
Nason Creek – Upper White Pine Reach

Draft Alternatives Report

Prepared by:

Chad Hermendorfer
Hydrologist - USDA Forest Service TEAMS Enterprise Unit
&
Brian Bair
Fisheries Biologist USDA Forest Service TEAMS Enterprise Unit

for:

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Introduction

The US Forest Service TEAMS Enterprise Unit (TEAMS) has entered into an agreement with the US Bureau of Reclamation (BOR) to develop an Alternatives Evaluation Report (AER) for the Upper White Pine Reach of Nason Creek (Figure 1 and Figure 29 in Appendix A). The Upper White Pine Reach encompasses Nason Creek from River Mile 12.0 near Merritt, WA upstream to River Mile 14.3 at the White Pine Road Bridge.

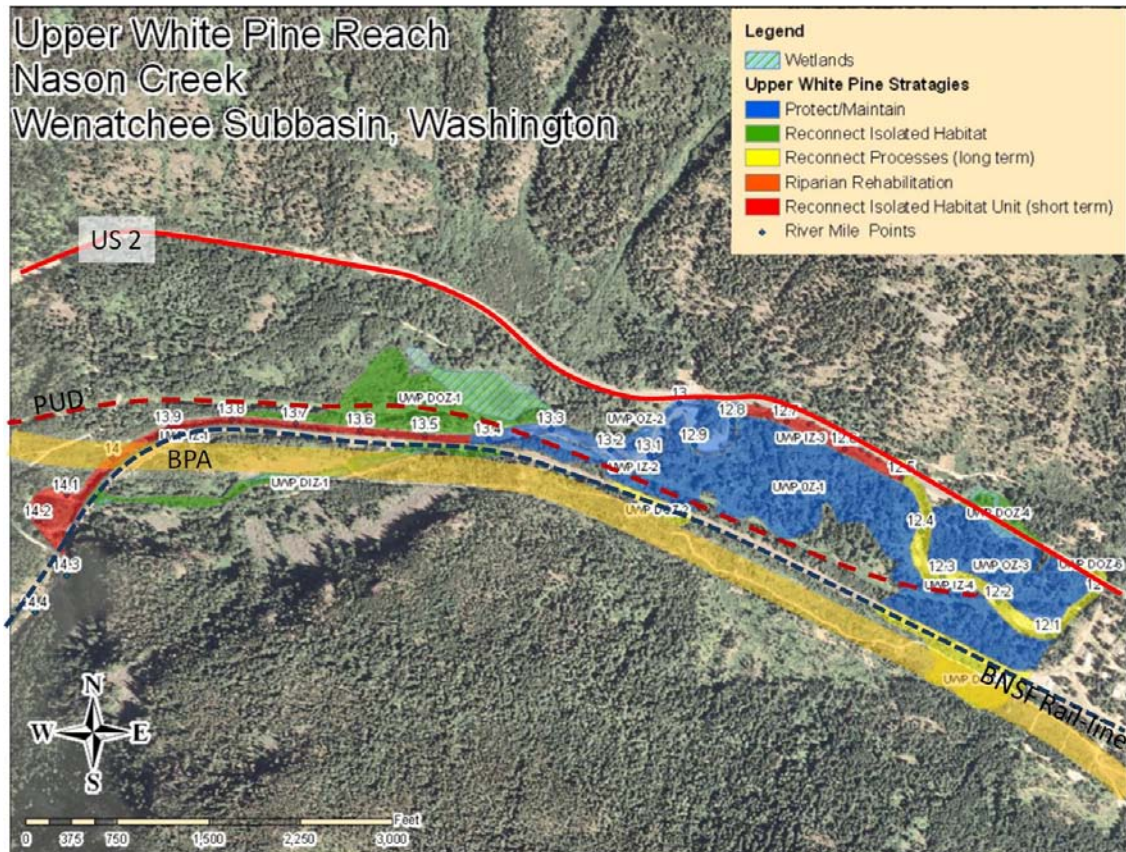


Figure 1. Map showing the Upper White Pine Reach of Nason Creek. Notice the locations of US Highway 2, the BNSF Railroad tracks, and the Bonneville Power Administration and Chelan County PUD above ground electrical lines. Stream flow is from left to right. Map borrowed from the Upper White Pine Reach Assessment (BOR, 2009).

A Nason Creek Tributary Assessment (BOR 2008) was completed in July 2008 followed by the Upper White Pine Reach Assessment (BOR 2009), completed in March 2009. The Tributary Assessment documents general conditions in Nason Creek from River Mile 4.6 upstream to River Mile 14.3. The Upper White Pine Reach Assessment documents more specific conditions of Nason Creek from River Mile 12.0 upstream to 14.3.

The next step in the process is to refine the analysis further by proposing alternatives that would improve the degraded conditions documented in the Tributary and Reach Assessments. This will be accomplished by completing an AER.

This document represents the first step in the development of the AER for the Upper White Pine Reach. It defines a range of conceptual draft alternatives that have been developed by TEAMS to improve hydrologic and aquatic habitat conditions throughout the Upper White Pine Assessment

Reach. This document will serve as a catalyst for constructive discussion and debate by the Wenatchee Habitat Sub Committee and will aid in the development of the final alternatives for the AER.

Note that cost estimates for individual alternatives in this report have not been developed at this time. Detailed cost estimates will be developed once concrete alternatives are developed for the AER.

Reach Description

From October 12-14, 2010 members of TEAMS evaluated the Upper White Pine area by walking and kayaking the reach. The field work, in conjunction with review of the Tributary and Reach Assessments and aerial photo analysis, provides the basis for the draft alternatives presented in this report.

The Upper White Pine Reach Assessment breaks the reach into “Subreach Units”. Subreach units are comprised of the active main channel, floodplain, and off-channel areas. Individual subreach units are shown in Figure 29 in Appendix A and include:

- Upper White Pine Inner Zone 1 (UWP IZ-1) (RM 14.3 downstream to between RM 13.5 and 13.4)
- Upper White Pine Disconnected Inner Zone 1 (UWP DIZ-1) (RM 14.1 downstream to RM 13.4)
- Upper White Pine Disconnected Outer Zone 1 (UWP DOZ-1) (RM 13.8 downstream to RM 13.3)
- Upper White Pine Inner Zone 2 (UWP IZ-2) (Between RM 13.5 and RM 13.4 downstream to RM 12.8)
- Upper White Pine Outer Zone 1 (UWP OZ-1) (Below RM 13.4 downstream to the reach end at RM 12.0)
- Upper White Pine Outer Zone 2 (UWP OZ-2) (RM 13.2 downstream to between RM 13.1 and RM 13.0)
- Upper White Pine Inner Zone 3 (UWP IZ-3) (RM 12.8 downstream to RM 12.5)
- Upper White Pine Inner Zone 4 (UWP IZ-4) (RM 12.5 downstream to RM 12.0)
- Upper White Pine Outer Zone 3 (UWP OZ-3) (Between RM 12.5 and 12.4 downstream to reach end at RM 12.0)
- Upper White Pine Disconnected Outer Zones 2 and 5 (UWP DOZ-2 and UWP DOZ-5) (Located south of RR Tracks)
- Upper White Pine Disconnected Outer Zones 3, 4, and 6 (UWP DOZ-3, UWP DOZ-4, and UWP DOZ-6) (Located north of U.S. Highway 2)

Following field review, TEAMS determined that subreach units would be further grouped into project areas that are connected geomorphically. The following describes the five project areas that will be used to describe alternatives for the Upper White Pine Reach of Nason Creek.

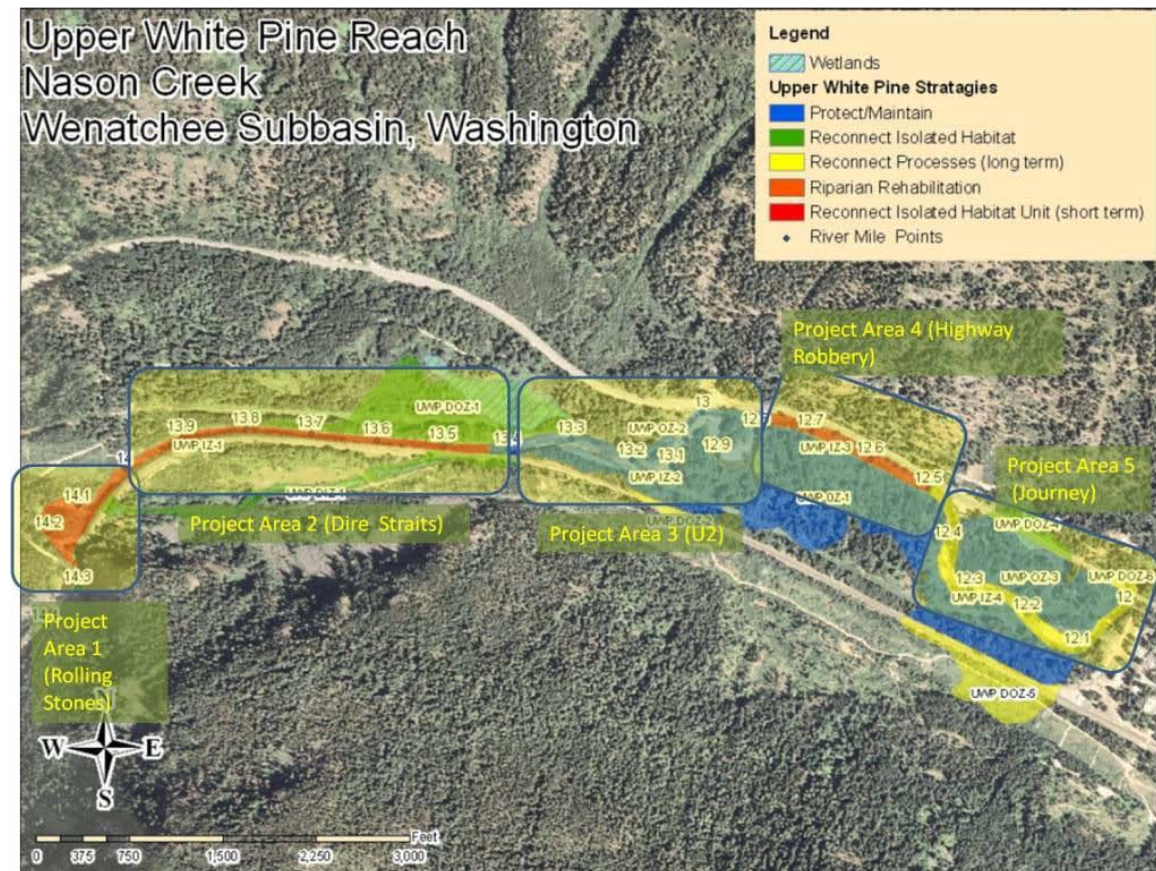


Figure 2. Location of project areas to be used for the Upper White Pine Alternative Evaluation Report (AER).

Project Area 1 (Rolling Stones)

The Rolling Stones project area encompasses the Upper White Pine Reach from River Mile 14.3 at the White Pine Bridge downstream to River Mile 14.0 (Figure 2 and Figure 3). The sub-reach units involved with Project Area 1 include:

- UWP IZ-1
- UWP DIZ-1

The Rolling Stones project area has been impacted by the construction of the railroad crossing and apparent channelization / stream diversion resulting from the construction of the rail corridor. The channel characteristics are steep, straight, highly entrenched with a few runs and riffle/cascades composed of boulder and cobble substrate (Figure 4).

From aerial photo interpretation (see AppendixB), it appears the original channel through this area was located where sub-reach unit UWP DIZ-1 is located. The BNSF railroad prism currently disconnects UWP DIZ-1 from the active channel and floodplain. This original channel appears to have been quarried for rock that was likely used for railroad or other grade construction. It is no longer a defined channel in many places, but a series of ponds at varying elevations.



