thousand dollars or by imprisonment in the county jail for not less than thirty days and not more than one year or by both the fine and imprisonment. Each subsequent violation within a five-year period of RCW 77.16.040, 77.16.050, or 77.16.060, or of RCW 77.16.020 or 77.16.120 involving big game or an endangered species, as defined by the commission under the authority of RCW 77.04.090, shall be prosecuted and punished as a class C felony as defined in RCW 9A.20.020. In connection with each such felony prosecution, the director shall provide the court with an inventory of all articles or devices seized under this title in connection with the violation. Inventoried articles or devices shall be disposed of pursuant to RCW 77.21.040.

(2) A person violating or failing to comply with this title or rules adopted pursuant to this title for which no penalty is otherwise provided is guilty of a misdemeanor and shall be punished for each offense by a fine of five hundred dollars or by imprisonment for not more than ninety days in the county jail or by both the fine and imprisonment. The commission may provide, when not inconsistent with applicable statutes, that violation of a specific rule is an infraction under chapter 7.84 RCW.

(3) A person placing traps on private property without permission of the owner, lessee, or tenant where the land is improved and apparently used, or where the land is fenced or enclosed in a manner designed to exclude intruders or to indicate a property boundary line, or where notice is given by posting in a conspicuous manner, is guilty of the misdemeanor of trespass as defined and established in RCW 9A.52.010 and 9A.52.080 and shall be punished for each offense by a fine of not less than two hundred fifty dollars.

(4) Persons convicted of a violation shall pay the costs of prosecution and the penalty assessment in addition to the fine or imprisonment.

(5) The unlawful killing, taking, or possession of each wildlife member constitutes a separate offense.

(6) District courts have jurisdiction concurrent with the superior courts of misdemeanors and gross misdemeanors committed in violation of this title or rules adopted pursuant to this title and may impose the punishment provided for these offenses. Superior courts have jurisdiction over felonies committed in violation of this title. [1988 c 265 º 3. Prior: 1987 c 506 º 69; 1987 c 380 º 19; 1987 c 372 º 2; 1982 c 31 º 1; 1981 c 310 º 6; 1980 c 78 º 92; 1955 c 36 º 77.16.240; prior: 1947 c 275 º 63; Rem. Supp. 1947º 5992-72. Formerly RCW 77.16.240.]

APPENDIX III

Wildlife Area Scheduling Index

STATE OF WASHINGTON

FISH PASSAGE PRIORITIZATION QUESTIONNAIRE

STATEWIDE WDFW LANDS INVENTORY

DEPARTMENT OF FISH & WILDLIFE

LANDS and HABITAT SERVICES PROGRAM
SALMONID SCREENING, HABITAT ENHANCEMENT &
RESTORATION SERVICES (SSHEAR)

Wildlife Area:
Wildlife Area Manager:

1. NUMBER OF FISH PASSAGE FACILITIES. Wildlife Areas will be ranked first according to the number of known fish passage problems. Please include additional *Wildlife Units* to the table below to update the area list. Estimate the total number of fish passage facilities within each unit of the Snoqualmie Wildlife Area and record the number of facilities that present either a partial or total barrier to fish passage:

WILDLIFE AREA UNIT	NUMBER OF FISH PASSAGE FACILITIES											
	CULVERTS		DAMS		FISHWAYS		DIVERSIONS		LAKE OUTLET SCREENS		PASSAGE CONCERNS	
	NUMBER OF CULVERTS ON STREAMS BEARING RESIDENT AND / OR ANADROMOUS FISH	NUMBER OF CULVERTS THAT MAY PRESENT FISH PASSAGE PROBLEMS	NUMBER OF DAMS	NUMBER OF DAMS THAT MAY PRESENT FISH PASSAGE PROBLEMS	NUMBER OF FISHWAYS	NUMBER OF FISHWAYS THAT MAY PRESENT FISH PASSAGE PROBLEMS	NUMBER OF DIVERSIONS	NUMBER OF DIVERSIONS THAT MAY PRESENT FISH BYPASS PROBLEMS	NUMBER OF LAKE OUTLET SCREENS	NUMBER OF LAKE OUTLET SCREENS THAT MAY PRESENT FISH PASSAGE PROBLEMS	ARE THERE ANY HIGH PROFILE FISH PASSAGE ISSUES OF PUBLIC INTEREST?	ARE THERE ANY FISH PASSAGE PROBLEMS THAT REQUIRE IMMEDIATE ATTENTION?
1.												
2.												
3.												
4.												

2. NUMBER OF FISH STOCKS. Wildlife Areas will also be ranked according to proposed Federal ESA listings. Any discrete at-risk salmonid stocks not included in the proposed ESA listing process, will be ranked according to SASSI (Washington Salmon and Steelhead Stock Inventory). Record the number of anadromous and resident fish stocks in the table below. Please be sure that you do not record the same stock for both the ESA listing and the SASSI stock status categories:

WILDLIFE AREA UNIT	NUMBER OF PROPOSED ESA LISTINGS						NUMBER OF AT-RISK SASSI STOCKS			
	ANADROMOUS			RESIDENT			ANADROMOUS		RESIDENT	
	ENDANGERED	THREATENED	CANDIDATE	ENDANGERED	THREATENED	CANDIDATE	CRITICAL	DEPRESSED	CRITICAL	DEPRESSED
1.										
2.										
3.										
4.										
5.										
6.										
7.										
8.										
9.										
10.										
11.										
12.										
13.										
14.										

Wildlife Area Fish Retrofit Prioritization

A Priority Index (PI) was calculated for each Wildlife Area according to the ranking of four separate factors: estimated total problem features, anadromous and/or resident utilization of the Wildlife Area, stock status, and the existence of any high profile fish passage issues of public interest within the Wildlife area boundaries. After the PI was calculated for each Wildlife Area, the inventory logistics were stratified according to the time of year in which the inventory could be accomplished. For example, the Eastern Washington inventories will be scheduled during the spring and summer months and the Western Washington inventories will be scheduled during the fall and winter months.

$$PI = \sqrt[4]{(P)(M)(S)(I)}$$

Where:

PI = Priority Index

- A ranking of Wildlife Areas to be inventoried based on four separate factors.
- A quadratic root in the equation was used to provide a more manageable number and represents a geometric mean of the factors used. The PI for each Wildlife Area was calculated as follows:

P = Number of Estimated Fish Passage Problems

- The number of fish passage problems was estimated with the addition of: the number of features (e.g culverts, dams, fishways, water diversions, and lake screens) reported by Wildlife Area Managers and potential crossings calculated utilizing DNR hydrology and transportation overlays derived from 1:24000 data.

