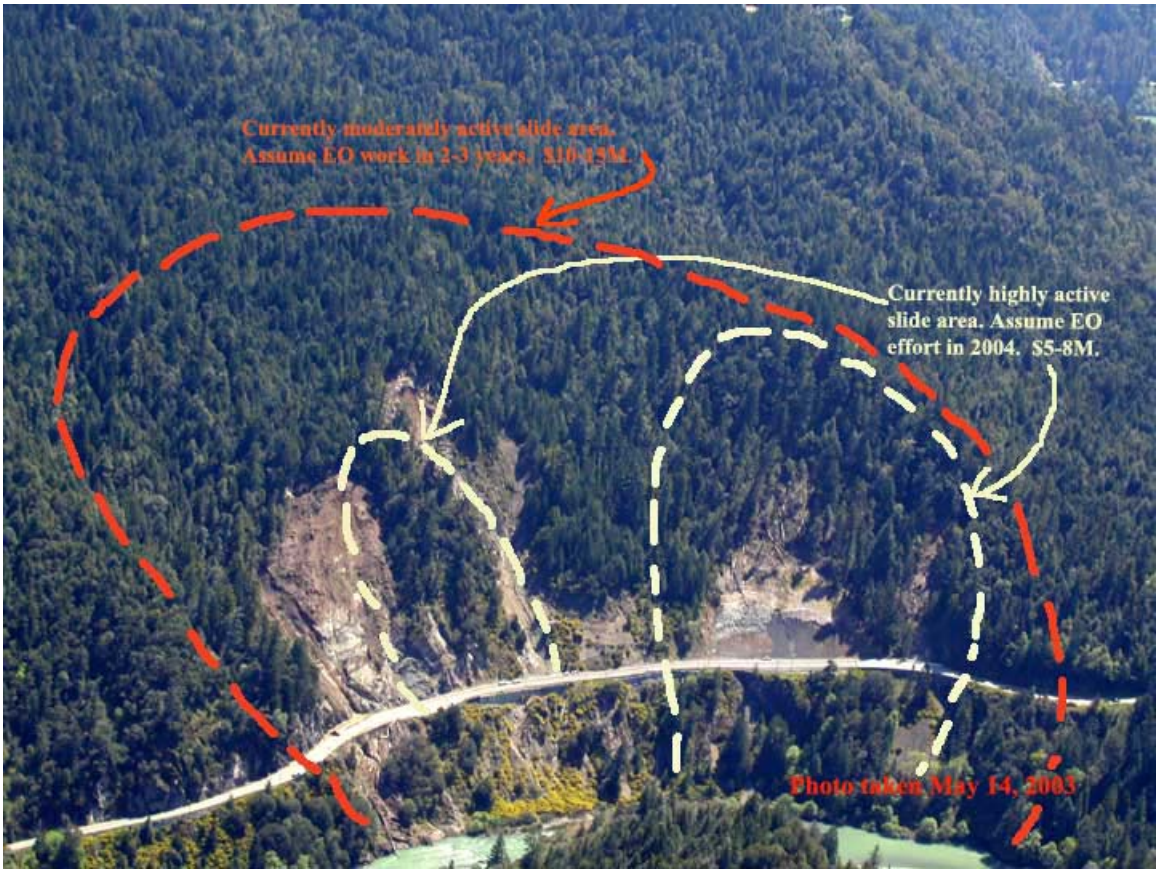
Confusion Hill Landslides

Economic Impact of US-101 Closure

Mendocino County P.M. 99.65



Office of Transportation Economics
Office of Advanced System Planning
Division of Transportation Planning
California Department of Transportation

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EXECUTIVE SUMMARY

US-101 is the primary route that provides direct access to the California's North Coast for commercial trucking year round, as well as for recreational traffic especially during tourist season. There has been a recurring problem of landslides around Confusion Hill on US-101 in northern Mendocino County over the last decade, resulting in frequent road closures and high maintenance costs at this location. When a major slide occurs that closes both lanes, the traffic south of Confusion Hill may have to backtrack and detour via Route-20/I-5/Rte 299 corridor, for an additional distance of **250 miles.**