Figure 3. Aerial photo showing the location of the Rolling Stones Project Area. The project area is represented by the yellow polygon, Nason Creek by the blue line, and the BNSF railroad prism by the red dashed line. Stream flow is from left to right.



Figure 4. View of the transition between the Rollings Stones and Dire Straits project areas.

Project Area 2 (Dire Straits)

The Dire Straits project area encompasses the Upper White Pine Reach from River Mile 14.0 downstream to River Mile 13.4 (Figure 2). The sub-reach units involved with Project Area 2 include:

- UWP IZ-1
- UW PIZ-2
- UWP DOZ-1
- UWP DIZ-1

This section of channel was constructed to protect the railroad infrastructure to the south. The creek is rip-rapped and dikes exist on both sides of the Nason Creek channel (Figure 5). The channel through Dire Straits has a lower channel slope than Rolling Stones and is similar in that it is still incised and highly entrenched due to the rip-rap and dikes. Due to the slightly lower gradient, Dire Straits contain more pool, glide and riffle habitat. Historically, as shown from aerial photo interpretation (see Appendix B), the channel was alluvial through this area and migrated across the valley floor. The channel was in balance with the water and sediment that was transported through the reach and the floodplain was functioning properly. The riparian component that existed through this segment provided the stream with floodplain roughness and supplied continuous large wood, shade, and fish habitat. Presently this section of channel is a transport reach (Montgomery and Buffington, 1993), and sediment is routed downstream.



Figure 5. Typical view of the Dire Straits Project Area. Notice the rip rap that dominates the stream banks through this segment. The railroad grade is located to the left and the dike that protects the PUD lines is located to the right.

Project Area 3 (U2)

The U2 project area encompasses the Upper White Pine Reach from River Mile 13.4 downstream to River Mile 12.8 (Figure 2). The sub-reach units involved with Project Area 3 include:

- UWP IZ-2
- UWP DOZ-1
- UWP DOZ-2
- UW OZ-1
- UW OZ-2

This section of channel provides some of the best fish habitat through the Upper White Pine Reach. U2 is alluvial in nature and includes 2 separate meander bends. These meanders have migrated at higher rates since the channelization of the upstream Dire Straits segment. Figure 6 illustrates the increased migration since 1970.



Figure 6. Illustration of changes to the migration pattern of the stream channel through the U2 project area. Note that the blue line is interpreted from LiDAR data taken in 2006 and represents the approximate current stream channel. The aerial photo was taken in 1970.

The segment provides quality habitat because of the interaction between the channel and floodplain. The channel has abundant large wood (Figure 7) created by an active floodplain with diverse riparian species and age classes as well as active beaver populations.

The U2 project area acts as a sediment storage and deposition area, and a response reach (Montgomery and Buffington, 1993). Sediment transported through the straightened segments upstream (Rolling Stones and Dire Straits) is deposited in this area as the level of channel confinement drops off after the channelized section.



Figure 7. View of inside meander bend within the U2 project area. Notice the diverse age class and species of riparian vegetation and the abundance of in-stream and floodplain large wood.

Project Area 4 (Highway Robbery)

The Highway Robbery project area encompasses the Upper White Pine Reach from River Mile 12.8 downstream to River Mile 12.5 (Figure 2). The sub-reach units involved with Project Area 4 include:

- UWP IZ-3
- UWP OZ-1

Highway Robbery is located along the road fill for US Highway 2 (Figure 8). The highway right of way has impacted riparian vegetation and large wood recruitment on the north bank of the project area break. Project Area 4 also has very low sinuosity however this section of stream currently provides some of the better spawning habitat in the Upper White Pine Reach. The stream is slightly entrenched through this segment and does not access the floodplain as regularly as it has in the past. LiDAR imagery and aerial photos (see Appendix B) suggest that the stream channel actively migrated through UWP OZ-1 over time (Figure 9) and the interaction between stream channel and floodplain was healthier in the past.



Figure 8. Aerial photo showing the location of the Highway Robbery project area.

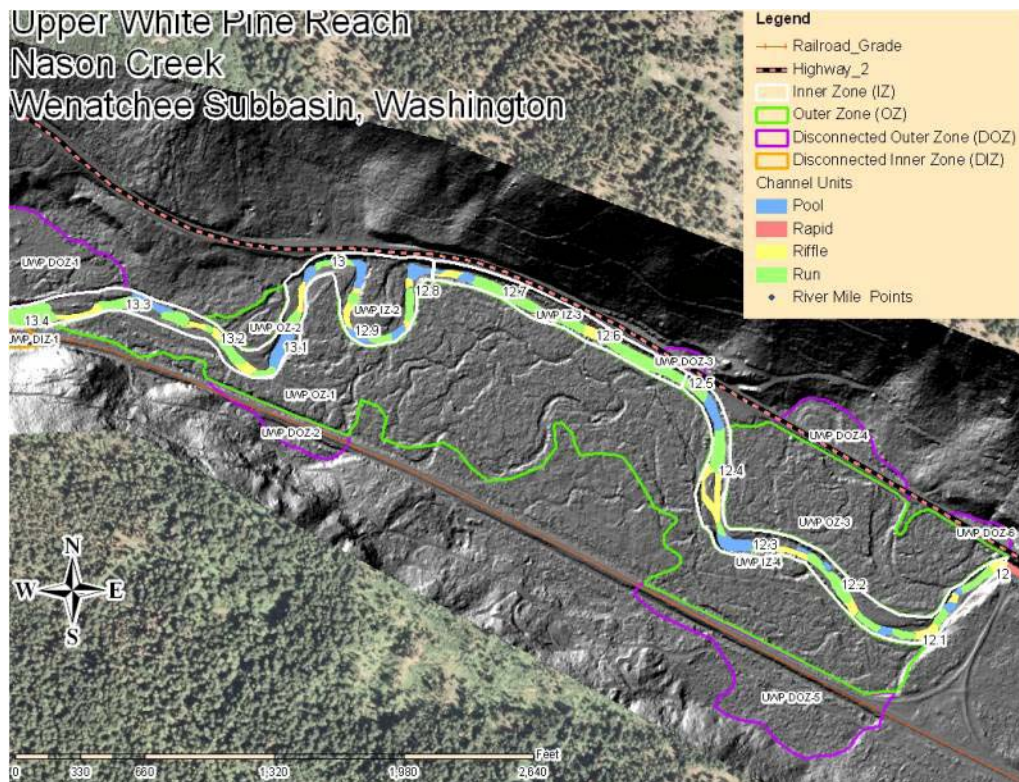


Figure 9. LiDAR image illustrating historic stream channel locations throughout UWP OZ-1 in the Highway Robbery project area.

Project Area 5 (Journey)

The Journey project area encompasses the Upper White Pine Reach from River Mile 12.5 downstream to the reach end at River Mile 12.0 (Figure 2). The sub-reach units involved with Project Area 5 include:

- UWP IZ-3
- UWP OZ-1

Journey starts where the channel leaves the US Highway 2 road fill and ends just upstream of the bridge at Merritt. The channel geometry, floodplain connectivity and riparian conditions within this project area are qualitatively in good shape and appear to be functioning and recovering from past perturbations well. However, there is a lack of large wood and channel roughness as a result of the US Highway 2 fill slope impact on riparian vegetation.



Figure 10. Aerial photo showing the location of project area 5 (Journey).

Draft Alternative Descriptions

Introduction

The following section describes the possible alternatives to be considered for the Upper White Pine Reach AER. In developing these alternatives there were no limitations as to what could be considered. This exercise is to give the Wenatchee Habitat Sub Committee a wide range of alternatives to consider, discuss, and refine.

All alternatives with the exception of the No Action alternatives would have various forms and intensities of riparian rehabilitation that are not discussed in this document.

Project Area 1 (Rolling Stones)

Rehabilitation options are limited in Project Area 1 due to the location of the White Pine Road and the BNSF Railroad tracks (Figure 3). Options include:

- PROJECT AREA 1 ALTERNATIVE A: Alternative 1A would involve placement of large wood structures and jams along the channel and floodplain to increase roughness, protect recovering riparian vegetation and provide resting habitat for fish. This alternative would also propose to place large wood structures within the existing high flow channel to prevent stream channel avulsion and provide grade control, high water refuge for fish and protect riparian vegetation (See Figure 11).
- PROJECT AREA 1 ALTERNATIVE B: Alternative 1B proposes to only place large wood structures and jams in the existing side channel to prevent stream channel avulsion and provide grade control, high water refuge for fish and protect riparian vegetation (See Figure 12).
- PROJECT AREA 1 ALTERNATIVE C: Alternative 1C would be the no action alternative and would leave the project area as is.

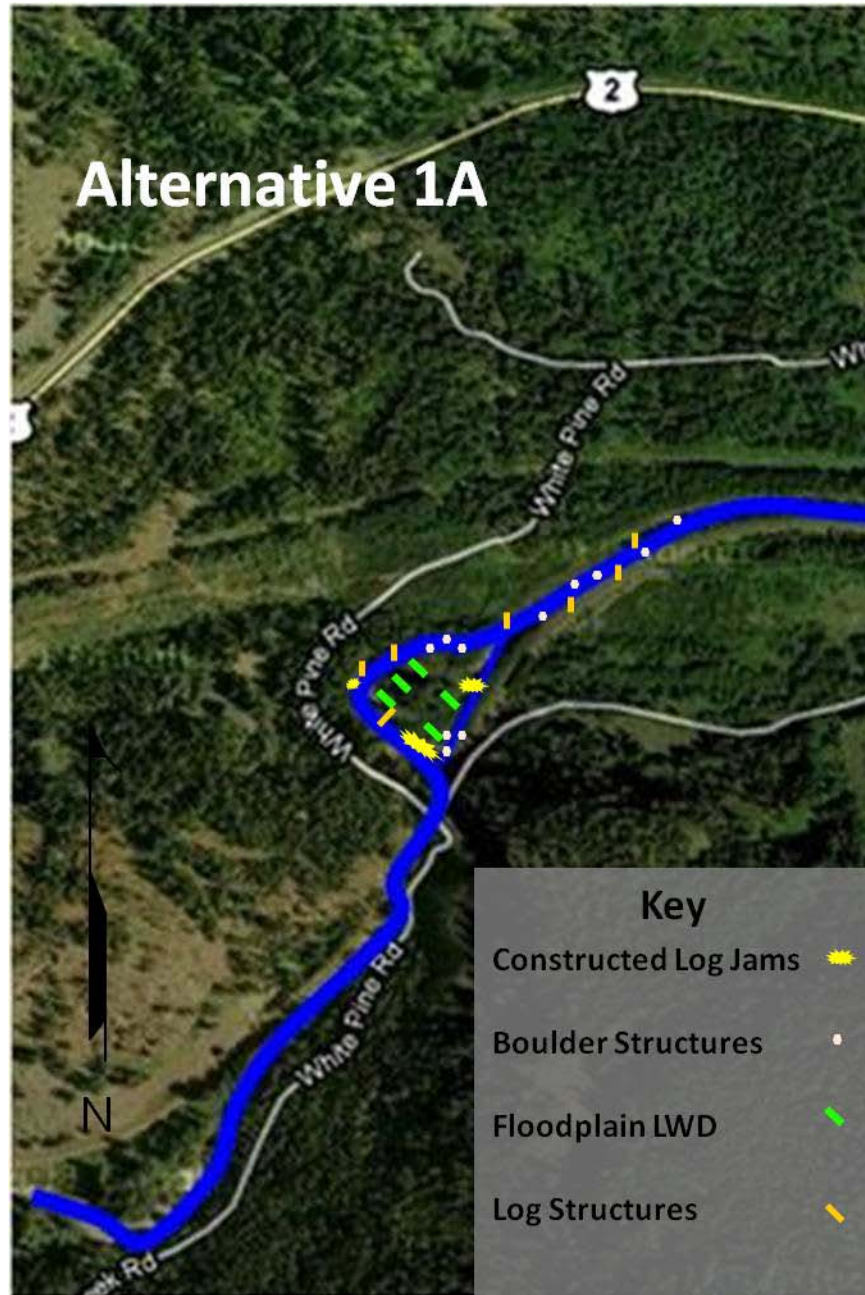


Figure 11. Conceptual plan view for Alternative 1A.

