

Location Hydraulic Studies

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State of California

ADDENDUM TO LOCATION HYDRAULIC STUDY



MERCED RIVER @ FERGUSON SLIDE AREA

Prepared By: Anthony Cipponeri, P.E.
District Hydraulics Engineer
Caltrans District-10
1976 E. Charter Way
Stockton, CA 95205

July 2008

**MERCED RIVER
MARIPOSA COUNTY
STATE ROUTE 140
Post-Mile 42.0/R42.7
EA 0P920X**

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1.0 INTRODUCTION

1.1 Purpose and Scope

This addendum addresses three additional alternatives for assessment of floodplain impacts. The primary topics of focus include the drainage criteria and methodology used in the runoff analysis and the analysis and effects to the base flood of the Merced River by the proposed alternatives. Drainage maps and calculations support discussion of these topics.

2.0 PROJECT ALTERNATIVES

2.1 Additional Alternatives

Three additional alternatives are currently under consideration.

- Alternative A
- Alternative S-2
- Alternative T-3

SR 140 is located within the Sierra National Forest within a 200-ft right of way width under a Special Use Permit with the US National Forest Service. This permit will require an amendment for the realignment alternatives.

Alternative A – Incline Road Realignment

This alternative proposes utilizing minimal bridges at or near the existing temporary bridges that will accommodate larger tour buses, but at a significantly less than standard design speed. State Route 140 would be realigned along the existing grade of Incline Road. The permanent upstream bridge would be 280 feet long and the permanent downstream bridge would be 320 feet long. The existing detour alignment along Incline Road would be utilized for the permanent State Route 140 alignment.

Alternative S-2 – Viaduct Realignment with Through-Truss Bridges

This alternative proposes to realign SR 140 by constructing two through-truss bridges across the Merced River and a side-hill viaduct/retaining wall on the north side of the river between the two bridges. The roadway will provide two 12 ft lanes, 8 ft outside shoulders.

Alternative T-3 – Tunnel Under Slide

This alternative proposes construction of a tunnel under the competent area of the slide. The tunnel will be 2200 feet long providing two 12 ft lanes, 8 ft outside shoulders, and two 4 ft emergency walkways. The construction schedule may be as long as 4 years with this proposal.

3.0 HYDROLOGICAL SITE CHARACTERISTICS

Refer to original Location Hydraulic Study for site characteristics

4.0 FLOODPLAIN ANALYSIS

4.1 Merced River

The watershed area was calculated using the Brigham Young University, Watershed Modeling System (WMS), and the area was then verified using United States Geological Survey (USGS) topographic mapping. The drainage area of the Merced River at the project site was determined to be 661 square miles. Analysis of the Merced River at the project area was performed using the US Army, Corps of Engineers (COE) Hydrologic Engineering Center - River Analysis System (HEC-RAS) computer software. Caltrans Structures Hydraulics Unit performed the HEC-RAS analysis. The 100-year flow used in the HEC-RAS analysis was 72,000 cubic feet per second.

The calculated flow was determined based on a compilation of data, which included gage data from various stations in the vicinity of the project site, most predominantly the Bagby Gage and recorded high water marks of the 1997 water year. The given 100-year flow at the project site was derived using a Log-Pearson III analysis and an Area-Ratio method. This method of calculating the flows was deemed the most appropriate for this watershed. This flow was then input into the HEC-RAS Program along with all cross section information and depending on the alternative, structure information was also input. The initial baseline run for the river was analyzed in its present condition with slide material impinging onto the pre-slide Highway 140 alignment and into the Merced River, minus any temporary structures that were placed under the emergency work contract in 2006. This established a water surface profile and the base floodplain limits throughout the project area. In the existing state the base flood inundates the existing highway and therefore makes the highway impassable during this event. The resulting impacts of the three additional alternatives to the base floodplain are addressed in this report under the heading of Floodplain Encroachments.

4.2 Floodplain Encroachments

Depending on the chosen alternative, the impact to the base floodplain will be non-significant to moderately significant. The alternatives are explained in detail under the heading of Additional Alternatives. The impacts of each alternative will be addressed separately within this section, since each one has specific impacts to the floodplain that must be considered. As a guideline, any structure encroaching on the base floodplain and parallel to the river thalweg will be considered a longitudinal encroachment. In the existing state the base flood inundates the existing highway in the project area to a maximum depth of 8.65 feet and therefore makes the highway impassable during this event, so regardless of the alternative, the highway closure status would not change in the 100-year flood event.

Alternative A:

This alternative modifies the existing detour but essentially keeps the same alignment. The existing "temporary" bridges would be replaced with new bridges that would accommodate larger tour buses. As with the present detour bridges, the new bridges would be inundated along with the existing highway in the 100-year flood event in excess

of 8-feet above roadway elevation. It is questionable whether these structures would withstand the force of water and debris in this event. If it is decided that this is the preferred alternative then Caltrans Structures Department should perform a detailed study concerning the integrity of these structures as a permanent solution. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

Alternative S-2:

This alternative will require the placement of two bridges across the Merced River. This proposal will have an impact on the base floodplain since abutments and portions of the structures will be placed within the Merced River base floodplain. The "Through Truss Bridge" design will allow these structures to span the river without any piers. The main portion of these structures will be above the base floodplain, but the approaches and abutments connecting to the existing roadway at both ends will be within the base floodplain, since analysis shows that the base flood would inundate the existing roadway. This alternative will produce a maximum water surface elevation increase within the base floodplain of 4.45 feet. This maximum occurs between the two proposed structures. Although the backwater increase between the upstream and downstream structures is substantial, the base flood in this area is confined within the steep canyon walls and there are no buildings within the 100-year Floodplain that would be affected. Flow velocities of the Merced River during the 100-year event will decrease in some locations and increase in others, due to the placement of these structures. Since the canyon walls are mainly composed of rock, the slight increase in water velocity should not cause any significant increase in erosion. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted due to this alternative.

