PESHASTIN CREEK PROJECT AT RM 8.8

CHANNEL RECONNECTION PROJECT
ALTERNATIVES ANALYSIS

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1. INTRODUCTION

This report presents the assessment of conceptual-level designs for river restoration alternatives associated with the Blewett Rock and Gravel (BRG) project site located between river mile (RM) 8.4 and RM 9.2 on Peshastin Creek, Chelan County, Washington. (Figure 1) These restoration actions are aimed at restoring habitats and river processes to improve impaired conditions related to ESA-listed salmonid habitat.

The Peshastin Creek Tributary and Reach Assessment (TRA) (Interfluve 2010a) identified the RM 8.8 channel reconnection project opportunity between river miles 8.4 and 9.2 within Reach 5b/6. In the TRA the project site is identified as Project RM 8.8 R and is associated with Subreach Units IZ-1, DIZ-1, DOZ-3, and DOZ-1.

In 2009, the CCNRD met with WSDOT to discuss side channel and floodplain reconnection opportunities associated with SR 97. In August 2010 the Yakama Nation completed a prioritization of all of the project sites identified in the TRA (Interfluve 2010b). In this prioritization, projects that provided process-based restoration and addressed limiting biological factors for target salmonid species and life-history stages ranked highest. Within Peshastin Creek, the reconnection of floodplain and lengthening of the mainstem is a Biological Strategy Tier 1 action and top priority for addressing limiting habitat factors and the recovery and long-term viability of salmonids in Peshastin Creek (UCRTT 2014, UCSRB 2007). The top-tier projects as ranked in the Yakama Nation prioritization were all projects that provided side channel reconnection, which included the RM 8.8 project site.

In 2013 the CCNRD received a grant from the Salmon Recovery Fund Board to analysize project alternatives and develop conceptual designs at the RM 8.8 site. This report presents the analysis of project alternatives with appendicies describing geomorphic and hydrologic conditions.

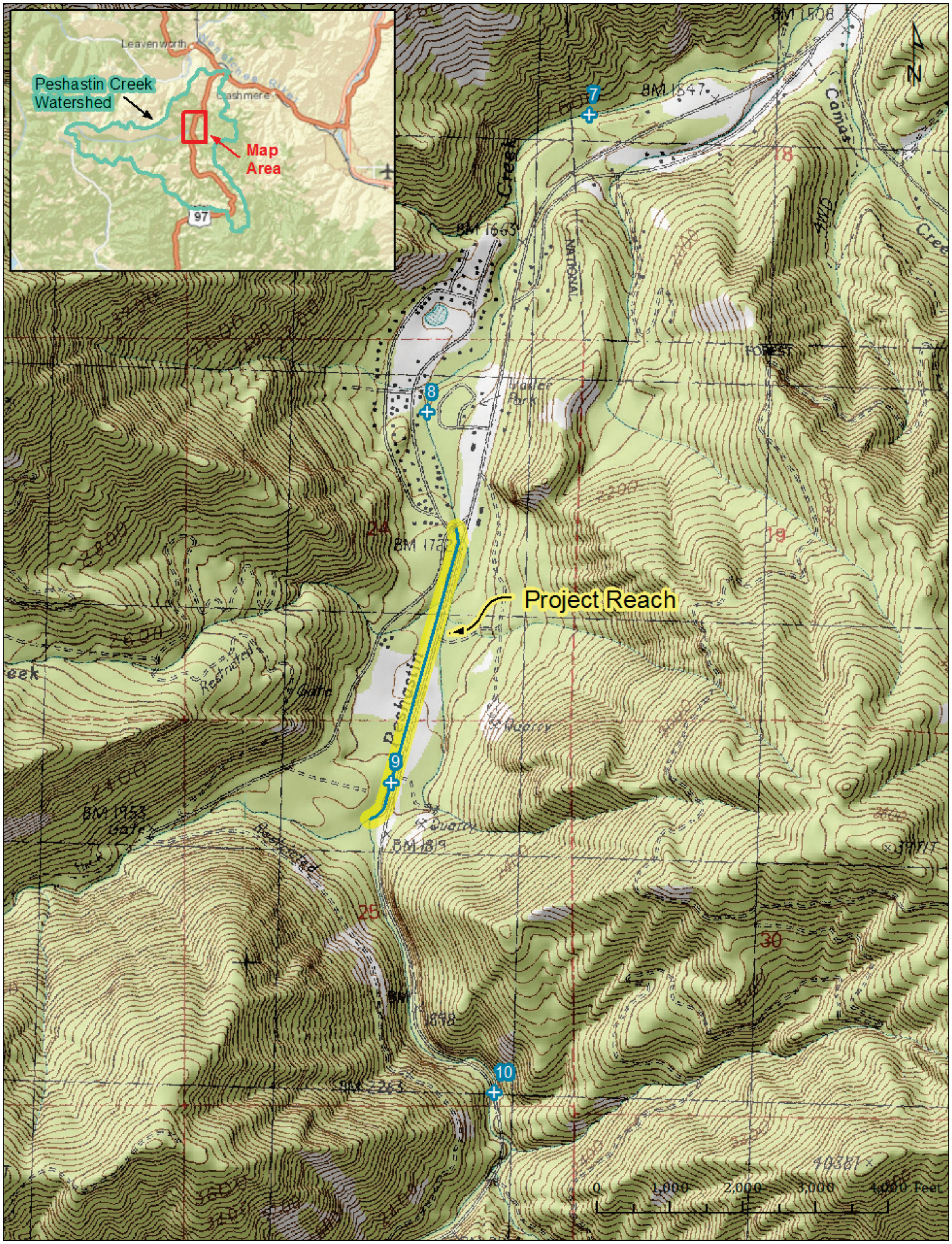

Figure 1. Project Location

2. EXISTING CONDITIONS

2.1 Location

Peshastin Creek is located on the east slope of the Cascade Mountains in Central Washington, within the Wenatchee River Basin (WRIA 45). Peshastin Creek is a tributary to the Wenatchee River and flows into the Wenatchee River at river mile 18.The RM 8.8 project site is located in Township 23 North, Range 17 East, Sections 24 and 13, between river miles 8.4 and 9.2 within Reach 5b/6 as identified in the TRA (Interfluve 2010a). The project extent runs between mileposts 177.1 and 177.8 on State Route (SR) 97 (Figure 1 and Existing Conditions, Appendix A).

2.2 Current Use

The primary land use associated with the RM 8.8 site is the SR 97 highway, the Blewett Rock and Gravel quarry, and the WSDOT sand and gravel yard. The BRG and WSDOT sand and gravel yard has resulted in extensive floodplain re-grading and vegetation clearing. Three private roads now cross the historic channel accessing properties to the east. These roads are identified as access roads 1 through 3 and are numbered sequentially from upstream to downstream.

At this section of SR 97, the highway consists of a north and south travel lane, and a large chain-up area that runs approximately 3,000 linear feet adjacent to the south bound travel lane.

2.3 ESA-Listed Fish

Peshastin Creek contains aquatic habitat for three species listed under the Endangered Species Act. These include (UCRTT 2014):

- Upper Columbia River steelhead (Threatened) (Major Spawning Area)
- Upper Columbia River spring Chinook salmon (Endangered) (Minor Spawning Area)
- Bull trout (Threatened)

The attached memo (Appendix B), and Table 1 below provide a detailed description of fish use in Peshastin Creek. Figure 2 below summarizes fish use within the project area with respect to daily average dischage.

In summary, spring chinook, steelhead/rainbow, and bull trout used the Peshastin Creek watershed in greater numbers than occur there today. Steelhead were likely the more populous anadromous species spawning in this system, however coho may also have been more abundant than spring chinook before coho were extirpated from the region (Andonaegui 2001). The project reach 5b/6 of Peshastin Creek supports spring Chinook, summer steelhead, bull trout and coho. Currently, spring Chinook redds have been observed within the project reach 5b/6 up to the confluence of Ingalls Creeks (RM 9.4), while rearing spring Chinook have been observed from the mouth up to RM 14.8. Steelhead/rainbow trout use Peshastin Creek for spawning, rearing, and as a migration corridor, although thought to do so in low numbers. Steelhead primarily use this reach as a migration corridor to upstream spawning areas. Historically, bull trout occurred in the watershed where habitat existed and access was not blocked by natural barriers. Very low numbers of bull trout have been observed in the Peshastin Creek mainstem. Summer chinook do not use the Peshastin Creek drainage, being mainstem Wenatchee spawners, except for possibly very limited rearing at the mouth.

Table 1. Current, known salmon, steelhead, and bull trout use in Peshastin Creek reach 5b/6.

Species	Rearing	Spawning	Migration
Spring Chinook	X	X	X
Steelhead	X		X
Bull Trout			X

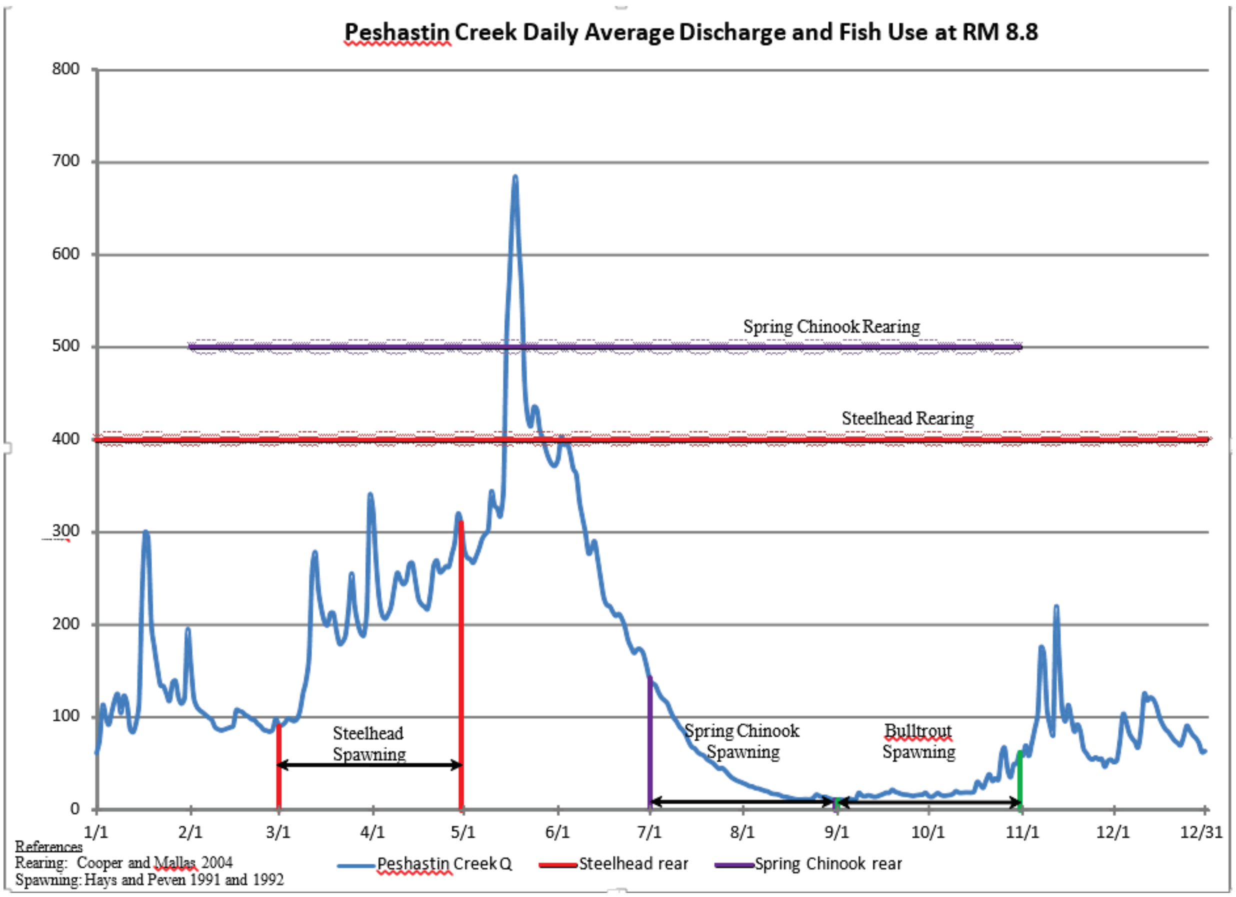

Figure 2. Peshastin Creek Daily Average Discharge and Fish Use at RM 8.8.

2.3.1 Ecological Concerns

The primary factors affecting habitat conditions within Peshastin Creek are related to increased channel confinement and decreased stream sinuosity, impaired riparian condition, reduced flood plain connectivity and gravel recruitment as impacted by the SR 97 road prism (Andonaegui 2001; UCSRB 2007; UCRTT 2014; InterFluve 2010a). Past human activities that have most notably impacted river processes include highway construction, mining and placement of mine tailing piles, logging of riparian forest, continued development, and flood protection (small levees, bridges, riprap, and roads). Water withdrawals for agriculture and naturally low summer flow quantities impede upstream migration, reduce rearing habitat, and likely contribute to elevated water temperatures (UCRTT 2014).