A catastrophic landslide at Confusion Hill could close US-101 in both directions for an extended period of time. Traffic bound for the North Coast/Eureka area from Sacramento and the San Francisco Bay Area would have to be diverted to I-5/Route 299 corridor, for an additional distance of about **75 miles**. Such detour would cost the traveling public (trucking industry and passenger vehicles) an estimated **$238,000** per day **($7.1 million per month**) in travel delay and added vehicle operating costs. The one-lane closures usually result in 30-60 minutes of delay per vehicle, and would cost an estimated **$56,000** per day **($1.7 million per month**) in travel delays.

The added cost of travel and inconvenience would discourage tourism, which is the leading economic and business sector in the Mendocino and Humboldt Counties. A 25% loss of tourism in both counties would result in **$13 million per month** loss in tourist-related business sales, which might force many smaller tourist-dependent establishments out of business. The added shipping costs also would put the struggling lumber industry in the region at a further disadvantage with respect to competitors. The increased shipping cost and reduced recreational travel could result in loss of jobs, reduced business and government revenues, and lower standard of living in the region.

The average cost of rectifying a catastrophic landslide is estimated at about **$45 million**, while the cost of the proposed 2-mile realignment project at this location is estimated to be **$71 million**. Given the economic, roadway, and user costs that would be avoided with the realignment, the benefit-to-cost ratio for the proposed realignment is estimated at **2.6**, which suggests that from an economic perspective, the proposed realignment project seems to be a sound and cost-effective investment.

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There has been a recurring problem of landslides and slipouts around Confusion Hill on US-101 in northern Mendocino County over the last decade. According to District 1 engineers, the hillside at Confusion Hill is unstable, and the entire hillside slide plane is moving. The slides to date have been relatively small slides within the larger hillside slide plane. Unstable soil and large block movement result in frequent road closures and high maintenance costs at this location. Geo-technical experts predict a major slide activity to occur every two to three years, with movements both above and below the roadway. These incidents are likely to cause major damage, close Route 101 for months, and require millions of dollars to keep this segment of the highway open. This paper presents a brief analysis of the traffic and economic impacts of a major landslide at Confusion Hill, which would close US-101 for an extended period of time, and an economic evaluation of the proposed realignment project in that location.

BACKGROUND

US-101 north of the Bay Area is a rural principal arterial that is considered the "lifeline of the California's North Coast". It is a part of the National Highway System (NHS), the Interregional Road System (IRRS), and both a "high emphasis" and "focus route" facility for priority improvements in the Interregional Transportation Strategic Plan (ITSP). This route is the primary route that provides direct access for commercial trucking year round, as well as recreational traffic especially during the summer months (tourist season). Maintaining US-101 open and in good condition between the San Francisco Bay Area and Eureka is very critical to the economic well being of the north coast region.

Road closures from post mile (PM) 99.0 to 100.3 due to debris fall and large block movements are responsible for a continual maintenance problem. When rock falls occur, the highway can sometimes be kept open only to one-way traffic, causing long delays to the traveling public and truckers. When a major slide occurs that closes both lanes, the traffic south of Confusion Hill may have to backtrack and detour via Route-20/I-5/Rte 299 corridor, for an additional distance of **250 miles** (see attached map). The vehicles north of Confusion Hill would have to backtrack on 101 and take Rte-299/I-5, for an additional distance of about **440 miles**.

TRAFFIC IMPACT

A potential, major slipout is expected to close the highway for months while repairs are made. A sketch-level analysis was performed to estimate the traffic impacts in case a major landslide at Confusion Hill effectively blocks Route 101 at Post Mile 99.65 in Mendocino County for an extended period of time. It was assumed that all traffic between Sacramento Valley/San Francisco Bay Area and Eureka would preplan their trip and take the I-5/Route-299 corridor. The following table shows the current traffic volumes on Route 101, and compares vehicle-miles of travel (VMT) on Route 101 vs. the I-5/299 detour for the same level of traffic.