Assessment - No significant impact.

Alternative T-3:

This alternative proposes construction of a tunnel under the competent area of the slide. The tunnel will be 2200 feet long providing two 12 ft lanes, 8 ft outside shoulders, and two 4 ft emergency walkways. The profile grade of the tunnel would essentially be the same as the original SR-140 grade. This alternative would have no adverse effects on the base floodplain. At the present time the talus slide material is actually impinging into the base floodplain, although this alternative would not remove the talus it would provide an alternate route for some of the base floodwaters to pass through. In the base flood event the tunnel would have a depth of water in excess of 8-feet. The tunnel width is 40-feet; this width will have the potential to pass well-sized debris. In the 100-year event the highway is inundated within the project limits to a maximum depth of 8.65 feet. No buildings will be impacted due to this alternative.

Assessment - No significant impact.

5.0 REFERENCES

Federal Emergency Management Agency (FEMA) Flood Insurance Study - Mariposa County, California; dated September 1990

Flood Insurance Rate Map; Mariposa County, Co. CA 06043C0150 B; Dated: 9/90

United States Geological Survey (USGS) Publication – Magnitude and Frequency of Floods in California; Dated 6/77

US Army, Corps of Engineers, Hydrologic Engineering Center
River Analysis System (HEC-RAS) computer software, Version 3.1.2
Davis, California; Dated 4/2004

United States Department of Agriculture, Natural Resources Conservation Service. 2007 Soil Survey of Yosemite National Park, California. Accessible online at: http://soils.usda.gov/surve/printed_survey/.

Watershed Modeling System (WMS), Version 8.0
Brigham Young University, Utah; Dated 12/2006

Weather Reports.com
Weather Averages for El Portal, CA

FLOODPLAIN EVALUATION REPORT SUMMARY

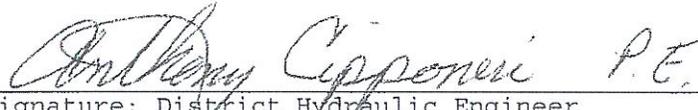
PROJECT: FERGUSON SLIDE
COUNTY: MPA
Route: 140
Alternative: A
PM: 42.0/R42.5
E/A: 0P920X

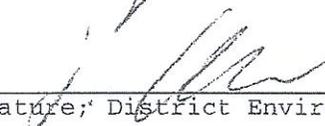
LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

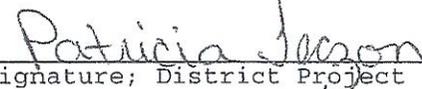
ENVIRONMENTAL

	DESCRIPTION	YES	NO
1.	Is the proposed action a longitudinal encroachment of a floodplain?		X
2.	Are the risks associated with the implementation of the proposed action significant?		X
3.	Will the proposed action support probable incompatible floodplain development?		
4.	Are there any significant impacts on the natural and beneficial floodplain values?		
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)?		X
7.	Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

 P.E. Date: 7/3/08
 Signature; District Hydraulic Engineer

 Date: 7/15/08
 Signature; District Environmental Branch Chief

 Date: 7/7/08
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

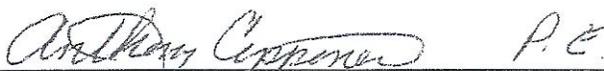
PROJECT: FERGUSON SLIDE **COUNTY:** MPA **Route:** 140 **Alternative:** S-2 **PM:** 42.0/R42.5 **E/A:** 0P920X

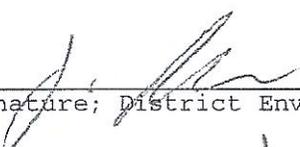
LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

ENVIRONMENTAL

	DESCRIPTION	YES	NO
1.	Is the proposed action a longitudinal encroachment of a floodplain?		X
2.	Are the risks associated with the implementation of the proposed action significant?		X
3.	Will the proposed action support probable incompatible floodplain development?		
4.	Are there any significant impacts on the natural and beneficial floodplain values?		
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)?		X
7.	Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

 P.E. Date: 7/3/08
 Signature; District Hydraulic Engineer

 Date: 7/15/08
 Signature; District Environmental Branch Chief

 Date: 7/7/08
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE COUNTY: MPA Route: 140 Alternative: T-3 PM: 42.0/R42.5 E/A: 0P920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
 TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
 FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

	DESCRIPTION	YES	NO
ENVIRONMENTAL	1. Is the proposed action a longitudinal encroachment of a floodplain?		X
	2. Are the risks associated with the implementation of the proposed action significant?		X
	3. Will the proposed action support probable incompatible floodplain development?		
	4. Are there any significant impacts on the natural and beneficial floodplain values?		
	5. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		
	6. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)?		X
	7. Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Anthony Cipponeri P.E. Date: 7/3/08
 Signature; District Hydraulic Engineer

J. [Signature] Date: 7/15/08
 Signature; District Environmental Branch Chief

Patricia Jason Date: 7/7/08
 Signature; District Project Engineer

I CONCUR:

 Signature; FHWA Date: _____

Technical Information for Location Hydraulic Study

Dist. 10 Co. MARIPOSA Rte. 140 P.M. 42.0/R42.5
 EA 0P92OX Bridge Number _____

Floodplain Description:

MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

VARIOUS ALTERNATIVES TO REPAIR SLIDE DAMAGE TO ROADWAY.