Andonaegui (2001) indicated that the Peshastin Creek channel, from the mouth to Tronsen Creek at RM 14.9, has been reduced in length by 0.8 miles due to the construction of SR 97 in the 1956 (Primary State Highway 2 at the time of construction). The highway construction resulted in the disconnection of 194 acres of the total acres of floodplain (565 acres) along Peshastin Creek (Andonaegui 2001). The reduced length and floodplain capacity has had a negative effect on the creeks morphology by increasing the longitudinal slope which increases bed shear stress and in turn increase the rate of sediment transport beyond the natural condition. The reduction in length has also had a negative impact on salmonid habitat by eliminating desirable channel diversity that is associated with sinuosity and unconstrained channel migration (e.g., variations in depth, accumulation of LWD at bends, overhanging banks, etc.). As a result, instream habitat complexity is low within Peshastin Creek in terms of low pool depth and frequency, low LWD counts, and a significant reduction in off-channel habitat (Andonaegui 2001). Low instream flows also impede upstream salmonid migration, and reduce rearing habitat (UCRTT 2014).

The factors affecting habitat conditons in Peshastin Creek are (UCRTT 2014):

- Channel migration, riparian habitat, floodplain function, stream sinuosity, and gravel recruitment are severely impacted by state highway.
- Low instream flows in lower Peshastin Creek impede upstream migration, reduce rearing habitat, and likely contribute to elevated water temperature.
- Loss of riparian habitat resulting from land development and state highway reduces quantity and quality of spawning and rearing habitat.

The ecological concerns for Peshastin Creek and habitat action recommendations in priority order are (UCRTT 2014):

- Water Quantity (Decreased Water Quantity)
  - Design and implement pumping from Wenatchee River to reduce irrigation water withdrawals from Peshastin Creek.
  - Water right purchase and lease
  - Water banking
  - Improve irrigation efficiencies
- Channel Structure and Form (Instream Structural Complexity)
  - Restore instream habitat diversity by enhancing large wood recruitment, retention, and complexity where feasible.
- Water Quality (Temperature)
  - Actions under riparian condition, side channel and wetland connection should address this ecological concern.
- Peripheral and Transitional Habitat (Side Channel and Wetland Connections)
  - Develop side-channel habitat from the confluence with the Wenatchee River to Ingalls Creek.
- Habitat Quantity (Anthropogenic Barriers)
  - Culvert replacement in Mill Creek (in progress as of 2012), Ruby, Shaser and Scotty creeks.
- Riparian Condition
  - Re-establish native vegetation where appropriate.

2.3.2 Site Geomorphology

The following provides a brief overview of site geomorphology as presented in the Baseline Reach Characteristics Memo (NSD 2015b).

The RM 8.8 project site is located between RM 9.2 and RM 8.4 immediately below the Ingalls Creek and Peshastin Creek confluence, and extends downstream to the Ingalls Road bridge. Immediately above the confluence with Ingalls Creek, Peshatin Creek transitions from being extremely confined in a bedrock dominated canyon, a moderately confined valley filled with unconsolidated glacial deposits and alluvium (Interfluve 2010).

The construction of SR 97 in 1956 changed the creek channel alignment through the project study area. The creek was relocated to remain on the west side of the road which created the existing 3,880 feet straight channel while disconnecting 4,320 feet of the historical Peshastin Creek channel. When the creek was relocated from the former meander to the existing straight channel, the channel length was reduced by 440 feet. The current channel is steep, with a step-pool morphology, and cobble and boulder bed material. The SR 97 prism to the east and the high glacial terrace to the west confine the creek allowing no flooding of the high floodplain and no lateral channel migration.

A portion of the historical channel planform remains to the east of SR 97 and still exhibits the cobble bed material. As seen in the profile comparisons (Geomorphic Assessment Memo, NSD 2015b), the thalweg elevations of the historic and existing channels match closely. However, the construction of access roads and the placement of fill has severely encroached on capacity of the historic channel. Sinuosity of the abandoned channel is 1.13 compared to 1.0 in the main channel.

2.3.3 Hydrology

The following provides a brief overview of hydrology as presented in the Baseline Reach Characteristics Memo (NSD 2015b).

The watershed upstream of the RM 8.8 project site drains an area of 102 square miles. Flow at the upper end of the reach is split between subbasins draining Ingalls Creek and Upper Peshastin Creek (Table 2). The Upper Peshastin subbasin drains an area about 62% greater than Ingalls Creek, however, the Ingalls Creek subbasin is about 48% wetter than Upper Peshastin. As such, the annual flow distribution is probably closer to an even split. Tributary inflow within the project reach includes Hansel Creek and two unnamed tributaries that drain hillslope areas from the east. The Hansel Creek subbasin accounts for about 4% of the total drainage area contributing flow to the project reach. The unnamed tributaries from the eastern hillslope account for less than 1% of the contributing drainage area.

The seasonal flow regime is characterized by a rainfall dominated period during fall, a snowfall dominated period during winter, snowmelt runoff during spring and early summer, and a period of low streamflow as snowmelt recedes in August and September. Peak flows occur with spring/summer snowmelt during most years. Extreme flood events; however, tend to occur in fall or winter in response to atmospheric river storm events that are associated with relatively warm temperatures that raise freezing levels and heavy rainfall that combines with melting snow to produce large amounts of runoff. The three largest floods recorded for the Wenatchee Basin in recent decades (Nov. 1990, Nov. 1995, and Nov. 2006) all were caused by large atmospheric river storms with substantial rain-on-snow contributions.

Table 2. Estimated flood frequency statistics for Peshastin Creek produced (Reclamation, 2008; as cited by Inter-Fluve, 2010).

	ESTIMATED PEAK FLOW (CFS)					
	Q2	Q5	Q10	Q25	Q50	Q100
Peshastin Creek above Camas Creek*	**895**	**1,370**	**1,750**	**2,310**	**2,780**	**3,310**
Peshastin Creek at Watershed Outlet	1,210	1,860	2,370	3,120	3,770	4,490

* used for project reach

3. PROJECT GOALS AND OBJECTIVES

The Lower Peshastin Creek Tributary and Reach Assessment (TRA) (Interfluve 2010) summarizes the short-term and long term objectives for Peshastin Creek. These objectives are based on the Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan (UCSRB 2007) and are consistent with the Biological Strategy (UCRTT 2014), and the Priority Reaches Actions Plan (UCRTT 2009). In addition, the restoration of Peshastin Creek habitat is identified as one of the top priorities in the Upper Columbia Biological Strategy (UCRTT 2014).

Short-Term Objectives

- Protect existing areas where high ecological integrity and natural ecosystem processes persist.
- Restore connectivity (access) throughout the historic range where feasible and practical for each listed species.
- Protect and restore water quality where feasible and practical within natural constraints.
- Increase habitat diversity in the short term by adding instream structures (e.g., LWD, rocks, etc.) where appropriate.
- Protect and restore riparian habitat along spawning and rearing streams and identify longterm opportunities for riparian habitat enhancement.
- Protect and restore floodplain function and reconnection, off-channel habitat, and channel migration processes where appropriate and identify long-term opportunities for enhancing these conditions.
- Restore natural sediment delivery processes by improving road network, restoring natural floodplain connectivity, riparian health, natural bank erosion, and wood recruitment.

Long-Term Objectives

- Protect areas with high ecological integrity and natural ecosystem processes.
- Maintain connectivity through the range of the listed species where feasible and practical.

Goals Specific to the Peshastin Creek Basin

- Re-establish connectivity throughout the assessment unit by removing, replacing, or fixing artificial barriers.
- Reduce water temperatures by increasing stream flows and restoring riparian vegetation along the stream.
- Increase habitat diversity and quantity by restoring riparian vegetation, adding instream structures and large woody debris, and reconnecting side channels and the floodplain with the stream.

3.1 Restoration Strategies

The primary goal at the RM 8.8 site is to reconnect stream channel process to the disconnected stream channel and floodplain. Based on this goal, the restoration strategies for the RM 8.8 site are listed below in order of providing the greatest benefit to stream process and biological benefit for listed species:

1. Full channel realignment into the historic channel through the installation of two large bridges.
2. Installation of two culverts in SR 97 at upstream and downstream points to allow high flows into the historic channel.

3. Installation of two culverts in SR 97, one at a mid-way point and one at the downstream end to allow high flows into the historic channel.
4. Replacement of the existing culvert located within SR97 at the downstream end of the historic channel with a large culvert to provide seasonal backwater habitat.

4. ALTERNATIVES ANALYSIS

Based on the goals and objectives detailed above, four restoration alternatives for Peshastin Creek at the RM 8.8 site were identified. Figures depicting each alternative are attached. The four alternatives that were evaluated include:

- Alternative 1 – Full Channel Reconnection
- Alternative 2 – Partial Channel Reconnection at RM 9.08
- Alternative 3 – Partial Channel Reconnection at RM 8.62
- Alternative 4 – Downstream Only Reconnection

Each of these alternatives were evaluated based on the following criteria:

- Goals Addressed and Expected Short Term and Long Term Benefits
- Geomorphic Response and Expected Project Lifespan
- Risk to Adjacent Landowners
- Construction Feasibility

Alternatives considered but rejected include:

- Full Highway Realignment
  - The removal of the highway would provide the greatest restoration of the channel migration zone to within this reach. The CCNRD examined the feasibility of moving SR 97 outside of the Peshastin Creek floodplain. Steep slopes to the east of the historic channel prevent the construction of a new highway alignment to the east of the existing alignment. Moving the highway to the west of the current alignment would require construction of a large bridge over the Peshastin Creek and Ingalls Creek confluence to reach the high glacial terrace that bounds the existing channel. This would require the construction of new highway to the west of the current alignment for approximately 0.8 miles and then a second bridge back across the Peshastin Creek to the existing highway alignment.
  - In order to achieve the geomorphic and biological benefits desired following the highway realignment, the channel would then be realigned into its historical alignment. The existing channel would be plugged or abandoned.
  - This alternative was rejected from further consideration as the full highway realignment, while requiring additional highway construction and private property purchase when compared to the full channel reconnection via two bridges, would still require a similar level of restoration work associated with the historical channel.
- Infiltration/Groundwater Gallery
  - This alternative proposed the construction of a new culvert at the downstream connection and the installation of an infiltration gallery near the head of the historical channel. The purpose of the infiltration gallery would be to increase cool groundwater input to the historical channel in association with a downstream only connection.
  - The infiltration gallery would require excavation in the existing channel, which would require ongoing maintenance due to large boulder movement and substantial fines. Outflow would be nominal and would require boring under HWY 97 at significant cost. This alternative was rejected from further consideration as the costs for would be high and the resulting flowrate would be quite low.

- Left Bank Floodplain Reconnection
  - This alternative proposes the connection of a low floodplain area to the river left of the existing creek channel near river mile 8.75. This alternative would require the removal of low earth levees, likely the spoils from the channel realignmnet work in the 1950's, and the excavation of a low floodplain terrace to improve floodplain capacity and connectivity.
  - This alternative would not include any reconnection of the historical channel or floodplain currently located to the east of the highway prism and would therefore not require any work within the highway.
  - This alternative is a feasible alternative if unforseeen factors prevent the reconnection of the channel and floodplain to the east of the existing highway.

4.1 Alternative 1 – Full Channel Reconnection

The full channel reconnection alternative proposes the placement of Peshastin Creek within its historical channel to the east of the existing SR 97 highway prism through the construction of two bridges within the SR 97 highway prism (Appendix A).

The reconnection of Peshastin Creek to its historical channel through the construction of two bridges in SR 97 would improve the channel migration potential, but the remaining SR 97 prism would be a constriction to future westward channel migration.

The remnant channel, lying on the east side of SR 97, would be required to convey the full Peshastin Creek discharge and the current channel would be plugged to prevent the future avulsion of the channel and to prevent the splitting of low flows. The following design assumptions were made for this alternative:

- Open-cut construction on SR 97, the construction of a traffic bypass, and the addition of 2 bridges is acceptable to WSDOT.
- Plug constructed within Peshastin Creek to redirect flow under the upstream bridge will be notched to allow annual spring high flows down the abandoned channel.
  - Except for the plug, no work is necessary in "abandoned" portion of existing channel.
  - The remaining channel would provide high flow refuge.
- Configuration of stream under the bridges allows for 68 ft (minimum) wide bankfull channel, 20 ft of floodplain on both banks.
  - Upstream bridge length ~150 ft
  - Downstream bridge length ~195 ft
- Two existing private access road crossings over the remnant channel would be removed and an alternative access route would be improved from downstream.
- The existing road crossing the remnant channel to the WSDOT gravel pit would be removed following construction.
- The new channel alignment would adopt the historical channel as feasible; improvements to the historical channel will be necessary to improve conveyance and habitat quality.
- Adjacent floodplain areas would be graded to remove fill and increase floodplain capacity and function.
- Spoils from the construction of the 1940's channel and piled on river left would be removed to improve floodplain capacity.

