Miller River Bridge West Approach Roadway Washout Project -M69005
Type, Size and Location (TSL) Feasibility Study Report

DRAFT

King County Department of Transportation

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Executive Summary

This Draft Type, Size, and Location feasibility report (TSL) has been prepared by the King County Department of Transportation's Road Services Division (RSD) for the Miller River Bridge #999W West Approach Washout Repair Project. The proposed repair project is located on a segment of the Old Cascade Highway that crosses the Miller River just upstream of its confluence with the South Fork of the Skykomish River, about 1.5 miles northwest of the Town of Skykomish. A road washout closed: the available detour for United States Highway 2 (US-2) near the Money Creek Tunnel, a designated school bus route and emergency services route, and a rural collector connecting residents west of the Miller River to the Town of Skykomish.

The west bridge approach road washout occurred on January 14, 2011 during a major storm event that hit Washington State, damaging facilities and infrastructure in 7 counties. On March 24, 2011, President Barack Obama proclaimed a declaration of emergency for the event, which was recognized by both Federal Emergency Management Agency (FEMA) and the Federal Highway Administration (FHWA). The road washout was a result of roadway overtopping, sediment aggradation, debris jamming, and channel movement on an unstable alluvial fan that occurred during the flood event.

As part of the FEMA project approval process, this report has been prepared to evaluate design and alignment alternatives aimed to restore the service of Old Cascade Scenic Highway. This study recommends option 3B as the recommended preferred option that will bring the road to service by balancing transportation needs, hydraulics, channel migration, debris flow and maintenance. It has been prepared based on the best available information without spending additional resources due to the budget and schedule. A life cycle cost analysis proves that this option will be the best for the money that is spent. This option will reestablish a transportation corridor across the alluvial fan of the Miller River and realign the road and, in turn, attempts to correct many deficiencies, bridge structural and size deficiencies and address flooding, channel migration, sedimentation, and alluvial fan hazards.

1 Introduction

1.1 Purpose of the Project

The western bridge approach of Miller River Bridge #999W originally consisted of an approximately 15-foot high road fill, a 60-inch diameter round concrete culvert, riprap armoring, and upstream large woody debris (LWD) armoring. The culvert was installed to facilitate overflow below the road during higher flows (primary outlet for floodwaters at the western bridge approach).

The roadway to the west of the culvert is designed as a Texas spillway allowing floodwaters to flow across the roadway surface to the North. To counteract scour and erosion, the Texas spillway required frequent application of rock armoring on the upstream (South) and downstream (North) sides of the roadway. After regular flow events, which deposited, King County maintenance crews removed sediment and debris from the traveling lanes. Much of the water, which flows over the roadway west of the bridge, emanates from overflow channels on the Miller River's alluvial fan, which leave the river's main channel upstream of the roadway. See geomorphic figures presented later in the report.

During the January 14, 2011 storm event, the Miller River overtopped its banks and flowed over the Old Cascade Highway at the west approach to Miller River Bridge #999W in the location of the 60-inch diameter culvert. As flows scoured the downstream side of the road fill, a catastrophic head cut of the roadway prism occurred resulting in a complete washout of the roadway and the LWD protection at the upstream side. The breach in the roadway immediately captured a large percentage of the Miller River in a new, steeper, and shorter flow path short circuiting the existing bridge opening.

When the river was captured into its new, more energetic configuration, a large volume of sediment (gravels and boulders) and wood debris was deposited in the old river channel. This large deposition of material, which is 10-15 feet deep, sealed the old river channel and established the new right bank of the Miller River in its current location. This type of channel movement is typical of alluvial fans such as the Miller River fan, including the deposition of large lateral deposits, which disconnect previous channels. This type of deposition can be seen upstream of the roadway as described in Herrera 2009.

Figure 1: 2006 flood- water over the roadway

The January 14, 2011 washout on the Old Cascade Highway severed a vital link of infrastructure leaving US-2 as route crossing the Miller River and its alluvial fan. This natural disaster, proclaimed by President Obama on March 25, 2011, left the Community of Berlin without a low-speed, low-volume route to access the goods and services in the Town of Skykomish.

The King County RSD, with funding assistance from the FEMA, proposes to repair the west approach of Miller River Bridge #999W to a safe, responsible, and cost-effective level of service to the residents of the Town of Skykomish and the Community of Berlin.

Due to the limited time and budget available during this phase of the project, this report will conclude or recommend an Option based on the current available data/reports at the project site.

1.2 Objective of the Preliminary TSL Study

The objective of this report is to define and evaluate the scope of different design alternatives and ultimately select a preferred design alternative that will bring the road back to service in a safe, responsible, and cost-effective manner. The factors considered in the design alternative selection process include: the local and agency needs for this route; future traffic conditions; hydraulic opening, floodplain considerations, channel migration; agency and local use planning for the area (i.e., recreation, conservation, or development); environmental constraints, impacts, and benefits; utility accommodation; and public impact. The selected design alternative will have the best overall combination of the following:

- Meets safety standards
- Meets current design standards
- Most cost effective
- Least environmental impacts
- Constructability; easiest to construct in the shortest time frame
- Least impact to private and/or public property

- Least potential for future maintenance, repair, and/or replacement cost.
- Reduce impact of potential channel migration
- Provides for greatest agency collaboration

This report is prepared to collect and evaluate the available data and reports close to the project and recommend alternatives for the bridge design and alignment for the washed out western approach of the Miller River Bridge #999W.

2 Project Setting and Conditions

2.1 Project Location

The project is located west of the Miller River Bridge #999W on Old Cascade Highway. This is the closest detour route available to bypass the tunnel on US-2. Next available detour is over 100 miles. It carries a low Average Daily Traffic (ADT) of less than 100 vehicles per day.

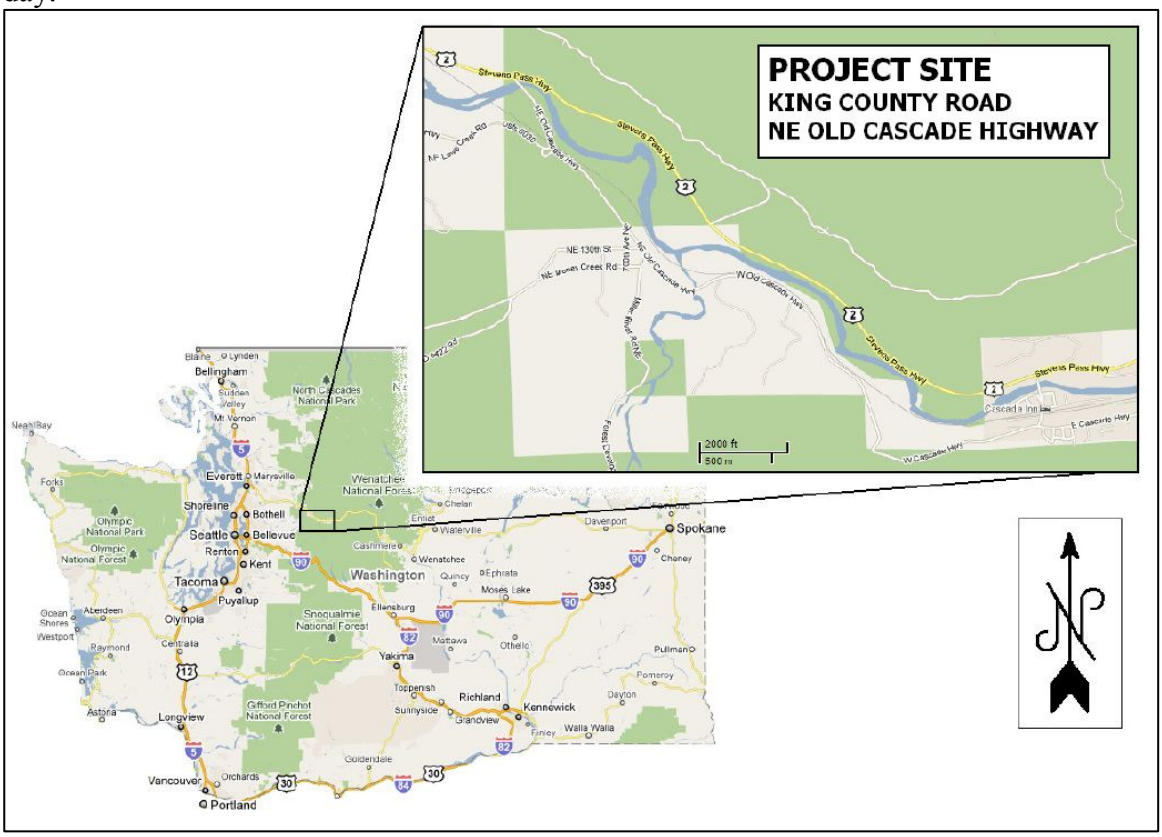


Figure 2: Vicinity map

2.2 Natural Resource and Geomorphic Conditions

The Miller River is a steep upland drainage (29,320 acres) in the west-central Washington Cascades, draining to the South Fork of the Skykomish River. The lower one mile of the Miller River near its confluence with the South Fork consists of a large alluvial fan. In this

area, the river passes through the washout location on the Old Cascade Highway as well as a Burlington Northern Santa Fe (BNSF) Railway Bridge just downstream. The Miller River fan represents a highly depositional area associated with its change in slope and reduced confinement as it enters the broader South Fork valley. This depositional environment creates a river in the alluvial fan reach that is characterized by multiple channels and by a tendency for the river to abandon its current channel during a large flood event and potentially avulse into another channel or rapidly establish a new channel across the alluvial fan. The river has done this historically; see Figure 13: channel flow history. While a formal channel migration study has not been conducted for the Miller River fan, historic channel migration rates appear to be high compared to non-alluvial fan stream settings and the risks to facilities due to this rapidly evolving stream channel network need to be carefully considered. The Old Cascade Highway is located near enough to the confluence that it is within the South Fork Skykomish River floodplain, and therefore subject to flooding hazards associated with both rivers.

The US Forest Service (USFS) manages 97% of the land in the Miller River basin while King County, BNSF, and private landowners own the remainder. Most of the basin is forested; 77% of the basin is designated as Alpine Lakes Wilderness and all but 50 acres of the remainder of the National Forest is afforded protection as Late Successional Reserves. Because of this level of forest protection and the fact that there are no dams in the basin, hydrology and water quality are not highly altered. As noted below, most of the impacts occur in the alluvial fan area.

The lower Miller River is home to three salmonid species listed as threatened under the Endangered Species Act (ESA) including Chinook salmon, steelhead trout, and bull trout. Chinook are found up to river mile 1.5 (above the Miller River fan), steelhead trout are present up to river mile six, and bull trout presumed forage up to river mile six of the Miller River. The lower Miller River is also home to coho, pink salmon and cutthroat trout. Between 1997 and 2001, an average of 566 Chinook spawners were observed in the South Fork Skykomish Watershed (including the Miller River) accounting for more than 25% of the overall Skykomish River Chinook population. The South Fork Skykomish also averages 600-800 steelhead trout and nearly 20,000 coho returning spawners annually.

The Miller River is a high priority for King County and the USFS for salmon habitat restoration. The natural riverine and floodplain physical and ecological processes of the Miller River fan have been altered and are constrained by transportation infrastructure and flood protection facilities; this has led to a loss of habitat for salmonids and other aquatic species. As such, the road washout presents an opportunity to remove or reduce significant constraints to sediment transport and other river processes on the Miller River alluvial fan in order to allow the river to more fully utilize its floodplain to store water and sediment and create new habitats during and in the aftermath of future flood events. Because the entire basin is relatively unaltered, restoration in the alluvial fan area carries a higher likelihood of success.

The Salmon Plan lists degraded juvenile salmonid rearing habitat as the primary limiting factor for Chinook in the Snohomish basin, which includes the SF Skykomish and Miller Rivers. The project site on the Miller River fan is located in a “primary restoration” subbasin designated by the Salmon Plan as one of the highest priority subbasins for restoration action.

These primary restoration subbasins currently have high priority habitat restoration targets for the King County portion of WRIA 7 including 80 acres of restored off-channel habitat and 5.5 miles of restored edge habitat. Restoration of the lower Miller River is a key element of fulfilling King County's commitment to achieve these Salmon Plan targets. Miller River restoration opportunities include preservation and restoration of hydrologic and sediment processes and removal of in-stream barriers. Specifically, restoration actions would result in increased off-channel habitat area, including juvenile rearing habitat and refugia and side channels where steelhead can spawn; edge habitat, including shallow water habitat (preferred by juvenile Chinook salmon); mainstem spawning habitat for Chinook salmon and rearing and foraging habitat for adult and sub-adult bull trout as well as holding habitat for returning adult salmon species.

2.3 Project Infrastructure Conditions

The existing bridge east of the wash out was built in 1921. It consists of a 160-foot main span with 2-span timber trestle approaches at each end. The total structure length is 228 feet. The main span truss is the oldest steel Pratt truss in King County and is listed in the King County Landmark register.

Figure 3: Existing Alignment

This bridge has the following structural and functional deficiencies:

- The width of the bridge roadway, which is 16 feet 9 inches, is too narrow to accommodate two lanes of traffic.
- The truss has inadequate overhead clearance of 13-feet 6 inches.
- It is posted for a load limit of 23 tons, with only one truck at a time on the bridge.
- The spread footing foundations are scour critical due to the channel migration and it is mitigated by heavy riprap protection.
- Some of the steel members exhibit minor corrosion as the bridge was encapsulated with paint in 1997.
- Portals have truck impact damages noted.
- Dirt accumulates on the 4"x12" deck planks and they are worn.
- Timber rails and curbs need frequent maintenance
- The timber stringers in the truss span are the most critical members in the bridge for the load rating.
- The sufficiency rating for this structure is 19.17 Structurally Deficient (SD).