2. ADT: Current 2100 Projected 3500

3. Hydraulic Data: Base Flood Q100= 72,000 CFS

WSE 100 = _____ NGVD The flood of record, if greater than Q100:

Q= _____ CFS WSE _____

Are NFIP maps available? Yes X No _____

Are NFIP studies available? Yes X No _____

4. Is the highway location alternative within a regulatory floodway? Yes No
 _____ X

5. Attach map with flood limits outlined showing all building or other improvements within the base floodplain.

Potential Q100 backwater damages:

A. Residences?	_____	<u>X</u>
B. Other Bldgs?	_____	<u>X</u>
C. Crops?	_____	<u>X</u>
D. Natural and beneficial Floodplain values?	_____	<u>X</u>

6. Type of Traffic:

A. Emergency supply or evacuation route?	<u>X</u>	_____
B. Emergency vehicle access?	<u>X</u>	_____
C. Practicable detour available?	<u>X</u>	_____
D. School bus or mail route?	<u>X</u>	_____

7. Estimated duration of traffic interruption for 100-year event 1 hours.

Technical Information for Location Hydraulic Study

8. Estimated value of Q100 flood damages (if any) – moderate risk level.
- | | | |
|-------------|----|----------|
| A. Roadway | \$ | <u>0</u> |
| B. Property | \$ | <u>0</u> |
| Total | \$ | <u>0</u> |

9. Assessment of Level of Risk
Low X Moderate _____ High _____
For High Risk projects, during design phase, additional Design Study Risk Analysis may be Necessary to determine design alternative.

PREPARED BY:

Anthony Cipponeri P.E.
Signature – Dist. Hydraulic Engineer
(Item Numbers 3, 4, 5, 7, 9)

7/3/08
Date

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? No _____ Yes X

If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

See the Location Hydraulic Study, Section 4.2, for discussion of this topic.

Information developed to comply with the Federal requirement for the Location Hydraulic Study Shall be retained in the project files.

Patricia Jackson
Signature – Dist. Project Engineer
(Item numbers 1, 2, 6, 8)

7/7/08
Date



State of California

LOCATION HYDRAULIC STUDY



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MERCED RIVER @ FERGUSON SLIDE AREA

Prepared By: Anthony Cipponeri, P.E.
District Hydraulics Engineer
Caltrans District-10
1976 E. Charter Way
Stockton, CA 95205

September 2007

MERCED RIVER
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C. Project Title Sheet and Layout Plan	
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1.0 INTRODUCTION

1.1 Purpose and Scope

This report summarizes the drainage study performed for the Merced River in and around the Ferguson Slide Area. The primary topics of focus include the drainage criteria and methodology used in the runoff analysis and the analysis and effects to the base flood of the Merced River by the proposed alternatives. Drainage maps and calculations support discussion of these topics.

1.2 Project Description

The project is located in Mariposa County on State Route (SR) 140 from 1.2 miles west (PM 42.0) to 0.5 miles west (PM 42.7) of the South Fork Merced River Bridge. This section of highway is located within the limits of an active, complex rockslide that has deposited debris on SR 140 resulting in closure of the highway and additionally encroaching about 30 feet into the Merced River. The project proposes to permanently restore full access to SR 140, but not necessarily on the original alignment. Costs were estimated in May 2007 and range from \$33 million to \$76 million. The project is proposed to be funded from the Major Damage Permanent Restoration Program (201.131) in the 2008/2009 FY.

There are five viable alternatives currently in the study process. Alternative "R" proposes to construct a rockshed/tunnel through the slide talus (rock debris) along the existing highway alignment. Alternatives "C" and "T," propose to realign the highway to the north side of the Merced River relocating the roadway out of the slide area. The two alternatives have the same vertical and horizontal alignments and both include two bridges. Alternative "C" proposes a large through cut between the bridges while Alternative "T" proposes a tunnel between the bridges. Alternative "S" also proposes to realign the highway to the north side of the Merced River relocating the roadway out of the slide area by constructing two bridges across the Merced River and a side-hill viaduct between the two bridges. Alternative "6" is the "No Build" alternative; this keeps the existing detour in place.

1.3 Project Background

On April 29, 1999 a moderate sized landslide took place at the project site. This landslide was identified as part of a larger prehistoric landslide. The geologists' conclusion was that the larger slide was not moving. Slide debris was removed from the roadway, the rock slope was scaled and steel drapery was installed on the slide face to stabilize the slope. On April 29, 2006 another slide covered the roadway. Slide debris was again removed and the same methods of slope stabilization began. On May 10, 2006 it was decided to install a rock fall barrier along the shoulder of the road.

The barrier was completed on May 14, 2006, but numerous large rock falls from a new source area on the east side of the 1999 slide occurred preventing the highway from opening to two-way traffic. On May 16, 2006, the geologists concluded the major

prehistoric landslide mass was moving. On May 18, 2006, it was decided to move the rock fall barrier to the center of the road restricting traffic to one-way control. The road was opened the morning of May 25, 2006 and closed again by that evening due to another significant slide that damaged the rock fall barrier. By May 28, 2006 major sections of the 20 ft high rock fall barrier had been completely covered, burying the highway and extending about 30 ft into the Merced River.

In April 2006 the Governor proclaimed a state of emergency within Mariposa County and directed Caltrans to immediately request federal assistance. A Director's Order was approved on June 17, 2006 to proceed with an emergency contract to construct a one-way temporary facility to bypass the active slide area. Two single lane temporary bridges were constructed along with a temporary roadway across the river on an old abandoned railway grade. A signal system at each bridge was installed. The one-way temporary bypass was opened on August 18, 2006, with a 28 ft vehicle length restriction.

A Federal Highway Administration Damage Assessment Form (DAF) was approved on September 26, 2006 in the amount of \$2 million for preliminary engineering for development of the permanent restoration work.

2.0 PROJECT ALTERNATIVES

2.1 Viable Alternatives

Five viable alternatives are currently under consideration.

- o Alternative R
- o Alternative C
- o Alternative T
- o Alternative S
- o Alternative 6

Alternative R is on the original SR 140 alignment within the limits of the slide. Alternatives C, T, S and "No Build" are realignments of the original SR 140. All build alternatives include removal of the temporary bridges and restoration of areas impacted by construction of the SR 140 temporary bypass.