Daily Traffic on US-101, and US-101 VMT vs. I-5/299 Detour

	AADT	VMT via Rte 101	VMT via Rte I-5/299	Added VMT
All Vehicles	5,800	1,430,000	1,910,000	435,000
5+ Axle Trucks	475	131,490	167,500	35,000

Truck Traffic

In the analysis for the trucking element, it was estimated that most of the 5+ axle trucks bound for the North Coast/Eureka would originate from distribution centers located in the East San Francisco Bay Area vicinity. Therefore, the logical point for these vehicles to divert from their route would be at the junction of Rte 80/580 in Alameda County. Selecting this particular location is due to the significant increase in the number of 5+ axle trucks on Route 101 north of the Route 580/101 junction; increasing from 494 to 1,622 vehicles per day, a 320% increase. While the bulk of the northbound 5+ axle trucks are destined to the urban centers in Marin County and smaller towns north, this corridor is the primary, most direct and shortest path for the estimated 475 trucks through Confusion Hill on a daily basis.

As the table below indicates, the number of extra truck-miles of travel required to detour from Route 101 to the more circuitous Route 299 via I-5 is approximately **75 miles**. Assuming an average traffic speed of 55 MPH, the detour via I-5/299 would take an estimated **1 hour and 20 minutes** of additional driving time per vehicle to complete the Eureka-Bay Area journey. It is estimated that the detour will cause **616 daily truck hours of delay**. Based on Caltrans Benefit-Cost Evaluation Model (Cal-B/C), the truck delay costs are **$17,000 per day**. The additional 35,000 miles of truck travel adds **$30,000 per day to** truck operating costs. Total added cost for trucks is estimated to be **$47,000** per day.

5+ Axle Truck Impact of Total Closure of US-101:

	AADT	VMT via Rte 101	VMT via Rte I-5/299	Added VMT
5+ Axle Trucks	475	131,490	167,500	35,000
Total Distance (Miles)		279	353	74
Daily Hours of Delay				616
Additional Time per Trucks (Hours/Trip)				1.3

In this analysis, geometric deficiencies along some segments of the detour routes were not considered when a speed of 55 MPH was averaged. Route 299 is a curvilinear, mountainous road, with the slower trucks and recreational vehicles having few passing opportunities. There are some sections on Route 299 with steep grades and posted signs advising 20 MPH. It is estimated that when approximately 5,800 vehicles are shifted from Rte-101, operational Level of Service (LOS) on Rte-299 between Eureka and Redding would drop from LOS D to LOS F, significantly increasing delays for recreational traffic and goods movement on that route.

Additionally, Route 299 through the city of Redding is experiencing a high level of congestion at peak hours, hence there would not be sufficient capacity during the peak periods to adequately handle the additional vehicles expected to detour this area, creating further delay and backups. This factor could also increase delays for regional and interregional travel.

Passenger Vehicles

For the rest of the vehicles (excluding 5+ axle trucks), the following scenario was developed for calculating travel delays. All drivers traveling to the North Coast are assumed to be well informed and aware that there would be a roadblock on Route 101. Therefore, drivers would be able to preplan their trips according to the District's Traffic Management Plan (TMP) recommendations, choosing an alternate route that would minimize delays on their journey. In the table below, it is assumed that there are four main travel-origins from which trips traveling to the North Coast are usually generated:

Passenger Vehicle Impacts of US-101 Closure:

	S.F. & South Bay	Mendocino County	Marin & Sonoma	Sacramento Valley
No. Of Vehicles	2,650	500	600	1,600
Vehicle Daily Hours of Delay	4,136	1,769	1,042	1,033
Additional VMT	227,503	97,310	57,288	56,832
Additional Travel Time/Vehicle	1.6	3.5	1.7	0.6
Additional Miles on Alternate Rte	85	194	95	35.5

Based on the above scenario, in case of the closure of Route 101, there will be an additional **7,980** daily vehicle hours of delay, which would cost motorists about **$92,900** per day. The additional **439,000** miles of travel per day would also cost motorists about **$98,550** per day in added vehicle operating costs. Therefore, the total additional user costs for travelers to the Eureka area would exceed **$190,000** a day as long as Route 101 remains closed. The total added user costs would amount to **$238,450 per day, or $7.1 million per month**. The table below summarizes the daily user costs of Route 101 closure. For lack of data, accident costs due to a long detour have been left out of this analysis.