This alternative provides a net gain of 900 ft of channel length resulting from the abandonment of 3,700 ft of existing Peshastin Creek and relocating to 4,600 ft of historical channel habitat.

4.1.1 Goals Addressed and Expected Short-Term and Long-Term Benefits

The goals of full channel reconnection would be to return Peshastin Creek to the historic channel to restore natural channel migration process, channel length and complexity. This option would immediately restore floodplain connectivity, increase stream length by 900 feet, increase sinuosity, decrease stream slope, and provide increased habitat complexity through the restoration of channel processes that would form and maintain complex pool and riffle habitats. The realignment of Peshastin Creek through this channel would also restore long-term channel migration and habitat forming processes along this section of Peshastin Creek.

To improve channel diversity, pools and complex LWD structures would be built into the restored channel alignment prior to reconnection, and the existing channel could be converted into high flow side channel habitats.

To increase the quantity of off-channel refuge and rearing habitat, the majority of the existing channel downstream of the plug would remain. The upstream plug would be designed to allow flows through the channel during spring events to provide high flow refuge habitats. Groundwater discharge would be expected to provide fall and winter refuge habitat within the channel as accessed from the downstream connection with the mainstem. This would provide approximately 3,500 feet and 4 acres of off-channel habitat.

4.1.2 Geomorphic Response/Lifespan

The new creek alignment would allow for dynamic channel response and floodplain activation through the majority of the project area. To ensure that the creek occupies the new channel at the outset of the reconnection, work would need to be done to the existing channel to direct flow in the creek down the reconnected meander. This would include partial filling of the existing channel and placement of a large structure such as an engineered log jam to direct the flow as desired.

Over the long-term the channel would likely continue to migrate dynamically in the reach immediately upstream of the upstream bridge reconnection as is evidenced today. The need to force the creek through the upstream bridge opening in this area may require future maintenance to ensure that the creek continues to flow through the bridge in the optimal angle. Similar bank hardening applications will also be required at the downstream outlet bridge on the new river right to ensure that the creek does not continue to migrate downstream beyond the new bridge opening location..

Within the new floodplain corridor the creek would be allowed to migrate east/right without constriction beyond the valley wall. Fo the majority of the realignment the creek channel would be aligned to the east and away from the SR97 road prism.

4.1.3 Risk to Landowners

Either full channel reconnection scenario would likely result in undesirable flooding and damage to the RM 8.8 and WSDOT properties adjacent to the historic channel. The long term goal of allowing the restored channel to migrate at natural rates would include erosion of the banks through private properties and would put some structures at risk.

4.1.4 Construction Feasibility

Bridge construction would likely require a bypass for traffic. At the upstream bridge the existing expanded west shoulder would provide area for at least a single lane traffic bypass during bridge construction. There is also the potential for the construction of a shoe-fly bypass to the east of the road prism. The expanded shoulder or a shoe-fly bypass could also be used for a single lane traffic bypass at the downstream bridge construction, thereby greatly improving construction feasibility.

New channel construction can be completed in isolation from Peshastin Creek which allows for the channel work to be completed prior to the highway and bridge work. Grading work will be also be required through most of the length of the side channel to improve channel capacity that has been constricted with fill material. The removal of fill material can be accomplished with excavators. Spoiling onsite may be possible as allowed by landowners.

4.2 Alternative 2 - High-Flow Inlet – Upstream Connection

It is possible that a complete reconnection of the historic channel would result in undesirable flooding and damage to current uses adjacent near the historic channel. If this is found to be the case, then a partial reconnection may provide some habitat benefit without causing flood damage. The partial reconnection could consist of either a new bridge or culvert installed in SR 97 at the upstream end of the historic channel, and the replacement of the existing 24-inch culvert with a larger culvert at the downstream end of the channel.

This alternative involves establishing an upstream connection to the remnant channel that is activated only at high flow events, specifically during sustained snowmelt during late spring and early summer. This connectivity will provide access to the side channel during high flows for juvenile salmonids, while avoiding reducing flows in Peshastin Creek during low-flow events. Near RM 9.08 a culvert will be installed within the SR 97 embankment to establish a connection between Peshastin Creek and its remnant channel on the east side of the highway. The invert of the culvert would be set to an elevation such that the remnant channel is activated during flows that occur during typical sustained snowmelt and also peak flow events.

The following design assumptions were made for this alternative:

- Reconnection will be established using culverts.
  - Culverts will be countersunk below the targeted invert to allow the construction of a streambed made of native materials throughout the culvert.
  - Culverts will be installed using trenchless or open cut construction techniques.
    - Culverts will be sized to convey targeted flow quantities and allow fish passage.
    - Culvert size limited is to a maximum of 12’ diameter if using trenchless installation.
- Three existing access road crossings create 100% fish passage barriers. Culverts or bridges will be installed at each crossing to allow predicted flows through as well as fish passage.
- The majority of the reconnected channel has the capacity to convey reconnected flows, fill in the historic channel currently impedes flows in several areas. Removal of this fill that currently blocks flows in the channel will be required.
- Invert of upstream culvert will be set to activate side channel at flows greater than 150 cfs.
- Downstream culvert invert may be set to backwater.
- The side channel will provide high flow refuge to 4,220 feet of habitat.

- Discharge from unnamed tributaries flowing into the reconnected channel will vary seasonally (max of ~6.5 cfs during spring runnoff to a minimum of 0 cfs during summer months) to provide wetted habitat area outside of the targeted spring in-flows.

4.2.1 Goals Addressed and Expected Short and Long Term Benefits

The upstream inlet would be set to divert spring (May – June) flows through the historical channel to provide several weeks of flows through the channel during typical years (See Figure 2). A hydraulic and sediment transport analysis would be required to determine the appropriate amount of flow to direct through the former meander so that a habitat benefit would be achieved, flood damage would be avoided, and there would be no unintended negative consequences to the main channel such as sediment deposition. Upstream inlet connectivity would be designed to disconnect flows prior to spring Chinook spawning in July, thus maintain maximum flows on the mainstem for spawning.

This option would provide immediate high flow refuge habitat for juvenile salmonids to 4,920 linear feet of side channel. Based on the analysis of tributary hydrology, surface flows are expected to provide wetted habitat below the upstream tributary confluence. This would allow fish access to 3,500 linear feet of rearing habitat during spring and winter months. Fish access to this side channel habitat during spring and winter flows would be from the backwater through the downstream culvert connection.

This reconnection will enable the side channel to function as many of the side-channel habitats on Peshastin Creek currently do through allowing flushing flows annually, while functioning as a backwater during low-flow periods. As described above, the existing historic channel consists of a series of impounded pools along with dense riparian vegetation. The flushing flows are important for increasing fish access during high water, and through the recharging of the habitats (removing algae, importing woody material and organics).

4.2.2 Geomorphic Response/Lifespan

The upstream connection culvert invert would be placed higher than the Peshastin Creek thalweg to divert the targeted spring high flows. This perched opening would restrict the recruitment of coarse-grained material being transported by the main channel, which likely increases the lifespan of the side channel to function as high flow refugia. In addition, the side channel would maintain a slope of 2 percent, and with expected spring flushing flows, fine sediment is unlikely to accumulate in quantities enough to block passage. Over time the reconnected channel would likely accumulate sands and gravels despite the seasonal flushing, possibly filling habitat features such as any constructed pools or LWD jams.

The restriction of flow quantity into the side channel will limit the splitting of flows from the mainstem during high flow events, thus allowing the existing hydraulic and sediment transport processes to continue. With the SR 97 prism still in place, and the glacial terrace to the west unaffected, little change to Peshastin Creek is expected between the upstream and downstream connections. This stability will provide long-term hydraulic connectivity between the creek and the two connection points.

4.2.3 Risk to Landowners

The risk to landowners from a partial/high-flow reconnection is primarily from flooding. The flows allowed into the channel would be controlled so they do not cause channel migration or severe bank erosion within the reconnected channel. Hydraulic modeling would be needed to evaluate possible flooding risk and the ability to design the inlet to restrict flows and limit that risk.

4.2.4 Construction Feasibility

Construction feasibility focuses on the construction of culvert structures in SR 97. In general, culvert construction would follow WSDOT standard procedures and would not be any more difficult than a typical culvert construction project on a state highway. Depending on the structure and construction technique, this may require a temporary bypass during construction. If a trenchless construction method is selected at this site then a temporary bypass will be unnecessary. If an open cut method is selected then traffic would be restricted to a single lane. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the construction of a bypass road.

The replacement of the three channel constrictions associated with access roads 1-3 will use standard construction methods to install either culverts or bridges.

New channel construction can be completed in isolation from Peshastin Creek which allows for the channel work to be completed prior to the highway work. Grading work will be also be required through most of the length of the side channel to improve channel capacity that has been constricted with fill material. The removal of fill material can be accomplished with excavators. Spoiling onsite may be possible as allowed by landowners.

4.3 Alternative 3 - High-Flow Inlet – Mid-Channel Connection

This alternative is very similar to Alternative #2 except that the upstream connection point is downstream of the historic channel connection (Alternative 3, Appendix B). Like Alternative #2, this alternative involves establishing a connection to the remnant channel that is activated only during high flows, specifically during sustained snowmelt during late spring and early summer. This connectivity will provide access to the side channel during high flows for juvenile salmonids, while avoiding reducing flows in Peshastin Creek during low-flow periods. Near RM 8.65 a culvert will be installed in SR 97 to establish a connection between Peshastin Creek and its remnant channel on the east side of the highway. The invert of the culvert would be set to an elevation such that the remnant channel is only activated during flows that occur during typical sustained snowmelt and also peak flow events. The following design assumptions were made for this alternative:

- Reconnection will be established using culverts.
  - Invert of upstream culvert within SR 97 embankment will be set to activate side channel at flows greater than 150 cfs.
  - Culverts will be countersunk below the targeted invert to allow the construction of a streambed made of native materials throughout the culvert.
  - Culverts will be installed using trenchless or open cut construction techniques.
    - Culverts will be sized to convey targeted flow quantities and allow fish passage.
    - Culvert size limited is to a maximum of 12’ diameter if using trenchless installation.
- Upstream connection will be set upstream of access road 2.
  - This location minimizes culvert length under SR 97 while providing the furthest upstream connection location to maximize spring flow-through habitat.
- Culverts or small bridges will be installed at access roads 2 and 3 to accommodate flow expected from the reconnection and discharge from unnamed tributaries upstream of the upstream reconnection point, and to allow fish passage to upstream habitats.

  - The replacement of the barrier at access road two will allow access to approximately 700 feet of habitat.
  - Fish access upstream of access road 2 will be improved through the removal of fill material within the channel. The removal of this fill will provide an additional 300 feet of habitat access during winter baseflow and spring months.
  - Existing channel capacity downstream of access road 3 is severely limited due to fill material. Approximately 600 feet of channel will require earthwork to improve conveyance capacity.
- A total of 2,800 feet of side channel habitat will be reconnected during spring and winter months.
- A total of 1,500 feet of flow through habitat will be reconnected during spring peak flows.
- Discharge from unnamed tributaries flowing into the reconnected channel will vary seasonally (max of ~6.5 cfs during spring runnoff to a minimum of 0 cfs during summer months) to provide wetted habitat area outside of the targeted spring in-flows.

4.3.1 Goals Addressed and Expected Short and Long Term Benefits

The upstream inlet would be set to divert spring (May – June) flows through the historic channel to provide several weeks of flows through the channel during typical years. A hydraulic and sediment transport analysis would be required to determine the appropriate amount of flow to direct through the former meander so that a habitat benefit would be achieved, flood damage would be avoided, and there would be no unintended negative consequences to the main channel such as sediment deposition.

This option would provide immediate high flow refuge habitat for juvenile salmonids to 2,800 linear feet of side channel. Of this length, 1,500 linear feet would be spring flow-through habitat located between the two culvert reconnection points. Based on the analysis of tributary hydrology, surface flows are expected to provide wetted habitat below the upstream tributary confluence. This would allow fish access to 2,800 linear feet of rearing habitat during late fall and winter months. Fish access to this side channel habitat during fall and winter flows would be from the backwater through the downstream culvert connection.

This inlet will provide flushing of the lower 1,500 feet of reconnected channel and exchange of waters between Peshastin Creek and the off-channel habitats during yearly spring flow events. This will enable the side channel to function as many of the side-channel habitats on Peshastin Creek currently do through allowing flushing flows annually, while functioning as a backwater during low-flow periods. As described above, the existing historic channel consists of a series of impounded pools along with dense riparian vegetation. The flushing flows are important for increasing fish access during high water, and through the recharging of the habitats (removing algae, importing woody material and organics).

With the removal of the access road and fill barriers the large pool upstream of access road 3 is expected to return to the narrow tributary-supported channel that is characteristic of conditions above access road 2. Downstream of access road 3 the annual flushing flows are expected to provide a rapid improvement to current conditions allowing the channel to restore surface flows and riparian vegetation.