A design speed of 40 mph is proposed with a minimum horizontal curvature of 550 ft. The 6th Edition of the Highway Design Manual (HDM), Index 101.2 states for a conventional rural highway in mountainous terrain the design speed should range from 40 – 50 mph. A maximum grade of 7 % is proposed. The project is located on the steep canyon inner gorge slopes of the Merced River and is subject to icy conditions that prevail during the winter months between October and April. A maximum superelevation rate of 8 % is proposed.

SR 140 is located within the Sierra National Forest within a 200-ft right of way width under a Special Use Permit with the US National Forest Service. This permit will require an amendment for the realignment alternatives.

Alternative R – Rock Shed/Tunnel

This alternative proposes construction of a “build and cover tunnel” through the talus of the slide along the existing alignment. The tunnel will provide two 12 ft lanes, 8 ft outside shoulders and a 5 ft walkway. The total capital cost to construct this alternative is estimated at \$71 Million.

Alternative C – Open-Cut Realignment

This alternative proposes to realign SR 140 by constructing two bridges across the Merced River and an open cut through the hillside located on the north side of the river. The roadway will provide two 12 ft lanes, 8 ft outside shoulders and 20 ft surface debris benches through the cut areas. This alternative includes a 550 ft horizontal curve at the west end and a 550 ft horizontal curve at the east end. The proposed bridges are located within the limits of the horizontal curves. The bridges are approximately 550 ft and 650 ft in length. The total capital cost to construct this alternative is estimated at \$53 Million.

Alternative T – Tunnel Realignment

This alternative has similar horizontal and vertical geometrics to Alternative C. Instead of the open cut through the hillside, it proposes a 725 ft long tunnel. The roadway will provide two 12 ft lanes, 8 ft outside shoulders and 5 ft walkways through the tunnel section. Like Alternative C, this alternative includes a 550 ft horizontal curve at the west end and a 550 ft horizontal curve at the east end. The bridges are approximately 550 ft and 650 ft in length. The total capital cost to construct this alternative is estimated at \$77 Million.

Alternative S – Viaduct Realignment

This alternative proposes to realign SR 140 by constructing two bridges across the Merced River and a side-hill viaduct/retaining wall on the north side of the river between the bridges. The roadway will provide two 12 ft lanes and 8 ft outside shoulders. This alternative includes a 550 ft horizontal curve at the west end and a 650 ft horizontal curve at the east end. The proposed bridges are located within the limits of the horizontal curves. The bridges are approximately 805 ft and 670 ft in length. The viaduct/retaining section between the two bridges is approximately 400 ft in length and will be supported by a combination of benching into the hillside and columns. The total capital cost to construct this alternative is estimated at \$35 Million.

Alternative 6 – No Build

This alternative keeps the existing detour in place along with the “temporary structures” that were placed in 2006. The signal system at each bridge would become a permanent function, due to the one-way traffic restriction. Unless further construction was performed, the 28 ft vehicle length restriction would also become a permanent design element.

2.2 Rejected Alternatives

Alternative T-2

A tunnel alternative was considered that would realign the highway to the south of the slide. The tunnel was approximately one mile long at a cost of approximately \$378 Million. This alternative was dropped due to excessive cost and a prolonged construction schedule.

Alternative E – Slide Removal

This alternative proposes to remove the talus (accumulated rock fall) from the roadway and part or all of the slide mass to stabilize the slope above the highway. It would generate approximately 800,000 cubic yards of waste. This alternative will include a subsurface drainage system and substantial slope stabilization measures. The highway would be restored to pre-damage condition maintaining the original highway geometric features. The construction cost for this alternative is estimated at \$71 Million. This alternative was dropped due to the findings within the Geotechnical Report.

3.0 HYDROLOGICAL SITE CHARACTERISTICS

3.1 Climatological Data

The climate in this area is characterized by a warm, dry season (May through September) and a cool, wet season (October through April). The precipitation occurs as a combination of rainfall and snowfall, with approximately 90 percent of the precipitation occurring within the wet season. The average annual high temperature for the area is 69 degrees Fahrenheit. The average annual low temperature for the area is 34 degrees Fahrenheit. Warm season highs usually reach close to 100 degrees Fahrenheit, while cool season lows are usually near 20 degrees Fahrenheit. The mean annual precipitation for the watershed area ranges from 37 inches near the project area to 60 inches at the higher elevations, yielding a composite rainfall over the entire watershed of 42 inches. The average annual snowfall for the project area is 37 inches.

3.2 Topography

The drainage watershed of the proposed project area traverses the terrain of the western slope of the Sierra Nevada Mountains, with steep and rugged slopes at the higher elevations. As the elevation lowers, the main stem of the Merced River moves into the floor of Yosemite Valley where the topography opens up into a widened canyon setting with extremely steep walls. As the Merced river continues towards the project site it turns into a narrow canyon setting with the river confined within the steep canyon walls. The elevations within the watershed area range from a high of approximately 12,000 feet to a low elevation at the project site of approximately 1,400 feet. There are some small lakes in the upper reaches of the watershed. Channel slopes vary greatly through this large watershed with the higher elevation channels being in the 20 percent range and the lower valley channels being close to 1 percent.

3.3 Land Use Characteristics

Typical land use for the drainage watershed consists mainly of logging and recreational uses such as camping, fishing, hiking, rock climbing, sightseeing, biking, rafting, and various other interests. Within Yosemite Valley and along the Merced River and South Fork Merced River, there are a few sparsely populated communities and some motels, stores, and various other buildings. Much of the watershed traverses through Yosemite National Park.

3.4 Groundwater

The groundwater elevation in the area of the project site is being determined and should be incorporated within the soils report for this project.