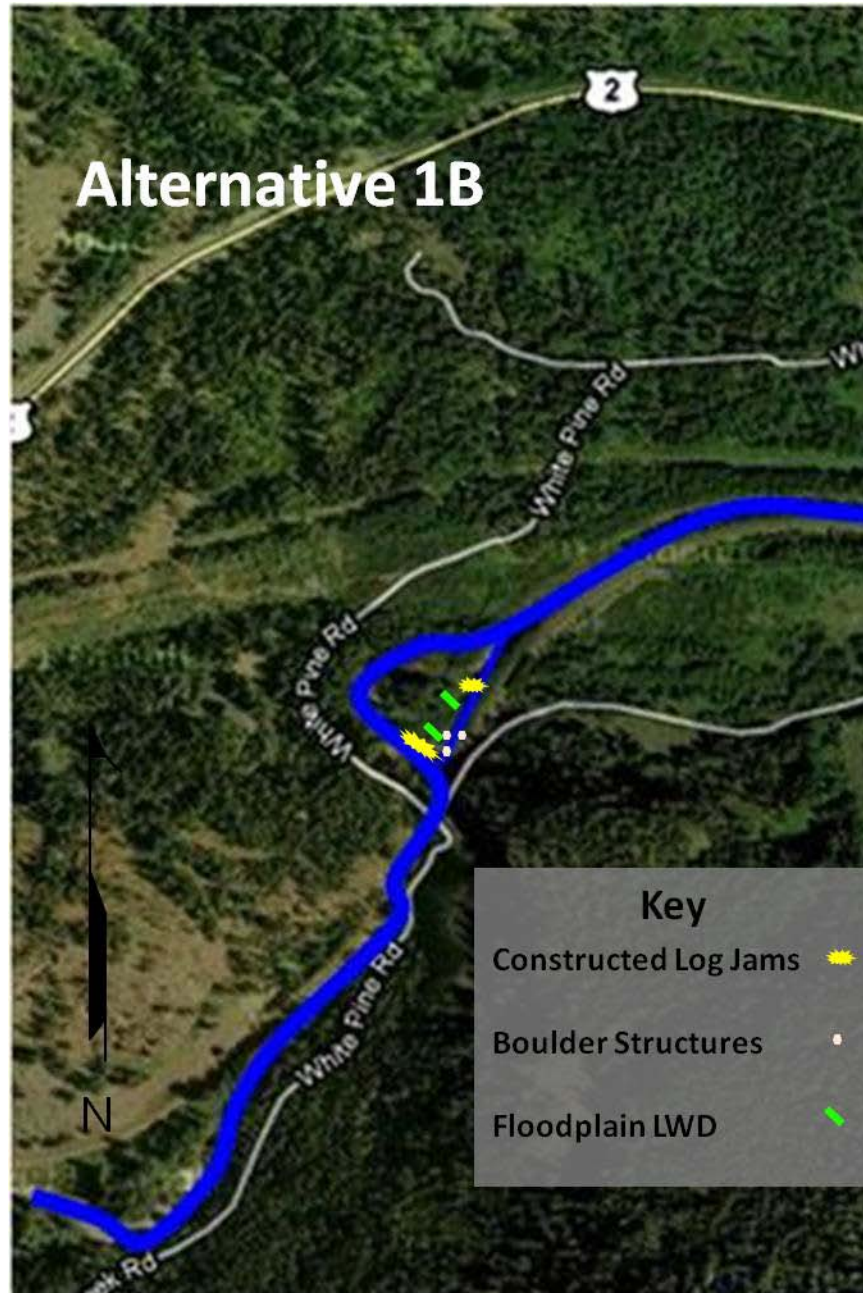


Figure 12. Conceptual plan view for Alternative 1B.

Project Area 2 (Dire Straits)

The past channelization of Dire Straits project area has created a straightened stream channel with no sinuosity, steeper gradient than before channelization, poor numbers and volumes of pools, limited spawning habitat, limited floodplain capacity, and reduced riparian function (Figure 5). To rehabilitate the channel to a properly functioning geomorphic condition with quality aquatic habitat major channel reconstruction is necessary. Options include:

○

- PROJECT AREA 2 ALTERNATIVE A: Alternative 2A proposes to relocate the existing railroad prism and PUD lines from their current locations to along the far south edge of the valley. Further, the old road prism on the north side of the current channel as well as the existing railroad prism to the south of the current channel would be removed. Currently, both the old road prism and BNSF railroad line function as dikes. The main stream channel would be reconstructed and floodplain side channels created. Stream channel sinuosity would be restored to within the historic range, lowering stream channel slope, increasing stream length and improving pool and spawning habitat for fish. Side channels and alcove backwater habitat features would also be constructed to provide off channel rearing and high flow refuge habitat. Large wood structures would be strategically placed along the reconstructed channel to maintain pools, provide roughness and encourage sediment capture and riparian establishment. Riffles and glides would be constructed to provide spawning habitat for salmon, steelhead, and bull trout. The majority of the existing channel would be abandoned, plugged and filled and/or serve as flood plain and off channel habitat and power line corridor (See Figure 13).
- PROJECT AREA 2 ALTERNATIVE B: Alternative 2B proposes to eliminate the old road prism on the north side of the stream and construct a new channel reconnecting the large existing wetland. This alternative would involve routing the channel around the PUD power poles or relocating the PUD lines out of this area to allow the channel to migrate freely in the future. As with Alternative 2A, stream channel sinuosity would be restored, stream channel slope lowered, stream length increased, and pool and spawning habitat improved for fish. Further, side channel and alcove backwater habitat features would also be constructed, large wood added, and riffle and glides constructed as in Alternative 2A. Further, the majority of the existing channel would be abandoned, plugged and filled and/or serve as flood plain and off channel habitat and power line corridor. In addition, a culvert just below River Mile 13.5 could be replaced with a larger culvert or multiple culverts to provide access to the historic southern half of the flood plain habitat in sub-reach unit UWP DIZ-1 now cutoff by the current railroad prism. (See Figure 14.)
- PROJECT AREA 2 ALTERNATIVE C: This alternative proposes to eliminate the old railroad prism and rip-rap on the north side of the stream and place large wood habitat structures in and along the channel for increased stream channel roughness, substrate and habitat diversity. Structures would be constructed to protect the power poles and the access route to each series of poles would also need to be reconstructed. This alternative would increase floodplain capacity through the reach and establish a riparian forest on the north side of the channel. However, riparian vegetation would be less than both Alternatives 2A and 2B due to the power pole access and vegetation management associated with the PUD power line corridor. This alternative also proposes to replace the railroad crossing culvert just below River Mile 13.5 with a larger culvert or multiple culverts to provide access to the historic southern half of the flood plain habitat in sub-reach unit UWP DIZ-1 now cutoff by the current railroad prism. (See Figure 15)
- PROJECT AREA 2 ALTERNATIVE D: This alternative proposes to create partial breaches of the old railroad prism on the north side of the channel with culverts

and/or openings and place large wood habitat structures in and along the channel for increased stream channel roughness, substrate and habitat diversity. As like Alternative 2C, structures would be constructed to protect the existing power poles. This alternative would increase floodplain capacity through the reach and establish a riparian forest on the north side of the channel. However, riparian vegetation would be less than Alternatives 2A, 2B, or 2C due to the power pole access and vegetation management associated with the PUD power line corridor. As like Alternatives 2B and 2C, this alternative also proposes to replace the railroad crossing culvert just below River Mile 13.5 (See Figure 16).

- PROJECT AREA 2 ALTERNATIVE E: This alternative proposes to leave the existing levee and construct a series of large wood structures and jams in and along the channel to increase roughness, stream bed substrate and fish habitat diversity. (See Figure 17).
- PROJECT AREA 2 ALTERNATIVE F: Alternative 2F would be the no action alternative and would leave the project area as is.

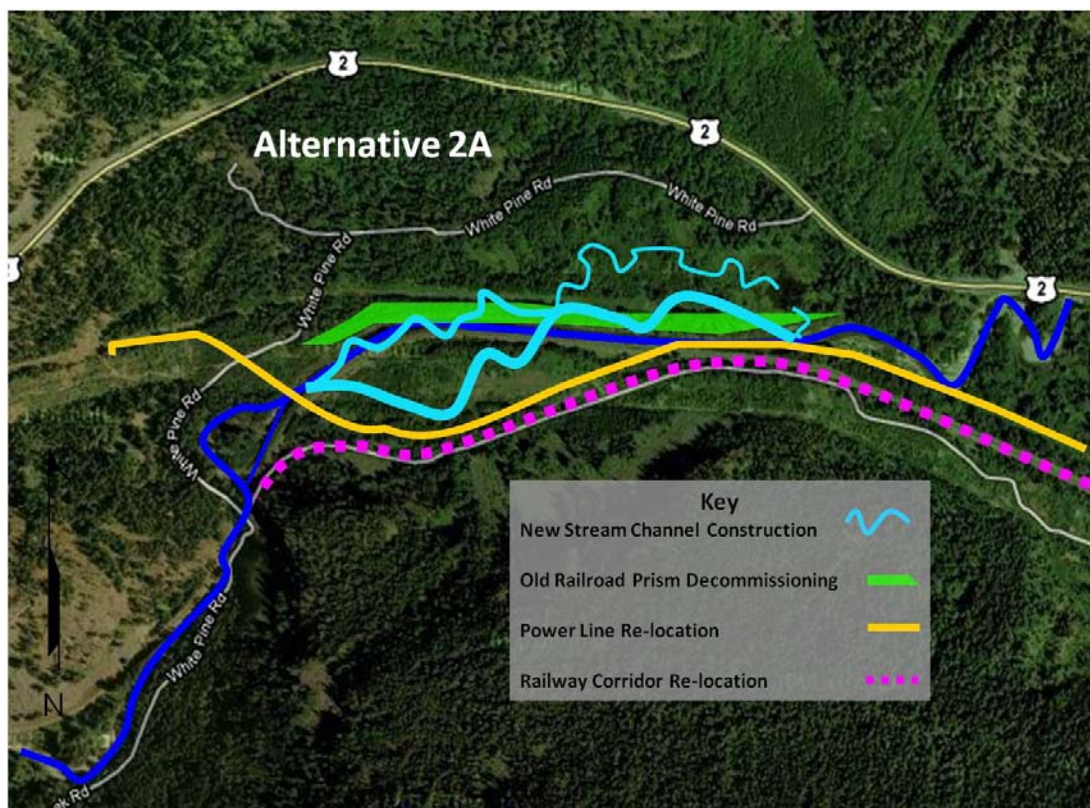


Figure 13. Conceptual plan view for Alternative 2A.

