Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

PN 0115000099

01-DN-101-PM 12.0-15.5

Contract No. 53A0208

Task Order No. 1045

October 2018

Prepared by

Value Management Strategies, Inc.

Value Management Strategies, Inc.

CORPORATE OFFICE:
900 Canterbury Place, Suite 330
Escondido, CA 92025
T: 760 741 5518 | F: 760 741 5617

Date: October 11, 2018

To: Jaime Matteoli, Project Manager

Subject: Final VA Study Report (Task Order 1058)
D-1 Del Norte 101 Last Chance Grade

Value Management Strategies, Inc. is pleased to submit this Final VA Study Report for the referenced project. This report summarizes the results and events of the study conducted September 27-31, 2018 in District 1 offices in Eureka, California.

It was a pleasure working with Caltrans District 1 on this project, and I look forward to the next one. If you have any questions or comments concerning this final report, please do not hesitate to contact me at (206) 679-8029 or EricT@vms-inc.com.

Sincerely,

VALUE MANAGEMENT STRATEGIES, INC.

Eric Trimble, CVS, MBA, PMP, ENV SP
VA Study Team Leader

Copy: (PDF) Addressees
(2 copies/PDF) Kevin Espinoza, District 1 VA Coordinator
(PDF) Joy Keller-Weidman, Senior Program Manager – Udall Foundations
(PDF) Erika Barrick, HQ VA Program Manager

TABLE OF CONTENTS

FINAL

VA STUDY SUMMARY REPORT

FINAL RESULTS

VA Study Summary Report – Final Results

D-1 Del Norte 101 Last Chance Grade

01-DN-101
PN 0115000099
(PM 12.0 – 15.3)

A Value Analysis (VA) study, sponsored by Caltrans and facilitated by Value Management Strategies, Inc., was conducted for the District 1 Del Norte 101 Last Chance Grade Project. The VA study was conducted August 27-31, 2018 in the Caltrans District 1 offices in Eureka, California. This *VA Study Summary Report – Final Results* provides an overview of the project, key findings, and the initial VA alternatives developed by the VA team for future consideration by the project team.

PROJECT SUMMARY

The proposed project is located on a segment of US 101 known as Last Chance Grade (LCG), which is in southern Del Norte County, between Wilson Creek and Crescent City (PM 12.0 – 15.5). A geologic study conducted for Caltrans by the California Geological Survey in 2000 mapped over 200 historical and active landslides (both deep-seated and shallow) within this corridor. The project will address the landslides and road failures at LCG which have required Caltrans to perform a considerable number of construction projects and maintenance activities in the LCG area to keep the roadway open. Since 1981, landslide mitigation projects, including retaining walls, drainage improvements, and roadway repairs, have cost over $54 million ($33 million Emergency Response Projects and $21 million Non-Emergency Response Projects).

The project is currently considering several alternatives that provide a more reliable connection, reduce maintenance costs, and protect the economy, natural resources, and cultural landscapes. The recent PSR proposed seven alternatives (M, A1, A2, C3, C4, C5, and F) in response to landslides and roadway failures at LCG, which have caused damage for decades. Six of the seven proposed alternatives would include realignment of US 101 with the goal of avoiding the unstable portions of LCG. One of the proposed alternatives (M – No Build) to maintain the existing roadway on its current alignment does not meet the purpose and need of the project, but is included to provide a baseline

for comparison. An additional two Alignment Alternatives (X and L) were included in an update to the Preliminary Environmental Analysis Report (PEAR).

The Realignment Alternatives (A1, A2, C3, C4, C5, F, X, and L) vary between 1 mile and 14 miles in length and range in expected cost of construction from $250 million to $2 billion. Depending on the Alignment Alternative selected, the project is anticipated to be completed between October 2034 and October 2039.

PROJECT PURPOSE AND NEED

The purpose of this project is to develop a permanent solution to the instability and potential roadway failure at LCG. A long-term sustainable solution at LCG is needed for many reasons, including the following:

- Economic ramifications of a long-term failure and closure
- Risk of delay / detour to traveling public
- Increasing maintenance and emergency project costs
- Increase in frequency and severity of large storm events caused by climate change

This segment of US 101 was constructed in 1937. LCG has a history of geologic instability, including deep seated landslides and slipouts, which presents a long-term challenge with roadway stability and maintenance costs. Surveys conducted by Caltrans have shown the landslides have shifted the roadway centerline by over 40 feet horizontally from the original roadway centerline constructed in 1937.

The process to study and environmentally clear a realignment of US 101 at this location is very important. Contributing to the sense of urgency for a realignment project are the accelerating movement of the roadway, toe erosion impacts to the nested landslides, frequency of repairs, lack of geometric resiliency, and increasing risk and concerns of the traveling public. Important project elements and facility deficiencies that the project needs to address include soil and slope instability, existing geometrics, structures, vehicle traffic data, and collision data.

VA STUDY TIMING

The VA study was conducted early in the PA&ED phase of the study, which is to be completed in February 2026. The project is scheduled for Ready to List (RTL) in September 2030.

VA STUDY OBJECTIVES

The VA study was tasked with analyzing the potential Alignment Alternatives that optimize project scope to meet the project need and purpose while addressing the long list of constraints and challenges. The VA study objectives were therefore to:

1. Analyze the current project design options, cost estimate, and schedule.

2. Provide direction in the determination of a preferred alternative.

3. Provide possible cost, schedule, and/or performance improvement recommendations which consider current and innovative new solutions.

KEY PROJECT ISSUES

The items listed below are the key drivers, constraints, or issues being addressed by the project and considered during this VA study to identify the most appropriate Alignment Alternatives and possible project improvements.

Environmental Considerations – The project will need to address many critical environmental concerns, including the minimization of impacts to old growth redwood trees, the protection of native species and sensitive habitat, as well as the preservation of cultural resources. The project will need to avoid disturbance to these where possible and appropriately mitigate where it cannot.

Geotechnical Risks – The project will need to address the multiple slide areas within the project limits and determine the most appropriate alignment that will minimize impacts to the ongoing operation of the facility and reduce the future maintenance needs and life-cycle costs (LCC).

Project Feasibility – The project will need to consider overall feasibility in terms of funding constraints, stakeholder acceptance, permit considerations, duration of implementation, and overall alignment constructability.

EVALUATION OF ALIGNMENT ALTERNATIVES

Performance Attributes
Mainline Operations
Temporary Impacts
Permanent Impacts
Maintainability

During the course of the VA study, a number of analytical tools and techniques were applied to develop a better understanding of the project and the Alignment Alternatives. A major component of this analysis was Value Metrics which seeks to assess the elements of cost, performance, time, and risk as they relate to overall project value. These elements required a deeper level of analysis, the results of which are detailed in the *Project Analysis* section of this report. The key performance attributes identified for the project are listed in the table, "Performance Attributes." A summary of the major observations and conclusions identified during the evaluation of the Alignment Alternatives led the stakeholders and VA team to identify which Alignment Alternatives to move forward with and to develop the VA alternatives recommended in this report.

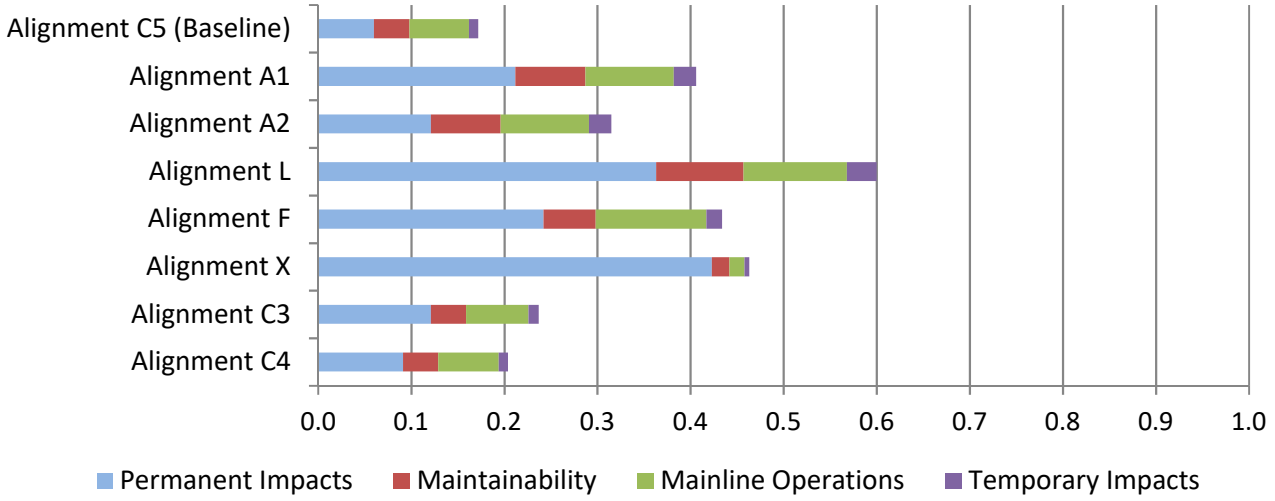
The stakeholders rated each of the performance attributes through a paired comparison process and found that Permanent Impacts (*or Environmental Impacts*) was of the utmost importance to the project with a relative weight of 60%. Maintainability and Mainline Operations were weighted the next highest at 19% and 16%, respectively. Temporary Impacts (*or Construction Impacts*) was weighted lowest – scoring only 5% – but was still seen as being an important consideration for overall project success.

The stakeholders then provided initial evaluations for each of the current Alignment Alternatives using these performance attributes and how each accomplished the project's stated purpose and need.

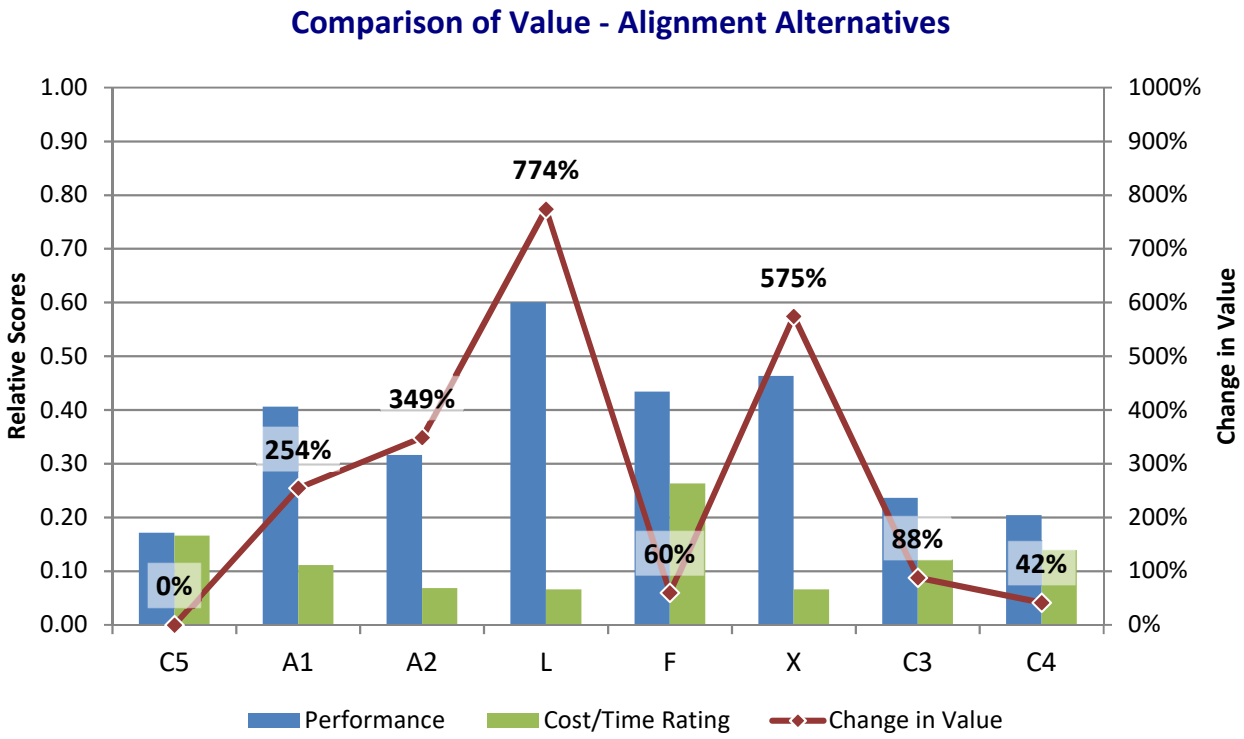
Although each of the alignment options were developed by the design team to address the specific goals of the project, it became clear through this exercise that the unique ways in which each Alignment Alternative would deliver the project led to a very wide range of performance outcomes in terms of the individual performance attribute scores for each alignment option and the stakeholder input on performance attribute weight as described above. The following chart demonstrates the variations between the Alignment Alternatives in which it becomes clear that Alignment Alternatives C3, C4, and C5 do not perform favorably when compared to the others – and most notably due to the large Permanent Impacts to the environment that each of these represents.

Note that for comparison purposes, Alignment Alternative C5 was used as the project baseline as it was identified as such in the PSR at this early stage of the project and reflects one of the most conservative approaches to project scope in terms of schedule and budget.

Comparison of Alignment Alternatives Performance



The next step was to add the initial cost and schedule components into the comparison to provide a more holistic approach to determining overall project value. The graphic below demonstrates that when these data points are integrated into the project value equation, Alignment Alternatives C3, C4, C5, and F deliver the lowest value to overall project benefit for the resources expended. Due in part to this analysis and validation through discussion, it was recommended that Alignments C3, C4, and C5 be removed from consideration as the project moves towards the Environmental Study phase. Please refer to the *Project Analysis* and *Appendices* sections of the report for a detail of the value metrics calculations and stakeholder input for alignment performance scoring.



VA ALTERNATIVES

Although the project has not yet identified a preferred alternative with which to move forward with, the VA team was tasked with identifying and developing concepts that may prove effective in adding value to one or more of the alignments under consideration using current or innovative new solutions to address project concerns.

The VA team developed 11 VA alternatives which provide potential improvement to the project. The following are the alternatives identified, along with their associated Alignment Alternative, potential additional capital cost impact, performance attribute focus, and a brief discussion of each.

Note: The Cost Impact column reflects the likely initial project cost addition to the baseline estimate. As the project cost data is in a very preliminary state, and the VA alternatives can relate to several design alternatives – with wide initial cost ranges – and multiple design alternative estimates, the cost impact information for each VA alternative is depicted using approximate values:

- *$ ≈ between $0 and $5M*
- *$$ ≈ between $5 and $50M*
- *$$$ ≈ between $50M and $100M*
- *$$$$ ≈ between $100M and $200M (or more)*

Note: The Performance Impact column refers to the following performance attributes:

- *Mainline = Mainline Operations*
- *Perm = Permanent Impacts*
- *Maint = Maintainability*

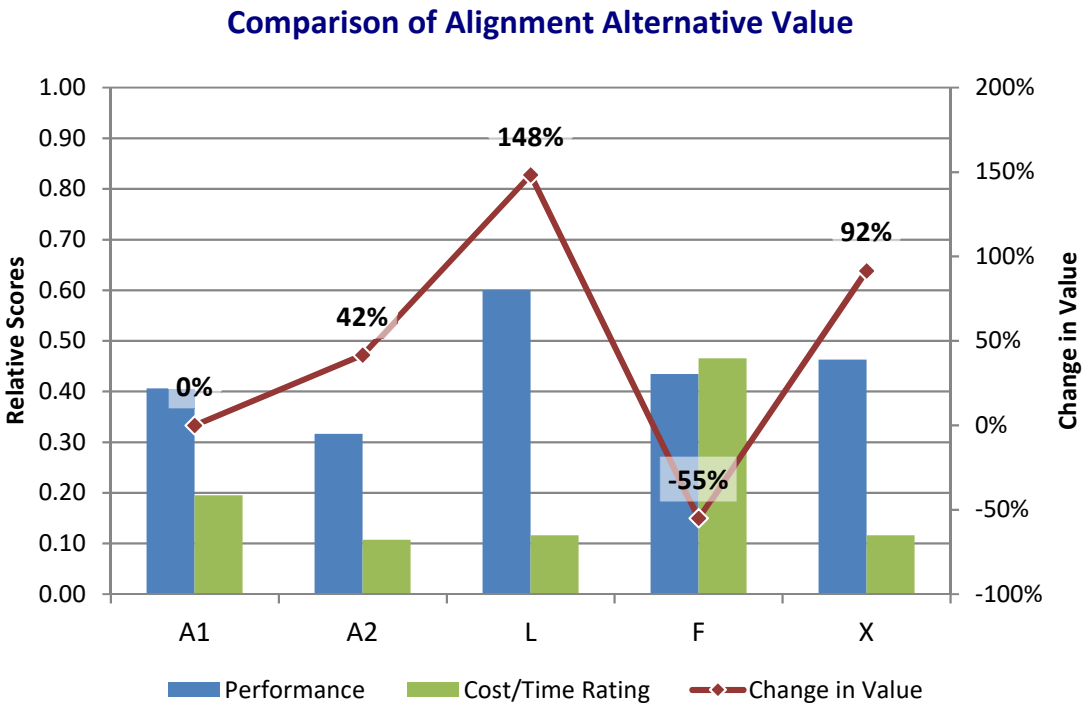
Alternative No. and Description	Associated Alignment Alt	Cost Impact	Performance Focus
1.0 Use mechanically stabilized earth / reinforced soil for slopes	**A1, A2, L**	**$$**	**Perm**
The initial design concept for the affected alternatives (A1, A2, and L) would incorporate use of 2:1 fills for the full extent of the project limits. The alternative concept would use steeper fills (1.5:1 or steeper) to reduce the project footprint and fill volumes. This concept uses steel or geosynthetic reinforcement strategies to mechanically stabilize or reinforced the soil slopes.			
2.0 Use catchment areas to protect roadway	**A1, A2, X, L**	**$**	**Maint**
The initial design concept for the affected alternatives (A1, A2, X, and L) would incorporate use of a standard shoulder width where possible for the full extent of the project limits. The alternative concept would target the use of catchment areas at designated slide-prone areas to provide additional debris and drainage management.			
3.0 Provide wider alignment where appropriate	**X**	**$$**	**Mainline**
The initial design concept for Alternative X proposes to use standard shoulder widths (8 feet for two-lane facilities) for the full extent of the project limits. The alternative concept would increase the width of paved shoulders (in excess of 8 feet) at targeted locations to enhance mobility and improve maintainability on the facility.			
4.0 Minimize fill through alternative alignment	**A1, A2**	**$**	**Perm**
There are two alignments proposed (A1 and A2) that bypass a portion of the existing alignment to avoid the LCG slide complex. The alternative concept would use a steeper alternate alignment to reduce the length of the proposed facility and the overall footprint of the southern part of the A1 and A2 alignments.			
5.0 Use retaining walls and bridges to reduce footprint	**A1, A2, L**	**$$$**	**Perm**
The initial design concept for the affected alternatives (A1, A2, and L) would incorporate use of 2:1 fills for the full extent of the project limits. The alternative concept would use structures (bridges and retaining walls) to reduce the project footprint and fill volumes.			
6.0 Incorporate wildlife bypass structures	**A1, A2, L**	**$$**	**Perm**
The initial alternative concepts for A1, A2, and L, while providing some degree of wildlife connectivity, do not include standalone wildlife bypass structures. The alternative concept would include specifically designed wildlife bypass structures at appropriate locations.			
7.0 Incorporate thicker AC segment to reduce maintenance / repair work	**All**	**$$**	**Maint**
The baseline concept proposes to use a standard AC thickness (6 inches) for all alignments throughout the project limits. The alternative concept would use thicker pavement sections (minimum 2 feet) in targeted locations to reduce maintenance and repair activities.			

Alternative No. and Description	Associated Alignment Alt	Cost Impact	Performance Focus
8.0 Incorporate K-rail in lieu of MBGR to reduce maintenance / repair work	**X**	**$**	**Maint**
The initial design concept for Alternative X proposes to use guard rail for the full extent of the project limits. The alternative concept would target use of K-rail at designated slide-prone areas to provide improved maintainability.			
9.0 Use stacked alignment to reduce roadway width	**A2**	**$$$$**	**Perm**
The baseline concept proposes to use conventional roadway and single deck structures for Alternatives A1 and A2 for the full project length. The alternative concept would use a stacked bridge alignment for the structures through the old growth tree section of each of these design alternatives. Note that this concept could include sections of the roadway that are not currently depicted as structure.			
10.0 Use independent alignments for northbound and southbound directions	**A2**	**$$$$**	**Perm**
The proposed A2 alignment combines the northbound and southbound directions on the same elevation and alignment in the conventional manner. The alternative concept would separate the northbound and southbound directions to reduce impacts to old growth trees.			
11.0 Incorporate tunnel maintenance structure into tunnel	**F**	**$$$$**	**Perm**
Alternative F would require a conventional standalone tunnel maintenance facility to support the proposed tunnel. The alternative concept would incorporate / integrate a tunnel maintenance facility below ground to support the tunnel and reduce permanent project impacts.			

VA STUDY RESULTS

With input from the project stakeholders, the VA team recommends that Alignment Alternatives C3, C4, and C5 be removed from further consideration. These alternatives were initially proposed to bypass the LCG landslide complex and avoid impact to the very important old growth redwood resource. Despite some of the benefits that they provide to roadway stability, low temporary impacts, and low future maintenance concerns, the stakeholders determined that these three alignments would have the greatest project footprints of those under consideration, which is directly related to the amount of old growth redwood tree and wildlife impacted in the National Park, the substantial additional right of way and roadway construction required, and the amount of cubic yardage of excess material (cut) that will need disposal. Additionally, the geotechnical expert-based risk assessment by BGC Engineering USA found that the risk to long-term performance of these Alignment Alternatives is very high.

When C3, C4, and C5 are removed from the calculation, and Alternative A1 is used as the new baseline, the value metric comparison graphic resembles the following:



With the elimination of these three alignments, the project can move more efficiently into the Environmental Study phase of the project. All remaining alignments (A1, A2, X, L, and F) should continue to be analyzed and studied and should not be eliminated unless it is clear that they no longer meet the project's purpose and need objectives or are determined to be outside of the scope of the project. It should be noted that this recommendation includes Alignment Alternative F (the Full Tunnel alignment), which has a very low value score due to its initial tunnel construction estimate and project duration assumption. That said, the VA team would recommend that this alignment remain in consideration at this time as it has one of the least impactful alignments in relation to limiting Permanent Impacts.

As the project moves forward, it is anticipated that the developed VA alternatives (and VA design suggestions) can be integrated in full or part into one or more of the Alignment Alternatives. The VA team recommends that these concepts continue to be studied to provide additional project efficiency and/or project performance benefit to aid in the successful identification of a preferred Alignment Alternative and the successful delivery of this valuable project to all stakeholders.

VA TEAM

VA Study Team

Name	Organization	Title / Role
Eric Trimble	VMS, Inc.	VA Study Facilitator
Charlie Narwold	Caltrans District 1	Geotechnical Services Manager
Arvin Lal	Caltrans District 1	Construction
Melinda Molnar	Caltrans District 1	Environmental
Todd Lark	Caltrans District 1	Design
Daniel Sessions	Caltrans District 1	Structures Design
Matt Smith	Caltrans District 1	Design
David Roemer	Redwood National Park	Stakeholder Representative
Scott Anderson	BGC Engineering	Geotechnical / Risk

Key Project Contacts

Name	Organization	Title
Kevin Espinoza	Caltrans District 1	District VA Coordinator
Jaime Matteoli	Caltrans District 1	Project Manager
Joy Keller-Weidman	Udall Foundation	Senior Program Manager

VALUE ANALYSIS ALTERNATIVES

The results of this study are presented as individual alternatives to the baseline concept. Each alternative consists of a summary of the baseline concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost impact, change in performance, discussion of schedule and risk impacts (if applicable), and a brief narrative comparing the baseline design with the alternative. (Please refer to the *Project Analysis* section of this report for an explanation of how the performance attributes and value are calculated.) Sketches and calculations are also presented where applicable.

VA ALTERNATIVE SUMMARY TABLES

Summary of VA Alternatives

VA Alternative No. & Description		Associated Alternatives	Performance Impact	Cost Impact
1.0	Use mechanically stabilized earth / reinforced soil for slopes	A1, A2, & L	Perm	$-$$
2.0	Use catchment areas to protect roadway	A1, A2, X, & L	Maint	$
3.0	Provide wider alignment where appropriate	X	Mainline	$$
4.0	Minimize fill through alternative alignment	A1 & A2	Perm	$
5.0	Use retaining walls and bridges to reduce footprint	A1, A2, & L	Perm	$$-$$$
6.0	Incorporate wildlife bypass structures	A1, A2, & L	Perm	$-$$
7.0	Incorporate thicker AC segment to reduce maintenance / repair work	All	Maint	$-$$
8.0	Incorporate K-rail in lieu of MBGR to reduce maintenance / repair work	X	Maint	$
9.0	Use stacked alignment to reduce roadway width	A2	Perm	$$$$
10.0	Use independent alignments for northbound and southbound directions	A2	Perm	$$$$
11.0	Incorporate tunnel maintenance structure into tunnel	F	Perm	$$$$

Note: Performance Impact column refers to the performance attributes (Mainline = Mainline Operations; Perm = Permanent Impacts; and Maint = Maintainability)

Note: The Cost Impact column reflects the likely initial project cost addition to the baseline estimate. As the project cost data is in a very preliminary state, and the VA alternatives can relate to several design alternatives – with wide initial cost ranges – and multiple design alternative estimates, the cost impact information for each VA alternative is depicted using approximate values:

- *$ ≈ between $0 and $5M*
- *$$ ≈ between $5 and $50M*
- *$$$ ≈ between $50M and $100M*
- *$$$$ ≈ between $100M and $200M (or more)*

DESIGN SUGGESTIONS

The VA team identified the following observations and design suggestions, relatively general in nature, for consideration by the Project Development Team (PDT).

SE-1 Use drainage system to dewater project areas and stabilize earth to reduce slide potential

This concept focuses primarily on Alternatives X and L and proposes to install a drainage system to help stabilize the earth in specific locations to reduce the slide potential. Similar systems have helped to reduce the occurrence and frequency of slides by reducing or eliminating groundwater accumulation.

SE-2 Perform groundwater study to determine drainage impacts on slope stabilization

This concept, which is to perform a groundwater study of the project area, again focuses primarily on Alternatives X and L to provide meaningful data on project area groundwater and to determine the possible drainage impacts on slope stabilization. This step is a necessity to pursue the drainage system in Design Suggestion SE-1; however, it could also provide beneficial groundwater and slope stability data that could be used for the other design alternatives as well as assessing impacts to water availability for shallow-rooted redwoods which could be affected by potential dewatering efforts.