Figure 4: Bridge #999W closed for traffic- looking west

Figure 5 West Approach Spans- looking Downstream

Figure 6: Aerial View of the Bridge and Washout - looking downstream- island

Figure 7: approach span and debris jam – looking upstream

The road is classified as a Rural Collector Arterial with an ADT of less than 400. This road also serves as an alternate route to SR-2 and is a school bus route.

The existing approach roadway width varies from 20 feet to 24 feet with no shoulder for much of the roadway. The west approach roadway is on a horizontal compound curve, with a 286-foot radius curve. The east approach roadway is on a 600-foot radius curve. The curved alignment appears to have no super elevation.

Figures 4 through 7 shows that the existing bridge has two timber approach spans. Both approach spans are protected by heavy riprap armoring. The east approach span (Figure 7) appears to be inundated with flowing water as evidenced by the racked large of woody debris accumulated under the bridge deck. The west approach spans are located on an island (Figure 6). All footings are shallow and very vulnerable to scour.

In addition to the existing steel truss bridge, there were two smaller bridges constructed prior to 1932, one east and one west of the existing bridge. The smaller bridge west of the existing bridge was built over a channel that existed at the location of the January 2011 washout. Both small bridges were replaced with 60-inch culverts in 1950 as shown in Figure 8 below.

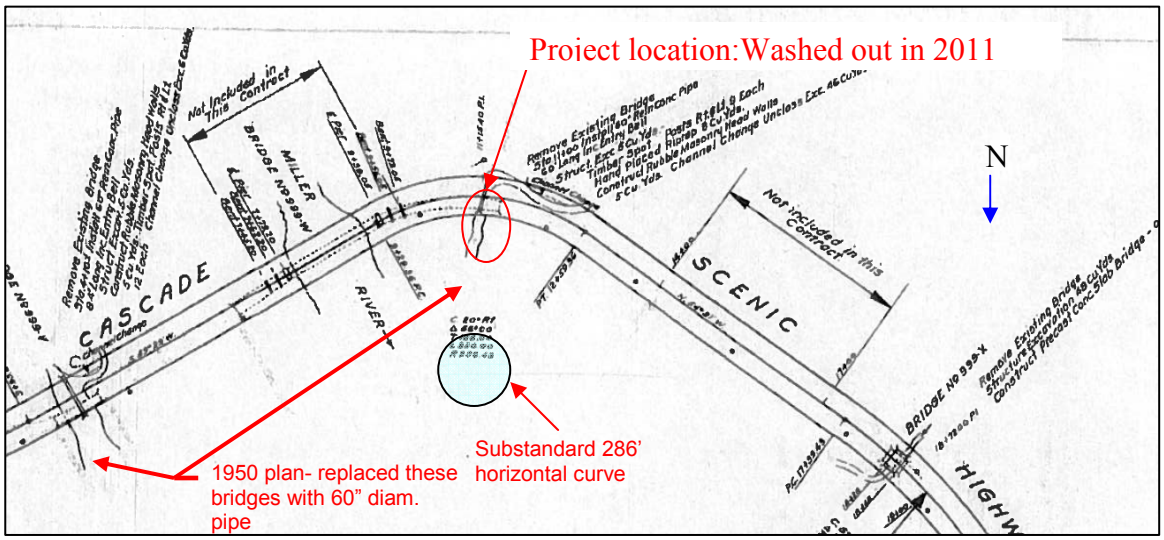


Figure 8: 1950 plan

2.4 River Facilities

There are three river training facilities near the Old Cascades Highway and Miller River Bridge washout, which serve to protect the highway and bridge. King County retains easements, which grant the authority but not the responsibility to maintain and repair these facilities, which are in the King County River and Floodplain Management Facility Inventory. They are listed from downstream to upstream. See Figure 9.

- Miller River Bridge Abutment armor - The bridge is protected by large rock riprap on both banks. The King County RSD supplemented the rock armor in the late 1990s when the bridge was raised 3-feet.

- Miller River Training Levee – King County installed a LWD training levee in 1998 upstream of the bridge on the left bank. The wood crib structure was constructed using a Chinook Helicopter with the intent of slowing bank erosion and channel migration. The wood crib structure spanned the bank between the downstream Miller River Bridge Abutment armoring and the upstream Miller River Curve facility. The majority of the Miller River Training Levee was destroyed in the January 14, 2011 flood event.

- Miller River Curve Levee- A large 10-12-foot high earth and rock levee is located at the upstream end of the Miller River Training Levee on the left bank. This Levee was constructed along the outside of a previous river alignment. The levee was constructed in the 1980s and repaired in the 1980s and the 1990s.

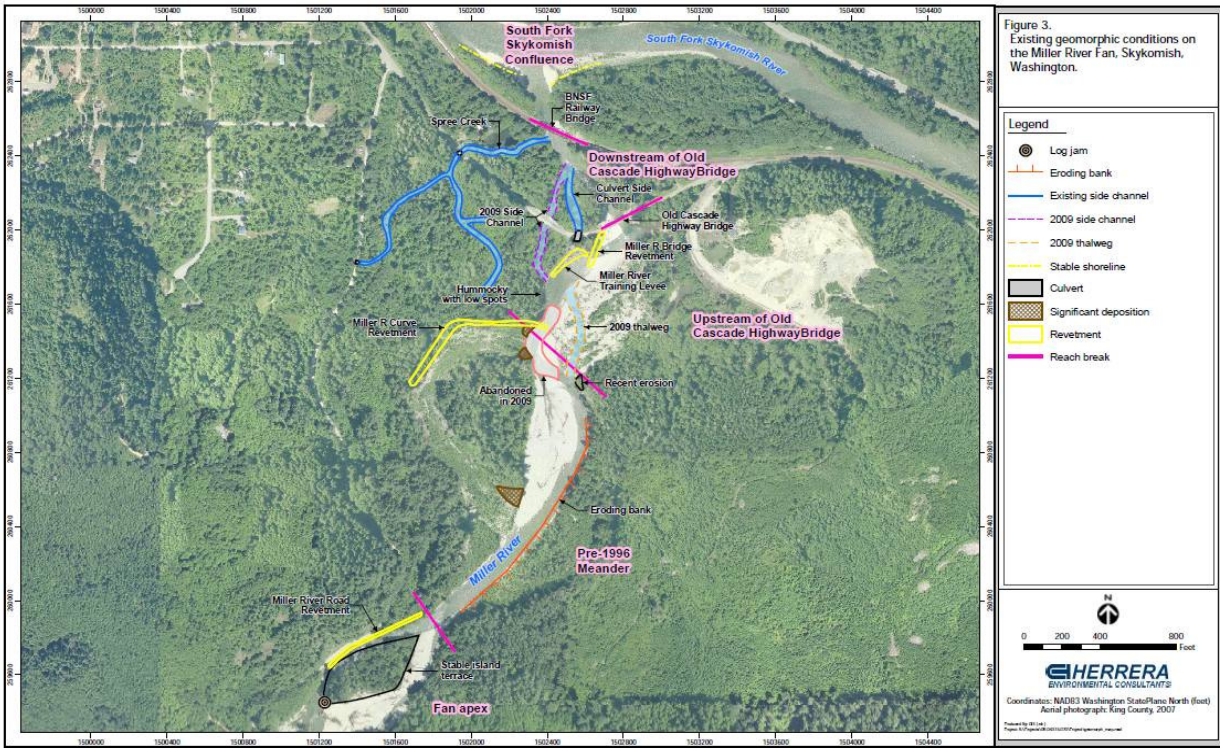


Figure 9: Existing geomorphic conditions

3 Available Existing Information

King County professionals (engineers, ecologists, hydrologists, and geologists) conducted a preliminary review of project sensitive areas to assist in the selection of a preferred design alternative. The preliminary review included an evaluation of previous studies and reports, site visits, aerial photograph review, and cursory archaeological/cultural resource screening.

3.1 Cultural Resources

The Miller River Bridge (#999W) is listed as a King County Landmark and is eligible for listing on the National Register of Historic Places. The King County Landmark Commission as well as the State Historical Preservation Officer (SHPO) must approve any changes to the integrity or look of this bridge.

The Old Cascade Highway is identified as a King County Heritage Corridor. Maintaining the corridor and its distinctive elements, including the bridge, is highly desirable to King County; as such, signage pertaining to the Heritage Corridor designation may be recommended as part of the King County Landmark Commission Certificate of Appropriateness (COA) process.

As part of the National Historic Preservation Act (NHPA) Section 106 Process, any ground-disturbing activities outside of the improved right-of-way will require an archaeological survey. The survey must be completed, submitted to, and approved by the Washington Department of Archaeology and Historic Preservation (DAHP). Additionally, depending on the final design, Miller River Bridge #999W will also require documentation as part of the Section 106 Process. This documentation will need to be completed, submitted to, and approved by the DAHP as well.

3.2 Streams

The Miller River is classified as a Type S (Shoreline of the State) under the King County Critical Area Code (21A.24.355) and Washington Department of Natural Resources (WDNR) Water Typing System (WAC 222-16-030). The Miller River is a tributary of the South Fork of the Skykomish River. The project site is located within Water Resource Inventory Area (WRIA) 7, the Snohomish River Basin. The Snohomish River system consists of two principal rivers, the Skykomish and the Snoqualmie.

The North Fork (NF) Skykomish (HUC 171100904) and South Fork (SF) Skykomish (HUC 1711000903) Watersheds lie within the Skykomish sub-basin of the Snohomish basin. The Snohomish River drains into Puget Sound near Everett, Washington. The Snohomish Basin is 1,856 square miles in area; it is the second largest basin draining into Puget Sound after the Skagit basin. The SF Skykomish watershed includes the Miller River drainage, but does not include either the Beckler, Foss, or the Tye River drainages that each flow into the SF Skykomish near the Town of Skykomish, Washington.

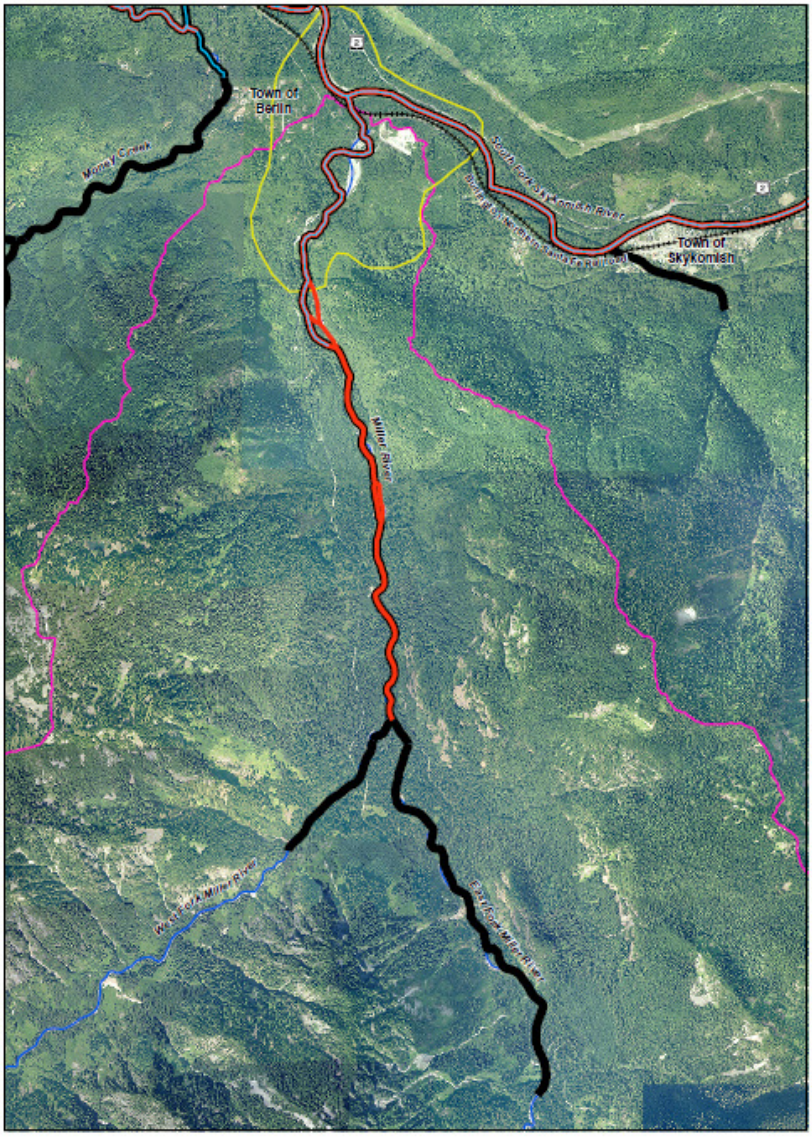
The NF Skykomish watershed is approximately 93,960 acres in area, of which 94 percent is managed by the Mt. Baker-Snoqualmie National Forest (MBSNF). Excluding the Miller River drainage, the SF Skykomish watershed spans 47,710 acres, with about 81 percent under management by the MBSNF (MBSNF 1997). The Miller River drainage covers 29,320 acres, with 97 percent managed by the MBSNF (MBSNF 2008). Most of the private and state lands in each of these drainages occur in the lowermost portions of the river systems, with some relatively small private in-holdings (e.g., patented mine sites) distributed farther upstream.