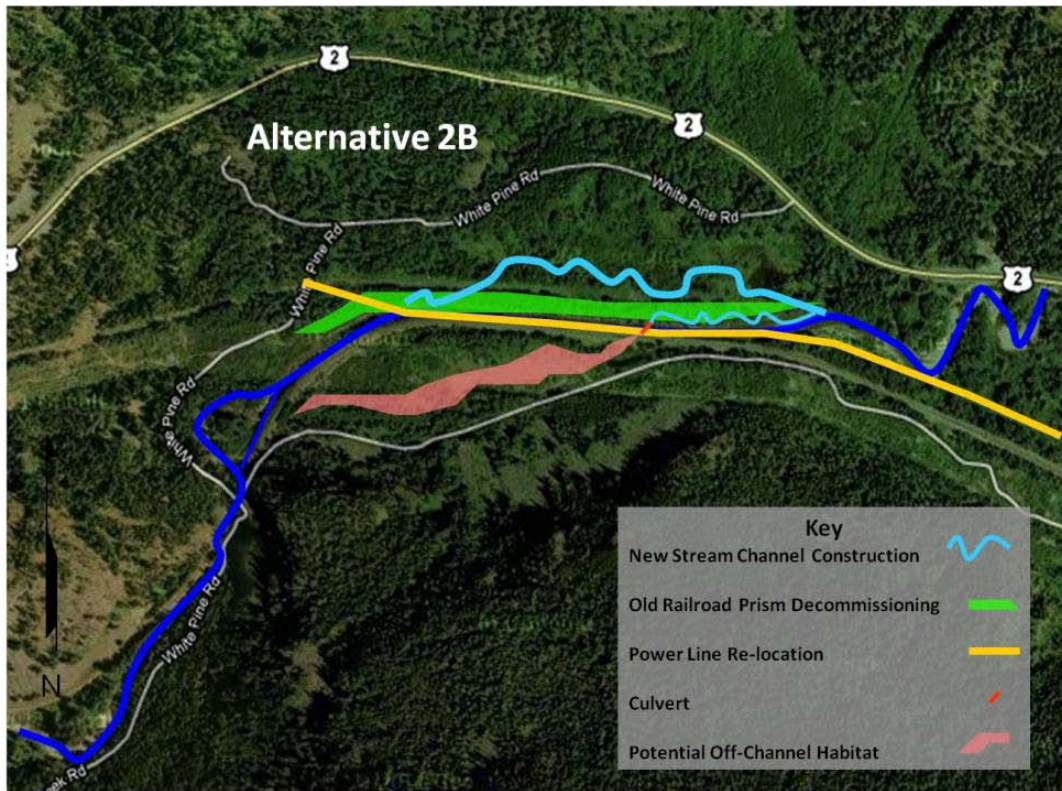


Figure 14. Conceptual plan view for Alternative 2B.

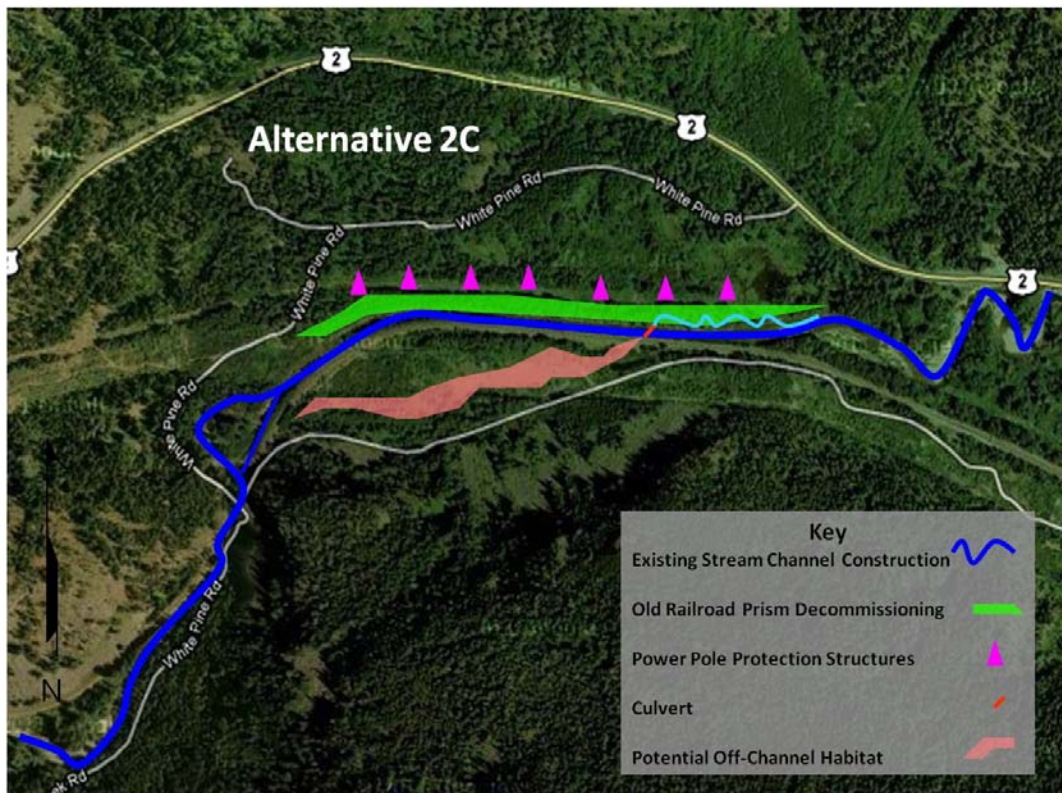


Figure 15. Conceptual plan view for Alternative 2C.

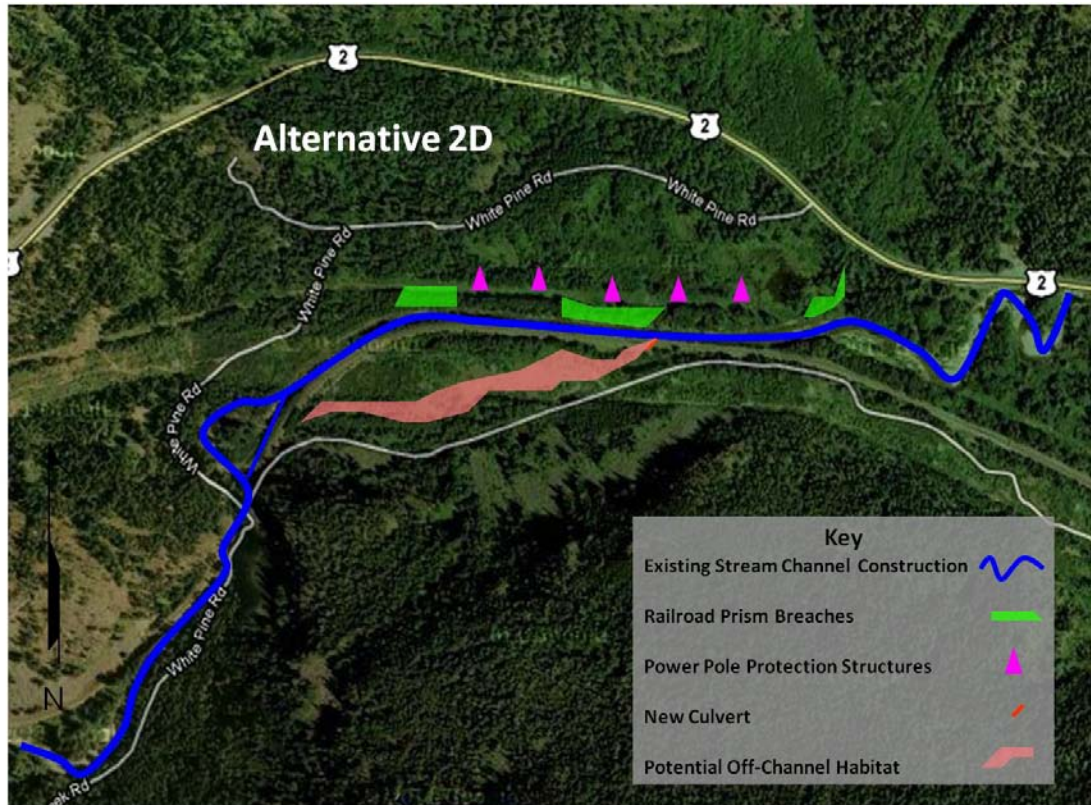


Figure 16. Conceptual plan view for Alternative 2D.

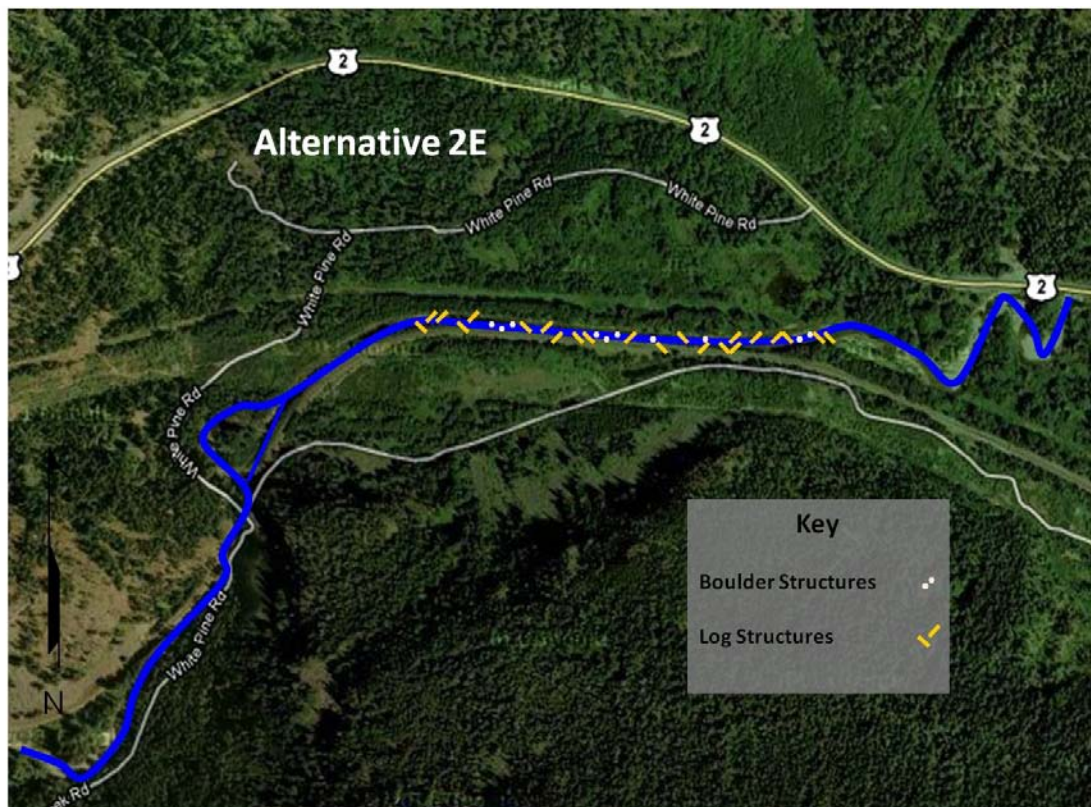


Figure 17. Conceptual view for Alternative 2E.

Project Area 3 (U2)

U2 provides some of the best fish habitat in the Upper White Pine Reach. There are, however, still impacts from the location of the PUD power lines and US Highway 2 road fill. Figure 18 shows the impacts to stream bank stability caused by the clearing of the PUD Utility corridor and Figure 19 shows the impacts from the US Highway 2 road fill location.

Rehabilitation options for Segment 3 include:

- PROJECT AREA 3 ALTERNATIVE A: Alternative 3A would add large wood structures to the existing channel to provide pool and hiding cover habitat for fish while providing protection for the power line crossing preventing the addition of sheet pile or rip-rap to protect the poles in the future. This alternative would also strategically place floodplain wood and gravel bar structures (See Figure 20).
- PROJECT AREA 3 ALTERNATIVE B: Alternative 3B would consist of adding floodplain large wood and gravel bar structures to decrease width to depth ratios throughout the reach (See Figure 21).
- PROJECT AREA 3 ALTERNATIVE C: Alternative 3C would involve moving the PUD power line corridor and reestablishing riparian vegetation in those impacted locations (See Figure 22).

PROJECT AREA 3 ALTERNATIVE D: Alternative 3D would be the no action alternative and would leave the project area as is.