3.5 Soils

The soils within this large watershed vary greatly, for detailed soil analyses of the immediate project area refer to the soils report for this project or other sources as noted in the references at the end of this report. Generally the soil within the river terrace of this area consists mainly of the Dystric Xeropsamments-Dystric Xerorthents association. The soil profile consists mainly of sand, coarse sand, gravelly sand, and extreme gravelly sand. These soils fall into Hydrologic soil group A. Group A soils are classified as having low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission. This type of soil was deposited mainly from alluvium derived from granitoid rock.

3.6 Designated Floodplains

This project and the lower portion of the drainage watershed are located within the Federal Emergency Management Agency (FEMA) – Flood Insurance Rate Mapping (FIRM) Floodplain Maps, numbers 06043C0150 B and 06043C0145 B in the Mariposa County Unincorporated Areas. The mapping designates the river area at the project site as being within “Zone A” (Special flood areas, inundated by 100-year flood with no base flood elevations determined), although the mapping does depict the footprint of the base floodplain.

4.0 FLOODPLAIN ANALYSIS

4.1 Merced River

The watershed area was calculated using the Brigham Young University, Watershed Modeling System (WMS), and the area was then verified using United States Geological Survey (USGS) topographic mapping. The drainage area of the Merced River at the project site was determined to be 661 square miles. Analysis of the Merced River at the project area was performed using the US Army, Corps of Engineers (COE) Hydrologic Engineering Center - River Analysis System (HEC-RAS) computer software. Caltrans Structures Hydraulics Unit performed the HEC-RAS analysis on the various alternatives. The 100-year flow used in the HEC-RAS analysis was 72,000 cubic feet per second.

The calculated flow was determined based on a compilation of data, which included gage data from various stations in the vicinity of the project site, most predominantly the Bagby Gage and recorded high water marks of the 1997 water year. The given 100-year flow at the project site was derived using a Log-Pearson III analysis and an Area-Ratio method. This method of calculating the flows was deemed the most appropriate for this watershed. This flow was then input into the HEC-RAS Program along with all cross section information and depending on the alternative, structure information was also

input. The initial baseline run for the river was analyzed in its present condition with slide material impinging onto the pre-slide Highway 140 alignment and into the Merced River, minus any temporary structures that were placed under the emergency work contract in 2006. This established a water surface profile and the base floodplain limits throughout the project area. In the existing state the base flood inundates the existing highway and therefore makes the highway impassable during this event. The resulting impacts of each alternative to the base floodplain are addressed in this report under the heading of Floodplain Encroachments.

4.2 Floodplain Encroachments

After fully assessing the alternatives, it was decided that the impacts would be non-significant. The viable alternatives are explained in detail within Sections 2.1. The impacts of each alternative will be addressed separately within this section, since each one has specific impacts to the floodplain that must be considered. As a guideline, any structure encroaching on the base floodplain and parallel to the river thalweg will be considered a longitudinal encroachment. In the existing state the base flood inundates the existing highway in the project area to a maximum depth of 8.65 feet and therefore makes the highway impassable during this event, so regardless of the alternative, the highway closure status would not change in the 100-year flood event.

Alternative R: This alternative removes the existing slide material from the original roadway, but only some of the slide material from the slope above the roadway, as necessary to perform the proposed work. The tunnel structure that is proposed will have an impact on the base floodplain, since it is proposed to be within the base floodplain. This alternative is considered a longitudinal encroachment on the base floodplain. Since the highway lies parallel to the river a longitudinal encroachment cannot be avoided with this alternative. This alternative will produce a maximum backwater increase within the base floodplain of 2.38 feet. Flow velocities of the Merced River during the 100-year event will decrease in some locations and increase in others, due to the placement of this structure. Since the canyon walls are mainly composed of rock, the slight increase in water velocity should not cause any significant increase in erosion. Moving the structure more into the mountainside and away from the river can lessen the impact of this action on the base floodplain. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of this structure. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

Alternative C: This alternative will require the placement of two bridges across the Merced River. This proposal will have an impact on the base floodplain since piers, abutments, and structures will be placed within the Merced River floodplain. The main portion of these structures will be above the base floodplain, but the approaches connecting to the existing roadway will be within the base floodplain, since analysis shows that the base flood would inundate the existing roadway. This alternative will produce a maximum water surface elevation increase within the base floodplain of 4.54 feet. This maximum occurs between the two proposed structures. Although the backwater increase between the upstream and downstream structures is substantial, the base flood in

this area is confined within the steep canyon walls and there are no buildings within the 100-year Floodplain that would be affected. Flow velocities of the Merced River during the 100-year event will decrease in some locations and increase in others, due to the placement of these structures. Since the canyon walls are mainly composed of rock, the slight increase in water velocity should not cause any significant increase in erosion. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

Alternative T: This alternative will require placement of the same two bridges as Alternative C. This proposal will have an impact on the base floodplain since piers, abutments, and structures will be placed within the Merced River floodplain. The main portion of these structures will be above the base floodplain, but the approaches connecting to the existing roadway will be within the base floodplain, since analysis shows that the base flood would inundate the existing roadway. This alternative will produce a maximum water surface elevation increase within the base floodplain of 4.54 feet. This maximum occurs between the two proposed structures. Although the backwater increase between the upstream and downstream structures is substantial, the base flood in this area is confined within the steep canyon walls and there are no buildings within the 100-year Floodplain that would be affected. Flow velocities of the Merced River during the 100-year event will decrease in some locations and increase in others, due to the placement of these structures. Since the canyon walls are mainly composed of rock, the slight increase in water velocity should not cause any significant increase in erosion. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