Anadromous fish species utilize the NF Skykomish watershed, Miller River watershedand the SF Skykomish watershed. Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kitsutch*), odd-year pink salmon (*O. gorbuscha*), chum salmon (*O. keta*), steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and Dolly Varden (*S. malma*) all occur in these areas.

The Miller, SF Skykomish, and NF Skykomish River systems comprise much of the Skykomish River Tier 1 Key Watershed (according to USFS 2009 Watershed Action Plan), which serves as crucial refugia for maintaining and recovering the at-risk stocks of Chinook, bull trout, and steelhead in the Skykomish system. Widespread impacts to estuarine habitats,

as well as instream, riparian, and upland communities (especially downstream of the Forest boundary), have resulted in large reductions in the quantity and quality of spawning and rearing habitats of resident and anadromous fish stocks within the North and South Fork Skykomish watersheds, as well as elsewhere within the Snohomish Basin.

The lower Miller River is home to three salmonid species listed as threatened under the Endangered Species Act (ESA) including Chinook salmon, steelhead trout, and bull trout. Between 1997 and 2001, an average of 566 Chinook spawners were observed in the South Fork Skykomish Watershed (including the Miller River) accounting for more than 25% of the overall Skykomish River Chinook population. The South Fork Skykomish also averages 600-800 steelhead trout and nearly 20,000 coho returning spawners annually.



Miller River/South Fork Skykomish Confluence Restoration Feasibility Analysis

Figure 3: Target Salmonids

Chinook Distribution
Bull Trout Distribution
Steelhead Distribution
Railroad
Study Area
Miller River Watershed Boundary

King County
Department of Natural Resources and Parks
Water and Land Resources Division

0 0.5 1
Miles

Figure 10 Target Salmonids

Restoration of lower Miller River is noted as a priority in King County, WRIA 7 and the Forest Service planning documents. The 2005 *Snohomish River Basin Salmon Conservation Plan,* (hereafter referred to as The Salmon Plan) identifies this location at the confluence of the Miller and SF Skykomish Rivers to be a primary restoration reach for high priority restoration actions. King County DNRP's proposed lower Miller River restoration as a high-priority action in the approved 2011 Snohomish River Basin 3-Year Work Plan (project #07-HSP4BW-006). The Salmon Plan lists degraded juvenile salmonid rearing habitat as the primary limiting factor for Chinook in the Snohomish basin. Miller River restoration will include: preservation and restoration of hydrologic and sediment processes, removal of in-stream barriers, reconnection of off-channel habitats, restoration of shoreline conditions, and riparian enhancement.

The US Forest Service's 2009 *Miller-Foss Watershed Analysis* also documented concern about this reach of the Miller River, noting that channel processes were impaired. Miller River restoration is listed as a high priority in the US Forest Service's 2009 *Watershed Action Plan for North and South Fork Skykomish;5th-Field Focused Watersheds* (project #0902-M-IN-01). The action plan describes previously completed work in the South Fork Skykomish as road drainage, erosion and fish-passage improvements pointing to the need for more in-stream restoration activities.

To determine the effects of the final design alternatives on the Miller River alluvial fan, a formal stream study will need to be completed. The stream study will include a general site survey and a more detailed in-stream habitat evaluation utilizing an accepted and approved habitat survey methodology. The stream study will evaluate in-stream fish habitat, channel morphology, substrate composition, floodplain connectivity, and riparian land-use and vegetation. The USFS is embarking on a restoration feasibility study of this reach of the lower Miller River. King County DNRP plans to coordinate with the USFS to develop and complete a study of various salmon habitat restoration projects leading to design of high priority projects. This study could facilitate further analysis of alternatives by providing stream survey data, hydraulic modeling and further geomorphic analysis. This could help refine final alternative selection or identification of mitigation opportunities.

The Old Cascade Highway in this area and the Miller River Bridge are within the regulated 100-year floodplain of the South Fork Skykomish River (Zone A) and all proposed repair Options are located within the designated floodplain. As such, all repairs would need to comply with King County code and have a completed Flood Hazard Certification demonstrating compliance with zero-rise criteria (0.01-foot) and compensatory storage requirements.

No flood study has been completed for the Miller River. Estimates from regional datasets indicate a 100-year recurrence interval flow of approximately 16,000 cfs.

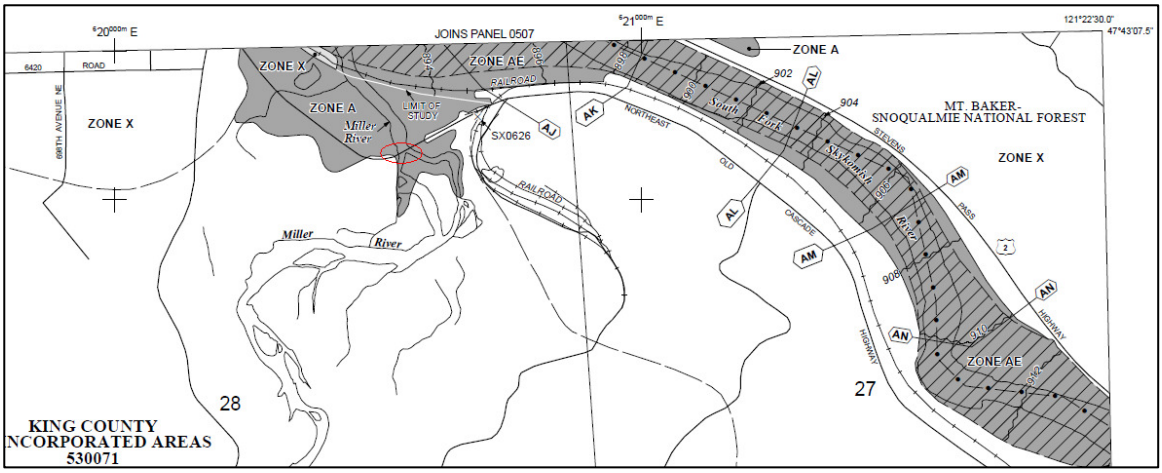


Figure 11 FEMA flood insurance map

Recent floods (November 2006, December 2008, January 2009, December 2010, and January 2011) have inundated the alluvial fan from the east abutment of the Miller River Bridge west to Spree Creek. The Old Cascade Highway is overtopped regularly west of the Miller River Bridge (see description and photos above). The roadway overtopping necessitates regular closing of the roadway due to water over the road and subsequent sediment removal and damage repairs.

Hydraulic modeling by King County RSD and West Consultants reproduce the extensive floodplain inundation seen during recent events. However, due to the complex topography and multiple existing flow paths existing on the Miller River's alluvial fan, a two dimensional hydraulic model would more accurately simulate the flooding conditions.

King County River and Floodplain Management Section acquired in 2011, a 28-acre parcel that extends across the entire Miller River alluvial fan, north and south of the Old Cascades Highway, recognizing the flood and channel migration hazard and documented damages. This acquisition was identified in the 2006 King County Flood Hazard Management Plan call for acquisition of the parcel and removal of the four structures at the west end of the parcel as a non-structural flood mitigatation strategy. The structures were damaged severely in 2008 and 2009 flooding events and are scheduled to be removed during the winter of 2011-12.

A report by Herrera Environmental Consultants in 2009 (Appendix J) documents the dynamic and hazardous nature of the Miller River alluvial fan. Additionally, Figures 12 and 13 in the report show historic channel positions across the entire width of the alluvial fan within the last 100 years illustrating the dynamic nature of alluvial fan hazards.

While formal channel migration hazard mapping has not been completed for the Miller River, the channel position mapping and dramatic channel relocation as seen in January 2011, indicate the capacity of this river to relocate rapidly across the alluvial fan creating a high risk to any infrastructure.

Figure 13 and the attached Appendix K show the history of the channel migration from 1906 to 2011.

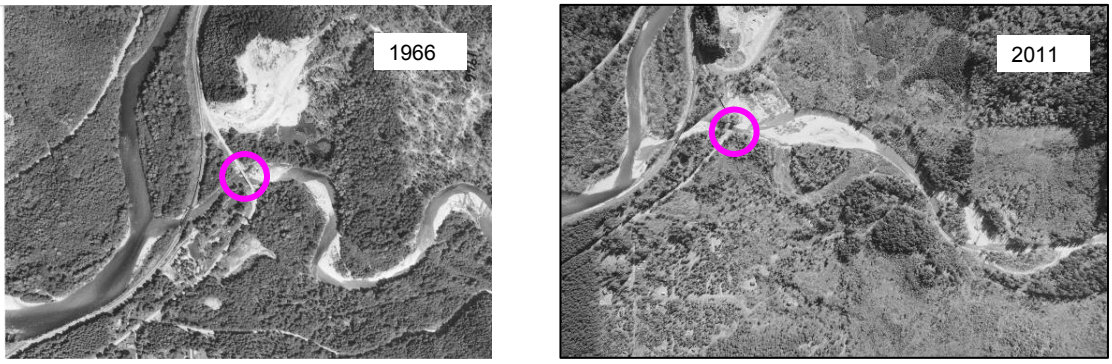


Figure 9: channel migration history

The 2009 Geomorphic Assessment presented by Herrera, shows the channel migration of the Miller River within the Fan Apex upstream of the bridge. It states that the two transportation corridors (Old Cascade Highway and the BNSF Railway) across the alluvial fan, constrain sediment transport in the lower part of the fan. The Miller River Bridge is the most constricting in the sense that it is causing a large amount of sediment aggradation upstream from it.

Figure 13 shows the nearby channels and the 2011 washout of the culvert side channel. It is taken from Appendix E Geomorphic Assessment Report revised to show the approximate flow after the 2011 flood.

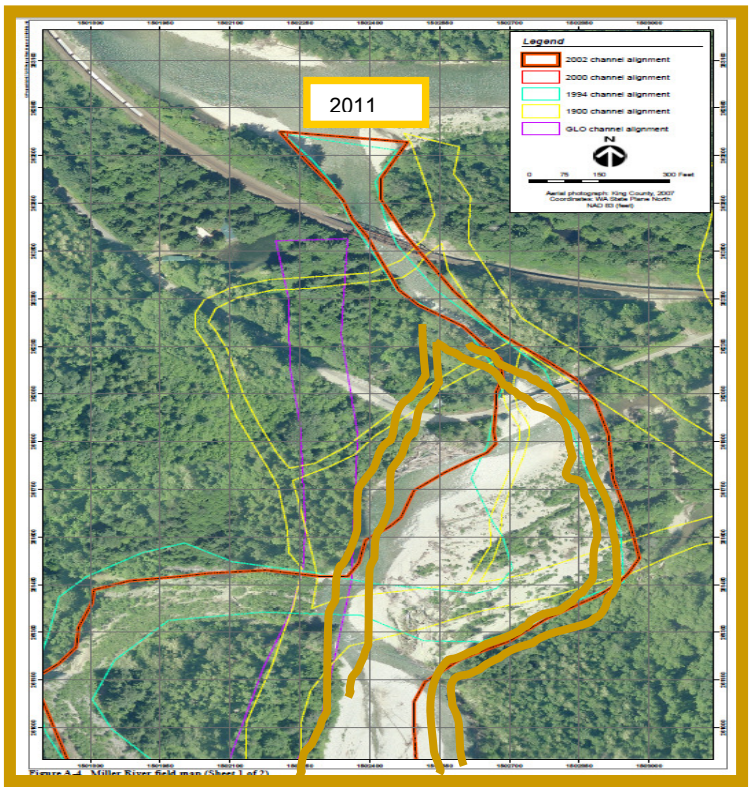


Figure 13: Channel flow history

The existing bridge and roadway alignment constrain the natural geomorphic function of the Miller River Fan. Any proposed Option for re-establishing a transportation corridor across the alluvial fan should provide plan for and accommodate channel migration processes as well as sufficient hydraulic capacity for flood waters.

Wetlands
A preliminary report completed by Parametrix on March 29, 1996 to identify sensitive areas (wetlands and shoreline areas) that could be impacted by a project near the existing bridge. A copy of this report is attached in Appendix G.

In this preliminary report, there were two wetland systems identified in the NE corner of the existing bridge. These wetlands and any others found within the surrounding project area will be delineated using the definitions methods and standards established in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Version 2.0) (U.S. Army Corps of Engineers 2010). This delineation information is needed to inform the preliminary project design and to apply for federal, state, and local permits.

3.3 Hydraulics

WEST Consultants, Inc. conducted a bridge hydraulic study in September 1996. At that time, the peak flow (Q100) determined was 9,600 cfs with a water surface elevation (WSEL) of 896. They noted that upstream of the bridge Miller River is extensively braided and migrates laterally (see attached Appendix K showing the history of the channel movement over the years from 1906 to the present). West goes on to say the low flow channel is relatively well-defined channel at the existing bridge; however, recognizes the potential relocation of the dynamic flood channels to the west of the Miller River Bridge. The large culvert located under the west approach roadway served as an overflow channel during large flood events. This is the culvert that was washed out in the January 2011 flood.

King County RSD recently conducted another hydraulic study in 2011 due to the new hydraulics at the bridge site. Hydrology with new USGS regression equations (StreamStats web software) has determined the peak flow to 16,100 cfs, an increase of 67% above the 1996 peak flow. This makes sense, as there have been record flows in the last 15 years all over the State of Washington. This flow rate was compared to known gage data taken from the Skykomish River and the results were reasonable. The higher flow rate of 16,100 cfs was used in hydraulic modeling. The mean basin slope for the Lower Miller River is about 60% making this reach a very flashy system that can quickly move sediment and debris. From aerial photos, logs up to 120’ are moving through the system.

With this higher flow rate, the stream hydraulics were modeled using recent abbreviated survey information (abbreviated due to budget and time constraints). Prior to the culvert blowing out and opening a 100-foot hole in the road, the WSEL was about 899 and peak channel velocities approached 12 fps. The higher water surface, as compared to West’s study, is from a larger peak flow and that the main channel had silted in about 200 square feet (flow area) under the bridge. With the large hole in the roadway, the WSEL drops to 897 and peak velocities reduce to about 7 fps. The bridge site with the large opening in the road is the new existing condition.

Several bridge options were modeled and compared to the existing condition. All of the bridge options showed a WSEL of about 897 with peak velocities between 5 – 7 fps. The flow area under the bridge(s) vary between 2500 to 8000+ square feet. The result is that for the various bridge options, the water surface does not change much. The peak velocities shift slightly in location but do not vary much in magnitude.

The dynamic nature of the lower Miller River causes significant lateral channel migration and rapid sediment accumulation. Since the culvert blow out in January 2011, the river is continuing to erode the left bank of the new channel and relocating sediment and debris. It is recommended that for any bridge option that the west abutment be set back as far as possible or that the west abutment and approach is heavily armored to resist the lateral migration, the low chord of the bridge should be installed no lower than elevation 903 to allow debris passage and future sediment accumulation, and that minimum span openings subjected to main flow are at least 100' long.

The following table compares the existing conditions to our proposed preferred alternative:

Results from Road Services HECRAS model and preliminary plans	**Existing 220' bridge**	**Proposed (option 3B)**
FLOODPLAIN / FEMA RIVER MILE	0.11	
Low chord elevation (ft)	903	903
Maximum Span	160	150
Area under the bridges (sf)	2350	8000+
100 yr peak flow(cfs)	16,100	16,100
100 yr velocity (ft/s)	6-7	4-5
100 yr WSEL (ft)	897	897
Clearance between low chord and 100 yr WSEL (ft)	6'	> 6'

The King County Road Design and Construction Standards (KCRDCS) calls for a minimum three foot clearance above the 100-year flood elevation unless otherwise required by the County Road Engineer based on an evaluation of conveyance factors such as hydraulic capacity, bed aggradations, safety margins, and bridges and levees, as specified in section 4.3.3.1 of the Surface Water Design Manual. This is also recommended by FHWA's Hydraulic Engineering Circular 18 section 2.3.1 design considerations.

As it is listed in the Table 1 above, the hydraulic clearance for the 100-year flood elevation is over three feet for both existing and proposed structures. The clearance required under the bottom chord is controlled by the size of the debris flowing under the bridge. The current bridge was raised three feet in 1961. There is no history of debris hitting the existing superstructure and therefore existing clearance deemed adequate. However, large woody debris has been racked up on the right bank abutment and jump span of the bridge less than 5 feet below the low chord of the bridge. This river has a history of conveying 100-foot long wood debris pieces. It is recommended that the minimum span length be kept at 100 feet and

the bottom chord of the new span be kept to a minimum of 903 feet to keep the minimum clearance of six feet.

3.4 Water Quality

The proposed design may trigger or be exempt from detention and water-quality requirements if the replaced impervious and new impervious surfaces are less than the thresholds required for treatment as defined by the King County Surface Water Design Manual. The trigger for detention/retention is greater than 2,000 square feet of the new impervious surfaces and the total new impervious surface is not more than 50 percent of the existing impervious surface within the project limits. The trigger for water quality is more than 5,000 square feet of new impervious surface that is not fully dispersed.

3.5 Geotechnical

The King County Materials Laboratory (KCML) conducted a geotechnical investigation of surface and subsurface conditions at the bridge site in December 2006. The investigation was performed to develop design recommendations for seismic retrofit improvements to the existing Miller River Bridge No. 999W. A copy of this draft preliminary geotechnical engineering report is attached in Appendix H. The report provides evidence that the roadway is founded on deep, non-cohesive alluvial or lacustrine deposits consistent with alluvial fan origins.

One boring was advanced at each of the two existing bridge abutments as part of the preliminary geotechnical investigation. The borings were advanced using ODEX and mud rotary drilling methods. Boring KCB-1 (west abutment) was advanced to a depth of 84 feet below the existing roadway surface and boring KCB-2 (east abutment) was advanced to a depth of 86 feet below the existing roadway surface.

Subsurface conditions encountered in these two borings generally consisted of roadway embankment fill to depths of approximately 15 feet below the existing road grade. The embankment fill soils generally consisted of gravel with varying amounts of sand and silt. Occasional cobble and boulder-sized materials were encountered, and it is suspected the embankment fill may include rip rap as armoring was observed on the slopes of both bridge approaches.

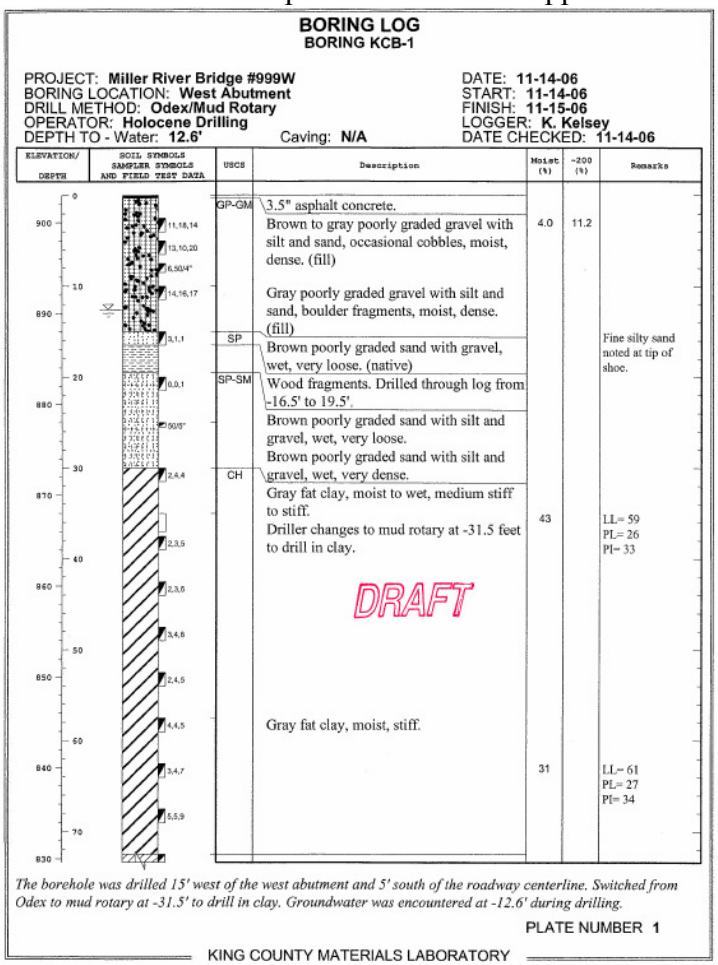
Naturally deposited sands and gravels with silt and cobbles were encountered below the fill to depths of about 30 feet. Wood debris was encountered in both borings at the interface between the fill and naturally deposited soils. An approximate five-foot layer of low-plasticity clay, confined by the naturally deposited granular soils, was encountered at about 19 feet below the surface in KCB-2. The naturally deposited sands and gravels between the fill and a depth of about 30 feet ranged in relative density from very loose to very dense. It is suspected the relative density of soils identified as “very dense” may be overstated due to gravel and cobbles.

Medium stiff to stiff clay, ranging in plasticity from low to high, was encountered below the naturally deposited sands and gravels. The clay soil was encountered to the termination depth of boring KCB-1 at a depth of 84 feet and to a depth of 81 feet in KCB-2. Dense to very dense silty sand and sandy silt was encountered below the clay to the termination depth of boring KCB-2 at 89 feet.

Groundwater was encountered in both borings at a depth of about 13 feet below the surface of the roadway and generally corresponds to the river elevation.

Figure 14 shows part of Boring log for KCB-1. The draft report is attached in Appendix H.

Estimated scour depths are on the order of 25 feet. Given the potential for scour and long-term settlement in the clays present between the depths of about 25 to 30 feet and 80 to 85 feet, it is recommended a deep foundation system be considered for initial planning purposes. Boring logs from the previous investigation indicate Drilled Shafts or Driven Steel Pipe Piles may be well suited for soil conditions near this site. Depending upon design loads, Drilled Shafts or Driven Steel Pipe Piles installed to depths on the order of 80 to 100 feet could be anticipated for each bridge bent for preliminary planning purposes.



BORING LOG
BORING KCB-1

PROJECT: **Miller River Bridge #999W**
BORING LOCATION: **West Abutment**
DRILL METHOD: **Odex/Mud Rotary**
OPERATOR: **Holocene Drilling**
DEPTH TO - Water: **12.6'** Caving: **N/A**

DATE: **11-14-06**
START: **11-14-06**
FINISH: **11-15-06**
LOGGER: **K. Kelsey**
DATE CHECKED: **11-14-06**

ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
	GP-GM	3.5" asphalt concrete.			
		Brown to gray poorly graded gravel with silt and sand, occasional cobbles, moist, dense. (fill)	4.0	11.2	
		Gray poorly graded gravel with silt and sand, boulder fragments, moist, dense. (fill)			
	SP	Brown poorly graded sand with gravel, wet, very loose. (native)			Fine silty sand noted at tip of shoe.
	SP-SM	Wood fragments. Drilled through log from -16.5' to 19.5'.			
		Brown poorly graded sand with silt and gravel, wet, very loose.			
	CH	Brown poorly graded sand with silt and gravel, wet, very dense.			
		Gray fat clay, moist to wet, medium stiff to stiff. Driller changes to mud rotary at -31.5 feet to drill in clay.	43		LL= 59 PL= 26 PI= 33
		Gray fat clay, moist, stiff.	31		LL= 61 PL= 27 PI= 34

The borehole was drilled 15' west of the west abutment and 5' south of the roadway centerline. Switched from Odex to mud rotary at -31.5' to drill in clay. Groundwater was encountered at -12.6' during drilling.

PLATE NUMBER 1

KING COUNTY MATERIALS LABORATORY

Figure 14: copy of boring log

It is recommended that one exploratory boring be performed for each of the planned bridge bents. Subsurface information from the two previous borings may be sufficient for bents planned at either end of the existing bridge. For initial planning purposes, it is estimated 13 borings would be required for option 3B.

It is estimated borings would need to be advanced to depths of about 100 feet based on soil conditions encountered during the previous investigation. Due to the gravels, cobbles and boulders in the existing fill and near surface naturally deposited soils, difficult drilling conditions are expected.

3.6 Traffic

The road is currently closed for traffic route (See Figure 15) and the detour is taking drivers on US-2. Motorists need to cross a single line of high-speed BNSF railroad tracks and the South Fork of the Skykomish River until it intersects with higher volume/speed US-2 about 500 feet west of State Tunnel structure number 2/108. This route is 1.34 miles longer.

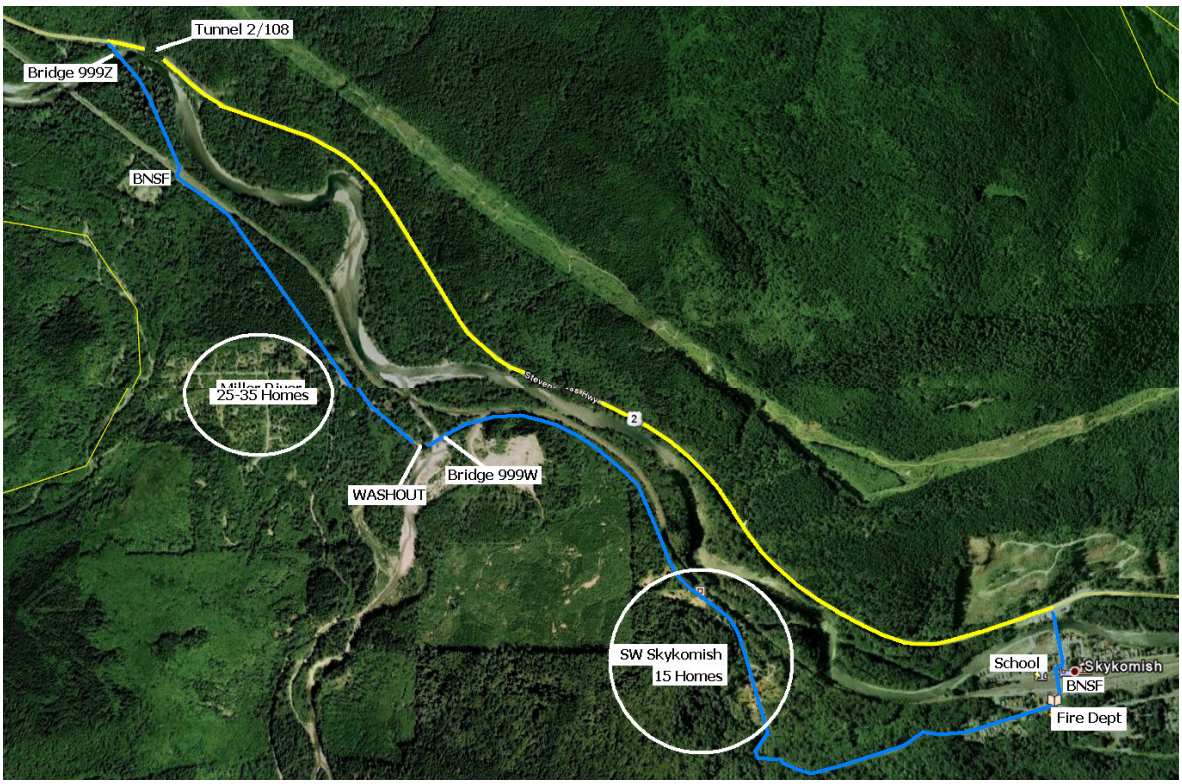


Figure 15: Detour route

The road serves the community of Berlin that has about 80 parcels of land with 25 to 35 of them having homes or cabins. It also serves the area of southwest Skykomish located along the Old Cascade Highway having about 15 homes and is about 0.8 mile east of the wash out.