Daily User Costs of US-101 Closure

	Delay Cost	Vehicle Operating Cost	Total Cost
5+ Axle Trucks	$17,000	$30,000	$47,000
All other Vehicles	$92,900	$98,550	$191,450
			$238,450

It should be noted that these user costs are based on the current average level of traffic. Daily traffic volume on Route 101 is projected to grow from the current 5,800 to 7,150 in 2011 and to 8,530 vehicles in 2021 (or 47% increase). Given this projected increase, the daily user costs due to the closure of Route 101 by the year 2021 could exceed $350,000 per day.

The landslides at Confusion Hill to date have not been of such a catastrophic magnitude and have generally resulted in 2-3 day full closures (there were 10 full closures in 2003) or about 2-3 months of one-lane closures. According to the Confusion Hill Slide Project Study Report, the one-lane closure during 2001 resulted in 30-60 minutes of delay per vehicle. Given the current 5,800 vehicles per day, an average 45-minute delay per vehicle due to a partial closure would cost about **$56,000 per day** in travel delays alone. In the last couple of years, the landslides at Confusion Hill have become more frequent and of larger magnitude. In the following section, we will assess how the increase in travel costs might affect the economy of California's North Coast.

ECONOMIC IMPACT

The closure of US-101 at the Confusion Hill for an extended period of time would directly impact tourist attraction businesses such as the "Tree House", "Confusion Hill", and a number of other tourist-dependent business establishments along Route 101 in Mendocino and Humboldt Counties. These small business establishments support the livelihood of many local business owners, their suppliers, and other entrepreneurs. The impact on these establishments cannot be accurately estimated due to a lack of information about their sales and revenues. But a prolonged closure of Route 101 could force many of the smaller establishments out of business.

The inconvenience and added cost of travel resulting from the closure of Route 101 for an extended period of time would discourage and reduce recreational travel to Humboldt and Mendocino and hurt many tourist-dependent businesses there. According to the Eureka Chamber of Commerce, "tourism is the only thing doing well in Eureka these days". In Eureka, the occupancy tax alone, from hotel rooms, generates $1.4 million for the city's general fund. So

a prolonged closure at Confusion Hill would hit this vibrant and growing industry disproportionately hard. Tourism would be virtually cut off if 101 is closed for an extended period of time. According to the Chamber, the tourism dollars went flat during each big slide in winter of 2003. Tourists simply did not take the alternative route; they spent their vacation elsewhere.

As the following table shows, travel-related business activity accounts for a very significant portion of local business revenues and employment in both Mendocino and Humboldt Counties. **Tourist expenditures account for one quarter of every dollar spent in the two counties**, making tourism by far the leading economic and business sector in Mendocino and Humboldt Counties. Travel-related employment in the two counties accounts for about **15%** of all wage and salary jobs. The declining logging industry, coupled with higher unemployment and lower per capita income in both Humboldt and Mendocino Counties, relative to the state average, has made tourism very critical to the economy of the region.

Selected Economic Data for Humboldt and Mendocino Counties:

	Humboldt County	Mendocino County	Total
Travel-Related (2001) [1]			
Spending ($ Million)	$293.4	$333.0	$626.4
Earnings ($ Million)	$84.7	$100.6	$185.3
Employment	5,950	6,040	11,990
Tax Revenues ($ Million)	$18.1	$21.2	$39.3
Total Taxable Sales (($ Million) [2]	$1,320.2	$1,006.3	$2,326.5
Taxable Sales - Eureka			$668.0
Travel Spending as % of Taxable Sales	*22.2%*	*33.0%*	*26.9%*
Total Employment [3]	50,300	32,740	83,000

Source: [1] California Travel and Tourism Commission, California Travel Impacts by County: 1992-2001, February 2003.
[2] Board of Equalization: Taxable Sales in California During 2001.
[3] California 2002-2020 County-Level Economic Forecast, Caltrans, November 2002.