Alternative S: This alternative will require the placement of two bridges across the Merced River and a side-hill viaduct/retaining wall on the north side of the river between the bridges. The two bridge alignments will be slightly different from Alternatives C and T. This proposal will have an impact on the base floodplain since piers, abutments, and structures will be placed within the Merced River floodplain. The main portion of these structures will be above the base floodplain, but the bridge approaches connecting to the existing roadway will be within the base floodplain, since analysis shows that the base flood would inundate the existing roadway. The entire retaining wall structure where it intersects the original ground of the slope will be outside the base floodplain. The footings for the retaining wall may be within the base floodplain and may be subjected to scour during the 100-year event, if this alternative is chosen as the preferred alternative then Caltrans Structures Hydraulics Department should perform a more detailed study of this alternative. This alternative will produce a maximum water surface elevation increase within the base floodplain of 4.54 feet. This maximum occurs between the two proposed bridges. Although the backwater increase between the upstream and downstream structures is substantial, the base flood in this area is confined within the steep canyon walls and there are no buildings within the 100-year Floodplain that would be affected.

Flow velocities of the Merced River during the 100-year event will decrease in some locations and increase in others, due to the placement of these structures. Since the canyon walls are mainly composed of rock, the slight increase in water velocity should not cause any significant increase in erosion. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

Alternative 6: This alternative keeps the existing detour in place along with the “temporary structures” that were placed in 2006. The structures within the present detour would be inundated along with the existing highway in the 100-year flood event in excess of 8-feet. It is questionable whether these structures would withstand the force of water and debris in this event. If it is decided that this is the preferred alternative then Caltrans Structures Department should perform a detailed study concerning the integrity of these structures as a permanent solution. The following assessment is based on the evaluation of the highway within the project limits during the 100-year flood event. During this event the highway is impassable, with or without the placement of these structures. No buildings will be impacted in the 100-year event due to this alternative.

Assessment - No significant impact.

5.0 REFERENCES

Federal Emergency Management Agency (FEMA) Flood Insurance Study - Mariposa County, California; dated September 1990

Flood Insurance Rate Map; Mariposa County, Co. CA 06043C0150 B; Dated: 9/90

United States Geological Survey (USGS) Publication – Magnitude and Frequency of Floods in California; Dated 6/77

US Army, Corps of Engineers, Hydrologic Engineering Center
River Analysis System (HEC-RAS) computer software, Version 3.1.2
Davis, California; Dated 4/2004

United States Department of Agriculture, Natural Resources Conservation Service. 2007 Soil Survey of Yosemite National Park, California. Accessible online at: http://soils.usda.gov/surve/printed_survey/.

Watershed Modeling System (WMS), Version 8.0
Brigham Young University, Utah; Dated 12/2006

Weather Reports.com
Weather Averages for El Portal, CA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE
 COUNTY: MPA
 Route: 140
 Alternative: R
 PM: 42.0/R42.5
 E/A: 0P920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

ENVIRONMENTAL

	DESCRIPTION	YES	NO
1.	Is the proposed action a longitudinal encroachment of a floodplain?	X	
2.	Are the risks associated with the implementation of the proposed action significant?		X
3.	Will the proposed action support probable incompatible floodplain development?		X
4.	Are there any significant impacts on the natural and beneficial floodplain values?		X
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		X
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)		X
7.	Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Tony Cipponese Date: 10/4/07
 Signature; District Hydraulic Engineer

J. Pe Date: 10/10/07
 Signature; District Environmental Branch Chief

Patricia Jerson Date: 10/5/07
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE
COUNTY: MPA
Route: 140
Alternative: C
PM: 42.0/R42.5
E/A: 0P920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

	DESCRIPTION	YES	NO
ENVIRONMENTAL	1. Is the proposed action a longitudinal encroachment of a floodplain?		X
	2. Are the risks associated with the implementation of the proposed action significant?		X
	3. Will the proposed action support probable incompatible floodplain development?		X
	4. Are there any significant impacts on the natural and beneficial floodplain values?		X
	5. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		X
	6. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)?		X
	7. Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Tony Cipponeri Date: 10/4/07
 Signature; District Hydraulic Engineer

J. Mc Date: 10/10/07
 Signature; District Environmental Branch Chief

Patricia Sezon Date: 10/5/07
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE
 COUNTY: MPA
 Route: 140
 Alternative: T
 PM: 42.0/R42.5
 E/A: 0P920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

	DESCRIPTION	YES	NO
ENVIRONMENTAL	1. Is the proposed action a longitudinal encroachment of a floodplain?		X
	2. Are the risks associated with the implementation of the proposed action significant?		X
	3. Will the proposed action support probable incompatible floodplain development?		X
	4. Are there any significant impacts on the natural and beneficial floodplain values?		X
	5. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		X
	6. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (q)		X
	7. Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Tony Cipione
 _____ Date: 10/4/07
 Signature; District Hydraulic Engineer

J. Mc
 _____ Date: 10/10/07
 Signature; District Environmental Branch Chief

Patricia Seaton
 _____ Date: 10/5/07
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE
COUNTY: MPA
Route: 140
Alternative: S
PM: 42.0/R42.5
E/A: 0P920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

ENVIRONMENTAL

	DESCRIPTION	YES	NO
1.	Is the proposed action a longitudinal encroachment of a floodplain?		X
2.	Are the risks associated with the implementation of the proposed action significant?		X
3.	Will the proposed action support probable incompatible floodplain development?		X
4.	Are there any significant impacts on the natural and beneficial floodplain values?		X
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		X
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)		X
7.	Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Tony Cipponeri Date: 10/4/07
 Signature; District Hydraulic Engineer

J. [Signature] Date: 10/10/07
 Signature; District Environmental Branch Chief

Patricia Season Date: 10/5/07
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

FLOODPLAIN EVALUATION REPORT SUMMARY

PROJECT: FERGUSON SLIDE **COUNTY:** MPA **Route:** 140 **Alternative:** 6 **PM:** 42.0/R42.5 **E/A:** OP920X