PT-2 Perform additional tree survey at northern alignment tie-in

This concept relates to Design Alternatives A1, A2, and F, and proposes to perform a more detailed and focused tree survey to provide precise coordinates of old growth redwood tree location information to aid in the placement of the roadway alignment. This is intended to assist in avoiding as many redwood trees as possible by optimizing the northern alignment tie-in point and by studying the areas on both sides of the proposed alignments.

MO-2 Further define the No Build alternative with LCC analysis

This concept proposes to further analyze the No Build alternative (Alternative M) to provide a better picture of the impacts to Caltrans and the community if the project does not proceed under one of the proposed design Alignment Alternatives (or a future design alternative or hybrid alternative yet to be developed). This is important to provide the proper context and understanding of all available options so that an effective and feasible preferred alternative once additional analysis has been performed.

PT-3 Shift grade at northern alignment tie-in to reduce tree impacts

This concept relates to Design Alternatives A1 and F and proposes to investigate the possibility of shifting the grades of the design Alignment Alternatives at the northern tie-in point to the existing roadway section slightly to avoid as many redwood trees (and need for environmental mitigation) as possible.

PT-1 Modify alignment on northern tie-in to reduce tree impact

This concept relates to Design Alternatives A1, A2, and F and is similar to the previous design suggestion, PT-3. This concept proposes to investigate the possibility of shifting the design Alignment Alternatives at the northern tie-in point to the existing roadway section slightly to avoid as many redwood trees (and need for environmental mitigation) as possible.

RM-4 Use rock to armor toe slope at ocean to reduce toe erosion

This concept relates to Design Alternative X and proposes to fortify the slope at the toe (the shoreline) to help reduce the impacts of erosion caused by wave action, marine environment exposure, and reduce the potential for future erosion and slides upslope. Although this is quite expensive and requires extensive consultation with outside agencies (i.e. Coastal Commission), there is a precedent for the use of this concept to stabilize slides and roadways on other Caltrans projects; however, most of this type of work has been performed as part of emergency repair action.

RM-3 Incorporate additional geotechnical monitoring system to provide slope movement information

This concept relates to all design alternatives and proposes to install and integrate additional geotechnical instrumentation to provide ongoing slide monitoring for Caltrans. The system would require the installation of multiple ground movement sensing devices in the locations identified in the geologic study conducted for Caltrans in 2000 by the California Geological Survey, which mapped over 200 historical and active landslides (both deep-seated and shallow) within the corridor between Wilson Creek and Crescent City. This equipment could be used by Caltrans to monitor ongoing ground movement and help to predict future slides which may impact the facility. This would provide valuable information for Caltrans Planning and Maintenance personnel to more effectively forecast slope movement, predict likely roadway impacts, and allocation of resources to maintain Highway 101 operations. This would have additional cost impacts as well as benefits for operations – including the most appropriate locations for instruments within the slide areas.

RM-8 Incorporate benches in lieu of tall cuts to reduce earthwork volumes and reduce maintenance (arrest rockfalls)

This concept relates to Design Alternatives X and L and proposes to arrest potential rockfalls and resulting traffic delays and necessary maintenance work by constructing benches into the slopes in slide-prone areas above the roadway. Although this represents additional design effort, more complex construction, and additional cost, the improvements to mainline operations and maintainability through this preventive maintenance concept may be worth the additional initial investment. It should be noted that the benches – once constructed – do require occasional

maintenance to ensure that the benches do not fill up with debris which would make them potential "launch points" for slide debris in the future.

PE-1 Provide turn-outs in lieu of third lane for slow-moving vehicles

This concept relates to Design Alternative L and proposes to construct additional sections of roadway for slow-vehicle turn-out. This would seek to improve mainline operations by reducing user delay to improve travel times and the overall level of service for Highway 101.

PE-2 Adjust shoulder widths in relation to geography

This concept relates to all design alternatives and proposes to alter the roadway shoulder widths from the Caltrans design standard to more effectively conform to the local geography. Although this may require several design exceptions, it would help to minimize the overall project footprint and reduce permanent impacts and potential environmental mitigation.

OR-1 Consider purchasing additional land from Green Diamond to more efficiently dispose of fill material

This concept proposes to approach the Green Diamond company (and potentially other adjacent property owners) to accept the disposal of project fill material. The assumed large quantities of fill material produced by the project on several of the design alternatives poses an issue for the project in terms of haul off distance and disposal at environmentally cleared areas. Hauling away and disposing of this fill material will be expensive and will also likely have a negative impact on other portions of Highway 101 and the surrounding road network. If Caltrans could dispose of a portion (or all) of the excess fill material on property (or properties) close to the project and potentially in already environmentally cleared areas, then these impacts and project cost can be reduced.

MO-4 Consider increasing grade at southern end of A1 and A2 alignments

This concept proposes to shift or increase the profile grade at the southern end of Design Alternatives A1 and A2 to reduce the project footprint, travel length, and earthwork. These two design alternatives represent a large amount of required earthwork and construction effort. If a more effective alignment can be identified, then this will make a positive contribution to the project in terms of construction and cost, as well as helping once again to reduce permanent impacts and potential environmental mitigation.

SUMMARY OF PERFORMANCE IMPROVEMENTS

The Caltrans HQ VA Program requires the following information to enable reporting of performance to the FHWA. Only the six standard Caltrans performance attributes, shown in the table below, are to be documented. Caltrans does not require reporting of the performance of any other attributes utilized in this study.

Summary of Proposed VA Alternative Performance Improvements

Alt. No.	*Mainline Operations*	*Local Operations*	*Maintainability*	*Environmental Impacts*	*Construction Impacts*	*Project Schedule*
1.0			Improved	Improved		
2.0	Improved		Improved			
3.0	Improved		Improved			
4.0	Improved		Improved	Improved	Improved	
5.0				Improved		
6.0				Improved		
7.0	Improved		Improved			
8.0	Improved		Improved		Improved	
9.0				Improved		
10.0				Improved		
11.0				Improved		

VALUE ALTERNATIVE 1.0 (RM-1)

Use geo-reinforcement to build steeper roadway fill slopes

Cost Impact: Increase
Schedule Impact: TBD

Description of Baseline Concept: The initial design concept for the affected alternatives (A1, A2, and L) would incorporate use of 2:1 fills for the full extent of the project limit.

Description of Alternative Concept: The alternative concept would use steeper fills (1.5:1 or steeper) to reduce the project footprint and fill volumes. This concept uses steel or geosynthetic reinforcement strategies to mechanically stabilize or reinforce the soil slopes.

Advantages:

- **Permanent Impacts –** Reduces the project footprint. Reduces environmental mitigation.
- **Maintainability** – Limits future potential maintenance effort by stabilizing slopes.

Disadvantages:

- **Temporary Impacts –** May increase construction time for necessary earthwork and steel and/or geosynthetic reinforcement components. Increases the quantity of excavated material to transport for permanent disposal.

Discussion: The main benefit of this alternative concept is to reduce the overall project footprint and reduce required environmental mitigation.

Project Management Considerations: The alternative concept will require coordination with the design team to determine the most effective locations for the use of either steel or geosynthetic reinforcement within the limits of the proposed project alignments.

Discussion of Schedule Impacts: This alternative concept may have an impact to the project schedule's critical path in terms of negotiating and permitting of the disposing of excavated material. Otherwise, this concept does not have a significant impact on the construction schedule.

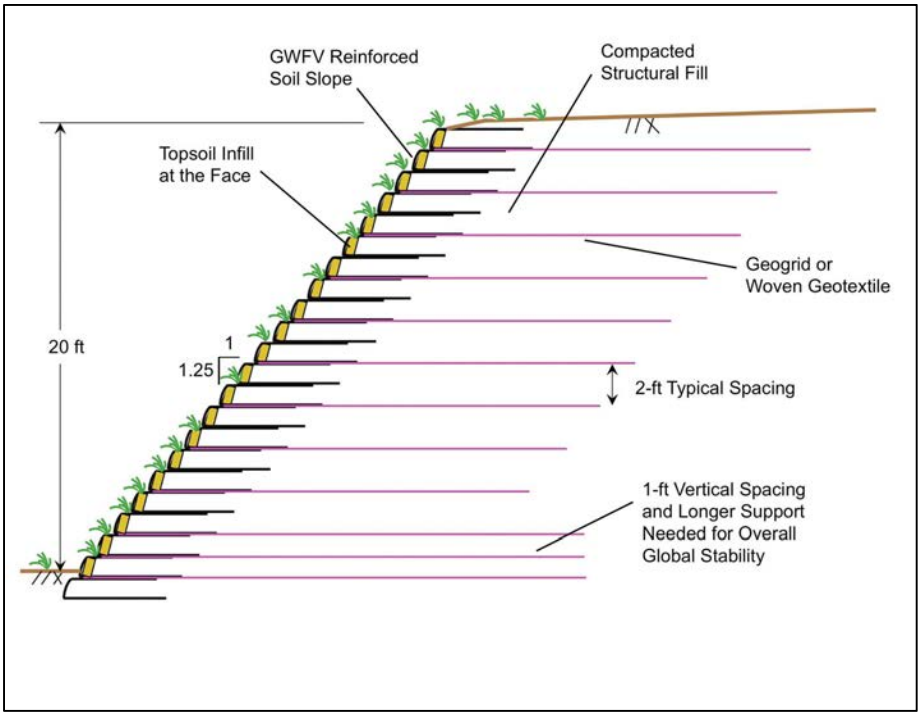
Discussion of Risk Impacts: It is assumed that the alternative concept will not have an impact on project risk; however, the use of this concept may reduce ongoing operational risk by reducing maintenance and facility downtime.

VALUE ALTERNATIVE 1.0 (RM-1)

Use geo-reinforcement to build steeper roadway fill slopes

VA Alternative Concept Images

Construction of mechanical stabilization techniques on roadway and/or slopes



VALUE ALTERNATIVE 1.0 (RM-1)

Use geo-reinforcement to build steeper roadway fill slopes

Assumptions and Calculations:

- Decrease in project footprint and right-of-way acquisition (slopes)
- Reduction in environmental mitigation
- Increase volume of excavated material transport and disposal

VALUE ALTERNATIVE 2.0 (RM-2)

Use catchment areas to protect the roadway

Cost Impact: Increase
Schedule Impact: NA

Description of Baseline Concept: The initial design concept for the affected alternatives (A1, A2, X, and L) would incorporate a standard shoulder width where possible for the full extent of the project limit.

Description of Alternative Concept: The alternative concept would target the use of catchment areas at designated slide-prone areas to provide additional debris and drainage management.

Advantages:

- **Mainline Operations –** Limits potential delays due to repair work when slide damage occurs. Reduces potential for delay and traffic conflicts (debris and stormwater concerns).
- **Maintainability** – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur). Will provide a more protected work area for maintenance personnel.

Disadvantages:

- **Temporary Impacts –** Slightly increases construction time for necessary earthwork.
- **Permanent Impacts** – Increases project footprint (shoulder width) to accommodate placement of catchment basins.

Discussion: The main benefit of this alternative concept is to improve overall maintainability while also providing better debris and stormwater management. This concept will also provide additional space to help avoid potential traffic conflicts and delays, as well as providing a larger work area for maintenance personnel and equipment. The use of catchment areas in certain locations may also increase sight distance.

Project Management Considerations: The alternative concept will require coordination with the design team to determine the most effective locations for the placement of catchment areas to limit the impact of landslides on ongoing operations.

Discussion of Schedule Impacts: This alternative concept does not represent a significant impact to the project schedule's critical path in terms of construction; however, the additional earthwork will reduce construction schedule flexibility.

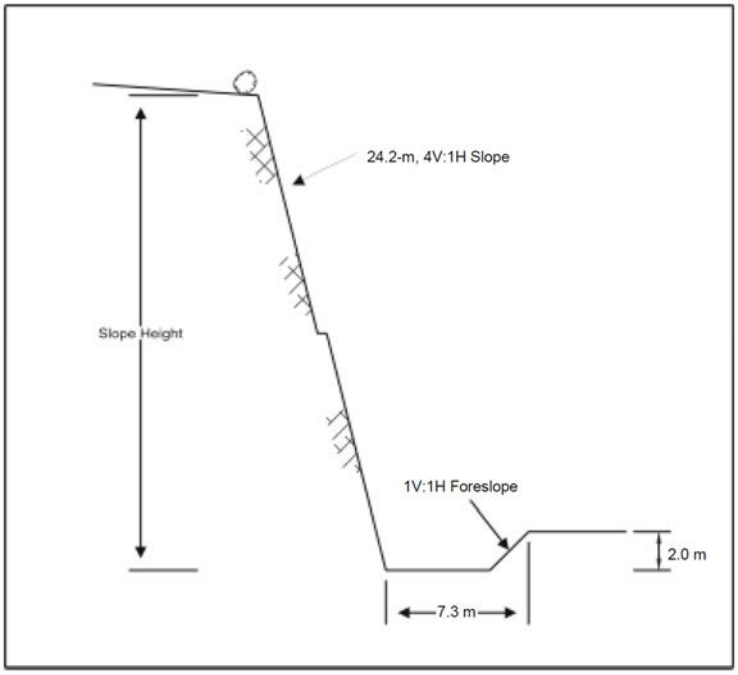
Discussion of Risk Impacts: It is assumed that the alternative concept will aid in emergency response and reduce the impacts of traffic delays on operations when a slide occurs. This should help to reduce ongoing facility operational risk.

VALUE ALTERNATIVE 2.0 (RM-2)

Use catchment areas to protect the roadway

VA Alternative Concept Images

Use of catchment area near slide prone slope



VALUE ALTERNATIVE 2.0 (RM-2)

Use catchment areas to protect the roadway

Assumptions and Calculations:

- Increase width of footprint at slide-prone areas
- Possible increase in earthwork and haul off excavated material
- Possible increase in environmental mitigation

VALUE ALTERNATIVE 3.0 (RM-5)

Provide wider shoulders in targeted locations to improve ongoing maintenance and operations

Cost Impact: Increase
Schedule Impact: NA

Description of Baseline Concept: The initial design concept for Alternative X proposes to use standard shoulder widths (8 feet for two-lane facilities) for the full extent of the project limit.

Description of Alternative Concept: The alternative concept would increase the width of paved shoulders (in excess of 8 feet) at targeted locations to enhance mobility and improve maintainability of the facility.

Advantages:

- **Mainline Operations** – Limits potential delays due to repair work when slide damage occurs. The wider shoulders will also provide a better clear recovery space and sight distance to reduce the potential for traffic conflicts. Will also help to accommodate bicycle traffic.
- **Maintainability** – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur).

Disadvantages:

- **Temporary Impacts** – Slightly increases construction time for necessary earthwork and structural section.
- **Permanent Impacts** – Increases project footprint (shoulder width) to accommodate placement of wider paved shoulder. Will also increase stormwater management needs due to the increase in impermeable surface.
- **Maintainability** – Represents additional surface area to maintain and stormwater management.

Discussion: The main benefit of this alternative concept is to improve overall maintainability while also providing better debris and stormwater management. This concept will also provide additional space to help avoid potential traffic conflicts and delays, as well as providing a larger work area for maintenance personnel and equipment. The use of wider shoulders in certain locations should also improve sight distance.

Project Management Considerations: The alternative concept will require coordination with the design team to determine the most effective locations for the wider shoulders to enhance mobility and maintainability.

Discussion of Schedule Impacts: This alternative concept does not represent a significant impact to the project schedule's critical path in terms of construction; however, the additional earthwork and structural section work will reduce construction schedule flexibility.

Discussion of Risk Impacts: It is assumed that the alternative concept will aid in the reduction of future traffic delays on operations if/when slides occur by providing additional space for traffic management or in maintaining operations. It will also help to reduce the potential of traffic conflicts due to debris, stormwater, and/or repair work.

VALUE ALTERNATIVE 3.0 (RM-5)

Provide wider shoulders in targeted locations to improve ongoing maintenance and operations

VA Alternative Concept Images

Use of wider shoulders along slide-prone slope

Assumptions and Calculations:

- Increase width of footprint within project limits
- Increase of structural section width at targeted locations
- Possible increase in earthwork and haul off excavated material
- Increase in environmental mitigation
- Increase in stormwater mitigation

VALUE ALTERNATIVE 4.0 (RE-1)

Minimize earthwork through alternative alignment

Cost Impact: Increase
Schedule Impact: TBD

Description of Baseline Concept: There are two alignments proposed (A1 and A2) that bypass a portion of the existing alignment to avoid the Last Chance Grade slide complex.

Description of Alternative Concept: The alternative concept would use an alternative alignment, in lieu of A1 and A2, to reduce the length of the proposed facility and the overall footprint of the southern alignment.

Advantages:

- **Mainline Operations** – Results in a shorter overall facility length.
- **Temporary Impacts** – Reduces overall construction effort by reducing project length.
- **Permanent Impacts** – Reduces overall project footprint and thereby reduces permanent tree and wildlife impacts.
- **Maintainability** – Reduces the amount of structures and roadway to maintain.

Disadvantages:

- **Temporary Impacts** – Significantly increases the amount of haul-off of excavated material.
- **Permanent Impacts** – Shifts a greater portion of impacted area to the Park in lieu of the Green Diamond property, which may require more environmental mitigation.

Discussion: The main benefit of this alternative concept is to reduce permanent impacts associated with Alternatives A1 and A2 by reducing the overall project footprint.

Note that additional alignment and grade options for modifying A1 and A2 should still be investigated that may allow for a smaller facility footprint, shorter travel distance, and reduced impacts to the environment.

Project Management Considerations: The alternative concept will require coordination with the project delivery team (including all externals) to determine the most effective and least impactful alignment.

Discussion of Schedule Impacts: This alternative concept represents no significant impact to the current critical path schedules of A1 or A2. However, construction time could be impacted if an alignment change has a significant increase or decrease to the amount of haul-off required for disposal.

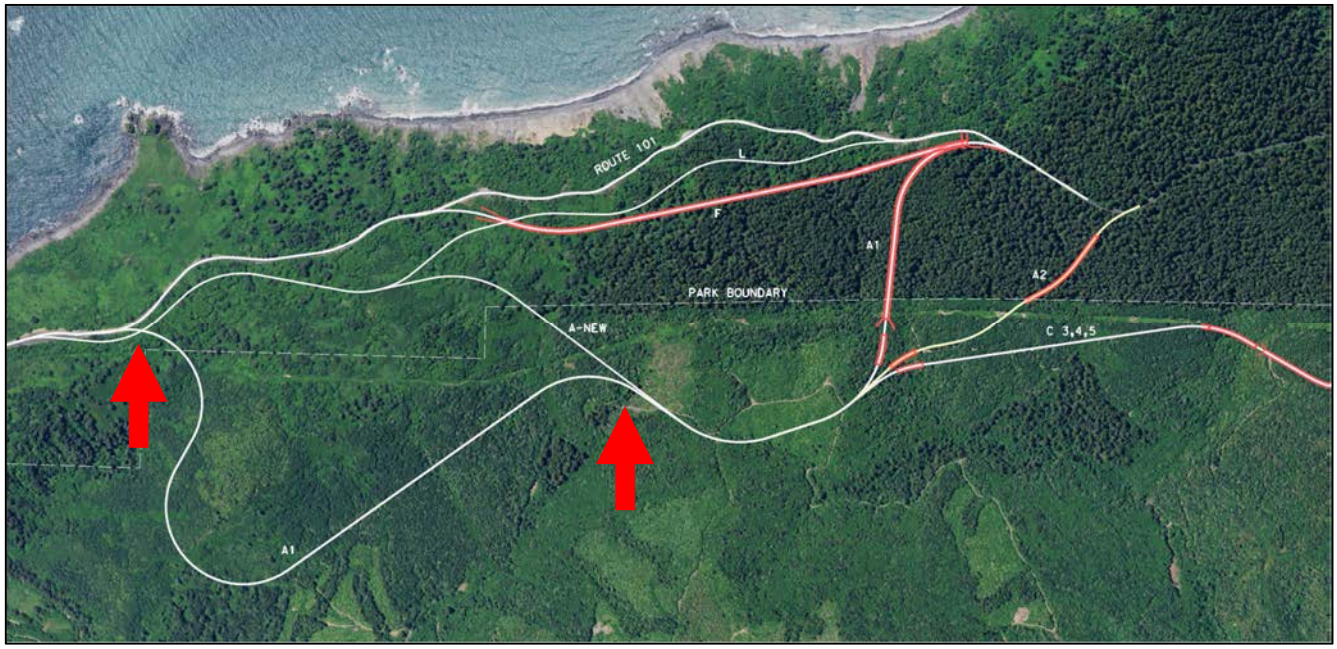
Discussion of Risk Impacts: It is assumed that the alternative concept will reduce the project risk by applying a more effective alignment than either A1 or A2 and reduce the potential for future traffic-related incidents by developing an alignment that is more suitable for mainline operations.

VALUE ALTERNATIVE 4.0 (RE-1)

Minimize earthwork through alternative alignment

VA Alternative Concept Images

Focal area (between arrows) of new alignment for either A1 or A2



Assumptions and Calculations:

- Reduction in pavement structural section (0.4 mile)
- Increase in cut quantities (and haul off of excavated material)
- Reduction in right-of-way parcel acquisition (from Green Diamond)
- Decrease in environmental mitigation (smaller footprint)
- Increase in recreational, wildlife, or forest management mitigation (for Park)

VALUE ALTERNATIVE 5.0 (RE-2)

Use retaining walls and bridges to reduce footprint

Cost Impact: Increase
Schedule Impact: TBD

Description of Baseline Concept: The initial design concept for the affected alternatives (A1, A2, and L) would incorporate use of 2:1 fills for the full extent of the project limit.

Description of Alternative Concept: The alternative concept would use structures (bridges and retaining walls) to reduce the project footprint and fill volumes.

Advantages:

- **Permanent Impacts** – Reduces the project footprint. Reduces environmental impacts and mitigation while providing opportunities to incorporate wildlife connectivity options.

Disadvantages:

- **Temporary Impacts** – Increases construction time for necessary bridge and retaining wall construction. Limits on-site disposal of fill.
- **Maintainability –** Increases the number of structures to maintain.

Discussion: The main benefit of this alternative concept is to reduce the overall project footprint and reduce required environmental mitigation. A potential added benefit of using structures with this concept is the opportunity to provide wildlife bypass options that will reduce environmental mitigation.

Project Management Considerations: The alternative concept will require coordination with the design team to determine the most effective locations for the use of either bridges, walls, or geosynthetic reinforced embankments within the limits of the proposed project alignments.

Discussion of Schedule Impacts: This alternative concept may have an impact to the project schedule's critical path in terms of negotiating and permitting of the disposal of the excavated material. Otherwise, this concept does not have a significant impact on the construction schedule.

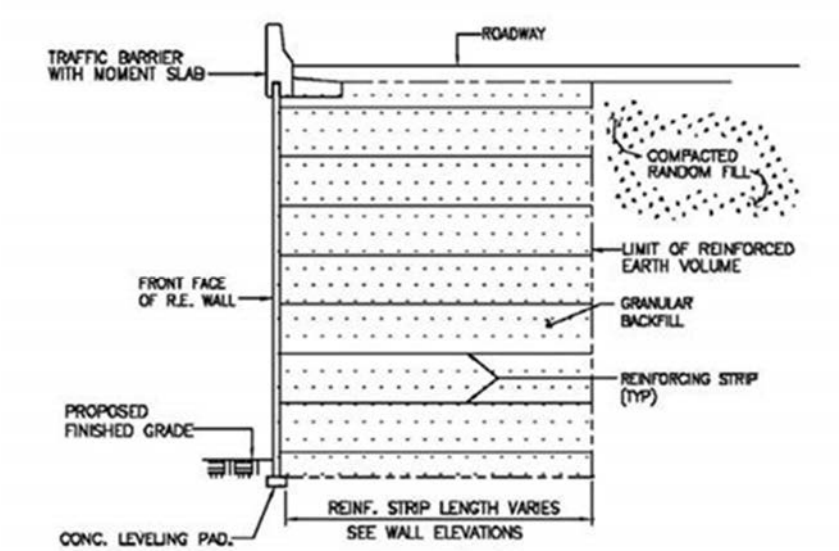
Discussion of Risk Impacts: It is assumed that the alternative concept will not have an impact on project risk; however, the use of this concept may reduce ongoing operational risk by reducing maintenance and facility down time.

VALUE ALTERNATIVE 5.0 (RE-2)

Use retaining walls and bridges to reduce footprint

VA Alternative Concept Images

Use of retaining walls (MSE) to stabilize slope



Use of structure (elevated bridge structure) along slope

VALUE ALTERNATIVE 5.0 (RE-2)

Use retaining walls and bridges to reduce footprint

Assumptions and Calculations:

- Decrease in project footprint and right-of-way acquisition
- Increase volume of excavated material transport and disposal
- Reduction in environmental mitigation

VALUE ALTERNATIVE 6.0 (PW-1)

Incorporate wildlife bypass structures

Cost Impact: Increase
Schedule Impact: NA

Description of Baseline Concept: The initial alternative concepts for A1, A2, and L, while providing some degree of wildlife connectivity, but do not include standalone wildlife bypass structures.

Description of Alternative Concept: The alternative concept would include specifically designed wildlife bypass structures at appropriate locations.

Advantages:

- **Permanent Impacts** – Will enhance wildlife passage within the project area by providing specific connectivity structures.

Disadvantages:

- **Temporary Impacts** – Will increase the number of additional structures to construct.
- **Maintainability** – Will increase the number of additional structures to maintain.

Discussion: The main benefit of this alternative concept is to reduce the new facility alignment's permanent impact on the native wildlife species in the project area (elk, bear, cougar, deer, racoon, marten, fisher, etc.).

Project Management Considerations: The alternative concept will require coordination with the design team and Environmental to determine the most effective potential locations for wildlife bypass structures within the project limits for the A1, A2, and L alignment options.

Discussion of Schedule Impacts: Although additional structures are needed with this alternative, this concept does not represent a significant impact on the project schedule's critical path.

Discussion of Risk Impacts: This alternative concept represents no real impact to overall project risk or ongoing operational risk, but does positively impact the environmental risks associated with impacts to area wildlife.

VALUE ALTERNATIVE 6.0 (PW-1)

Incorporate wildlife bypass structures

VA Alternative Concept Images

Use of wildlife passage structures on Caltrans facilities

0

Assumptions and Calculations:

- Increase in structures (wildlife bypass structures) – assume 2-3 structures for the A1, A2, and L alignments
- Possible reduction in offsite wildlife mitigation

VALUE ALTERNATIVE 7.0 (RM-6)

Incorporate thicker AC segment to reduce maintenance and repair work

Cost Impact: Increase
Schedule Impact: NA

Description of Baseline Concept: The baseline concept proposes to use a standard AC thickness (6 inches) for all alignments throughout the project limit.

Description of Alternative Concept: The alternative concept would use thicker pavement sections (minimum 2 feet) in targeted locations to reduce maintenance and repair activities.