M = Mobility Modifier

- Accounts for benefits to each fish stock for increased mobility (access to habitat being evaluated); gives greater weight to projects that increase productivity of species that are highly mobile and subject to geographically diverse recreational and commercial fisheries by providing access to habitat currently limiting productivity.
- 2 = Highly mobile stock subject to geographically diverse recreational and commercial fisheries (anadromous species)
- 1 = Moderately mobile stock subject to local recreational fisheries (resident species)

S = Fish Stock Status

- Representation of status of stocks present; gives greater weight to less healthy stocks that have Federal ESA status or as listed in the Washington State Salmon and Steelhead Stock Inventory (SASSI) report, (WDF, et. al., 1992). The greatest value between ESA and SASSI was used in the quadratic equation. In the absence of Federal ESA status or SASSI assignment, stock condition should be estimated using the best available information.

ESA

3 = 2 or more species of ESA concern.

2 = 1 species of ESA concern.

1 = No species of ESA concern.

SASSI

3 = 2 or more species depressed or critical.

2 = 1 species depressed or critical.

1 = No species depressed or critical

I = Interest

- Representation of Wildlife Areas that have high profile fish passage issues of public interest.

3 = There are currently high profile fish passage issues within the Wildlife Area boundaries that require immediate attention..

2 = There are currently high profile fish passage issues within the Wildlife Area boundaries.

1 = There are currently no high profile fish passage issues within the Wildlife Area boundaries.

WILDLIFE AREA	WILDLIFE AREA FISH RETROFIT PRIORITY INDEX													
EASTERN WA	TOTAL CULVERTS	X TO FIX	POTENTIAL X TO FIX	TOTAL OTHER	OTHER TO FIX	TOTAL TO FIX	SASSI	ESA	STATUS	STOCK MOBILITY	INTEREST	PRODUCT	RANK	LC RANK
CHIEF JOSEPH	1	1	1	7	0	2	3	3	3	2	2	2.21	9	10
COLOCKUM	15	3	2	0	0	5	2	2	2	2	2	2.51	8	9
COLUMBIA	1	1	2	26	21	24	3	3	3	1	1	2.91	7	7
KLICKITAT	0	0	1	0	0	1	2	2	2	2	2	1.68	11	6
LECLERC	0	0	1	0	0	1	1	2	2	1	1	1.19	15	15
METHOW	3	3	2	8	3	8	3	3	3	2	3	3.46	2	1
LT. MURRAY	50	5	3	10	0	8	2	3	3	2	2	3.13	5	4
OAK CR	1	0	2	4	3	5	3	3	3	2	3	3.08	6	5
SCOTCH CR	5	0	1	3	2	3	1	1	1	2	1	1.57	13	13
SHERMAN CR	0	0	1	4	1	2	1	2	2	1	1	1.41	14	14
SINLAHEKIN	6	6	1	5	5	12	3	3	3	2	2	3.46	2	8
SUNNYSIDE	9	0	1	3	0	1	2	2	2	2	2	1.68	11	12
SWANSON	0	0	1	0	0	1	1	1	1	1	1	1	16	16
WELLS	2	1	2	10	10	13	2	3	3	2	2	3.53	1	11
WENAS	4	2	3	4	4	9	3	3	3	2	2	3.22	4	3
WOOTEN	0	0	1	12	0	1	3	3	3	2	3	2.06	10	2
WESTERN WASHINGTON														
COWLITZ	18	2	2	4	3	7	3	3	3	2	2	3.03	3	3
LK TERRELL	1	1	1	1	1	3	2	2	2	2	1	1.86	8	8
OLYMPIC	14	4	1	0	0	5	3	3	3	2	3	3.08	2	2
REGION 7	0	1	1	0	0	2	3	3	3	2	2	2.21	7	7
SCATTER CR	0	0	1	0	0	1	2	2	2	2	2	1.68	9	9
SHILLAPOO	4	2	1	6	1	4	3	3	3	2	2	2.63	4	4
SKAGIT	6	0	1	3	3	4	2	2	2	2	3	2.63	4	4
SNOQUALMIE	25	19	1	3	2	22	2	2	2	2	3	4.03	1	1
PUGET SOUND	5	1	1	3	8	10		2	2	2	1	2.51	6	6

Wildlife Area Prioritization
Table Definitions

Total Culverts, X to Fix, Total Other and Other to Fix are dams, diversions, fishways, and lake outlet screens recorded from prioritization questionnaire.

SASSI and ESA based on questionnaire results received from Wildlife Area Managers.

Potential X to Fix based on DNR Hydrology and Transportation overlays.

Total to Fix is the addition of X to Fix, Potential X to Fix and Other to Fix.

Stock Status is the larger of SASSI or current ESA Listing values.

ESA encompasses stocks currently "listed", " proposed", or "candidate".

Total to Fix, Stock Status, Stock Mobility and Interest used to calculate Product (Geometric Mean).

LC Rank represents ranking order after interaction with Lands Coordinators.

Potential X: 1=0-200 Potential x-ings, 2=200-400 Potential x-ings, 3=400 or more Potential x-ings

SASSI: 1=No Stocks Depressed or Critical, 2=1 Stock Depressed or Critical, 3=2 or more Stocks Depressed or Critical.

ESA: 1=No Stocks of ESA Concern, 2=1 Stock of ESA Concern, 3=2 or more Stocks of ESA Concern.

Mobility: 1=Primarily Resident Salmonids, 2=Mixture of Resident and Anadromous Salmonids.

Interest: 1=There are currently no high profile fish passage issues within the Wildlife Area boundaries. 2=There are currently high profile fish passage issues within the Wildlife Area boundaries. 3=The are currently high profile fish passage issues that require immediate attention.

Shading = Top 3 for eastern and western Washington

APPENDIX IV

Screening Requirements

SCREENING REQUIREMENTS FOR WATER DIVERSIONS

Washington State Laws (RCW 77.16.220; RCW 75.20.040, RCW 75.20.061) require all diversions from waters of the state to be screened to protect fish.