The Skykomish School District No. 404 has an elementary school with 47 students and a high school with 29 students. The round trip now is 8 miles compared to 4 miles and has added safety issues with four additional turns, on/off/across US-2.

King County Road Services relied on the Old Cascade Highway to drive heavy equipment to the Miller River and Money Creek roads. Without the Old Cascade Highway as a detour, King County trucks will be forced to put heavy equipment onto trailers adding additional congestion to US-2.

Road detours from a closed Old Cascade Highway could prove fatal, adding an additional five to ten minutes for emergency aid response. If a train blocks crossings at US-2, without a

detour route, aid vehicles would have no alternative but to wait for the train to pass, potentially causing fatal delays in response time.

The Washington State Department of Transportation uses Old Cascade Highway as an unofficial, light-duty, detour route. The Old Cascade Highway is identified on the federal classification system as a rural minor collector. King County plans to pursue a modification to this classification to designate Old Cascade Highway as a rural collector given its importance as a detour route.

4 Design Alternative Selection

Ten design alternatives were evaluated during the initial stages of the screening process. Using a set of selection criteria, seven of the alternatives were eliminated. This process as well as a description of the remaining three alternatives are provided in the following subsections.

4.1 Screening Criteria

King County developed a set of criteria that would provide a precursory screening of the ten preliminary alternatives. The criteria included:

- Restore transportation service
- Provide for an improvement to hydraulic flow
- Accommodate highly possible channel migration and debris passage
- Reduce maintenance, and repair costs
- Minimize impacts to wildlife and habitat (with special concern to Endangered Species Act (ESA)
- Encourage agency (WSDOT, KCDOT, KCDNRP, FEMA, EMD) support and collaboration
- Minimize environmental impacts
- Avoid, minimize, or mitigate for flood hazard and other potential floodplain impacts
- Minimize overall permitting and construction cost and timing
- Provide the greatest level of constructability
- Economically cheaper

This set of criteria is applied to each of the ten preliminary alternatives under consideration. The description of each design alternatives and the reasons for elimination of those options from further consideration are listed below.

4.2 Preliminary Design Alternatives

To start the project approval process, FEMA requested a preliminary alternatives analysis from King County that compared the advantages, disadvantages, and feasibility on a range of alternatives (including alternatives that would restore the approach to its previous condition). The initial list included the ten alternatives listed below. Option 1's looked into restoring

back to original condition. Option 2's are looking into building a new bridge on the existing alignment. Option 3's consider a realignment that will capture meeting the geometric and hydraulic standards while providing a feasible environmentally friendly structure for the community.

1) **Option 1A: Restore the western bridge approach to its pre-washout condition.** Option 1A consisted of the following major work items:
    - Move Miller River back into its pre-washout channel: excavate/dredge about 33,000 cubic yards from the obstructed river channel and re-build the excavated area as a river channel;
    - Replace the 60-inch drainage culvert in-kind;
    - Replace and armor the eroded embankment section and restore road prism (asphalt road and shoulder);
    - Replace/repair the 100-foot-long rock armored embankment section (commonly referred to as the Miller River Training Levee) to its pre-washout configuration; and
    - Replace the protective log jam.

This option is eliminated from further review for the following reasons:

- The proposed project creates a major disruption to the river, including: inhibiting natural channel migration, blocking side channel habitat, degradation of habitat condition, as well as dredging impacts.
- It is highly possible that the undersized culvert will fail again. This west road approach has experienced chronic and repetitive failures due to inadequate repairs.
- This repair will likely result in long-term costs associated with repetitive emergency "repair" efforts.
- This repair precludes and constricts the natural dynamics of Miller River from the South Fork of the Skykomish.
- Based on King County's experience on similar projects, this project would be very difficult to permit. Agencies will not continue to permit the same fix to a re-occurring problem.
- Replacement of the culvert crossing that was blown out needs to meet state standards as stated in both the WAC and the RCW, which would require a larger, more costly crossing structure (NMFS and USFWS fish passage requirements specifically).
- Due to the amount of in-water work proposed, the project may need to span two years.
- Costs associated with dredging and off-channel habitat mitigation construction would be at least $1.2 million.

2) **Option 1B: Restore the western bridge approach to its pre-washout condition with added armoring protection**. Option 1B consisted of the following major work items:

- Move Miller River back into its pre-washout channel: excavate/dredge about 33,000 cubic yards from the obstructed river channel and re-build the excavated area as a river channel;
- Replace the 60-inch drainage culvert in-kind;
- Replace and armor the eroded embankment section and restore road prism (asphalt road and shoulder);
- Replace the 100-foot-long rock armored embankment section (commonly referred to as the Miller River Training Levee) with a longer embankment and deflectors (spurs); and
- Replace the protective log jam.

This option is eliminated from further consideration for the following reasons:

- The proposed project creates a major disruption to the river, including: inhibiting natural channel migration, blocking side channel habitat, and dredging impacts.
- The increased length of the levee will eliminate additional habitat function and further disconnect the river from the floodplain.
- It is possible that this project will fail again due to the dynamic nature of the channels.
- Costs associated with mitigation construction high.
- Based on King County's experience on similar projects, this project would be very difficult to permit. Agencies will not likely approve such a significant loss and disruption to existing habitat.
- Due to the amount of in-water work proposed, the project may need to span two years.

3) **Option 2A: Same alignment- build new bridge using a minimum span (30'/125'/30') and approach fill.** Option 2A consisted of the following major work items:
    - Construct a minimum span, at-grade crossing structure that spans the existing channel with deep foundation placed in the channel to support the concrete girder or steel plate girders;
    - Rebuild at grade road approach to match the at-grad slab crossing structure, including fill re-grade, asphalt, and shoulders;
    - Armor the new abutments with rip rap; and
    - Armor the upstream side of the island located between the new at-grade stream crossing structure and the existing structure.

    THIS OPTION IS INCLUDED AS THE MINIMUM REPAIR ALTERNATIVE REQUESTED BY FEMA TO BE CONSIDERED AS A BASE LINE COST.

4) **Option 2B: Same alignment-build a new bridge connects to existing bridge with a truss structure and slab/trestle approach**

(67'/100'/100'/140'/73'/20'=500'). Option 2B consisted of the following major work items:

- Construct a 140-foot span truss over the new channel;
- Construct elevated concrete or steel plate girders to connect the new truss to the old truss;
- Construct the west approach to the new truss structure; and

5) **Option 2C: Same alignment-build new bridge conects to existing bridge with a Truss structure and fill approach (40'/140'/73'/20'=273'.** Option 2C consisted of the following major work items:
   - Construct a 140-foot span truss over the new channel;
   - Construct elevated concrete slabs to connect the new truss to the old truss; and
   - Construct west approach with fill, 2:1 sloped shoulders and asphalt.

This option is eliminated from further consideration due to the following reasons:

- The fill section is in the flood plain and channel mitigation zone compared to option 2B.

6) **Option 2D: Same alignment-Build a new elevated structure connects to existing bridge to span the flood plain (1400').** Option 2D consisted of the following major work items:

   - Construct a 1400-foot-long bridge trestle to span the floodplain; and
   - Remove about 1,000 feet of asphalt and road fill below the trestle and re-contour with stream features for overflow.

This option is eliminated from further consideration due to the following reasons:

- The cost is high.
- This will not eliminate the deficient existing structure compared to the option 3B.
- This will not remove the substandard horizontal curve compared to option 3B

7) **Option 3A: Realignment-Build a new bridge (110'/110'/150'/150'/150'=670').** Option 3A consisted of the following major work items:
   - Clear and grade the limits of the new road alignment located with a revised horizontal curve radius;
   - Construct a new bridge that spans the new and old channels;
   - Remove the abandoned portion of the road (asphalt and fill) and re-vegetate with riparian vegetation; and
   - Demolish or re-locate the County Landmark Bridge.

This option is eliminated from further consideration due to the following reasons:

- This option places abutments in the channel migration zone compared to option 3B.

8) **Option 3B: Realignment-Build a new bridge and extend to span spree creek (6 spans @ 115'/ spans @150'=1140').** Option 3B consisted of the following major work items:
   - Clear and grade the limits of the new road alignment located with a revised horizontal curve radius;
   - Construct a new bridge that spans the new and old channels;
   - Remove the abandoned portion of the road (asphalt and fill) and re-vegetate with riparian vegetation; and
   - Demolish or re-locate the County Landmark Bridge.

9) **Option 4: Upstream alignment-build a new bridge and road at the apex of the Miller River fan and close the Old Cascade Highway crossing of Miller River**. Option 4 consisted of the following major work items:
   - Build a new bridge that spans Miller River at its apex;
   - Build a new segment of road (clearing, grading, and improving with asphalt and shoulders) that connects Miller River Road to the west abutment of the new bridge crossing;
   - Build a new segment of road (clearing, grading, and improving with asphalt and shoulders) connecting the east abutment of the new bridge to the Old Cascade Highway.
   - Close the portion of the Old Cascade Highway currently located west of the existing Miller River Bridge #999W (removing asphalt and revegetating); and
   - Abandon the existing bridge in place or re-locate it (per COA requirements).

This option is eliminated from further review for the following reasons:

- New road right-of-way would be needed.
- The risks associated with engineering and environmental permitting is very unpredictable.
- There would be impacts to riparian areas as a result of the required road improvements.
- Permitting needs will likely be very time intensive and costly due to the preparation of an EA/EIS.

10) **Option 5: Close the road permanently**- Option 5 consisted of the following major work items:
   - Close the portion of the Old Cascade Highway currently located west of the existing Miller River Bridge #999W and an appropriate length of the road to the east of the bridge (removing asphalt and revegetating); and
   - Abandon the existing bridge in place or re-locate it (per COA requirements).
   - Improve or mitigate for the impacts

Option 5 was eliminated from further consideration due to the results of the practicality analysis and the traffic detour analysis and includes the following:

- Transportation service will not be restored.
- US-2 detour will be over 100 miles.
- School buses need to take the higher speed, larger volume route to collect students.
- Maintenance division will spend extra time and materials to take the highway to maintain the roads.
- Million plus dollars needs to be spend to remove the king county landmark bridge and restore the area.

4.3 Final Design Alternatives

Three of the ten design alternatives were selected for further consideration. The alternatives are selected based on utilizing the existing alignment and a minimal realignment options. Option 2A evaluated and presented as one of the option because this is the minimum repair alternate FEMA wanted to consider. Option 2B is the best alternate for a repair using the existing alignment. Option 3B will provide the best for the money considering all of the other benefits received from this option. Each of the final design alternatives are listed below along with a brief description of the alternative design scope.

1) Option 2A: Same alignment-using a minimum span and approach fill. (minimum to repair the missing link)
2) Option 2B: Same alignment-build a new bridge with a truss structure or steel plate girder and slab/trestle approach.
3) Option 3B: Realignment-build new bridge.

The table below relatively compares the three options for the screening criteria on a scale from 1 (worst) to 5 (best).

Table 2: Option Criteria Evaluation

Screening criteria (5 – Best case, 1- worst case)	**Option 2A: Same alignment using a minimum span and approach fill**	**Option 2B: Same alignment- build a new bridge with a truss structure and slab/trestle approach.**	**Option 3B: Build new bridge on realignment with girder structure**
Restore transportation service	5	5	**5**
Provide for an improvement to hydraulic flow	1	4	**5**
Provide for channel migration	1	4	**5**
Reduce maintenance, repair, and potential replacement costs	1	2	**5**
Minimize impacts to wildlife and habitat (with special concern to ESA	1	4	**5**
Encourage agency support and collaboration	1	3	**5**
Minimize environmental impacts	1	4	**3**
Mitigate for flood hazard and other potential floodplain impacts	1	3	**5**
Minimize overall permitting and construction cost and timing	1	4	**4**
Provide the greatest level of constructability	1	2	**4**
Economically cheaper	4	2	**1**
Total Score	18	37	**47**
Rank:	**3**	**2**	**1**

All options other than Option 3B leave the structurally deficient, functionally obsolete, scour critical existing bridge in place. Option 3B will bring the horizontal curve to standard. As listed in the Table 2 above, Option #3B ranks #1 providing the best balance of all screening criteria.

Table 3 below shows the comparison of advantages and disadvantages for these options.