Advantages:

- **Mainline Operations** – Will reduce delays due to roadway cracking or the associated repair work.
- **Maintainability** – Will reduce the amount of future maintenance work and/or the complexity of the maintenance work required (e.g. grinding as opposed to reconstruction).

Disadvantages:

- **Temporary Impacts** – Will require more AC pavement work and batching.

Discussion: The main benefit of this alternative concept is to provide a thicker pavement surface that increases roadway durability and allows for quicker and more efficient repairs. When standard pavement thicknesses fail due to subsurface soil movements, the underlying gravel is exposed and requires full reconstruction. When a thicker pavement section is used, the repair activity can be limited to simply grinding the surface to match to grade and thereby reduce repair-related traffic delays.

Project Management Considerations: The alternative concept will require coordination with the design team and Materials to determine the most effective locations for the thicker pavement sections.

Discussion of Schedule Impacts: This alternative concept represents no significant impact to the project schedule's critical path in terms of construction.

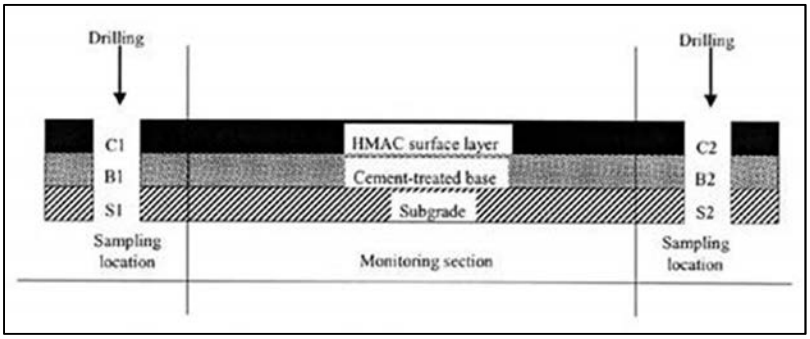
Discussion of Risk Impacts: It is assumed that the alternative concept will not have a significant impact on project risk; however, it does represent a slight reduction in ongoing facility risk by reducing traffic-related incidents by decreasing future maintenance activities.

VALUE ALTERNATIVE 7.0 (RM-6)

Incorporate thicker AC segment to reduce maintenance and repair work

VA Alternative Concept Images

Construction of thicker AC sections



Pavement repair by additional grinding

VALUE ALTERNATIVE 7.0 (RM-6)

Incorporate thicker AC segment to reduce maintenance and repair work

Assumptions and Calculations:

- Increase in AC pavement

VALUE ALTERNATIVE 8.0 (RM-7)

Incorporate K-rail in lieu of guard rail to reduce maintenance and repair work

Cost Impact: Increase
Schedule Impact: NA

Description of Baseline Concept: The initial design concept for Alternative X proposes to use guard rail for the full extent of the project limits.

Description of Alternative Concept: The alternative concept would target use of K-rail at designated slide-prone areas to provide improved maintainability.

Advantages:

- **Mainline Operations** – Limits potential delays due to repair work when slide damage occurs.
- **Maintainability** – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur).
- **Temporary Impacts** – Easier to construct/install when compared to guard rail.

Disadvantages:

- **Temporary Impacts** – Increases the amount of cut and potential retaining wall needed.
- **Permanent Impacts** – Increases structural section width (or compacted area) to accommodate placement of K-rail. Also introduces an aesthetic impact / degrades view.

Discussion: The main benefit of this alternative concept is to improve overall maintainability and the reduction of potential delays to traffic when landslides occur and repair work is needed.

Project Management Considerations: The alternative concept will require coordination with the design team to determine the most effective locations for the placement of K-rail to limit the impact of landslides on ongoing operations.

Discussion of Schedule Impacts: This alternative concept does not represent a significant impact to the project schedule's critical path in terms of construction.

Discussion of Risk Impacts: It is assumed that the alternative concept will aid in emergency response and reduce the impacts of traffic delays on operations when a slide occurs.

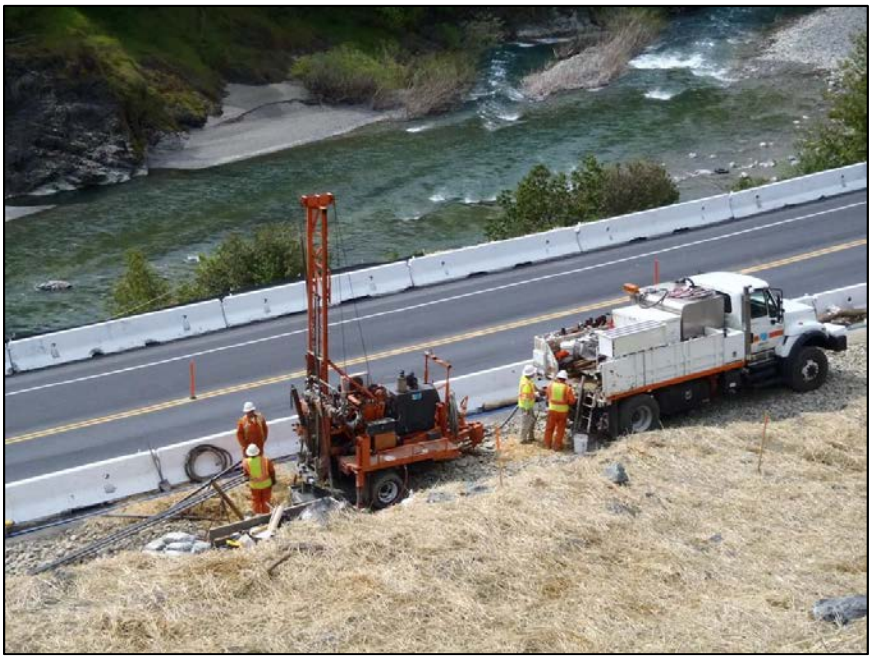
VALUE ALTERNATIVE 8.0 (RM-7)

Incorporate K-rail in lieu of guard rail to reduce maintenance and repair work

VA Alternative Concept Images

Installation of guard rail

Use of K-rail



VALUE ALTERNATIVE 8.0 (RM-7)

Incorporate K-rail in lieu of guard rail to reduce maintenance and repair work

Assumptions and Calculations:

- Reduction of guard rail
- Increase in K-rail
- Increase width of structural sections at slide-prone areas
- Possible increase in earthwork and haul off of excavated material
- Possible increase in environmental mitigation

VALUE ALTERNATIVE 9.0 (PE-3)

Use stacked alignment to reduce roadway and structure width

Cost Impact: Increase
Change in Schedule: TBD – Potential Increase

Description of Baseline Concept: The baseline concept proposes to use conventional roadway and single deck structures for Alignment Alternatives A1 and A2 for the full project length.

Description of Alternative Concept: The alternative concept would be to use a stacked bridge alignment for the structures through the old growth tree section of these design alternatives. Note that this concept could include sections of the roadway that are not currently depicted as structure.

Advantages:

- **Permanent Impacts** – Reduces project footprint through old growth tree areas.

Disadvantages:

- **Temporary Impacts** – Represents a more complex structure to construct – this could increase construction schedule.
- **Maintainability** – More complex structure to maintain.

Discussion: The main benefit of this alternative concept is to reduce overall permanent impacts to the project area – specifically reducing the impact to the old growth forest section of the project as it relates to the bridge structures of Alternatives A1 and, particularly, A2.

Project Management Considerations: The alternative concept will require coordination with the design team, Environmental, and Structures to determine what is feasible with regard to the location characteristics and finding the most effective locations for stacking the alignment within the project limits.

Discussion of Schedule Impacts: This alternative concept represents a potential increase to the project schedule's critical path in terms of construction duration.

Discussion of Risk Impacts: It is assumed that the alternative concept will increase project risk due to the more complex nature of the structure being constructed.

VALUE ALTERNATIVE 9.0 (PE-3)

Use stacked alignment to reduce roadway and structure width

VA Alternative Concept Images

Examples of stacked alignments to reduce roadway width

VALUE ALTERNATIVE 9.0 (PE-3)

Use stacked alignment to reduce roadway and structure width

Assumptions and Calculations:

- Reduction in project footprint and park right of way (old growth forest)
- Increase in bridge structures
- Reduction in environmental impacts which will lead to reduced environmental mitigation

VALUE ALTERNATIVE 10.0 (PE-4)

Use independent alignments for northbound and southbound directions

Cost Impact: Increase
Change in Schedule: TBD – Potential Increase

Description of Baseline Concept: The proposed A2 alignment combines the northbound and southbound directions on the same elevation and alignment in the conventional manner.

Description of Alternative Concept: The alternative concept would separate the northbound and southbound directions to reduce impacts to old growth trees.

Advantages:

- **Permanent Impacts** – Provides flexibility to reduce potential tree impacts.

Disadvantages:

- **Temporary Impacts** – Increases construction time and complexity (requires two independent foundations).
- **Permanent Impacts** – Increases overall project footprint. Increases impermeable surface.
- **Maintainability** – Increases the amount of bridge structures to maintain. Reduces temporary traffic management flexibility. Reduces future traffic management flexibility.

Discussion: The main benefit of this alternative concept is to minimize the number (or specific) of old growth trees impacted by the alignment. The benefit of separate alignments is premised on achieving a reduction in the number of old growth trees that would require removal, or the avoidance of specific “high-value” old growth trees.

Project Management Considerations: The alternative concept will require coordination with the design team, Environmental, and Structures to determine what is feasible with regard to the location characteristics and finding the most effective locations for the split alignment.

Discussion of Schedule Impacts: This alternative concept represents a potential increase to the project schedule’s critical path in terms of construction duration.

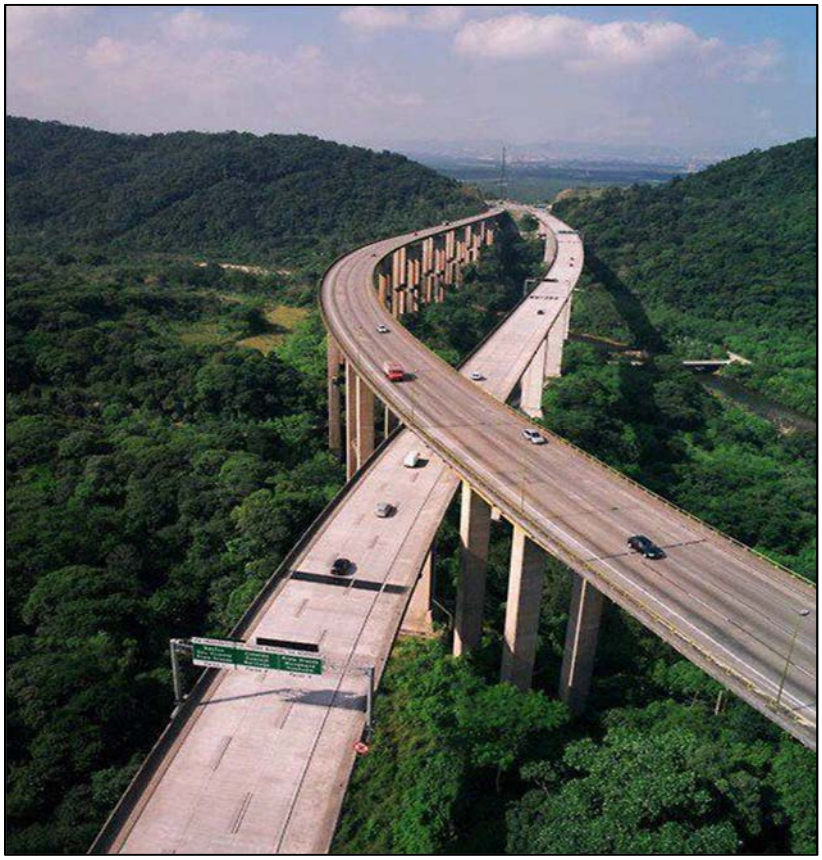
Discussion of Risk Impacts: It is assumed that the alternative concept will increase project risk due to the more complex nature of the structure(s) being constructed.

VALUE ALTERNATIVE 10.0 (PE-4)

Use independent alignments for northbound and southbound directions

VA Alternative Concept Images

Use of independent alignments to address environmental concerns



Assumptions and Calculations:

- Increases project footprint and park right of way
- Increase in bridge structure
- Reduction in environmental impacts (old growth forest) which will lead to reduced environmental mitigation

VALUE ALTERNATIVE 11.0 (PE-6)

Incorporate tunnel maintenance structure into tunnel structure

Cost Savings: Increase
Change in Schedule: TBD – Potential Increase

Description of Baseline Concept: The baseline concept of Alternative F would require a conventional standalone tunnel maintenance facility to support the proposed tunnel. This would require greater impact at north or south portal.

Description of Alternative Concept: The alternative concept would incorporate/integrate a tunnel maintenance facility below ground to support the tunnel and reduce permanent project impacts.

Advantages:

- **Permanent Impacts** – Reduces project footprint, environmental impacts, and environmental mitigation.

Disadvantages:

- **Temporary Impacts** – Represents a more complex structure to excavate and construct.
- **Maintainability** – Represents a more complex facility to maintain.

Discussion: The main benefit of this alternative concept is to reduce the overall project footprint and thereby reduce permanent impacts within the project limits.

Project Management Considerations: The alternative concept will require coordination with the design team, Environmental, and Structures to determine what is feasible with regard to constructing an integrated tunnel maintenance facility.

Discussion of Schedule Impacts: This alternative concept represents a potential increase to the project schedule's critical path in terms of construction duration due to its complexity.

Discussion of Risk Impacts: It is assumed that the alternative concept will increase project risk due to the more complex nature of the structure being constructed.

VALUE ALTERNATIVE 11.0 (PE-6)

Incorporate tunnel maintenance structure into tunnel structure

VA Alternative Concept Images

Example of exterior maintenance facility for tunnel

Assumptions and Calculations:

- Reduces project footprint and right of way
- Increase in tunnel excavation and structure
- Reduction in environmental impacts which will lead to reduced environmental mitigation

PROJECT INFORMATION

PROJECT INFORMATION

BACKGROUND

Existing Facility

US 101 between PM 12.0 and 15.5 (LCG) is classified as conventional rural two- to four-lane highway. Beginning at the southern project limits along US 101 at Wilson Creek Road the roadway transitions from two to four lanes and begins ascending on a 6.3% grade. At PM 13.3 there is a scenic overlook, and the roadway is reduced to three lanes (two northbound lanes and one southbound lane), which exists until PM 14.2 where the roadway is reduced to two lanes. Within the project limits there are intermittent flat areas that span 300 to 500 feet along with segments where the roadway grade reaches slopes as high as 7.5%. The average grade of US 101 within the project limits is 5.2% from Wilson Creek Bridge to PM 15.5; however, US 101 within the project limits exhibits slope undulations throughout due to slide movement. The horizontal alignment is curvilinear, with tangents up to 700 feet in length. Horizontal curve radii vary between 300 to 1,200 feet. At PM 15.5, US 101 shifts east away from the coast and begins a 1,400-foot-long tangent section continuing at a 6% grade through dense redwood forest. To keep US 101 open to the traveling public there are a series of existing retaining walls within the project limits supporting the existing roadway.

Since a 2010 Federally Declared Storm event, US 101 at LCG has experienced continued movement and deformation resulting in five federal Emergency Repair (ER) approved Damage Assessment Forms (DAFs). These DAFs appropriated a total of $20 million in ER funds for three Emergency Opening contracts and two Permanent Restoration (PR) projects at three locations. The work associated with these projects is considered temporary due to the deep-seated nature of the landslide.

As a result of storm damage, increased landslide activity, and emergency response efforts, Caltrans installed a surface monitoring network and multiple slope indicators and has measured movement of LCG since July 2012. Current subsurface investigations reveal that the landslide complex is failing as deep as 260 feet with multiple nesting shallower landslides. Since October of 2014, roadway deformation has accelerated at a much faster rate than previously experienced at the grade. Subsurface boring data at the area of greatest roadway deformation reflects movement occurring at approximate depths of 100 feet, 75 feet, 40 feet, and 35 feet. Recent photography also indicates ocean erosion at the bluff base is contributing to instability.

The accelerated movement has required Caltrans Maintenance to fill and level scarps in the roadway surface with pavement as they develop. The paving is needed on average at least once a month. The scarps that appear are typically between 2 and 4 inches across with depths ranging from a few inches to many feet with voids developing under the roadway surface. In 2016, Caltrans issued two additional Emergency Projects for $4 million to temporarily address the safety issue that has developed due to the accelerated movement. The emergency contract installed a GPS monitoring and notification system and performed roadway repairs. US 101 at LCG has been moving westward and downward progressively in response to storm events since the roadway was constructed. Since the roadway right of way was purchased, the road has moved 50 feet horizontally with portions of the roadway now outside Caltrans right of way.

The significance of this movement is that the roadway has moved to a position where it is now at the edge of the bluffs that are subject to active coastal erosion. In addition, US 101 passes through Redwood National and State Parks, a designated World Heritage Site. Constructing a route around the slide has the potential to affect an iconic old growth redwood forest and to remove old growth trees that are protected in these state and national parks. Caltrans cannot construct a full retreat away from the eroding bluffs into the hillside without the potential removal of between 275 and 542 old growth redwood trees. At the rates of movement currently being experienced, it is likely that at least a small retreat will be necessary to keep US 101 open to the traveling public while a more permanent solution can be developed. Keeping the roadway on its current alignment is not a fiscally feasible option given a landslide complex that is over a mile long and at its deepest 260 feet deep.

Since the March 2012 storm event, there has been an increase in appeals from the public and elected officials to Caltrans to address the instability and progressive loss of the roadway. Caltrans initiated an Engineered Feasibility Study (EFS) to address the public's concerns and determine and define feasible alternatives. The EFS, completed in June 2015, provides seven alternatives ranging in cost from $300 million to $1.2 billion (Year-of-Construction dollars). In addition, Caltrans prepared an Economic Impact Study to determine if a project would be economically justifiable. The Economic Impact Study concluded that a project costing up to $1 billion (2015 dollars) would be a sound investment for the State of California. The PID delivery had been accelerated to be delivered July 2016. At that time, Caltrans wanted to pursue Federal ER funds to environmentally clear, design, and construct a roadway relocation at Last Chance Grade.

The costs to Caltrans and the FHWA ER Program for emergency repairs associated with maintaining US 101 at LCG are expected to escalate as retreats and repairs become more difficult. The ultimate risk of not relocating US 101 away from Last Chance Grade is complete loss of the roadway and the continuity of coastal US 101. The alternate route would increase travel distance up to 320 miles.

Project Purpose and Need

The purpose of this project is to develop a permanent solution to the instability and potential roadway failure at LCG. The project is currently considering several alternatives that provide a more reliable connection, reduce maintenance costs, and protect the economy, natural resources, and cultural landscapes. Landslides and road failures at LCG have been an ongoing problem for decades. A geologic study conducted for Caltrans by the California Geological Survey in 2000 mapped over 200 historical and active landslides (both deep-seated and shallow) within the corridor between Wilson Creek and Crescent City.

Over the years, Caltrans has conducted a considerable number of construction projects and maintenance activities in the LCG area to keep the roadway open. Since 1981, landslide mitigation projects, including retaining walls, drainage improvements, and roadway repairs have cost over $54 million ($33 million Emergency Response Projects, $21 million Non-Emergency Response Projects). A long-term sustainable solution at LCG is needed for many reasons, including the following:

- Economic ramifications of a long-term failure and closure
- Risk of delay / detour to traveling public

- Increasing maintenance and emergency project costs
- Increase in frequency and severity of large storm events caused by climate change

This segment of US 101 was constructed in 1937. LCG has a history of geologic instability, including deep seated landslides and slipouts, which presents a long-term challenge with roadway stability and maintenance costs. Surveys conducted by Caltrans have shown the landslides have shifted the roadway centerline by over 50 feet horizontally from the original roadway centerline constructed in 1937.

The process to study and environmentally clear a realignment of US 101 at this location is very important. Contributing to the sense of urgency for a realignment project are the accelerating movement of the roadway, toe erosion impacts to the nested landslides, frequency of repairs, lack of geometric resiliency, and increasing risk to and concerns of the traveling public. Important project elements and facility deficiencies that the project needs to address include soil and slope instability, existing geometrics, structures, vehicle traffic data, and collision data.

Stakeholder Involvement

During the development of the Last Chance Grade Feasibility Study (completed in June 2015), Caltrans partnered with agencies and Tribal Governments with a vested interest and land management responsibilities near US 101 at LCG. The partnership consists of Caltrans, California Department of Parks and Recreation, National Park Service, Yurok Tribe, Elk Valley Rancheria, and the Tolowa Dee-ni' Nation, as well as Green Diamond Resource Company and Resighini Rancheria that were added in 2018 (collectively, "the Partners"). The goal of creating the partnership was to study and develop permanent solutions to the instability at LCG as Caltrans and the Partners recognized the need for extensive public participation during the development of the project and its successful delivery.

PROJECT DESCRIPTION

The proposed project is located on a segment of US 101 known as Last Chance Grade, which is in southern Del Norte County, between Wilson Creek and Crescent City (PM 12.0 – 15.5). The draft PSR proposed seven alternatives (M, A1, A2, C3, C4, C5, and F) in response to landslides and roadway failures at LCG, which have caused damage for decades. Six of the seven proposed alternatives would include realignment of US 101 with the goal of avoiding the unstable portions of LCG. One of the proposed alternatives (M – No Build) to maintain the existing roadway on its current alignment does not meet the purpose and need of the project, but is included to provide a baseline for comparison. An additional two Alignment Alternatives were included in an update to the Preliminary Environmental Analysis Report (PEAR): Alternative X and Alternative L. The Realignment Alternatives (A1, A2, C3, C4, C5, F, X, and L) vary between 1 mile and 14 miles in length. A detailed description of each alternative, extracted directly from the Project Study Report and PEAR Supplemental Memo, is included below.

Alignment Alternative A1 (PM 13.47 to PM 15.56): Rudisill Road to LCG Tunnel

This alternative departs US 101 with an 850-foot radius horizontal curve at Rudisill Road (PM 13.47) and enters Redwood National Park (RNP) at an elevation of 380 feet. The alignment crosses the California Coastal Trail (CCT), exits RNP after 500 feet, and gains approximately 900 feet of elevation as it climbs the back side of the LCG hill. Connectivity to the CCT will need to be reestablished, possibly with an undercrossing where the fill prism is shallow and narrow. At 2.3 miles along the alignment, it heads west and utilizes a 125-foot-high bridge (Bridge 1a) over an ephemeral tributary of Wilson Creek, and enters a tunnel (Tunnel 1) before reaching the eastern boundary of Del Norte Coast Redwoods State Park. Tunnel 1 is 2,425 feet long with a 2.6% grade and a northern portal near US 101 at PM 15.56. The alignment ties back into US 101 on a 900-foot radius horizontal curve. The alignment is 3.2 miles in length and eliminates a 2.1-mile-long segment of existing US 101.

Alignment Alternative A2 (PM 13.47 to PM 15.92): Rudisill Road to Damnation Trailhead

Alternative A2 mirrors Alternative A1 for the initial 2.3 miles of the alignment, where the alignment then continues northeast from mile 2.3 and enters a large cut section before crossing an ephemeral tributary of Wilson Creek on a proposed 115-foot-high bridge (Bridge 2a). The alignment continues on a side-hill ascent through a small cut and enters an 1,100-foot-long bridge with a 7% grade (Bridge 2b) just prior to Del Norte Coast Redwoods State Park's eastern boundary, and then passes through old growth forest. The alignment reconnects with existing US 101 within 450 feet of the viaduct at PM 15.92, prior to the Damnation Creek Trailhead pull-out. The alignment is also 3.2 miles in length and eliminates a 2.5-mile-long segment of existing US 101.

Alignment Alternative C3 (PM 13.47 to PM 19.81): Rudisill Road to South of Mill Creek Access

Alternative C3 mirrors Alternatives A1 and A2 for the initial 2.3 miles of the alignment. At mile 2.3 the alignment continues north while remaining east of the Del Norte Coast Redwoods State Park and crosses three ephemeral tributaries of Wilson Creek utilizing two bridges (Bridge C1 and C2). At mile 3.25 the alignment enters the southern portal of a 1,680-foot-long tunnel (Tunnel 3) with a 3.9% grade. The tunnel in this alternative is used to avoid a significant cut section through an unavoidable 1,100-foot-high ridge. From the northern tunnel portal, the alignment continues north for 3,000 feet, crossing one ephemeral tributary of Wilson Creek on a bridge (Bridge C3), then swings to the east to avoid old growth forest within the State Park. Through this section, north of the tunnel, estimated cut and fill lines appear close to the Park boundary. Once survey information is available and design work commences, the alignment and/or profile will be adjusted as necessary to avoid direct impact to the Park. The alignment crosses two more ephemeral tributaries of Wilson Creek, turns north, and at mile 4.9 enters previously harvested State Park forest land. At mile 5.4 the alignment extends through a low gap in the ridge while transitioning from the Wilson Creek watershed to the West Branch (WB) Mill Creek / Smith River watershed. The alignment continues northwest crossing a tributary of WB Mill Creek with a bridge (Bridge C4) at mile 6.6. It continues northwest crossing another tributary (no bridge) to mile 6.7. Bridge C4 was added to the alternative after completion of the Advance Planning Study. At mile 6.7, at an elevation of approximately 800 feet, the alignment extends northwest and crosses a drainage of WB Mill Creek on an 1,100-foot-long bridge (Bridge 3a) before ascending at 6.9% through a large cut. At mile 7.8 the alignment reconnects with existing US 101 at PM 19.81, approximately 0.4 mile south of the Mill Creek Campground Road intersection, at an elevation of

1,100 feet. The alignment is 7.8 miles in length and eliminates a 6.3-mile-long segment of existing US 101.

Alignment Alternative C4 (PM 13.47 to PM 20.82): Rudisill Road to North of Mill Creek Access

Alternative C4 mirrors Alternative C3 for the initial 6.7 miles of the alignment. From mile 6.7 Alternative C4 extends northwest and crosses a drainage of WB Mill Creek on a 564-foot-long bridge (Bridge 4a). At mile 7.5 the alignment crosses Mill Creek Campground Road near its midpoint and continues a long tangent section. A required public connection to the Mill Creek Campground appears to be feasible at this location. The alignment then crosses a drainage of WB Mill Creek on a 150-foot-high bridge (Bridge 4b). At mile 7.7 the alignment begins ascending at 5.9% and crosses two more WB Mill Creek drainages (without bridges). At mile 8.6 the alignment reconnects with existing US 101 at PM 20.82. The alignment is 8.6 miles in length and eliminates a 7.4-mile-long segment of existing US 101.