Figure 18. View of stream bank erosion caused by the placement of the PUD power line in Project Area 3. Notice the lack of mature riparian vegetation on the outer bend of the meander.



Figure 19. View of rip rapped section of project area 3 along the north bank of US Highway 2. Notice the lack of riparian vegetation and large wood through this section of channel.

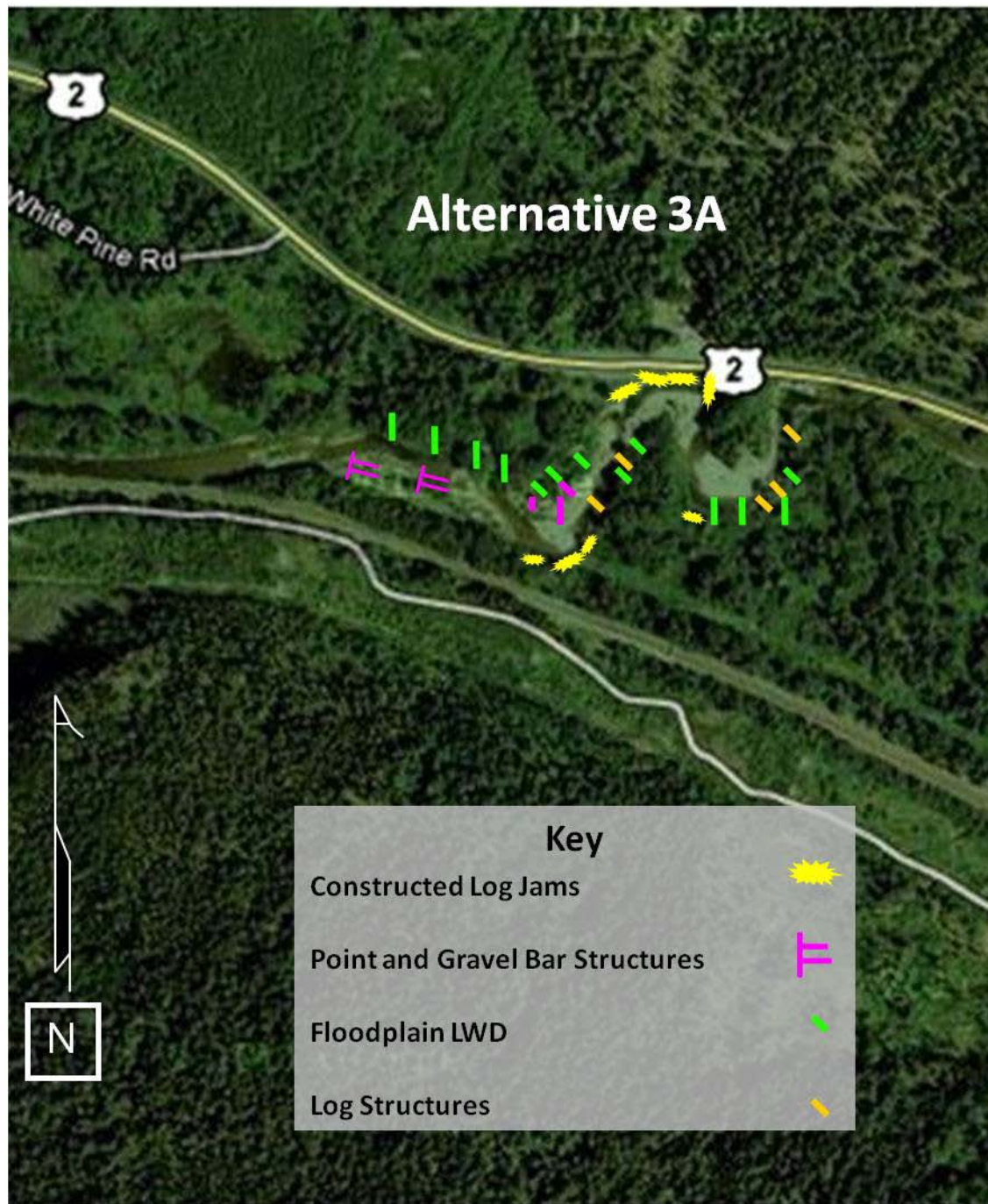


Figure 20. Conceptual plan view for Alternative 3A.

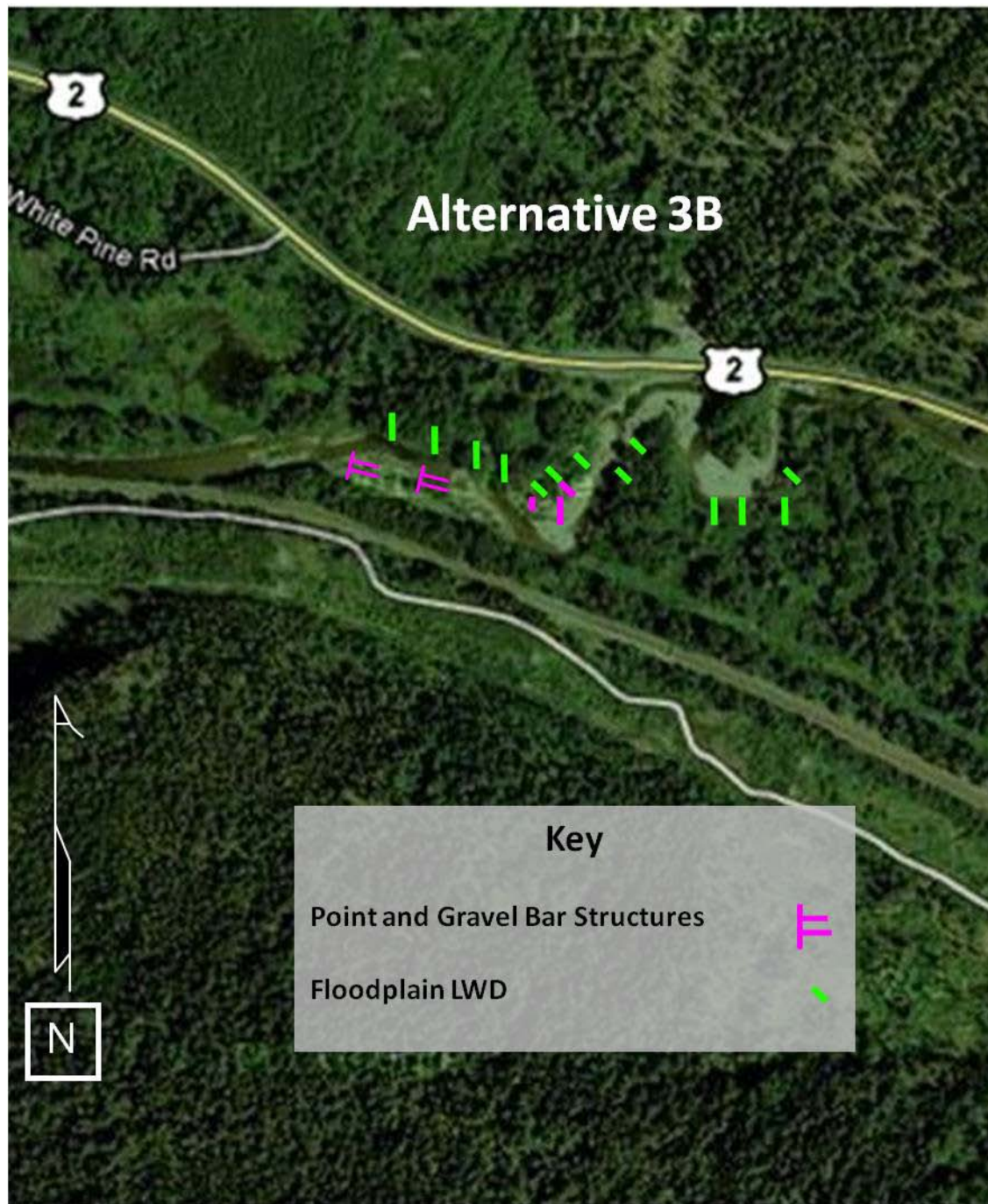


Figure 21. Conceptual plan view for Alternative 3B.



Figure 22. Conceptual plan view for Alternative 3C.

Project Area 4 (Highway Robbery)

The Highway Robbery project area provides some of the best spawning habitat in the Upper White Pine Reach. The project area has very low sinuosity (Figure 23) and is located along the US Highway 2 road fill. It is felt that this reach was moved to be along the Highway 2 road fill at some point in the past. Exactly when and why this occurred is unknown. Figure 9 illustrates that

the stream channel has moved regularly across the historic flood plain, indicating that the straight alignment is not natural for this setting.

Rehabilitation options for project area 4 include:

- PROJECT AREA ALTERNATIVE A: Alternative 4A would construct a new meander that moves the channel away from US Highway 2 and accesses the floodplain and riparian habitat located in UWP OZ-1 This alternative would also construct a series pools, riffles, spawning glides and large wood structures (See Figure 24).
- PROJECT AREA 4 ALTERNATIVE B: Alternative 4B would leave the channel in its existing alignment and construct a series of large wood habitat structures to increase pool, hiding cover and habitat complexity (See Figure 25).
- PROJECT 4 ALTERNATIVE C: Alternative 4C would involve adding in stream structures that would aggrade the channel or increase water surface elevation to restore flood plain connectivity and riparian habitat located in UWP OZ-1. This alternative would activate legacy floodplain areas that have not been accessed in the recent past due to the current channel alignment and elevation (Figure 26).
- PROJECT AREA 4 ALTERNATIVE D: Alternative 4D would be the no action alternative and would leave the project area as is.



Figure 23. Typical view of Highway Robbery Project Area. US Highway 2 road fill is located on the left side of the photo. Photo is looking downstream.