Above access road 2 and the reconnection point, the removal of debris will improve access, however, without annual recharging flows, there is likely to be the continued growth of dense algae mats during summer months, and reed canarygrass. This will limit the habitat quality of these reconnected habitats.

4.3.2 Geomorphic Response/Lifespan

The upstream connection culvert invert would be placed higher than the Peshastin Creek thalweg to divert the targeted spring high flows. This perched opening would restrict the recruitment of coarse grained material being transported by the main channel, which likely increases the lifespan of the side channel to function as high flow refugia. In addition, the side channel would maintain a slope of 2%, and with expected spring flushing flows, fine sediment is unlikely to accumulate in quantities enough to block passage. Over time the reconnected channel would likely accumulate sands and gravels despite the seasonal flushing, possibly filling habitat features such as any constructed pools or LWD jams.

The restriction of flow quantity into the side channel will limit the splitting of flows from the mainstem during high flow events, thus allowing the existing hydraulic and sediment transport processes to continue. With the SR 97 prism still in place, and the glacial terrace to the west unaffected, little change to Peshastin Creek is expected between the upstream and downstream connections. This stability will provide long-term hydraulic connectivity between the creek and the two connection points.

4.3.3 Risk to Landowners

The risk to landowners from a partial/high-flow reconnection is primarily from flooding. The flows allowed into the channel would be controlled so they do not cause channel migration or severe bank erosion. Hydraulic modeling would be needed to evaluate possible flooding risk and the ability to design the inlet to restrict flows and limit that risk.

4.3.4 Construction Feasibility

Construction feasibility focuses on the construction of culvert structures in US 97. In general, culvert construction would follow WSDOT standard procedures and would not be any more difficult than a typical culvert construction project on a state highway. Depending on the structure and construction technique, this may require a temporary bypass during construction. If a trenchless construction method is selected at this site then a temporary bypass will be unnecessary. If an open cut method is selected then traffic would be restricted to a single lane. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the construction of a bypass road.

Construction would also include a small amount of instream work within the actively flowing channel of Peshastin Creek at the connection points to provide connections at the desired elevations, and to install structures to protect the banks as needed.

The replacement of the channel constrictions associated with access roads 2 and 3 will use standard construction methods to install either culverts or bridges.

New channel construction can be completed in isolation from Peshastin Creek which allows for the channel work to be completed prior to the highway work. Grading work will be also be required downstream of the upstream culvert reconnection within the side channel to improve channel capacity that has been constricted with fill material. The removal of fill material can be accomplished with excavators. Spoiling onsite may be possible as allowed by landowners.

4.4 Alternative 4 – Outlet Only/Alcove

The downstream only connection alternative involves replacing an existing 24" culvert with a larger culvert (Alternative 4, Appendix B). The new culvert will provide a backwater connection to the remnant channel to target high flow and low-flow refugia. The invert of the replacement culvert will be set such that flow in Peshastin Creek can backwater the remnant channel during the widest range of flows possible. The following design assumptions were made for this alternative:

- Reconnection will be established using culvert.
  - Invert of the downstream culvert within SR 97 embankment will be set to allow backwater through summer low-flow events.

    - The culvert will be countersunk below the targeted invert to allow the construction of a streambed made of native materials throughout the culvert.
    - The culvert will be installed using trenchless or open cut construction techniques.
        - The culvert will be sized to convey targeted flow quantities and allow fish passage.
        - Culvert size limited is to a maximum of 12' diameter if using trenchless installation.
- Culverts or small bridges will be installed at access roads 2 and 3 to accommodate flow expected from unnamed tributaries upstream of the upstream reconnection point, and to allow fish passage to upstream habitats.
    - The replacement of the barrier at access road 2 will allow access to approximately 700 feet of habitat.
    - Fish access upstream of access road 2 will be improved through the removal of fill material within the channel. The removal of this fill will provide an additional 300 feet of habitat access during winter baseflow and spring months.
    - Existing channel capacity downstream of access road 3 is severely limited due to fill material. Approximately 600 feet of channel will require earthwork to improve fish access to upstream habitats.
- A total of 2,800 feet of side channel habitat will be reconnected as accessible from the downstream culvert connection.

Discharge from unnamed tributaries flowing into the reconnected channel will vary seasonally (max of ~6.5 cfs during spring runnoff to a minimum of 0 cfs during summer months) to provide wetted habitat during winter and spring months.

4.4.1 Goals Addressed and Expected Short and Long Term Benefits

The outlet-only project would provide high-flow backwater refuge habitat for juvenile salmonids. The downstream end of the historic channel would also provide low-flow alcove habitat during summer months. With the proposed removal of fish barriers within the historic channel, the downstream only connection would provide up to 2,800 linear feet of habitat during spring high flows. This connection may also provide access to winter rearing habitat based on probable flow inputs from two unnamed tributaries to the historic channel.

While this alternative is expected to provide access to refuge and rearing habitats, the quality of those habitats may be limited without the annual flushing flows that typical side channels on the lower Peshastin Creek experience. These annual flushing flows are important for increasing fish access during high water, and through the recharging of the habitats (removing algae, importing woody material and organics). With the removal of the access road and fill barriers the large pool upstream of access road 3 is expected to return to the narrow tributary-supported channel that is characteristic of conditions above access road 2. It is also expected that the removal of fill downstream of access road 3 will allow the channel to restore surface flows and riparian vegetation. These actions will improve rearing habitats, however, the without the annual recharging flows, there is likely to be the growth of dense algae mats during summer months, as well as the establishment of reed canarygrass. This will limit the habitat quality of these reconnected habitats.

The single downstream inlet would be difficult for juvenile fish to find during high flows as high velocities on the mainstem across the face of the culvert would likely flush fish past the culvert entrance. This would further reduce the use and benefit associated with this alternative.

4.4.2 Geomorphic Response/Lifespan

The primary limit to the long-term function of the outlet-only project is the risk of future debris entering the historical channel from the steep slopes to the east of the historical channel. This could consist of the limited spring flows that are expected to flow through the outlet will not have velocities of sufficient magnitude to move any sandy material out of the historical channel into Peshastin Creek. Over time organic debris is also expected to accumulate in the channel, further reducing fish access and use.

4.4.3 Risk to Landowners

The risk to landowners to the east of SR 97 is very low as no new flows will be introduced at the upstream end of the project and SR 97 would remain as a barrier to Peshastin Creek migration. The possibility from increased flooding from improved connectivity still is low as it is expected that the new culvert would have little effect to flood elevations associated with the existing 24-inch diameter culvert. It is possible this project could reduce risk of flooding to some landowners because it would provide a larger opening at the downstream end of the site which would pass the spring fed flows more efficiently and reduce ponding. The proposed replacement of flow barriers at access road 3 would alleviate flooding of the road that occurs during spring flow events.

4.4.4 Construction Feasibility

Construction feasibility focuses on the construction of a single culvert structure in SR 97. In general, culvert construction would follow WSDOT standard procedures and would not be any more difficult than a typical culvert construction project on a state highway. Depending on the structure and construction technique, this may require a temporary bypass during construction. If a trenchless construction method is selected at this site then a temporary bypass will be unnecessary. If an open cut method is selected then traffic would be restricted to a single lane. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the construction of a bypass road.

New channel construction can be completed in isolation from Peshastin Creek which allows for the channel work to be completed prior to the highway work. Construction would also include a small amount of instream work within the actively flowing channel of Peshastin Creek at the connection point to provide a connection at the desired elevations, and possibly to install structures to control sediment deposition.

4.5 Comparison of Alternatives

The selection of a preferred alternative was completed through the comparison of the four design alternatives described in detail above. Each of the four alternatives was evaluated based on the ability to meet the primary ecological concerns, construction feasibility, and social acceptance. Table 3 below summarizes the evaluation criteria for each of the alternatives.

Construction costs for each alternative were determined based on the concept-level plans. Cost estimates for Alternatives 2 – 4 were developed by ICF (2012).

Table 3. Overview of project alternatives.

Alternative	Ecological Concerns	Construction Feasibility	Social Acceptance	Cost
1 Full Channel Reconnection	Directly addresses the primary ecological concerns:	High level of construction feasibility both for the bridge work and new channel alignment.	Will require agreements with exisitng	$14 million

Alternative	Ecological Concerns	Construction Feasibility	Social Acceptance	Cost
	• Restores full channel dynamic process to 4,600 linear feet of channel. • Breaches an artificial barrier. • Increases floodplain capacity and connectivity. • Increases stream length. • Improves channel complexity. • Increases off-channel refuge and rearing habitat including retaining 3,700 linear feet of current mainstem channel as rearing backwater habitat.	• Bridge construction will require a reduction in highway capacity or a traffic bypass. Existance of the wide shoulder areas improve the feasibility of a bypass. • New channel construction can be completed in isolation from Peshastin Creek which allows for the channel work to be completed well ahead of the SR 97 bridge work and reconnection of flows.	landowners and relocation of current land uses within the proposed reconnected floodplain area. Unknown at this time whether landowners will agree to this critical element.	
2 High-Flow Inlet – Upstream Connection	Directly addresses these primary ecological concerns: • Breaches an artificial barrier. • Increases floodplain capacity and connectivity. • Connects 4,200 linear feet of historical channel to high spring flows. • Provides access to 3,700 linear feet of winter and summer backwater habitat. Does not restore full channel dynamic process.	High level of construction feasibility both for the bridge work and new channel alignment. • The construction of culvert structures in SR 97 may require a temporary traffic bypass during construction. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the construction of a bypass road. • Restoration of the historical channel can be completed in isolation from Peshastin Creek which allows for the channel work to be	This alternative includes preservation of the interior access roads that currently cross the historical channel, thus preserving landowner access and use. Changes to current land uses will depend on the flooding effects. The upstream culvert size can be manipulated to reduce unwanted flooding at a cost to	$617,000

Alternative	Ecological Concerns	Construction Feasibility	Social Acceptance	Cost
		completed well ahead of the SR 97 bridge work and reconnection of flows.	hydraulic and habitat connectivity.	
3 High-Flow Inlet – Mid-Channel Connection	Partially addresses these primary ecological concerns: • Breaches an artificial barrier. • Increases floodplain capacity and connectivity. • Connects 1,600 linear feet of historical channel to high spring flows. • Provides access to 3,700 linear feet of winter and summer backwater habitat. Does not restore full channel dynamic process. Does not restore full connectivity to the upper 2,600 linear feet of historical channel.	High level of construction feasibility both for the bridge work and new channel alignment. • The construction of culvert structures in SR 97 may require a temporary traffic bypass during construction. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the construction of a bypass road. • Restoration of the historical channel can be completed in isolation from Peshastin Creek which allows for the channel work to be completed well ahead of the SR 97 bridge work and reconnection of flows.	This alternative includes preservation of the interior access roads that currently cross the historical channel, thus preserving landowner access and use. Changes to current land uses will depend on the flooding effects. The upstream culvert size can be manipulated to reduce unwanted flooding at a cost to hydraulic and habitat connectivity.	$501,000
4 Outlet Only/Alcove	Partially addresses these primary ecological concerns: • Breaches an artificial barrier. • Provides access to 3,700 linear feet of , spring, winter and summer backwater habitat. Does not restore full channel dynamic process. Does not restore full connectivity to the upper historical channel.	High level of construction feasibility both for the bridge work and new channel alignment. • The construction of a single culvert in SR 97 may require a temporary traffic bypass during construction. The existing road surface has wide shoulders which could be used for a single lane bypass, thus allowing the use of an open cut construction while not requiring the	This alternative includes preservation of the interior access roads that currently cross the historical channel, thus preserving landowner access and use. Changes to current land uses will depend on the	$293,000

Alternative	Ecological Concerns	Construction Feasibility	Social Acceptance	Cost
	Does not restore flow-through processes to the historical channel.	construction of a bypass road. • Restoration of the historical channel construction can be in isolation from Peshastin Creek which allows for the channel work to be completed well ahead of the SR 97 bridge work and reconnection of flows.	flooding effects. The upstream culvert size can be manipulated to reduce unwanted flooding at a cost to hydraulic and habitat connectivity.	

4.6 Selection of the Preferred Alternative

Alternative 1 – Full Channel Reconnection was selected as the preferred alternative. This alternative best addresses the ecological project goals and objectives, while maintaining a high level of construction feasibility. Construction of this alternative will require coordination with landowners and a modification of current land uses within the reconnected floodplain area.

Please refer to the Basis of Design Report (NSD 2015b) for the detailed conceptual plans and design rationale for the Full Channel Reconnection.

5. CITATIONS

Andonaegui, C. 2001. Salmon, Steelhead, and Bull Trout Habitat Limiting Factors for the Wenatchee Subbasin (Water Resource Inventory Area 45) and Portions of WRIA 40 within Chelan County (Squilchuck, Stemilt and Colockum drainages). Washington State Conservation Commission. Olympia, WA.