Based on the above estimates, even as little as 25% loss of tourism activity in the Mendocino and Humboldt Counties would result in a loss of **$157 million per year** in tourist-related business. There is little hard data available to enable the Department to conduct a more rigorous analysis and assessment of the impact of the closure of Route 101 on the California's North Coast. Anecdotal evidence, however, may shed some light on the magnitude of the impact on the local business establishments. The lodging establishments in the Redwood tourism area that were contacted by the staff of the Office of Transportation Economics were all concerned about the situation at Confusion Hill because this major slide area is in the vicinity of the major Redwood tourist sites. Not only would the region north of the slides be impacted, but south of the slides would also suffer significant economic loss. Tourists would simply choose to go somewhere else if the main attraction, the Redwoods, become inaccessible. The closure not only would directly impact all lodging, souvenir shops and other attractions, but also other services like grocery stores and gas stations. The famed Benbow Inn would be completely cut off and the smaller "Mom and Pop" resorts would suffer heavily and possibly go out of business.

The economic impact of Route 101 closure extends beyond tourism. As discussed earlier, additional daily costs to the trucks carrying goods between the San Francisco Bay Area and Eureka could amount to about **$50,000 per day**. This would translate to added shipping costs for goods transported to and from the region. The added shipping costs would in turn affect the economic competitiveness for the goods produced in the North Coast region and deteriorate the already lower standard of living of the area.

About half of the customers and suppliers of Jordan's Produce, a local restaurant supplier, are located south of the slide area, while their warehouse is located 20 miles north in Garberville. In the event of a prolonged closure,

the firm could stay in business but would have to lay off 4-6 workers, which would be a large economic impact in such a small community. The firm's owner estimates that it would lose about $40,000 worth of business per week of closure. During past slides and road closures that forced them to take Route 299 to reach their customers and suppliers, it cost them twice as much as usual and took them two days instead of one because it would be impossible to make a round trip in one day with commercial trucks. Some business establishments are also concerned about traffic accidents on this section of US-101, which tie up traffic for many hours at a time. Such traffic accidents are an ongoing serious disruption and economic cost to neighboring businesses. Other small businesses, including Sentry Supermarket, Ray's Shop Smart, and the local Radio Shack could be equally impacted.

According to "The Long-Term Financial Feasibility of the Northwestern Pacific Railroad" report (July 2002), current commerce with mills and forest product facilities in Ukiah area rely in part on product from timber produced north of Confusion Hill and would be disrupted. Many of the forest product firms in the Eureka region use a reload facility in Redding. However, Humboldt Bay Forest Products sends 60 million board-feet to Willits, which would be severely disrupted if Route 101 is closed. Samoa Pacific receives 150 truckloads of wood products a day from Mendocino County and all of that would have to be rerouted at considerable cost, or not shipped at all. Other firms like Capital Lumber in Healdsburg, Piedmont Lumber in Calpella, Mendocino Forest Products and Agwood Mill & Lumber, Inc. in Ukiah, and Harwood Products in Branscomb would face much higher shipping costs if their lumber had to be shipped, mostly to Los Angeles, via the alternate route. As it is, California loggers are facing stiff competition from elsewhere and the road closure and added cost of shipping would put them even at a greater disadvantage with respect to their competitors.

THE PROPOSED REALIGNMENT

According to the Confusion Hill Slide Project Study Report, a freeway route was adopted on October 25, 1968. The adopted alignment is located on the west side of the Eel River, with crossings near the community of Leggett, and near Red Mountain Creek. That project was shown in the District 1 status of projects until January of 1974, when it was dropped due to funding constraints and high costs. Since the adoption of that alignment preceded the current environmental process, the adopted alignment cannot be considered valid without a full study of alternatives and a new approved environmental impact report. The route concept for this portion of 101 is being reduced to a 2-lane facility from a 4-lane freeway consistent with environmental and funding limitations.