These laws and the following design criteria are essential for the protection of fish at surface water diversions. Fish drawn into hydropower, irrigation, water supply, and other diversions are usually lost from the fish resources of the state of Washington.

The following criteria are based on the philosophy of physically excluding fish from being entrained in water diverted without becoming impinged on the diversion screen. The approach velocity and screen mesh opening criteria are based upon the swimming stamina of emergent size fry in low water temperature conditions. It is recognized that there may be locations at which design for these conditions may not be warranted. Unless conclusive data from studies acceptable to Washington Department of Fish and Wildlife indicate otherwise, it is assumed that these extreme conditions exist at some time of the year at all screen sites.

Additional criteria may be required for unique situations, large facilities or intakes within marine waters.

I. Screen Location and Orientation

A. Fish screens in rivers and streams shall be constructed within the flowing stream at the point of diversion and parallel to the stream flow. The screen face shall be continuous with the adjacent bankline. A smooth transition between the screen and bankline shall be provided to prevent eddies in front, upstream and downstream of the screen.

Where it can be thoroughly demonstrated that flow characteristics or site conditions make construction or operation of fish screens at the diversion entrance impractical, the screens may be installed in the canal downstream of the diversion.

B. Diversion intakes in lakes and reservoirs shall be located offshore in deep water to minimize the exposure of juvenile fish to the screen. Salmon and trout fry generally inhabit shallow water areas near shore.

C. Screens constructed in canals and ditches shall be located as close as practical to the diversion. They shall be oriented so the angle between the face of the screen and the approaching flow is no more than 45°. All screens constructed downstream of the diversion shall be provided with an efficient bypass system.

II. Approach Velocity

The approach velocity is defined as the component of the local water velocity vector perpendicular to the face of the screen. Juvenile fish must be able to swim at a speed equal or greater than the approach velocity for an extended length of time to avoid impingement on the screen. The following approach velocity criteria are maximum velocities that shall not be exceeded anywhere on the face of the screen. A maximum approach velocity of 0.4 feet per second is allowed.

The approach velocity is calculated based on the gross screen area not the net open area of the screen mesh.

The intake structure and/or fish screen shall be designed to assure that the diverted flow is uniformly distributed through the screen so the maximum approach velocity is not exceeded.

III. Minimum Screen Area

The minimum required screen area is determined by dividing the maximum diverted flow by the maximum allowable approach velocity. To find the screen area in square feet, divide the diverted flow in cubic feet per second (450 gpm = 1.0 cubic foot per second) by the approach velocity 0.4 feet per second):

$$Minimum\,Screen\,Area = \frac{Diverted\,Flow\,(cubic\,feet/second)}{Approach\,Velocity\,(feet\,per\,second)}$$

The minimum required screen area must be submerged during lowest stream flows and may not include any area that is blocked by screen guides or structural members.

Diversions less than or equal to 180 gallons/minute (0.4 cfs) require a minimum submerged screen area of 1.0 square foot, which is the smallest practical screening device.

IV. Sweeping Velocity

The sweeping velocity is defined as the component of the water velocity vector parallel to and immediately upstream of the screen surface. The sweeping velocity shall equal or exceed the maximum allowable approach velocity. The sweeping velocity requirement is satisfied by a combination of proper orientation (angle of screen 45° to the approaching flow) of the screen relative to the approaching flow and adequate bypass flow.

Screen bay piers or walls adjacent to the screen face shall be flush with screen surfaces so the sweeping velocity is not impeded.

V. Screen Mesh Size, Shape, and Type of Material

Screen openings may be round, square, rectangular, or any combination thereof, provided structural integrity and cleaning operations are not impaired.

Screen mesh criteria is based on the assumption that steelhead and/or resident trout fry are ubiquitous in the state of Washington and will be present at all diversion sites.

Following are the maximum screen openings allowable for emergent salmonid fry. The maximum opening applies to the entire screen structure including the screen mesh, guides, and seals. The profile bar criteria is applied to the narrow dimension of rectangular slots or mesh.

Woven Wire Mesh	Profile Bar	Perforated Plate
0.087 inch (6-14 mesh)	1.75 mm (0.069 inch)	0.094 inch (3/32 inch)

The allowable woven wire mesh openings is the greatest open space distance between mesh wires. An example allowable mesh specifications is provided; there are other standard allowable openings available. The mesh specification gives the number of mesh openings per lineal inch followed by the gauge of the wires. For example, 6-14 mesh has six mesh openings per inch of screen. It is constructed with 6, 14-gauge (0.080 inch diameter) wires per inch.

The profile bar openings are the maximum allowable space between bars. The allowable perforated plate openings are the diameter of circular perforations. Perforated slots are treated as profile bars.

Screens may be constructed of any durable material; woven, welded, or perforated. The screen material must be resistant to corrosion and ultraviolet damage.

For longevity and durability, minimum wire diameter for woven mesh shall be 0.060 inch (18 gauge) on fixed panel screens, where they are not subjected to impact of debris. Minimum wire diameter for woven mesh shall be 0.080 inch (14 gauge) for rotary drum screens, traveling belt screens, and in areas where there is a potential for damage from floating debris or cleaning operations.

VI. Bypass

All screens constructed downstream of the diversion shall be provided with an efficient bypass system to rapidly collect juvenile fish and safely transport them back to the river. The downstream end of the screen shall terminate at the entrance to the bypass system. It is the water diversion owner's responsibility to obtain necessary water rights to operate the fish bypass; failure to do so may be considered failure to meet state screening law requirements.

VII. Cleaning

Fish screens shall be cleaned as frequently as necessary to prevent obstruction of flow and violation of the approach velocity criterion. Automatic cleaning devices will be required on large screen facilities.

Additional detailed information is available explaining the background and justification of these criteria and showing standard details of flow distributors, acceptable bypass designs, and screen areas required for various flows.