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Interfluve. 2010b. Peshastin Project Ranking. Wenatchee Subbasin, Chelan County, WA. Prepared for Yakama Nation Fisheries, Toppenish, WA. August.

(NSD) Natural Systems Design. 2015a. Baseline Reach Characteristics: Peshastin Creek at RM 8.8 Project Site. Prepared for the Chelan County Natural Resource Department. October.

(NSD) Natural Systems Design. 2015b. Peshastin Creek at RM 8.8 Channel Reconnection Project Basis of Design Report. Prepared for the Chelan County Natural Resource Department. October.

(UCRTT) Upper Columbia Regional Technical Team. 2009. Draft priorities for reaches and actions for implementing habitat actions. February 11, 2009.

UCRTT (Upper Columbia Regional Technical Team). 2014. A biological strategy to protect and restore salmonid habitat in the Upper Columbia Region. A Draft Report to the Upper Columbia Salmon Recovery Board. From The Upper Columbia Regional Technical Team. 44 pages plus appendices.

(UCSRB) Upper Columbia Salmon Recovery Board. 2007. Upper Columbia Spring Chinook Salmon and Steelhead Recovery Plan. August 2007. Available online at http://www.ucsrb.com/plan.asp or http://www.ucsrb.com/UCSRP%20Final%209-13-2007.pdf.

APPENDIX A
FIGURES

ICF INTERNATIONAL

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SCALE OF FEET

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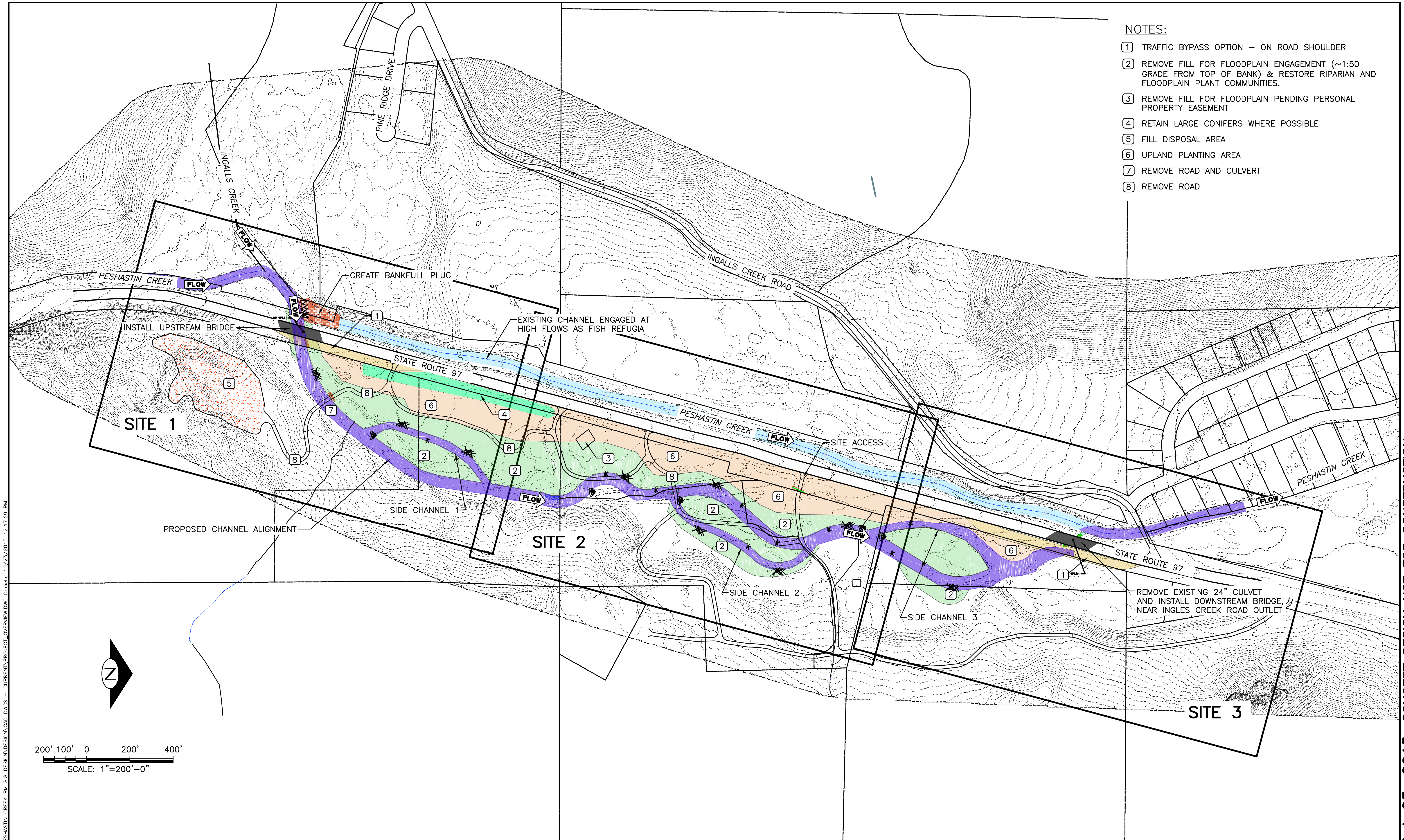
Peshastin Creek River Mile 8.8R
Blewett Rock and Gravel – Channel Reconnection Project
Existing Conditions



Oct 23, 2015 CONCEPT DESIGN NOT FOR CONSTRUCTION

N:\PROJECTS\CCNRD\PESHASTIN CREEK RM 8.8 DESIGN\DESIGN\CAD DWGS – CURRENT\PROJECT OVERVIEW.DWG Danielle 10/23/2015 12:17:29 PM

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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT PLOTTED TO ORIGINAL SCALE.

Natural Systems Design

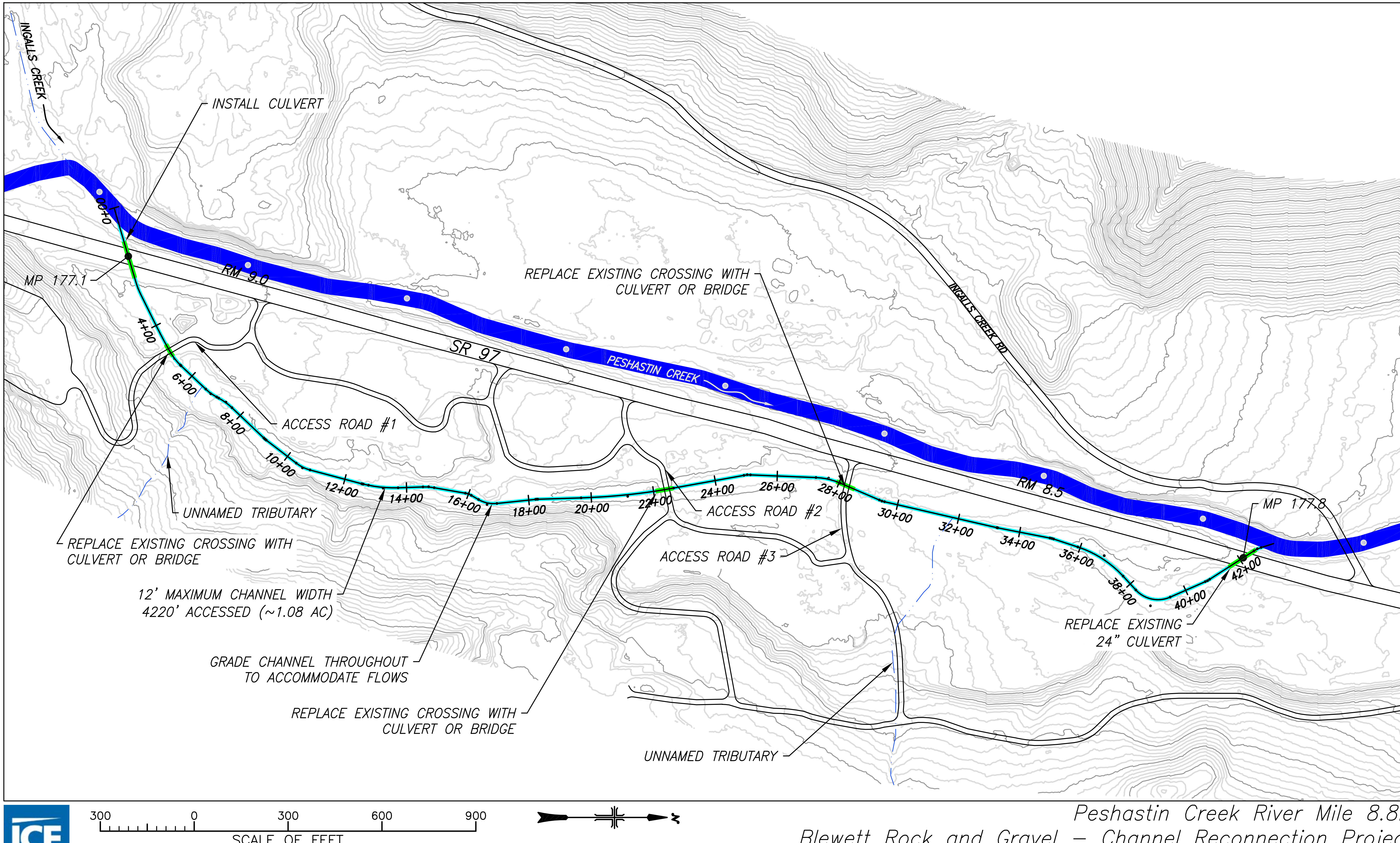
NAME OR INITIALS AND DATE	
DESIGNED	DESIGNED BY
CHECKED	DESIGNED CHECKED BY
DRAWN	DRAFTED BY
CHECKED	DRAFTED CHECKED BY

GEOGRAPHIC INFORMATION	
LATITUDE	47°10'18.50"N
LONGITUDE	122°19'9.75"W
TN/SC/RG	T23N/S25/R17E
DATE	–

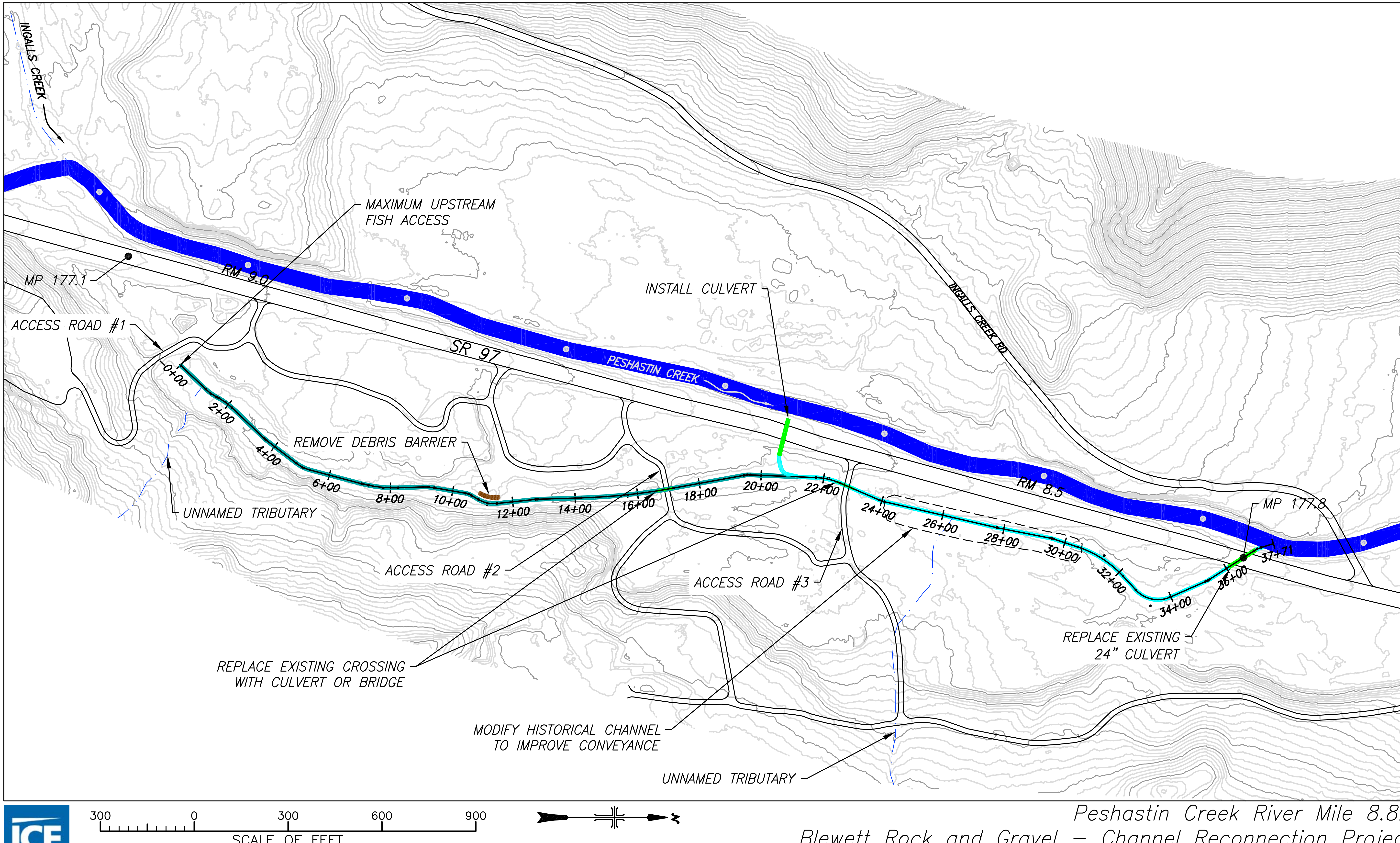
Alternative 1 – Full Channel Reconnection