Alignment Alternative C5 (PM 13.47 to PM 22.73): Rudisill Road to Hamilton Road

Alternative C5 mirrors Alternative C4 for the initial 7.7 miles of the alignment. From mile 7.7 the alignment extends northeast and crosses a tributary of WB Mill Creek (without a bridge) and enters a large side-hill through-cut. At mile 8.0 the alignment crosses a WB Mill Creek tributary with a 94-foot-high bridge (Bridge 5b). Upon departure from Bridge 5b, the alignment enters a large through-cut, and at mile 8.4 enters a final decent. At mile 9.4 an ephemeral tributary of WB Mill Creek is crossed by a 66-foot-high bridge (Bridge 5c). At mile 9.9 a larger tributary of WB Mill Creek is crossed by a 12-foot-high bridge (Bridge 5d) while the alignment intersects Hamilton Road and extends west. From this point, the alignment follows the general course of Hamilton Road on a relatively flat grade to its intersection with existing US 101 at PM 22.73. Three smaller bridges (Bridge 5e-5g) are anticipated for this last section. The alignment is 11.7 miles in length and eliminates a 9.3-mile segment of existing US 101, including the Cushing Creek area.

Alignment Alternative X (PM 14.55 to PM 15.56): Maintain Existing Alignment

Alternative X maintains the existing alignment with segments of slight realignment to improve alignment geometry and retreat from failing areas. The area of improvement begins at PM 14.55 and conforms to the existing highway at PM 15.56. The alignment cuts into the hillside at spot locations. Approximately 12 existing walls will be reconstructed to match the new alignment and profile. Additional upslope retaining walls are proposed for areas of new cut. This alternative does not meet full geometric standards. There are no bridges or tunnels associated with this area. The alignment is 1.1 miles in length and replaces 1.1 miles of existing segment of US 101. The alignment will be entirely within Parks and the Coastal Zone. It crosses no major waterways and does not impact the old growth redwoods on the ridge.

Alignment Alternative L (PM 13.45 to PM 15.56): Retreat

Alternative L departs US 101 near Rudisill Road (PM 13.45) and retreats into hillside east of the existing alignment. The alignment consists of mostly large cut sections and includes an additional northbound climbing lane for 1.5 miles of 7% grade. The road then travels near the hill ridgeline for approximately 0.75 mile before conforming to the existing highway at PM 15.56. The entire

alignment remains within Del Norte Coast State Park and Redwood National Park and has been designed to avoid impacts to old growth redwoods. It will stay just west of the old growth redwoods on the ridge, but will cross mature coastal Douglas Fir stands. A 700-foot retaining wall is proposed at the northern end of the realignment. Additional upslope walls may also be required within the large (100'+) cut slope areas. There are no bridges or tunnels associated with this alternative. The alignment is 2.2 miles in length and eliminates an approximately 2.0-mile segment of US 101.

Alignment Alternative F (PM 14.24 to PM 15.56): Full Tunnel

Alternative F proposes a complete tunnel option to realign US 101. The alternative departs US 101 at PM 14.24 with a northeast bearing in order to go behind the landslide failure planes. The alignment extends 750 feet before entering the southern tunnel portal (Tunnel 2) at an elevation of approximately 610 feet. The tunnel maintains a grade of 4% until reaching its northern portal at an elevation of approximately 840 feet. Upon leaving the northern portal, the alignment extends approximately 450 feet while ascending at a grade of 5.6% before reconnecting to existing US 101 at PM 15.56. The proposed tunnel is 5,600 feet in length and would generate approximately 200,000 cubic yards of excess excavation material. In the event a location near the alignment cannot be identified, an off-site location will need to be found. The alignment is 1.3 miles in length and eliminates a 1.3-mile segment of US 101. The tunnel's feasibility has not yet been proven, and is complicated by the fact that it passes between the boundary separating the Franciscan Complex Broken Formation and the Melange. Extensive geotechnical studies will be needed to determine if this is a viable alternative.

Alignment Alternative M (PM 12.0 to PM 15.5): Maintain Existing (No Build)

This alternative will have no planned construction and US 101 will continue its existing alignment. Regular maintenance and operations will continue with this alternative, with emergency restoration projects as needed to address changing conditions. Current annual maintenance costs of $2 million with a projected cost of approximately $26 million by 2034 (District 1 Climate Change Vulnerability Assessment and Pilot Studies). Engineering solutions, such as retaining walls, have not been able to provide long-term stability, but will continue to be necessary to provide an adequate highway facility. As the landslides move, the road will require costly repairs and maintenance with potential environmental impacts including old growth redwood impacts associated with roadway retreats to keep US 101 open. The potential for a slide movement which is deep and large enough could result in a major roadway failure requiring complete closure of the roadway indefinitely. A major roadway failure would have economic impacts and require a significant detour that is outlined in a LCG Engineered Feasibility Study.

PROJECT DESIGN EXCEPTIONS

At the time of the study, no mandatory or advisory design exceptions were noted.

INFORMATION PROVIDED TO THE VA TEAM

The following project documents were provided to the VA team for their use during the study:

- Project Study Report - Permanent Restoration – Last Chance Grade, Caltrans, June 2016

- Last Chance Grade PEAR Supplemental Memo – Caltrans, August 2018
- Last Chance Grade – Expert-Based Risk Assessment – BGC Engineering USA, Inc., June 2018

Note: The information presented in this section of the report may have been excerpted either in part or in full from the documents/information provided to the VA team listed above.

PROJECT DRAWINGS

The project team provided preliminary project alternative layouts and cross-sections for the VA team during the VA study. The project location and existing grade, the alternative layout options, and typical cross-section drawings are included on the following pages.

PROJECT COST ESTIMATE

The VA study team used the initial project cost estimates for the alternative layouts for reference during the study. It should be noted that these estimates vary in the level of detail and are of a rough order of magnitude (ROM) nature with many unknowns and several line item costs serving simply as placeholders at this phase of the project delivery process. An overview of the alignment estimates is provided in the *Project Analysis* section.

DESIGN STUDY ONLY

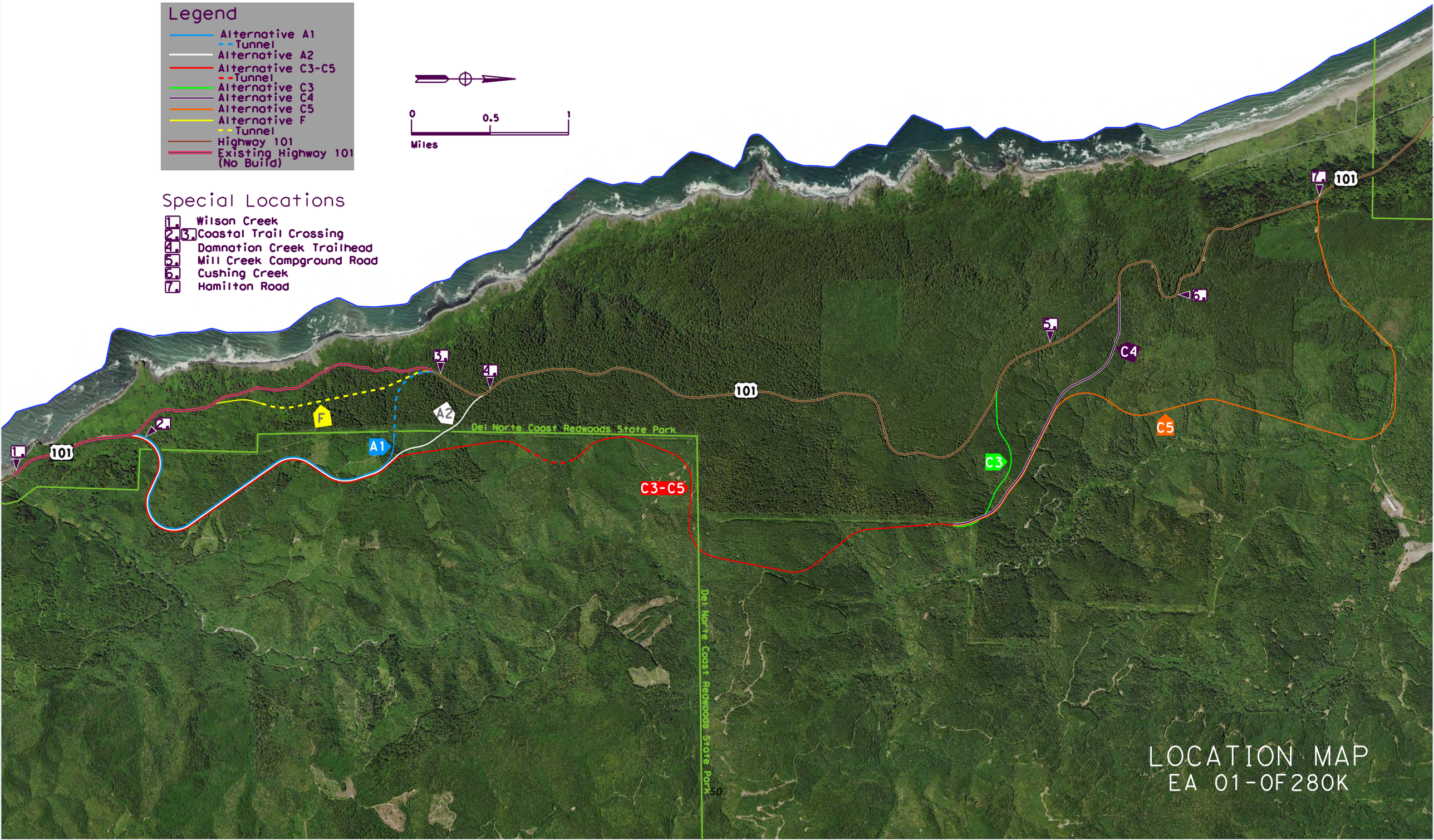
Legend

- Alternative A1
- Tunnel
- Alternative A2
- Alternative C3-C5
- Tunnel
- Alternative C3
- Alternative C4
- Alternative C5
- Alternative F
- Tunnel
- Highway 101
- Existing Highway 101 (No Build)

0 0.5 1
Miles

Special Locations

1. Wilson Creek
2. 3. Coastal Trail Crossing
4. Damnation Creek Trailhead
5. Mill Creek Campground Road
6. Cushing Creek
7. Hamilton Road

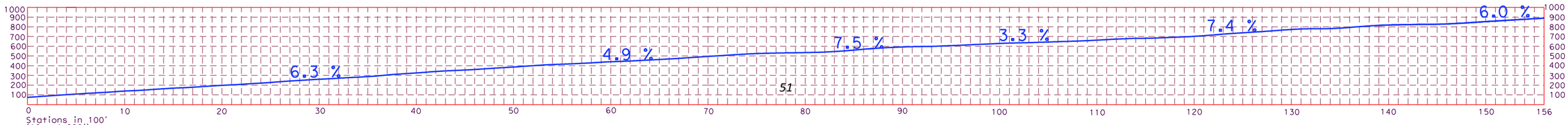


LOCATION MAP
EA 01-0F280K

50


0'
1,000'
Scale
PM 12.0
Begin 4-Lane
Wilson Creek
Picnic Area
Overlook
End 4-Lane
PM 13.2
Rudisill RD.
PM 13.47
End 3-Lane
PM 14.2
PM 14.4
Wilson Creek Slide
Retaining Walls
PM 15.0
LCG South
Slide
LCG North
Slide
PM 15.5
Seven Retaining Walls
101
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
156
Del Norte Coast Redwoods State Park
LAYOUT & PROFILE
EXISTING GRADE
EA 01-0F280K

PROFILE


1000
900
800
700
600
500
400
300
200
100
6.3 %
4.9 %
7.5 %
3.3 %
7.4 %
6.0 %
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
156
Stations in 100'
(10 = 1,000')

DESIGN STUDY ONLY

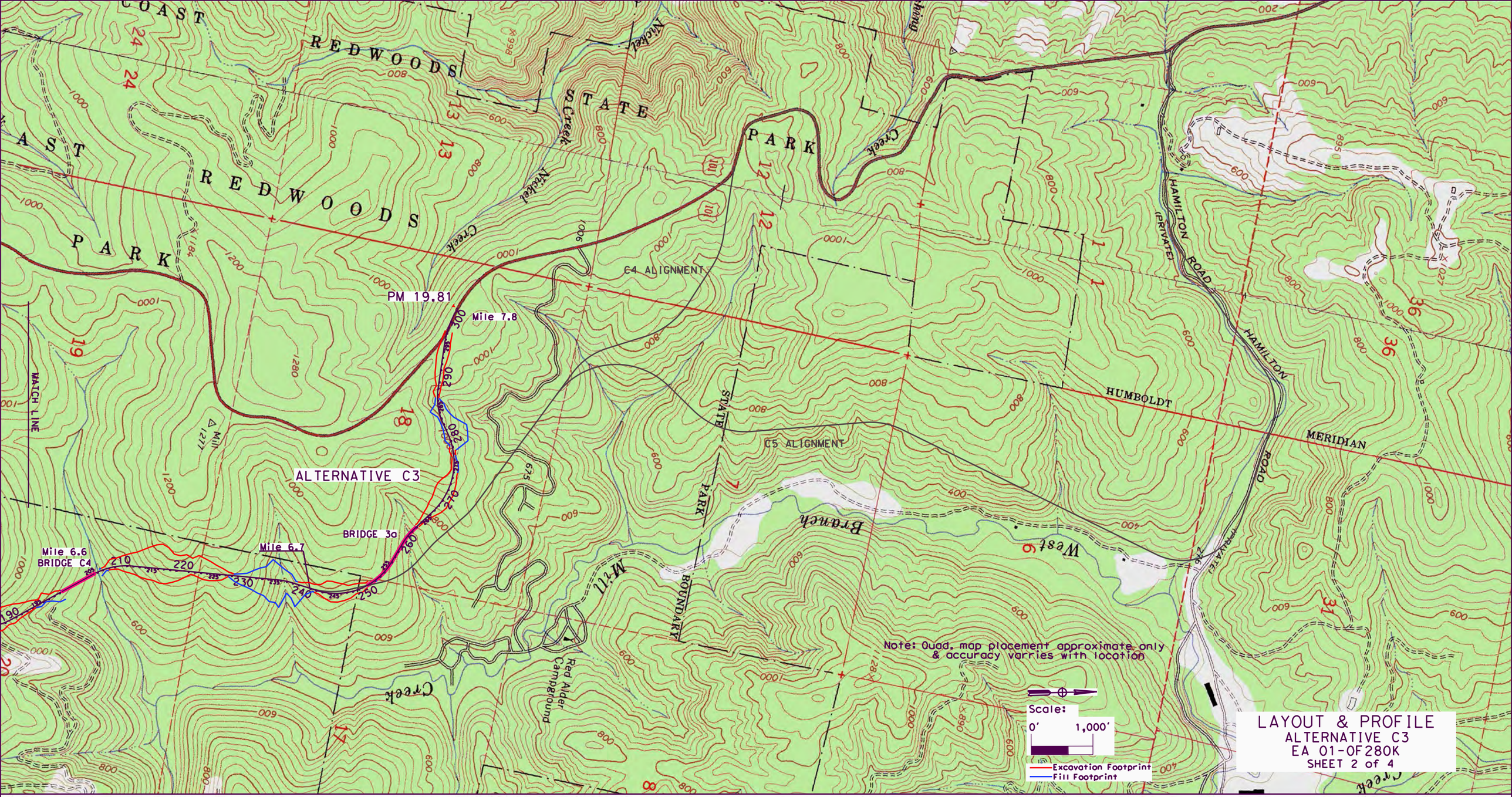
LAST CHANCE GRADE ALIGNMENT "A1"

SCALE 1"= 200'

L-1

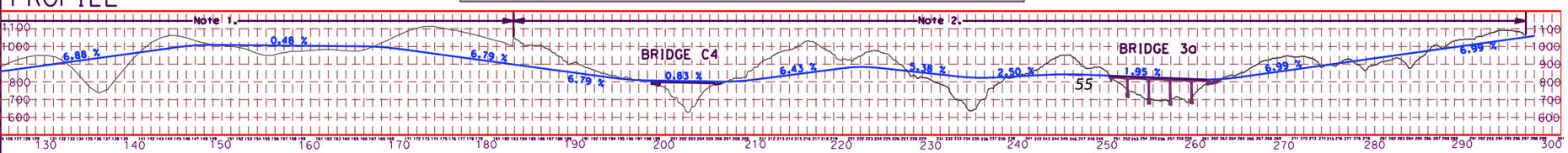

"A1" 179+14.78 END
END TUNNEL
"A1" 172+80
"A1" 160+98.22 BC
Beg. TUNNEL
"A1" 148+55
END BRIDGE
"A1" 146+54
"A1" 145+83.91 EC
Beg. BRIDGE
"A1" 143+08
"A2"
CUT/FILL
"A1" 97+38.37 BC
"A1" 110+12.13 EC
"A1" 117+09.18 BC
"A1" 127+14.19 EC
"A1" 133+20.00 BC
DESIGN STUDY ONLY
LAST CHANCE GRADE
ALIGNMENT "A1"
SCALE 1"= 200'
L-2

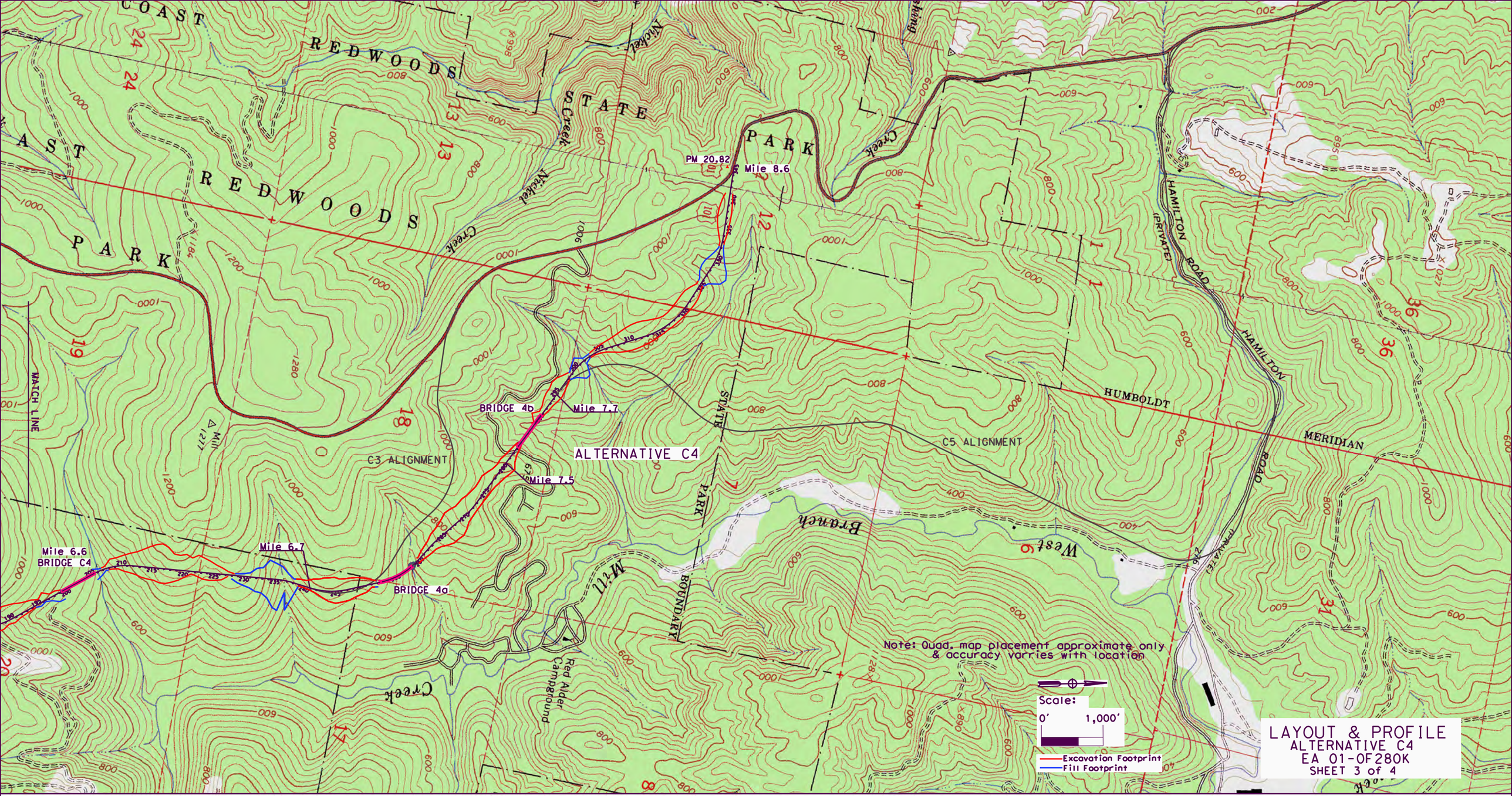

Route 101
Route 101
"A1"
"A2" 179+14.78 END
"A2" 177+21.12 EQ
"A2" 172+80.55 BC
"A2" 168+89.89 EQ
END Bridge
"A2" 172+91
"A2" 164+11.27 BC
"A2" 161+86.08 EQ
"A2" 160+11.95 BC
"A2" 156+80.73 EQ
"A2" 151+57.86 BC
"A2" 149+54.13 EQ
Beg. Bridge
"A2" 161+92
"A2" 143+48.64 EQ
END Bridge
"A2" 148+00
Beg. Bridge
"A2" 143+85
"A2" 137+79.89 EQ
"A2" 133+20.00 BC
"A2" 127+14.79 EQ
"A1" 117+09.81 BC
"A1" 110+22.38 EC
CUT/FILL
DESIGN STUDY ONLY
LAST CHANCE GRADE
ALIGNMENT "A2"
SCALE 1"= 200'
L-1



Vertical Exageration = 2:1 (V:H)
Note 1: Profile Uses 98' DEM Derived from Quad. Map
Note 2: Profile Uses 3' DEM Derived from 2009/2011 Lidar
Design
Ground

PROFILE

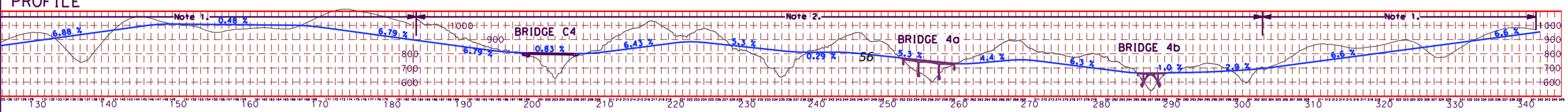


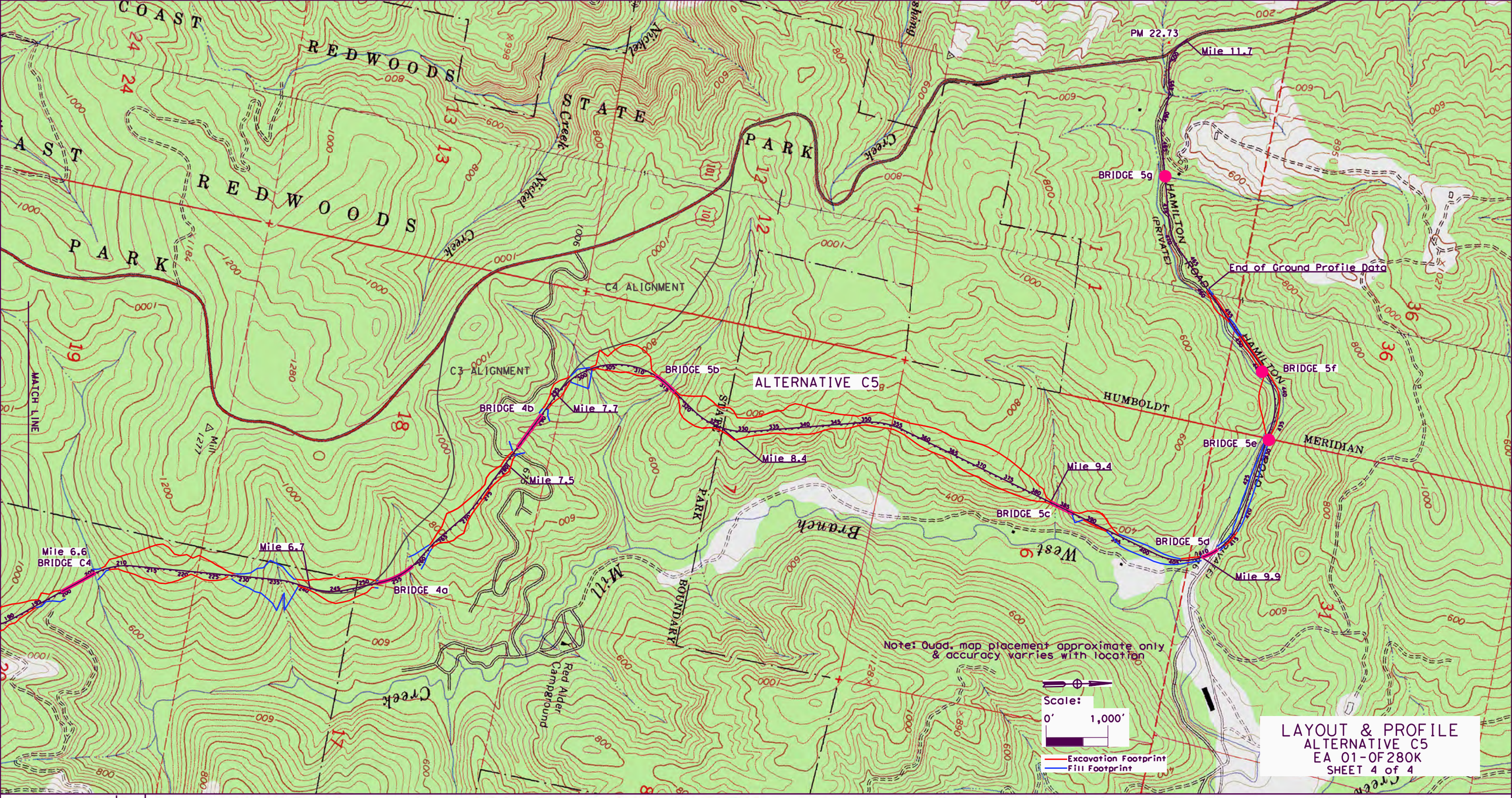


LAYOUT & PROFILE
ALTERNATIVE C4
EA 01-0F280K
SHEET 3 of 4

Vertical Exageration = 2:1 (V:H)
Note 1: Profile Uses 98' DEM Derived from Quad. Map
Note 2: Profile Uses 3' DEM Derived from 2009/2011 Lidar
Design
Ground