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APPENDIX V

Inventory Features Attributes & Values

Inventory Feature Attributes & Values

Site Description

Field Name	Description
SITE ID	Unique identifier for site, used to link to child tables. Format is variable. Required entry.
FEATURE	Name of item being evaluated (culvert, fishway, etc.)
EAST	State plane co-ordinate, generated by GPS, used for mapping and GIS.
NORTH	State plane co-ordinate, generated by GPS, used for mapping and GIS.
GPSTIME	Date and time of culvert evaluation, in UTM, generated by GPS, also used to track data logger files.
OWNER	Owner of culvert, if known, capitalize first letter of proper names, abbreviate county as Co(no period), use acronyms for state agencies (e.g. WSDOT).
ADDRESS	Street or PO Box.
CITY	
STATE	State - abbreviated.
ZIPCODE	
CONTACT	Name and phone number of responsible individual.
ROAD NUMBER	Number designator assigned to road by county, if available, source is typically CRIS database (county road inventory system).
ROAD NAME	Road name.
MILE POST	Distance in miles from the beginning of the road to the culvert location.
COUNTY	County in which feature is located.
REGION	WDFW Region in which the feature is located.
DISTRICT	Watershed Management District in which feature is located.
STREAM	Name of the stream surveyed, 25 character maximum, Capitalize first letter of names, signify river with R and creek with Cr, forks abbreviated to upper case initials MF, NF, etc, no period. If stream has no name use unnamed.
TRIB_TO	Name of the stream to which the surveyed stream is connected, 25 character maximum, Capitalize first letter of names, signify river with R and creek with Cr, forks abbreviated to upper case initials MF, NF, etc, no periods. WRIA number may be included after name.
WRIA	WRIA and stream number for the stream on which the barrier is located, 10 character maximum consisting of 6 digits, 1 decimal point, and up to 3 upper case letters (00.0000ABC). If the stream number is not known enter the WRIA number only (first 2 digits).

Field Name	Description
RM	River mile where feature is located.
HUC	Hydrologic Unit Code
WAU	Watershed Assessment Unit
QSEC	Quarter section.
SECTION	Section number: 01 - 36
TOWNSHIP	Township number
RANGE	Range number
LOCATION	Description of feature location relative to local landmarks, driving directions etc.
FISH USE	Subjective evaluation of fish use. Answer determines level of feature evaluation.
FU CRITERIA	Criteria used for fish use decision.
SPECIES	Species utilizing stream or expected to use stream if no barriers were present. Limited to those species use in the Priority Index Model: so = sockeye, ch = chum, pk = pink, co = coho , ck = chinook, sh = steelhead, ct = cutthroat, rb = rainbow, db = dolly/bull trout, eb = brook trout, bt = brown trout.

Dam

Field Name (Attribute)	Value/Unit	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
Fr Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
DamName	see description	Recorded legal name, or local name.
ResvName	see description	Recorded legal name, or local name.
Fishway	yes, no	Presence of fishway incorporated with dam.
FishPass	0,33,66,100,	Percentage of passability in regards to anadromous and/or resident fish.
Span	full,partial	Does the structure span completely or only partially across the stream.

Field Name (Attribute)	Value/Unit	Description
Type	va,cb,cn,re,pg,ms,mt, mv,er,st,tb,ot	Type of dam: va = arch, cb = buttress, cn = concrete, re = earthfill, pg = gravity, ms = masonry, mt = metal, mv = multi-arch, er= rockfill, st = stone, tb = timber, and ot = other.
PrimePurp	d,c,h,i,n,p,q,r, s,t,o	Primary purpose of dam: d = debris control, c = flood control, h = hydroelectric, i = irrigation, n = navigation, p = stock or farm pond, q = water quality, r = recreation, s = water supply, t = tailings, o = other.
Length	feet (0.1)	The distance, the dam spans across the stream.
Height	feet (0.1)	The height from the front base of the dam, to the crest.
Impoundmnt	acre/ft (10.0)	The volume of water impounded by the dam.
Recheck	no,gps,photo,pass hf,pass lf	Reasons to revisit site: no = no need, gps = need gps position, photo = need photo, pass hf = evaluate passability at high flow, pass lf = evaluate passability at low flow.
Problem	comment	Description of problems associated dam.
DComments	comment	Additional comment space

Culvert

Field Name (Attribute)	Value/Unit	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
FR Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
FishPass	0, 33, 66, 100, unknown	The percentage of all species that use the stream system in question that for which passability is achievable.
Recheck	no,gps,photo, pass hf,pass lf	Reasons to revisit site: no = no need, gps = need gps position, photo = need photo, pass hf = evaluate passability at high flow, pass lf = evaluate passability at low flow.
Shape	rnd,pip,box, arch,ell,oth	rnd = round, pip = squash, box = box, arch = bottomless arch, ell = ellipse, oth = other.
Material	pcc,cst,cal, sps,spa,cpc, pvc,tmb,mry, oth	pcc = precast concrete, cst = corrugated steel, cal = corrugated aluminum, sps = structural plate steel, spa = structural plate aluminum, cpc = cast in place concrete, pvc = plastic, tmb = timber, mry = masonry, oth = other.
Coating	non,gal,bit, epx,fbg,con,pol, oth	non = none, gal = galvanized, bit = bituminous (asphalt), epx = epoxy, fbg = fiberglass, con = concrete (on pcc or cpc use non), pol = polymeric, oth = other.

Field Name (Attribute)	Value/Unit	Description
Span/Diar	feet (0.1)	Inside horizontal dimension of pipe.
Rise	feet (0.1)	Height, inside dimension of arch, box, and squash pipes..
Length	feet (1.0)	Length of pipe.
Slope	(%)	Incline of pipe measured with stadia rod and level or clinometer.
CulH2ODepth	feet (0.1)	Depth of water inside pipe, used to evaluate sheetflow.
OutfallDrop	feet (0.1)	At the downstream end of the pipe, the distance from the water surface within the pipe, to water surface of the plunge pool.
PPLength	feet (0.1)	Linear distance of the plunge pool, used to evaluate velocity problems.
PPWetWidth	feet (0.1)	The wetted width of the plunge pool, used to evaluate velocity problem.
PPOHWWidth	feet (0.1)	The width measured at the ordinary high water mark, used to evaluate velocity problems.
PPMaxDepth	feet (0.1)	The depth measured at the deepest part of the plunge pool, used to evaluate velocity problems.
PPTailDepth	feet (0.1)	The depth measured at the middle of the tailout, used to evaluate velocity problems.
PPDomSub	sand,gravel, rubble, boulder, rip rap, boulder	Type of dominate substrate, used to evaluate velocity problems.
ChannelWidth	feet (0.1)	A measurement taken at ordinary high water, used to evaluate pipe sizing problems.
Skew	degrees r or l	Description of angle stream enters pipe from the r = right or l = left. (e.g. 45l).
FillDepth	feet (1.0)	The depth of fill measured from the pipe to road surface, used to estimate replacement cost.
Headwall	none,upstream, downstream, both ends	Presence and location of pipe headwalls.
Wingwall	none,upstream, downstream, both ends	Presence and location of pipe wingwalls.
Apron	none,upstream, downstream, both ends	Presence and location of pipe aprons.
Tidegate	yes,no	Presence of tidegate.