Table 3: Option Comparison

Option	**Description**	**Advantageous**	**Disadvantageous**
• Option 2A: Same alignment using a minimum span and approach fill.	• Keep the existing bridge • Build a new structure to span the new washout • Fill the approaches • Protect the island	• Least expensive option • Improves hydraulic opening • No additional ROW is needed • Less temporary construction impacts • Improves hydraulic flow	• The island is very vulnerable to erosion due to scour and potential channel migration • Will still have a structurally deficient functionally obsolete load limited bridge as a detour alternate for US-2 • Will still have a vulnerable road way section at the Texas

Option	Description	Advantageous	Disadvantageous
			spill way. • The bridge will be on a substandard horizontal curve – safety is an issue • There will be a bottle neck as the 24' wide bridge narrows down to the 16'9" wide existing bridge. • Adds fill to the flood plain • Will have the substandard horizontal curve • Additional restoration efforts will be necessary by the Texas crossings • Lower flood clearance – does not meet the 6' clearance-minimum design criteria • Fill into the vulnerable section of roadway • Lots of fill in the approach roadway flood plain
• Option 2B: Same alignment-build a new bridge with a Truss structure and slab/trestle approach.	• 500' long • Keep the existing bridge • In order to keep the clearance under the low chord, the superstructure needs to be truss. • The island is vulnerable for channel migration and the structure is extended to the main span of the existing bridge. Thus eliminating the risk of washing out of that section of the road.	• Improves hydraulic opening • Allows debris to pass through • Allows spill way without damaging the road. • The vulnerability of island is taken care of by extending it to the existing bridge span.	• Will still have a structurally deficient functionally obsolete load-limited bridge as a detour alternate for US- 2 • Will have the substandard horizontal curve- a safety issue • Will need to use a high cost truss superstructure to meet the minimum clearance over the 100 year WSEL. • There will be a bottle neck at the transition from 24' wide new structure to the 16'9" existing structure. • The new bridge is on a tight horizontal curve and truss has to be 34' wide to accommodate 24' wide roadway. • Lots of fill in the approach roadway blocking the water overtopping
• Option 3B: build new bridge on realignment and extend to cover Spree Creek	• Realignment will allow raising the road profile to allow low cost superstructures such as precast girder, steel plate girders, etc. rather than a truss. • Compared to option 3A, this will extend to cover the Spree creek and most of the channel migration area	• Realigning will improve the horizontal curve to greater than 380' standard radius. Existing is 286'. • Provide an unrestricted detour route for US-2 by replacing the structurally obsolete, functionally deficient, load posted, scour potential bridge. • Removing the old bridge will remove the maintenance cost • Increase in habitat function • Nearly self- mitigating - Aligns with habitat • Will span spree creek and thus reduce more potential channel migration related roadway damages	• Removal of the King County Landmark bridge • Cost is higher but compensated by raising the profile and using a low cost precast girders as superstructure. • The structure will be on a horizontal curve. • Costs too high • Will need some ROW due to the realignment

Option 2A is the minimum and the least cost structure that can build to repair the washout to provide a minimum hydraulic opening for the new channel. This option ranks low in all of the screening criteria. Option 2B provides a good option to repair the washout on the existing alignment by not replacing the existing bridge. Options 2A and 2B will likely require continued maintenance and repair of upstream river facilities. Option 3B is the best option however, the most expensive. This option will provide the community with a safer bridge by eliminating the structurally deficient, functionally obsolete, load limited bridge, improving seismic vulnerability, and reducing the risk of further channel migration effect on the road.

5 Design Considerations

In January 2011, a major rain storm hit Washington State, damaging facilities and infrastructure in seven counties. On March 24, 2011, President Obama proclaimed a declaration of emergency for the event, recognized by both FEMA and the Federal Highways. This storm event washed out Old Cascade Highway at Miller River in Northwestern King County, Washington State, stopping highway 2 users using this easily accessible viable detour route.

King County is seeking FEMA, EMD, WSDOT and King County DNRP assistance with this project. Each funding source will have a set of minimum criteria to be met to be eligible. Environmental regulations will play into the determination of the final scope of the project. Both the public and WSDOT will benefit from preserving this detour route. However, the existing load limited, functionally obsolete and structurally deficient bridge will be an obstacle to achieve this purpose completely. Option 3B is the only one that will solve this issue. Option 2B will reach all the way to the main pier of the old truss eliminating vulnerability of washing out the island. Option 2A will pose a vulnerable island and need to be protected by a lot of riprap upstream side of the bridge, which will be considered fill in the ordinary high water. Option 2A, 2B, 2C and 2D also will bring challenges in connecting the new structure to the existing one structurally and functionally as the existing structure is only one lane with 16.8’ curb-to-curb width.

The following Standards were referenced in the preparation of this report:

- A policy on Geometric Design of Highways and Streets (2004)
- WSDOT Local Agency Guidelines (LAG)
- King County Road Design and Construction Standards (KCRDCS)
- King County Surface Water Design Manual 2009 (KC SWDM)
- WSDOT Design Manual 2009
- Bridge Design Manual
- AASHTO LRFD

  Relevant federal, state, and local codes

5.1 Roadway Design Standard and Typical Section

The road is classified as a Rural Collector Arterial with an ADT of under 400 vehicles per day; AASHTO geometric design of Very low-volume local road (ADT<400) can be used as the design guideline. The posted speed is 35MPH.

To balance in roadway design, all geometric elements, as far as economically practical, should be designed to provide safe, continuous operation at a speed likely to be observed under the general conditions for the roadway. This project is considering building bridge and roadway under the current existing or more favorable alignment.

Table 4 – Design Criteria

Design Element	Existing	AASHTO (Very Low-Volume ADT<400) Standard	KCRDCS Table 2.02(A)	Proposed (Existing Alignment 2A and 2B)	Proposed (New alignment 3B)
Bridge #999W	16.8’	20’ for one lane bridge	20’ minimum one way paved width	16.8’	**22’**
Approach roadway width	22’-28’	24’	30’	24’	**24’**
Posted speed	35MPH	-	-	-	**-**
Design speed	45MPH	-	-	-	**-**
Super elevation	0%	6%	6%	6%	**6%**
Lane width (approach)	10	11	11’	11’	**11’**
Shoulder width	1	1	4’	1’	**1’**
Total travelled way	22’	24’	30’	24’	**24’**
Horizontal curve West approach	286’	380’ (Exhibit 5)	650’	286’	**550’**
Horizontal curve- East approach	573’	380’(Exhibit 5)	650’	573’	**573’**
ROW width	60’	60’	60’	60’	60’

a) Bridge Design

The proposed bridge will be designed in accordance with most recent versions of the WSDOT Bridge Design Manual and the AASHTO LRFD code and Washington Administration Code (WAC) requirements. Design loading is for AASHTO HL-93.

WAC 220-110-070 Water crossing structures states that “Water crossing structure projects shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat. The following technical provisions shall apply to water crossing structures

(1) Bridge construction.

(a) Excavation for and placement of the foundation and superstructure shall be outside the ordinary high water line unless the construction site is separated from waters of the state by

use of an approved dike, cofferdam, or similar structure.

(b) The bridge structure or stringers shall be placed in a manner to minimize damage to the bed.

(c) Alteration or disturbance of bank or bank vegetation shall be limited to that necessary to construct the project. All disturbed areas shall be protected from erosion, within seven calendar days of completion of the project, using vegetation or other means. The banks shall be revegetated within one year with native or other approved woody species. Vegetative cuttings shall be planted at a maximum interval of three feet (on center), and maintained as necessary for three years to ensure eighty percent survival. Where proposed, planting densities and maintenance requirements for rooted stock will be determined on a site-specific basis. The requirement to plant woody vegetation may be waived for areas where the potential for natural revegetation is adequate, or where other engineering or safety factors preclude them.

(d) Removal of existing or temporary structures shall be accomplished so that the structure and associated material does not enter the watercourse.

(e) The bridge shall be constructed, according to the approved design, to pass the 100-year peak flow with no off-site increase in base flood elevation, consideration of debris likely to be encountered. Exception shall be granted if applicant provides hydrologic or other information that supports alternative design criteria. Additionally the KC SWDM requires bridges accommodate sufficient hydraulic capacity and account for long term bed aggradation.

(f) Wastewater from project activities and water removed from within the work area shall be routed to an area landward of the ordinary high water line to allow removal of fine sediment and other contaminants prior to being discharged to state waters.

(g) Structures containing concrete shall be sufficiently cured prior to contact with water to avoid leaching.

(h) Abutments, piers, piling, sills, approach fills, etc., shall not constrict the flow so as to cause any appreciable increase (not to exceed 0.01 feet) in backwater elevation (calculated at the 100-year flood) or channel wide scour and shall be aligned to cause the least effect on the hydraulics of the watercourse. Compensatory storage requirements of no net fill from the project must also be considered.

(i) Riprap materials used for structure protection shall be angular rock and the placement shall be installed according to an approved design to withstand the 100-year peak flow."

5.2 Evaluation of Bridge Superstructure and Substructure Types

The low chord elevation of the existing bridge is 903' and the 100-year WSEL is 897 ft. There is a history of up to 80'-100' long log jams occurring upstream of this bridge. The

existing bridge #999W was raised 3' in 1961. Therefore, working with the limitations of the existing grade and elevations, it is prudent to keep the bottom chord elevation the same for the new span across the new waterway. Thus, the profile grade is limiting the superstructure depth. The available depth for the super structure is approximately 42". Also the minimum span recommended for the passing of the woody debris is about 100'. So the superstructure type for the main span will be a truss and the approach spans can be precast prestressed girders.

Channel migration and scour are one of the major factor in the decision of the foundation type. It is recommended to use deep foundation to account for the possibility of scour occurring through channel migration and by local hydraulic effects. Based on the reconnaissance of the site and previous investigation performed in November 2006, fill soils from the existing roadway subgrade to a depth of 10 to 15 feet are expected. The fill soils are expected to consist primarily of gravelly sand and sandy gravel with some cobbles. Occasional boulders and/or rip rap should be anticipated. Naturally deposited gravelly sand and sandy gravel with some cobbles are anticipated below the fill to depths on the order of 25 feet. Below the granular material medium stiff to stiff low plasticity silts and clays are expected to depths of about 80 feet. Very dense sands and gravels were encountered at a depth of 80 feet in one of the two previously completed borings. A deep foundation system such as driven piles or drilled shafts is anticipated due to the potential for scour. Water was encountered at about 13 feet below the ground surface, generally corresponding to the river elevation.

The washout created an island, which will be vulnerable for another washout due to potential channel migration. The existing structure will need to be protected with riprap for potential scour and channel migration conditions.

5.3 Right-of-Way

Sixty feet of right-of-way (ROW) is available at the bridge site (See Figure 16). The east approach roadway is located within the BNRR ROW of 200 feet. Option 3 will require

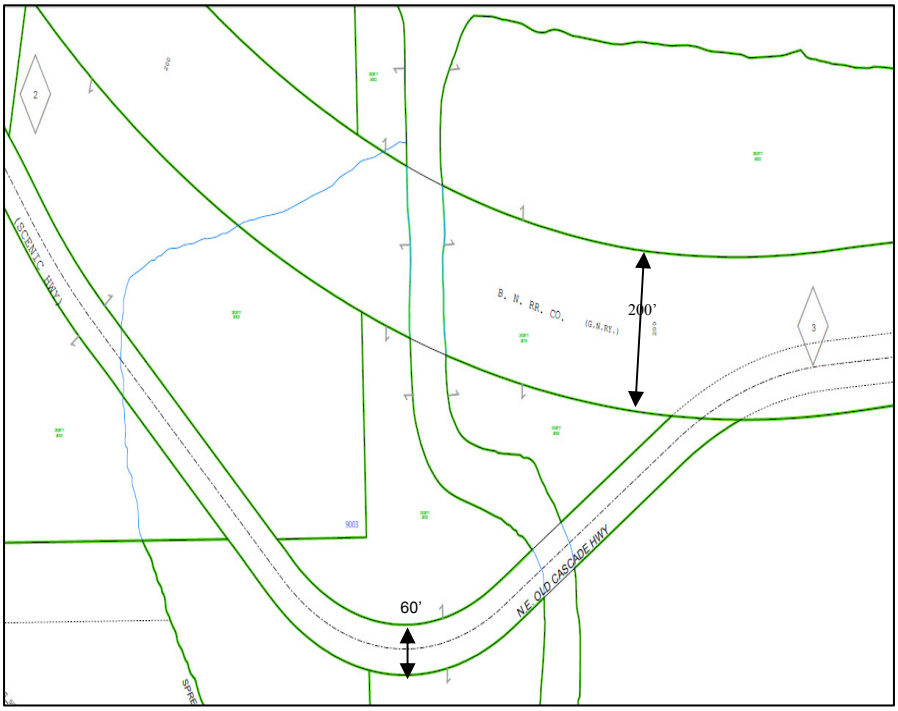


Figure 16: ROW map

coordination and approval from BNRR and King County Rivers as the new alignment will project outside the existing ROW. Other options working in the existing alignment may require installation of a temporary bridge to construct the footing in the island. Additional ROW easement will be needed for this.

5.4 Utilities

There is a 4" fiber optic conduit owned by Qwest that was damaged during the washout. The fiber optic line is now attached to the overhead power poles. Coordination will be necessary for these services.

6 Construction

The construction challenges will include project location as it is located on a rural area of northeast King County. There are wetlands, tributaries and other sensitive areas adjacent to the bridge that must be protected. All construction will be in the 100-year flood plain and channel migration areas. This will most likely a two season construction project.

A temporary structure will be needed to construct the new footing and spans in the island. Existing bridge is load limited and the width is narrow.

7 Environmental Impact Analysis

This section briefly describes potential impacts to sensitive areas associated with all of the three proposed alternatives. Since the primary element of the project is to address the washout of Western bridge approach of Miller River Bridge #999W, many of the project elements are similar for the design alternatives, and therefore many of the environmental impacts are similar under each of the alternatives (especially with regards to Options 2A and 2B). The significant difference as it relates to the amount of environmental impact to any alterative would be the level at which the river will be allowed to reclaim its surrounding floodplain and restore its natural functions. The severity of the environmental impacts increases the smaller the crossing structure and the greater amount of road fill and associated riprap needed.