PROFILE




PM 22.73
Mile 11.7
BRIDGE 5g
HAMILTON (PRIVATE) ROAD
End of Ground Profile Data
HAMILTON
BRIDGE 5f
BRIDGE 5e
MERIDIAN
HUMBOLDT
ROAD
BRIDGE 5d
BRIDGE 5c
Mile 9.9
Mile 9.4
ALTERNATIVE C5
BRIDGE 5b
Mile 8.4
C4 ALIGNMENT
C3 ALIGNMENT
BRIDGE 4b
Mile 7.7
Mile 7.5
Mile 6.7
Mile 6.6
BRIDGE C4
BRIDGE 4a
MATCH LINE
COAST REDWOODS
STATE PARK
Creek
Branch
BOUNDARY
Red Alder Campground
Note: Quad. map placement approximate only & accuracy varries with location
Scale:
0'
1,000'
Excavation Footprint
Fill Footprint
LAYOUT & PROFILE
ALTERNATIVE C5
EA 01-0F280K
SHEET 4 of 4

PROFILE
BRIDGE 4a
BRIDGE 4b
BRIDGE 5b
BRIDGE 5c
BRIDGE 5d
BRIDGE 5e
BRIDGE 5f
Note 2:
Note 1:
Vertical Exageration = 2:1 (V:H)
Note 1: Profile Uses 98' DEM Derived from Quad. Map
Note 2: Profile Uses 3' DEM Derived from 2009/2011 Lidar
Design
Ground

"F" 10+00.00 BEG

"F" 10+65.35 BC

"F" 17+14.15 EC

Route 101

"F" 31+51.96 BC

"F" 37+19.19 EC

Beg. Tunnel
"F" 23+00

CUT/FILL

DESIGN STUDY ONLY

LAST CHANCE GRADE ALIGNMENT "F"

SCALE 1"= 200'

L-1

DESIGN STUDY ONLY

LAST CHANCE GRADE
ALIGNMENT "F"

SCALE 1"= 200'

L-2

"X" 450+25.00 BEG

"X" 454+71.16 BC

"X" 458+80.21 EC

"X" 459+12.00 BC

"X" 462+30.43 EC

"X" 467+80.35 BC

"X" 474+85.83 EC

"X" 476+63.71 BC

"X" 480+16.83 EC

"X" 482+16.65 BC

"X" 484+91.88 EC

"X" 487+03.58 BC

"X" 490+48.01 EC

"X" 492+97.64 BC

"X" 496+69.46 EC

"X" 496+60.08 BC

"X" 497+96.52 EC

"X" 504+29.59 BC

"X" 506+84.78 END

CUT/FILL

DESIGN STUDY ONLY

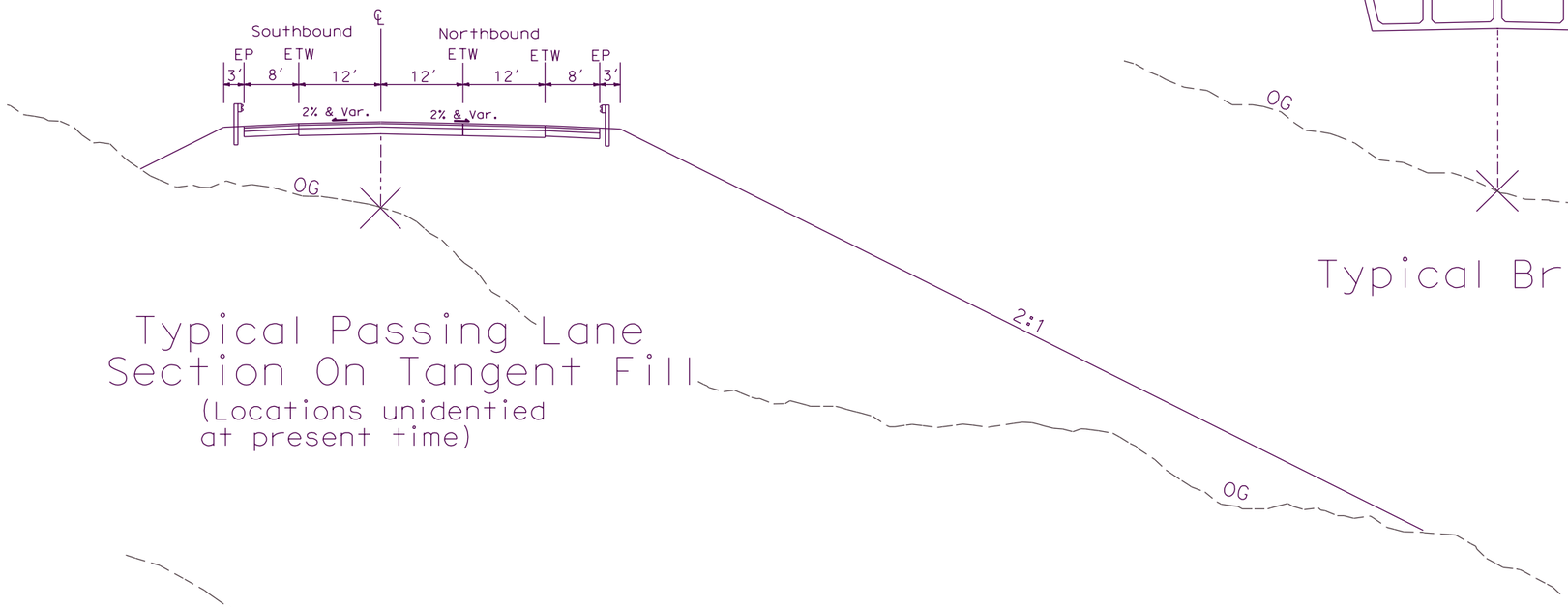
LAST CHANCE GRADE
ALIGNMENT "X"

SCALE 1"= 200'

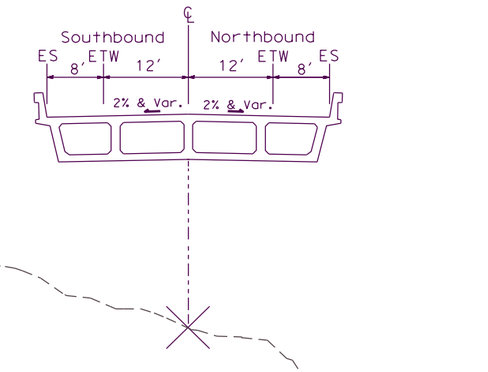
L-1


"L-NEW" 475+42.28 EC
"L-NEW" 471+48.91 BC
"L-NEW" 466+02.65 EC
US ROUTE 101
"L-NEW" 461+71.63 BC
"L-NEW" 456+85.81 EC
"L-NEW" 448+16.45 BC
"L-NEW" 438+04.31 EC
"L-NEW" 428+84.90 BC
"L-NEW" 424+64.13 EC
"L-NEW" 416+21.03 BC
"L-NEW" 412+00.40 BC
"L-NEW" 408+19.43 BC
CUT/FILL
DESIGN STUDY ONLY
LAST CHANCE GRADE
ALIGNMENT "L"
SCALE 1"= 200'
L-1

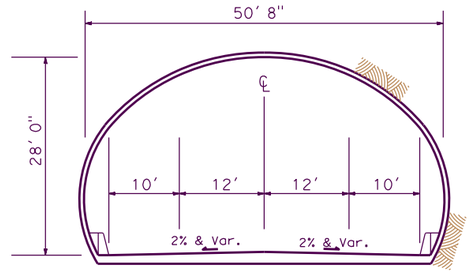

"L-NEW" 480+41.13 EC
US ROUTE 101
"L-NEW" 486+89.86 EC
"L-NEW" 491+16.26 BC
"L-NEW" 498+17.96 EC
"L-NEW" 502+34.76 BC
"L-NEW" 506+33.72 EC
"L-NEW" 510+41.46 BC
"L-NEW" 513+58.07 EC
WALL
L=595'
"L-NEW" 517+90.99 BC
"L-NEW" 519+66.64 EC
WALL
L=153'
"L-NEW" 523+62.27 BC
"L-NEW" 527+25.94 EC
"L-NEW" 531+52.40 END
CUT/FILL
DESIGN STUDY ONLY
LAST CHANCE GRADE
ALIGNMENT "L"
SCALE 1"= 200'
L-2



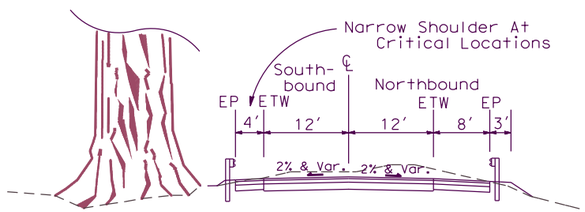
Typical Passing Lane
Section On Tangent Fill
(Locations unidentied
at present time)



Typical Bridge



Typical Tunnel



Typical Near 'Tie-in'

Typical 'Through-Cut'
On Curve

TYPICAL CROSS SECTIONS
(ALL ALTERNATIVES)
EA 01-0F280K

PROJECT ANALYSIS

PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

- Key Project Factors
- Cost Model
- Function Analysis
- Value Metrics

KEY PROJECT FACTORS

The first day of the VA study included meetings with the project stakeholders. The following summarizes key project issues and site visit observations identified during these sessions.

Project Issues

The following are some of the issues and concerns associated with the project.

Environmental Considerations – The project will need to address many critical environmental concerns including the minimization of impacts to old growth redwood trees, the protection of native species and sensitive habitat, as well as the preservation of cultural resources. The project will need to avoid disturbance to these where possible and appropriately mitigate where it cannot.

Geotechnical Risks – The project will need to address the multiple slide areas within the project limits and determine the most appropriate alignment that will minimize impacts to the ongoing operation of the facility and reduce the future maintenance needs and life-cycle costs (LCC).

Project Feasibility – The project will need to consider overall feasibility in terms of funding constraints, stakeholder acceptance, permit considerations, speed of implementation, and overall alignment constructability.

Site Visit Observations

Many of the VA study team members were familiar with the project site area; however, a virtual site visit was conducted to visually assess the project site conditions and to provide context to all project design components. Through this effort, and using several project plan sheets, graphics, and documents, the VA team was able to fully understand the constraints, challenges, and issues relating to this unique rehabilitation project.

COST MODEL

Due to the multiple project Alignment Alternatives being considered – and their initial cost ranges – a single cost model was not used; however, the VA team did have access to the eight project alignment estimates and used these to identify major construction elements or trade categories, the original estimated costs, and the percent of total project cost for the significant cost items.

The table below provides an indication of the prospective initial construction costs for each of the design alternatives under consideration and indicates that excavation (cut and fill), new roadway construction length (pavement material and construction), new structures (wall, bridge, and tunnel material and construction), right-of-way acquisition, project escalation (schedule duration), and environmental costs (old growth redwood avoidance and wildlife, habitat, and cultural mitigation) are all key project cost drivers to the project.

Alternative	New Construction										Capital Cost (millions)
	Construction Length (miles)	Structures			Length in Parks (miles)	Construction Footprint (acres)	Construction Schedule (years)	Cut (cubic yards)	Fill (cubic yards)	Excess Material (cubic yards)	
		Walls	Tunnel	Bridges							
A1	3.4	Unk	1	2	1.0	77	4	3,359,780	3,731,250	-371,500	**$672**
A2	3.5	Unk	0	3	0.9	80	3.5	4,990,000	3,800,000	1,190,000	**$240**
L	2.2	1	0	0	2.2	47	3.5	2,084,100	129,100	1,955,000	**$220**
F	1.5	2	1	0	_	5	7	2,500,000	Negligible	2,250,000	**$1100 - $2000**
X	1.1	15	0	0	1.1	20	3.5	575,000	Negligible	570,000	**$220**
C3	8.0	Unk	1	5	3.5	225	4	21,870,000	Negligible	20,000,000	**$798**
C4	9.0	Unk	1	11	4.3	270	5	23,410,000	Negligible	23,200,000	**$847**
C5	12.2	Unk	1	16	7.5	332	6	24,160,000	865,000	23,295,000	**$1,000**

FUNCTION ANALYSIS

Function analysis was performed and a Function Analysis System Technique (FAST) Diagram was produced, which revealed the key functional relationships for the project. This analysis provided a greater understanding of the total project and how the project's performance, cost, time, and risk characteristics are related to the various functions identified. The FAST diagram arranges the functions in logical order so that when read from left to right, the functions answer the question, "How?" If the diagram is read from right to left, the functions answer the question, "Why?" Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column (a "When?" relationship).

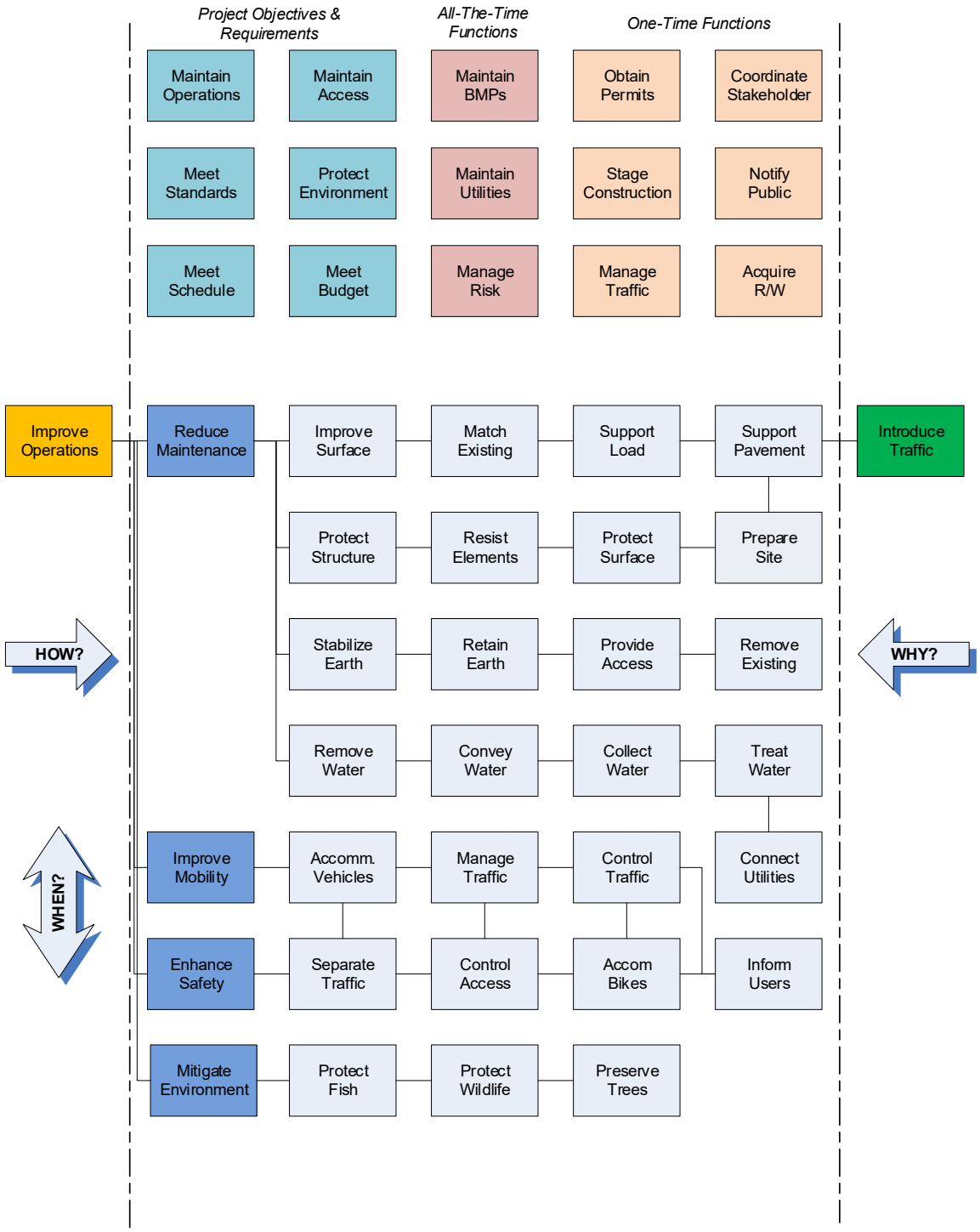
Random Function Determination

Project Element	Function
Construction	Prepare Site
Construction	Remove Existing
Design	Accommodate Bikes
Design	Accommodate Vehicles
Design	Control Access
Design	Enhance Safety
Design	Improve Mobility
Design	Improve Operations
Design	Maintain Access
Design	Match Existing
Design	Meet Standards
Design	Provide Access
Design	Reduce Maintenance
Environmental	Obtain Permits
Environmental	Preserve Trees
Environmental	Protect Environment
Environmental	Protect Fish
Environmental	Protect Wildlife
Materials	Improve Surface
Need	Introduce Traffic
Materials	Protect Surface
Materials	Resist Elements
Materials	Support Load
Materials	Support Pavement

Project Element	Function
PAO	Notify Public
Project Management	Coordinate Contracts
Project Management	Coordinate Stakeholders
Project Management	Inform Users
Project Management	Maintain Operations
Project Management	Manage Risk
Project Management	Meet Budget
Project Management	Meet Schedule
Project Management	Obtain Funding
Project Management	Stage Construction
R/W	Connect Utilities
R/W	Maintain Utilities
R/W	Obtain R/W
Stormwater	Collect Water
Stormwater	Convey Water
Stormwater	Maintain BMPs
Structures	Protect Structures
Stormwater	Remove Water
Structures	Retain Earth
Structures	Stabilize Earth
Traffic	Control Traffic
Traffic	Manage Traffic
Traffic	Separate Traffic

The VA team concluded that the higher order function of the project is to *Improve Operations* through the basic functions of *Reduce Maintenance, Improve Mobility, Enhance Safety,* and *Mitigate Maintenance.* Key secondary functions include *Stabilize Earth*, *Retain Earth*, *Accommodate Vehicles*, *Control Traffic, Resist Elements, Remove Water,* and *Preserve Trees.* Essential requirements included *Maintain Existing Operations, Maintain Access, Protect Environment, Meet Budget, Meet Schedule, Meet Standards,* and *Reduce Risk*.

FAST Diagram



VALUE METRICS

Value Methodology (VM) has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of the role that VM can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

Project performance must be properly defined and agreed to by the stakeholders at the beginning of the VA study. The performance requirements and attributes developed are then used throughout the study to identify, evaluate, and document alternatives. This process, Value Metrics, emphasizes the interrelationship between the elements of performance, cost, and time and can be quantified and compared in terms of how they contribute to overall value. The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved and costs for all VA alternatives have been developed, measuring value is very straightforward.

The following pages describe the steps in the Value Metrics process.

Define Performance Requirements

Performance requirements represent essential, non-discretionary aspects of project performance. Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the VA study, cannot be considered as a viable solution. Concepts that do not meet a performance requirement cannot be considered further unless such shortcomings are addressed through the VA study process in the form of VA alternatives. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were selected for this project.

Performance Requirement	Definition
Highway Design Standards	Any deviation from the Caltrans Highway Design Manual must be approvable by the District's Design Reviewer.
Structural Design Standards	Any structure on the project must comply with current seismic design standards and meet the Load Resistance Design Factor.
Environmental Review Process	Any concept or design modification considered must comply with state and federal environmental law and be compatible with the environmental review process.

Performance Requirement	Definition
Project Milestones	Several critical schedule milestones must be met in order to meet legislative and/or funding requirements. These include: PA&ED February 2026; PSE April 2030; RTL September 2030; Advertise December 2030; Award April 2031; Begin Construction June 2031; End Construction October 2039.

Define Performance Attributes and Scales

Performance attributes represent those aspects of a project's scope that may possess a range of potential values. For example, an attribute called "Environmental Impacts" may have a range of acceptable values for a project ranging from 1 acre to 20 acres of wetlands mitigation. It is clear that a concept that offered 15 acres of mitigation would perform at a higher level than one that offered 5 acres, but both would meet the project's need and purpose, and their values (i.e., the relationship between performance and cost) could be rationally compared. The following performance attributes were selected for this project.

Mainline Operations

An assessment of traffic operations and safety on the mainline facility(s), including off-ramps and collector-distributor roads. Operational considerations include level of service, as well as geometric considerations such as design speed, sight distance, lane widths, and shoulder widths.

Rating	Label	Description
0.0	Unacceptable	Mainline operations equivalent to LOS F during peak hour. Very poor level of traffic operations. May require multiple design exceptions.
2.0	Poor	Mainline operations equivalent to LOS E during peak hour. Poor level of traffic operations. May require multiple design exceptions.
4.0	Fair	Mainline operations equivalent to LOS D during peak hour. Fair level of traffic operations. May require some design exceptions.
6.0	Good	Mainline operations equivalent to LOS C during peak hour. Good level of traffic operations. Meets all or most design standards.
8.0	Very Good	Mainline operations equivalent to LOS B during peak hour. High level of traffic operations. Meets all mandatory design standards. Meets all or most advisory design standards.
10.0	Excellent	Mainline operations equivalent to LOS A during peak hour. Highest level of traffic operations. Meets or exceeds all design standards.

Short-Term Impacts (Construction Impacts)

An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours, and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust, and construction traffic; environmental impacts related to water quality, air quality, soil erosion, and local flora and fauna.

Rating	Label	Description
0.0	Unacceptable	Temporary traffic and/or environmental impacts will be severe and create impacts that are unacceptable to the public.
2.0	Poor	Temporary traffic impacts will be extensive, lengthy, and very disruptive. Temporary environmental impacts will require extraordinary mitigation measures and create major inconveniences to the public.
4.0	Fair	Temporary traffic impacts will be significant and be much greater than what would normally be anticipated for similar projects. Temporary environmental impacts will be more significant in nature and require greater mitigation measures and/or inconveniences to the public.
6.0	Good	There will be some nighttime lane closures and/or temporary ramp closures. There will be some minor to moderate temporary environmental impacts. Impacts will be fairly "typical" for this type of project and can be handled through normal processes and procedures.
8.0	Very Good	There will be some minor temporary traffic and/or environmental impacts expected during construction. Impacts will be less than typical.
10.0	Excellent	There will be no temporary traffic or environmental impacts during construction.

Permanent Impacts (Environmental Impacts)

An assessment of the permanent impacts to the environment, including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice); impacts to cultural, recreational, and historic resources. Also considered under this attribute are drainage and hydraulic issues.

Rating	Label	Description
0.0	Unacceptable	The environmental impacts are severe and the project does not comply with state and/or federal environmental laws.

Rating	Label	Description
2.0	Poor	The project introduces environmental impacts that are both significant in number and impact that require extensive mitigation.
4.0	Fair	The project introduces many new environmental impacts that will require extensive mitigation.
6.0	Good	The project introduces some new environmental impacts that can be addressed through standard and accepted mitigation approaches.
8.0	Very Good	The project introduces no new environmental impacts.
10.0	Excellent	The project improves upon the existing environmental conditions while introducing no new environmental impacts.

Maintainability

An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity, and maintainability of pavements, structures, and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.

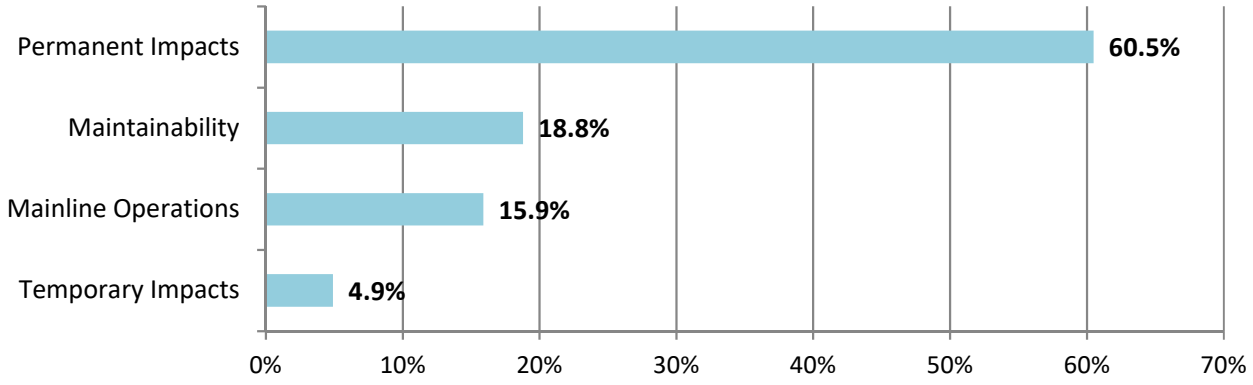
Rating	Label	Description
0.0	Unacceptable	The anticipated level of maintenance for the project will be extreme and unacceptably high.
2.0	Poor	The project is expected to require maintenance that far exceeds the norm for a facility of its kind.
4.0	Fair	The highway facility is expected to require greater than normal maintenance due to existing site conditions or materials selection.
6.0	Good	The project provides a satisfactory level of maintainability and is typical of a highway facility of this kind statewide.
8.0	Very Good	The project provides a high level of maintainability. The facility utilizes many low maintenance features and is better than average in terms of expected maintenance.
10.0	Excellent	The project provides the highest possible level of maintainability and far exceeds expectations when compared to comparable facilities statewide. Examples are the use of long-life pavement, low maintenance water quality facilities, low maintenance structures, etc.

Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined and their scales developed, the Project Team and stakeholders prioritized them based on their relative importance to the project. The Analytic Hierarchy Process (AHP) was utilized in the prioritization process. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The chart below provides the results of this analysis and includes the complete breakdown of the priorities, expressed as a percentage of the whole.

Performance Attribute Prioritization



Measure Performance of Baseline Concept (Alignment Alternative C5)

The project team and stakeholders evaluated the performance of the Baseline Concept relative to the scales previously identified. Alignment Alternative C5 was selected as the project baseline for this analysis as it was identified as such in the PSR at this early stage of the project and reflects one of the most conservative approaches to project scope in terms of schedule and budget. The information below reflects the performance ratings for each Alignment Alternative attribute provided by the stakeholders present and the general rationale as paraphrased from the input discussion.

Mainline Operations
Rating: **4.0**

Rationale: Adding distance and risk of closure increases with distance traveled.

Temporary Impacts
Rating: **2.0**

Rationale: Includes many structures and stream impacts, as well as soil movement.

Permanent Impacts
Rating: **1.0**

Rationale: Represents large impacts to the OGR and fisheries.

Maintainability
Rating: **2.0**

Rationale: Very difficult to maintain because of length.

Measure Performance of Design Options (Alignment Alternatives)

The project team and stakeholders evaluated the performance of the Design Options (Alignment Alternatives) relative to the scales identified previously. The information below reflects the performance ratings and associated rationale for each attribute.

Alignment Alternative A1

Mainline Operations
Rating: **6.0**

Rationale: Still one of the longer alternatives. Not a radically improved road from any of the other options.

Temporary Impacts
Rating: **5.0**

Rationale: Long construction duration due to building tunnels. Significant cut and fill. The goal is to achieve a balanced project with cut and fill, but will require seasonal storage of materials.

Permanent Impacts
Rating: **3.5**

Rationale: Impact to OGR. Limits to adjacent landowner access. Tunnel portals have a large environmental and visual impact.