Fishway

Field Name (Attribute)	Value/Unit	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
FR Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
FW Type	bc,bf,cc,sp,gc,lc, rc,scc,th,wp,vs,pcbl	bc = baffled culvert, bf = baffled flume, cc = concrete control, sp = steep pass, gc = gabion control, lc = log control, rc = rock control, scc = sacrete control, th = trap and haul, wp = weir pool, vs = vertical slot, pc = pool chute, bl = blasted falls.
FWmaterial	concrete, rock, wood, metal , other	The primary material composing the fishway.
Number of pools	number	The number of pools or steps within the fishway structure.
EntDepth	feet (0.1)	The depth measured outside of the fishway structure at the downstream end.
HeadDiff	feet (0.1)	The hydraulic drop measured at each weir or baffle from water surface to water surface.
Number of Baffles	number	The number of baffles within a baffled culvert or flume.
Baffle Type	concrete, metal, plastic, wood, rock, other	The type of material of which the baffles are composed.
Number of Weirs	number	The number of weirs used within the fishway.
Weir Type	concrete, metal, plastic, wood, other	The type of material of which the weirs are composed.
Bed Control	none, upstream, downstream, both	Presence and location of streambed controls.
Control Type	concrete, rock, plank, log, plastic, metal, other	The type of material of which the streambed control is composed.
Aux Water	yes, no, unknown	The presence of an auxiliary water supply used within the fishway structure.
Trash Rack	yes, no, unknown	The presence of a trash rack associated with the fishway structure.
FishPass	mn,mnc,mnr	mn = maintenance is needed to ensure fish passage, mnc = fishway is in chronic need of maintenance (e.g. fishway is prone to debris build up and requires continual monitoring and maintenance to ensure fish passage, mnr = fishways receiving this designation require reconstruction and are not passable to fish in their present condition.
Recheck	no,gps,photo,pass hf,pass lf	Reasons to revisit site: no = no need, gps = need gps position, photo = need photo, pass hf = evaluate passability at high flow, pass lf = evaluate passability at low flow.

Gravity Diversion Protocol

Field Name (Attribute)	Value/Unit	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
FR Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
Access	foot, orv, vehicle	Type of transportation capable of accessing site.
POD	lb, rb	Point of diversion: lb = left bank, rb = right bank, referenced looking downstream.
DvsnDam	yes ,no	Presence of instream diversion structure.
HgTrashRk	yes, no	Presence of headgate trash rack.
Headgate	yes, no	Presence of headgate.
DitchWidth	feet (0.1)	Wetted width of diversion ditch or canal.
DitchDepth	feet (0.1)	Depth of diversion ditch or canal.
Flow	cfs (0.1)	Flow in cubic feet per second of diversion. If obtained in other units, convert prior to entry.
Derivation	measured, water right, other	How flow was derived: measured = gauge/flow meter is present, water right = legal documentation.
DistoPower	feet (range)	Distance from screen/diversion to electrical power in a range of distances (0-500, 500-2500, >2500ft)
Meter No	meter I.D. #	Identification number of power meter if present.
Screened	yes, no, unknown	Reports whether the diversion is screened for fish protection.
ScnTrashRk	yes, no	Presence of trash rack at screen.
ScreenType	rd,tr,f2,f1,ot,xx	Type of screening device: rd = rotary drum, tr = traveling screen, f2 = two track flat, f1 = one track flat, ot = other, xx = none.
ScreenMat	wm,pm,pp,pb, em,oth	Material screen is constructed of: wm = wire mesh, pm = plastic mesh, pp = perf plate, pb = profile bar, em = expanded metal, oth = other.
Diameter	feet (0.1)	Diameter of drum screens.
Height	feet (0.1)	Height of traveling, or flat screens.
Length	feet (0.1)	Length of screen (all types).
Area	sq.feet (0.1)	Area of screen, calculated using above dimensions.

Field Name (Attribute)	Value/Unit	Description
OpenDmnsn	inches (0.00)	Dimension of the screen material opening. Single entry indicates diameter, rectangular openings entered as 0.00 x 0.00.
ScrnThick	inches (0.00)	Thickness dimension screen plate or wire .
Skew	degrees r or l	Angle of screen relative to flow, referenced looking downstream, r = right, l = left.
Cleaning	manual, spray, brush	Screen cleaning mechanism.
ScFunction	ok, mn, mnc, mnr, unknown	Descriptor of screen function and/or maintenance requirements: ok = functioning properly, mn = minor maintenance needed, mnc = chronic maintenance needs, mnr = major rebuild needed, unknown = functional status unknown.
Bypass	yes, no	Presence of fish bypass.
DistoScrn	feet (0.1)	Distance from screen to bypass entrance.
BpFeasible	n/a, no, yes, unknown	Feasibility of bypass if one is not present, also to be completed if diversion is not screened (n/a = not applicable, bypass is present).
DistoStrm	feet (0.1)	Distance from potential bypass location to stream.
ElevDrop	feet (0.1)	Elevation drop from potential bypass location to stream.
Recheck	no, gps, photo, flow, function	Reasons to revisit site: no = no need, gps = need gps position, photo = need photo, flow = need to measure flow, function = need to evaluate screen function.
Problems	comment	Description of problems associated with screen, bypass, etc.
SealCond	comment	Comments specific to the condition of the screen seals.
GDComments	comment	Additional comment space.
WaterRight	water right I.D. #	Water right number associated with diversion.

Pump Diversion

Field Name (Attribute)	Value/Unit	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
FR Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
Access	foot, orv vehicle	Type of transportation capable of accessing site.
POD	lb, rb	Point of diversion: lb = left bank, rb = right bank, referenced looking downstream.