LOCATION DESCRIPTION: SR-140, 8-MILES WEST OF EL PORTAL
TYPE OF WORK: REPAIR SR-140, FERGUSON SLIDE AREA
FLOODPLAIN DESCRIPTION: MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS

ENVIRONMENTAL

	DESCRIPTION	YES	NO
1.	Is the proposed action a longitudinal encroachment of a floodplain?		X
2.	Are the risks associated with the implementation of the proposed action significant?		X
3.	Will the proposed action support probable incompatible floodplain development?		X
4.	Are there any significant impacts on the natural and beneficial floodplain values?		X
5.	Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain value? If yes, explain.		X
6.	Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR 650.105 (g)		X
7.	Are location hydraulic studies that document the above answers on file? If not, explain.	X	

PREPARED BY:

Tony Cipponeri Date: 10/4/07
 Signature; District Hydraulic Engineer

J. M. Date: 10/10/07
 Signature; District Environmental Branch Chief

Patricia Jason Date: 10/5/07
 Signature; District Project Engineer

I CONCUR:

_____ Date: _____
 Signature; FHWA

Technical Information for Location Hydraulic Study

Dist. 10 Co. MARIPOSA Rte. 140 P.M. 42.0/R42.5
 EA 0P92OX Bridge Number _____

Floodplain Description:

MERCED RIVER, MODERATELY SLOPING CHANNEL WITH COBBLES TO LARGE BOULDERS.

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

VARIOUS ALTERNATIVES TO REPAIR SLIDE DAMAGE TO ROADWAY.

2. ADT: Current 2100 Projected 3500

3. Hydraulic Data: Base Flood Q100= 72,000 CFS

WSE 100 = _____ NGVD The flood of record, if greater than Q100:

Q= _____ CFS WSE _____

Are NFIP maps available? Yes X No _____

Are NFIP studies available? Yes X No _____

4. Is the highway location alternative within a regulatory floodway? Yes No
X _____

5. Attach map with flood limits outlined showing all building or other improvements within the base floodplain.

Potential Q100 backwater damages:

A. Residences?	_____	<u>X</u>
B. Other Bldgs?	_____	<u>X</u>
C. Crops?	_____	<u>X</u>
D. Natural and beneficial Floodplain values?	_____	<u>X</u>

6. Type of Traffic:

A. Emergency supply or evacuation route?	<u>X</u>	_____
B. Emergency vehicle access?	<u>X</u>	_____
C. Practicable detour available?	<u>X</u>	_____
D. School bus or mail route?	<u>X</u>	_____

7. Estimated duration of traffic interruption for 100-year event 1 hours.

Technical Information for Location Hydraulic Study

8. Estimated value of Q100 flood damages (if any) – moderate risk level.

A. Roadway	\$	<u>0</u>
B. Property	\$	<u>0</u>
Total	\$	<u>0</u>

9. Assessment of Level of Risk

Low X Moderate _____ High _____

For High Risk projects, during design phase, additional Design Study Risk Analysis may be Necessary to determine design alternative.

PREPARED BY:

Tony Cyron _____
Signature – Dist. Hydraulic Engineer Date 10/4/07
(Item Numbers 3, 4, 5, 7, 9)

Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? No _____ Yes X

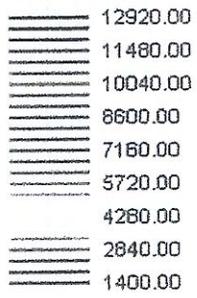
If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

See the Location Hydraulic Study, Section 4.2, for discussion of this topic.

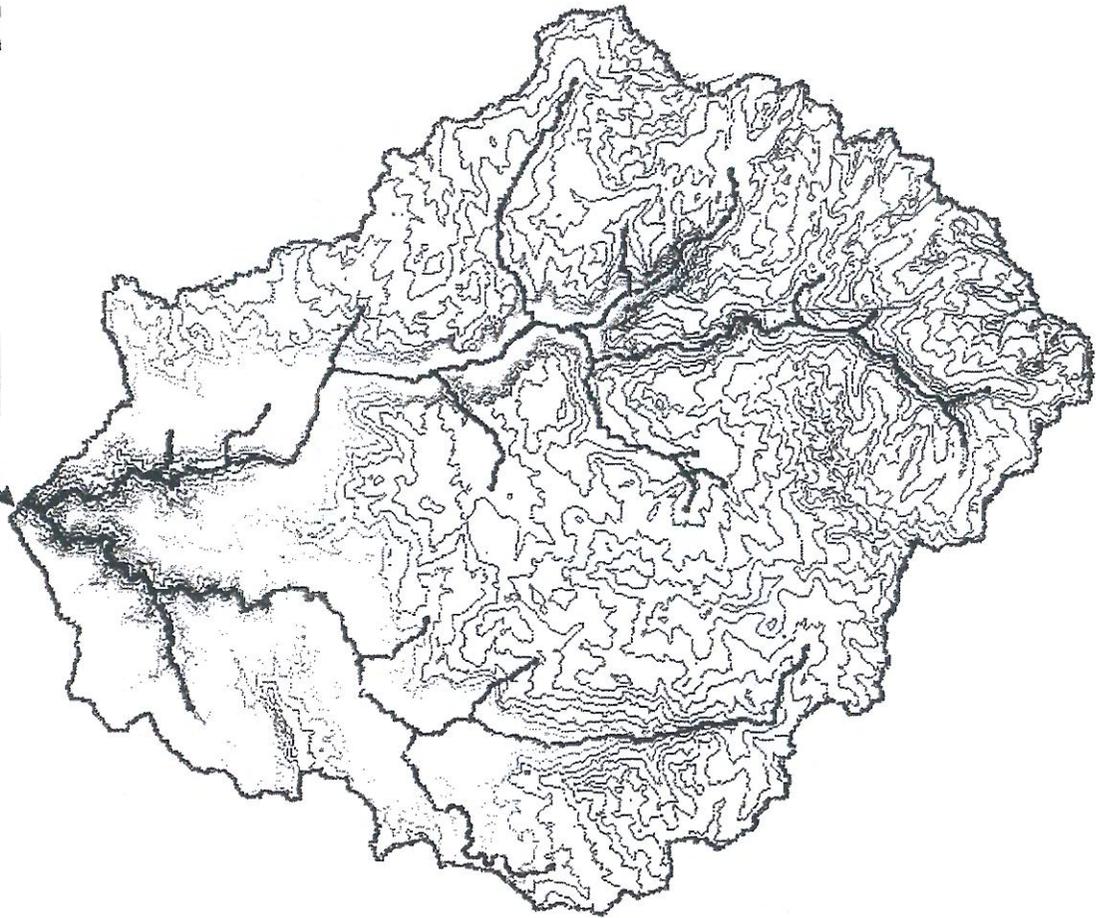
Information developed to comply with the Federal requirement for the Location Hydraulic Study Shall be retained in the project files.