Maintainability
Rating: **4.0**

Rationale: Higher expense of maintaining tunnel and requires a facility to support it (e.g., ventilation, etc.).

Alignment Alternative A2

Mainline Operations
Rating: **6.0**

Rationale: No tunnel, but two more bridges than A1. Fewer driver safety issues than a tunnel, but less reliability than a tunnel due to potential for buckling at bridge areas.

Temporary Impacts
Rating: **5.0**

Rationale: Shorter construction window. More haul-off material.

Permanent Impacts
Rating: **2.0**

Rationale: Approximately 37 old growth trees impacted.

Maintainability
Rating: **4.0**

Rationale: Potential for bridges to buckle if geologic movement occurs.

Alignment Alternative L

Mainline Operations
Rating: **7.0**

Rationale: Shorter and straighter than existing alignment or Alternatives A1 and A2. Still close to slide areas, but getting further away from the most immediate threat to the roadway, which is erosion / slides at the toe slope and below the current alignment. May be able to stabilize the slide at the head scarp (top of bridge).

Temporary Impacts
Rating: **6.5**

Rationale: Shorter, but could be greater impact due to working above the current alignment. Would need to figure out staging. Fewer bridges / tunnels. Longer length within park.

Permanent Impacts
Rating: **6.0**

Rationale: Impacts 18 acres of redwood, Douglas fir, and spruce within the park. Reduces the wildlife connectivity issues that existing with other alternatives.

Maintainability
Rating: **5.0**

Rationale: Less distance to maintain. No tunnels or bridges, just one long wall that should be stable once anchored in.

Alignment Alternative F

Mainline Operations
Rating: **7.5**

Rationale: The 1.1-mile tunnel makes it shorter and faster than some other alternatives. Low chance of failure, very drivable, but still have to deal with the portals and their impacts.

Temporary Impacts
Rating: **3.5**

Rationale: Large impacts to current highway during construction. Excessive amount of material to move.

Permanent Impacts
Rating: **4.0**

Rationale: Represents significant visual impacts. Maintenance facility needs to be built. Northern portal in OGR area. Less OGR impact overall. Fewer wildlife connectivity barriers.

Maintainability
Rating: **3.0**

Rationale: Requires permanent maintenance facility to operate the tunnel with pumps, ventilation, etc.

Alignment Alternative X

Mainline Operations
Rating: **1.0**

Rationale: Significant impacts to current highway during construction.

Temporary Impacts
Rating: **1.0**

Rationale: Extreme impacts expected during construction.

Permanent Impacts
Rating: **7.0**

Rationale: Fewer impacts since this alternative keeps the same alignment as existing.

Maintainability
Rating: **1.0**

Rationale: Not a significant improvement from current alignment.

Alignment Alternative C3

Mainline Operations
Rating: **4.2**

Rationale: Shorter distances than C4 or C5.

Temporary Impacts
Rating: **2.2**

Rationale: Fewer impacts because it is a shorter alignment than C4 and C5.

Permanent Impacts
Rating: **2.0**

Rationale: An improvement over C4 and C5.

Maintainability
Rating: **2.0**

Rationale: Same terrain, but less road and structures to maintain than C5. More unknowns between bridges, which are more stable.

Alignment Alternative C4

Mainline Operations
Rating: **4.1**

Rationale: Will take longer to travel with more bridges.

Temporary Impacts
Rating: **2.1**

Rationale: Less impact to US 101 during construction, but will need to deal with a lot of construction material and other impacts.

Permanent Impacts
Rating: **1.5**

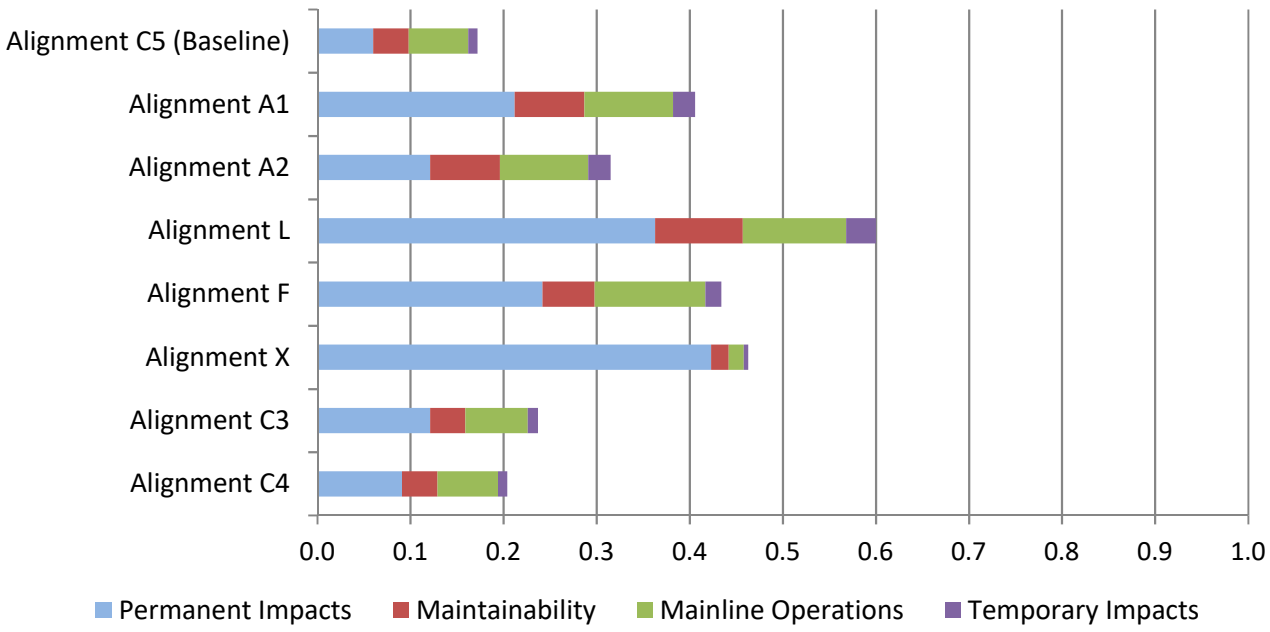
Rationale: Somewhat better than C5.

Maintainability
Rating: **2.0**

Rationale: Same terrain, but less road and structures to maintain than C5. More unknowns to deal with between bridges, which are more stable.

Compare Performance – Alignment Alternatives

The stakeholders and VA team considered the combined effect of all Alignment Alternatives for project. The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. A total performance score of "1" would indicate the highest level of desired performance (i.e., "ideal" performance). The chart below compares the total performance scores for the Alignment Alternatives.



Compare Value

The cost and time (i.e., schedule) elements were compared and normalized for the Alignment Alternatives using the following tables. These tables illustrate how cost and time (schedule) scores were derived. In this comparison, a lower score is desirable as the project will benefit from lower costs and a shorter schedule.

Alignment Alternatives	Cost	Score
Alignment C5 (Baseline)	$1,000,000,000	0.167
Alignment A1	$672,000,000	0.112
Alignment A2	$240,000,000	0.040
Alignment L	$220,000,000	0.037

Alignment Alternatives	Cost	Score
Alignment F	$2,000,000,000	0.334
Alignment X	$220,000,000	0.037
Alignment C3	$798,000,000	0.133
Alignment C4	$847,000,000	0.141
TOTAL	**$5,997,000,000**	**1.000**

Strategies	Time	Score
Alignment C5 (Baseline)	72 months	0.164
Alignment A1	48 months	0.110
Alignment A2	42 months	0.096
Alignment L	42 months	0.096
Alignment F	84 months	0.192
Alignment X	42 months	0.096
Alignment C3	48 months	0.110
Alignment C4	60 months	0.137
TOTAL	**438 months**	**1.000**

Project Management indicated the following preferences in considering trade-offs between cost and time:

Relative Importance	
COST	50.00 %
TIME	50.00 %

Once relative scores for performance, cost and time have been derived, the next step is to synthesize a value index for each of the Alignment Alternatives. This is achieved by applying the following algorithm for value:

- V = Value
- f = Function
- P = Performance
- C = Cost
- t = Time
- α = Risk

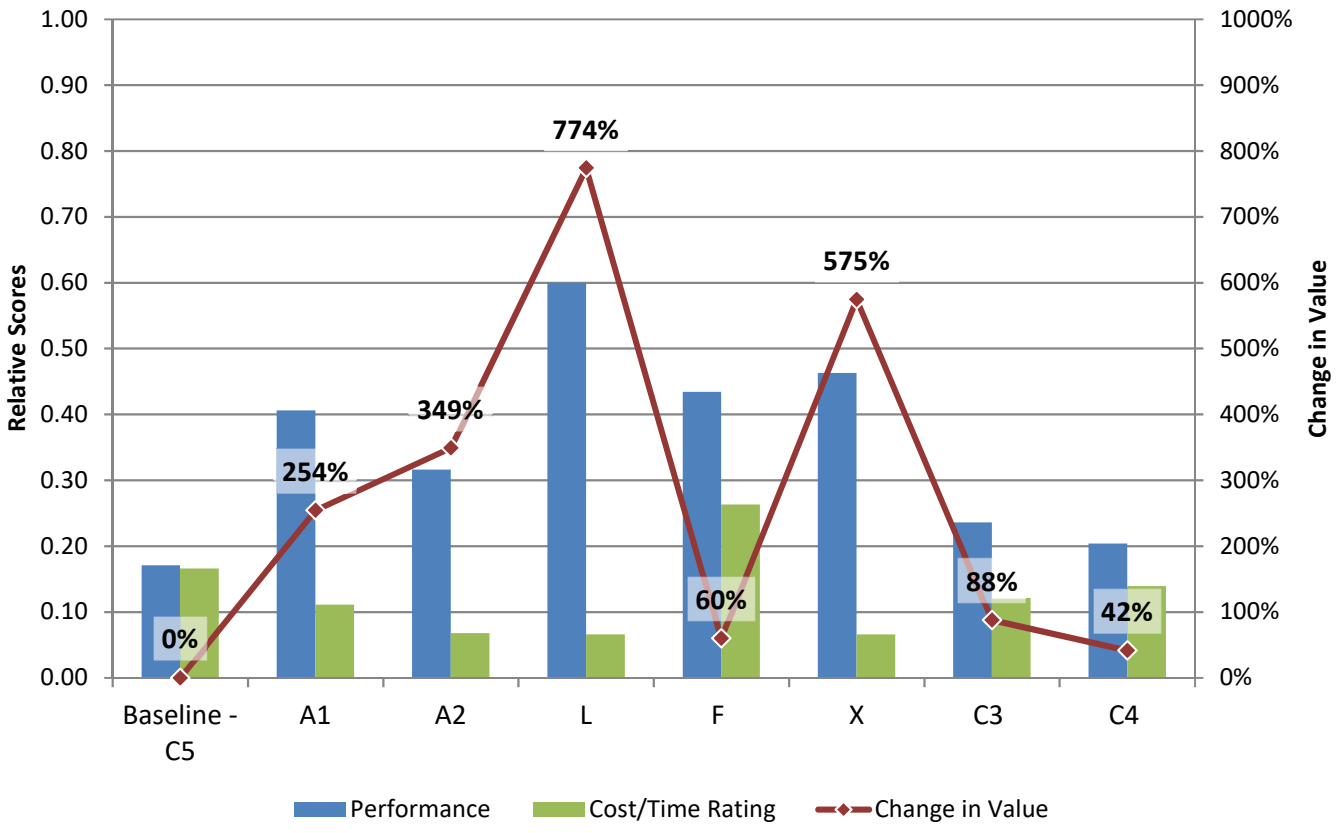
$$V_f(P,C,t)_{total} = \frac{\sum_{n=1}^{\infty} P_n \cdot \alpha}{\sum_{n=1}^{\infty}[(C_n \cdot \alpha) + (t_n \cdot \alpha)]}$$

A Value Matrix was prepared which facilitated the comparison of competing strategies by organizing and summarizing this data into a tabular format. The performance scores for each strategy were divided by the total cost/time scores for each strategy to derive a value index. The value indices for the Alignment Alternatives are then compared against the value index of the baseline Alignment Alternative (Alignment C5) and the difference is expressed as a percent (±%) deviation.

Value Matrix - Alignment Alternatives

Alignment Alternatives	Performance Score	Change in Performance	Cost/Time Score	Net Change	Value Index	Change in Value
Alignment C5 (Baseline)	0.171	--	0.166	--	1.035	--
Alignment A1	0.406	+ 137 %	0.111	- 33 %	3.667	+254 %
Alignment A2	0.316	+ 84 %	0.068	- 59 %	4.646	+ 349 %
Alignment L	0.600	+ 250 %	0.066	- 60 %	9.044	+ 774 %
Alignment F	0.434	+ 154 %	0.263	+ 59 %	1.654	+ 60 %
Alignment X	0.463	+ 170 %	0.066	- 60 %	6.981	+ 575 %
Alignment C3	0.236	+ 38 %	0.121	- 27 %	1.944	+ 88 %
Alignment C4	0.204	+ 19 %	0.139	- 16 %	1.464	+ 41 %

Comparison of Value - Alignment Alternatives



IDEA EVALUATION

IDEA EVALUATION

The ideas generated by the VA team were carefully evaluated, and project-specific attributes were applied to each idea to assure an objective evaluation.

PERFORMANCE ATTRIBUTES

The following are key performance attributes identified for this project and used to assist the VA team in evaluating the ideas:

- Mainline Operations
- Temporary Impacts
- Permanent Impacts
- Maintainability

The VA team enlisted the assistance of the stakeholders and project team (when available) to develop these attributes so that the evaluation would reflect their specific requirements.

EVALUATION PROCESS

The VA team generated and evaluated ideas on how to perform the various project functions using other approaches. The idea list was grouped by function or major project element. Each idea was evaluated with respect to the functional requirements of the project. Performance, cost, time, and risk may also have been considered during this evaluation.

Once each idea was fully evaluated, it was given a total rating number. This is based on a scale of 1 to 7, as indicated by the rating index described in the *Value Analysis Process* section of this report. Ideas rated 4 to 7 were developed further and those that were found to have the greatest potential for value improvement are documented in the *Value Analysis Alternatives* section of this report. The rationale for why ideas that were rated highly but were not developed as alternatives is documented later in this section.

IDEA SUMMARY

All of the ideas that were generated during the Speculation Phase using brainstorming techniques were recorded on the following pages. Ideas received an idea code based on the function statement under which it was brainstormed. The following table indicates the functions related to each idea code.

Idea Code	Related Function
MO	Maintain Operations
OR	Obtain Right of Way
PE	Protect Environment
PT	Preserve Trees
PW	Protect Wildlife

Idea Code	Related Function
RE	Remove Existing
RE	Retain Earth
RM	Reduce Maintenance
SE	Stabilize Earth

A detailed idea evaluation summary is also included. This summary includes additional information related to how each idea improves or degrades the elements of performance, cost, time (schedule), and risk. Only those elements where the idea differs from the baseline concept are included in this summary.

IDEA SUMMARY LIST

Idea Code and Description	Rating
MO-1: Combine Alts X and L into hybrid alignment	ABD
MO-2: Further define the No Build alternative with LCC analysis	DS
MO-3: Explore use of decommissioned segments for potential emergency bypass routes	DIS
MO-4: Consider increasing grade at southern end of A1 and A2 alignments to reduce project footprint, travel length, and necessary earthwork	DS
OR-1: Consider purchasing additional land from Green Diamond (or adjacent property owners) to more efficiently dispose of fill material	DS
PE-1: Provide turn-outs in lieu of third lane for slow-moving vehicles	DS
PE-2: Adjust shoulder widths in relation to geography	DS
PE-3: Use stacked alignment	5
PE-4: Use independent alignments for northbound and southbound directions	6
PE-5: Incorporate tunnel on southern segment of alignment	DIS
PE-6: Incorporate tunnel maintenance structure into tunnel structure	5
PT-1: Modify alignment on northern tie-in to reduce tree impact	DS
PT-2: Perform additional tree survey at northern alignment tie-in (both sides of existing alignment)	DS
PT-3: Shift grade at northern alignment tie-in to reduce tree impacts	DS
PW-1: Incorporate wildlife bypass structure(s)	6
RE-1: Minimize earthwork through alternative alignment (use alignment A-New)	5
RE-2: Use retaining walls and bridges to reduce footprint	7
RM-1: Use mechanically stabilized earth or reinforced soil for slopes to reinforce roadway prism and limit footprint	7
RM-2: Use catchment areas to protect downslope areas (debris and drainage)	5
RM-3: Incorporate additional geotechnical monitoring system to provide slope movement information	DS
RM-4: Use rock to armor toe slope at ocean to reduce toe erosion	DS
RM-5: Provide wider alignment where appropriate to improve ongoing maintenance and operations	5

Idea Code and Description	Rating
RM-6: Incorporate thicker AC segment to reduce maintenance / repair work	5
RM-7: Incorporate K-rail in lieu of MBGR to reduce maintenance / repair work	5
RM-8: Incorporate benches in lieu of tall cuts to reduce earthwork volumes and reduce maintenance (arrest rockfalls)	DS
SE-1: Use drainage system to dewater project areas and stabilize earth to reduce slide potential	DS
SE-2: Perform groundwater study to determine drainage impacts on slope stabilization	DS
SE-3: Use independent alignments for northbound and southbound directions	DS

DEV: Develop / combine with another VA Alternative
DS: Design Suggestion
ABD: Already Being Done [in one of the Baseline Concept]
DIS: Dismissed

DETAILED IDEA EVALUATION SUMMARY

MO-1: **Combine Alts X and L into hybrid alignment** — Overall Rating: **ABD**

General comments: This concept applies to Design Alt A2. This concept is already being pursued by the design team.

MO-2: **Further define the No Build alternative with LCC analysis** — Overall Rating: **DS**

General comments: This concept should be pursued as a VA Design Suggestion as it will assist in properly framing the current project and the best potential design alternatives. This concept will be developed as a Design Suggestion.

MO-3: **(All) Explore use of decommissioned segments for potential emergency bypass routes** — Overall Rating: **DIS**

General comments: This concept applies to all Design Alts. Dismiss - There is no expected longevity - creates additional infrastructure to maintain - represents additional liability concerns.

MO-4: **Consider increasing grade at southern end of A1 and A2 alignments to reduce project footprint, travel length, and necessary earthwork** — Overall Rating: **DS**

General comments: This concept will be developed as a Design Suggestion.

OR-1: **Consider purchasing additional land from Green Diamond (or adjacent property owners) to more efficiently dispose of fill material**

Overall Rating: **DS**

General comments: This concept will be developed as a Design Suggestion.

PE-1: **Provide turn-outs in lieu of third lane for slow-moving vehicles**

Overall Rating: **DS**

General comments: This concept applies to Design Alt L. This concept reflects a reduction in project footprint and permanent impacts, but has liability concerns and will require a design exception due to grade and maintaining traffic operations. This concept will be developed as a Design Suggestion.

PE-2: **Adjust shoulder widths in relation to geography**

Overall Rating: **DS**

General comments: This concept applies to all Design Alts. This concept reflects a reduction in permanent impact, but has liability concerns and will require a design exception. This concept will be developed as a Design Suggestion.

PE-3: **Use stacked alignment**

Overall Rating: **5**

General comments: This concept applies to Design Alt A2. It reduces project footprint, but introduces cost, constructability, and maintainability concerns. This concept will be developed as a VA Alternative.

PE-4: **Use independent alignments for northbound and southbound directions**

Overall Rating: **6**

General comments: This concept applies to Design Alt A2. Provides route flexibility to reduce environmental impacts to big trees, but introduces more total width. This concept will be developed as a VA Alternative.

PE-5: **Incorporate tunnel on southern segment of alignment**

Overall Rating: **DIS**

General comments: This concept applies to Design Alts A1 and A2. Dismiss - the grade is too steep to make this a feasible option.

PE-6: **Incorporate tunnel maintenance structure into tunnel structure**

Overall Rating: **5**

General comments: This concept applies to Design Alt F. This concept will be developed as a VA Alternative.

PT-1: **Modify alignment on northern tie-in to reduce tree impact**

Overall Rating: **DS**

General comments: This concept applies to Design Alts A1, A2, and F. This concept will be developed as a Design Suggestion.

PT-2: **Perform additional tree survey at northern alignment tie-in (both sides of existing alignment)**

Overall Rating: **DS**

General comments: This concept applies to Design Alts A1, A2, and F. Combine with PT-1 or develop as a standalone Design Suggestion.

PT-3: **Shift grade at northern alignment tie-in to reduce tree impacts**

Overall Rating: **DS**

General comments: This concept applies to Design Alts A1 and F. Terminate tunnel in existing alignment - Combine with PT-1 or develop as a standalone Design Suggestion.

PW-1: **Incorporate wildlife bypass structure(s)**

Overall Rating: **6**

General comments: This concept applies to Design Alts A1 and A2. Need to determine the most appropriate locations. This concept will be developed as a VA Alternative.

RE-1: **Minimize earthwork through alternative alignment (use alignment A-New)**

Overall Rating: **5**

General comments: This concept applies to Design Alts A1 and A2. This concept will be developed as a VA Alternative.

RE-2: **Use retaining walls and bridges to reduce footprint**

Overall Rating: **7**

General comments: This concept applies to Design Alts A1, A2, and L.

RM-1: **Use mechanically stabilized earth or reinforced soil for slopes to reinforce roadway prism and limit footprint**

Overall Rating: **7**

General comments: This concept applies to Design Alts A1, A2, X, and L. This concept will be developed as a VA Alternative.

RM-2: **Use catchment areas to protect downslope areas (debris and drainage)**

Overall Rating: **5**

General comments: This concept applies to Design Alts A1, A2, X, and L. This concept will be developed as a VA Alternative.

RM-3: **Incorporate additional geotechnical monitoring system to provide slope movement information**

Overall Rating: **DS**

General comments: This concept applies to all Design Alts. This concept will be developed as a Design Suggestion.

RM-4: **Use rock to armor toe slope at ocean to reduce toe erosion**

Overall Rating: **DS**

General comments: This concept applies to Design Alt X. Represents permitting challenges; however, there is precedent with other projects – usually emergency projects however. This concept will be developed as a Design Suggestion.

RM-5: **Provide wider alignment where appropriate to improve ongoing maintenance and operations**

Overall Rating: **5**

General comments: This concept applies to Design Alt X. The catchment area concept also addresses this concern better while minimizing the permanent impacts. This concept will be developed as a VA Alternative.

RM-6: **Incorporate thicker AC segment to reduce maintenance / repair work**

Overall Rating: **5**

General comments: This concept applies to all Design Alts. This concept will be developed as a VA Alternative.

RM-7: **Incorporate K-rail in lieu of MBGR to reduce maintenance / repair work**

Overall Rating: **5**

General comments: This concept applies to Design Alt X. This concept will be developed as a VA Alternative.

RM-8: **Incorporate benches in lieu of tall cuts to reduce earthwork volumes and reduce maintenance (arrest rockfalls)**

Overall Rating: **DS**

General comments: This concept applies to Design Alts X and L. This concept will be developed as a Design Suggestion.

SE-1: **Use drainage system to dewater project areas and stabilize earth to reduce slide potential**

Overall Rating: **DS**

General comments: This concept applies to Design Alts X and L. This concept will be developed as a Design Suggestion.

SE-2: **Perform groundwater study to determine drainage impacts on slope stabilization**

Overall Rating: **DS**

General comments: This concept applies to Design Alts X and L. This concept will be developed as a Design Suggestion.

SE-3: **Use independent alignments for northbound and southbound directions**

Overall Rating: **DS**

General comments: This concept applies to Design Alt L. This concept will be developed as a Design Suggestion.

VALUE ANALYSIS PROCESS

VALUE ANALYSIS PROCESS

The Caltrans VA process involves 16 activities needed to accomplish a VA study, organized in three parts: Pre-study, VA Study, and Report. Integral to Caltrans' VA process is the Value Metrics process. Value Metrics offers the cornerstone of the Caltrans VA process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value.

Value Analysis has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of the role that VA can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

Project performance must be properly defined and concurred by the stakeholders at the beginning of the VA study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document alternatives. This process, Value Metrics, emphasizes the interrelationship between cost and performance and can be quantified and compared in terms of how they contribute to overall value.

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved, and costs for all VA alternatives have been developed, measuring value is straightforward.

Value Metrics can improve VA studies by:

- Building consensus among project stakeholders (especially those holding conflicting views)
- Developing a better understanding of a project's goals and objectives as they relate to purpose and need
- Developing a baseline understanding of how the project is meeting performance goals and objectives
- Identifying areas where project performance can be improved through the VA process
- Developing a better understanding of an alternative concept's effect on project performance
- Developing a deeper understanding of the relationship between performance and cost in determining value
- Using value as the basis for selecting the best project or design concept

The following provides an overview of the Caltrans approach to VA. The Caltrans VA Study Activity Chart at the end of this narrative identifies the steps in each activity, which are detailed as follows.

PRE-STUDY

Meaningful and measurable results are directly related to the pre-study work performed. Depending on the type of study, all or part of the following information needs to be determined during the pre-study phase:

- Clear definition of the current situation and study objectives
- Identification of study team members
- Identification of project stakeholders
- Definition of how stakeholders are impacted by the project
- Identification of key issues and concerns
- Identification of project's performance requirements and attributes
- Status of project cost estimate
- Project data gathered to be distributed to VA team

In preparation for the VA study, the team leader confers with owners and stakeholders to outline the VA process, initiate data gathering, refine project scope and objectives, structure the scope and team members and technical specialists, and finalize study plans. Specific deliverables are provided.

Following the initial planning meeting, the team leader reviews the data collected for the project and develops a cost model. The team leader also consults with the technical specialists to prepare them for the VA study.

VA STUDY

The VA Job Plan guides the VA team in their search to enhance value in the project or process. Caltrans follows a seven-phase VA Job Plan:

1. Information Phase
2. Function Phase
3. Creative Phase
4. Evaluation Phase
5. Development Phase
6. Presentation Phase
7. Implementation Phase

Information Phase

At the beginning of the VA study, the design team presents a more detailed review of the design and the various systems. This includes an overview of the project and its various requirements, which further enhances the VA team's knowledge and understanding of the project. The project team also responds to questions posed by the VA team.

The project's performance requirements and attributes are discussed, and the performance of the baseline concept is evaluated.

Function Phase

Key to the VA process is the function analysis techniques used during the Function Phase. Analyzing the functional requirements of a project is essential to assuring an owner that the project has been designed to meet the stated criteria and its need and purpose. The analysis of these functions in terms cost, performance, time, and risk is a primary element in a VA study, and is used to develop alternatives. This procedure is beneficial to the VA team, as it forces the participants to think in terms of functions and their relative value in meeting the project's need and purpose. This facilitates a deeper understanding of the project.