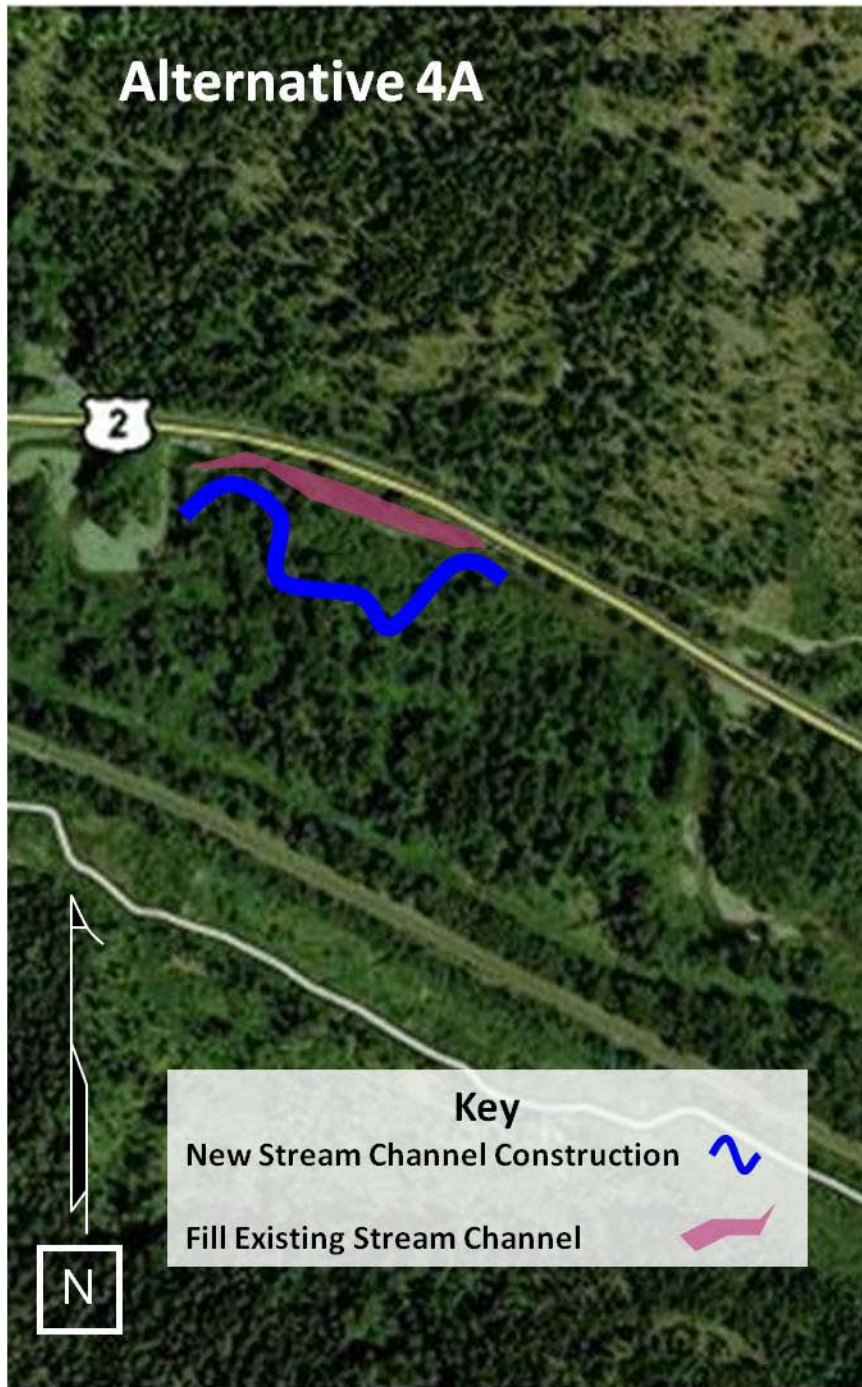


Figure 24. Conceptual plan view for Alternative 4A.

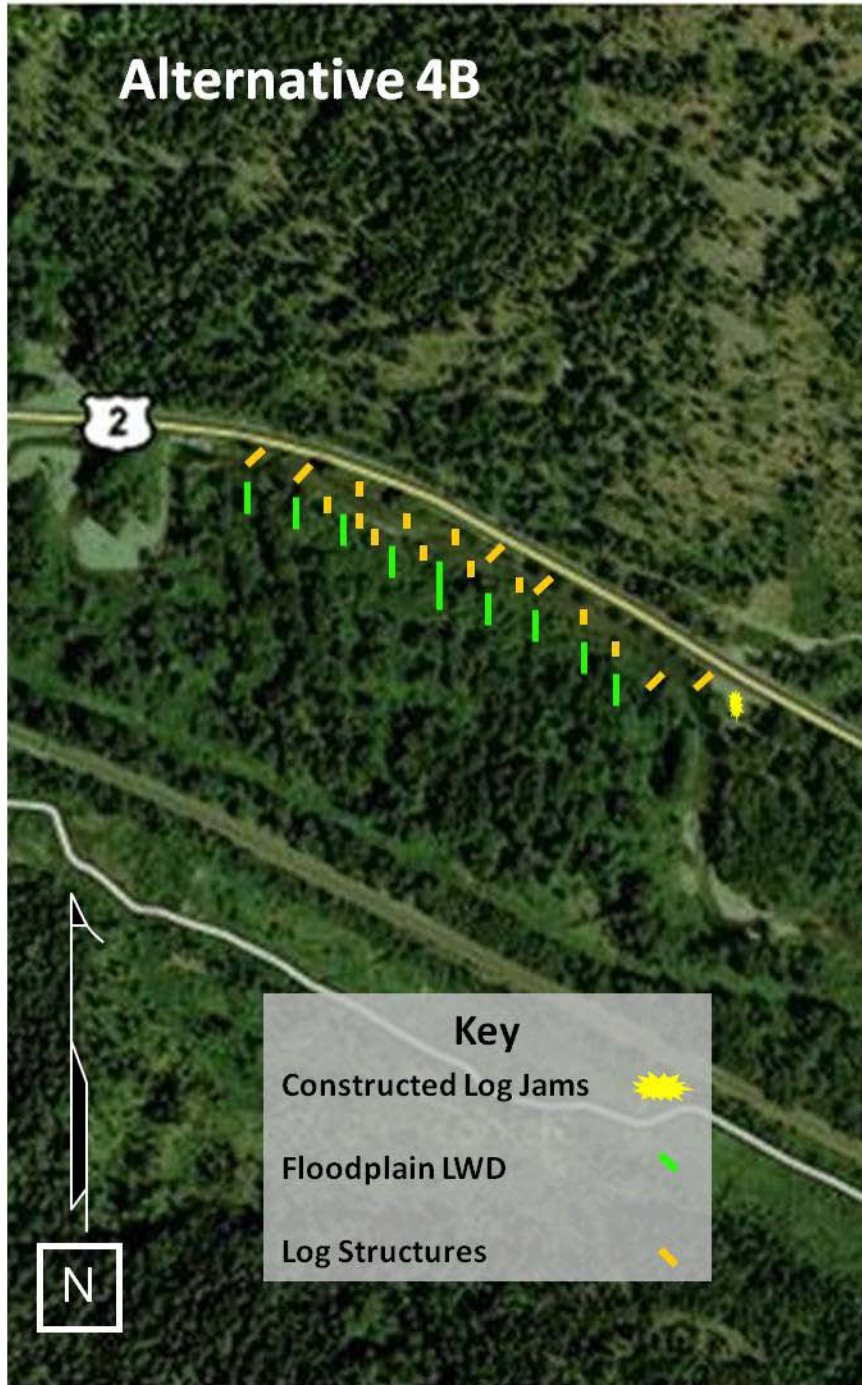


Figure 25. Conceptual plan view for Alternative 4B.



Figure 26. Conceptual plan view for Alternative 4C.

Project Area 5 (Journey)

The habitat through the Journey project area is in relatively good shape but could be improved. Historically, channel roughness and complexity were higher than at present. Rehabilitation options include:

- PROJECT AREA 5 ALTERNATIVE A: Alternative 5A would construct large wood structures along the stream and throughout the flood plain to improve roughness and complexity of the stream channel and floodplain (See Figure 27).
- PROJECT AREA 5 ALTERNATIVE B: Alternative 5B would reconnect the historic meander midway through the project area to restore sinuosity, increase pool and off channel habitat (See Figure 28).
- PROJECT AREA 5 ALTERNATIVE C: Alternative 5C would be the no action alternative and would leave the project area as is.

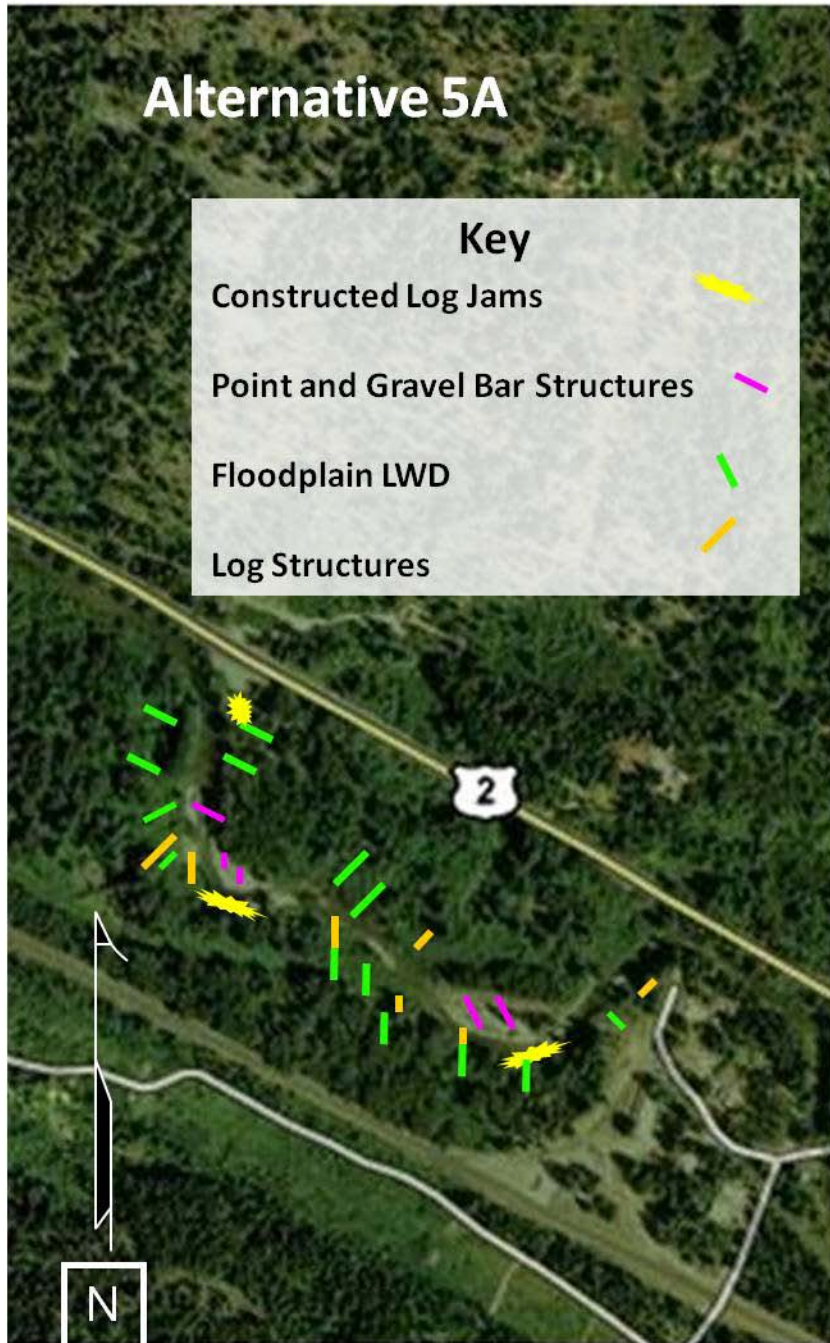


Figure 27. Conceptual plan view for Alternative 5A.



Figure 28. Conceptual plan view for Alternative 5B.

Alternative Comparison

Multiple alternatives have been proposed for each of the five individual project areas discussed in this report. It is recognized that the selection of a particular alternative in an individual project area could impact the management decision in an upstream or downstream project area. Table 1 provides an alternative comparison table that shows the actions that are proposed for the Upper White Pine AER and the alternatives associated with those actions.

Table 1. Alternative comparison table showing the proposed rehabilitation actions by alternative.

Actions Proposed	Alternatives
Alteration of railroad prism (bridge or culvert construction)	2A, 2B, 2C, and 2D
Channel reconstruction/plugging of abandoned channel	2A, 2B, 4A, and 5B
Riparian Rehabilitation	1A, 1B, 2A, 2B, 2C, 2D, 3A, 3B, 3C, 4A, 4B, 4C, 5A, and 5B
In stream/floodplain and/or side channel large wood placement	1A, 1B, 2A, 2B, 2C, 2D, 2E, 3A, 3B, 4A, 4B, 4C, 5A, and 5B
Removal of dike/breaching of dike	2A, 2B, 2C, and 2D
Relocating PUD lines	2A, 2B and 3C
Side channel construction	2A and 2B
Structure construction to protect PUD power poles	2A, 2B, 2C, 2D, 3A, and 3B

Biological Benefits

Alternatives were developed to address the limiting factors that impact the Upper White Pine Reach of Nason Creek. These limiting factors were devised from publications and reports that have been compiled and published since 2001. They include:

- The Upper Columbia Salmon Recovery Board Regional Technical Team (RTT) 2009 document that states the priority in Nason Creek is to restore natural stream channel processes to the system.
- The Upper White Pine Reach Assessment (BOR 2009) which states, “In the instance of the Upper White Pine (of Nason Creek) reach, the habitat-forming processes have been unfavorably impacted, with over 93 percent of the river condition indicators in a degraded condition (i.e., over one-quarter of the indicators are at unacceptable risk and another two-thirds at risk, as shown in Table 2). With the exception of habitat access, all other pathways have at least one river condition indicator functioning in an at-risk or unacceptable-risk condition. This is indicative of impaired habitat-forming processes. Three indicators in particular, large woody debris (LWD), pool quality, and floodplain connectivity, are symptomatic of the larger issue of lost geomorphic potential.”