Field Name (Attribute)	Value/Unit	Description
Location	rb,os,ln,cv	Location of pump intake: rb = river bank, os = off shore, ln = lagoon, cv = cove. A lagoon is separated from river by pipe or channel. A cove is open to the river.
DvsnDam	yes, no	Presence of instream diversion structure (If yes complete dam protocol).
Screened	yes, no, unknown	Reports whether the diversion is screened for fish protection.
ScreenType	bx,br,cy,cn,st, ot, xx	Type of screening device: bx = box, br = barrel, cy = cylinder, cn = cone, st = strainer, ot = other, xx = none.
NoScnOpen	# of openings, (screen area)	Provide number of structure openings on vaulted structure or number of individual screens on barrel, box and other types.
ScreenMat	wm,pm,pp,pb,em, ot	Material screen is constructed of: wm = wire mesh, pm = plastic mesh, pp = perf plate, pb = profile bar, em = expanded metal, ot = other.
Diameter	feet (0.1)	Diameter of barrel, cylinder or cone screen.
Height/Length	feet (0.1)	Height of barrel, box or cone screen / Length of box or cylinder screen
Area	feet (0.1)	Area of screen, calculated using above dimensions.
OpenDmnsn	inches (0.00)	Dimension of the screen material opening. Single entry indicates diameter, rectangular openings entered as 0.00 x 0.00.
ScnThick	inches (0.00)	Thickness dimension of screen plate or wire.
ScFunction	ok, mn, mnc, unknown	Descriptor of screen function and/or maintenance requirements: ok = functioning properly, mn = minor maintenance needed, mnc = chronic maintenance needs, mnr = major rebuild needed, unknown = functional status unknown.
PipeIDia	inches (0.1)	If possible, measured inside diameter of intake pipe.
PipeODia	inches (0.1)	If possible, measured outside diameter of pipe.
NoOfPumps	# of pumps	The total number of pipes used at site.
PumpType	centrifugal, turbine	Type of pump design.
TotalHP	number	Accumulative horsepower rating for all pumps at site.
Meter No	meter I.D. #	Meter identification number.
Capacity	gpm/cfs (0.1)	Volume of water, measured or calculated in gpm or cfs.
Units	gpm, cfs	Type of units used: gallons per minute or cubic feet per second.
Derivation	calculated, measured, water right	How flow was derived. calculated = pump rating, measured = gauge present, verbal = verbal agreement between WDFW and owner, water right = legal documentation.

Field Name (Attribute)	Value/Unit	Description
Bypass	yes ,no	Presence of fish bypass.
BpFeasible	n/a, no, yes, unknown	Feasibility of bypass if one is not present, also to be completed if diversion is not screened (n/a = not applicable, bypass is present).
DistoStrm	feet (0.1)	Distance from potential bypass location to stream.
ElevDrop	feet (0.1)	Elevation drop from potential bypass location to stream.
Recheck	no,gps,photo, flow, function	Reasons to recheck/revisit site. No = no need, gps = need gps position, photo = need photos, flow = need to measure flow, function = need to evaluate screen function.
Problem	comment	Description of problems associated with screen, bypass, etc.
SealCond	comment	Comments specific to the condition of the screen seals.
PGComments	comment	Additional comment space.
WaterRight	water right ID.	Water right number associated with diversion.

Lake Screen

Field Name (Attribute)	Value/Units	Description
Site ID	varies/unique	Unique identifier for site, used to link to parent/child tables.
FR Crew	name	Last name(s) of the field review team responsible for data, individuals separated by / (e.g. Gower/Cox).
FR Date	mm/dd/yy	Field review date.
FR Time	hh:mm:ss	Field review time - 24 hour format.
Access	foot, orv, vehicle, hv, equip	Type of transportation capable of accessing site.
Abandoned	yes, no, unknown	In regards to the screen itself, has the screening device been removed.
Structure	see description	Type of structure: stop dam, stop apron, permeable dam, earthen dam, wood w/screen, concrete w/screen, other.
StrLength	feet (0.1)	The linear distance of the structure.
Str Width	feet (0.1)	The distance the structure spans across the lake outlet
StrHeight	feet (0.1)	The head differential between the structure crest and plunge pool surface.
ScnTrashRk	yes, no	Presence of a trash rack in front of screen.
ScreenType	rd,tr,f2,f1ot,xx	Type of screening device: rd = rotary drum, tr = traveling screen, f2 = two track flat, f1 = one track flat, ot = other, xx = none.
ScreenMat	wm,pm,pp,pb, em,ot	Material screen is constructed of: wm = wire mesh, pm = plastic mesh, pp = perf plate, pb = profile bar, em = expanded metal, ot = other.
ScDiameter	feet (0.1)	Diameter of drum screens.
ScHeight	feet (0.1)	Height of traveling, or flat screens.
ScLength	feet (0.1)	Length of screen (all types).
ScArea	sq.feet (0.1)	Area of screen, calculated using above dimensions.
OpenDmnsn	inches (0.00)	Dimension of the screen material opening. Single entry indicates diameter, rectangular openings entered as 0.00 x 0.00.
ScrnThick	inches (0.00)	Thickness dimension of screen plate or wire.
Skew	degrees r or l	Angle of screen relative to flow, referenced looking downstream, r = right, l = left.
Cleaning	manual, spray, brush	Screen cleaning mechanism.
Condition	ok, mn, mnc, mnr, unknown	Descriptor of screen function and/or maintenance requirements: ok = functioning properly, mn = minor maintenance needed, mnc = chronic maintenance needs, mnr = major rebuild needed, unknown = functional status unknown.