Creative Phase

The Creative Phase involves identifying and listing creative ideas. During this phase, the VA team participates in a brainstorming session to identify as many means as possible to provide the necessary project functions. Judgment of the ideas is not permitted in order to generate a broad range of ideas.

The idea list includes all of the ideas suggested during the study. These ideas should be reviewed further by the project team, since they may contain ideas that are worthy of further evaluation and may be used as the design develops. These ideas could also help stimulate additional ideas by others.

Evaluation Phase

The purpose of the Evaluation Phase is to systematically assess the potential impacts of ideas generated during the Creative Phase relative to their potential for value improvement. Each idea is evaluated in terms of its potential impact to performance, cost, time, and risk. Once each idea is fully evaluated, it is given a total rating number. This is based on a scale of 1 to 7, as indicated by the following rating index:

7 = Major Value Improvement 6 = Moderate Value Improvement 5 = Minor Value Improvement 4 = Possible Value Improvement	These ratings represent the subjective opinion of the VA team regarding the potential benefits of the concepts in order to prioritize them for development.
3 = Minor Value Degradation	Concept results in a minor cost or performance improvement at the expense of the other.
2 = Moderate Value Degradation	Concept reduces cost but creates an unacceptable degradation to performance.
1 = Major Value Degradation	Concept is not technically feasible or does not meet project need and purpose.

Ideas rated 4 to 7 are developed further and those found to have the greatest potential for value improvement are documented in the *VA Alternatives* section of this report. The rationale for why

ideas were rated highly but not developed as alternatives is documented in the *Idea Evaluation* section of the report.

Development Phase

During the Development Phase, the highly rated ideas are expanded and developed into VA alternatives. The development process considers the impact to performance, cost, time, and risk of the alternative concepts relative to the baseline concept. This analysis is prepared as appropriate for each alternative, and the information may include a performance assessment, initial cost and life-cycle cost comparisons, schedule analysis, and an assessment of risk. Each alternative describes the baseline concept and proposed changes and includes a technical discussion. Sketches and calculations are also prepared for each alternative as appropriate.

Presentation Phase

The VA study concludes with a preliminary presentation of the VA team's assessment of the project and VA alternatives. The presentation provides an opportunity for the owner, project team, and stakeholders to preview the alternatives and develop an understanding of the rationale behind them.

Implementation Phase

After the stakeholders have had an opportunity to review the alternatives identified by the VA team, the team leader conducts an implementation meeting to discuss the alternatives and resolve appropriate action for each VA alternative. If necessary, any other VA report edits requested by the representatives are also made by the VA team leader and a final report is issued.

This implementation meeting helps to ensure that savings or process improvements are not lost due to lack of communication, and that those VA alternatives that are accepted are properly integrated into the project design.

VA REPORT

Preliminary Report

Following the completion of the VA study, the team leader compiles the information developed during the VA study into the *Preliminary Value Analysis Study Report*. This report, documenting viable alternatives, is provided to the customer within the timeframe requested (usually within two weeks). The preliminary report also contains a *VA Study Summary Report – Preliminary Findings*, designed to highlight critical elements of the VA study, including detailed documentation of VA alternatives, in a concise manner for the use of parties without the opportunity to review the report in its entirety. More details can be found in the complete preliminary report, which consists of the following documentation: Executive Summary, VA Alternatives, Project Information, Project Analysis, Idea Evaluation, and VA Process.

Written Report – VA Implementation Action Memo

If the disposition of all VA alternatives cannot be determined at the Implementation Meeting, then a *VA Implementation Action Memo* is submitted. This memo states which alternatives are accepted, which are rejected and the rationale for rejection, and which VA alternatives are conditionally accepted with further study required. For these alternatives, the memo states what action must be completed so that a decision can be made as to the disposition of this VA alternative, when that action is expected to be completed, and who is responsible to complete this action. If all VA alternatives are either accepted or rejected then this memo is not required.

Written Report – Final Report

Once all VA alternatives have been either accepted or rejected, the team leader updates the *Preliminary Value Analysis Study Report* to show the final results of the study in a *Final Value Analysis Study Report*. In addition, a Value Analysis Study Summary Report (VASSR) is sent to Caltrans HQ to permit easy documentation into the Caltrans Annual Report to FHWA.

The following Caltrans VA Study Activity Chart describes each activity.

CALTRANS VA JOB PLAN & STUDY ACTIVITY CHART

PREPARATION

INITIATE STUDY 1
- Identify study project
- Identify study roles and responsibilities
- Define study goals
- Select team leader
- Prepare draft Study Charter

ORGANIZE STUDY 2
- Conduct Pre-Study Meeting
- Select team members
- Identify stakeholders, decision-makers, and technical reviewers
- Identify data collection
- Select study dates
- Determine study logistics
- Update VA Study Charter
- Identify and define performance requirements

PREPARE DATA 3
- Collect and distribute data
- Develop construction cost models
- Develop highway user benefit / life cycle cost (LCC) model (if required)

VA STUDY WORKSHOP

INFORM TEAM 4
- Review study activities and confirm reviewers
- Present design concept
- Present stakeholders' interests
- Review project issues and objectives
- Discuss Design Exceptions
- Rate performance of baseline concept
- Visit project site

ANALYZE FUNCTIONS 5
- Analyze project data
- Expand project functions
- Prepare FAST diagram
- Determine functional cost drivers and performance
- Assess Risk (if needed)

CREATE IDEAS 6
- Focus on functions
- List all ideas
- Apply creativity and innovation techniques (group and individual)

EVALUATE IDEAS 7
- Apply key performance attributes to rate idea
- List advantages and disadvantages
- Consider cost impacts
- Rank all ideas
- Assign alternatives for development

DEVELOP ALTERNATIVES 8
- Develop alternative concepts
- Prepare sketches and calculations
- Measure performance
- Estimate costs, LCC benefits/costs

CRITIQUE ALTERNATIVES 9
- VA Alternatives Technical Review
- VA Alternatives Team Consensus Review
- Identify mutually exclusive groups of alternatives
- Identify VA strategies
- Validate performance

PRESENT ALTERNATIVES* 10
- Present findings
- Document feedback
- Confirm pending reviews

**Interim presentation of study findings*

DETERMINE DISPOSITION

DOCUMENT VA STUDY 11
- Document process and study findings
- Develop and Distribute *VA Study Summary Report - Preliminary Findings and VA Study Preliminary Report*
- Distribute electronic report to HQ VA Branch

ASSESS ALTERNATIVES** 12
- Review Study Summary Report
- Assess alternatives for project acceptance
- Prepare draft implementation dispositions

***Activities performed by PDT, Technical Reviewers, and Stakeholders*

RESOLVE ALTERNATIVES 13
- Review implementation dispositions
- Conduct Implementation Meeting
- Resolve implementation actions with decision-makers and stakeholders
- Document VA Alternative Disposition
- Develop Implementation Action Memo (If Conditionally Accepted (CA) Alternatives remain)

FINALIZE ALTERNATIVES 14
- VA Team Leader follow up with PM on CA Alternatives
- Resolve Conditionally Accepted Alternatives
- Develop Implementation Plan with PM
- Design Manager Sign off on VA Implementation Plan Authorization
- Final presentation of study results (if needed)

REPORTING RESULTS

PUBLISH RESULTS 15
- Document process and study results
- Incorporate all comments and implementation plan
- Distribute *Final VA Study Report* in PDF format
- Submit *VA Study Summary Report* (VASSR) and two-page summary to HQ VA for FHWA Auditing
- Include Implementation Plan Authorization in Final VA Report

Day 1 – Monday, August 27th – Crescent City, Fire Protection District Training Room

8:00 Facilitator Set-up
10:00 Introductions
10:05 Overview of VA Process, Objectives, & Deliverables (VA Facilitator)
10:15 Sponsor In-Brief (PM, Design Team & VA Facilitator)

- ***Need & Purpose***
- ***Overview of Current Project Status***
- ***Overview of Current Design Alternatives***

11:00 Discuss and Weight Performance Measures (Review)
12:00 Working Lunch
1:00 Discuss and Score Current Design
2:00 Risk Register Review and Discussion of VA Focus Areas
3:00 Stakeholder Kickoff Meeting Adjourn
3:30 VA Team Discussion *(or possible Site Visit)*
5:00 VA Team Adjourn

Day 2 – Tuesday, August 28th – Caltrans District 1 HQ, Eureka

7:45 Facilitator Set-up
8:00 Review Agenda
8:15 Team Review and Discussion of Design Documentation
9:00 Estimate Review
10:00 FAST Analysis Discussion
11:30 Lunch
12:30 Team Brainstorming Team
2:30 Evaluation of VA Ideas
5:00 Adjourn

Day 3 – Wednesday, August 29th – Caltrans District 1 HQ, Eureka

7:45 Facilitator Set-up
8:00 Review Agenda
8:15 Technical Review of VA Ideas
10:00 Team Development of VA Alternatives
11:30 Lunch
12:30 Team Development of VA Alternatives (cont.)
5:00 Adjourn

Day 4 – Thursday, August 30th – Caltrans District 1 HQ, Eureka

7:45 Facilitator Set-up
8:00 Review Agenda
8:15 Review Team Development of VA Alternatives
9:00 Team Development of VA Alternatives (cont.)
11:30 Lunch
12:30 Team Development of VA Alternatives (cont.)
5:00 Adjourn

Day 5 - Friday, August 31st – Crescent City, Fire Protection District Training Room

7:45 Facilitator Set-up
8:00 Review Agenda
8:15 Finalization of VA Alternatives
10:00 Determine and Score Team Recommended VA Strategy
11:30 Team Review of VA Study Presentation
12:00 Lunch
1:00 Presentation of Initial VA Study Results (Team Recommended VA Strategy)
3:00 Adjourn

LAST CHANCE GRADE STAKEHOLDER GROUP
MEMBER ROSTER/SIGN-IN SHEET
Aug. 27, 2018

#	ORG/ROLE	NAME	EMAIL	PHONE	Attended 08/27/18	Attended 08/31/18
1	California Highway Patrol	Lieutenant Larry Depee	*LDepee@chp.ca.gov*	707-464-3117	x	
2	California State Parks	Victor Bjelajac	*Victor.Bjelajac@parks.ca.gov*	707-445-6547 x.11 OR 707-407-7481	x x	x
3	Caltrans, D1 Project Manager Caltrans, Construction	Jaime Matteoli, PE Sebastian Cohen	*Jaime.matteoli@dot.ca.gov* *Sebastian.cohen@dot.ca.gov*	707-441-2097 707-441-3969	x x	x x
4	Community Representative	Kurt Stremberg	*Kurt@kurtstremberg.com*	707-465-2121	x	x
5	Crescent City	Jason Greenough	*Jgreenough@cc.crescentcity.org*	707-464-7483 x. 223	x	x
6	Crescent City-Del Norte Chamber of Commerce	Sarah Caron	*Sarahcaroncmt@gmail.com*	(707) 464.3174	x	x
7	Del Norte Local Transportation Commission	Gerry Hemmingsen	*Ghemmingsen@co.del-norte.ca.us*	707-464-7204	x	x
8	Del Norte County *(Bd. of Supervisors)*	Lori Cowan	*Lcowan@co.del-norte.ca.us*	707-218-7040		x
9	Elk Valley Rancheria, *Chairman*	Dale Miller	*Dmiller@elk-valley.com*	707 465-2601 707-218-5086	x	x

LAST CHANCE GRADE STAKEHOLDER GROUP
MEMBER ROSTER/SIGN-IN SHEET
Aug. 27, 2018

#	ORG/ROLE	NAME	EMAIL	PHONE	Attended 08/27/18	Attended 08/31/18
10	EPIC	Tom Wheeler	*Tom@wildcalifornia.org*	707-822-7711 (c)206-356-8689	x	x
11	Friends of Del Norte	Eileen Cooper	*Upsprout@yahoo.com*	707-465-8904	x	x
12	Green Diamond Resource Co	Craig Compton	*Ccompton@greendiamond.com*	707-668-4424 707-498-9714	x	x
13	Humboldt County *(Bd. of Supervisors)*	Ryan Sundberg	*Rsundberg@co.humboldt.ca.us*	707-476-2396	x	
14	Humboldt County Association of Governments	Gordon Johnson	*Gordar2@att.net* *(Council member, City of Rio Dell)*	707-764 3050		
15	Redwood National Park	David Roemer	*Dave_roemer@nps.gov*	707-951-7818; 707 465-7700	x	x
16	C. Renner Petroleum	Sabina Renner	*Sabina@c-renner.com*	707-465-1776 707-954-7006	x	
17	Rumiano Cheese	Gary Smits	*Gary@rumianocheese.com*	866- 328-2433		
18	Save the Redwoods League	Laura Lalemand	*Llalemand@savetheredwoods.org*		x	x
19	Tolowa Dee-ni' Nation	Stevie Lemke	*Stevie.lemke@tolowa.com*	707-487-9255		
20	Yurok Tribe	Joseph James	*Jjames@yuroktribe.nsn.us*	707-954-0692		

LAST CHANCE GRADE STAKEHOLDER GROUP
MEMBER ROSTER/SIGN-IN SHEET
Aug. 27, 2018

ORG/ROLE	NAME	EMAIL	PHONE	Attended 08/27/18	Attended 08/31/18
Office of Rep. Jared Huffman	John Driscoll Lindsay Righter	*John.Driscoll@mail.house.gov* *Lindsay.Righter@mail.house.gov*	707- 407-3585	x x	x x
U.S Institute for Environmental Conflict Resolution	Joy Keller-Weidman	*Kellerweidman@udall.gov*	520- 268-6751	x	
Value Management Strategies, Inc.	Eric Trimble, CVS, MBA, PMP, ENV SP Vice President	*erict@vms-inc.com*	(760) 741-1155 ext. 2	x	x

ADDITIONAL CALTRANS SUPPORT TEAM

Caltrans, Chief of Geotechnical Services	Charlie Narwold	*Charlie.narwold@dot.ca.gov*		x	x
Caltrans, Design	Matt Smith	*Matt.Smith@dot.ca.gov*	707-441-6526	x	x
Caltrans, Environmental	Jason Meyer	*Jason.meyer@dot.ca.gov*	707-445-6322	x	x

LAST CHANCE GRADE STAKEHOLDER GROUP
MEMBER ROSTER/SIGN-IN SHEET
Aug. 27, 2018

ORG/ROLE	NAME	EMAIL	PHONE	Attended 08/27/18	Attended 08/31/18
ADDITIONAL VA TEAM					
Caltrans, Construction	Arvin Lal	*Arvin.lal@dot.ca.gov*		x	x
BGC Engineering, Principal Geotechnical Engineer	Scott Anderson	*ScAnderson@bgcengineering.ca*		x	x
Caltrans, Environmental	Melinda Molnar	*Melinda.l.molnar@dot.ca.gov*		x	x
Caltrans, Design	Todd Lark	*Todd.lark@dot.ca.gov*		x	x
Caltrans, Structures Design	Daniel Sessions	*Daniel.sessions@dot.ca.gov*		x	x
ADDITIONAL AGENCY REPS FOR VA PROCESS					
National Marine Fisheries Service	Dan Free	*Dan.free@noaa.gov*		x	x
US Fish & Wildlife Service	Greg Schmidt	*Gregory_Schmidt@fws.gov*			
California Coastal Commission	Bob Merrill	*Bob.Merrill@coastal.ca.gov*			

LAST CHANCE GRADE STAKEHOLDER GROUP
MEMBER ROSTER/SIGN-IN SHEET
Aug. 27, 2018

ORG/ROLE	NAME	EMAIL	PHONE	Attended 08/27/18	Attended 08/31/18
CA Department of Fish & Wildlife	Mike Van Hattem	*Michael.vanHattem@wildlife.ca.gov*		x	x
US Army Corps of Engineers	Kasey Sirkin	*Ll.k.sirkin@usace.army.mil*			
North Coast Regional Water Quality Control Board	Brandon Stevens	*Brandon.Stevens@Waterboards.ca.gov*			
Resighini Rancheria	Moonchay Dowd	*Moonchaykaridowd@gmail.com*	707-482 2431		
Wetlands Coordinator / Biologist	Bradford Norman	*bnorman.resighini@gmail.com*	707-954-5532	x	x

ADDITIONAL RSVPs

Caltrans	Brad Mettam	*Brad.mettam@dot.ca.gov*	707-445-6413	x	
Humboldt County Assoc. of Governments	Marcella Clem	*Marcella.clem@hcaog.net*	707-444-8208	x	
Del Norte Local Transportation Commission	Tamera Leighton	*Tamera@dnltc.org*	707-465-3878	x	x
Crescent City	Alex Fallman	*Afallman@cc.crescentcity.org*			X

APPENDIX A

8/27/18 Meeting Notes

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

On August 27, 2018, from 10:00 a.m. to 3:00 p.m., the 10th meeting of the Last Chance Grade Stakeholders Group took place in Crescent City, at the Crescent Fire Protection District HQ Training Room. This meeting was the kick-off of the Value Analysis (VA) Study process, led by Eric Trimble, Vice President, Value Management Strategies, Inc.

AGENDA ITEMS & HIGHLIGHTS

TOPIC	DETAILS
Kick Off & Welcome	Jaime Matteoli, Caltrans PM for LCG, welcomed everyone and introduced Eric Trimble who is the Value Analysis consultant and facilitator. John Driscoll from Congressman Huffman's office also welcomed everyone. He introduced Lindsay Righter, his colleague, who has generously offered to take notes throughout the meeting. He clarified that this was not the usual stakeholders meeting, but a Caltrans-led Value Analysis process meeting that included LCG stakeholders and other invitees.

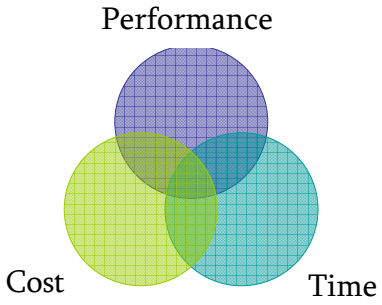
TOPIC	DETAILS
Meeting Overview	Eric Trimble, Vice President, Value Management Strategies, Inc., reviewed the meeting agenda and facilitated Introductions. Meeting agenda included: • Introductions • Overview of VA Process, Objectives, & Deliverables (VA Facilitator) Sponsor In-Brief (PM, Design Team & VA Facilitator) Need & Purpose Overview of Current Project Status Overview of Current Design Alternatives • Discuss and Weight Performance Attributes • Working Lunch – Review Discussion of Project Constraints, Issues, Risks, & Opportunities • Discuss and Score Current Design Alternatives • Discuss Current Design Alternative Value Rankings • Stakeholder Kickoff Meeting Adjourn <u>Ground rules included:</u> 1. We are all on the same team 2. Respect each other 3. One conversation at a time 4. Be flexible 5. Have fun

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

TOPIC	DETAILS
Stakeholders Introductions	Meeting attendees included representatives from LCG stakeholder groups, Caltrans LCG Project support team members, VA team members, agency representatives for the VA process, and other invited guests. ***Please see attached roster for details.***

TOPIC	DETAILS
Overview of VA Process	VA Facilitator, Eric Trimble, provided an overview of VA Process, Objectives, & Deliverables: ♦ The Caltrans VA process involves 16 activities needed to accomplish a VA study, organized in three parts: Pre-study, VA study, and Report. A Value Metrics process is used to provide a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value. ♦ Objective: Recommend an optimal solution that meets the project need and purpose. Current and innovative solutions should be considered along with constraints and challenges to aid in identifying feasible options. Value = Performance / Cost + Time  ♦ Performance Attributes include: Mainline Operations, Local Operations, Temporary Impacts, Permanent Impacts, Maintainability

TOPIC	DETAILS
Sponsor In-Brief	In-Brief (PM Jaime Matteoli, *Project Manager, Caltrans)*, Design Team members & VA Facilitator (Eric Trimble) presented the following information: ♦ Need & Purpose ○ LCG is composed of 3 landslides that have experienced slow and steady movement since the current alignment of the road was completed in 1937 (movement =~2"/year). ○ Caltrans needs to keep existing road open and safe – has $35M to do this

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

- Also needs to find a long-term solution – has $10M for geotechnical and environmental studies mandated by state and federal laws

♦ Overview of Current Project Status

- Caltrans generally believes that if there was a large slide, they could get the road open within a week by carving further into the hillside. No closure has lasted more than 24 hours since the 1930s. If there was a massive failure (e.g., earthquake) that caused difficulty getting equipment to the project site, delays could be longer.
- Need to narrow list of alternatives (VA process being part of this) to identify areas of impact so they can begin the multi-year environmental studies ASAP. Also need info from preliminary geotech investigations to inform this.
- Preliminary geotechnical investigations have discovered historic landslides in every direction around the project

♦ Overview of Current Design Alternatives

- Expert-Based Risk Assessment (EBRA) - geotech assessment
  - Created Alternative X – improvements to strengthen existing alignment
  - Created Alternative L – upslope realignment that would provide better stability and minimize old-growth redwood (OGR) and other environmental impacts
  - EBRA evaluated 6 alternatives (X, L, F, A1, A2, and C3) in terms of the chances of high maintenance costs, unusual repairs that cause delays, and requirement of long-term closure or abandonment over time
  - General Conclusions:
    - C has highest risk, F has lowest risk/highest cost
    - Construction schedules range from 3.5-7 years
    - Capital costs (includes right-of-way and mitigation costs) range from $150M-$2,000M
  - Alternative A1:
    - Uses 1.1-mile tunnel to avoid OGR, but tunnel still exits in OGR, so anticipate 1-2 acres of impacts depending on required tunnel footprint
    - Possible mitigation option would be to buy OGR land not currently protected or support late seral management projects such as State Parks' Mill Creek watershed project

- Risk of ownership according to geotech: Medium, 47% probability of closure within 50 years
- Construction Length: 3.4 miles, Construction Footprint: 77 acres, Construction Schedule: 4 years, Construction Cost: $672M

▪ Alternative A2:
- Tunnel cuts through more OGR (~0.25 mile, ~37 trees greater than 6' diameter), impacts to northern spotted owl (NSO) and marbled murrelets
- Risk of ownership according to geotech: Higher, 88% probability of closure within 50 years
- Construction Length: 3.5 miles, Construction Footprint: 80 acres, Construction Schedule: 3.5 years, Construction Cost: $240M

▪ Alternative L:
- Upslope option - mostly a large cut with a couple small fills
- Entirely within coastal zone and state and national parks; coastal prairie with large Douglas fir, spruce, and redwood; mostly 4'-6' trees; will be close to but mostly outside of OGR; on side slope, so becomes barrier for wildlife connectivity, but less so than A and C alignments
- Already edge forest habitat, avoids fisheries and OGR issues, so mitigations and objections should be less
- Possibility that Alternative L could be considered a "betterment", as opposed to a "realignment," which means some potential of using FHWA Emergency Relief funding that can't be used for a realignment
- Risk of ownership according to geotech: Medium, 48% probability of closure within 50 years
- Construction Length: 2.2 miles, Construction Footprint: 47 acres, Construction Schedule: 3.5 years, Construction Cost: $220M

▪ Alternative F:
- Full tunnel, in coastal zone, length of tunnel would require an onsite maintenance facility
- Tunnel portals impact OGR

	• Risk of ownership according to geotech: Low, 4% probability of closure within 50 years • Construction Length: 1.5 miles, Construction Footprint: 5 acres, Construction Schedule: 7 years, Construction Cost: $1,100-2,000M ▪ Alternative X: • Stays on alignment, replaces 12 retaining walls and adds three 50'-60' long retaining walls • Risk of ownership according to geotech: High, 80% probability of closure within 50 years • Construction Length: 1.1 miles, Construction Footprint: 20 acres, Construction Schedule: 3.5 years, Construction Cost: $150M ▪ Alternatives C3, C4, and C5: • Goes around the entire OGR area with bridges, large cuts, and fills • Largest barriers for wildlife connectivity, goes through Mill Creek watershed which impacts coho salmon habitat • Risk of ownership according to geotech: Highest, 99+% probability of closure within 50 years • Construction Length: 8-12.2 miles, Construction Footprint: 225-332 acres, Construction Schedule: 4-6 years, Construction Cost: $800-1,000M

TOPIC	DETAILS
Weight Performance Attributes	***Discuss Weight Performance Attributes***: This agenda item reviewed the key performance aspects that contribute to overall project success and then weight them – based on stakeholder input – to identify which represent the most value to the project and should be a primary focus for the VA team. ♦ Mainline Operations – Assessment of traffic operations and safety on the mainline facility, including off-ramps and collector-distributor roads. Considerations include level of service relative to the 20-year traffic projections, as well as considerations such as design speed, sight distance, lane widths, and shoulder widths. Level service A is ideal, F is the worst (Most local roads are level service C, some B and some D). ♦ Temporary (Construction) Impacts – Assessment of the temporary impacts to

	the public during construction related to traffic disruptions, detours, and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust, and construction traffic; environmental impacts related to water quality, air quality, soil erosion, and local flora and fauna. ♦ Permanent Impacts – Assessment of the permanent impacts to the environment, including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice); impacts to cultural, recreational, and historic resources; drainage and hydraulic issues. ♦ Maintainability – Assessment of the long-term maintainability of the transportation facility, including overall durability, longevity, and maintainability of pavements, structures, and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel. ♦ *REMOVED FROM DISCUSSION BECAUSE DEEMED A REQUIREMENT:* Local Operations – Assessment of traffic operations and safety on the local roadway infrastructure, including on-ramps and frontage roads. Critical component for adjacent landowners such as Green Diamond Resource Company

TOPIC	DETAILS
Discussion of Project Constraints, Issues, Risks, & Opportunities	Working Lunch: Review Discussion of Project Constraints, Issues, Risks, & Opportunities ♦ **Mainline Operations vs. Permanent Impacts:** o Group Score (Scale 1 = Equal, 9 = Extreme): **3.5** weighted toward Permanent Impacts o Discussion: ▪ This project must happen – not optional ▪ There are very viable alternatives that meet mainline operational needs with lower impacts ▪ One group expressed that this is not just a road anywhere - it is a road here. Could possibly accept a level of service C with fewer environmental impacts rather than sacrificing more impacts for a higher speed (and service level) route. ♦ **Mainline Operations vs. Temporary Impacts** o Group Score (Scale 1 = Equal, 9 = Extreme): Weighted **4.2** toward Mainline Operations o Discussion: ▪ General feeling that it would be preferable to deal with some short-term disruption for a better project outcome ▪ One group expressed more concern about all kinds of impacts, temporary or permanent, than mainline operations

- Many felt that temporary impacts should have been broken out into more specific categories since not all are equal, but this is how the process is designed
- Concern expressed that the length of harm from "temporary" environmental impacts could extend long-term depending what they are (e.g., erosion impacts to fisheries).