6

SHEET 6 OF 20

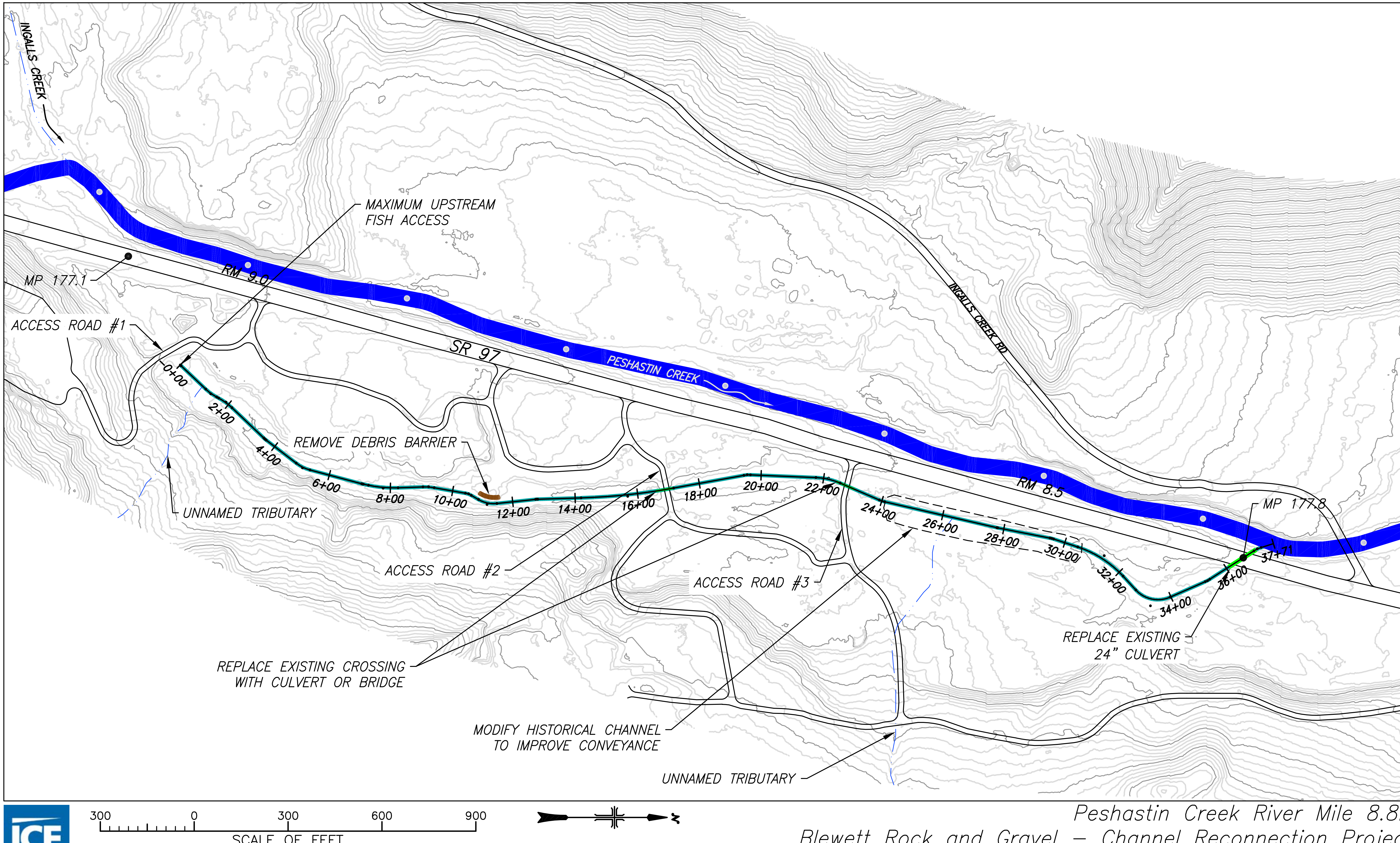


Peshastin Creek River Mile 8.8R
Blewett Rock and Gravel – Channel Reconnection Project
Alternative 2 – High Flow Reconnection at RM 9.08



ICF INTERNATIONAL

Peshastin Creek River Mile 8.8R
Blewett Rock and Gravel – Channel Reconnection Project
Alternative 3 – High Flow Reconnection at RM 8.66



Peshastin Creek River Mile 8.8R

Blewett Rock and Gravel – Channel Reconnection Project

Alternative 4 – Downstream Connection Only

APPENDIX B
PESHASTIN CREEK FISH USE

Memorandum

Date:	April 25, 2012
To:	Mike Kane, Chelan County Natural Resource Department
Cc:	
From:	Joy Juelson and John Soden
Subject:	**ESA Listed Fish Use in Peshastin Creek—Wenatchee Subbasin, Upper Columbia Region**

Introduction

This objective of this memo is to discuss Endangered Species Act (ESA)-listed species use in the Peshastin Creek and tributaries.

Peshastin Creek is located on the east slope of the Cascade Mountains in Central Washington and is a tributary to the Wenatchee River at river mile (RM) 18. The Peshastin Creek watershed encompasses 78,780 acres. Primary discharge to Peshastin Creek comes from Ingalls Creek and Ettienne Creek (formerly Negro Creek). The watershed is divided in ownership with 82% managed by the U.S. Forest Service (USFS) and 18% privately held (Cappellini 1997).

The Peshastin Creek is utilized by a number of resident and anadromous fish species including: spring Chinook, coho, steelhead trout, rainbow trout, bull trout, west slope cutthroat trout, brook trout, sculpin, sucker, speckled dace, long nose dace, and crappie (Andonaegui 2001 and NPPC 2004). Three of these species are currently listed under ESA and include spring Chinook (*Oncorhynchus tshawytscha*), summer steelhead (*Oncorhynchus mykiss*), and bull trout (*Salvelinus confluentus*). Peshastin Creek is a Category 2 watershed. It contains a major spawning area for steelhead and a minor spawning area for spring Chinook and is a bull trout core area (UCRTT 2008).

Lower and Upper Peshastin Creek is used for juvenile rearing of steelhead, bull trout, and spring Chinook (Table 1). Lower Peshastin Creek is a migration corridor for both steelhead and bull trout that spawn in the upper reaches and tributaries of Peshastin Creek. There is limited spawning in the lower Peshastin Creek by spring Chinook and steelhead.

Table 1. Peshastin Creek Major Tributaries and ESA Listed Fish Use

		Steelhead/Rainbow			Spring Chinook			Bull Trout		
Peshastin Watershed Tributary	**River Mile Confluence with Peshastin Creek**	**Spawning**	**Rearing**	**Migration**	**Spawning**	**Rearing**	**Migration**	**Spawning**	**Rearing**	**Migration**
Peshastin	0.0–16.6	X	X	X	X	X	X		X	X
Mill	5.2	X @ Mouth	X							X*
Camas	6.2	X	X	X						X*
Ingalls	9.4	X	X	X		X		X	X	X
Ruby	10.5	X	X	X		X				X*
Ettienne	11.1	X	X	X				X	X	X
Tronsen	14.9	X	X							X*
Shaser	15.5		X	X					*	X*
Scotty	16.6		X	X					*	X*

x* Adapted from Andonaegui 2001.

* Because bull trout reside year-round, adults or subadults may move into these creeks during foraging movements depending on time of year and temperature (Neibauer pers. comm.).

A reach based assessment was recently completed by the Yakama Nations (YN) from the Wenatchee and Peshastin confluence to RM 9.3; this reach is termed the “lower Peshastin”. The assessment indicated that the lower 8.4 miles of Peshastin Creek are at an “at risk” or “unacceptable risk” condition for several parameters important to the spawning and rearing life stages of salmonids (Interfluve 2010). An assessment has not been completed on the “upper Peshastin” reach. The Upper Columbia Regional Technical Team (UCRTT) identified limiting factors (UCRTT 2008) affecting fish in Peshastin Creek. Table 2 shows the crosswalk between those UCRTT limiting factors and the newly adopted National Marine Fisheries Service (NMFS) ecological concerns.

Table 2. Crosswalk between UCRTT Limiting Factors and NMFS Ecological Concerns

Peshastin Creek – UCRTT (2008) Identified Limiting Factors	NMFS Ecological Concerns	NMFS Ecological Concerns Subcategory
Instream flows (lower Peshastin Creek)	Water Quantity	Decreased Water Quantity Altered Flow Timing
Channel migration	Channel Structure and Form	Instream Structural Complexity
Floodplain function	Peripheral and Transitional Habitats	Floodplain Condition
Stream sinuosity	Channel Structure and Form	Bed and Channel Form
Gravel recruitment	Sediment Conditions	Decreased Sediment Quantity
Riparian habitat	Riparian Condition	Riparian Vegetation
Fish Passage	Habitat Quantity	Anthropogenic Barriers

These limiting factors are primarily caused by State Highway 97, development, and irrigation water diversions below RM 4.8 that dewater the lower reach. These limiting factors contribute to the reduction of the quantity and quality of spawning and rearing habitat, impede upstream migration, reduce high quality pools and quantities of large woody debris and elevate water temperatures (Andonaegui 2001 and NPPC 2004). Peshastin Creek is characterized as a high gradient, boulder cobble stream that is potentially more suited for steelhead than Chinook. However, the stair stepping nature of Peshastin Creek creates numerous small pools in the upper reaches and tributaries such as Ingalls Creek. These microhabitats are thought to have the potential to provide excellent habitat for the rearing of small salmonids (Mullan et al. 1992).

Steelhead

Current abundance and distribution of steelhead have been reduced in Peshastin Creek compared to historical conditions (Andonaegui 2001). Peshastin Creek has been identified as a Major Spawning Area for summer steelhead (UCRTT 2008). Summer steelhead currently uses the mainstem Peshastin Creek for spawning and rearing and as a migration corridor to access the upper basin spawning grounds (Figure 1). Steelhead and rainbow trout have been planted in the basin by WDFW as recently as 1990 (Andonaegui 2001) and the last hatchery release was in 1998 (WDFW 2009). After spending 1 or 2 years in the ocean, steelhead can migrate to their spawning grounds as early as 9 months prior to spawning. They can enter the Wenatchee River system from May to October to begin spawning in March.

During smolt monitoring conducted in 2004 using a screw trap at RM 6.3, 4,302 steelhead/rainbow trout comprised 48% of the catch. The expanded population estimate was 16,082 steelhead/rainbow trout (Cooper and Mallas 2004).

In 2009, the U.S. Forest Service performed status and trend fish surveys within the Peshastin Creek as a component of the Integrated Status and Effectiveness Monitoring Program (ISEMP). Fish abundance and distribution was evaluated using snorkeling and electrofishing surveys, and 2827 steelhead were identified near the mouth of Peshastin Creek (Dawson and Call 2010).

Spawning surveys conducted by WDFW have been completed annually from 2004 to 2010 in the same areas using the same methods throughout many tributaries the Wenatchee basin including Peshastin Creek (Table 3). Peshastin Creek had 12.2% of all the redds located in the Wenatchee subbasin in 2010 (Hillman et al. 2011). Figure 2 shows the spawning distribution in the Peshastin subbasin from 2009 to 2011. The majority of the spawning is distributed in the lower Peshastin between RM 3 to 6.5. In the upper Peshastin steelhead show a patterns of concentrated spawning between Ingalls and Tronsen Creek with dispersed spawning to just past RM 14.9 at Tronsen Creek; steelhead also spawn in Tronsen Creek.

Table 3. Peshastin Creek Basin Steelhead Spawning Survey Counts (2003–2010)

Peshastin Watershed Tributary	RM Confluence with Peshastin Creek	2003	2004	2005	2006	2007	2008	2009	2010
Peshastin Creek	0–16.6	15	32	91	67	17	48	32	115
Mill Creek	5.2	--	--	1	0	0	1	0	0
Ingalls Creek	9.4	0	0	0	0	--	--	--	0
Ruby Creek	10.5	0	0	0	--	--	--	0	--
Tronsen Creek	14.9	0	2	5	0	0	0	0	3
Scotty, Shaser and Schafer Creeks	15.5–16.6	0	0	0	0	0	0	0	0
Total		**15**	**34**	**97**	**67**	**17**	**49**	**32**	**118**

Source: Tonseth 2010

Spring Chinook

Spring Chinook were historically distributed throughout Peshastin Creek and its tributaries (Andonaegui 2001). It is believed spring Chinook were extirpated from this watershed due to past irrigation diversions that formally blocked passage in the lower 5 RMs of Peshastin Creek during low water periods when spring Chinook were migrating (USFS 1999).