Table 2. Reach based ecosystem indicators (REI) for the UWP Reach (BOR 2009).

Pathway	Reach Based Indicator	Condition
Water Quality	Temperature	Unacceptable risk
	Turbidity	At risk
	Chemical contaminants/nutrients	At risk
Habitat Access	Physical barriers	adequate
Habitat Quality	Substrate	At risk
	LWD	Unacceptable risk
	Pool Frequency and Quality	At risk
	Connectivity w/main channel	At risk
Channel condition and dynamics	Floodplain connectivity	At risk

Pathway	Reach Based Indicator	Condition
	Bank stability/channel migration	At risk
	Vertical channel stability	At risk
Riparian vegetation	Structure	At risk
	Disturbance	Unacceptable risk
	Canopy cover	Unacceptable risk

- The biological strategy to protect and restore salmonid habitat in the Upper Columbia Region (UCRTT 2008) which states that habitat action recommendations include:
 1. Floodplain Restoration
 2. Riparian Restoration
- The Carmen 2001 executive summary which states that, “Maintaining the remaining functioning floodplain and riparian habitat is the first priority in the Nason Creek watershed. Habitat restoration projects that allow Nason Creek to adjust to changes in flows and sediment within the channel migration zone are second in priority. This would include projects aimed at improving riparian habitat functions and floodplain functions, especially reconnecting off-channel habitat to the extent it is determined to cumulatively show an appreciable improvement in channel function. Habitat restoration projects aimed at reducing sediment delivery to stream channels from human-induced causes should be the third in priority. “

As stated, draft alternatives have been developed to address these limiting factors to varying degrees. Table 3 summarizes how each proposed alternative would address these limiting factors in comparison to other alternatives while Table 4 compares the construction feasibility of each alternative proposed. Table 5 lists each subreach unit involved in the Upper White Pine Reach, shows which project area it correlates to, and ranks the importance of the subreach unit as it relates to the entire Nason Creek Project Area (ICF Jones & Stokes 2009).

Table 3. Proposed alternatives and their effects to limiting factors.

Alt*	Brief Description**	Limiting Factors Addressed					
		Natural Stream Processes	Water Quality	Habitat Quality	Channel Condition and Dynamics	Riparian Vegetation	Floodplain Condition
1A	Place wood and boulder structures in both channels			~1,600 linear feet improved			
1B	Place wood and boulder structures only in side channel			~2,100 linear feet improved			
2A	Re-locate BNSF railroad prism and CPUD line, remove north berm and current railroad prism, stream channel re-construction	~50-60 acres of floodplain reconnected, ~5 acres floodplain fill removed, ~1.2-1.5 miles of functioning stream channel constructed	Improved stream temperature	~6,000-7,000 linear feet improved	CPUD lines and BNSF railroad would be moved out of historical floodplain	~6,400 linear feet of rip rap removed	~50-60 acres of floodplain reconnected
2B	Re-locate CPUD line, remove north berm, connect DIZ-1 off-channel habitat, stream channel re-construction	~20-30 acres of floodplain reconnected, ~2 acres floodplain fill removed, ~0.7-1.0 miles of functioning stream channel constructed	Improved stream temperature	~4,500-5,500 linear feet improved	CPUD lines and BNSF railroad would be moved out of historical floodplain	~3,200 linear feet of rip rap removed	~20-30 acres of floodplain reconnected
2C	Protect CPUD lines, remove north berm, connect DIZ-1 off-channel habitat		Improved stream temperature	~3,200 linear feet improved		~3,200 linear feet of rip rap removed	~10-15 acres of floodplain reconnected
2D	Breach north berm, protect CPUD lines, connect DIZ-1 off-channel habitat		Improved stream temperature	~3,200 linear feet improved		1,600 linear feet of rip rap removed	~5-10 acres of floodplain reconnected
2E	Add large wood and boulder structures to existing channel			~3,200 linear feet improved			
3A	Place large wood structures, power line protection, log jams to stabilize bank		Improved stream temperature	~3,200 linear feet improved			Increased roughness with addition of large wood
3B	Place large wood structures, power line protection		Improved stream temperature	~3,200 linear feet improved			Increased roughness with addition of large wood
3C	Move CPUD power lines		Improved stream temperature			50-100 feet of riparian vegetation re-established	
4A	New channel construction	~15-20 acres of floodplain reconnected, , ~0.2-0.4 miles of functioning stream channel constructed	Improved stream temperature	~1,750 linear feet improved	Channel is moved away from Highway 2 road fill	~1,000 feet of riparian vegetation currently affected by the road fill would be allowed to establish with construction of the new channel	~15-20 acres of floodplain reconnected
4B	Place large wood structures in existing channel			~1,600 linear feet improved			~5-10 acres of floodplain reconnected
4C	Constructed riffle for grade control			~1,600 linear feet improved			~5-10 acres of floodplain reconnected
5A	Add large wood to existing channel/floodplain		Improved stream temperature	~2,600 linear feet improved			
5B	Large wood and meander restoration	~5-10 acres of floodplain reconnected, ~0.2-0.4 miles of functioning	Improved stream temperature	~2,800 linear feet improved			~5-10 acres of floodplain reconnected

Alt*	Brief Description**	Limiting Factors Addressed					
		Natural Stream Processes	Water Quality	Habitat Quality	Channel Condition and Dynamics	Riparian Vegetation	Floodplain Condition
		stream channel constructed					

* No action alternatives were not included in Table 3.
** Please see the report for full alternative description.

Table 4. Construction feasibility comparison by alternative.

Alternative	Construction Feasibility*					
	Ownership/Easement Complexity (Multiple Owners/Easements)	Material Acquisition	Permitting Complexity	Cost Benefit Ratio	Total	Feasibility Rating
1A	5	10	10	5	30	Low
1B	5	10	10	1	26	Moderate
2A	5	10	5	5	25	Moderate
2B	10	10	5	10	35	Low
2C	10	10	5	5	30	Low
2D	10	10	10	1	31	Low
2E	10	10	10	1	31	Low
3A	10	10	5	10	35	Low
3B	10	10	10	5	35	Low
3C	5	10	10	1	26	Moderate
4A	1	10	5	5	21	Moderate
4B	1	10	10	5	26	Moderate
4C	5	10	10	5	30	Low
5A	1	10	10	10	31	Low
5B	1	10	10	5	26	Moderate

*Construction feasibility addressed ownership/easement complexity (multiple owners/easements), ease of acquiring materials, permitting complexity, and cost benefit ratios. Ratings are as follows: 4-16 = High difficulty to implement, 17-29 = Moderate difficulty to implement, and 30-40 = Low difficulty to implement.

Table 5. Subreach Unit Prioritization and Relationship to Project Areas (ICF Jones & Stokes 2009). Table is organized by the type of restoration strategy.

Sub Unit Name	Project Area	Prioritized Habitat Action (Option 1 as described in Reach Assessment)	Biological Benefit	Social Feasibility	Construction Feasibility	Construction Cost	Overall Feasibility	Nason Creek Prioritization Rank	Description
Protect and Maintain Processes Biological Strategy Priority 1 (21 projects in the prioritization)									
UWP OZ-1	4	Protect and maintain current levels of geomorphic, hydrologic, and riparian function. Riparian Rehabilitation: Replant sections of riparian vegetation at 10-meter, 30-meter, and floodplain width to address the area impacted by the transmission and power lines (about 0.5 acres) and to improve canopy cover, large wood recruitment potential, and riparian composition within the floodplain. Address noxious weeds through planting and education/prevention programs.	5	3	N/A	N/A	3	2	46 acres; 14% private ownership
UWP OZ-3	5	Protect and maintain current levels of geomorphic, hydrologic, and riparian function. Riparian Rehabilitation: Replant sections of riparian vegetation at 10-meter, 30-meter, and floodplain width to address the area impacted by the transmission and power lines (about 0.3 acres) and to improve canopy cover, large wood debris recruitment potential, and riparian composition within the floodplain. Address noxious weeds through planting and education/prevention programs.	5	3	N/A	N/A	3	3	15 acres; 42% private ownership w/ UWP DOZ-4 & 6
UWP IZ-2	3	Protect and maintain current levels of geomorphic, hydrologic, and riparian function. Riparian Rehabilitation: Replant sections of riparian vegetation at 10-meter, 30-meter, and floodplain width to address the area impacted by the transmission and power lines (about 0.5 acres) and to improve canopy cover, large woody debris recruitment potential, and riparian composition within the floodplain. Address noxious weeds through planting and education/prevention programs. Reconnect Habitat Unit: Modify riprap and sheet piling with and/or construct large woody debris complexes to improve habitat-forming processes by increasing retention of incorporated large woody debris and sediment retainment. Shortterm benefits include improvement of channel complexity, cover, and biomass. Existing In-stream structures should be evaluated and potentially modified to improve the functionality of refugia and hiding cover, sorting and retention of spawning gravel, and large woody debris retention. This is listed as a Tier 1 habitat action in the Biological Strategy (UCRTT 2007).	3	3	N/A	N/A	3	6	10 acres; 0% private ownership
UWP OZ-2	3	Protect and maintain current levels of geomorphic, hydrologic, and riparian function.	1	5	N/A	N/A	5	17	1 acre; 0% private ownership
Reconnect Isolated Habitat Biological Strategy Priority 2 (9 projects in the prioritization)									
UWP DIZ-1	2	Reconnect Isolated Habitat: Remove or modify railroad grade with bridges where appropriate to reconnect historic channel and reinitiate habitat-forming processes. Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover, and large woody debris recruitment potential within the rehabilitated floodplain. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	5	3	3	1	7	2	Railroad reconnection
UWP DOZ-1	2	Reconnect Isolated Habitat: Remove or modify levee, in combination with resloping of the left bank to reconnect existing wetlands and floodplain and reinitiate habitat-forming processes. Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover, and large woody debris recruitment potential within the rehabilitated floodplain. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	3	5	5	5	15	4	Levee breach
UWP DOZ-4	5 (outside)	Reconnect Isolated Habitat: Remove or modify Highway 2 with bridges where appropriate to reconnect floodplain and existing wetlands and	3	3	3	3	9	7	US 2 reconnection w/ UWP OZ-3