Field Name (Attribute)	Value/Units	Description
FishPass	0, 33, 66, 100, unknown,	The percentage of all species that use the stream system in question that for which passability is achievable.
Recheck	no,gps,photo, pass hf,pass lf	Reasons to revisit site: no = no need, gps = need gps position, photo = need photo, pass hf = evaluate passability at high flow, pass lf = evaluate passability at low flow.
OrigPurp	impound, prevent	Original purpose of structure; impound = keep fish in lake, prevent = keep fish from entering lake.
CurrPurp	impound, prevent, lake level	Current purpose of structure; impound = keep fish in lake, prevent = keep fish from entering lake, lake level = control lake level.
Adjudicatd	yes, no, unknown	Is there legal documentation establishing water rights?
WaterMastr	yes, no, unknown	Is there a Water Master?
WMName	see discription	Water master name.
WMAddress	see discription	Water master address.
WMCity	see discription	Water master City.
WMState	see discription	Water master State.
WMZip	see discription	Water master zipcode
WMPhone	see discription	Water master phone.
Problems	Comment	Description of problems with structure or screen. 200 characters.
LSComments	Comment	General comments on lake screens.
OperMaint	see discription	Description of who performs operations and maintenance. 100 characters.
LandUseNo	see discription	Land use agreement number for non-agency owned lands.
DateAbandn	mm/dd/yy	Date structure was abandoned.

APPENDIX VI

Inventory of Features at Region 6 Access Areas

Introduction

In cooperation with the Access Area Managers and as part of the Wildlife Area Fish Retrofit project, SSHEAR evaluated fish passage and water diversion conditions on all Washington Department of Fish and Wildlife (WDFW) Access Areas in Region 6. The methodology used for the Region 6 Access Area inventory was identical to that used for the Olympic Wildlife Area Fish Retrofit. Both are an attempt to bring all features on WDFW lands into compliance with RCW's 75.20.40, 75.20.060, 75.20.100, 77.12.425, 77.16.210 and 77.16.220.

Results / Discussion

A total of 11 features were evaluated at 11 individual sites. There are nine culverts, one lake outlet screen and one dam. Nine features are considered to be on fish bearing streams or lakes. Eight were identified as barriers. Habitat assessment revealed four barrier features with significant habitat gain. They are located at Bogachiel Rearing Ponds, Failor Lake and Haven Lake, which has already been repaired. Table 1 lists numbers of fish passage features (culverts, dams, fishways, lake outlet screens) and fish screening features (water diversions) evaluated at WDFW Region 6 Access Areas. Fishways and lake outlet screens are assumed to be in fish bearing waters. Table 2 lists the location, type and repair status of features in fish bearing waters at WDFW Region 6 Access Areas. Repair status indicates whether the site has no significant habitat gain (NG), the site requires repair (RR) or if the site does not require repair (OK). Table 3 lists the fish passage barriers requiring repair at Region 6 Access Areas. Barriers are sorted by unit, listing tributary to, barrier type, potential spawning and rearing habitat gain, estimated passability, number of additional human-made barriers within the drainage (including non-WDFW ownership), priority index, total PI, species benefitting from repair, recommended correction and cost.

Bogachiel Rearing Pond and Access Area

The Bogachiel Rearing Pond is located near Forks, Washington. Site 980294 (Photos 15 & 16) is immediately downstream from the rearing pond. If the agency decides to revert the stream back to it's original function, a total of 667 square meters of spawning habitat and 23,653 square meters of rearing habitat would be gained for coho, steelhead and resident salmonids. The best option for this site would be replacement with a properly sized squash pipe or bottomless pipe arch at an estimated cost of $150,000. Several other barriers are located on the same stream, including the rearing pond outlet screen of the hatchery. To realize maximum habitat gain, the screen would need to be passable for upstream migration and additional barriers upstream of the pond would need to be repaired.

Failor Lake

Failor Lake is approximately 9.9 miles north of Hoquim, Washington. Failor Lake (WRIA 22.0021), flows into the Humptulips River. On the property, seven culverts were inventoried. Sites 980331 and 980332 were considered to be nonfish bearing and sites 980333, 980334, 980335, 980337 and 980338 were fish bearing. At the outlet of the lake, a dam was constructed for water supply for the city of Hoquim and to maintain water levels (Site 980317) (Photo 17 & 18). There is a large natural waterfall downstream of the dam, making any upstream habitat inaccessible to anadromous fish

species. Though cost and lack of anadromous access account for the low PI, it should eventually be retrofitted with a fishway for resident fish migration patterns. If the dam were retrofitted, the expense is estimated at over $500,000, but it would allow access to 12,789 square meters of spawning habitat and 33,469 square meters of rearing habitat. Site 980335 was the only culvert on the Failor Lake access area with significant habitat upstream (Photo 19). During the time of inventory, the crossing was not a barrier, but due to the huge plunge pool (app. 13 x 20 m) is was obvious that it was a partial barrier during high flow periods. It is upstream of the dam and should be corrected simultaneously with the dam. A larger culvert is recommended. The cost is estimated at $100,000.

Haven Lake

West of Belfair, Washington on the Haven Lake access area, one culvert (Site 980315) crosses the parking area and empties immediately above the lake outlet screen (Site 980316) (Photo 20 & 21). The stream does not have a significant reach upstream of the culvert and thus does not require repair. The lake outlet screen was a total barrier at the time of inventory. It has been repaired and now provides passage for chinook, coho, steelhead and resident species to the additional 536 square meters of spawning habitat and 558,230 square meters of potential rearing habitat.

Table 1. Number of features (culverts, dams, fishways, lake outlet screens and water diversions) evaluated at WDFW Region 6 Access Areas.

Wildlife Area Unit	Culverts			Dams			Fishways		Lk Outlet Screens		Water Diversions		
	Total	Fish Bearing	Barriers	Total	Fish Bearing	Barriers	Total	Barriers	Total	Barriers	Total	Fish Bearing	Unscreened
Bogachiel	1	1	1	0	0	0	0	0	0	0	0	0	0
Failor Lake	7	5	5	1	1	1	0	0	0	0	0	0	0
Haven Lake	1	1	1	0	0	0	0	0	1	1	0	0	0
Totals	**9**	**7**	**7**	**1**	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**0**

Table 2. The location, type and repair status of features in fish bearing waters at WDFW Region 6 Access Areas. Repair status indicates whether the site has no significant habitat gain (NG), the site requires repair (RR), the site does not require repair (OK) or fixed (FX).