Due to the need for a more permanent solution to the Confusion Hill Slide problem, and the lack of an environmental impact document, additional studies commenced in the spring of 1999. The goal of those studies was to complete a Project Study Report (PSR) for that portion of Route 101. Five additional freeway/expressway alternates were developed along with a 2-lane bypass of the Confusion Hill Slide. Efforts were redirected to the preparation of a feasibility study. The report "Feasibility of Improvements to Route 101 Between Leggett and Red Mountain Creek" which completed in the summer of 2001, recommended that further studies of the entire segment be dropped. District 1 completed a PSR in July of 2001, which discusses proposed solutions for that section of Route 101 at Confusion Hill that continues to be a major maintenance concern. No further studies have been undertaken since the PSR was approved.

The existing facility has experienced frequent road closures in the winter, due to slides. Numerous closures have occurred at the slide north of Confusion Hill resulting in frequent highway closures within this segment during winter

months. According to the District 1 estimates, the recurring costs of keeping Route 101 open following closures due to landslides in the future years could add up to over **$100 million** in the next 20 years**,** with a present (discounted) value of **$67 million.**

Confusion Hill Existing Alignment: Men 101-99.5-100.5

Projected Costs for Routine Maintenance & Emergency Opening

Fiscal Year	Contract Cost	Maintenance Costs	Days Closed
00/01	$3,500,000	$46,000	6
01/02	$115,000	$0	
02/03	$6,655,000	$100,000	18
03/04*	$8,000,000	$100,000	20
04/05*	$0	$75,000	
05/06*	$14,000,000	$150,000	25
06/07*	$0	$75,000	
07/08*	$6,000,000	$75,000	15
08/09*	$0	$75,000	
09/10*	$14,000,000	$150,000	25
10/11*	$0	$75,000	1
11/12*	$0	$75,000	1
12/13*	$14,000,000	$150,000	25
13/14*	$0	$75,000	0
14/15*	$5,000,000	$50,000	12
15/16*	$0	$75,000	2
16/17*	$15,000,000	$150,000	25
17/18*	$0	$50,000	0
18*19*	$0	$75,000	1
19/20*	$10,000,000	$150,000	20
20/21*	$0	$75,000	2
21/22*	$0	$75,000	1
22/23*	$8,000,000	$100,000	15
Total	**$104,270,000**	**$2,021,000**	

Source: Caltrans District 1.

It should be noted that the above estimates do not include a potential catastrophic failure within the next 20 years. In case of such a major event, the roadway could be completely closed for 4-6 months. District 1 estimates

that the cost to reopen the roadway following a catastrophic landslide, assuming that it would be feasible on the existing alignment, could be between **$30 to 60 million**.

The proposed Confusion Hill Slide Bypass is a 2-lane conventional highway on Route 101. The cost of the bypass construction is currently estimated at about **$71 million**. Using Caltrans Benefit-Cost Model (Cal-B/C), based on the data provided by District 1, the proposed realignment would generate an estimated $17.6 million in travel time savings over 20 years due to improved speed, and an additional $2.3 million in vehicle operating cost savings. It is assumed that the realignment would avoid $45 million cost of a catastrophic landslide, and would prevent a 25% ($78 million) loss of tourist business for 6 months (25% x $626.4 mil x ½ year), and $42.6 million in added user costs of the detour ($7.1 mil x 6). The table below summarizes the results of the benefit-cost analysis of the proposed realignment:

Benefits and Costs of the Proposed Realignment

	$ Million	
Realignment Project Cost	71.0	
Project Benefits		
User Benefits	20.0	
Costs Avoided		
Loss of 25% Tourism	78.0	
User Costs of Detour	42.6	
Cost of a Major Landslide	45.0	
Total Benefits	185.6	
Benefit-Cost Ratio		**2.6**

Therefore, given the potential economic, roadway, and user costs that would be avoided, the proposed realignment project seems to be a sound, cost-effective investment.