Sub Unit Name	Project Area	Prioritized Habitat Action (Option 1 as described in Reach Assessment)	Biological Benefit	Social Feasibility	Construction Feasibility	Construction Cost	Overall Feasibility	Nason Creek Prioritization Rank	Description
		reinitiate habitat-forming processes. Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover and large woody debris recruitment potential within the rehabilitated floodplain. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.							
Riparian Restoration (6 projects in the prioritization, but none from UWP)									
Reconnect Processes (Long Term) Biological Strategy Priority 3 (24 projects in the prioritization)									
UWP DOZ-5	5 (outside)	Reconnect Processes: Modify railroad grade with ridges or culverts where appropriate to reconnect floodplain area to riverine system Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover and large woody debris recruitment potential within the rehabilitated floodplain. Address noxious weeds through planting and education/prevention programs. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	5	3	3	3	9	4	Railroad reconnection
UWP IZ-4	5	Reconnect Processes through the use of various habitat actions from multiple habitat action classes including in-stream structures, floodplain Rehabilitation and large woody debris Rehabilitation that will result in an increase in the current bed elevation. This will in turn allow fluvial processes to work within adjacent outer zones more frequently. Combine with Riparian rehabilitation: Apply efforts for a long-term approach that will result in increased large woody debris recruitment potential, increased sinuosity, sorting and retention of spawning gravels, increased number of complex pools, and water quality. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	3	3	3	3	9	12	Instream structures
UWP DOZ-6	5	Reconnect Processes: Modify Highway 2 with culverts or bridges where appropriate to reconnect existing floodplain area to riverine system; Combine with riparian rehabilitation of sections of riparian vegetation at 10-meter, 30-meter, and floodplain width to address the disturbed area and to improve canopy cover, large woody debris recruitment potential, and riparian composition within the floodplain. Address noxious weeds through planting and education/prevention programs. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	1	5	3	3	11	21	US 2 reconnection w/ UWP OZ-3
UWP DOZ-2	3 (outside)	Reconnect Processes: Modify railroad with bridges or culverts where appropriate to reconnect floodplain area to riverine system Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover and large woody debris recruitment potential within the rehabilitated floodplain. Address noxious weeds through planting and education/prevention programs. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	1	5	3	1	9	23	Railroad reconnection
UWP DOZ-3	4 (outside)	Reconnect Processes: Modify Highway 2 with bridges or culverts where appropriate to reconnect existing floodplain to riverine system and reinitiate habitat-forming processes. Combine with riparian rehabilitation at 10-meter, 30-meter, and floodplain width to provide adequate composition, canopy cover and large woody debris recruitment potential within the rehabilitated floodplain. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	1	3	3	3	9	24	US 2 reconnection
Reconnect Habitats (Short Term) Biological Strategy Priority 5 (8 projects in the prioritization)									
UWP IZ-1	1 and 2	Riparian rehabilitation: Apply efforts for a long-term approach that will result in increased large woody debris recruitment potential, increased	3	3	1	3	7	5	Instream structures - along railroad

Sub Unit Name	Project Area	Prioritized Habitat Action (Option 1 as described in Reach Assessment)	Biological Benefit	Social Feasibility	Construction Feasibility	Construction Cost	Overall Feasibility	Nason Creek Prioritization Rank	Description
		sinuosity, sorting and retention of spawning gravels, increased number of complex pools, and water quality. This habitat action should be implemented in conjunction with Reconnect Habitat Unit: Modify riprap and/or construct large woody debris complexes to improve habitat-forming processes by increasing retention of incorporated large woody debris and sediment retainment. Short-term benefits include improvement of channel complexity, cover and biomass. Existing instream structures should be evaluated and potentially modified to improve the functionality of refugia and hiding cover, sorting and retention of spawning gravel, and large woody debris retention. This is listed as a Tier 1 habitat action in the Biological Strategy (UCRTT 2007). Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.							
UWP IZ-3	4	Reconnect Habitat Unit: Modify riprap and/or construct large woody debris complexes to improve habitat-forming processes by increasing retention of incorporated large woody debris and sediment retainment. Short-term benefits include improvement of channel complexity, cover and biomass. Existing in-stream structures should be evaluated and potentially modified to improve the functionality of refugia and hiding cover, sorting and retention of spawning gravel, and large woody debris retention. This is listed as a Tier 1 habitat action in the Biological Strategy (UCRTT 2007). This habitat action should be implemented in conjunction with Riparian rehabilitation: Apply efforts for a long-term approach that will result in increased large woody debris recruitment potential, increased sinuosity, sorting and retention of spawning gravels, increased number of complex pools, and water quality. Protect and maintain resulting levels of rehabilitated geomorphic, hydrologic, and riparian function.	1	5	3	5	13	7	Instream structures - along US 2 (Rayrock)

Summary and Next Steps

This document outlines the initial draft alternatives developed by TEAMS for the Upper White Pine Nason Creek Alternative Evaluation Report (AER). This document will serve as a catalyst for constructive discussion and debate by the Wenatchee Habitat Sub Committee and will aid in the development of the final prioritized alternatives for the AER.

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Appendix A

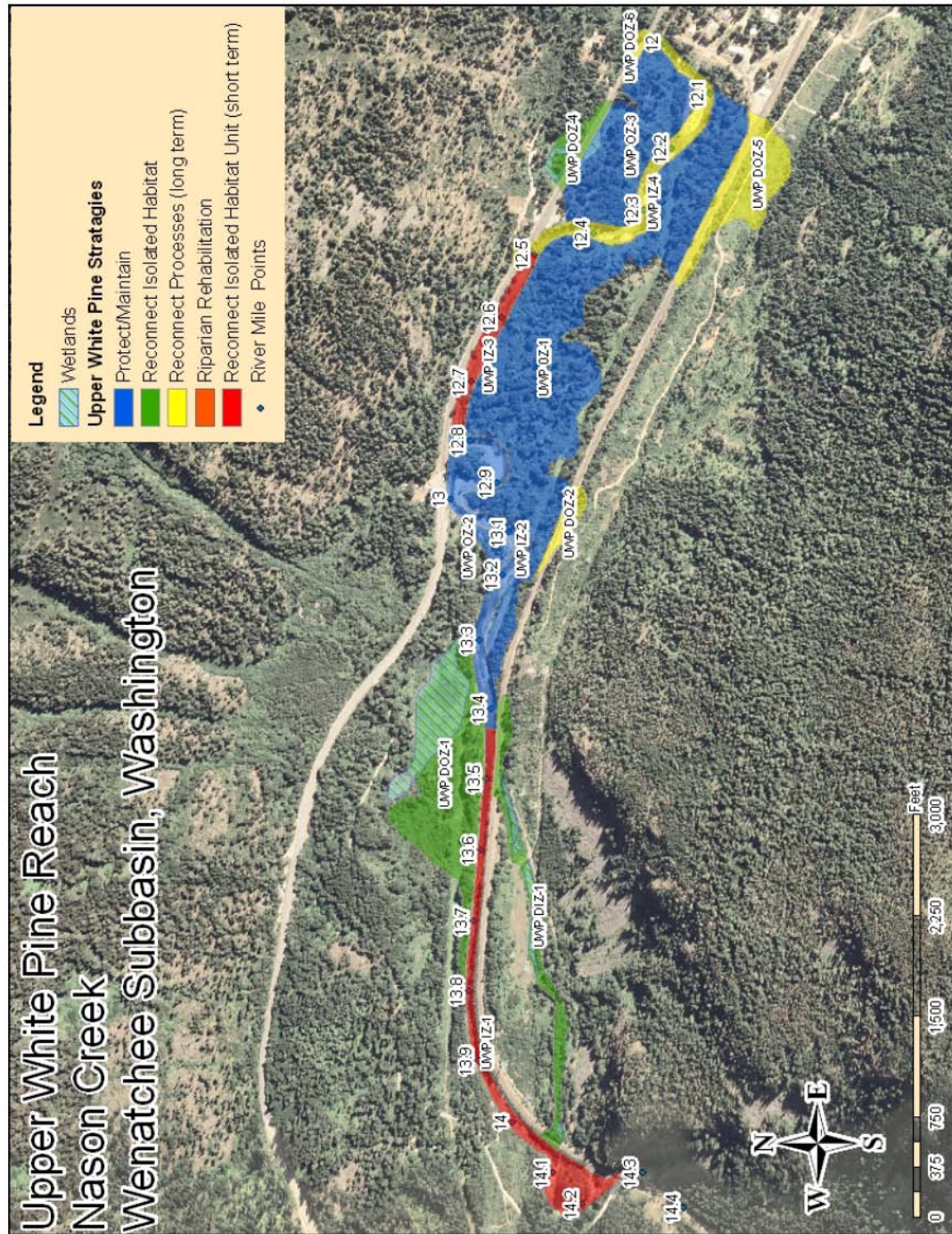


Figure 29. Upper White Pine subreach units and management strategies as defined by the Upper White Pine Reach Assessment (BOR 2009)

Appendix B



Figure 30. 1962 aerial photo of the Upper White Pine Reach.

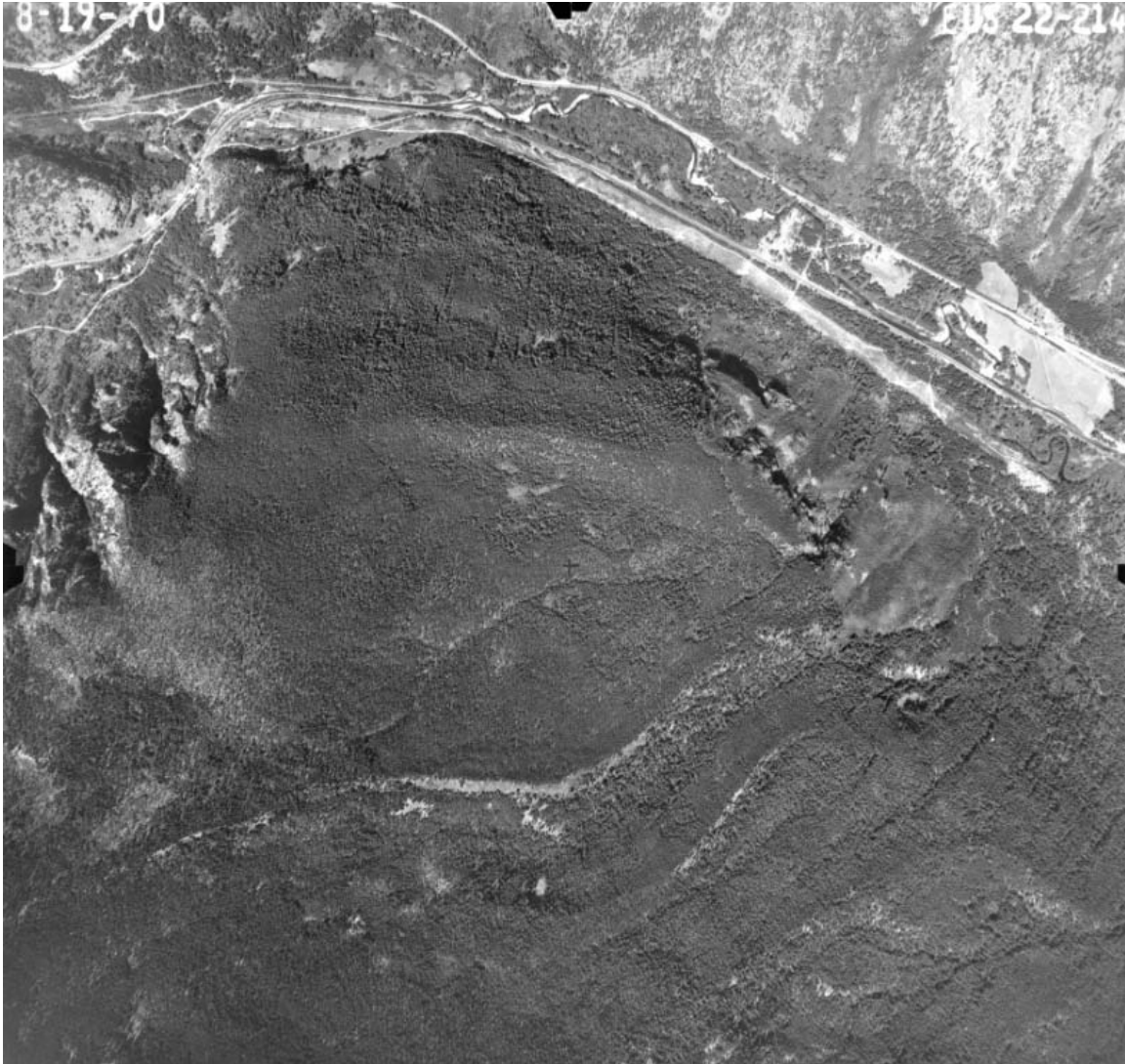


Figure 31. 1970 aerial photo of the Upper White Pine Reach.