Road systems and associated land use can have dramatic effects on aquatic ecosystems. These effects may be directly evident or may be indirect because of altered connectivity. Direct effects result from the local immediate alteration of the natural aquatic conditions. Indirect effects occur where the roads intentionally or inadvertently disrupt connectivity within aquatic systems. Any of the replacement alternatives will have direct and indirect effects. The Snohomish Salmon Plan (adopted by the King County Council) includes policy language regarding new infrastructure in sensitive areas such as, “locate new infrastructure or utility corridors away from critical areas, unless no feasible alternative exists. Avoid or minimize impacts through planning, design, use of best management practices, and use of innovative, non-invasive techniques.” King County needs to strive to minimize the impacts of this bridge project on critical areas including floodplains, wetlands, and channel migration areas.

Construction of any proposed project that includes vegetation removal and a crossing structure will affect aquatic and wildlife species, the habitat features within the Miller River, and its riparian buffer that support populations of species. Sensitive areas may be temporarily or permanently degraded. Vegetation removal or lack of area for riparian vegetation to exist would degrade riparian habitat by reducing canopy cover, organic inputs, prey sources, bank stability, and future large wood recruitment. The river will experience hydraulic changes within the project area and depending on the crossing structure size, orientation, amount and area of road fill and associated riprap will have some degree of effect on the greater floodplain, channel migration zone, alluvial fan and the SF Skykomish River. These changes have the potential to modify fish habitat in the river, such as the locations and depths of pools, quantity and quality of salmonids rearing and refuge habitat, and quantity of spawning gravel.

The placement of the road, bridge and culvert has already dramatically affected the area by blocking the natural flows of organisms, materials, and energy. Altered connectivity can result through changes in water quality, physical habitat, and interactions with adjacent

terrestrial ecosystems. Upstream and downstream connections may be severed where culverts or bridges limit upstream migration of fish due to water elevation drops or excessive current velocity. Floodplain and river interactions are impeded where roadbeds on valley floors interrupt the natural flow of water over the floodplain areas through secondary channels and sedimentation patterns that drive habitat forming processes.

Interactions between the channel and the adjoining floodplain are considered critical to river functions. Large, floodplain-bordered rivers are believed to depend substantially in inundation of floodplain areas for supporting river productivity and maintaining the biological diversity of river ecosystems. Placement of road, crossing structures, abutments and riprap within the floodplain and river impedes the natural functions of a river or shoreline. There are numerous river functions and most if not all are directly or indirectly impacted with placement of structures within or along a river or its floodplain. The project for example may only slightly affect the river's hydrologic character and/or chemical processes depending on the amount, size and location of the structure but other functions of the river like morphological evolution, sediment processes, riparian succession, habitat and biological community processes could be severely impacted with any amount of riprap or structures placed within the floodplain. Minimizing structures in the floodplain will encouraging more natural and sustainable habitat forming processes necessary to create and sustain salmon and aquatic habitat.

8 Permits and Approvals

The criteria for selecting a preferred design scope includes the need to avoid, minimize, or mitigate anticipated impacts to the environment, including critical habitats, vegetation, wildlife, and fish; as well as cultural resources and the community. The basis for determining permit requirements is dependent on the nature of the damage incurred, resulting impacts, mitigation required, and funding source.

Two main conditions can trigger a federal link for any project: 1) federal funds obligated to the project, and 2) work conducted in the waterway or wetlands that are under federal jurisdiction. Since the washout damage on Miller River Road resulted from river migration and high flows during a storm event, the project is eligible for FEMA funding, meeting the first condition. Additionally, the proposed work will occur adjacent to and depending on the final design, potentially within the Miller River, meeting the second condition.

The following sub-sections contain a list of the permits and approvals that may be required for the bridge construction alternatives. The list includes permit triggers for each potential permit.

8.1 Federal Permits

Section 404 Permit – US Army Corps of Engineers

A permit from the U.S. Army Corps of Engineers will be required under Section 404 of the Clean Water act if fill material discharges into waters of the U.S., including special aquatic sites such as wetland. All of the design options would likely require a Section 404 permit

based on the potential use of rip rap for bank armor and the potential installation of piles in the water. The type of Section 404 permit that the Corps will issue will be dependent on the specifics of the design alternative chosen.

The two types of Section 404 permits are:

- Nationwide Permit: A Nationwide Permit could be issued for the project if the fill or dredging activities in Miller River (or adjacent wetlands) have minimal impacts that meet a specific list of predefined criteria. Activities associated with Options 2A and 2B are more likely to meet the criteria for a Nationwide Permit because the activities will occur in the alignment of the existing road and bridge.

- Individual Permit: A Section 404 Individual Permit would be required for fill or dredging in Miller River (or adjacent wetlands) if the project does not meet the conditions of a Nationwide Permit. The work activities associated with Option 3B include building a new road alignment, which is more likely to be outside the scope of activities covered by a Nationwide Permit.

Section 401 Water Quality Certification – Washington Department of Ecology
A permit from the Washington Department of Ecology will be required under Section 401 of the Clean Water Act if the project triggers a Section 404 permit. If a Section 404 Nationwide Permit is issued than the 401 Water Quality Certification is typically issued as part of the Nationwide Permit and does not require separate review by the Washington Department of Ecology. However, if a Section 404 Individual Permit is required, than an Individual Section 401 Water Quality Certification will also be required, and the project will be reviewed and approved separately by the Washington Department of Ecology.

National Historic Preservation Act Section 106 Concurrence – Washington Department of Archaeology & Historic Preservation (DAHP), interested tribes, and the King County Landmark Commission. Consultation is required for projects with a federal nexus (i.e., involving federal funding; federal licenses, permits, or approvals; use of federal lands; or a federal program). This law requires an analysis of impacts to cultural, archaeological, and historic resources.

Miller River Bridge 999W is a King County Landmark and is eligible for listing on the National Register of Historic Places. All of the proposed options will have some level of impact on this King County Landmark. Any improvements to the Landmark bridge as part of Options 2A, or 2B; or the abandonment or relocation of the bridge as part of Option 3B will require consultation with SHPO. Additionally, any land cleared for temporary roads, structures or staging areas as part of Options 2A or 2B or permanent clearing as part of Option 3B need to be screened and evaluated for archaeological resources.

Endangered Species Act (ESA) Section 7 Consultation – U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS). Consultation is required for

projects with a federal nexus (i.e., involving federal funding; federal licenses, permits, or approvals; use of federal lands; or a federal program). This law requires an analysis of impacts to listed endangered species and habitat (terrestrial and aquatic).

Due to the presence of ESA aquatic species (Chinook, steelhead, and bull trout) in the project and ESA terrestrial species and critical habitat documented in proximity of the project, a Biological Assessment must be prepared for all of the options to evaluate the project's impacts to ESA-protected species and habitat. The Biological Assessment must be reviewed and approved by the federal lead agency, NMFS, and USFWS. The final design of the alternatives will ultimately determine whether the Biological Assessment requires informal (not likely to adversely affect) or formal ESA review (likely to adversely affect).

Magnuson-Stevens Fisheries Conservation and Management Act, Essential Fish Habitat (EFH) Consultation – NOAA Fisheries. Consultation is required for projects with a federal nexus (i.e., involving federal funding; federal licenses, permits, or approvals; use of federal lands; or a federal program).

The lead federal agency will consult with NOAA Fisheries in accordance with the Magnuson-Stevens Fisheries Conservation and Management Act, regarding the project's impacts to EFH. Potential and actual impacts to EFH will be addressed for all of the options in the Biological Assessment prepared as part of the ESA Section 7 consultation (discussed above).

National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit – Washington Department of Ecology. Required for any land-disturbing activities such as clearing, grading, excavation, and/or demolition that: 1) disturbs one or more acres of land area; or 2) are "part of a larger common plan of development or sale" that will ultimately disturb one or more acres of land; and 3) discharges stormwater from the site into state surface water(s) or into storm drainage system, which discharge to state surface waters. Stormwater associated with construction-support activities (e.g., off-site equipment staging yards, material storage areas, borrow areas, etc.) are also covered by this permit.

It is unlikely that Options 2A and 2B will disturb one or more acres of land; as such, it is unlikely that Options 2A and 2B will trigger the need for an NPDES permit.

The new alignment associated with Option 3B may require up to one acre of land disturbance, and as such, may trigger the need for an NPDES permit.

Migratory Bird Treaty Act (MBTA) – USFWS and Secretary of the Interior. It is unlawful to pursue, hunt, take, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg of any such bird, unless authorized under a permit issued by the Secretary of the Interior, and enforced by the USFWS.

The presence of the pristine environment that surrounds the project area triggers the need for MBTA consultation with USFWS, which will include, at a minimum, bird screening and reporting prior to- and during construction activities.

Bald and Golden Eagle Protection Act – USFWS. The permit will authorize limited, non-purposeful take of Bald Eagles and Golden Eagles; authorizing individuals, companies, government agencies (including tribal governments), and other organizations to disturb or otherwise take eagles in the course of conducting lawful activities such as operating utilities and construction projects. The permit is enforced by USFWS.

The presence of the pristine environment that surrounds the project area as well as the documented presence of bald eagle nests within ½ mile of the project area triggers the need for Bald and Golden Eagle Protection Act consultation with USFWS. USFWS consultation will include, at a minimum: construction techniques and timing to minimize impacts to identified nests; and screening and reporting prior to and during construction activities.

National Environmental Policy Act (NEPA). NEPA is required for projects with a federal nexus (i.e., involving federal funding; federal licenses, permits, or approvals; use of federal lands; or a federal program).

Accepting funding assistance from a federal agency (FEMA) triggers the need to complete NEPA. Based on King County's initial review of the design alternatives, it is anticipated that the three alternatives will not have the potential to significantly affect the quality of the human environmental. Therefore, the three alternatives will not likely trigger the need to conduct an Environmental Assessment or an Environmental Impact Statement. It is anticipated that the three design alternatives will meet FEMA Categorical Exclusions (CATEX).

Federal Emergency Management Agency (FEMA) Letter of Map Revision (LOMR). A LOMR is required for projects within the regulated 100-year floodplain. Since the project is in regulated Zone A, based flood elevations will need to be established for this project. While the project is Early coordination with FEMA, at 30% design, is encouraged.

8.2 State Permits

State Environmental Policy Act (SEPA) – King County as the lead agency. Any proposal that requires a state or local agency to license, fund, or undertake a project, or the proposed adoption of a policy, plan, or program can trigger environmental review under SEPA.

Since King County is the project proponent (taking it on as well as funding a portion of it), a SEPA Environmental Checklist will be required for all of the design alternatives. Based on a review of impacts at this time for the three design alternatives, it is anticipated that the preparation of the SEPA Checklist, issuance of a Determination of Non-Significance and the

Notice of Action Taken, and satisfying the public notification/comment requirements of SEPA will be sufficient to comply with the SEPA requirements.

Joint Aquatic Resources Permit Application (JARPA)/Hydraulic Project Approval (HPA) – Washington Department of Fish and Wildlife (WDFW). Required for any work that uses, diverts, obstructs, or changes the natural flow or bed of state waters.

Since all of the three design alternatives will involve construction or structural work associated with a bridge structure waterward of - or across the ordinary high water line of state, the design alternatives will require an HPA. Additionally, the Washington Administrative Code (WAC) requires that water crossing structure projects shall incorporate mitigation measures as necessary to achieve no-net-loss of productive capacity of fish and shellfish habitat (see Design Considerations for WAC requirements on bridge design).

8.3 Local Permits

Clearing and Grading Permit – King County Department of Development and Environmental Services (DDES). A clearing permit is required for any removal of trees or vegetation from a critical area or from properties subject to urban clearing standards or clearing restrictions in a special district overlay defined in 21A.38 of the King County Code (KCC). A grading permit is required for any amount of grading around a critical area. Otherwise, the threshold for a grading permit is 100 cubic yards or the creation of 2,000 square feet of new impervious surface.

A clearing and grading permit will be required for work outside of the existing roadway prism and any work in the stream and/or stream buffer. It is anticipated that all three of the design alternatives will require clearing and grading as part of the project activities, thus requiring a clearing and grading permit.

Shoreline Substantial Development Permit – King County DDES. A Shoreline Substantial Development Permit is required to build on or within 200 feet of any lake, river, or stream that is a designated Shoreline of State and for which the project improvement value exceeds $5,718.

All three of the design alternatives involve the installation of structure to span the new Miller River channel at the Old Cascade Highway. Therefore, all of the design alternatives will require a Shoreline Substantial Development Permit from King County DDES.

King County Critical Areas Ordinance (CAO) – King County DDES. Stream, wetland, and wildlife resources in King County are regulated primarily by the CAO (2008, which is Section 21A.24 of the KCC). The Washington State Growth Management Act requires King County and other local municipalities to designate and protect critical areas, including fish and wildlife conservation areas.

All three of the design alternatives involve work within critical areas; and therefore, all of the design alternatives would require documentation that discusses the impacts to the protected critical areas, proposed mitigation, and the performance measures. The proposed mitigation and performance measures require approval from King County DDES.

King County Certificate of Appropriateness (COA) Process – King County Landmarks Commission. Any project that alters a designated feature of a King County Landmark must be approved through a formal design review process, Certificate of Appropriateness.