♦ **Permanent Impacts vs. Temporary Impacts**

- Group Score (Scale 1 = Equal, 9 = Extreme): Weighted **8.5** toward Permanent Impacts
- Discussion:
  - General consensus that permanent impacts, particularly environmental, are of the utmost concern given the project location

♦ **Mainline Operations vs. Maintainability**

- Group Score (Scale 1 = Equal, 9 = Extreme): Weighted **1.9** toward Maintainability
- Discussion:
  - Level of service of mainline operations versus how easy it is to operate
  - One group expressed that maintainability is currently a major concern and high cost, which could continue into the future regardless of the alternative, so focus should be on how well that facility operates. We have a high level of cost right now, so if we're going to be spending a similar amount over time, might as well be for a good project
  - One group expressed a strong desire to reduce ongoing high maintenance costs into the future
  - Concern expressed that there are environmental costs to a road failure or maintenance needs, which could vary greatly, but need to be considered
  - One group expressed that they want the mainline operations to be worth the cost of maintainability

♦ **Permanent Impacts vs. Maintainability**

- Group Score (Scale 1 = Equal, 9 = Extreme): Weighted **6.2** toward Permanent Impacts
- Discussion:
  - General consensus that permanent impacts, particularly environmental, are of the utmost concern given the project location

♦ **Temporary Impacts vs. Maintainability**

- Group Score (Scale 1 = Equal, 9 = Extreme): Weighted **4.4** toward Maintainability

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

	○ Discussion: ▪ Minimal discussion of importance of maintainability ♦ **Overall Scores:** ○ Mainline Operations – 15.9% ○ Temporary Impacts – 4.9% ○ Permanent Impacts – 60.5% ○ Maintainability – 18.8% ○ Discussion ▪ Group is highly concerned about permanent impacts. We know we need something we can maintain and that connects points A to B, but we need to make sure permanent impacts are minimized. ▪ The fact that permanent impacts were so highly rated by the whole group could help minimize the project delivery timeline if we use this criteria to narrow the list of alternatives since less time will be required for impact assessments

TOPIC	DETAILS
Current Design Alternatives	Discuss and Score Current Design Alternatives: This reviewed each of the design alternatives and uses stakeholder input to determine how each performs in relation to the identified performance attributes. ♦ **Mainline Operations**

Alternative	Score	Rationale
A1	6	Still one of the longer alternatives. Not a radically improved road from any of the other options
A2	6	No tunnel, but two more bridges than A1. Fewer driver safety issues than a tunnel, but less reliability than a tunnel due to potential for buckling at bridge areas
L	7	Shorter and straighter than existing alignment or Alternatives A1 & A2. Still close to slide areas, but getting further away from the most immediate threat to the roadway, which is erosion/slides at the toe slope and below the current alignment. May be able to stabilize the slide at the head scarp (top of ridge)
F	7.5	1.1-mile tunnel makes it shorter and faster than some other alternatives. Low chance of failure, very drivable, but still have to deal with the portals and their impacts
X	1	Large impacts to current highway during construction
C3	4.2	Shorter distances

C4	4.1	Will take longer to travel and more bridges
C5	4	We're adding distance and risk of closure increases with distance traveled

- **Temporary Impacts**

Alternative	Score	Rationale
A1	5	Long construction duration due to building tunnels. Lot of cut and fill, goal is to achieve a balanced project with cut and fill but will require seasonal storage of materials.
A2	5	Shorter construction window. More excess material
L	6.5	Shorter, but could be greater impacts due to working above the current alignment. Would need to figure out staging. Less bridges/tunnels. Longer length within park.
F	3.5	Large impacts to current highway during construction. Excessive amount of material to move.
X	1	Extreme impacts expected
C3	2.2	Fewer impacts because shorter
C4	2.1	Less impact to Hwy 101 during construction, but will need to deal with a lot of construction material and other impacts
C5	2	Lot of structures and stream impacts, soil movement

- **Permanent Impacts**

Alternative	Score	Rationale
A1	3.5	Impact to OGR. Limits to adjacent landowner access. Tunnel portals have a large impact. Big visual impact.
A2	2	~37 old growth trees impacted
L	6	Impacts 18 acres of redwood, Douglas fir, and spruce within the park. Reduces the wildlife connectivity issues that exist with other alternatives
F	4	big visual impacts, maintenance facility needs to be built, northern portal in OGR area, less OGR impact overall, fewer wildlife connectivity barriers
X	7	Fewer impacts since keeping existing alignment
C3	2	
C4	1.5	A little better than C5
C5	1	Impacts a lot of OGR and fisheries

- **Maintainability**

Alternative	Score	Rationale
A1	4	Higher expense of maintaining tunnel and requires a

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

		facility to support it, ventilation, etc.
A2	4	Potential for bridges to buckle if geologic movement
L	5	Less distance to maintain, no tunnels or bridges, just one long wall that should be stable once anchored in
F	3	Requires permanent maintenance facility to operate the tunnel with pumps, ventilation, etc.
X	1	Not a significant improvement from current alignment
C3	2	
C4	2	Same terrain but less road and structures to maintain than C5, more unknowns to deal with between bridges, which are more stable
C5	2	Very difficult to maintain because of distance

TOPIC	DETAILS
Current Design Alternative Value Rankings	Discuss Current Design Alternative Value Rankings: This revealed how the various design alternatives compare to one another based on stakeholder input on performance as well as known cost and schedule values. This should help to identify the initial leading design alternatives and possibly a preferred alternative. Conversely, this will also help to eliminate those design alternatives that do not hold a high enough value to the need and purpose of the project based on stakeholder input. ♦ Group agrees that consideration of C alternatives (C3, C4, C5) can be eliminated ♦ Keeping Alternative X under consideration because it doesn't cost much to study and may need to remain under consideration for federal funding ♦ VA team will spend the week looking for ways to improve these alternatives and add value

NEXT STEPS:

What	*By Whom*	*By When*
Find out what L prime is	*VA team*	*8/31*
What	*By Whom*	*By When*
Attend Debrief	*Stakeholders*	*8/31*
What	*By Whom*	*By When*
Review, edit and send notes with Sign In sheet to Eric	*Lindsay/Joy*	*8/29*

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 27, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

TOPIC	DETAILS
Parking Lot:	VA team: 1. Maintain Access 2. Find out what L prime is.

Attachments:
Participants Sign in Sheet (ROSTER)

APPENDIX B

8/31/18 Meeting Notes

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

On August 31, 2018, from 10:00 a.m. to 3:00 p.m., the 11th meeting of the Last Chance Grade Stakeholders Group took place in Crescent City, at the Crescent Fire Protection District HQ Training Room. This meeting was the continuation of the Value Analysis (VA) Study process, led by Eric Trimble, Vice President, Value Management Strategies, Inc.

AGENDA ITEMS & HIGHLIGHTS

TOPIC	DETAILS
Meeting Welcome and Overview	Elk Valley Rancheria Chairman Dale Miller opened the meeting with a prayer. Jaime Matteoli, Caltrans LCG PM, introduced Eric Trimble, Vice President of Value Management Strategies, Inc., who reviewed the meeting agenda and facilitated introductions. Meet agenda included: - Introductions - Presentation of VA Study Process & VA Team Recommendations - Discussion of Initial VA Study Results (Team Recommended VA Strategies)

TOPIC	DETAILS
Stakeholders Introductions	Twenty-nine attendees included representatives from LCG stakeholder groups, in addition to LCG Caltrans LCG Project support team members, VA team members, agency representatives for the VA process, and other invited guests. ***Please see attached roster for details***.

TOPIC	DETAILS
Presentation of VA Study Process	VA Facilitator, Eric Trimble, provided a presentation to review the VA Study Process: ♦ Pre-Study Prep ♦ Information Phase – Kickoff ♦ Analysis Phase ♦ Creativity Phase ♦ Evaluation Phase ♦ Development Phase ♦ Presentation Phase ♦ Implementation Phase VA Study Kickoff Review/Summary ♦ Performance Prioritization Input o Permanent Impacts – 60.5% o Maintainability – 18.8% o Mainline Operations – 15.9%

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

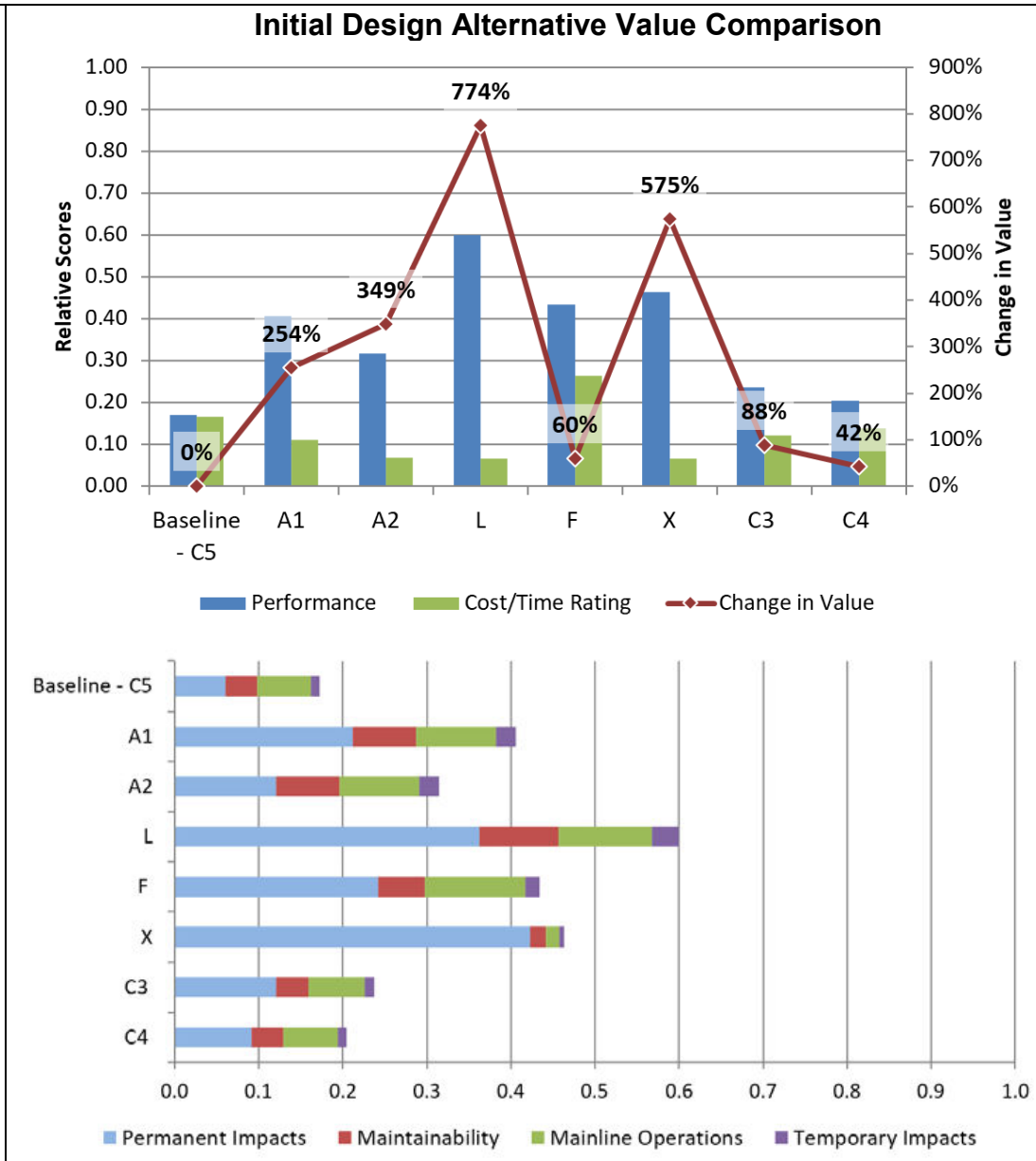
	○ Temporary Impacts – 4.9% ♦ Design Alternative Performance ○ Consensus reached that design alternatives C3, C4, & C5 should be removed from consideration due to the high level of risk, cost, and permanent impacts that they represent ○ All other alternatives (A1, A2, X, L, & F) are still in consideration pending additional investigation and study ♦ Additional clarification of remaining alternatives is needed

TOPIC	DETAILS
Presentation of VA Team Recommended Strategies	Design Team & VA Facilitator (Eric Trimble) led the participants through the scoring of the recommendations: *This will sort, combine, and apply the developed VA Team recommendations to the appropriate initial design alternatives in an effort to improve their overall value score – again based on stakeholder input. This will attempt to enhance the initially determined values of the remaining design alternatives based on the performance, cost, and schedule impacts as a result of the developed (and potentially applied) VA team recommendations.* *(con't)*

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS



LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

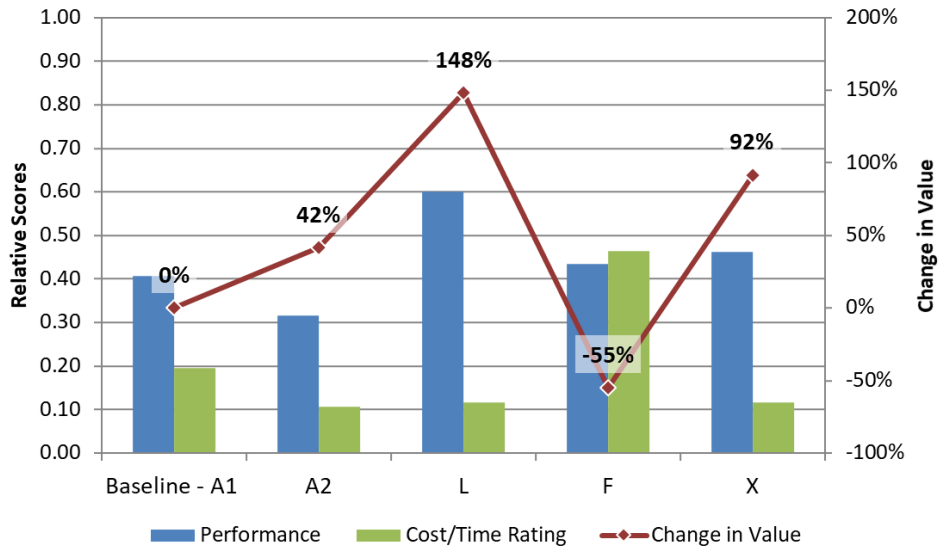
Design Alternative Summary

Alt	Purpose & Need?	Proactive/ Reactive	Primary Objective	Capital Cost	Schedule
M Maintain Existing	N	Reactive	No Build	Escalating*	NA
X Alignment Reconstruction	TBD	Proactive	Use current geometry	$220M	3.5 Yrs
L Upslope Realignment	TBD	Proactive	Minimize New Construction & Permanent Impacts	$220M	3.5 Yrs
A1 Realignment w/ Bridge/ Tunnel	TBD	Proactive	Avoid Coastal Slide & Minimize OGR Impact	$672M	4 Yrs
A2 Realignment w/ Bridges	TBD	Proactive	Avoid Coastal Slide & Minimize Cost	$240M	3.5 Yrs
F Full Tunnel	TBD	Proactive	Avoid Coastal Slide & Minimize OGR Impact	$2B	7 Yrs

**$85 million in repair costs since 1997*

- VA study group spent three days trying to identify ways to improve the five alternatives still under consideration.

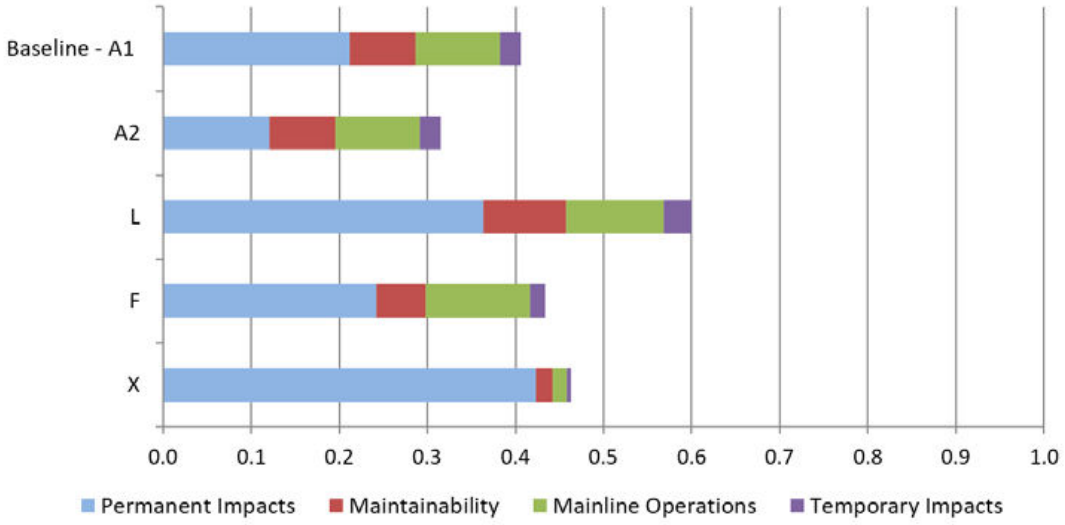
Updated Design Alternative Value Comparison



LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS



VA Alternative Summary

Alternative No & Description	Associated Alternatives	Performance Impact	Cost Impact
RM-1 Use mechanically stabilized earth/reinforced soil for slopes	A1, A2, & L	Perm.	$-$$
Build embankments with steeper slopes. *Advantages:* • *Perm Impacts - Reduces project footprint. Reduces environmental mitigation* • *Maintainability – Limits future potential maintenance effort by stabilizing slopes.* *Disadvantages:* • *Temporary Impacts – Slightly increases construction time for necessary earthwork and steel and/or geosynthetic reinforcement components. Increases the quantity of excavated material to transport and dispose of.*			
RM-2 Use catchment areas to protect roadway	A1, A2, X, & L	Maint.	$
Advantages: • *Mainline Operations – Limits potential delays due to repair work when slide damage occurs. Reduces potential for delay and traffic conflicts (debris and stormwater concerns).* • *Maintainability – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur), Will provide a more protected work area for maintenance personnel.*			

Disadvantages:
- *Temporary Impacts – Slightly increases construction time for necessary earthwork*
- *Permanent Impacts – Increases project footprint (shoulder width) to accommodate placement of catchment basins.*

RM-5 Provide wider alignment where appropriate	X	Mainline	$$

Advantages:
- *Mainline Operations – Limits potential delays due to repair work when slide damage occurs. The wider shoulders will also provide for a better clear recovery space and sight distance to reduce the potential for traffic conflicts. Will also help to accommodate bicycle traffic.*
- *Maintainability – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur).*

Disadvantages:
- *Temporary Impacts –Slightly increases construction time for necessary earthwork and structural section.*
- *Permanent Impacts –Increases project footprint (shoulder width) to accommodate placement of catchment basins. Will also increase storm water management needs due to the increase in impermeable surface.*
- *Maintainability –Represents additional surface area to maintain and stormwater management.*

RE-1 Minimize fill through alternative alignment	A1 & A2	Perm.	$

Creates possible new alternative called "A-New" by using a large through-cut over steeper grade to avoid wide initial curve at beginning of A1 alignment

Advantages:
- *Mainline Operations –Results in a shorter overall facility length.*
- *Temporary Impacts –Reduces overall construction effort by reducing project length.*
- *Permanent Impacts –Reduces overall project footprint and thereby reduces permanent tree and wildlife impacts.*
- *Maintainability –Reduces the amount of structures and roadway to maintain.*

Disadvantages:
- *Temporary Impacts –Significantly increases the amount of haul-off of excavated material and increases need for environmentally-cleared*

offsite disposal areas.

- *Permanent Impacts –Shifts a greater portion of impacted area to the State Park in lieu of Green Diamond Resource Company property, which may require more environmental mitigation (but possibly fewer fisheries impacts).*

RE-2 Use retaining walls and bridges to reduce footprint	A1, A2, & L	Perm.	$$-$$$

Advantages:

- *Permanent Impacts – Reduces the project footprint. Reduces environmental impacts and mitigation while providing opportunities to incorporate wildlife connectivity options.*

Disadvantages:

- *Temporary Impacts – Increases construction time for necessary bridge and retaining wall construction. Limits on-site disposal and fill.*
- *Maintainability – Increases the number of structures to maintain.*

PW-1 Incorporate wildlife bypass structures	A1, A2, & L	Perm.	$-$$

Use approximately three strategically-placed wildlife tunnels and/or overpasses. Current cost = ~$6M-$7M.

Advantages:

- *Permanent Impacts – Will enhance wildlife passage within the project area by providing specific connectivity structures.*

Disadvantages:

- *Temporary Impacts – Will increase additional structures to construct.*
- *Maintainability – Will increase the number of additional structures to maintain.*

RM-6 Incorporate thicker AC segment to reduce maintenance/repair work	All	Maint.	$-$$

AC = Asphalt Concrete

Advantages:

- *Mainline Operations – Will reduce delays to roadway cracking or the associated repair work.*
- *Maintainability – Will reduce the amount of future maintenance work and/or the complexity of the maintenance work required (e.g., grinding as opposed to reconstruction).*

		Disadvantages: • *Temporary Impacts – Will require more AC pavement work and batching.*			
		RM-7 Incorporate K-rail in lieu of MBGR to reduce maintenance/repair work	X	Maint.	$
		Advantages: • *Mainline Operations – Limits potential delays due to repair work when slide damage occurs* • *Maintainability – Easier to maintain (allows flexibility for maintenance activities and repair work when slides occur)* • *Temporary Impacts – Easier to construct/install when compared to guard rail* *Disadvantages:* • *Temporary Impacts – Increases the amount of cut and potential retaining wall needed* • *Permanent Impacts – Increases structural section width (or compacted area) to accommodate placement of K-rail. Also introduces an aesthetic impact/reduces view.*			
		PE-3 Use Stacked Alignment	A2	Perm.	$$$$
		Advantages: • *Permanent Impacts – Reduces project footprint through OGR areas.* *Disadvantages:* • *Temporary Impacts – Represents a more complex structure to construct – this could increase construction schedule.* • *Maintainability – More complex structure to maintain*			
		PE-4 Use independent alignments for northbound and southbound directions	A2	Perm.	$$$$
		Advantages: • *Permanent Impacts – Provides flexibility to reduce potential tree impacts.* *Disadvantages:* • *Temporary Impacts – Increases construction time and complexity (requires two independent foundations).* • *Permanent Impacts – Increases overall project footprint. Increases impermeable surface.*			

- *Maintainability – Increases the amount of bridge structures to maintain. Reduces temporary traffic management flexibility. Reduces future traffic management flexibility.*

PE-6 Incorporate tunnel maintenance structure into tunnel	F	Perm.	$$$$

Advantages:
- *Permanent Impacts – Reduces project footprint, environmental impacts and environmental mitigation.*

Disadvantages:
- *Temporary Impacts – Represents a more complex structure to excavate and construct.*
- *Maintainability – Represents a more complex facility to maintain.*

Design Suggestions

RM = Reduce Maintenance
RE = Retain Earth
PW = Protect Wildlife
PE = Protect Environment
PT – Preserve Trees
MO = Maintain Operations
OR = Obtain Right of Way
SE = Stabilize Earth

Alternative	Description	Associated Alternatives
SE-1	Use drainage system to dewater project areas and stabilize earth to reduce slide potential	X & L
SE-2	Perform groundwater study to determine drainage impacts on slope stabilization	X & L
PT-2	Perform additional tree survey at northern alignment tie-in	A1, A2 & F
MO-3	Further define the No Build Alternative with LCC analysis	
PT-3	Modify alignment (shift grade) on northern tie-in to reduce tree impact	A1, A2 & F
RM-4	Use rock to armor toe slope at ocean to reduce erosion	X
RM-3	Include additional geotechnical monitoring system to provide slope movement information	All
RM-8	Incorporate benches in lieu of tall cuts to reduce earthwork volumes and reduce maintenance	X & L
PE-1	Provide turn-outs in lieu of 3rd lane for slow-moving vehicles	L
PE-2	Adjust shoulder widths in relation to geography	All

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

		OR-1	Consider purchasing additional land from adjacent property owners to more efficiently dispose of fill material	A1, A2, F & T
		MO-5	Consider increasing grade at southern end to reduce project footprint, travel length and necessary earthwork	A1 & A2
		SE-2	Use independent alignments for northbound and southbound directions	L
		MA-2	Provide access points for adjacent property owners	A1 & A2

TOPIC	DETAILS
General Discussion	♦ Concerns from the group were expressed about Alternative X and why it is still under consideration. Clarification was made that Alternative X is still under consideration because Caltrans is legally bound (NEPA/CEQA) to consider all alternatives that may meet the purpose and need of the project without impacting right of way, new grounds, etc. If an alternative is determined to not meet the purpose and need of the project, it may be rejected. Although Alternative X has some significant issues, such as requiring a very expensive dewatering system in the slide and use of a rock abutment to secure the toe of the slide, which likely would not be allowed by the CA Coastal Commission, it cannot yet be rejected at this stage. ♦ Concern expressed that Alternative F is economically unrealistic and discussion whether it should remain under consideration. It has a low risk of failure and less environmental impact, so in terms of NEPA/CEQA, it can't be excluded from consideration if it meets the purpose and need based on cost alone at this time. Since the area of X & L will already be studied, it will not add cost to study F. There is also risk of eliminating it from consideration too early due to project extension caused by litigation later. ♦ Moving Forward: o Caltrans wants to know which alternatives to move forward with studying by November 2018. o Caltrans plans to ask the CTC for the full funding needed for environmental studies, which they hope to have in place by June 2019. They currently have $9M for these studies. Jaime and his project team need to let Matt Brady, Caltrans District Director, know what the projected cost will be, so eliminating C alternatives is a big step in this process. Note that if Proposition 6 succeeds and SB1 funding is cut, it will be very difficult to obtain funding for this project.

LAST CHANCE GRADE STAKEHOLDERS GROUP MEETING

August 31, 2018, 10 a.m.-3 p.m.
Crescent Fire Protection District HQ Training Room, Crescent City

MEETING HIGHLIGHTS

NEXT STEPS:

What	*By Whom*	*By When*
VA Study facilitator to prepare report for distribution	*Eric*	*9/15/18*
What	*By Whom*	*By When*
An Implementation meeting will be held to further consider concepts & design alternatives prior to November decision	*Jaime*	*TBD*
What	*By Whom*	*By When*
The Final VA Report Issued in about 2 weeks after the Implementation Meeting if there are no conditionally accepted VA Alternatives.	*Eric/Jaime*	*TBD*

Attachments:
Participants Sign in Sheet (ROSTER)

Value Management Strategies, Inc.

Offices in Escondido, California; Grand Junction, Colorado; Chicago, Illinois;
New York City, New York; Portland, Oregon; San Antonio, Texas; Seattle, Washington

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018

Value Management Strategies, Inc.

Final Value Analysis Study Report

D-1 Del Norte 101 Last Chance Grade

CALTRANS DISTRICT 1 – DEL NORTE COUNTY, CA

Contract 53A0208

T.O. 1057

October 2018