Peshastin Creek has been identified as a Minor Spawning Area for spring Chinook (UCRTT 2008). Figure 3 illustrates the current presence and distribution of spring Chinook in Peshastin Creek. From 2001 to 2004, spring Chinook were reintroduced to Peshastin Creek using out-of-basin non-ESA-listed stock taken from the Leavenworth National Fish Hatchery in a joint effort by USFWS and YN (Cooper and Mallas 2004). Table 4 shows an increase in spring Chinook spawning during that timeframe. Smolt monitoring was conducted in 2004 by the USFWS, Mid-Columbia River Fisheries Resource Office (MCRFRO) using a screw trap at RM 6.3, near the Camas Creek confluence. In 2004, 4,310 spring Chinook juveniles were captured which comprised 48.2% of the catch with most of the remainder being steelhead/rainbow trout. A total of 66,395 subyearling spring Chinook were estimated in Peshastin Creek at that time (Cooper and Mallas 2004). The majority of the catch was newly emerged Chinook fry most likely displaced by spring discharge events, possibly indicating forced rather than volitional migration (Cooper and Mallas 2004). During the 2004 trapping season there was relative lack of yearling Chinook or age-1+, and only one yearling Chinook was captured. It may be possible the absence of yearling Chinook indicates that Peshastin Creek does not provide adequate over wintering habitat (Cooper and Mallas 2004).

After spending 2 or 3 years in the ocean spring Chinook enter the Wenatchee River where they ultimately reach Peshastin Creek from May to August and then begin spawning in August through September. Spawning ground surveys from 1958 to 1989 found an average of five redds per year and surveys from 1990 to 1995 found ten Chinook redds total (Hays and Peven 1991, 1992; Peven 1992, 1994; Peven and Truscott 1995; Peven and Mosey 1996). Surveys by the Chelan County Public Utility District (CCPUD) and WDFW found no spring Chinook redds from 1997 to 2000 (Mosey & Murphy 2000). From 2000 to 2011, CCPUD has found limited spawning that primarily occurs in lower Peshastin Creek from river mile 4.8 (Mill Creek Bridge) to 7.3 (Allen Creek) (Table 2) while rearing typically occurs from RM 0 to RM 14.8 (Magnet Creek) (Andonaegui 2001). Figure 4 shows the spawning distribution in the Peshastin subbasin from 2009 to 2011.

In 2009, USFS performed status and trend fish surveys within the Peshastin Creek as a component of ISEMP. Fish abundance and distribution was evaluated using snorkeling and electrofishing surveys and 75 juvenile Chinook were identified near the mouth of Peshastin creek over three site visits (Dawson and Call 2010). It is unclear whether the juvenile Chinook were spring or summer run.

Table 4. Peshastin Creek Spring Chinook Spawning Data (2000–2011)

Peshastin Reach	RM	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Mouth to Highway Bridge	0.0-3.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	1
Highway Bridge to King Bridge	0.0-3.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	2
King Bridge to Washout/Mill Cr. Bridge	3.3-4.8	N/A	3	0	17	2	0	2	1	2	1	2	4
Washout/Mill Cr. Bridge to Allen Cr.	4.8-7.3	0	45	20		3	3	3	4	11	8	3	11
Allen Cr. Bridge To Ingalls Cr.	7.3-9.0-	0	18	8	9	15	0	0	0	0	0	0	2
Ingalls Cr. Mouth To Ruby Cr.	9.0-9.7		N/A	17	3		0	0	0	0	0	0	1
Total		**0**	**66**	**45**	**29**	**20**	**3**	**5**	**5**	**13**	**9**	**5**	**21**

*Data provided by Chelan County PUD

Bull Trout

Peshastin Creek was once host to a notable run of bull trout in the late summer (Andonaegui 2001). Currently, there is believed to be a small population of stream-resident bull trout in Ingalls Creek and Ettienne Creek (formerly Negro Creek) (Figure 5). Peshastin Creek has been identified as a Core Area for bull trout (UCRTT 2008). Of the three ESA-listed species, bull trout prefer the coldest water to spawn (typically 15 degrees Celsius or less). The mainstem Peshastin Creek mostly serves as a bull trout migration corridor to Ingalls and Ettienne Creek. These two tributaries are known to support bull trout spawning and rearing (USFWS 2002). Bull trout commonly migrate upstream to their spawning grounds from May to early September, and spawning occurs in mid-September and October (Kelly-Ringel and DeLaVergne 2005). Bull trout are also likely move into and take advantage of multiple creeks throughout the Peshastin Creek basin depending on the temperature and time of year. Bull trout use these habitats for holding and overwintering of adult bull trout and for seasonal rearing of juvenile bull trout (Neibauer pers. comm.).

Past surveys by various entities have found low numbers of bull trout in the Peshastin Creek basin. Bull trout were found in Ingalls Creek during surveys in 1994 and 1995, but none were found in Peshastin Creek surveys from RM 10.5 to RM 16.6. Surveys in 1997 between the mouth and Ingalls Creek found three bull trout, but only within the first 1.42 miles. No bull trout redds were found by USFS during surveys of Ingalls Creek in 2000 (Andonaegui 2001). One redd was found in 2001, five redds were found in 2002, and nine redds were found in 2003, but no spawning data have been collected since (Kelly-Ringel 2011).

Smolt monitoring in 2004 at RM 6.3 captured 112 bull trout. These bull trout were captured primarily in the spring and fall as they were presumably emigrating to the Wenatchee River (Cooper and Mallas 2004). In 2006, USFWS observed 40 juvenile/subadult bull trout in upper Ingall's Creek by USFWS when collecting fin clips for development of a genetics baseline (Neibauer pers. comm.). In 2006, 2007, and 2009, USFS performed status and trend fish surveys as a component of ISEMP within the Peshastin Creek, and Ettienne Creek. There is limited survey data from 2009 through 2011 in the Peshastin watershed.

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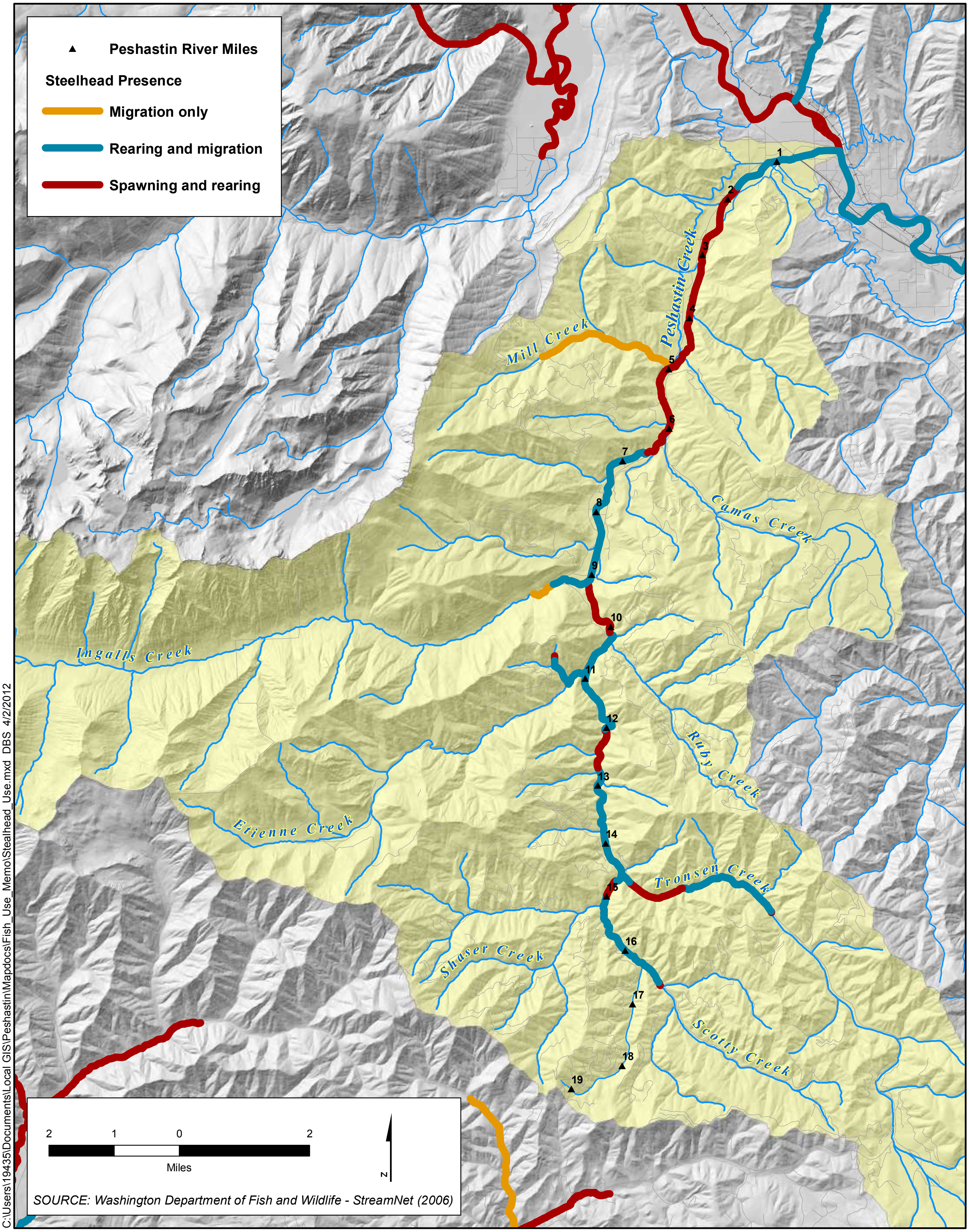