Miller River Bridge 999W is a King County Landmark and is eligible for listing on the National Register of Historic Places. All of the proposed options will have some level of impact on this King County Landmark. Any improvements to the Landmark bridge as part of Options 2A or 2B will require consultation with the County Landmark Commission. In Option 3B, the King County Landmark Bridge would be either abandoned in place or re-located, which would also require consultation with the County Landmark Commission.

Flood Hazard Certification – King County DDES. Development proposals must not reduce the effective base flood storage volume of a floodplain and they must not increase the base flood elevation. Grading or other activity that would reduce the effective storage volume must be mitigated by creating compensatory storage on the site. The compensatory storage must provide equivalent volume at equivalent elevations to that being displaced, be hydraulically connected to the source of flooding, be provided in the same construction season and before the flood season begins on September 30, and occur on site or off site if legal arrangements can be made to assure that the effective compensatory storage volume will be preserved over time.

Because KCRSD will be working within a 100-year floodplain, a Flood Hazard Certification will likely be required (typically required before the clearing and grading permit is issued) from DDES to document that the project meets King County requirements for protection of floodplain storage and floodplain conveyance. A hydraulic and scour study/report will be needed to show that the project meets the appropriate requirements including zero–rise and compensatory storage analysis.

Table 5 summarizes the list of permits needed based on the federal link (FEMA Funding).

TABLE 5: Permit and Approvals Summary

Required Permits	Option 2A	Option 2B	Duration – for Permit Approval	Option 3B	Duration for Permit Approval
FEDERAL PERMITS					
Nationwide Permit – Corps	X	X	6-9 mos.		
Individual Section 404 Permit – Corps	X	X	6-9 mos.	X	9-12 mos.
Individual Section 401 Water Quality Certification - Ecology	N/A	N/A	N/A	X	9-12 mos.
Section 106 – DAHP	X	X	6-7 mos.	X	6-7 mos.
Section 7 ESA Consultation – NMFS and USFWS *(assume informal consultation and FEMA Lead Agency)*	X	X	12 mos. Depends on FEMA staff availability	X	12 mos. Depends on FEMA staff availability
Section 7 ESA Consultation – NMFS and USFWS *(assume informal consultation and Corps Lead Agency)*	X	X	3-6 mos.	X	3-6 mos.
EFH Consultation - NMFS	X	X	Linked to Section 7 ESA	X	Linked to Section 7 ESA
NPDES - Ecology				X	3 mos.
Migratory Bird Treaty Act – USFWS	X	X	2-3 mos.	X	2-3 mos.
Bald and Golden Eagle Protection Act – USFWS	X	X	2-3 mos.	X	2-3 mos.
NEPA CE	X	X	4-6 mos.	X	4-6 mos.
STATE PERMITS					
SEPA DNS	X	X	3-5 mos.	X	2-4 mos.
HPA - WDFW	X	X	45 days	X	45 days
LOCAL PERMITS					
Clearing and Grading Permit – KC DDES	X	X	9-12 mos.	X	9-12 mos.
Shoreline Development Permit –KC DDES	X	X	6-9 mos.	X	6-9 mos.
KC CAO – KC DDES	X	X	Linked to C & G Permit	X	Linked to C&G Permit
KC COA Process – KC Landmark Commission	X	X	3-4 mos.	X	3-4 mos.
Flood Hazard Certification – KC DDES	X	X	Linked to C&G Permit	X	Linked to C&G Permit

9 Budget Estimate

The estimated total project cost for the recommended option 3B is estimated to be $19.1M. A breakdown of the total project cost is shown in Table 6. Appendix D provides the detailed preliminary construction cost.

TABLE 6: Budget Summary

Option	Construction cost	Design cost	Construction Engineering	Total Estimated Project Cost
Option 2A: Same alignment- minimum span and fill-185'	$4,404,000	$1,201,200	$800,800	$6,406,000
Option 2B: Same alignment - truss and trestle -500'	$7,960,000	$1,809,000	$1,447,200	$11,216,200
Option 3B- Realignment and extend to spree creek -1140'	$14,001,000	$2,545,600	$2,545,600	$19,092,200

It is estimated that the existing bridge replacement cost will be about $7.3M. Corporation with Bridge Replacement Advisory Committee (BRAC) is necessary to fund option 3B. If approved by BRAC, the expected cost share is as shown in the table below.

Cost share for option 3b assume FEMA approves alternate	Total Cost option 3B	FEMA	EMD	Difference	BRAC
Construction	$14,001,000	$9,450,675.00	$1,750,125.00	$2,800,200.00	$2,800,200.00
Construction Engineering	$2,545,600	$1,718,280.00	$318,200.00	$509,120.00	$509,120.00
Design and permitting	$2,545,600	$1,718,280.00	$318,200.00	$509,120.00	$509,120.00
Total:	$19,092,200	$12,887,235.00	$2,386,525.00	$3,818,440.00	$3,818,440.00

Assumptions:

- Scope of work stays the same
- Coordination with BNRR is minimum
- Updates to Hydraulic and geomorphology study stays the same

9.1 Life Cycle Cost Analysis

A quick analysis of life cycles cost for the options 2B and 3B is listed below. Using existing alignment and repairing the washout will imply future maintenance and replacement cost of exiting structure.

Option	Construction cost	Design cost	Construction Engineering	Total Estimated Project Cost	Total including existing bridge
Option 2B: Same alignment - truss and trestle -500'	$7,960,000	$1,809,000	$1,447,200	$11,216,200	$18,544,200
Option 3B- Realignment and extend to spree creek -1140'	$14,001,000	$2,545,600	$2,545,600	$19,092,200	$19,092,200
Existing bridge replacement cost	$5,038,000	$1,145,000	$1,145,000	$7,328,000	

10 Project Schedule

Below is the project schedule to meet the 18-month design to construction requirements for the funding requirement. This will depend on securing matching funds.

ID		Task Name	Duration	Start	Finish
1		**Miller river bridge construction**	**830 days**	**1/9/2012**	**3/13/2015**
2		**Design**	**374 days**	**1/9/2012**	**6/13/2013**
3		NTP	0 days	1/9/2012	1/9/2012
4		Funding and project setup	4 ewks	1/9/2012	2/6/2012
5		**CDR**	**100 days**	**2/3/2012**	**6/22/2012**
16		**70% Design**	**80 days**	**6/25/2012**	**10/12/2012**
22		**90% design**	**85 days**	**9/28/2012**	**1/25/2013**
27		**100% design**	**35 days**	**1/28/2013**	**3/15/2013**
30		**Enviornmental**	**247 days**	**6/22/2012**	**6/4/2013**
40		**Funding**	**64 days**	**3/15/2013**	**6/13/2013**
41		Federal funding obligation	3 emons	3/15/2013	6/13/2013
42		**Advertise**	**20 days**	**7/11/2013**	**8/8/2013**
43		Ad	4 ewks	7/11/2013	8/8/2013
44		**Construction**	**286 days**	**8/9/2013**	**9/14/2014**
45		Contract award	30 days	8/9/2013	9/19/2013
46		Construction	12 emons	9/19/2013	9/14/2014
47		**Project closeout**	**130 days**	**9/14/2014**	**3/13/2015**
48		Project closeout	6 emons	9/14/2014	3/13/2015

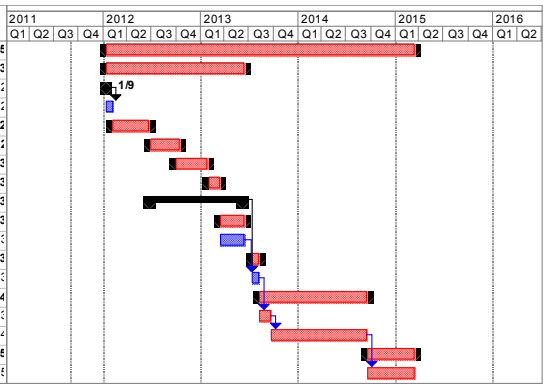


Figure 17: Project Schedule

11 Recommendation/Conclusion

The preferred design for this project is to reconstruct the road with Option 3B. The figure 18 below shows the plan and profile view of the proposed design of the project.

Option 3B ranks the best of the options to reconstruct the road within or near its current alignment. This option will provide the community with a safer bridge by eliminating the structurally deficient, functionally obsolete, load limited bridge, improving seismic vulnerability, providing unrestricted detour route for US-2. By elevating the roadway across the alluvial fan the risks from flooding and future channel migration can be effectively mitigated compared to the other reconstruction options.

The preferred option locates the new 1,140-foot structure immediately downstream of the existing bridge, tying into the old abutments. Replacement of the old bridge raises the superstructure high above the floodplain, vastly improving debris passage characteristics while eliminating the sharp horizontal curve, a 13.5-foot vertical clearance obstruction, and a 23-ton, one-lane load restriction. Setting the west approach back 700 feet to the west edge of the migration zone gives enough room for anticipated channel migration.

To fund this option, King County has initiated conversations with the Washington State Department of Transportation and the EMD to share costs that will match FEMA's contribution. The estimated cost for King County's preferred option is $19.1M, which includes $7.3M for the cost of replacing the old Miller River Bridge.

The two other options considered would reconstruct a bridge on the existing alignment, but do nothing to replace the old Miller River Bridge. In addition, these options do not provide enough space to accommodate expected channel migration of the Miller River.

From King County's perspective, the other two options are an inappropriate use of precious federal, state, and local funds because of the extremely migratory nature of the river. Historic and current data prove this, as the configuration of bridges and roadways over the Miller River has changed several times over the span of the last fifty years.

If FEMA funding can be secured, the County can begin design in 2012 and start construction in the spring/summer of 2013, with any minimal in-water work during the fish window of 2013. Once the rainy season starts, the river can quickly overflow the work area, so accelerated bridge construction will be anticipated. Following this timeline, the new Miller River Bridge could be completed in early 2014.

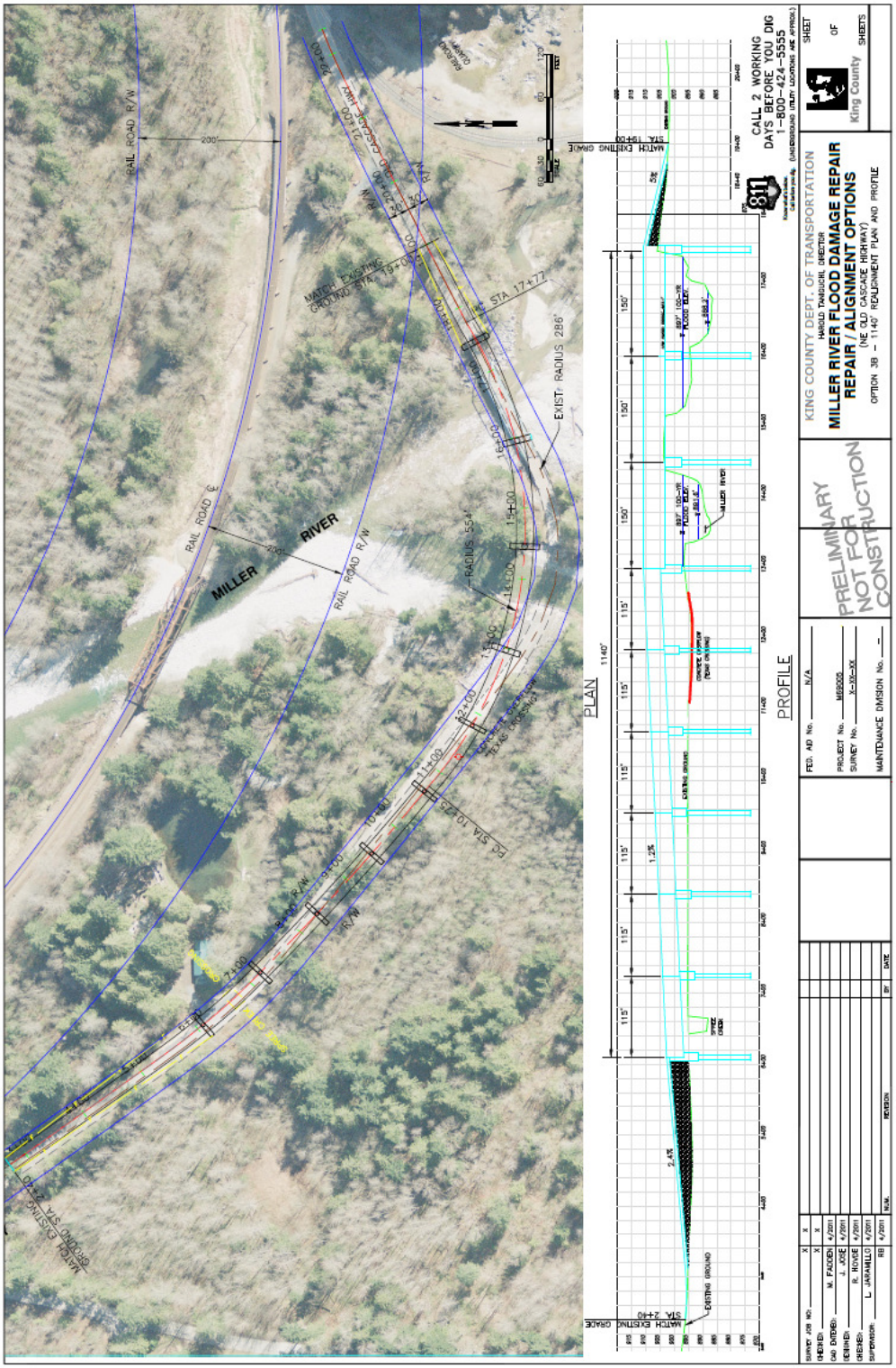


Figure 18: Option 3B