Site ID	Access Area	Stream Name	Tributary to	Feature Type	Repair Status
980294	Bogachiel Ponds	Unnamed	Bogachiel R	culvert	RR
980317	Failor Lk	Deep Cr	Humptulips R	dam/screen	RR
980333	Failor Lk	Unnamed	Failor Lk	culvert	NG
980334	Failor Lk	Unnamed	Failor lk	culvert	NG
980335	Failor Lk	Deep Cr	Humptulips R	culvert	RR
980337	Failor Lk	Unnamed	Failor Lk	culvert	NG
980338	Failor Lk	Unnamed	Failor Lk	culvert	NG
980315	Haven Lk	Unnamed	Haven Lk	culvert	NG
980316	Haven Lk	Unnamed	Tahuya R	lake outlet screen	FX

Table 3. Fish passage barriers requiring repair at Region 6 Access Areas. Barriers are sorted by unit, listing tributary to, barrier type, potential spawning and rearing habitat gain, estimated passability, number of additional human-made barriers within the drainage (including non-WDFW ownership), priority index, total PI, species benefitting from repair, recommended correction and cost. Species benefitting from repair are indicated by a PI value.

Site ID	Stream/Tributary to	Barrier Type	% Passable	Habitat Gain (m^2)		Additional Barriers		Priority Index								Recommended Correction	Estimated Cost
				Spawning	Rearing	Upstream	Downstream	Total	CK	CO	CH	SH	CT	DB	RB		
Bogachiel																	
980294	Unnamed/Bogachiel R	culvert	536	558,230	67	3	0	16.66		6.12		2.77	4.85		2.91	Replace	$150,000
Failor Lake																	
980317	Failor Lk/Humptulips R	dam	12,789	33,469	0	6	0	11.58					5.87	2.18	3.52	Fishway	$500,000
980335	Deep Cr/Failor Lk	culvert	9,978	63,331	67	5	1	12.24					6.21	2.3	3.73	Replace	$100,000
																TOTAL	**$750,000**

Appendix VII

Photographs of Fish Passage Barriers
On Olympic Wildlife Area and Region 6 Access Areas

Olympic Wildlife Area / Elk River Unit / Site 980235

Photo 1. Breaching the dike at the Elk River Unit created excellent estuary habitat, but the solid plate steel tide gates create a near total fish passage barrier to additional rearing habitat.

Olympic Wildlife Area / Hoxit Unit / Site 980299

Photo 2. Unnamed tributary to the Chehalis River. This stand pipe was installed to increase water fowl habitat, creating a total barrier to potential rearing and spawning habitat further upstream on the system.

Photo 3. Judging by the size of the corrugated steel pipe and the streambed toe width downstream, if the stand pipe configuration were made to be passable and maintain water levels (i.e. fishway) this crossing would be sufficient.

Olympic Wildlife Area / John's River Unit / Site 980259

Photos 4 & 5 . Beaver Creek (WRIA 22.1271), tributary to John's River. The top photo illustrates the intense erosion that is occurring at the upstream end due to the large tidal fluctuations. The bottom photo illustrates the large outfall drop at any tide level other than high tide and therefore a large plunge pool was created.

Olympic Wildlife Area / John's River Unit / Site 980260

Photo 6. The upstream end of double stand pipes installed to maintain increased water levels. The large wetland area upstream of this site was created by building a large dike to improve water fowl habitat. This created a total barrier to additional rearing habitat vital for salmonid survival.

Photo 7. View looking down inside one of the Upstream end stand pipes.

Photo 8 . The tide gates on the downstream end add to the fish passage barrier.

Olympic Wildlife Area / John's River Unit / Site 980262

Photo 9. Unnamed tributary to John's River. The upstream stand pipe structure is failing due to intense tidal fluctuations. The dike is slowly being eroded away. Currently, this crossing is scheduled to be removed and another tidal control structure is to be installed that is passable to fish, at a different location on the dike.

Photo 10. The downstream end currently has large tide gates to keep out salt water for crop cultivation and increasing waterfowl habitat. The existing tide gates are currently failing, and therefore another reason for replacement.

Olympic Wildlife Area / Olympic Unit / Site 980233

Photo 11. Due to the culvert being undersized and the slope greater than 1%, velocities render this crossing a partial barrier.

Olympic Wildlife Area / Smith Creek / Site 980284

Photo 12 . Unnamed tributary to Smith Creek. A perfect example of culverts that are abandoned on salmonid bearing streams. The upstream end has become completely inundated with debris, causing the stream to flow over the road and then erode back down through the road bed creating a total barrier to fish passage.

Olympic Wildlife Area / Wynoochee Unit / Site 980240

Photo 13. Unnamed tributary to the Wynoochee River. This round corrugated steel culvert is a good example of a undersized pipe causing an outfall drop and deep plunge pool to develop.

Olympic Wildlife Area / Wynoochee Unit / Site 980244

Photo 14. Another unnamed tributary to the Wynoochee River. Primarily slope alone made this polyethylene pipe a partial barrier to fish passage.

Region 6 Access Areas / Bogachiel Rearing Pond Access / Site 980294

Photo 15. The trash racks at the upstream end of the culverts pose no immediate threat to fish passage. Although twin culverts are used at the crossing, they were considered to be undersized and therefore creating a high velocity problem at periods of increased flow. These culverts are located on the same stream as the Bogachiel rearing pond. The outlet of the pond is screened for hatchery purposes constituting a barrier to upstream migration.

Photo 16. The downstream end of the same crossing illustrating plunge pool size created at high flows.

Region 6 Access Areas / Failor Lake / Site 980317

Photo 17. Failor Lake on Deep Creek (WRIA 22.0021) was built by the City of Hoquiam or water storage. Note the existing fish screen to retain fish in the lake.

Photo 18. Looking upstream at the spillway from the tailrace of the dam. An obvious barrier to fish migration.

Region 6 Access Areas / Failor lake / Site 980335

Photo 19. Deep Creek (WRIA 22.0021) at the inlet to Failor lake. This crossing is the only fish bearing culvert with significant habitat gain upstream located on the WDFW access area property at Failor Lake. Though it looks completely fine for fish passage, the 40 by 60 foot plunge pool downstream is evidence of velocities exceeding the capacity of the culvert, creating a partial barrier.

Region 6 Access Areas / Haven Lake / 980316

Photo 20. Unnamed tributary (WRIA 15.0461) to the Tahuya River. Looking downstream from the forebay at the original trash-rack on the barrier lake screen structure.

Photo 21. The lake screen retains fish in Haven Lake, but at the same time created a total barrier to upstream fish migration. View looking upstream from tailrace of original structure.