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ICF INTERNATIONAL

Figure 1
Steelhead Presence in the Peshastin Basin
Peshastin Creek Fish Use

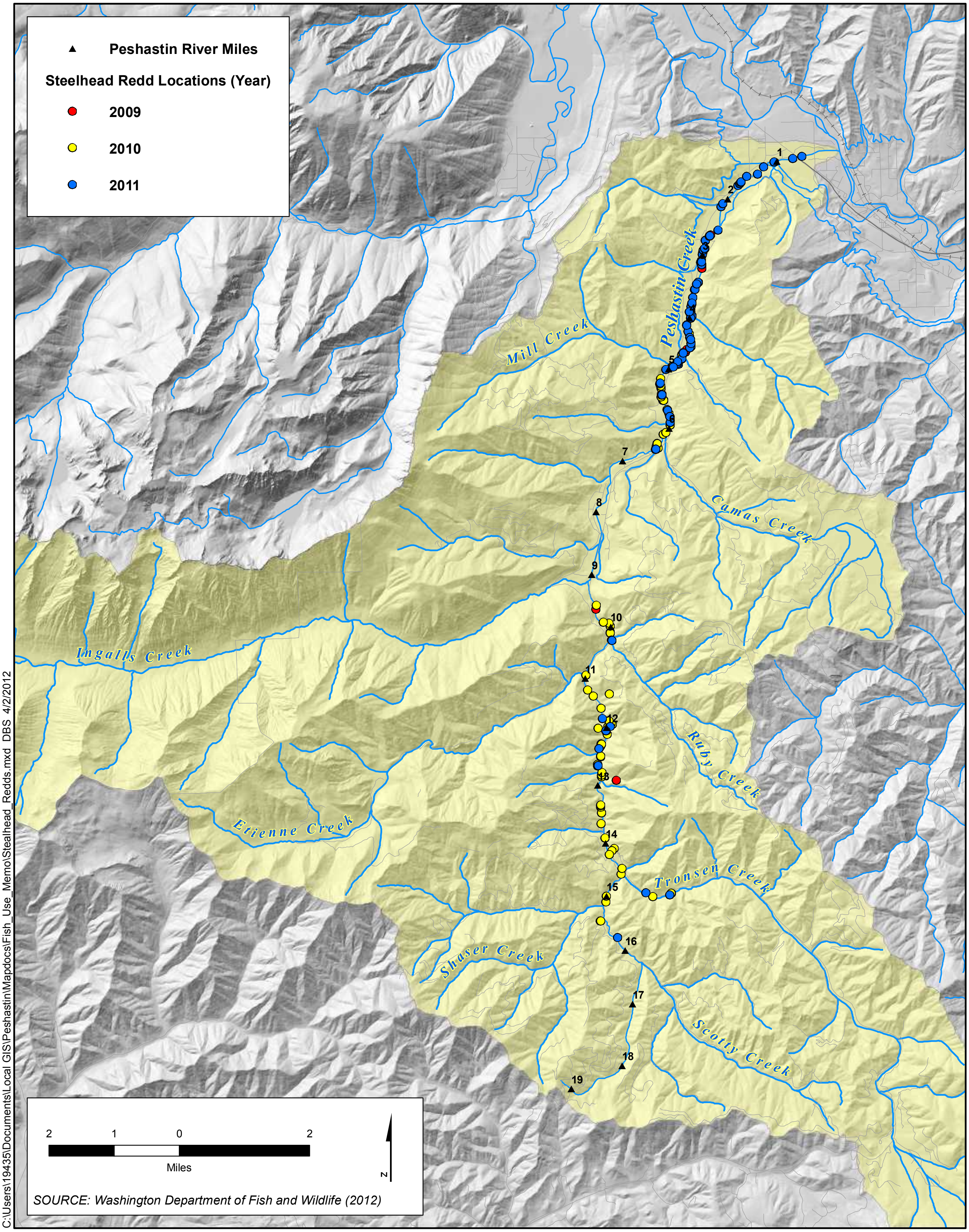

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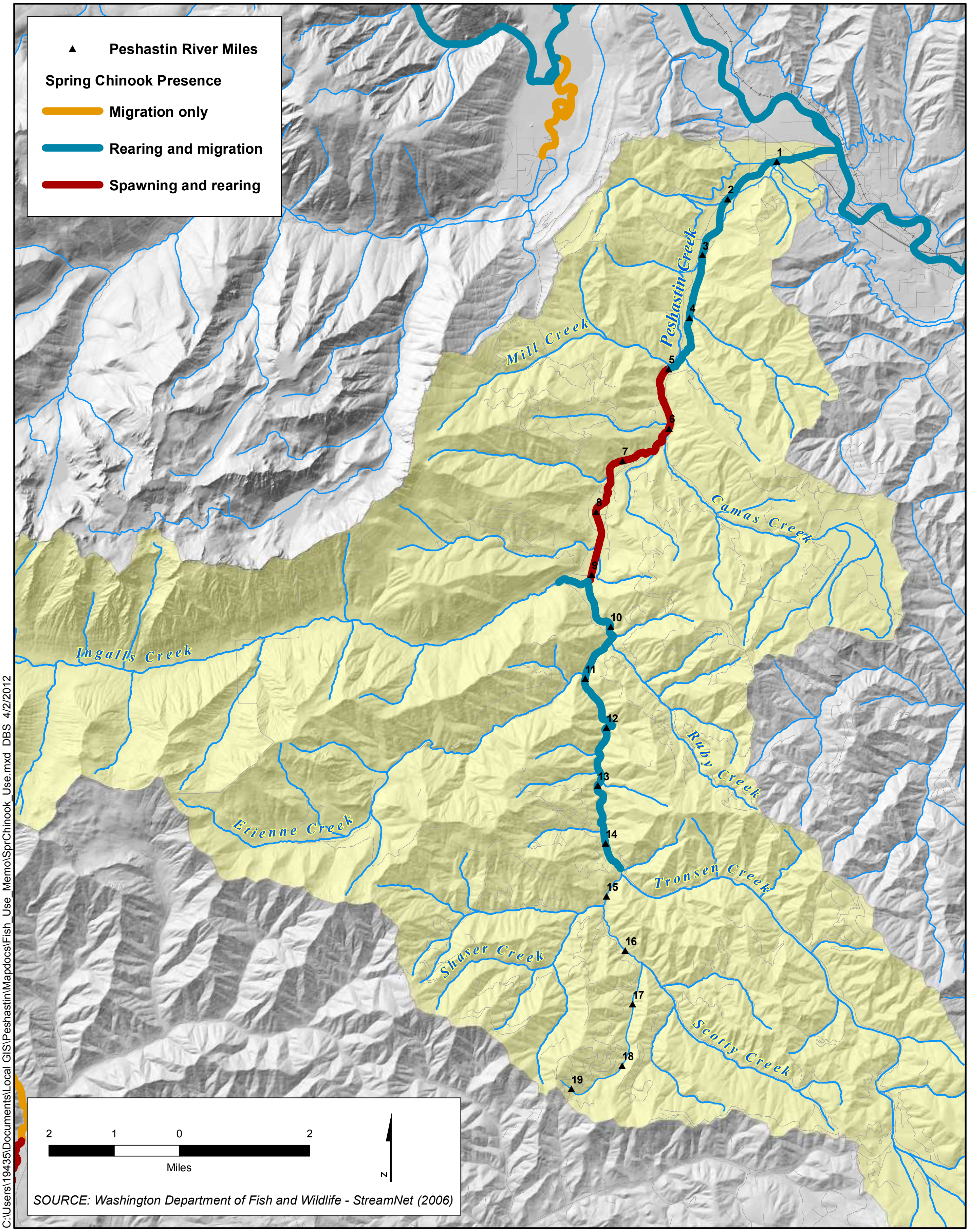
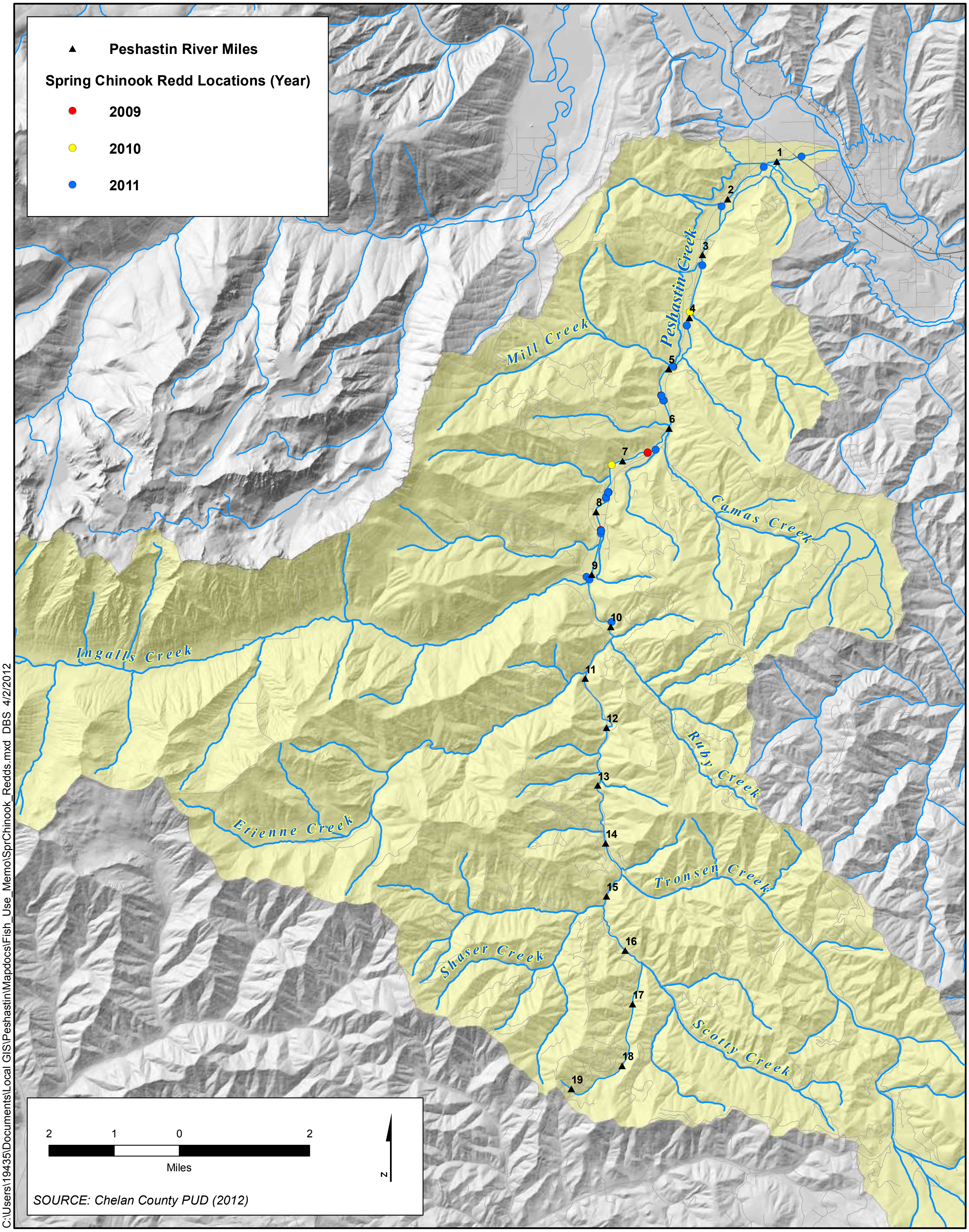
Figure 2
Steelhead Spawning Distribution in the Peshastin Basin
Peshastin Creek Fish Use



ICF INTERNATIONAL

Figure 3
Spring Chinook Presence in the Peshastin Basin
Peshastin Creek Fish Use



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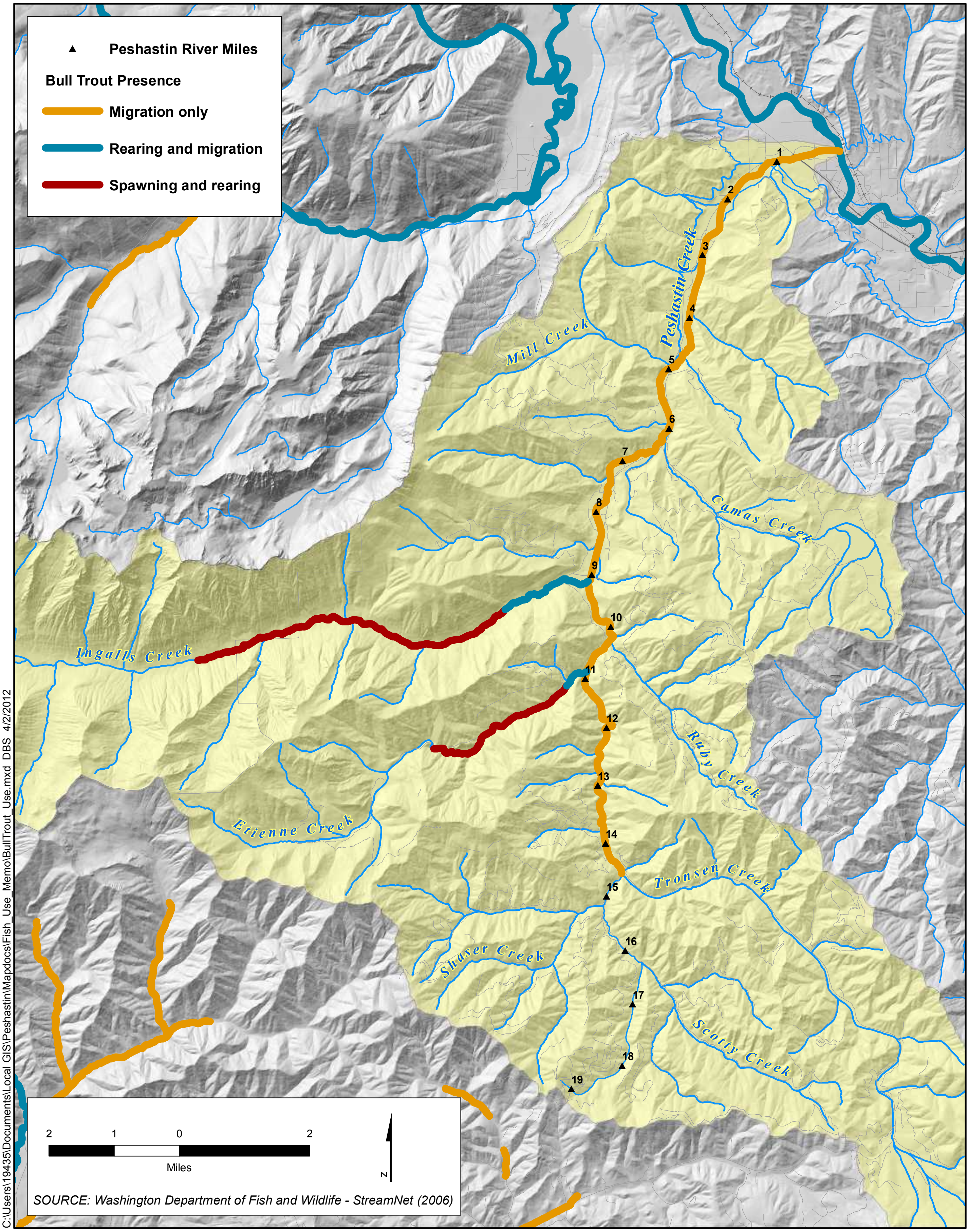
ICF INTERNATIONAL

Figure 4
Spring Chinook Spawning Distribution in the Peshastin Basin
Peshastin Creek Fish Use



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ICF INTERNATIONAL

Figure 5
Bull Trout Presence in the Peshastin Basin
Peshastin Creek Fish Use