Patricia Jenson _____
Signature – Dist. Project Engineer Date 10/5/07
(Item numbers 1, 2, 6, 8)

DEM Contours



Project Location



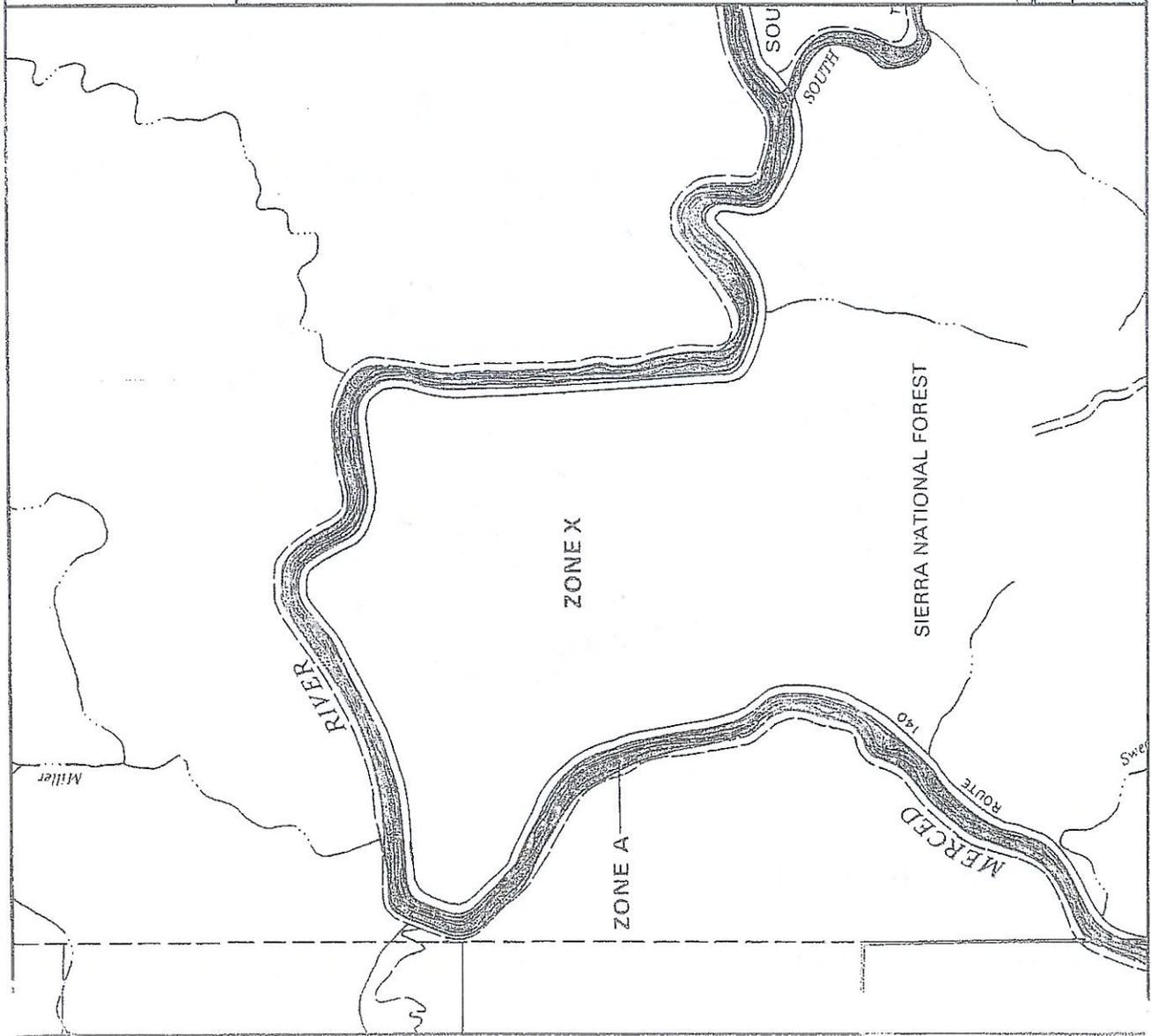
WATERSHED MAP

MERCED RIVER @ FERGUSON SLIDE AREA

ATTACHMENT D1



APPROXIMATE SCALE IN FEET
 2000 0 2000



NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP
 MARIPOSA COUNTY,
 CALIFORNIA AND
 INCORPORATED AREAS

PANEL 150 OF 475



PANEL LOCATION

CONTAINS:
 COMMUNITY
 UNINCORPORATED AREAS 0150 8

MAP NUMBER
 06043C0150 B

EFFECTIVE DATE:
 SEPTEMBER 5, 1990



Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov